

Annual Report for Period:09/2011 - 08/2012

Submitted on: 06/07/2012

Principal Investigator: Dana, Gayle L.

Award ID: 0814372

Organization: NV System of Higher Ed

Submitted By:

Jackson, Marcie - Other Authorized User

Title:

Nevada Infrastructure for Climate Change Science, Education, and Outreach

Project Participants

Senior Personnel

Name: Dana, Gayle

Worked for more than 160 Hours: Yes

Contribution to Project:

Name: Lancaster, Nicholas

Worked for more than 160 Hours: Yes

Contribution to Project:

Name: Mensing, Scott

Worked for more than 160 Hours: Yes

Contribution to Project:

Name: Piechota, Thomas

Worked for more than 160 Hours: Yes

Contribution to Project:

Name: Koracin, Darko

Worked for more than 160 Hours: Yes

Contribution to Project:

Name: Arnone, John

Worked for more than 160 Hours: Yes

Contribution to Project:

Name: Young, Michael

Worked for more than 160 Hours: No

Contribution to Project:

Name: Stone, Asako

Worked for more than 160 Hours: No

Contribution to Project:

Name: Buck, Paul

Worked for more than 160 Hours: Yes

Contribution to Project:

Name: Yu, Zhongbo

Worked for more than 160 Hours: Yes

Contribution to Project:

Name: Riddle, Brett
Worked for more than 160 Hours: Yes
Contribution to Project:

Name: Devitt, Dale
Worked for more than 160 Hours: Yes
Contribution to Project:

Name: Smith, William
Worked for more than 160 Hours: Yes
Contribution to Project:

Name: Latifi, Shahram
Worked for more than 160 Hours: Yes
Contribution to Project:

Name: Hassenzahl, David
Worked for more than 160 Hours: No
Contribution to Project:

Name: Farley, John
Worked for more than 160 Hours: Yes
Contribution to Project:

Name: Bassett, Scott
Worked for more than 160 Hours: Yes
Contribution to Project:

Name: Biondi, Franco
Worked for more than 160 Hours: Yes
Contribution to Project:

Name: Saito, Laurel
Worked for more than 160 Hours: Yes
Contribution to Project:

Name: Kauneckis, Derek
Worked for more than 160 Hours: Yes
Contribution to Project:

Name: Dascalu, Sergiu
Worked for more than 160 Hours: Yes
Contribution to Project:

Name: Harris, Fred
Worked for more than 160 Hours: Yes
Contribution to Project:

Name: Collopy, Michael

Worked for more than 160 Hours: Yes

Contribution to Project:

Name: Saiidi, Saiid

Worked for more than 160 Hours: No

Contribution to Project:

Name: Ewing-Taylor, Jacque

Worked for more than 160 Hours: Yes

Contribution to Project:

Name: Fuchs, Alan

Worked for more than 160 Hours: No

Contribution to Project:

Name: Sheridan, Robert

Worked for more than 160 Hours: Yes

Contribution to Project:

Name: Rudd, Lawrence

Worked for more than 160 Hours: Yes

Contribution to Project:

Name: Perveen, Shama

Worked for more than 160 Hours: No

Contribution to Project:

Name: Fritzing, Eric

Worked for more than 160 Hours: Yes

Contribution to Project:

Name: McMahon, Michael

Worked for more than 160 Hours: Yes

Contribution to Project:

Name: Abella, Scott

Worked for more than 160 Hours: Yes

Contribution to Project:

Name: Dowling, Winnie

Worked for more than 160 Hours: No

Contribution to Project:

Name: Futrell, Robert

Worked for more than 160 Hours: Yes

Contribution to Project:

Name: Kreamer, David

Worked for more than 160 Hours: No

Contribution to Project:

Name: Louis, Sushil

Worked for more than 160 Hours: No

Contribution to Project:

Name: Nicolescu, Monica

Worked for more than 160 Hours: No

Contribution to Project:

Name: Nussbaum, Edward

Worked for more than 160 Hours: Yes

Contribution to Project:

Name: Tillery, Denise

Worked for more than 160 Hours: No

Contribution to Project:

Name: Varol, Yaakov

Worked for more than 160 Hours: No

Contribution to Project:

Name: Thomas, James

Worked for more than 160 Hours: No

Contribution to Project:

Name: Stone, Mark

Worked for more than 160 Hours: No

Contribution to Project:

Name: Sinatra, Gale

Worked for more than 160 Hours: No

Contribution to Project:

Name: Sharpe, Saxon

Worked for more than 160 Hours: No

Contribution to Project:

Name: Ahmad, Sajjad

Worked for more than 160 Hours: No

Contribution to Project:

Name: Sada, Donald

Worked for more than 160 Hours: Yes

Contribution to Project:

Name: Ryan, Keri

Worked for more than 160 Hours: No

Contribution to Project:

Name: Rodriguez, Sylvia

Worked for more than 160 Hours: No
Contribution to Project:

Name: Nikolich, George

Worked for more than 160 Hours: No
Contribution to Project:

Name: Hillyard, Stanley

Worked for more than 160 Hours: No
Contribution to Project:

Name: DuBois, Dave

Worked for more than 160 Hours: No
Contribution to Project:

Name: Coonrod, Julie

Worked for more than 160 Hours: No
Contribution to Project:

Name: Colby, BG

Worked for more than 160 Hours: No
Contribution to Project:

Name: Chief, Karletta

Worked for more than 160 Hours: No
Contribution to Project:

Name: Pan, Lin-Lin

Worked for more than 160 Hours: No
Contribution to Project:

Name: Wilcox, Eric

Worked for more than 160 Hours: Yes
Contribution to Project:

Name: Obrist, Daniel

Worked for more than 160 Hours: No
Contribution to Project:

Name: Chen, Li

Worked for more than 160 Hours: No
Contribution to Project:

Name: Redmond, Kelly

Worked for more than 160 Hours: No
Contribution to Project:

Name: Rhode, David

Worked for more than 160 Hours: No
Contribution to Project:

Name: Stephen, Haroon
Worked for more than 160 Hours: Yes
Contribution to Project:

Name: Schaerer, Marcel
Worked for more than 160 Hours: No
Contribution to Project:

Name: Chan, Li Han
Worked for more than 160 Hours: No
Contribution to Project:

Name: Boyle, Douglas
Worked for more than 160 Hours: Yes
Contribution to Project:

Name: Christian, Marguerite
Worked for more than 160 Hours: No
Contribution to Project:

Name: Walker, Mark
Worked for more than 160 Hours: Yes
Contribution to Project:

Name: Weisberg, Peter
Worked for more than 160 Hours: Yes
Contribution to Project:

Name: Albright, Thomas
Worked for more than 160 Hours: Yes
Contribution to Project:

Name: Boyer, Lindsey
Worked for more than 160 Hours: Yes
Contribution to Project:

Name: Fenstermaker, Lynn
Worked for more than 160 Hours: Yes
Contribution to Project:

Name: Jasoni, Richard
Worked for more than 160 Hours: Yes
Contribution to Project:

Name: Mehta, Adadhana
Worked for more than 160 Hours: Yes
Contribution to Project:

Name: Neill, Helen

Worked for more than 160 Hours: Yes
Contribution to Project:

Name: Rollins, Kim

Worked for more than 160 Hours: Yes
Contribution to Project:

Name: Shen, Jeffrey

Worked for more than 160 Hours: Yes
Contribution to Project:

Name: Tang, Guoping

Worked for more than 160 Hours: Yes
Contribution to Project:

Name: Jiang, Yingtao

Worked for more than 160 Hours: Yes
Contribution to Project:

Post-doc

Name: Vellore, Ramesh

Worked for more than 160 Hours: No
Contribution to Project:

DRI Post Doctoral Fellow

Name: Liu, Zhongwei

Worked for more than 160 Hours: Yes
Contribution to Project:

Name: Mejia, John

Worked for more than 160 Hours: Yes
Contribution to Project:

Name: Gautam, Mahesh

Worked for more than 160 Hours: Yes
Contribution to Project:

Name: Morris, Brendan

Worked for more than 160 Hours: Yes
Contribution to Project:

Graduate Student

Name: Hatchett, Benjamin

Worked for more than 160 Hours: Yes
Contribution to Project:

DRI Graduate Student

Name: Koonce, Jeremy

Worked for more than 160 Hours: Yes

Contribution to Project:**Name:** Zulauf, Jenna**Worked for more than 160 Hours:** No**Contribution to Project:****Name:** Sanders, Alan**Worked for more than 160 Hours:** No**Contribution to Project:****Name:** Safi, Ahmad**Worked for more than 160 Hours:** Yes**Contribution to Project:****Name:** Walker, David**Worked for more than 160 Hours:** No**Contribution to Project:****Name:** Northrup, Amy**Worked for more than 160 Hours:** No**Contribution to Project:****Name:** Bonde, Aubrey**Worked for more than 160 Hours:** Yes**Contribution to Project:****Name:** Dolloff, Michael**Worked for more than 160 Hours:** No**Contribution to Project:****Name:** Kilpatrick, Mackenzie**Worked for more than 160 Hours:** Yes**Contribution to Project:****Name:** Solander, Kurt**Worked for more than 160 Hours:** No**Contribution to Project:****Name:** Thurman, Sasha**Worked for more than 160 Hours:** No**Contribution to Project:****Name:** Okamoto, Sohei**Worked for more than 160 Hours:** Yes**Contribution to Project:****Name:** Ivanov, Victor**Worked for more than 160 Hours:** No**Contribution to Project:**

Name: Slayden, Melissa

Worked for more than 160 Hours: No

Contribution to Project:

Name: Wagner, Amanda

Worked for more than 160 Hours: Yes

Contribution to Project:

Name: Hoover, Kelli

Worked for more than 160 Hours: No

Contribution to Project:

Name: Guida, Ross

Worked for more than 160 Hours: No

Contribution to Project:

Name: Hernandez, Leonardo

Worked for more than 160 Hours: Yes

Contribution to Project:

Name: Hornsby, Angela

Worked for more than 160 Hours: Yes

Contribution to Project:

Name: Jiang, Peng

Worked for more than 160 Hours: Yes

Contribution to Project:

Name: Jin, Yan

Worked for more than 160 Hours: No

Contribution to Project:

Name: Karam, Sarah

Worked for more than 160 Hours: Yes

Contribution to Project:

Name: Tian, Guoxun

Worked for more than 160 Hours: No

Contribution to Project:

Name: Mishra, Subhashree

Worked for more than 160 Hours: Yes

Contribution to Project:

Name: Skaza, Heather

Worked for more than 160 Hours: No

Contribution to Project:

Name: Patel, Jigarkumar

Worked for more than 160 Hours: No

Contribution to Project:**Name:** Nelson, Zachary**Worked for more than 160 Hours:** Yes**Contribution to Project:****Name:** Johnson, Brittany**Worked for more than 160 Hours:** Yes**Contribution to Project:****Name:** Jia, Lijuan**Worked for more than 160 Hours:** No**Contribution to Project:****Name:** Fraser, Noah**Worked for more than 160 Hours:** Yes**Contribution to Project:****Name:** Fisk, Terry**Worked for more than 160 Hours:** Yes**Contribution to Project:****Name:** Eckstut, Mallory**Worked for more than 160 Hours:** Yes**Contribution to Project:****Name:** Cuffe, Orion**Worked for more than 160 Hours:** Yes**Contribution to Project:****Name:** Hay, Michael**Worked for more than 160 Hours:** Yes**Contribution to Project:****Name:** Hochrein, Michelle**Worked for more than 160 Hours:** Yes**Contribution to Project:****Name:** Kruse, Kerensa**Worked for more than 160 Hours:** Yes**Contribution to Project:****Name:** Mischel, Nolan**Worked for more than 160 Hours:** No**Contribution to Project:****Name:** Apodaca, Lorenzo**Worked for more than 160 Hours:** Yes**Contribution to Project:**

Name: Beck, Abby
Worked for more than 160 Hours: No
Contribution to Project:

Name: Fossile, Lauren
Worked for more than 160 Hours: Yes
Contribution to Project:

Name: Wilde, Kiersten
Worked for more than 160 Hours: Yes
Contribution to Project:

Name: Patton, Stephanie
Worked for more than 160 Hours: No
Contribution to Project:

Name: Sharifahmadian, Ershad
Worked for more than 160 Hours: Yes
Contribution to Project:

Name: King, Kristien
Worked for more than 160 Hours: Yes
Contribution to Project:

Name: Becker, Miles
Worked for more than 160 Hours: No
Contribution to Project:

Name: Bozorgi, Mandna
Worked for more than 160 Hours: Yes
Contribution to Project:

Name: Gibbs, Ivan
Worked for more than 160 Hours: Yes
Contribution to Project:

Name: Hossinpour, Farnaz
Worked for more than 160 Hours: Yes
Contribution to Project:

Name: Kiley, Timothy
Worked for more than 160 Hours: Yes
Contribution to Project:

Name: Owens, Marissa
Worked for more than 160 Hours: Yes
Contribution to Project:

Name: Perryman, Nyssa
Worked for more than 160 Hours: Yes

Contribution to Project:**Name:** Shreck, Stephanie**Worked for more than 160 Hours:** Yes**Contribution to Project:****Name:** Stepanov, Regina**Worked for more than 160 Hours:** Yes**Contribution to Project:****Name:** Stramer, Janicke**Worked for more than 160 Hours:** Yes**Contribution to Project:****Name:** Vitale, Andrew**Worked for more than 160 Hours:** Yes**Contribution to Project:****Undergraduate Student****Name:** Williams, Arpree**Worked for more than 160 Hours:** No**Contribution to Project:****Name:** Erickson, Crystal**Worked for more than 160 Hours:** No**Contribution to Project:****Name:** Kobey, Robert**Worked for more than 160 Hours:** No**Contribution to Project:****Name:** Huang, Ryan**Worked for more than 160 Hours:** No**Contribution to Project:****Name:** McDonald, Austin**Worked for more than 160 Hours:** No**Contribution to Project:****Name:** Luinetti, Alessio**Worked for more than 160 Hours:** No**Contribution to Project:****Name:** Clark, Lindsey**Worked for more than 160 Hours:** No**Contribution to Project:****Name:** Davey, Bradley**Worked for more than 160 Hours:** No

Contribution to Project:**Name:** Newburn, Jessica**Worked for more than 160 Hours:** No**Contribution to Project:****Name:** Bernardo, Marsha**Worked for more than 160 Hours:** No**Contribution to Project:****Name:** Hannasch, David**Worked for more than 160 Hours:** No**Contribution to Project:****Name:** Stefka, John**Worked for more than 160 Hours:** No**Contribution to Project:****Name:** Lassaline, Peter**Worked for more than 160 Hours:** No**Contribution to Project:****Name:** Miller, Rachel**Worked for more than 160 Hours:** No**Contribution to Project:****Name:** Pugh, Shawn**Worked for more than 160 Hours:** No**Contribution to Project:****Name:** Siwinska, Karolina**Worked for more than 160 Hours:** No**Contribution to Project:****Name:** McKenna, Rebekah**Worked for more than 160 Hours:** No**Contribution to Project:****Name:** Moltz, Michael**Worked for more than 160 Hours:** No**Contribution to Project:****Name:** Villaluz, Joseph**Worked for more than 160 Hours:** No**Contribution to Project:****Name:** Johnson, Anna**Worked for more than 160 Hours:** No**Contribution to Project:**

Name: Lewis, Arthur

Worked for more than 160 Hours: No

Contribution to Project:

Name: Joslyn, Nichole

Worked for more than 160 Hours: No

Contribution to Project:

Name: Rafter, Kimberly

Worked for more than 160 Hours: No

Contribution to Project:

Name: Castana, Lina

Worked for more than 160 Hours: No

Contribution to Project:

Name: Hickenbottom, Keri

Worked for more than 160 Hours: No

Contribution to Project:

Name: Lay, Kira

Worked for more than 160 Hours: No

Contribution to Project:

Name: Ross, Sean

Worked for more than 160 Hours: No

Contribution to Project:

Name: Stillwell, Alicia

Worked for more than 160 Hours: No

Contribution to Project:

Name: Vaughn, Robert

Worked for more than 160 Hours: No

Contribution to Project:

Name: Kertson, Samantha

Worked for more than 160 Hours: No

Contribution to Project:

Name: Culverson, David

Worked for more than 160 Hours: No

Contribution to Project:

Name: Arthur, James

Worked for more than 160 Hours: No

Contribution to Project:

Name: Larsen, Joel

Worked for more than 160 Hours: No

Contribution to Project:**Name:** Alvarez, Camila**Worked for more than 160 Hours:** No**Contribution to Project:****Name:** Greenhalgh, Ted**Worked for more than 160 Hours:** No**Contribution to Project:****Name:** Rocovits II, David**Worked for more than 160 Hours:** No**Contribution to Project:****Name:** Yap, Christina**Worked for more than 160 Hours:** No**Contribution to Project:****Name:** Waldron, Courtney**Worked for more than 160 Hours:** No**Contribution to Project:****Name:** Ulrich, Michael**Worked for more than 160 Hours:** No**Contribution to Project:****Name:** Tu, Valerie**Worked for more than 160 Hours:** No**Contribution to Project:****Name:** Tooth, Matthew**Worked for more than 160 Hours:** No**Contribution to Project:****Name:** Rahe, Dylan**Worked for more than 160 Hours:** No**Contribution to Project:****Name:** Polasko, Matthew**Worked for more than 160 Hours:** No**Contribution to Project:****Name:** Le, Evan**Worked for more than 160 Hours:** No**Contribution to Project:****Name:** Kover, Stephanie**Worked for more than 160 Hours:** No**Contribution to Project:**

Name: Kee, Tanya

Worked for more than 160 Hours: No

Contribution to Project:

Name: Guy, Jessica

Worked for more than 160 Hours: No

Contribution to Project:

Name: Frey, Garrett

Worked for more than 160 Hours: No

Contribution to Project:

Name: Fleming, Maxwell

Worked for more than 160 Hours: No

Contribution to Project:

Name: Flagg, Michaela

Worked for more than 160 Hours: No

Contribution to Project:

Name: Ebert, Jonathan

Worked for more than 160 Hours: No

Contribution to Project:

Name: Covert, Terri

Worked for more than 160 Hours: No

Contribution to Project:

Name: Atherton, Ramona

Worked for more than 160 Hours: No

Contribution to Project:

Name: Beck, Melanie

Worked for more than 160 Hours: No

Contribution to Project:

Name: Freeze, Patrick

Worked for more than 160 Hours: No

Contribution to Project:

Name: Gallaspy, Brian

Worked for more than 160 Hours: No

Contribution to Project:

Name: Greenhalgh, Frank

Worked for more than 160 Hours: No

Contribution to Project:

Name: Gritts, Mitchell

Worked for more than 160 Hours: No

Contribution to Project:**Name:** Heslop, Joanne**Worked for more than 160 Hours:** No**Contribution to Project:****Name:** Komarov, Tsventan**Worked for more than 160 Hours:** No**Contribution to Project:****Name:** Mar, Diane**Worked for more than 160 Hours:** No**Contribution to Project:****Name:** McBride, Samantha**Worked for more than 160 Hours:** No**Contribution to Project:****Name:** Mital, Jenny**Worked for more than 160 Hours:** No**Contribution to Project:****Name:** Morrison, Muir**Worked for more than 160 Hours:** No**Contribution to Project:****Name:** Noack, Keri**Worked for more than 160 Hours:** No**Contribution to Project:****Name:** Pak, Heidi**Worked for more than 160 Hours:** No**Contribution to Project:****Name:** Peterson, Aaron**Worked for more than 160 Hours:** No**Contribution to Project:****Name:** Raney, Lindsey**Worked for more than 160 Hours:** No**Contribution to Project:****Name:** Restori, Sarah**Worked for more than 160 Hours:** No**Contribution to Project:****Name:** Skilman, Ashley**Worked for more than 160 Hours:** No**Contribution to Project:**

Name: Teator, Aaron

Worked for more than 160 Hours: No

Contribution to Project:

Name: Toomey, Liz

Worked for more than 160 Hours: No

Contribution to Project:

Name: Vonnahme, Morgan

Worked for more than 160 Hours: No

Contribution to Project:

Name: Flores, Isabel

Worked for more than 160 Hours: No

Contribution to Project:

Name: Conlu, Rhea

Worked for more than 160 Hours: No

Contribution to Project:

Name: Fulbright, Michelle

Worked for more than 160 Hours: No

Contribution to Project:

Name: Ha, Diane

Worked for more than 160 Hours: No

Contribution to Project:

Name: Heuton, Matthew

Worked for more than 160 Hours: No

Contribution to Project:

Name: Ho, Ho Nam

Worked for more than 160 Hours: No

Contribution to Project:

Name: Khan, Alexa

Worked for more than 160 Hours: No

Contribution to Project:

Name: Lam, Norris

Worked for more than 160 Hours: No

Contribution to Project:

Name: Magnuson, Natiera

Worked for more than 160 Hours: No

Contribution to Project:

Name: Perry, Jeanette

Worked for more than 160 Hours: No

Contribution to Project:**Name:** Pukpayat, Padtaya**Worked for more than 160 Hours:** No**Contribution to Project:****Name:** Rhodes, Elisha**Worked for more than 160 Hours:** No**Contribution to Project:****Name:** Sweigart, Maile**Worked for more than 160 Hours:** No**Contribution to Project:****Name:** Burroughs, Kate**Worked for more than 160 Hours:** No**Contribution to Project:****Name:** Baker, Nicholas**Worked for more than 160 Hours:** Yes**Contribution to Project:****Name:** Benchetler, Peter**Worked for more than 160 Hours:** Yes**Contribution to Project:****Name:** Benito, Gabriella**Worked for more than 160 Hours:** Yes**Contribution to Project:****Name:** Burden, Emily**Worked for more than 160 Hours:** Yes**Contribution to Project:****Name:** Calica, Nicole**Worked for more than 160 Hours:** Yes**Contribution to Project:****Name:** Choi, Charlotte**Worked for more than 160 Hours:** Yes**Contribution to Project:****Name:** Chua, Raymond**Worked for more than 160 Hours:** Yes**Contribution to Project:****Name:** DelaCruz, Steven**Worked for more than 160 Hours:** Yes**Contribution to Project:**

Name: Dugan, Sam
Worked for more than 160 Hours: Yes
Contribution to Project:

Name: Ego, Hilary
Worked for more than 160 Hours: Yes
Contribution to Project:

Name: Glover, Chris
Worked for more than 160 Hours: Yes
Contribution to Project:

Name: Graves, David
Worked for more than 160 Hours: Yes
Contribution to Project:

Name: Groso, Emilia
Worked for more than 160 Hours: Yes
Contribution to Project:

Name: Hardage, Sara
Worked for more than 160 Hours: Yes
Contribution to Project:

Name: Heisler, Devon
Worked for more than 160 Hours: Yes
Contribution to Project:

Name: Iubelt, Mirte
Worked for more than 160 Hours: Yes
Contribution to Project:

Name: Jones, Micheil
Worked for more than 160 Hours: Yes
Contribution to Project:

Name: Karr, David
Worked for more than 160 Hours: Yes
Contribution to Project:

Name: Lin, Hongfei
Worked for more than 160 Hours: No
Contribution to Project:

Name: King, Greg
Worked for more than 160 Hours: No
Contribution to Project:

Name: Leufven, Toni
Worked for more than 160 Hours: Yes

Contribution to Project:**Name:** Lubling-Kolbow, David**Worked for more than 160 Hours:** Yes**Contribution to Project:****Name:** Liu, Rui**Worked for more than 160 Hours:** Yes**Contribution to Project:****Name:** McDonnell, Steven**Worked for more than 160 Hours:** Yes**Contribution to Project:****Name:** Mynster, Patrica**Worked for more than 160 Hours:** Yes**Contribution to Project:****Name:** Ravi, Likhitha**Worked for more than 160 Hours:** Yes**Contribution to Project:****Name:** Redei, Alex**Worked for more than 160 Hours:** Yes**Contribution to Project:****Name:** Rehmat, Aberra**Worked for more than 160 Hours:** Yes**Contribution to Project:****Name:** Rossi, James**Worked for more than 160 Hours:** Yes**Contribution to Project:****Name:** Sadoti, Giancarlo**Worked for more than 160 Hours:** Yes**Contribution to Project:****Name:** Scully, Ellen**Worked for more than 160 Hours:** Yes**Contribution to Project:****Name:** Sefein, Kirellos**Worked for more than 160 Hours:** Yes**Contribution to Project:****Name:** Seymour, Lauren**Worked for more than 160 Hours:** Yes**Contribution to Project:**

Name: Sinanian, Pamela
Worked for more than 160 Hours: Yes
Contribution to Project:

Name: Sumlin, Benjamin
Worked for more than 160 Hours: Yes
Contribution to Project:

Name: Teppo, Brandon
Worked for more than 160 Hours: Yes
Contribution to Project:

Name: Trinh, Annie
Worked for more than 160 Hours: Yes
Contribution to Project:

Name: Truong, Emily
Worked for more than 160 Hours: Yes
Contribution to Project:

Name: Trustman, Benjamin
Worked for more than 160 Hours: Yes
Contribution to Project:

Name: Vallin, Carmen
Worked for more than 160 Hours: Yes
Contribution to Project:

Name: Villamagna, Ian
Worked for more than 160 Hours: Yes
Contribution to Project:

Name: Wehan, Bryce
Worked for more than 160 Hours: Yes
Contribution to Project:

Technician, Programmer

Name: Levins, Pamela
Worked for more than 160 Hours: Yes
Contribution to Project:

Name: Ward, Alice
Worked for more than 160 Hours: No
Contribution to Project:

Nevada NSF EPSCoR Outreach and Evaluation Coordinator (Year 1)

Name: Schulze, William
Worked for more than 160 Hours: No
Contribution to Project:

Director, Nevada EPSCoR Office

Name: Brazfield, Lori

Worked for more than 160 Hours: Yes

Contribution to Project:

Assistant Director of Operations, Nevada EPSCoR Office

Name: Contreras, Lisa

Worked for more than 160 Hours: No

Contribution to Project:

Communication Specialist, Nevada EPSCoR Office

Name: Kreidberg, Roger

Worked for more than 160 Hours: Yes

Contribution to Project:

DRI Science Support Editor

Name: Neely, Paul

Worked for more than 160 Hours: No

Contribution to Project:

DRI Manager, Systems Administration

Name: McCord, Travis

Worked for more than 160 Hours: No

Contribution to Project:

DRI Computer System Programmer

Name: Charlet, Therese

Worked for more than 160 Hours: Yes

Contribution to Project:

Name: Bird, Brian

Worked for more than 160 Hours: Yes

Contribution to Project:

Name: Vierra, Larry

Worked for more than 160 Hours: No

Contribution to Project:

Nevada Small Business Development Center @ UNLV

Name: Parker, Al

Worked for more than 160 Hours: No

Contribution to Project:

Nevada Small Business Development Center @ UNLV

Name: Strachan, Scotty

Worked for more than 160 Hours: Yes

Contribution to Project:

Name: McAlister, Juan

Worked for more than 160 Hours: Yes

Contribution to Project:

Name: Casella, Michele

Worked for more than 160 Hours: Yes

Contribution to Project:**Name:** McAllister, William**Worked for more than 160 Hours:** No**Contribution to Project:****Name:** Leeper, John**Worked for more than 160 Hours:** No**Contribution to Project:****Name:** Healy, John**Worked for more than 160 Hours:** No**Contribution to Project:****Name:** Lyles, Bradley**Worked for more than 160 Hours:** Yes**Contribution to Project:****Name:** McCurdy, Greg**Worked for more than 160 Hours:** Yes**Contribution to Project:****Name:** Jackson, Marcie**Worked for more than 160 Hours:** Yes**Contribution to Project:****Name:** Clack, Christina**Worked for more than 160 Hours:** Yes**Contribution to Project:****Name:** Fruth, Lori**Worked for more than 160 Hours:** Yes**Contribution to Project:****Other Participant****Name:** Hardimon, Alvin**Worked for more than 160 Hours:** Yes**Contribution to Project:**

Financial Manager, Nevada EPSCoR Office

Name: Park, Min Sun**Worked for more than 160 Hours:** No**Contribution to Project:**

Grants and Project Analyst, Nevada EPSCoR Office

Name: Poole, Angela**Worked for more than 160 Hours:** No**Contribution to Project:**

Administrative Assistant, Nevada EPSCoR Office

Name: Shaw, Rose

Worked for more than 160 Hours: No

Contribution to Project:

External Evaluator

Name: Mercer, Laura

Worked for more than 160 Hours: Yes

Contribution to Project:

Name: Coleman, James

Worked for more than 160 Hours: No

Contribution to Project:

Member of the External Research and Technical Advisory Board (ERTAB)

Name: Choobineh, Fred

Worked for more than 160 Hours: No

Contribution to Project:

Member of the External Research and Technical Advisory Board (ERTAB)

Name: Hughes, Malcolm

Worked for more than 160 Hours: No

Contribution to Project:

Member of the External Research and Technical Advisory Board (ERTAB)

Name: Leung, Lai-Yung

Worked for more than 160 Hours: No

Contribution to Project:

Member of the External Research and Technical Advisory Board (ERTAB)

Name: Campana, Michael

Worked for more than 160 Hours: No

Contribution to Project:

Member of the External Research and Technical Advisory Board (ERTAB)

Name: Wang, Young-Doo

Worked for more than 160 Hours: No

Contribution to Project:

Member of the External Research and Technical Advisory Board (ERTAB)

Name: Gray, Jeffrey

Worked for more than 160 Hours: No

Contribution to Project:

Member of the External Research and Technical Advisory Board (ERTAB)

Name: Nichols, Jane

Worked for more than 160 Hours: No

Contribution to Project:

Member of the Nevada EPSCoR Advisory Board

Name: Amy, Penny

Worked for more than 160 Hours: No

Contribution to Project:

Member of the Nevada EPSCoR Advisory Board

Name: Brenner, Mark

Worked for more than 160 Hours: No

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New Mexico Technet Inc

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US Forest Service, Las Vegas, NV

USDA Natural Resources Conservation Service

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USDA Forest Service - Rocky Mountain Experiment Station

USDA Agricultural Research Service

CSIRO Division of Soils

BUREAU OF LAND MANAGEMENT

Southern Nevada Water Authority

Summit Lake Tribe

Pyramid Lake Tribe

Dine College

US Geological Survey

Denver, CO

NASA Goddard Institute for Space Studies

Provo Shrub Science Laboratory, Provo UT

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Activities and Findings

Research and Education Activities:**Findings:****Training and Development:****Outreach Activities:****Journal Publications**

Timilsena, J.; Piechota T.; Tootle G.; Singh A., "Associations of Interdecadal/Interannual Climate Variability and Long-Term Colorado River Basin Streamflow", *Journal of Hydrology*, p. 289, vol. 365, (2009). Published,

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Aziz, O.A.; Tootle, G.A.; Gray, S.T.; and Piechota, T.C., "Identification of Pacific Ocean sea surface temperature influences of Upper Colorado River Basin snowpack", *Water Resources Research*, p. , vol. , (2010). Published, DOI:10.1029/2009WR008053

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Lamb, K.W., Piechota, T.C., Aziz, O.A., Tootle, G.A., "A Basis For Extending Long-Term Streamflow Forecasts In The Colorado River Basin", *Journal of Hydrologic Engineering*, p. 1000, vol. 16, (2011). Published, DOI: 10.1061/(ASCE)HE.1943-5584.0000153

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Biondi, F., Jamieson, L., Strachan, S., Sibold, J., "Dendroecological testing of the pyroclimatic hypothesis in the central Great Basin, Nevada, USA", *Ecosphere*, p. art5, 20, vol. 2(1), (2011). Published, DOI:10.1890/ES10-00068.1

Miller, W.P., Piechota, T.C., Gangopadhyay, S., Pruitt, T., "Development of Streamflow Projections under Changing Climate Conditions over Colorado River Basin Headwaters", *Hydrology and Earth System Sciences*, p. 2145-2164, vol. 15, (2011). Published, DOI:10.5194/hess-15-2145-2011

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Books or Other One-time Publications

Piechota, T.C.; Neumann E., "Climate Change, Global Warming, and Sustainability: Civil Engineering Curriculum and Student Perceptions", (2008). Conference Proceeding, Published

Bibliography: Proceedings of the 2008 ASEE Annual Conference

Biondi, F.; Strachan S., "Hypothesis-driven research on climate change impacts: the Nevada NSF-EPSCoR example", (2010). Conference Abstracts, Accepted

Bibliography: High-Five Symposium: The Future of High-Elevation Five-Needle White Pines in Western North America, University of Montana, Missoula

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Hornsby, A.D.; Matocq, M.D., "Quaternary biogeography of *Neotoma cinerea*: Linking genetic patterns with environmental change", (2010). Conference Abstracts, Published

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Bird, B.; Strachan, S.; Simeral, D.; Jasoni, R., "Design and Status of the Elevationl Transect and Monitoring Systems for Nevada?s NSF EPSCoR Climate Change Research Program", (2010). Conference Abstracts, Published

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Sady, M.; Arnone, J.; Bollinger, A.; Sady, A., "Waterfall Fire Interpretive Trail", (2010). Conference Abstracts, Published

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Leary, P.; Charlet, D., "Biotic responses to climate change in the Mojave Desert: Floristics", (2010). Conference Abstracts, Published

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Karam, S.L.; Weisberg, P.J.; Sunderman, S.O., "Tree population dynamics at Ash Meadows National Wildlife Refuge: Influences of environmental stress and disturbance", (2010). Conference Abstracts, Published

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Biondi, F.; Strachan, S., "A 2300-year tree-ring chronology and its climatic implications for the eastern Sierra Nevada/western Great Basin", (2009). Conference Abstracts, Published

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- Fisk, T., "Effects of climate change on groundwater resources", (2010). Conference Abstracts, Published
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Bibliography: Report

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Collection: Toward a Sustainable Water Future

Bibliography: Reston, VA: American Society of Civil Engineers

Web/Internet Site**URL(s):**

<http://sensor.nevada.edu>, <http://epscorspo.nevada.edu>

Description:

See narrative for more information.

Other Specific Products**Product Type:****Poster Presentation****Product Description:**

Poster Presentation - PACLIM - Pacific Climate Workshop in Pacific Grove, CA April 20 - 22, 2009. Lead author Gayle Dana, Co-Authors included Tom Piechota, Scott Mensing, and Nick Lancaster

Sharing Information:

Poster Presentation on Nevada RII Project with be shared at various Climate Change Workshops, Meetings, and Conferences

Product Type:**Poster Presentation****Product Description:**

Poster Presentation - "Nevada Infrastructure for Climate Change Science, Education, and Outreach" AGU Annual Meeting December 15-19,2008. Special CIRMOUNT session: Complex Mountain Climates Create Complex Ecosystem Responses and Require Complex Management Strategies. Lead author Gayle Dana, Co-Authors included Tom Piechota, Scott Mensing, and Nick Lancaster

Sharing Information:

Poster Presentation on Nevada RII Project with be shared at various Climate Change Workshops, Meetings, and Conferences

Product Type:**Data or databases****Product Description:**

Smith

Sharing Information:

Smith

Product Type:**Management Plan for the CI group****Product Description:**

Cyberinfrastructure Development Plan

Sharing Information:

Meetings, Conferences, and Symposiums

Product Type:**Survey Report****Product Description:**

Survey Report - Existing Climate Change Portals

Sharing Information:

Meetings, Conferences, and Symposiums

Product Type:**Survey Report****Product Description:**

Survey Report - Existing Software Tools

Sharing Information:

Meetings, Conferences, and Symposiums

Product Type:

Software (or netware)

Product Description:

Software Specification Document - Data Portal/Database

Sharing Information:

Meetings, Conferences, and Symposiums

Product Type:

Software (or netware)

Product Description:

Design Document - Data Portal/Database

Sharing Information:

Meetings, Conferences, and Symposiums

Product Type:

Software (or netware)

Product Description:

Database Schema for Data Portal

Sharing Information:

Meetings, Conferences, and Symposiums

Product Type:

Software (or netware)

Product Description:

Software Specification Document - Software Framework

Sharing Information:

Meetings, Conferences, and Symposiums

Product Type:

Software (or netware)

Product Description:

Software Design Document - Software Framework

Sharing Information:

Meetings, Conferences, and Symposiums

Product Type:

Software (or netware)

Product Description:

Prototype User Interface - Data Portal

Sharing Information:

Meetings, Conferences, and Symposiums

Product Type:

Data or databases

Product Description:

1. Landsat TM 5 scenes and analysis products (181 scenes);
2. Transect webcam images;
3. Transect solar radiation;
4. Transect wind direction and speed;
5. Transect air temperature;
6. Transect relative humidity;
7. Transect precipitation;
8. Transect net radiation;
9. Transect soil moisture (TDR, DPHP, HDU);
10. Transect soil temperature and heat flux;
11. Transect plant sap flow;
12. Transect plant dendrometer

Note: Each of the transect sensors for which we are collecting data are listed; they can be grouped under 1 heading (transect data) or under three headings (Transect micrometeorology, transect soil sensors and transect vegetation sensors).

Sharing Information:

Publications, conference, and symposiums

Product Type:

Teaching aids

Product Description:

Flyer - "How to Green Your Business"

Sharing Information:

Publications, conference, and symposiums

Product Type:

Software (or netware)

Product Description:

Landscape Vegetation Simulation Model (Process-based simulation model linking downscaled climate scenarios to fire regime and Great Basin vegetation persistence traits)

Sharing Information:

Publications, conference, and symposiums

Product Type:

Data or databases

Product Description:

Excel spreadsheet of vegetation, spatial, and physical data for 2765 sample locations in Clark, Nye, Lincoln, and White Pine Counties

Sharing Information:

Publications, conference, and symposiums

Product Type:

Data or databases

Product Description:

Portfolio of 42,000+ high resolution, georeferenced photographs accompanying Excel spreadsheet of vegetation, spatial, and physical data for 2765 sample locations in Clark, Nye, Lincoln, and White Pine Counties

Sharing Information:

Publications, conference, and symposiums

Product Type:

Data or databases

Product Description:

ArcMap 10.0 shapefiles of database (the databases of Excel spreadsheet of vegetation, spatial, and physical data for 2765 sample locations in Clark, Nye, Lincoln, and White Pine Counties and accompanying portfolio of 42,000+ high resolution, georeferenced photographs)

Sharing Information:

Publications, conference, and symposiums

Product Type:

Physical collection (samples, etc.)

Product Description:

374 botanical collections from throughout Nevada donated to Wesley E. Niles Herbarium at UNLV

Sharing Information:

Publications, conference, and symposiums

Product Type:

Conference presentation

Product Description:

Climate Modeling: From Global Climate Models to Regional Climate Applications

Sharing Information:

Publications, conference, and symposiums

Product Type:

Conference presentation

Product Description:

Evaluation of three climate downscaling techniques in forcing a coupled hydrological model in a snow-dominated watershed in the Lake Tahoe basin

Sharing Information:

Publications, conference, and symposiums

Product Type:

Conference presentation

Product Description:

Climate signatures of the wind stress and wind stress curl over the U.S. West Coast

Sharing Information:

Publications, conference, and symposiums

Product Type:

Conference presentation

Product Description:

The Response of the Offshore Atmospheric Marine Layer to Coastal Topography

Sharing Information:

Publications, conference, and symposiums

Product Type:

Conference presentation

Product Description:

Low-level flow around the Baja California peninsula during NAME

Sharing Information:

Publications, conference, and symposiums

Product Type:

Software (or netware)

Product Description:

Database schema for data portal

Sharing Information:

Publications, conference, and symposiums

Product Type:

Software (or netware)

Product Description:

Prototype user interface - software framework

Sharing Information:

Publications, conference, and symposiums

Product Type:

Software (or netware)

Product Description:

Source code - software framework

Sharing Information:

Publications, conferences, and symposiums

Product Type:

Software (or netware)

Product Description:

Source code - NetCDF file format read/write library

Sharing Information:

Publications, conferences, and symposiums

Product Type:

Software (or netware)

Product Description:

Software architecture document - software framework

Sharing Information:

Publications, conferences, and symposiums

Product Type:

Software (or netware)

Product Description:

Source code - drag and drop browser FTP file manager

Sharing Information:

Publications, conferences, and symposiums

Product Type:

Software (or netware)

Product Description:

Latitude & Longitude parser and formatter (A coordinate parser for latitude and longitude)

Sharing Information:

Publications, conferences, and symposiums

Product Type:

Audio or video products

Product Description:

Monitoring transect installation video (Dale Devitt)

Sharing Information:

Publications, conferences, and symposiums

Product Type:

Audio or video products

Product Description:

Monitoring transect helicopter lift video (Lynn Fenstermaker)

Sharing Information:

Publications, conferences, and symposiums

Product Type:

Audio or video products

Product Description:

Software framework demo video on data portal

Sharing Information:

Publications, conferences, and symposiums

Product Type:

Data or databases

Product Description:

Site installation information sheet (draft) - Used by site installers to document information

Sharing Information:

Publications, conferences, and symposiums

Product Type:

Software (or netware)

Product Description:

Data portal alpha version user interface

Sharing Information:

Publications, conferences, and symposiums

Product Type:

Software (or netware)

Product Description:

Data portal beta-1 version user interface

Sharing Information:

Publications, conferences, and symposiums

Product Type:

Software (or netware)

Product Description:

Data portal beta-2 version user interface

Sharing Information:

Publications, conferences, and symposiums

Product Type:

Physical collection (samples, etc.)

Product Description:

Configured virtualization servers (2) - Used to host virtual machines

Sharing Information:

Publications, conferences, and symposiums

Product Type:

Software (or netware)

Product Description:

Virtualized infrastructure servers (8) - Configured servers for web server, database, etc.

Sharing Information:

Publications, conferences, and symposiums

Product Type:

Physical collection (samples, etc.)

Product Description:

Configured storage server - Primary storage location

Sharing Information:

Publications, conferences, and symposiums

Product Type:

Data or databases

Product Description:

Database of public organizations in Nevada

Sharing Information:

Publications, conferences, and symposiums

Product Type:

Summary Report to Component and Stakeholders

Product Description:

State and Local Government Perspectives on Climate Change Priorities: Results from a Survey in the State of Nevada

Sharing Information:

Publications, conferences, and symposiums

Product Type:

Data or databases

Product Description:

Database of rancher and farmer perceptions of climate change

Sharing Information:

Publications, conferences, and symposiums

Product Type:

Data or databases

Product Description:

Database of Native American perceptions of climate change

Sharing Information:

Publications, conferences, and symposiums

Product Type:

Data or databases

Product Description:

Database of student perceptions of climate change

Sharing Information:

Publications, conferences, and symposiums

Product Type:

Data or databases

Product Description:

Database of business perceptions of climate change

Sharing Information:

Publications, conferences, and symposiums

Product Type:

Data or databases

Product Description:

Databases of general population, energy and water purveyors

Sharing Information:

Publications, conferences, and symposiums

Product Type:

Audio or video products

Product Description:

DVD for climate change outreach

Sharing Information:

Publications, conferences, and symposiums

Product Type:

Software (or netware)

Product Description:

Nevada Climate Change Portal version 1.0

Sharing Information:

NCCP release December 2011 (substantially revised HTML 5 portal software with new integrated resources that are being improved continuously)

Product Type:

Software (or netware)

Product Description:

Nevada Climate Change Portal version 2.0

Sharing Information:

Planned new NCCP release (June 30, 2012)

Product Type:

Data or databases

Product Description:

Core SENSOR database and schema

Sharing Information:

The central mechanism of all our data storage and operations

Product Type:

Software (or netware)

Product Description:

Campbell Scientific data importer

Sharing Information:

Software service that monitors new data collected by Campbell Scientific loggers and adds it to the data systems, managing any errors appropriately.

Product Type:

Software (or netware)

Product Description:

Silverlight data search interface

Sharing Information:

Software user interface that utilizes web services to provide advanced data search capabilities

Product Type:

Software (or netware)

Product Description:

Demeter software framework

Sharing Information:

Web-service based software resources for model and data interoperability

Product Type:

Software (or netware)

Product Description:

Persephone graphical user interface of the Demeter framework

Sharing Information:

The GUI component of the Demeter framework

Product Type:

Software (or netware)

Product Description:

Process-based simulation model developed in the agent-based simulation environment, Netlogo

Sharing Information:

Ccapable of exploring consequences of climate scenarios and fire regime on long term persistence of sagebrush (*Artemisia* spp.)

Product Type:

Instruments or equipment developed

Product Description:

Remote data IP networking system, Spring Valley, Nevada

Sharing Information:

Nevada Climate Change Portal open access data. Conferences, presentations, and seminars.

Product Type:

Instruments or equipment developed

Product Description:

Remote data IP networkign system, Snake Valley, Nevada

Sharing Information:

Nevada Climate Change Portal open access data. Conferences, presentations, and seminars.

Product Type:

Instruments or equipment developed

Product Description:

Remote data IP networking system, Sheep Range, Nevada

Sharing Information:

Nevada Climate Change Portal open access data. Conferences, presentations, and seminars.

Product Type:

Data or databases**Product Description:**

Monitoring Station Equipment Inventories, 12 stations

Sharing Information:

Nevada Climate Change Portal open access data. Conferences, presentations, and seminars.

Product Type:**Data or databases****Product Description:**

Monitoring Station Layout Maps, 12 stations

Sharing Information:

Nevada Climate Change Portal open access data. Conferences, presentations, and seminars.

Product Type:**Data or databases****Product Description:**

Monitoring Station Access and Use Policies, 12 Stations

Sharing Information:

Nevada Climate Change Portal open access data. Conferences, presentations, and seminars.

Product Type:**Data or databases****Product Description:**

Monitoring Station Wiring Diagrams, 12 Stations

Sharing Information:

Nevada Climate Change Portal open access data. Conferences, presentations, and seminars.

Product Type:**Data or databases****Product Description:**

Monitoring Station Inventory Photographic Collection, 12 Stations

Sharing Information:

Nevada Climate Change Portal open access data. Conferences, presentations, and seminars.

Product Type:**Brochure****Product Description:**

Nevada Climate Change (NevCAN) Trifold and Electronic Brochures

Sharing Information:

Disseminate via website and at various conferences, seminars and events.

Product Type:**Audio or video products****Product Description:**

UNLV TV has developed multiple YouTube videos highlighting project activities.

Sharing Information:

Website dissemination. Use at conferences and seminars.

Contributions**Contributions within Discipline:**

Please refer to Annual Report (pdf file)

Contributions to Other Disciplines:

Please refer to Annual Report (pdf file)

Contributions to Human Resource Development:

Please refer to Annual Report (pdf file)

Contributions to Resources for Research and Education:

Please refer to Annual Report (pdf file)

Contributions Beyond Science and Engineering:

Please refer to Annual Report (pdf file)

Conference Proceedings

Special Requirements

Special reporting requirements: None

Change in Objectives or Scope: None

Animal, Human Subjects, Biohazards: None

Categories for which nothing is reported:

Activities and Findings: Any Research and Education Activities

Activities and Findings: Any Findings

Activities and Findings: Any Training and Development

Activities and Findings: Any Outreach Activities

Any Conference

Nevada Infrastructure for Climate Change Science,
Education, and Outreach

Year 4 Annual Report (2011/2012)
Cooperative Agreement EPS-0814372

Submitted by:

Dr. Gayle Dana
Project Director
Nevada NSF EPSCoR

June 7, 2012

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I. Executive Summary

A. Vision of Project

The vision of Nevada's NSF EPSCoR Climate Change Project (Track 1 RII) is to create a statewide interdisciplinary program and virtual climate change center that will stimulate transformative research, education, and outreach on the effects of regional climate change on ecosystem resources and support use of this knowledge by policy makers and stakeholders.

B. Brief description of project efforts in specific areas.

The key *research* activities in year four included the following efforts. Two Integrated Science Project (ISP) awards were implemented in year four. The ISPs consist of inter-institutional teams of NSHE faculty conducting research that integrates the six infrastructure building components of the project and addresses the two main science questions. Climate modeling efforts focused on using a Regional Climate Model (RCM) based on the Weather Research and Forecasting (WRF) tool to downscale general circulation model outputs into resolutions appropriate for hydrological, ecological, and economic impact modeling studies and predictions for impact assessment over the arid and semi-arid regions of the southwestern United States (with emphasis over the state of Nevada). Completion of the Nevada Climate-ecohydrological Assessment Network (NevCAN) will be achieved in September 2012. NevCAN is unique within the inter-mountain western U.S., providing real time measurements of climate variability and its impact on water, soil, and plants within key vegetation zones from valley to mountaintop. The policy group brings together scientists from the sciences and social sciences to share work on climate change issues and to identify what is known or unknown with respect to theory, models and data and provide new perspectives on available data, knowledge about how data was generated and model assumptions. These interactions are critical to transforming research activities and advancing knowledge for scientists, policymakers, and ultimately general public within the state of Nevada.

The project has been active in *broadening participation* through Summer Institutes, Community College Faculty Fellowships, Curriculum development awards, Graduate Student Assistantships and Fellowships, Undergraduate Research Scholarships, and outreach to stakeholders and small businesses. Summer Institutes this year will reach out to 14 middle school teachers in Nevada to provide formal training on climate change science and education and new tools for the teachers to incorporate climate change into their science classrooms, affecting 800 middle school students. The Community College Faculty Summer Fellowship program is providing funding for a faculty member from the Nevada State College to integrate data from the Nevada Climate Change Portal into curriculum materials on climate science and climate change for science teaching methods classes for K-12 pre-service teachers. Funds were awarded to ten NSHE faculty members, including one at the four-year Great Basin College and one to the Public Lands Institute, to develop college courses or course modules related to climate change through a competitive process. The project supported 20 Graduate Student Assistants and 8 Graduate Fellows conducting research on climate change as well as 31 Undergraduate students participating in research activities on climate change and other STEM subjects. Additionally, Nevada EPSCoR has become active members of state groups

such as Nevada STEM Coalition, Nevada Dept. of Education's STEM Task Force, and Gathering Genius.

The project has been increasing *diversity* in a number of significant ways. The project offered a graduate research assistantship specifically targeted to underrepresented minorities, which resulted in the hiring of an African-American student in the Ecological Change component. The Nevada Small Business Development Center (NSBDC) hired a Disadvantaged Business Enterprise (DBE) business advisor in March 2012. The Education, Outreach and Diversity (EOD) program within Nevada NSF EPSCoR has also implemented key activities and partnerships in order to broaden current and future participation of URM and women into STEM at a statewide level. These include: outreach to over 30 underrepresented-specific campus organizations, and implementation of the Nevada STEM Pipeline, the Nevada Mentor Network, and the Tri-State Diversity Strategic Action Plan (in conjunction with Track 2).

The project has five significant *workforce development* mechanisms: Summer Institute; Nevada Small Business Development Center; graduate student and undergraduate student development; supporting professional certifications; sending project members to project-specific trainings and workshops, and through new faculty hires. The first three provide professional development for different population sectors of Nevada and are described above. The NSBDC provides business and management training to thousands each year throughout the state. Much of this is focused on creating and saving jobs, starting businesses, and capital formation. The project is supporting workforce development in climate change through three new faculty hires in year 4 along with continued funding of all faculty and postdoc hires implemented in prior years of the project.

In year four, the project's *Cyberinfrastructure* Component released to the public the technological foundation – the Nevada Climate Change Portal – on which the other five project components will perform their computer-related activities, collaborate, and coordinate their activities. The Portal will advance knowledge and expertise in creating science data portals, particularly through new solutions for content organization, end-user presentation, architectural design, detailed design, and performance optimization that will beneficially transform the way such portals are built. The Portal is available online to the public at sensor.nevada.edu/. The Portal is continuously acquiring and importing high-resolution measurements from all monitoring stations in the NevCAN network (over 358 million measurements as of April 10, 2012), making this data immediately available to researchers. Other major CI achievements include: completion of the GeoVisualization Laboratory at UNLV, which will be used by researchers to communicate science results to stakeholders; the continued development of the Demeter framework, a set of web service-oriented software resources which, as of year four, includes a plug-in system for allowing different activity component standards and third-party components to be integrated into its functionality; extending our regional climate modeling work into global climate modeling capabilities by installing the Community Earth System Model (CESMO) on our computer cluster; and convening of the Tri-State Cyberinfrastructure Working Group (ID, NV, NM) at the 4th annual Tri-State Consortium meeting on April 5, 2012. Track 1 CI activities have been greatly enhanced by close links with the Track 2 Western Tri-State Consortium.

Outreach and communication included making presentations to the scientific community (over 50), to Nevada's business community and other stakeholders, and through the project web site (nvclimatechange.org) and Nevada Climate Change Portal (sensor.nevada.edu/). Outreach to the science community included numerous presentations at national and international conferences. Communication to the scientific community within Nevada was accomplished by the 3rd annual NSF EPSCoR State Climate Change Conference, which 119 faculty, students and stakeholders attended at UNLV in Las Vegas NV on February 13, 2012. The Nevada Climate Change monthly seminar series provided outreach to the NSHE scientific community. The centerpiece for communications and outreach with our colleagues in Idaho and New Mexico was through the 4th Annual Tri-State Meeting, held in Sun Valley ID, April 2-5, 2012; 195 researchers, educators, and administrators from NV, NM, ID as well as AK, CA and DC attended the meeting. To promote the visibility and use of the Nevada Climate Change Portal two workshops were held in 2012: at the 2012 Annual Nevada NSF EPSCoR Climate Change Meeting, and at the July 2012 CUAHSI Biennial Science Meeting in Boulder CO.

Over thirty meetings and field trips were held between project members and stakeholders, including local, state, federal and non-governmental agencies. Through a partnership with UNLV TV, the project has produced five videos that are posted on the NV EPSCoR YouTube channel (www.youtube.com/user/nevadaepscor). For the public, the Losing the Lake game was installed at the Las Vegas Natural History Museum, and will be installed at the Lake Mead visitor's center. In September 2011, Nevada was fortunate to host "NSF Science: Becoming the Messenger", where 92 NSHE participants learned skills to communicate their science effectively to a broad audience. In addition to the NSBDC outreach activities described above, the NSBDC frequently assists faculty members at UNR and UNLV in submitting SBIR proposals, as well as working with companies to identify faculty who can assist them in their R&D work.

The project's *evaluation and assessment* component measures the project's progress and success as facilitated and guided by the external evaluator, the project's External Research and Technical Advisory Board (ERTAB), AAAS site reviews, and NSF Reverse Site Visits. The external evaluator provides quarterly evaluation reports (three formative and one summative) to the project management team; the reports are also provided to NSF by the management team. The eight-member ERTAB convened at UNLV on February 14, 2012. Our year four NSF Reverse Site visit occurred just prior to the start of year four, on August 12, 2012.

Sustainability was addressed through five mechanisms: proposal development efforts that build on the project's climate change infrastructure; providing technical writer's support to improve competitiveness of proposals submitted; and new faculty hires. In Year four, project members submitted 47 proposals. Of those, 11 (23%) were awarded funding for a total amount of \$12,862,735. Twenty of the 47 (43%) submitted are still pending. Several of the project leads are in the process of preparing sustainability plans for key infrastructure pieces of the project. The ERTAB advised us that partnerships with stakeholders constitute a key mechanism for sustainability for our infrastructure. To facilitate these partnerships, the project is funding a Stakeholder Outreach Coordinator (Dr. Lynn Fenstermaker) starting in May 2012, to continue through the end of year 5.

The *management structure* includes the Management Team (PD, and Co-PIs), the Leadership Council (Co-PIs, Component Leads, PIs of Interdisciplinary Science Teams); and Steering Committees (one member each from UNR, UNLV, DRI). To encourage effective communication and management, there have been bi-monthly PI meetings, quarterly Leadership Council Videoconference meetings, and Steering Committee meetings as needed. The Management Team held a 2-day planning retreat on May 16-17, 2012 to review progress made in year four, and discuss plans for year five activities.

C. Key Accomplishments

Key accomplishments are summarized below in intellectual merit and broader impacts.

Intellectual Merit

An overarching goal of Nevada's Track 1 RII is to promote climate change scientific discovery by carrying out nationally competitive collaborative capacity building in climate change science to address two broad fundamental scientific questions: *How will climate change affect water resources and linked ecosystem services and human systems?*; and *How will climate change affect disturbance regimes and linked systems?* The key capacity building activities in year four include: completion of four seed grants to NSHE faculty for conducting research that utilizes the new infrastructure built by the project; implementation of two Integrated Science Projects that integrate the six infrastructure building components of the project and addresses the two main science questions; implementing a Regional Climate Model (RCM) based on the Weather Research and Forecasting (WRF) tool to downscale general circulation model outputs into resolutions appropriate for hydrological, ecological, and economic impact modeling studies and predictions for impact assessment over the arid and semi-arid regions of the southwestern United States); public availability of the online Nevada Climate Change Portal, which will advance knowledge and expertise in creating science data portals, particularly through new solutions for content organization, end-user presentation, architectural design, detailed design, and performance optimization that will beneficially transform the way such portals are built; completion of the Nevada Climate-ecohydrological Assessment Network (NevCAN) which is unique within the inter-mountain western U.S., providing real time measurements of climate variability and its impact on water, soil, and plants within key vegetation zones from valley to mountain top; and bringing together scientists from the physical, biological, and social sciences on climate change issues. These interactions are critical to transforming research activities and advancing knowledge for scientists, policymakers, and ultimately general public within the state of Nevada. As the result of nationally competitive searches, human capacity in climate change was increased in year four by the hiring of one new DRI faculty (Ecosystem Modeler) and two new UNLV faculty (Ecohydrologist; Data Visualization).

Broader Impacts

Climate change education and outreach are critical aspects of this Track 1 RII project. The primary education goal is to create a scholarly environment to promote research skills and intellectual development for Nevada educators and students. In year four the project met this goal by funding eight graduate student fellowships and 20 graduate research assistants to conduct climate change research. Competitive undergraduate research scholarships were

provided to 31 undergraduates. Student involvement in research is an effective tool to motivate academically talented undergraduates to pursue graduate degrees and go onto careers in STEM fields. Students presented their research at the Nevada Undergraduate Research Symposium held in April 2012 and those participating in the summer program will present at a poster session in August 2012. Fourteen middle school teachers from Nevada will receive professional development by attending the project's 4th annual Summer Institute in summer 2012. The Summer Institute will provide formal training on climate change science and education and new tools for the teachers to incorporate climate change into their science classrooms. One Nevada State College faculty member was awarded a fellowship to conduct climate change research during summer 2012 with a faculty mentor from UNR. The primary goal of the fellowship is to facilitate integration of research and education, and improve science curriculum at the Community and State Colleges. College courses or course modules related to climate change are being developed by ten faculty and educators, including one from the four-year Great Basin College and one from the Public Lands Institute. This course development program has broadened participation to other disciplines, such as English (a research and composition course related to scientific topics), history (how humans have adapted to climate change in the past), mathematics and geography.

The primary outreach goal of the project is to document, interpret, and communicate institutional and societal impacts of the project's climate change research findings to all interested and affected parties. The Policy Component is broadening project outreach and communication by completing surveys of Nevada groups (rural, business, Native Americans, NGOs and government, students) on their perceptions, assumptions, and observations on climate change. Project members have made contact with and presented project presentations to stakeholder groups in Nevada and the region. Small businesses are reached through the project's SBIR Component run by the Nevada Small Business Development Center (NSBDC). The impacts of SBIR grants awarded to Nevada businesses are immediate and are felt in employment and they result in the development of innovative products.

D. Progress toward meeting goals outlined in the Strategic Plan.

The project's Strategic Plan was revisited by team members and updated on December 31, 2011 and can be found at: <http://epscorspo.nevada.edu/nsf/climate1/library.html>. The project is on track to meeting the goals and milestones outlined in the updated plan.

E. Actions from site visits, reverse site visits, evaluation reports, advisory committee visits.

The management team used the evaluator's reports from year three to inform and make adjustments in plans for year four. The project's External Research and Technical Advisory Board (ERTAB) summarized their comments and recommendations from the February 14, 2012 meeting in a report to the management team. The management team responded to each report recommendation with strategies on how we will incorporate the recommendations into the project. The 2012 ERTAB report, with project team responses embedded, can be found in Appendix I. Nevada's year four NSF Reverse Site visit (RSV) occurred just prior to the start of year four, on August 12, 2012. In the time since the RSV, team members have been implementing the recommendations made by the RSV panel.

II. Detailed Report

A. RII participants and participating institutions.

See Fastlane entries and Template Appendix A.

B. Program/Project Description.

1. Research Accomplishments and Plans.

Research accomplishments and plans are provided for four infrastructure-building components as well as for integrative activities of the project. The four components are: Climate Modeling, Ecological Change, Water Resources, and Policy, Decision Making and Outreach. In addition we report on research on climate change education.

Climate Modeling: The main goal is to develop a capability to model climate change and its effects at regional and sub-regional scales. Objectives include developing and implementing different approaches to downscale Global Climate Models (GCMs) at relatively coarse spatial resolution (typically 100km) to resolutions appropriate for hydrological, ecological, and economic impact modeling studies and predictions for assessment of climate change impacts over the southwestern U.S. (with emphasis over the state of Nevada). With the addition of three NSF EPSCoR faculty hires in years 2-4, two new objectives were included: investigate uncertainties and errors in climate modeling and assess climate forcing mechanisms for the urban heat island effect.

The Climate Modeling Component uses a model to dynamically downscale coarse-scale GCM simulations from the Couple Model Intercomparison Project phase 3 (CMIP3) datasets archive to scales more relevant to regional and local impact studies. Model outputs provides high resolution data for process (Monsoon, ENSO) and impact (Hydrology, Ecology, Urban) studies across the western US and, in particular, for Nevada and the Great Basin. The geographical domain of the model covers the Western United States, parts of southwestern Canada, and the North American Monsoon Region. During last year, the first set of simulations was finished and observations were synthesized for distribution through the Nevada Climate Change data portal (sensor.nevada.edu) for analysis and applications proposed by other project components and end-users over the Western US.

To address and quantify uncertainty in our climate simulations, the climate modeling group has adopted two strategic approaches:

1. An analysis of CMIP3 GCM (including new GCM simulated output from CMIP5) biases and a spread of hydroclimate parameters to evaluate their ability to simulate current climate at resolvable scales over Western US. Analysis of uncertainty at this level is important because these datasets are used to drive the downscaling approaches.
2. The uncertainty introduced by the downscaling approaches is assessed by intercomparison composed of the downscaling methodologies developed within the Tri-State consortium (DRI-RCM-DRI and MACA-Idaho) and others developed by the Bureau of Reclamations (BCSD and BCCA) and the North American Regional Climate Change Assessment Program (NARCCAP). Initial results from are expected by the end of Summer 2012.

Another study will bridge the gap between the large-scale climate changes and small-scale hydrologic processes and can be applied to other states for similar research. The spatiotemporal changes of extreme precipitation in western United States were investigated and the ability of current Regional Climate Models (RCMs) to represent the multi-scale temporal variability in their precipitation outputs was examined. Downscaling methods are being used to disaggregate the precipitation scenarios from current GCMs for a hydrologic model system (HMS), which will give stream flow simulations at Lees Ferry, AZ. Together with the stream flow simulations from other models (VIC), an ensemble of supply scenarios will be created. Future demand scenarios will be simulated by a system of dynamic modeling for the Las Vegas Metro Area, and the uncertainty analysis of water sustainability in this region will be conducted.

A historical examination and future projections of the forcing mechanisms of the Truckee Meadows urban heat island was completed. It was shown that incorporation of a historical period that includes the maximum urban heat island signal is vital to producing robust results. It was shown that merely using gridded, spatially downscaled climate data (such as from the Lawrence Livermore National Lab) without downscaling to urban stations produced insufficient results during the future period 2041-2060 for use in land use and resource planning. Preliminary results indicate that the summertime North American Monsoon may play a role in generating conditions more suitable for heat island events to develop.

The research described above will continue into year five (2012-13) of the project.

Ecological Change and Water Resources: The main goal of the Ecological Change component is to develop data collection, modeling, and visualization infrastructure to determine and analyze effects on ecosystems and disturbance regimes. The primary goal of the Water Resources Component is to develop data collection, modeling, and visualization infrastructure to better quantify and model changes in water balance and supply under climate change.

Instrumented Environmental Transects. The center stone infrastructure for attaining the goals of both the Ecology and Water Components is a network of Instrumented environment transects to observe, measure and analyze the effects of climate change on ecosystems and water resources. These transects are located in two ecoclimatic areas, one that is dominated by winter snowpack dynamics (Great Basin National Park and adjacent areas in eastern Nevada), and the other that is strongly influenced by summer precipitation (southern Nevada).

The Ecological Change and Water Resources Components have continued to communicate and collaborate with national climate, ecological and water resources initiatives to insure our project outputs are compatible. These initiatives include CIRMOUNT, MTNCLIM, CZO, NEON, LTER, and MOJN. A new development that has provided excellent bridging between our project and NEON is the addition of Dr. Jim Gosz to the project's ERTAB. Dr. Gosz is on the NEON Board of Directors.

The Ecology and Water Components have made significant progress in infrastructure construction, research, and education. Team members were able to negotiate a permit with the Great Basin National Park for a monitoring station within an east-facing subalpine region

of the park and thus providing east and west-facing subalpine monitoring sites within the same mountain range. The field team made significant progress on completing the NevCAN installation with the last tower being co-erected with a SCAN site at Hayford Peak (Sheep Range Subalpine site) in early September 2012

The Ecology and Water team members are heavily involved in one of the project's Integrated Science Projects (ISP), the goal of which is to demonstrate the quality and utility of the Nevada Climate-ecohydrological Assessment Network (NevCAN) data via analysis of multiple datasets from network instruments and observations in a collaborative interdisciplinary environment, and communication of these results to the scientific and land management communities. The overarching science question of this effort is to *How do climate variability and climate change impact ecosystems and water in the Great Basin (including the northern Mojave Desert)?* Specific ISP objectives include:

1. Determine temporal and spatial relationships between key climate and ecohydrological variables.
2. Assess causal linkages among climatic, hydrologic, and ecologic processes using the RHESSys Model.
3. Assess the extent to which Nevada CAN data are representative of a wider spatial and temporal framework and develop methods to extrapolate Nevada CAN observations to larger temporal and spatial scales.
4. Publish initial results from the Nevada CAN, including documentation of transect instrumentation and datasets.
5. Conduct outreach to scientific community and land management agencies to attract additional projects that use Nevada CAN infrastructure and data.

In addition to the ISP, three new efforts have been initiated by Dr. Dale Devitt (UNLV) to enhance NevCAN measurements and research. These three efforts include: 1) measurement of groundwater oscillations within the phreatophytic zone on the east side of the Snake Range transect; 2) three-dimensional assessment of cold air drainage between the Sheep Range transect Montane and Pinyon/Juniper monitoring stations; and 3) measurement of phenological variation among key species at the Sheep Pinyon/Juniper site.

The Water Component currently has four graduate students completing or continuing climate change research efforts. Lorenzo Apodaca (UNLV M.S. student) is continuing work on a study examining the effect of interannual variation in vegetation response to climate change using historical remote sensing and shrub growth ring analysis. Jeremy Koonce is completing his PhD at UNLV on semi-aridland shrub ET estimation via assessment of soil moisture. Kerensa Kruse (UNR M.S. student) is examining the effect of rainfall amounts and intensities on runoff within the mountainous terrain of the Sheep and Snake Range transects. Finally, Amanda Wagner is completing her M.S. research on water source partitioning for shrubland transpiration. Additionally the water component provided an opportunity for three foreign exchange students (from France) and four undergraduate students to gain knowledge of Great Basin ecosystems and expertise in performing field research.

Research topics of proposals submitted by members of the Ecology Group include: ecohydrological processes along elevational gradients and under different climatic regimes;

micrometeorological variability; relationships among snowcover, temperature, vegetation indices, and tree dynamics; using field manipulation to experimentally calibrate proxy records of climate; and characterizing the thermal and evaporative environment for identifying risks to animal survival in high temperatures. A number of research talks (mostly oral, but also posters) were presented at national and international scientific meetings to report on current progress. Several peer-reviewed papers were partially supported by project funds awarded to senior and junior faculty. The research described above will continue into year five (2012-13) of the project.

Policy, Decision Making, and Outreach: The main goal is to develop data collection and modeling infrastructure to assess effects on human systems, responses to institutional and societal aspects, and enhance policy-making and outreach to communities and stakeholders.

The resources from the Nevada NSF EPSCOR grant provide unique opportunities to bring together scientists from the sciences and social sciences to share work on climate change issues. Such meetings enable scientists to identify what is known or unknown with respect to theory, models and data and provide new perspectives on available data, knowledge about how data was generated and model assumptions. These interactions are critical to transforming research activities and advancing knowledge for scientists, policymakers, and ultimately general public within the state of Nevada. Members of the Policy Component presented 26 papers and exchanged ideas at multiple academic conferences during the year. With respect to advancing knowledge, key accomplishments include four funded grant proposals, three published journal articles, and three journal articles accepted for publication.

Visualization of scientific and social data helps in understanding and communication of useful concepts and results. In year four, construction of the Geovisualization Laboratory at UNLV was finished. The “GeoVis” lab completes the project’s GIS and Remote Sensing (GISRS) Core Lab, which provides advanced GIS, remote sensing, and now visualization capabilities to the UNLV campus. GeoVis has a multi-screen/large-screen wall with multiple projection systems. The facility is equipped with software and hardware for 3D visualization, video conferencing, and wide display presentation.

Other accomplishments by the Policy group include:

- Hosted four workshops to different stakeholder groups (e.g., rural residents and scientists) to provide unique opportunities to exchange information and learn more about Climate Change issues in Nevada. Such interactions provide new perspectives and insights for refining research efforts that will ultimately lead to better decisions.
- Hired a new faculty member in the School of Environmental and Public Affairs at UNLV: Dr. Jaewon Lim, a Demographer with expertise in Quantitative Spatial Methods and Economic Migration Models. As a result of the national search for this demographer, UNLV decided to hire one of the other excellent candidates, D. J. Waddell, a scholar with expertise in studying vulnerable groups characterized by poverty and environmental disasters. Dr. Waddell was hired to work in the Public Administration program at UNLV. Both of these faculty will start at the beginning of year five of the project.
- Hired Dr. Zhongwei Liu as Assistant Director of the GIS Remote Sensing Laboratory

Research on Climate Change Education: The education component continues to support a study on the attitudes of higher education faculty towards the teaching of climate change. The former Education Component lead, Dr. Gale Sinatra (now a professor at the University of Southern California), and the former graduate research assistant (GRA), Abby Beck, prepared one journal manuscript on this subject. The present GRA, Marissa Owens, further analyzed the data, finding that despite a general liberal orientation, 34% of the faculty still do not believe that climate change is occurring. Furthermore, there was no correlation between political orientation and the feeling of responsibility to teach about climate change.

Education Component personnel (Nussbaum and Owens) and collaborators (Abeera Rehmat and Jackie Cordova) are contributing to two other research studies: 1) an evaluation of the *Losing the Lake* computer game (which educates middle-schoolers and the general public on the reasons for declining lake levels); and 2) development and evaluation of refutational texts on climate change (these texts target common student misconceptions, such as confusions between the greenhouse effect and the ozone hole). Pre and post-test and interest data on *Losing the Lake* were collected from two middle schools (approximately 150 students) and are presently being analyzed. In the coming year, similar evaluation data on the refutational texts will be collected, and journal manuscripts will be prepared for all three research projects.

Integrative Research and Activities: Integrative research is accomplished through three mechanisms: Integrated Science Projects, Seed Grants, and Tri-State Innovation Working Groups. Interdisciplinary Science Projects (ISPs) are comprised of faculty and students from different disciplines, backgrounds and campuses that integrate the six infrastructure building components of the project and address the two main science questions of the project. Two ISPs were funded in year four and will continue to the end of year five. The one-year Seed Grant programs promoted use of new project infrastructure and data. Details on the ISPs and Seed Grants are in the “Seed Funding and Emerging Areas” section below.

The Tri-State Innovation Working Groups (IWGs) – a collaboration among NV, ID, and NM – provide a venue for engaging scientists and educators, along with key nationally and internationally recognized experts, to address the grand challenges that can transform science and education. This program supports week-long working group activities that are modeled after those hosted by the highly successful NSF-supported National Center for Ecological Analysis and Synthesis (NCEAS). Note that while this IWG program is a tri-state effort, the idea originated as a collaborative of the individual Track 1 projects of the three states. The Tri-State Consortium awarded two IWGs in year four:

1. Carbon and Nutrient Dynamics in Semi-Arid Ecosystems. Lead: Dr. Marie-Anne de Graaf, Boise State University

This IWG included seven faculty and students from BSU, DRI, NMSU, The primary goal of the "Carbon and Nutrient Dynamics in Semi-Arid Ecosystems" Innovation Working Group was to write a review paper addressing the uncertainties associated with soil C cycling in semi-arid and arid ecosystems in the northern hemisphere, and to use this paper as a foundation for development of a competitive proposal to be submitted to the National Science Foundation. The participants are in the process of writing a review paper, which should be completed this

summer 2012. A pre-proposal was submitted to the NSF, Carbon dynamics in arid ecosystems: mechanistic responses to climate variability and climate change from microsite to landscape scales, in response to the RFP: DEB-Ecosystem Studies. If accepted, a full proposal will be written that sets out to evaluate how changes in precipitation will affect carbon cycling processes across desert ecosystems.

2. The Role of Downscaling Methods on Climate Impact Modeling in Complex Terrain. Lead: Dr. John Abatzoglou, University of Idaho (awaiting final report)

The IWG spurred an effort to quantify the fractional uncertainty of climate change projections at local scales due to the choice of downscaling method. The group is conducting a coordinated inter-downscaling comparison building off the downscaling methodologies developed within the Tri-State consortium, and will be applying these data to both hydrologic and ecological models to better contextualize the choices of downscaling methods for assessing climate impacts in complex terrain. The IWG was designed to better address this gap in scientific knowledge that has both theoretical and practical implications, and to increase synergy between groups in the Tri-State consortium in preparation for the next round of models created for the fifth assessment report of the Intergovernmental Panel on Climate Change.

2. Diversity and Broadening Participation, including Institutional Collaborations.

a. Diversity and Broadening Participation

Project demographics: In year four the total number of participants, including faculty, staff, students and external advisory board members, in Climate Change research and education has increased from a baseline of 24 to 176 (as of April 2012), a ~7 fold increase (see table below). The total number of participants increased slightly from 159 in year three to 176 in year four. The percentage of women involved increased from 17% at baseline to 39% in year four of the project. The participation of women has shown an increase every year of the project. The involvement of Community and State College participants has increased from one at baseline to eight in year four. This represents a small decrease in participation by that group in year one (10) and year two (12) but stable compared to year three (8).

| Institution | Participants | | | | | Male | | | | | Female | | | | |
|----------------|--------------|------------|------------|------------|------------|-----------|------------|------------|------------|------------|----------|-----------|-----------|-----------|-----------|
| | Baseline | Year 1 | Year 2 | Year 3 | Year 4 | Baseline | Year 1 | Year 2 | Year 3 | Year 4 | Baseline | Year 1 | Year 2 | Year 3 | Year 4 |
| NSHE (Prime) | 0 | 12 | 11 | 11 | 10 | 0 | 2 | 2 | 2 | 1 | 0 | 10 | 9 | 9 | 9 |
| DRI | 6 | 17 | 21 | 21 | 22 | 4 | 14 | 17 | 17 | 18 | 2 | 3 | 4 | 4 | 4 |
| UNLV | 7 | 37 | 42 | 37 | 44 | 7 | 28 | 32 | 19 | 22 | 0 | 9 | 10 | 18 | 22 |
| UNR | 10 | 62 | 68 | 58 | 70 | 8 | 38 | 42 | 35 | 43 | 2 | 24 | 26 | 23 | 27 |
| NSC | 1 | 2 | 3 | 3 | 2 | 1 | 2 | 3 | 3 | 2 | 0 | 0 | 0 | 0 | 0 |
| CSN | 0 | 5 | 5 | 3 | 3 | 0 | 5 | 5 | 3 | 2 | 0 | 0 | 0 | 0 | 1 |
| TMCC | 0 | 2 | 3 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 2 | 0 | 0 |
| WNC | 0 | 1 | 1 | 2 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 0 |
| GBC | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 |
| Advisory Board | 0 | 22 | 22 | 24 | 22 | 0 | 15 | 17 | 20 | 17 | 0 | 7 | 5 | 4 | 5 |
| Total | 24 | 160 | 176 | 159 | 176 | 20 | 106 | 120 | 100 | 107 | 4 | 54 | 56 | 59 | 69 |

The table below shows that the percentage of underrepresented minorities (as defined by NSF) has increased from 0 (0%) at baseline to twenty (13%) in year four. After a slight decrease in year three (7%), the unrepresented minorities in year four is comparable to years one (11%) and two (15%). The percentage of disabled participants has increased from zero

percent at baseline to 2.6% in year four (up from 1% in year 1, 3% in year two, and <1% in year three).

Changes in Demographics - Baseline Compared to Years 1-4

| | Participants | | | | |
|--------------------------------|--------------|------------|------------|------------|------------|
| | Baseline | Year 1 | Year 2 | Year 3 | Year 4 |
| Black/African American | 0 | 4 | 4 | 3 | 5 |
| American Indian/Alaskan Native | 0 | 1 | 4 | 1 | 1 |
| Asian | 3 | 14 | 17 | 21 | 20 |
| Caucasian | 20 | 109 | 114 | 104 | 114 |
| Hispanic | 0 | 10 | 15 | 5 | 14 |
| Total | 23 | 138 | 154 | 135 | 154 |
| Disability | 0 | 2 | 5 | 1 | 4 |
| Not Reported | 1 | 0 | 2 | 0 | 0 |

Numbers in this table do not include Advisory Board Members

The project has incorporated ethnic diversity into its student and research components. Of the 31 undergraduate research scholars funded, 15 were females (48%), and two (6.5%) were from underrepresented minorities as defined by NSF. Two of the undergraduate researchers were also disabled (6.5%). Eight Graduate Fellowships were funded, four of which were female (50%) and one was an underrepresented minority (12.5%). Of the 20 graduate research assistants funded in year four, ten were female (50%) and four (20%) were from underrepresented minorities, a significant increase from seven women in year three and 0% of underrepresented minorities in year three.

Project mechanisms for broadening participation and increasing diversity: The project has been active in broadening participation through several mechanisms: Summer Institutes, Community College Faculty Fellowships, Undergraduate Research Scholarships, Graduate Research Assistantships and Fellowships, outreach by the Policy Component, outreach to stakeholders, and outreach to the small business community. The project also leverages other broader programs run by Nevada’s NSF EPSCoR Education, Outreach and Diversity Program, as well as other statewide initiatives.

Summer Institutes reach out to middle school teachers in Nevada and provide formal training on climate change science and education and new tools for the teachers to incorporate climate change into their science classrooms. It is estimated that through this program 800 middle school students are impacted annually, via the teachers that participate in the program. Fourteen middle school teachers (seven each in Reno and Las Vegas) will participate in this year’s Summer Institute, which will take place in July/August 2012. Many of these teachers are from underrepresented groups or teach in schools with large student enrollments of underrepresented groups. The 2012 Institute will focus on one of the projects primary science question, “*How will climate change affect disturbance regimes (e.g., wildland fires, invasive species, insect outbreaks, droughts) and linked systems?*” In preparation for the Summer Institute, participants took an on on-line UNLV course in Spring 2012 course on climate change.

Since the 2011 Summer Institute took place after the previous year's annual report was submitted to NSF, we report a summary here. Teachers from 14 new secondary schools participated in the 2011 Summer Institutes (7 in the north, 7 in the south), which was held July 25 through August 5, 2011. In the north, teachers explored water, local water issues, and climate change in Northern Nevada. Each of the seven participating teachers learned about watersheds and water resources, Lake Tahoe and Pyramid Lake water science, local and regional water treatment, and climate change from researchers and working professionals in the region. They toured the Verdi Hydroelectric Plant, the Chalk Bluff and Incline Village Waste Water Treatment Facilities, the UC Davis/Sierra Nevada College Demonstration Gardens and Environmental Research Center, and Pyramid Lake with its surrounding environmental sites. At the Desert Research Institute, participants observed the EcoCELL lab, experienced the Center for Advanced Visualization, Computation and Modeling (CAVCaM), and viewed ice cores with Nevada's leading ice core scientists. DRI generously donated the time of eight scientists and staff members for the Institute's visit with them. At the Raggio Research Center, participants gathered daily to discuss ways to bring the content into their classrooms through inquiry with the state and national standards in mind. They were also visited in the RRC by several other prominent scientists and community science leaders for informational talks and presentations. By the end of the Summer Institute, these teachers had developed unique, standards-aligned classroom lessons, which addressed regional climate change, water science and practical water use issues, and science inquiry. Those lessons were implemented in fall 2011 with participating teachers using the data to investigate classroom learning.

Community College Faculty Fellowships broaden participation by providing funding for community college faculty to conduct climate change research with a faculty mentor from UNR, UNLV, or DRI. The primary goal of the fellowship is to facilitate integration of research and education, and improve science curriculum at the Community and State Colleges. Each fellow is expected to bring knowledge gained as a result of their research experience back to Community and State College classrooms in Nevada. The Community College Faculty Summer Fellowship program is providing funding for a faculty member (Lawrence Rudd) from the Nevada State College to integrate data from the Nevada Climate Change Portal into curriculum materials on climate science and climate change for science teaching methods classes for K-12 pre-service teachers.

Undergraduate Research Scholarships increase involvement of students and faculty mentors from all NSHE institutions, including community colleges. Both academic year and summer Undergraduate Research Opportunity Program (UROP) solicitations were conducted during the year. In year four, 15 undergraduates received academic year awards, which were completed in May 2012. Students in the academic year program presented their research results at Nevada Undergraduate Research Symposium held in April 2012 at UNR. The summer UROP solicitation resulted in 15 awards. The research associated with the summer program will be completed by August, 2012. Sixty percent of the students receiving awards were female. Ten were students at UNLV, 19 at UNR, and 1 at Great Basin College.

Graduate Research Assistantships and Fellowships: Eight graduate fellows and 20 graduate research assistants were funded in year four to conduct research that supports the

goals and objectives of the Track 1 project. The project offered a graduate research assistantship specifically targeted to underrepresented minorities, which resulted in the hiring of an African-American student in the Ecological Change component.

The *Policy, Decision Making and Outreach Component* has broadened project *outreach* and *communication* and has made significant efforts to work with underrepresented and potentially vulnerable Native American tribes through the efforts of Dr. William Smith and his team in building connections with researchers and indigenous groups in rural Nevada. This group documented these efforts with a documentary entitled “Nevada’s Native American Tribes and Climate Change”, which is available on the NV EPSCoR YouTube channel (www.youtube.com/user/nevadaepscor). Since its debut on YouTube earlier this year, the video has been viewed over 1,000 times in more than 30 countries. A Spanish version of this video was broadcast over TV and Internet to further outreach and educate the public. The Summit Lake Paiute Tribe and the Pyramid Lake Paiute Tribe is acknowledged for their help in the project. Dr. Smith’s efforts are particularly noteworthy and will provide education materials for the general public, educators, and policymakers on the perspective of a group that is traditionally underrepresented.

Small businesses are reached through the project’s *SBIR* Component run by the Nevada Small Business Development Center (NSBDC). The NSBDC continued to market technology services to our statewide small business network, including women and disadvantaged businesses (DBEs). To broaden participation to DBE’s, the NSBDC hired a Disadvantaged Business Enterprise business advisor in March 2012. This advisor will specifically address the needs of women and minority owned businesses and will be working closely with women and minority groups throughout Nevada.

Nevada NSF EPSCoR Education, Outreach, and Diversity Program: The Education, Outreach and Diversity (EOD) program for NSF EPSCoR has implemented key activities and partnerships in order to broaden current and future participation of URM and women into STEM. With the March 2011 hire of C2-funded Diversity Coordinator, Mirna Mejia, more targeted approaches have been implemented to not only meet Track-1 and Track-2 goals but to grow the applicant pool for future STEM research and workforce opportunities. Outreach to over 30 URM-specific campus organizations, to include e-mail and presentations to groups and college classes were conducted. During the presentations given, 77 individuals were reached and of that group, 71% were URM and/or female. Other EOD activities include the development and April 2012 implementation of the Nevada STEM Pipeline, an online clearinghouse of STEM related programs and resources in Nevada (www.nvstempipeline.org). The Pipeline also mutually links to both Idaho and New Mexico’s pipeline sites in order leverage resources and provide project sustainability through program and information sharing. Implementation of the Pipeline also addresses one of the six strategies of the Western Tri-State Consortium Diversity Strategic Plan to Engage the interest of URM students and women in scientific research and, more broadly, in STEM disciplines early in their educational experiences by providing information that allows them to explore and prepare for a career in the field. The Pipeline received startup funds from NSF EPSCoR and will also be supported next year by NASA EPSCoR.

During the April 2012 Western Tri-State Consortium Annual Meeting, the Diversity Leadership hosted a one-day workshop. The workshop focused on providing state updates on the strategic plan, exploring the idea of pursuing a tri-state REU for URM students, and drafting a set of recommendations for states to use when drafting the 2013-2018 NSF EPSCoR RII proposals.

In Fall 2011, the Nevada Mentor Network was rolled out. This is a searchable database of Nevada faculty mentors in science and engineering and some liberal arts. This database was also used as a model for the Nevada System of Higher Education's Health Science Systems project. This year the NSF EPSCoR also implemented a FaceBook page that currently has 66 followers. The page is used to share NSF and other related program information and announcements.

In looking toward building sustainability for the overarching EOD activities of this project, leveraging resources across all three of Nevada's EPSCoR projects has been beneficial. Funding through the C2 project will support, in partnership with Extreme Science and Engineering Discovery Environment (XSEDE), a Cyberinfrastructure training at Great Basin Community College and College of Southern Nevada to educate about resources available for the incorporation of computational modeling and simulation into undergraduate curriculum. This will also be available via distance education to three other remote Nevada GBC campuses. This project will serve Track-1 by providing possibilities to utilize data collected from the data portal into curricula for the sake of education and outreach.

In broadening participation, EOD has become active members of state groups such as Nevada STEM Coalition, Nevada Dept. of Education's STEM Task Force, and Gathering Genius. Involvement with these groups provides access to the K-12 pipeline and further encourages partnerships and pathways into higher education.

Statewide mechanisms for broadening participation and increasing diversity: The Nevada System of Higher Education (NSHE) encourages broad participation by students from community colleges, women, underrepresented racial/ethnic minorities (Hispanic/Latino; American Indian or Alaskan Native; Black or African American, and Native Hawaiian or other Pacific Islander), people with disabilities and first-generation/low socioeconomic status students. Project solicitations encourage participation of candidates from diverse backgrounds and ethnicity. National searches for new faculty and graduate fellows are advertised in forums that reach diverse groups, such as the SYSTERS listserv, Women Into Computing Science and Engineering (WiCSE), and Chronicle of Higher Education. The project also advertises open positions through specific organizations, both locally and nationally. Professional societies relative to the climate change focus include: American Geophysical Union, American Meteorological Society, and American Indian Science & Engineering Society. Other forums through which the Climate change project recruits include: Latinos in Higher Education, HigherEdJobs.com, Diversity.com, and Multicultural Environmental Leadership Development Initiative (MELDI). Statewide, recruitment is also done through local chambers of commerce, specifically the Nevada Latin Chamber, Nevada Black Chamber, and Nevada Urban Chamber. Currently, the College of Southern Nevada is leading an effort to develop listservs that will include contacts for Historically Black Colleges & Universities and Hispanic Serving Institutions in order to advertise open faculty and student positions and opportunities.

NSF EPSCoR Climate Change project has access to all these listservs. Institutional and geographic diversity has been accomplished by participation of NSHE students, faculty and staff from the three research institutions, the state college and two community colleges and Nevada small business owners from both northern and southern parts of the state.

b. Institutional Collaborations.

Collaborations among NSHE Institutions. The project has engaged in institutional collaborations among NSHE institutions in the following ways:

- The project was set up with a management and research structure that facilitates collaborations among faculty from the different NSHE campuses. Each component has a three-person steering committee consisting of one faculty member from each campus.
- A requirement for the Integrated Science Projects is that faculty from at least two NSHE institutions participate.
- Through the Summer Community College Fellowship Program, faculty from Nevada's Community Colleges collaborate with faculty mentors from the research institutions (UNLV, UNR, or DRI).
- Two faculty mentors are required for each student receiving a Graduate Fellowship, which cultivates collaborations.
- Collaboration with the Nevada Seismological Laboratory (NSL) continues, in the development of the Digital Nevada research and education high-speed networking backbone. NSL is also acquiring a set of standalone seismometers to be placed at some EPSCoR research stations which will be connected to the real-time network and provide strong-motion earthquake detection and analysis in rural geographic areas where no sensors currently exist.
- The development of the Nevada Climate Change Portal and its related cyberinfrastructure system has continued to involve sustained collaboration with individuals from the various NSHE institutions who have contributed their expertise and knowledge to improving the CI Component research and development work.
- The NOAA-funded Western Regional Climate Center (at DRI) has continued to be a close collaborator. Their hardware configuration support and past data collection experience is facilitating our own deployment and data collection activities.
- Representatives from a variety of institutions participated as guest speakers in the Summer Institutes, including Truckee Meadows Water Authority, the Tahoe Environmental Research Center, the Incline Village General Improvement District, the Verdi Hydroelectric Plant, the Tahoe Science Consortium, the Springs Preserve, Las Vegas Water Treatment Facility, and the Sunpower Photovoltaic facility.

Collaborations between NSHE and Institutions Outside of Nevada. The Climate Modeling group has collaborated with ID and NV researchers in several Tri-State EPSCoR IWGs as experts in climate modeling for the Western U.S. Several proposals have been submitted from these collaborations. The group has initiated strategic collaborations with the climate

modeling group from the University of Arizona (Francina Dominguez and Christopher Castro) and a statistical downscaling group at the University of Idaho (John Abatzoglou). The group is leveraging EPSCoR results and infrastructure for collaboration in two new funded federal research activities (NASA and USBR) aiming to demonstrate the applicability of downscaled simulated data in different impact studies, including projections of extreme flood events and dust emissions in the southwest, and the relationship of climate change to surface and groundwater interaction. Additionally, two undergraduate students from universities outside of NV (Marietta College and California State Polytechnic University, Pomona) have been participating in field research involving the collection of climate data.

The Water and Ecology Components have developed closer relationships with the land-owner agencies (Bureau of Land Management, Fish and Wildlife Service, Great Basin National Park, Long Now Foundation and Nevada Land Conservancy) by inviting them to participate in our annual science meeting and a workshop demonstrating the capability and utility of the Nevada Climate Change Portal, which provides access to NevCAN data. The group also developed a collaborative relationship with the USDA Natural Resources Conservation Service (NRCS) in Nevada. Dr. Lynn Fenstermaker met with the Nevada State Scientist (Levi Steptoe) and a Resource Soil Scientist (Dr. Doug Merkler) to negotiate the characterization and analysis of NevCAN soil pedons by NRCS personnel with analysis being performed by the NRCS National Lab in Lincoln NE. This effort will occur during the last two weeks of September 2012 and the project will provide travel funds for two NRCS National Lab personnel to fly to NV for the soil sampling effort. All other costs will be covered by the NRCS. Through communication with the NEON Airborne Observatory Platform Assistant Director, Dr. Fenstermaker was able to secure two slots for Nevada Climate Change personnel to participate in a NEON workshop on Spatial and Temporal Scaling in Ecology that will be held in Boulder CO, June 11-12, 2012. We sent two members of our field team to an NCEAS, LTER and DataONE sponsored workshop on "Software Tools for Sensor Networks" in Albuquerque NM (May 1-4, 2012) and are applying for attendance at an LTER and University of New Mexico sponsored workshop on "Data Acquisition from Remote Locations.

Collaborations with New Mexico and Idaho are fostered through the Tri-State Consortium, which was developed as an integral part of the Track 1 and Track 2 RII projects of the three states. Several mechanisms have been developed to promote the Tri-State collaborations. The first mechanism is the Cyberinfrastructure Working Group, which met at the 2012 Annual Tri-State Meeting in Idaho. The Annual Track 2 report describes the 2012 CI Working Group activities in detail. The New Mexico CI group has continued to be a close collaborator and particularly instrumental in providing information about the features and characteristics of their own data portal and metadata systems. Through our New Mexico partners we are in the process of approaching the DataOne initiative, with the goal of connecting with it and contributing to it part of our results and resources (for this, Nevada CI members will attend the DataOne Users Group meeting in July 2012 in Boulder, CO). Also, the Idaho group has closely collaborated with us and provided useful information pertaining to their development of the CUAHSI system and related ODM databases. Our collaborations with New Mexico and Idaho are part of continued joint activities for CI developments in the Tri-State Western Consortium. This partnership has met several times throughout the year, hosting regular

teleconferences and two full-day CI workshops (in October 2011 in Coeur d'Alene, ID, and in April 2012 in Sun Valley, ID). This Tri-state collaboration has produced results published or submitted jointly for publication during this year.

The second tri-state collaboration mechanism is the annual Tri-State Meeting. The 4th Annual Tri-State Meeting, held in Sun Valley ID, April 2-5, 2012. 195 researchers, educators, and administrators from NV, NM, ID as well as AK, CA and DC attended the meeting.

The third tri-state collaboration mechanism is the Tri-State's Innovation Working Group (IWG) Program, which supports collaborative, trans-disciplinary work by the three member states. The IWG provides a venue for engaging scientists and educators, along with key nationally and internationally recognized experts, to address the grand challenges that can transform science and education. The IWGs awarded in year four are described in an earlier section of this report.

The fourth tri-state collaboration mechanism is the Interdisciplinary Modeling Course "Water-Related Issues and Changing Climate" for graduate students from NV, NM, and ID. The course will take place June 4-15, 2012 at New Mexico State University and is lead by Dr. Laurel Saito (UNR) with faculty lecturers from all three states. Graduate students will be introduced to models that are available in different disciplines and how such models might be applied together to address water-related issues regarding climate change, address issues of variability and uncertainty in implementing interdisciplinary approaches, and gain experience in working in interdisciplinary teams to apply interdisciplinary modeling approaches to increase knowledge about water-related issues regarding climate change. Students will use a common software to do an interdisciplinary project regarding the New Mexico acequias project. This is the second time this tri-state course has been taught, with the first time being at the University of Nevada, Reno in 2010.

3. Workforce Development

The project has a number of significant workforce development mechanisms: 1) Summer Institute (2) Nevada Small Business Development Center (NSBDC); 3) Intensified workforce development in Cyberinfrastructure; 4) Graduate student and undergraduate student development; 5) New faculty hires, 6) Curriculum development, and 7) Other educational activities.

1) *Summer Institute*: This program is described above in the Broadening Participation section).

2) *Nevada Small Business Development Center (NSBDC)*: The NSBDC provides business and management training to thousands each year throughout the state. Much of this is focused on creating and saving jobs, starting businesses, and capital formation. The SBIR program and other activities associated with the NSBDC are developed in collaboration with multiple institutions. Offices are found at UNR, UNLV, Great Basin College, as well as economic development authorities and chambers of commerce throughout the State. The NSBDC frequently assists faculty members at these institutions who are submitting their own SBIR proposals, as well as it works with companies to identify faculty who can assist them in their R&D work. NSBDC promotes SBIR project development, which results in employment, development of innovative products, and enables startup companies to succeed in the

marketplace. The companies that are successful in the competition for SBIR hire full-time and part-time employees to support their R&D. In addition, they retain outside consultants.

Major accomplishments of the NSBDC include:

- In summer 2012 the NSBDC is offering a new, one day proposal writing workshop as well as a one day program on Planning a Business for Scientists and Engineers.
- The Nevada Small Business Innovation Research Program Manager has met individually with 20 company representatives to go over the SBIR and its requirements.
- The Nevada SBIR Manager participates regularly in business meetings in order to promote SBIR services available.
- Staff at the NSBDC worked intensively with the Nevada Institute for Renewable Energy Commercialization on a \$1 million proposal under the I6 Clean Technology Grants Program through DOE. The proposal was a finalist in the competition, but was not funded.
- NSBDC submitted a proposal under the Federal And State Technology Program (FAST) that was designed to promote SBIR and is especially intended to stimulate universities as the catalyst for the formation of more high tech companies. The project was funded for \$54,400 and is being implemented.
- NSBDC counselors statewide consulted with companies about SBIR, as well as provided business assistance related to technology. Four companies were assisted with SBIR proposals.
- The NSBDC Business Environmental Program Wood Utilization Manager, Dusty Moller, continued involvement with the Pinyon/Juniper Partnership's project to develop a field-scale evaluation of biochar manufactured from Pinyon pine and juniper biomass. Moller met with Princeton Energy Group, Sausalito, California, to discuss the potential siting of a wood pelletizing plant in White Pine or Lincoln counties. Moller presented a plan to test the effects of using biochar on land owned by the Southern Nevada Water Authority. Successful field trials in Nevada could lead to other "sand" states converting millions of tons of available biomass to biochar for the benefit of watersheds, farming and ranching and range and forestland restoration.

3) *Cyberinfrastructure*: As part of the CI educational plan created by the group, we aim to enhance personnel development, including the development of the component's two professional database/software engineer members, students, and faculty members. Related activities include support for training and professional certifications for Mike McMahon (database specialist). Certifications obtained, or scheduled to be obtained by Mike are:

- Microsoft Certified Professional Developer: Web Developer 4 (obtained)
- Microsoft Certified Technology Specialist: .NET Framework 4, Service Communication Applications (obtained)
- Microsoft Certified Technology Specialist: .NET Framework 4, Data Access (obtained)
- Microsoft Certified Professional Developer: Windows Developer 4 (planned)

- Attended the “Software Tools for Sensor Networks” week-long training workshop in May 2012 in New Mexico

4. *Graduate student and undergraduate student development:* In year four the project met this goal by funding eight graduate student fellowships and 20 graduate research assistants (GRAs) to conduct climate change research.

5. *New faculty and postdoctoral fellow hires.* The project hired three new faculty member in year four that will add to the workforce. Details on this hire can be found below in the section on Sustainability.

6. *Curriculum Development:* There were two major curriculum development activities in year four. The first was funding curriculum development program and the second a 1-day workshop in Climate Modeling.

Funds were awarded to 10 NSHE faculty members to develop courses or course modules related to climate change. These included one four-year college (Great Basin College), and the Public Lands Institute (for a course to assist national park interpreters facilitate public dialogue). In addition to STEM other disciplines included, English (a research and composition course related to scientific topics), history (how humans have adapted to climate change in the past), mathematics and geography.

The Climate Modeling group (Drs. Koracin, Mejia, and Wilcox, and GRA Hatchett) developed a one-day Climate Modeling Workshop (Tutorial) that was held as part of the 2012 Tri-state annual NSF-EPSCoR meeting in Sun Valley, ID. The workshop presented concepts of the climate change, climate modeling (global and regional scales), and practical work using the available NSF-developed software, EdGCM.

7. *Other Education Activities:* The climate modeling group has participated in various education programs, including graduate level classes (UNR Atmospheric Science Graduate, Climate Modeling, Spring 2012.) and by participation as Subject Matter Experts for USBR/COMET Impact of Climate Change on Water Resources modules: Assessing Future Climate Impacts on Surface Hydrology and Crop Irrigation Water Requirements. Also of note is an invitation to participate in the NASA Climate Variability and Change Program aiming to review state-of-the-science in climate variability and change impacts and to recommend adaptation and mitigation strategies for the Mojave Desert region over Southern California. This workshop was sponsored by NASA/DFRC and took place in Palmdale, CA (August 2011).

4. Cyberinfrastructure.

The main goal of the project’s *Cyberinfrastructure (CI) Component* is to develop a data portal and software to support interdisciplinary research via integration of data from observational networks and modeling. Major achievements of the CI group are described above in the Executive Summary. This section expands on these achievements by providing details on the CI key expected outputs: the Nevada Climate Change data portal, and software frameworks for enhanced model interoperability. Key CI accomplishments are provided for the Water and Ecology components (NevCAN), as well as the Policy component (Geovisualization Facility).

Nevada Climate Change Portal and related CI. In accordance with the project's CI Management and Development Plan, significant developments have taken place. Benefitting from guidance by the members of the projects Data Portal Task Force, created in May 2011 and consisting of about 15 members from all project components, the development of the Nevada Climate Change Portal (NCCP) has led to the expansion and public release of the portal in 2011. Most notably, our CI systems are continuously acquiring and importing high-resolution measurements from all NevCAN data loggers deployed at each monitoring location (over 358 million measurements as of April 10, 2012), making this data immediately available to researchers. The implementation of this capability required the creation of a high-performance software service to manage the automatic import of data collected by the loggers, the development of database procedures and schema modifications for efficient incorporation of the data, and the interconnection of the data loggers with the Nevada Seismological Lab network and the CI servers.

The web interface of the NCCP has also been significantly improved. Using the layout, colors, and some of the graphics developed for the beta version, the entire front-end was re-implemented using Scalable Vector Graphics, animations, styles, and JavaScript libraries to create a modern, fully HTML 5-compliant website.

The content of the portal has been expanded to include a larger number of videos, publications, graphics, and informational resources that target audiences ranging from students to educators and researchers. Focused on completing the data pipeline from sensors to researchers, the CI group has implemented new search interfaces, each adding new features to better serve stakeholders interested in retrieving data. Based on user feedback and testing, the CI group is actively revising the search interfaces to provide not only a generalized, cross-discipline data search system, but also several dedicated views that target specific research fields (e.g., hydrology or atmospheric sciences). Furthermore, as requested by researchers, the web cameras deployed by field personnel have been integrated into the data collection system and the portal. Currently, over a dozen images from each web camera are recorded every hour and made available via the portal using archival software; in addition, the portal allows users to view live video streams and real-time site conditions for each site and, with pre-approval from monitoring personnel, users may control the cameras.

Key amongst the activities of the CI component has been the development of several SOAP (Simple Object Access Protocol) web services, which provide access to collected data, infrastructure information, and images. Based on the current version of the NCCP and related CI, our plans are to expand the portal's informational content, incorporate new capabilities for data access and processing, and work towards establishing a larger community of NCCP users. To achieve these, several data portal workshops, contacts with potential stakeholders, and usability studies have taken (and will take) place.

Software framework. The development of the Demeter framework, a set of web service-oriented software resources, has also made significant progress. The framework now includes a plug-in system for allowing different activity component standards and third-party components to be integrated into its functionality. In addition, the scenario runtime has been abstracted out to a web service, with substantial increase in execution performance (particularly useful for downloading large datasets). Data interoperability features have been

integrated in the form of data format converters, which are plug-ins that facilitate transmission of data between components. Further, as a collaborative effort with our Tri-State Western Consortium partners, DotSpatial tools developed in Idaho have been integrated into the Demeter framework by using the aforementioned plug-in system, and additional integration of such tools is planned. Other planned enhancements to the framework include a translator for the popular OpenMI standard and an online component catalogue that will allow users to contribute and download data processing activities, format converters, and other components.

Nevada Climate-ecohydrological Assessment Network (NevCAN): The Water and Ecology Components have had close collaborations with CI personnel throughout the year. Integration of CI services and practices into the science data flow has allowed for efficient and standardized data transport, storage, and distribution. All NevCAN stations are connected via a remote, real-time high-speed TCP/IP network linked directly to project CI, and field sensor/asset maintenance tracking is enhanced via CI metadata tools. Field scientists and technical personnel are able to connect directly to IP-enabled field dataloggers, controllable cameras, and support hardware (such as solar charge controllers) over this network from any internet connection via CI servers hosting control software. This connectivity dramatically enhances quality of data, as problems with individual components may be recognized and troubleshooting performed prior to field visits. On-site personnel in remote field locations are capable of connecting to any other point on the network (and also the internet), increasing field efficiency substantially.

Geovisualization Facility at UNLV: in year four, the Policy Component finished construction of the Geovisualization Laboratory at UNLV. The “GeoVis” lab completes the project’s GIS and Remote Sensing (GISRS) Core Lab, which provides advanced GIS, remote sensing, and now visualization capabilities to the UNLV campus. GeoVis has a multi-screen/large-screen wall with multiple projection systems. The facility is equipped with software and hardware for 3D visualization, video conferencing, and wide display presentation.

5. External Engagement.

Outreach and communication included making public installations, making presentations to and hosting workshops for the scientific community, Nevada’s business community and other stakeholders, by posting videos on Nevada EPSCoR’s YouTube Channel and through the project web site (nvclimatechange.org).

Public Installations: The *Losing the Lake* game was developed from one of the Interdisciplinary Science Team project that was funded in years two and three of the project. The goals of the game are to link water supply and demand models to global climate models, and to use the game to teach about water and climate change. In year four, the game was installed at the Las Vegas Natural History Museum and will be installed at two sites operated by the National Park Service (input on design was also solicited from the Southern Nevada Water Authority, Springs Preserve, and federal Bureau of Reclamation). The game was also field tested by the Clark County School District. A representative from the state-funded Regional Professional Development Program will assist with dissemination, and gave additional input on the design of the refutational texts.

Outreach to the businesses of Nevada was accomplished by the Nevada Small Business Development Center (NSBDC). These activities were described above in the Workforce Development and Broadening Participation sections.

Outreach through YouTube: Over the past three years five videos on research activities have been produced by the project in partnership with Lori Fruth (Journalism and Media Studies, Greenspun College of Urban Affairs, UNLV). The most recent video, released this year, is “Nevada’s Native American Tribes and Climate Change”. This video has been viewed over 1,000 times in more than 30 countries since its debut on YouTube. All five videos are available on the NV EPSCoR YouTube channel (www.youtube.com/user/nevadaepscor).

Outreach to the Scientific Community: Members of the Water and CI Components collaborated to organize and present two workshops on the Nevada Climate Change Portal and NevCAN data. The first workshop was held at the Annual Nevada NSF EPSCoR Climate Change meeting (February 13, 2012, Las Vegas NV). The second workshop is part of the CUASHI 3rd Biennial Colloquium on Hydrologic Science and Engineering (July 14-29, 2012 in Boulder CO).

Communication to the scientific community within Nevada was accomplished by the 3rd annual NSF EPSCoR State Climate Change Conference, which 119 faculty, students and stakeholders attended at UNLV in Las Vegas NV on February 13, 2012. The agenda and oral presentations are available on line at <http://epscorspo.nevada.edu/nsf/2012-annual-meeting/index.html>. The Nevada Climate Change monthly seminar series provided outreach to the NSHE scientific community.

The centerpiece for communications and outreach with our colleagues in Idaho and New Mexico was through the 4th Annual Tri-State Meeting, held this year in Sun Valley, ID, April 2-5, 2012. The meeting is described in more detail above in the section “Institutional Collaborations”. The agenda and presentations can be found online at: <http://www.certain.com/system/profile/web/index.cfm?PKWebId=0x307193a72f>.

Outreach to the national and international science communities included over 50 presentations at national (e.g., AGU, AAG, Remote Sensing and Hydrology Symposium, AWRA) and international conferences (e.g. ICCBALI International Conference, World Environmental and Water Resources Congress, World Automation Congress 2010, IWSSA- 2011 and IEEE INDIN-2011). A listing of meeting and conference presentations occurring in year 4 is shown in the table below.

| Conference Presentations | | | | |
|---------------------------------------|--|---|-------------------|-------------------------|
| Presenter's Names | Talk Title | Conference Title | Location | Conference Dates |
| Barth, C., D. P. Boyle and S. Bassett | An approach for estimating and comparing paleoclimate conditions in pluvial lake systems using a simple hydrologic | American Geophysical Union Annual Meeting | San Francisco, CA | Dec-11 |

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| | model | | | |
| Barth, C. D. B. Boyle and S. Bassett | A hydrologic modeling approach to estimating paleoclimate conditions in pluvial Jakes Lake, NV | UNR College of Science Poster Competition | Reno, NV | Nov-11 |
| Boyle, D. P., C. Barth, and S. Bassett | An approach for estimating, comparing, and evaluating paleoclimate conditions in pluvial lake systems | Comer Science and Education Abrupt Climate Change Conference | Soldiers Grove, WI | Sep-11 |
| D. Boyle, M. Hausner, and C. Barth | Improving the USGS Thornthwaite water balance model in semi-arid settings by including baseflow | American Geophysical Union Annual Meeting | San Francisco, CA | Dec-11 |
| C. Barth and D. Boyle | A hydrologic modeling approach to estimating paleoclimate conditions in pluvial Jakes Lake, NV | UNR College of Science Graduate Student Poster Competition | UNR College of Science, Reno, NV | Nov-11 |
| C. Barth and D. Boyle | Modeling the Impacts of Climate Change on Hydrology at Galena Creek, Nevada | UNR College of Science Graduate Student Poster Competition | UNR College of Science, Reno, NV | Nov-11 |
| Hatchett, B., Mejia, J., Koracin, D. | Untangling the urban heat island signal in an arid complex terrain city | 93rd American Meteorological Society Annual Meeting | New Orleans, La | January 21-25, 2012 |
| K.C. King, J. F. Mejia and D. Koracin | Analysis of skill and uncertainty in regional climate models | 19th Conference on Applied Climatology | Asheville, NC. | 18–20 July 2011 |
| Koracin, D., J. F. Mejia, K. E. Kunkel, and C. E. Dorman | Coastal climate and upwelling | 19th Conference on Applied Climatology | Asheville, NC. | 18–20 July 2011 |

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| Andrew Joros and J. F. Mejia | Impact of Eastern and Central Pacific ENSO events over the Continental United States | 19th Conference on Applied Climatology | Asheville, NC. | 18–20 July 2011 |
| Koracin, D., R. Vellore, and J. Mejia, and J. Jiang, C. E. Dorman, I. Ceroveck, J. McClean, and M. C. Hendershott | Mesoscale atmospheric and ocean dynamics over Kuroshio Extension region | AGU-OSLO-Ocean. Soc., Ocean Sciences Meeting | Salt Lake, Utah | March, 2012 |
| Mejia John F.; Kristien C. King; Darko Koracin | North American Monsoon Mean and Transient Rainfall Patterns from RCM products | AGU Fall Meeting | San Francisco, CA | Dec, 2011 |
| Kristien C. King; John F. Mejia; Darko Koracin | Evaluation of Added Value to Precipitation Predictions using Regional Downscaling in the Western United States | AGU Fall Meeting | San Francisco, CA | Dec, 2011 |
| K.C. King and J. F. Mejia | Optimal Combination of Statistical and Dynamical Downscaling | World Climate Research Program (WCRP) Open Science Conference 2011 | Boulder, CO | October, 2011 |
| Smith, Jr., W.J., D. Koracin, A. Safi, Z. Liu, K. Chief, M. Gautam, | Societal Knowledge, Assumptions and Preferences Regarding Climate Change in Nevada. | Meteorology in Public Eye Conference. Croatian Meteorological Society | Zagreb, Croatia | 6-7 March 2012 |
| Jiang, P., M, Gautam, J. Zhu, and Z. Yu | Non-stationary precipitation scenarios development in the Southwest U.S. | 4th Annual EPSCoR WESTERN CONSORTIUM TRI-STATE MEETING | Sun Valley, ID | 2-5 April 2012 |
| Jiang, P., Z. Yu, M. Gautam, and T. Piechota | Precipitation extremes in the western United States: its spatiotemporal changes under natural climate variability and human-induced | NSF EPSCOR Climate Change State Meeting 2012 | Las Vegas, NV | 13-Feb-12 |

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| | climate change | | | |
| Jiang, P., and Z. Yu | The trend of the multi-scale temporal variability of precipitation in Colorado River Basin, Abstract H43I-1340 | AGU 2011 Fall Meeting | San Francisco, CA | 5-9 December 2011 |
| Jiang, P., Z. Yu, and T. Piechota | The impact of changes in temporal distribution of precipitation on hydrological processes in upper Colorado River Basin | 3rd Annual EPSCoR WESTERN CONSORTIUM TRI-STATE MEETING | Santa Ana Pueblo, NM | 6-8 April 2011 |
| Jiang, P., and Z. Yu | Hydrological impacts of climate change on Colorado River Basin | 2010 Annual Nevada NSF EPSCoR Climate Change Conference | Las Vegas, NV | 2-Feb-10 |
| Dascalu, S. | Imagine a million file cabinets of climate data: The Nevada Climate Change Portal | Nevada Climate Change Seminar Series | UNLV, Las Vegas | SEPT 7 2011 |
| Dascalu, S. | Cyberinfrastructure developments for climate change science and education in Nevada | Seminar Series, Department of Informatics, Systems, and Communications, University of Milano-Bicocca | University of Milano-Bicocca, Milan, Italy | JAN 11 2012 |
| Dascalu, S. and McMahon, Jr., M. | Nevada cyberinfrastructure for climate change research | UNR College of Engineering Advisory Board Meeting | UNR, College of Engineering | MARCH 30 2012 |
| Ewing-Taylor, J. | Climate Change Science in the K-12 Classroom: Does it Fit? | 2012 Annual Nevada State Climate Change Meeting | Las Vegas, Nevada | 2/13/2012 |
| Kiley, T. | Northern Nevada Science Teachers Present: Climate Change Activities for the Classroom | 2012 Annual Nevada State Climate Change Meeting | Las Vegas, Nevada | 2/13/2012 |

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| Kiley, T. | Northern Nevada EPSCoR Science Teachers Bring Climate Change to the Classroom (poster presentation) | 2012 Annual Nevada State Climate Change Meeting | Las Vegas, Nevada | 2/13/2012 |
| Kiley, T. | Laboratory Manual: Laboratories and Inquiry Activities for Climate Change Science (poster presentation) | 4th Annual EPSCoR Western Consortium Tri-State Meeting | Sun Valley, Idaho | April 2-5, 2012 |
| Calica, Nicole | Nitrite Oxidation in Tengchong Geothermal System | Nevada Undergraduate Research Symposium | Reno, NV | April 18-19, 2012 |
| Dugan, Sam | The Effect of Myosin Binding on Cooperative Thin Filament Activation | Nevada Undergraduate Research Symposium | Reno, NV | April 18-19, 2012 |
| Glover, Chris | Investigation of Thermoelectric Power Generation Using Waste Heat | Nevada Undergraduate Research Symposium | Reno, NV | April 18-19, 2012 |
| Graves, David | Pelletization of Biochar Mixed With Raw Biomass | Nevada Undergraduate Research Symposium | Reno, NV | April 18-19, 2012 |
| Groso, Emilia | New Pyridyl-Based Photoaffinity Labeling Agents | Nevada Undergraduate Research Symposium | Reno, NV | April 18-19, 2012 |
| Heisler, Devon | Increasing Biofuel Production Efficiency Through the Discovery of Novel Thermostable Enzymes | Nevada Undergraduate Research Symposium | Reno, NV | April 18-19, 2012 |
| Jones, Micheil | Production of Renewable Diesel Fuel from Free Fatty Acids Using Organic Electrochemistry | Nevada Undergraduate Research Symposium | Reno, NV | April 18-19, 2012 |

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| King, Greg | A Molecular Characterization of Insect Larval Molting: A Critical Developmental Stage Regulated by Steroid Hormones | Nevada Undergraduate Research Symposium | Reno, NV | April 18-19, 2012 |
| McDonnell, Steven | Quantifying Carbonates in Mojave Desert Soils as a Function of Depth and biota | Nevada Undergraduate Research Symposium | Reno, NV | April 18-19, 2012 |
| Scully, Ellen | Dietary Modulation of Sleep in Drosophila | Nevada Undergraduate Research Symposium | Reno, NV | April 18-19, 2012 |
| Seymour, Lauren | What is Preventing Geothermal Development in the Western United States? | Nevada Undergraduate Research Symposium | Reno, NV | April 18-19, 2012 |
| Sinanian, Pamela | Spring Mountains Forest Structure Project | Nevada Undergraduate Research Symposium | Reno, NV | April 18-19, 2012 |
| Teppo, Brandon | Sixty-five Years of Vegetation Trend in the Nevada Plot Grazing Exclosures | Nevada Undergraduate Research Symposium | Reno, NV | April 18-19, 2012 |
| Trustman, Benjamin | Snow Data Collection at Remote Wildlife Guzzlers | Nevada Undergraduate Research Symposium | Reno, NV | April 18-19, 2012 |
| Vallin, Carmen | Effects of environmental stress on mutagenesis of Bacillus subtilis | Nevada Undergraduate Research Symposium | Reno, NV | April 18-19, 2012 |
| Collopy, M. | Promoting the undergraduate research experience: What can we learn from feedback provided by NSF-EPSCoR undergraduate | Annual Nevada NSF EPSCoR Climate Change Meeting | Las Vegas, NV | Feb 2012 |

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| | researchers? | | | |
| Rudd, L., Bonde, A., & Buck, P. | Preparing Secondary School Teachers to Teach about Climate Change: The Professional Development Model Used in Southern Nevada as Part of Nevada NSF EPSCoR. | The Fourth International Conference on Climate Change: Impacts and Responses | Seattle, WA | July 12-13, 2012 |
| Rudd, L., Rowland, S., & Buck, P. | Invigorating High School and Middle School Earth Science Through Inquiry and Student Research: A Field-Oriented Geoscience Workshop for Secondary Science Teachers in Southern Nevada | GSA Annual Meeting | Minneapolis, MN | Oct 9-12, 2011 |
| Nussbaum, E. M. | Where did all the dammed water go? | Nevada Climate Change Seminar | Las Vegas, NV | Dec 2011 |
| Owens, M. C. & Nussbaum, E. M. | Political Orientation and Climate Change at the University: A Look at Professors' Political Views and Beliefs Concerning Climate Change | NSF Nevada EPSCoR Annual Climate Change Meeting | Las Vegas, NV | Feb 2012 |
| Buck, P. | A summary and evaluation of the Nevada EPSCoR climate change secondary science teacher professional development program | 4th Annual EPSCoR Western Consortium Tri-State Meeting | Sun Valley, Idaho | April 2-5, 2012 |
| Nussbaum, E. M. | Losing the Lake: An online resource for middle-school teachers on water resources and climate change | 4th Annual EPSCoR Western Consortium Tri-State Meeting | Sun Valley, Idaho | April 2-5, 2012 |

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| Kruse K., Saito L. | Using runoff collectors to understand surface runoff in remote Nevada catchments | Nevada Water Resources Association Annual Conference | Las Vegas, NV | March 5-8, 2012 |
| Trustman B., Saito L. , Walker M. | Remote snow data collection | Nevada Water Resources Association Annual Conference | Las Vegas, NV | March 5-8, 2012 |
| Fenstermaker, L. | NevCAN (Poster and Oral presentations) | Great Basin Consortium 1st Annual Conference | Reno, NV | Nov 7-8, 2011 |
| Apodaca, L., Devitt, D., Fenstermaker L. | Assessing Interannual Variation in Vegetation Response to Climate in Spring Valley, NV | Annual Nevada NSF EPSCoR Climate Change Meeting | Las Vegas, NV | 13-Feb-12 |
| Apodaca, L., Devitt, D., Fenstermaker L. | Assessing Interannual Variation in Vegetation Response to Climate in Spring Valley, NV | Nevada Water Resources Association Annual Conference | Las Vegas, NV | March 5-8, 2012 |
| Apodaca, L., Devitt, D., Fenstermaker L. | Assessing Interannual Variation in Vegetation Response to Climate in Spring Valley, NV | 4th Annual EPSCoR Western Consortium Tri-State Meeting | Sun Valley, ID | April 2-5, 2012 |
| Bird, B., Devitt, D. | Expanding NevCAN capabilities: monitoring cold air drainage flow along a narrow wash within a Montane to PJ ecotone (poster) | 4th Annual EPSCoR Western Consortium Tri-State Meeting | Sun Valley, ID | April 2-5, 2012 |
| Apodaca, L., Devitt, D., Fenstermaker L. | Soil characteristics of Spring Valley, NV and their relation to Big Sagebrush (<i>Artemesia tridentata</i>) stands | UNLV 2012 Geosymposium | Las Vegas, NV | 13-Apr-12 |
| Devitt, D., Bird, B. | Expanding NevCAN capabilities: monitoring cold air drainage flow along a narrow wash within a Montane to PJ ecotone (oral) | Annual Nevada NSF EPSCoR Climate Change Meeting | Las Vegas, NV | 13-Feb-12 |

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| Fossile, L. and W. Smith Jr. | Energy Purveyors and Climate Change in Nevada: Knowledge, Needs, and Perspective | Association of American Geographers | New York, NY | 2012 |
| Gautam, M., K. Chief, K. Wilde, and W. Smith Jr. | The Vulnerability of Pyramid Lake Paiute Tribal Water Resources to Climate Change: Analysis of Perception, Power, and Influence | American Indian Studies Program, University of Arizona | University of Arizona, Tucson, AZ | 2011 |
| Gautam, M., K. Chief, K. Wilde, and W. Smith Jr. | Climate change vulnerabilities- an integrated assessment in Pyramid Lake Paiute Indian Reservation | American Geophysical Union | San Francisco, CA. | 2011 |
| Guida, R. J., H. Stephen , C. L. Roberts, S. R. Abella, W. J. Smith Jr., Z. Liu , and J. S. Holland. | Vegetation and climate change in the Newberry Mountains, southern Nevada: Maxent and GIS modeling for policy decision support | Association of American Geographers | Seattle, WA | 2011 |
| Kauneckis, D. | The Climate Science Policy Nexus | Lake Tahoe Basin Science Conference | Lake Tahoe, NV | 5/24/2012 |
| Kauneckis, D. (Author Only), Berry, K. (Author Only), Saito, L. S. (Presenter & Author), Berry, C. A. (Author Only), | Perceptions of success regarding cooperation for water quality issues in western US interstate river watersheds | Consortium for Comparative Research on Regional Integration and Social Cohesion | Durbin, South Africa | 10/1/2011 |
| Kauneckis, D. (Author Only), Cuffe, O. (Presenter & Author), | Assessing climate policy networks in state & local water management | Association for Public Policy Analysis and Management | Washington, DC | 11/3/2011 |
| Kauneckis, D. (Author Only), Cuffe, O. (Presenter & Author), | Natural resource climate policy networks | National NSF EPSCoR Conference, National Science Foundation | Washington, DC | 10/25/2011 |
| Kauneckis, D. (Author Only), MacGill, S. (Presenter & Author), | Does federally mandated collaboration work? The case of | Association for Public Policy Analysis and Management | Washington, DC | 11/3/2011 |

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| | Communities of Care homeless planning networks | | | |
| Kauneckis, D. (Author Only), Pearson, D. (Presenter & Author), | Which types of nations join international environmental agreements | University of Nevada Undergraduate Research Conference | Reno, NV | 9/10/2011 |
| Kauneckis, D. (Author Only), Seymour, L. (Presenter & Author), | Public and private sector differences in the perspective on regulatory hurdles to developing geothermal resources | University of Nevada Undergraduate Research Conference | Reno, NV | 9/10/2012 |
| Kauneckis, D. (Author Only), Seymour, L. (Presenter & Author), | Perspectives on geothermal energy policy instruments across stakeholders | National Conference of Undergraduate Research | Ogden, UT | 3/30/2012 |
| Kauneckis, D. (Author Only), Seymour, L. (Presenter & Author), | What is Preventing Geothermal Energy Development in the Western United States? | National Conference on Undergraduate Research (NCUR) | Boise, ID | 3/30/2012 |
| Kauneckis, D. (Presenter & Author), | Governing Pooled Knowledge Resources: Thematic Conference by International Association for the Study of the Commons | International Association for the Study of the Commons, | Louvain-la-Neuve, Belgium | 9/13/2011 |
| Kauneckis, D. (Presenter & Author), | Integrating decision sciences with hydrological modeling: improving the resilience of water management to climate change impacts | EcoSummit | Ohio State University | 9/5/2012 |
| Kauneckis, D. (Presenter & Author), Berry, K. (Author Only), Saito, L. S. (Author Only), | Water Quality Cooperation in the Truckee River Basin and Other Western US Interstate Watersheds | Truckee River Symposium, Nevada Water Users Association | Reno, NV | 9/29/2011 |

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| Kauneckis, D. (Presenter & Author), Seymour, L. (Presenter & Author), | What is Preventing Geothermal Energy Development in the Western United States? | Lake Tahoe Basin Science Conference | Incline Village, NV | 5/20/2012 |
| Kauneckis, D. (Presenter & Author), Straemer, J. (Author Only), | Mapping Informal Climate Information Networks across Policy Domains: The case of the Nevada Local Government Networks | Lake Tahoe Basin Science Conference | Incline Village, NV | 5/23/2012 |
| Kauneckis, D. (Presenter & Author), Stramer, J. (Presenter & Author), | Mapping informal climate information networks across policy domains: The case of the Nevada local government networks | Lake Tahoe Basin Science Conference | Incline Village, NV | 5/23/2012 |
| Kauneckis, D. , | The environment and human well-being | Lake Tahoe Basin Science Conference | Incline Village, NV | 5/22/2012 |
| Kauneckis, D. , | A comparative analysis of institutional vulnerability across two urban western water systems | ICARUS III systems," Columbia University. (May 17, 2012). | New York, NY | 5/17/2012 |
| Kauneckis, D. , | Snowpack to Thirst: How a Changing Climate is Impacting Water & Energy Needs for Millions | National Conference on Science, Policy, and the Environment(Januar y 8, 2012). | Washington, DC | 1/8/2012 |
| Liu, Z. and W. Smith Jr. | Climate change belief and perception of Nevada residents | Association of American Geographers | New York, NY | 7/3/2011 |
| Liu, Z., H. Stephen, A. Safi., and W. J. Smith Jr. | Communication and the status of climate change in rural Nevada | Nevada EPSCoR | Reno, NV | 2011 |
| Liu, Z., W. J. Smith Jr., and A. Safi. | 2011. Climate change risk perceptions of ranchers and farmers in Nevada. Annual Meeting of the AAG, Seattle, WA. | Association of American Geographers | Seattle, WA | 2011 |

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| Liu, Z., W. J. Smith Jr., and A. Safi. | 2011. Climate change perceptions among Nevada's farmers and ranchers. 3rd Annual Tri-State Western Consortium Meeting. Albuquerque, NM. | 2011. Climate change perceptions among Nevada's farmers and ranchers. 3rd Annual Tri-State Western Consortium Meeting. Albuquerque, NM. | Albuquerque, NM | 2011 |
| Neill, H. and H. Ego | American Real Estate Society Meeting | American Real Estate Society Meeting | St. Petersburg, FL | 4/20/2012 |
| Safi, A. and W. Smith Jr. | Rural Nevada: Vulnerability, Environmental Behavior and Risk Perception | Association of American Geographers | Seattle, WA | 2011 |
| Safi, A. S., W. J. Smith Jr., K. Chief, and Z. Liu. | Native Americans and climate change: beliefs, risk perceptions and policy preferences | 3rd Annual Tri-State Western Consortium Meeting | Albuquerque, NM | 2011 |
| Safi, A. S., Z. Liu, W. J. Smith Jr., and K. Chief. | Rural Nevada: climate change perception, policy and vulnerability | Annual Meeting of the Nevada EPSCoR | Reno, NV | 2011 |
| Safi, A., W. Smith Jr., K. Chief and Z. Liu. | Native Americans and Climate Change: Beliefs, Risk Perceptions and Policy Preferences, poster presentation | 3rd Annual Tri-State Western Consortium Meeting | Albuquerque, NM | 2011 |
| Safi, A., Z. Liu, W. Smith Jr., and K. Chief. | Rural Nevada: Climate Change Perception, policy and vulnerability | Nevada NSF EPSCOR 2011 Meeting | Reno, NV | 2011 |
| Safi, Ahmad S. and W. Smith, Jr. | Rural Nevada: Vulnerability, Politics and Willingness to Decrease Fossil Fuel Consumption | Interdisciplinary Science of Consumption Meeting | Ann Arbor, MI | 2012 |

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| Smith Jr., W. | Nevada's Native American tribes and climate change: What they know, want, and are ready for -- and how to collaborate with them | Association for the Association of Environmental Studies and Sciences annual meeting, Santa Clara, CA. | Santa Clara, CA | 2012 |
| Smith Jr., W., A. S. Safi, Z. Liu, K. Chief, K. Miranda, and M. Gautam. | Societal knowledge, assumptions & preferences regarding climate change in Nevada | Association of Environmental Studies and Sciences | Burlington, VT | 2011 |
| Smith Jr., W., Z. Liu and A. Safi. | Rural societal knowledge, assumptions & preferences regarding climate change in Nevada | Association of American Geographers | New York, NY | 2012 |
| Smith, Jr., W., D. Koracin, A. Safi, Z. Liu, K. Chief, M. Gautam. | Societal Knowledge, Assumptions and Preferences Regarding Climate Change in Nevada | Croatian Meteorological Society | Zagreb, Croatia | 2012 |
| Stephen, H., W. J. Smith Jr., and Z. Liu. | Development of geovisualization facility at GIS and remote sensing core lab | Association of American Geographers | Seattle, WA | 2011 |
| Wilde, K. and W. Smith Jr. | Water Purveyor's Perceptions and Attitudes Towards Climate Change: A Survey of Nevada | Association of American Geographers | New York, NY | 2012 |
| Wilde, K., M. Gautam, R., K. Chief, and W. Smith Jr. | Analysis of Stakeholder Influence in Truckee River Operating Agreement Negotiations | Truckee River Symposium, Desert Research Institute | Reno, NV | 2011 |
| Albright, TP | Hot extremes: Characterizing a key driver of ecological change | US Regional Chapter of International Association of Landscape Ecology Annual Symposium | Newport, RI | 8-12 April, 2012 |

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| Albright, TP, AM Pidgeon, VC Radeloff, & BD Wardlow | Identifying thermally challenging landscapes and time periods for wildlife using remote sensing | American Geophysical Union, Fall Meeting | San Francisco, CA | 5-9 Dec 2011 |
| Charlet, D.A. | Baseline vegetation and floristic data for the Snake Range, White Pine County, Nevada | 2012 Annual Nevada State Climate Change Meeting | University of Nevada, Las Vegas, Las Vegas, NV | February 13, 2012 |
| Fenstermaker, L, D. Devitt, L. S. Saito, J. Arnone, F. Biondi, B.Riddle, M. J. Walker, R. Jasoni, S. Strachan, B. Bird, G. McCurdy, B. Lyles | Monitoring Climate Variability and Change Along Two Elevation Gradients in the Mojave and Great Basin Deserts | 96th Annual Meeting, Ecological Society of America (ESA) | Austin, Texas | August 11, 2011 |
| Fenstermaker, L, S. Strachan, G. McCurdy, B. Bird, D. Devitt, F. Biondi, J. Arnone, L. Saito, R. Jasoni, B. Johnson, B. Lyles | NevCAN: Monitoring Climate Variability and Change along Two Elevation Gradients | EPSCoR Tri-State Western Consortium | Sun Valley, Idaho | April 2-5, 2012 |
| Hay, M., F. Biondi, J. Chew, and R. Tausch | Forest simulation modeling to test climatic impacts on selected ecosystems in Nevada | Geography Colloquium Series | University of Nevada, Reno, Reno, NV | May 2, 2012 |
| Hay, M., F. Biondi, J. Chew, and R. Tausch | Applying Forest Simulation Modeling to Test the Impact of Climatic Change on Selected Ecosystems at two Mountain Transects in Nevada | 2012 Annual Nevada State Climate Change Meeting | University of Nevada, Las Vegas, Las Vegas, NV | February 13, 2012 |
| Johnson, B.G., R.L. Jasoni, J.A. Arnone III | Quantifying environmental controls on sap flow in Great Basin tree species and their possible significance for mountain groundwater recharge under anthropogenic climate change | 2012 Annual Nevada State Climate Change Meeting | University of Nevada, Las Vegas, Las Vegas, NV | February 13, 2012 |

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| Johnson, B.G., R.L. Jasoni, J.A. Arnone III | Quantifying responses of woody plant transpiration to anthropogenic climate change along elevational gradients in the Great Basin | 4th Annual Western Consortium Tri-State Meeting | Sun Valley Resort, Sun Valley, ID | April 2-5, 2012 |
| Johnson, B.G., R.L. Jasoni, J.A. Arnone III | Quantifying responses of woody plant transpiration to anthropogenic climate change along elevational gradients in the Great Basin | Geography Colloquium Series | University of Nevada, Reno, Reno, NV | April 25, 2012 |
| McMahon Jr., M., F.C. Harris, Jr., S.M. Dascalu, and S. Strachan | S.E.N.S.O.R. – Applying Modern Software and Data Management Practices to Climate Research | Computer Applications in Industry and Engineering 2011 (CAINE 2011) | Honolulu, Hawaii | November 16-18, 2011 |
| Simeral, DS, TP Albright | Topographic Influences on Near-Surface Temperature Regimes in Complex Terrain, San Francisco Peaks, Arizona | US Regional Chapter of International Association of Landscape Ecology Annual Symposium | Newport, RI | 8-12 April, 2012 |
| Strachan, S., J. Arnone, F. Biondi, D. Devitt, L. Fenstermaker, and L. Saito | Measuring Climate and Environmental Response in the Great Basin – the NevCAN long-term monitoring sites | EPSCoR Tri-State Western Consortium | Sun Valley, Idaho | April 2-5, 2012 |

Outreach to Stakeholders. A listing of meetings, conferences, and workshops occurring in year 4 where project members formally or informally communicated to *stakeholders* about our Track 1 is shown in the table below. Over 25 stakeholder meetings were attended by project members.

| Stakeholder Meetings | | | | | | |
|-----------------------------|-------------|---------------------------------|----------------------------|-------------------------------|--------------------------------|----------------------------------|
| Year | Date | Stakeholder | Stakeholder Contact | Meeting | Location | NSF EPSCoR Project Member |
| 2011 | 06/26/11 | Southern Nevada Water Authority | Keely Brooks | NSF EPSCoR Project-ISP: Water | UNLV – Science and Engineering | John Mejia |

| | | | | Vulnerability | Building | |
|------------------|-----------|--|--|---|---|---------------------|
| 2012 | 06/22/12 | The Long Now Foundation | Laura Welcher, Director of Operations | Annual Long Now Field Science Day | Snake Range research sites, NV | Scotty Strachan |
| 2011-2012 | Multiple | Southern Nevada Water Authority | Multiple | In person, by email, or by phone | Nevada | Franco Biondi |
| 2011-2012 | Multiple | US Fish and Wildlife Service | Multiple | By email or phone | Nevada | Franco Biondi |
| 2012 | Multiple | Office of the Nevada State Climatologist | Multiple | In person | Nevada | Franco Biondi |
| 2012 | 3/1/2012 | Great Basin National Park | Gorden Bell, Environmental Protection Specialist | N/A | Phone training on accessing NevCAN webcams | Fenstermaker |
| 2011 | | Natural Resources Conservation Service | Levi Steptoe, State Soil Scientist and Doug Merkler, Resource Soil Scientist | N/A | DRI/SNSC, Las Vegas NV | Fenstermaker |
| 2012 | 2/13/2012 | Natural Resources Conservation Service | Doug Merkler, Resource Soil Scientist | Annual Nevada NSF EPSCoR Climate Change Meeting | UNLV, Las Vegas, NV | Fenstermaker |
| 2012 | 2/13/2012 | Nevada Land Conservancy | Chuck Pope, CEO | Annual Nevada NSF EPSCoR Climate Change Meeting | UNLV, Las Vegas, NV | Fenstermaker |
| 2011-12 | | Southern Nevada Water Authority | Keely Brooks, Climate Change Policy Analyst | NV Climate Change Seminar Series | UNLV and DRI, Las Vegas, NV | Fenstermaker |
| 2011 | 11/15/11 | Truckee Meadows Water Authority | Director | Urban Water Vulnerability | Washoe County Department of Water Resources | Kauneckis, Piechota |

| | | | | | | |
|-------------|----------|--|-----------------------------|--|---------------------------------|--|
| 2012 | 2/13/12 | Scientists | Participants and audience | Data Portal Workshop following the Annual Nevada Climate Change Meeting | GIS/RS Lab in SEB, UNLV | Liu, Stephens and members from other components |
| 2012 | 5/1/12 | Southern Nevada Water Authority | Brooks | Urban Water Vulnerability | Southern Nevada Water Authority | Piechota, Rollins, Mejia, Ahmad, Neill, Fossile |
| 2011 | 10/31/11 | Pyramid Lake Paiute Tribe | N/A | Pyramid Lake Paiute Outreach Workshop | Pyramid Lake | Chief, Mahesh, & Smith |
| 2012 | Feb 13 | Scientists, educators, students | Annual Nevada CC Conference | Data Portal Workshop at the Annual Nevada NSF EPSCoR Climate Change Conference | UNLV | Sergiu Dascalu, Lynn Fenstermaker, Eric Fritzinger |
| 2012 | April 4 | Scientists, educators, students | 3-State Western Consortium | Data Portal Workshop at the Annual 3-State Western Consortium Meeting | Sun Valley, ID | Sergiu Dascalu, M. McMahon, Eric Fritzinger |
| 2011 | Sept. 7 | Scientists, educators, students, policy makers, general public | Dr. Tom Piechota | Nevada Climate Change Seminar Series | UNLV | Sergiu Dascalu |
| 2012 | Jan 13 | Scientists, educators, students | Dr. Claudia Raibulet | Invited seminar at U. of Milano-Bicocca, Italy | Milano, Italy | Sergiu Dascalu |
| 2012 | March 30 | Scientists, business, policy | Dr. Manos Maragakis | Project presentation | UNR, Reno, NV | Sergiu Dascalu, M. |

| | | | | | | |
|-------------|----------|---|--|---|------------------------------|---|
| | | makers | | focused on NCCP | | McMahon |
| 2012 | July 1-5 | Environmental modeling community | IEMSS-2012 | Presentation on Demeter Software framework | Leipzig, Germany | Sergiu Dascalu |
| 2012 | July 19 | Scientists, CUAHSI user community | CUAHSI Biennial | NCCP portal workshop at CUAHSI Biennial | Boulder, CO | M. McMahon, Lynn Fenstermaker, Sergiu Dascalu |
| 2011 | 09/19/11 | National Park Service | Chief, education; educational outreach; district interpreter, creative consultant, water program manager | NSF EPSCoR Losing the Lake (LTL) installation negotiations. | District office Boulder City | Nussbaum, Owens |
| 2011 | 9/15/11 | Southern Nevada Water Authority | Climate change analysts | Provided feedback on LTL in writing | Not Applicable | Michael Nussbaum |
| 2011 | 11/5/11 | Fremont Middle School, Clark County School District | 7 th grade teachers, UNLV coordinator | Negotiated LTL field testing | School site, Las Vegas | Nussbaum |
| 2011 | 11/8/11 | Clark County School District | Math and Science Coordinator | Approved plans for LTL field testing. | District office, Las Vegas | Nussbaum |
| 2011 | 11/15/11 | Harney Middle School, Clark County School District | 7 th grade teacher | Negotiated LTL field testing | School site, Las Vegas | Nussbaum |

6. Evaluation and Assessment.

The project's progress and success is measured by 1) the project's External Research and Technical Advisory Board; 2) AAAS site review, 2) NSF Reverse Site visits, and 4) the external evaluator. Details for each are provided below.

1) *External Research and Technical Advisory Board (ERTAB)*. The eight-member ERTAB convened at UNLV February 14, 2012. Based on presentations made by the project team, the

ERTAB reviewed progress toward achieving outcomes of the projects, and made constructive suggestions for improving and/or changing the direction of the work underway. The ERTAB summarized their comments and recommendations in a report to the management team. The management team responded to each report recommendation with strategies on how we will incorporate the recommendations into the project. The 2012 ERTAB report, with project team responses embedded, can be found online in Appendix 1.

2) *AAAS Site Review*. Nevada did not have a AAAS site review in year 4.

3) *NSF Reverse Site Visit*: Nevada’s year four NSF Reverse Site visit (RSV) occurred just prior to the start of year four, on August 12, 2012. In the time since the RSV, team members have been implementing the recommendations made by the RSV panel.

4) *External Evaluator*. The external evaluator, Dr. Lisa Kohne of SmartStart ECS, uses formative and summative evaluation processes to assess progress of the project in attaining their goals and objectives. The external evaluator provides quarterly formative reports and an annual summative evaluation report to the project management team; the annual report is also provided to NSF by the management team. The management team will use the evaluator’s annual evaluation report from year four to inform and make adjustments in plans for year four. We will receive the external evaluator’s year four annual report in August 2012. The external evaluator creates and administers participant surveys for project activities, which used to determine if the meetings, workshops and conferences met their objectives and goals, and to inform planning for subsequent year’s meetings.

7. Sustainability and Project Outputs.

Sustainability an projects outputs was addressed through: 1) proposal development efforts that build on the project’s climate change infrastructure; 2) providing technical writer’s support to improve competitiveness of proposals submitted; 3) new faculty, postdoctoral and technician hires; 4) graduation of students funded by the project; and 5) specific efforts to for long-term sustainability of the project infrastructure. Further details on these sustainability efforts and outputs are shown below.

1) Proposal Development Efforts

In Year four, project members submitted 47 proposals. Of those, 11 (23%) were awarded funding for a total amount of \$12,862,735. Twenty of the 47 (43%) submitted are still pending. Track 1 related proposal development efforts are listed below.

| Proposals Submitted, Funded, and Pending in Year 4 | | | | |
|---|--|-------------------------------|---------------|---------------|
| Funding Agency & Department or Program | Title | PI/Co-PI w/institution | Amount | Status |
| DOI - Bureau of Reclamation | Evaluation of Regional Climate Downscaling Techniques in Forcing a Coupled Hydrological Model in Small Snow- | John Mejia (PI-DRI) | \$240,000 | Awarded |

| | | | | |
|------------------------------------|---|--|-----------|----------|
| | Dominated Watershed | | | |
| NSF | Collaborative Research: Coastal Upwelling and Land Heating Over the California-Oregon Coast: Dynamics and Climatic Scale Land-Ocean-Atmosphere Interactions | Dark Koracin (PI-DRI) | \$380,000 | Declined |
| NASA-ROSES-11-A.30 | Strategies for Climate Change Adaptation at the Dryden Flight Research Center and Within the Mojave Desert Region | John Mejia, PI (DRI); Vicken Etyemezian, Co-PI (DRI); Julianne Miller, Co-PI (DRI); Lynn Fenstermaker, Co-PI (DRI); and Thomas Mace, Co-PI (NASA/DRFC) | \$348,000 | Accepted |
| NASA ROSES-11 A.32 | Desert birds in a warming world: Characterizing thermal stress with daily Earth observation data in complex terrain | Thomas Albright, PI (UNR); John Mejia (collaborator) | \$358,602 | Pending |
| NASA-EPSCoR | Nonlinear Coupling Among Atmospheric Rivers, Terrain, Radiative Forcing and Ecohydrological Processes in the Southwestern U.S. | Mike Kaplan, PI lead (DRI); Mejia, co-PI (DRI); J.M. Lewis, co-PI (NOAA,DRI); D. Myrick, co-PI (NOAA) | None | Pending |
| NSF/EAR Global Change | CR: Holocene Monsoon History from Tibetan Paleolakes | Boyle (UNR) | \$48,897 | Pending |
| NSF/Geography and Spatial Sciences | Refinement of historical variability and the baseline for hydroclimatic conditions within the Walker Basin, Nevada/California | Biondi, F. (UNR) and S. Strachan (UNR) | \$404,674 | Pending |
| NSF, Directorate | P2C2: From Intra- | Biondi, F. (UNR) | \$515,837 | Pending |

| | | | | |
|---|---|---|-------------|----------|
| for Geosciences, Paleo Perspectives on Climate Change (P2C2) Program | Seasonal Wood Anatomy to Remote Sensing Measurements for Calibrating Millennia-Long Regional Climate Reconstructions | | | |
| USGS Intergovernmental Personnel Agreement | Tree-Ring Records of Climate Change in the Mojave Desert | Biondi, F. (UNR) | \$10,000 | Awarded |
| Southern Nevada Water Authority | Tree-Ring Investigations for Water Resources Planning | Biondi, F. (UNR) | \$138,500 | Awarded |
| U.S. Department of Agriculture, National Institute of Food and Agriculture, Agriculture and Food Research Initiative (AFRI) | Thresholds in semi-arid rangelands: the interactive role of rates and trends in climate, disturbance, and management | Saito, L.S. (UNR), Biondi, F. (UNR), and others | \$499,995 | Declined |
| Workshop proposal to the Mountain Research Institute (MRI) | The Value of Long-term Instrumented Sites in Mountain Regions | Biondi, F. (UNR), John Arnone (DRI) | None | Pending |
| NASA EPSCoR | Using NASA Assets in Nevada: Water Resources and Ecohydrological Systems (UNAN-WRES) | Fritsen, C. (DRI); Ahmad, S.; Berli, M.; Fenstermaker, L. (DRI); Kaplan, M. (DRI); Lewis, J.; McGwire, K. (DRI); Myrick, D. (NWS); Painter, T. (NASA); Saito, L.S. (UNR); Underwood, S.J. (UNR); Biondi, F. (UNR); Albright, T. (UNR) | \$750,000 | Declined |
| NSF, Directorate for Biological Sciences, Emerging Frontiers Program, Macrosystems Biology Program | Collaborative Research: Quantifying Mechanistic Linkages Between Climate Variability and Ecological and Hydrologic Responses of | Biondi, F. (UNR) | \$2,382,011 | Declined |

| | Great Basin Ecosystems | | | |
|------------------|--|--|-------------|----------|
| NASA | Strategies for Climate Change at the Dryden Flight Research Center and within the Mojave Desert Region | Mejia (DRI) Etyemezian (DRI) Miller (DRI) Fenstermaker (DRI) Mace (NASA-DFRC) | \$348,846 | Awarded |
| DOE TES | Abiotic and Microbial Mechanisms of Soil Carbon Flux and Storage in Arid Ecosystems | Fenstermaker (DRI) Berli (DRI) Devitt (UNLV) Hausrath (UNLV) Moser (DRI) Twarakavi (DRI) Young (UTX) | \$950,646 | Declined |
| NASA EPSCoR | Using NASA assets in Nevada: water resources and ecohydrological systems (UNAN-WRES) | Fritsen (DRI/EPSCoR) Ahmad (UNLV) Berli (DRI) Biondi (UNR) Fenstermaker (DRI) Kaplan (DRI) Lewis McGwire (DRI) Myrick Painter Saito (UNR) Underwood Albright (UNR) | \$750,000 | Declined |
| NSF Macrosystems | Quantifying mechanistic linkages between climate variability and ecological and hydrological responses in Great Basin ecosystems | Arnone (DRI) Biondi (UNR) Devitt (UNLV) Abella (UNLV) | \$3,656,859 | Declined |

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|-------------------------------------|--|---|---------------|-----------------------------|
| | | | | |
| USDA | Critical thresholds in semi-arid rangelands: the interactive role of rates and trends in climate, disturbance and management | Saito (UNR) | \$499,995 | Declined |
| NSF | Adaptive responses to changing ecosystem services in a semi-arid environment | Saito (UNR) | \$755,000 | Declined |
| NASA EPSCoR | UAS and Multi-State Monitoring of Environmental Dynamics for Science and Education | Fenstermaker (DRI) Devitt (UNLV) Albright (UNR) McGwire (DRI) Charlet (CSN) | \$750,000 | Pending |
| NSF Macrosystems | Quantifying effects of natural climate variability and manipulated precipitation on ecosystem processes that control water availability in the Great Basin | Arnone (DRI) Jasoni (DRI) Biondi (UNR) Devitt (UNLV) | \$6,123,914 | Pending |
| NSF | EPSCoR Water, Energy and Environment Nexus | Kauneckis, UNR and others from DRI and UNLV | \$ 14,900,000 | Declined |
| Tahoe Truckee Foundation | Tahoe Truckee Foundation | Pathways to environmental innovation | \$ 29,000 | Submitted 2/10/12 |
| NSF - Coupled Human Natural Systems | Resilience of Reservoir Ecosystems to Climate Change: Integrating Institutional analysis and decision sciences with hydro-ecological modeling | Kauneckis, PI with coauthors | \$ 14,950,000 | Submitted November 15, 2011 |
| California | Understanding what | Kauneckis | \$ 53,566 | Submitted |

| | | | | |
|--|---|---|--------------|----------------|
| Landscape Conservation Cooperative (CA LCC) | resource managers need from the climate sciences: an assessment of climate science gaps and information networks in the California Landscape Conservation Cooperative | | | March 23, 2012 |
| NSF/US Dept. of Agriculture | DRRC: Disaster Resilience in Rural Great Basin Communities: Sociological, Economic, and Political Science Insights Into the Sources of Community Differences | Kauneckis, Derek K (Co-Principal), Evans, Mariah D (Principal), Rollins, Kimberly S (Co-Principal), Harris, Thomas R (Co-Principal), Peoples, Clayton D (Co-Principal), Christman, Laine (Co-Principal) | \$ 800,000 | Declined |
| NSF - IGERT | IGERT: Integrating ecosystem function, human adaptive responses, and changing ecosystem services in semi-arid environments | Kauneckis, Derek K (Co-Principal), Saito, Laurel S (Principal), Peacock, Mary M (Co-Principal), Rollins, Kimberly S (Co-Principal), Tyler, Scott W (Co-Principal) | \$ 1,500,000 | Submitted |
| National Oceans and Atmospheric Administration | Forecasting Reservoir Operations to Mitigate Climate Impacts on Fish Sustainability Below Shasta Lake | Kauneckis, Derek K (Co-Principal), Saito, Laurel S (Principal), (Co-Principal), | \$ 249,368 | Accepted |
| Department of Defense | Security Implications of Epidemic Outbreaks: | Kauneckis, Derek K (Co- | \$ 1,600,000 | Declined |

| | | | | |
|--------------------|--|--|---|--|
| | Evaluating governance impacts on emerging security challenges | Principal), Ostergard, Robert L (Principal) | | |
| NSF | CARME Science and Technology Center Pre-Proposal | Kauneckis, Derek K (Supporting), McCarthy, Maureen (Co-Principal), Collopy, Michael W (Co-Principal) | \$ 30,000,000 | Declined |
| Bally Technologies | Bally-sponsored Senior Project in Computer Science and Engineering | S. Dascalu (UNR)-PI | \$10,300 | Awarded |
| NSF | Collaborative Research: Large-Scale Modeling and Real-Time Simulation of Brain Dynamics and Interaction | F. Harris (UNR)-PI S. Dascalu(UNR)-CoPI | \$623,000 | Pending |
| NASA EPSCoR | A Highly Automated Platform for Continuous Monitoring of Astronaut Health and Performance in Space Exploration Missions | S.Latifi (UNLV) PI F. Harris (UNR) CoPI S. Dascalu (UNR) CoPI | \$750,000 | Pending |
| ONR | Brain Modeling and Simulation at UNR (tentative title) | F. Harris (UNR) PI S. Dascalu (UNR)-CoPI | \$900,000 | In preparation (to be submitted July 2012) |
| NSF | TBD (for NSF BIGDATA Program Solicitation) | S. Dascalu (UNR, PI) F. Harris (Co-PI) | \$2,500,000 | To be submitted June 2012 |
| NSF/Cyberlearning | DIP: Collaborative Research Project: Losing the Lake: Building a Simulation Game and Learning Environment to Transform Students' Argumentation and | Sinatra (USC)/ Nussbaum (UNLV)/ Piechota (UNLV). | \$1.3 million (\$1 million to Univ. of Southern CA, \$350,000 to UNLV). | Pending |

| | | | | |
|----------|---|-----------|-----------|---------|
| | Reasoning Skills, Attitudes, and Dispositions about Water Conservation and Climate Change | | | |
| U.S. SBA | Federal and State Program to Stimulate Technology (FAST) Small Wood Project | Males/UNR | \$55,444 | Awarded |
| U.S.F.S. | Federal and State Program to Stimulate Technology (FAST) Small Wood Project | Lynch/UNR | \$129,000 | Awarded |

2) Technical Writers Assistance

The project provides *technical writers assistance* for proposal writing for NSHE faculty (<http://www.nevada.edu/epscor/grant-resources.html>). Assistance was provided to 11 faculty who submitted proposals to the following agencies (number of proposals submitted to each in parentheses): NSF (9), DOE (1) and Southern Nevada Public Land Management Program (1).

3) New Hires

All faculty and postdoctoral searches and hires described below are *new positions* funded by this Track 1 RII, and are the result of competitive, national searches.

Water Resources: A new academic tenure-track faculty member with expertise in ecohydrology, Assistant Professor Haroon Stephen, started in year four in the Department of Civil and Environmental Engineering at UNLV. The project will continue to support Dr. Stephen in year 5.

Cyberinfrastructure: A new academic tenure-track faculty member with expertise in computer visualization, Assistant Professor Brendan Morris, started in year four in the Department of Electrical and Computer Engineering at UNLV. The project will continue to support Dr. Morris in year 5.

Policy and Education: A national search for a demographer in year four resulted in hiring two new faculty at UNLV. These faculty will start in year five of the project and will be included in the year five report.

4) Graduation and Employment of Students Funded by Project.

| Students Funded by Track 1 Project – Graduation and Employment during Year Four | | | | | |
|--|-----------------------------------|--------------------|--------------------------|------------------------|---|
| Student Name | Degree | Institution | Project Component | Graduation Date | Future Plans |
| Lauren Fossile | MS-Mechanical Engineering | UNLV | Policy & Outreach | May 2012 | Obtain a job in the industry; pursue another degree in the future but would like experience in the renewable energy sector first. |
| Kiersten Wilde | MS | UNLV | Policy | May 2012 | |
| Gregory King | BS-Cellular and Molecular Biology | UNLV | | May 2012 | Work for a year and then apply to a PhD program in Molecular Biology |
| Pamela Sinanian | BS-Environmental Studies | UNLV | | May 2012 | Work for the Applied Ecology Research Group at UNLV for the summer while looking for a job in restoration ecology. Possibly grad school in the fall of 2013 for a masters in Biology. |
| Terry Fisk | MS-Hydrogeology | UNR | Water | Dec 2011 | Currently working at the U.S. Fish |

| | | | | | |
|-------------------|--------------------------------------|-----|---------------------|----------|---|
| | | | | | and Wildlife Service in Klamath Falls, OR. |
| Subhashree Mishra | PhD- Atmospheric Sciences | UNR | Climate Change | Dec 2011 | Post-doctoral associate at the National Severe Storms Lab through CIMMS-NOAA in OK. |
| Sohei Okamoto | PhD-Computer Science and Engineering | UNR | Cyberinfrastructure | Dec 2011 | Full time post-doctoral scholar at UNR for same EPSCoR project |
| Chris Glover | BS-Mechanical Engineering | UNR | | May 2012 | Will be applying for entry level employment with several companies, including Boeing. |

5) Long-term sustainability of Specific Project Infrastructure

Climate Modeling Components: The Climate Modeling component continues to be very active in disseminating information about their research results, building external collaborations and pursuing other research funding opportunities. Each of these efforts plays an important role in sustaining the climate modeling efforts beyond the lifetime of the current grant. There is a high level of interest in the downscaled regional climate products our group has been producing. Individuals from federal, state and local agencies as well as other universities and project participants have requested information and/or data products. Coupled with the activities described in the above paragraph, the climate modeling component has generated significant recognition and interest in their efforts that are already leading to new funding to continue their modeling efforts beyond the timeframe of the NSF EPSCoR project.

Water Resources and Ecological Change Components: Sustainability efforts for the NevCAN, the environmental transects, include initiating new research, proposals and collaborative arrangements with stakeholder agencies. The ERTAB advised us that partnerships with stakeholders constitute a key mechanism for sustainability for our infrastructure. To facilitate these partnerships, the project is funding a Stakeholder Outreach Coordinator (Dr. Lynn Fenstermaker) starting in May 2012, to continue through the end of

year 5. Additionally, planning has begun for hosting a regional workshop on climate change with a significant focus on use of climate change data by stakeholders. We expect to hold this workshop in May 2013. A new collaborative arrangement was negotiated in year 4 with the USDA Natural Resources Conservation Service to perform soil characterization and soil sample analyses at each of the NevCAN tower locations. We have also continued collaborations with the Southern Nevada Water Authority to share data and are providing meteorological data to Mesowest for input to National Weather Service forecasting models. During summer 2012, we are registering NevCAN data with the CUASHI Hydrological Information System and provided a workshop on NevCAN and the Nevada Climate Change Portal at the Nevada EPSCoR Annual Science Meeting and the CUASHI Biennial Science Meeting.

The communication network that transmits data from the field sites to the data portal at UNR is being developed in conjunction with other NSHE collaborators, including the Nevada Seismological Laboratory and Great Basin College. These collaborations are helping spread costs and maximize efforts, leading to greater integration within the NSHE system and long-term sustainability. We are establishing a mechanism for tracking all sensor installation and maintenance work on the transect towers for sustaining a system of ongoing maintenance and upkeep of the infrastructure. This includes tracking costs for sensor replacement, calibration and labor. This information is going into an infrastructure sustainability plan that will help inform us of the needs and costs for maintaining the physical infrastructure. We are also working on developing a set of policies for ongoing use and maintenance of the transects by members throughout the scientific community. We have received requests for doing on-site experiments or adding sensors to expand the research capability of the transects. We are in the process of developing protocols that would guide the rules of use, to ensure minimum disturbance of the environment, ensure that no experiments alter the data for other users, and that existing infrastructure and the data portal can support data from new sensors.

Policy Component: Sustainability plans include activities that support outcomes related to overall project goals: continuing to submit journal articles; develop and submit grant proposals to competitive organizations; hold a workshop with scientists from public agencies such as Southern Nevada Water Authority (SNWA) and academics including new faculty and capital infrastructure; give a conference on climate change issues; review and updating plans for cost recovery; help new hires adjust and integrate into ongoing efforts; identify resources to support existing academic programs to develop and/or refine interdisciplinary programs/courses to be offered at undergraduate and graduate levels; and work with existing student groups to support experiential learning opportunities with communities in Nevada. These last two efforts will include writing grant proposals and requests to foundations that support innovative educational and workforce development ventures to serving the state of Nevada.

The *Cyberinfrastructure (CI) Component* has been active this past year and engaged in several efforts that will enhance this group's sustainability. In addition to nine conference presentations, two journal publications, five peer-reviewed conference proceedings and six proposals, this group has significantly improved the Nevada Climate Change Portal (NCCP) and organized three workshops to provide information and training on the NCCP. The first workshop was provided at the 2012 Annual Nevada State Climate Change Meeting held on

Feb 13, at UNLV. Meeting attendees, NevCAN land owners and other stakeholders were invited to participate in this workshop and given training on how to access NCCP and download data from NevCAN. The second workshop was held at the 4th Annual Tri-State Western Consortium meeting held in Sun Valley, ID, and provided similar content to the first workshop. Surveys were conducted after both of these workshops to gain insights on how to improve the NCCP. The third workshop presents information and training on NCCP and NevCAN to registered attendees at the CUASHI 2012 Biennial Science Meeting held July 14-19, 2012 in Boulder CO. The continuing enhancements to the NCCP in addition to archiving of NevCAN and other component data and web-based climate change modules provides further significant potential for the sustainability of this system into the future.

Education Component: Six new courses are being developed through project funding as part of the goal of enhancing STEM education and climate science curriculum within the NSHE system. These courses will become permanent new climate change curriculum at both UNLV and UNR. The courses will be first taught in year 5 of the program, and thereafter on a regular basis. The courses are being designed to be able to be taught remotely to reach each of the seven campuses in the system, including community colleges in rural communities.

The EPSCoR summer institute model for training K-12 teachers in climate science through hands on field experiences that translate into classroom science modules was included in a new proposal submitted to the NSF Geography and Spatial Sciences program (PIs Mensing and Ewing-Taylor). This proposal, if funded, would support six K-12 teachers in summer institutes over a three-year period.

Nevada Small Business Development Center: The Nevada Small Business Innovation Research Program operates out of the Nevada Small Business Development Center. The NSBDC continues to submit grants and work on projects to promote SBIR outreach, also a priority with the Governor's office (as noted in the recent Brookings report). At the company level, sustenance depends upon the receipt of the initial SBIR grant. These grants come in two phases and while both grants provide substantial funding (up to \$1 million), they are often augmented with additional funding by the Federal agencies involved, as well as by angel funding and venture capital investment groups. Validation by the Federal grants often makes follow on funding more likely.

a. Seed Funding and Emerging Areas

The four seed grants awarded in year two were completed in year 4:

- Climate Change Collaboration, Education & Outreach - Rajan Chakrabarty (Lead) (DRI); Michael Robinson (UNR)
- Evaluating the Vulnerability of Pyramid Lake Paiute Indian Water Rights Under Climate Change- Karletta Chief (Lead) (DRI); Mahesh Gautam (DRI), William Smith Jr. (UNLV)
- Assessing the Envelope of Interannual Variation in Vegetation - Lynn Fenstermaker (Lead) (DRI); Dale Devitt (UNLV); David Costa (UNLV)
- Physiological Stress as an Indicator of Climate Change - Stanley Hillyard (Lead) (UNLV); Frank van Breukelen (UNLV)

Two Integrated Science Projects were implemented in year 4. The new ISPs are interdisciplinary “end to end” projects that will: 1) address the project’s two interdisciplinary science questions; 2) leverage existing resources; 3) link and integrate multiple components; 4) lead to attainment of component and overall project science goals; 5) result in desired science outputs and outcomes; 6) produce new products of value to the scientific community, educators, and stakeholders; and 7) result in a new transformative capability for interdisciplinary research on climate change. As recommended by the AAAS panel in 2010, the ISPs are “engineered” (rather than competitive) and lead by the three project CoPIs working in collaboration with project components and others (e.g., stakeholders). The two ISPs are:

- “Vulnerability and Resilience of Urban Water Systems under Uncertain Changing Climate Scenarios” (Tom Piechota, lead) and
- “Great Basin Ecohydrology – Demonstration of the Utility of the Nevada Climate Transect System as a Novel Research Platform” (Scott Mensing and Nick Lancaster, Co-Leads).

Each ISP will receive \$150,000 per year in years four and five of the project.

b. Human Resources Development.

The project’s human resources development activities and outcomes include recruitment and retention of new faculty, students, and technicians, workforce development, and workforce and education activities. These activities are described in detail in prior sections of this report.

c. Leveraging NSF Programs.

One of the most significant collaborations is with two other EPSCoR states, Idaho and New Mexico. Tri-State Consortium activities are described above in more detail. Water Component members are continuing their efforts to ensure compatibility among NevCAN transect monitoring design and operation and other monitoring networks such as LTER, NEON, CZO and the CUASHI HIS programs. We are continuing discussions with representatives of each program and are actively engaged in either providing NevCAN data to other databases or registering NevCAN with other networks. The Nevada Small Business Development Center provides counseling to Nevada small businesses for obtaining NSF Small Business Innovation Research in Nevada which is specifically aimed at for-profit companies which do not qualify for most other NSF grants.

C. Management Structure.

1. EPSCoR governing committee meetings and relevant actions.

The Nevada EPSCoR Advisory Board was scheduled to meet on January 20th, 2012, but the meeting was cancelled due to a Special Session called by the NSHE Board of Regents on that day. A four person sub-section of the Advisory Board met three times (September 23, 2011, March 23, 2012, and April 9, 2012) to discuss and help guide the approach and development of pre-proposals for the next Track-1 RII proposal that will be submitted in 2012.

2. EPSCoR management team meetings and actions, changes in personnel.

The Track 1 NSF EPSCoR Management Team consists of the Project Director (Dr. Gayle Dana) and a Co-PIs from each of NSHE's three research institutions: Dr. Nick Lancaster (DRI), Dr. Scott Mensing (UNR), and Dr. Tom Piechota (UNLV). The management structure also includes a Leadership Council, which includes the CoPIs and project component leads. There were two changes in the Leadership Council in year four. Dr. Gale Sinatra, Education Component Lead, left to take a position outside Nevada. Dr. Sinatra was replaced by Dr. Michael Nussbaum (UNLV Dept. of Educational Psychology). Dr. William Smith, Jr., Policy Component Lead, left his faculty position in the UNLV School of Environmental and Public Affairs to take a position at the Harry Reid Center for Environmental Studies (also at UNLV). Dr. Smith was replaced by Dr. Helen Neill (UNLV School of Environmental and Public Affairs, UNLV). All of these changes in leadership were made following the project's Succession Plan. The Management team meets for one to two hours bi-monthly via Webex, and also convenes an annual PI retreat to plan for the upcoming project year. The PI retreat in year four occurred May 16-17, 2012 in Incline Village, NV. The Management Team meets with the Leadership Council (Component Leads) quarterly via videoconferencing. Agendas, minutes and action items for each meeting are available upon request. This information is sent to the project's external evaluator after each meeting.

3. Institutional affiliation and demographics for RII committees and team.

The project's leadership and management structure consists of four PIs/Co-PIs, six Component Leads and a three member Steering Committee for each component. The Component Steering Committees consist of the Component Lead plus two members from the other two institutions. Additionally, there are two Leads for the Undergraduate Research Program and two K-12 instructors. The institutional breakdown is: six faculty with the Desert Research Institute (DRI); seven faculty with the University of Nevada, Las Vegas (UNLV); seven faculty with the University of Nevada, Reno (UNR); one faculty with Nevada State College (NSC); and one faculty has a DRI/NSC joint appointment. There are 17 male (77%) and four female (23%) team members. Nineteen are White (86%), and three are Asian (14%). Please see the table below for a detailed breakdown.

| Title | Name | Institution | Male | Female | Ethnicity |
|-------------------------------------|----------------|-------------|------|--------|-----------|
| Project Director/Lead PI | Gayle Dana | DRI | | 1 | White |
| Co-PI/Institutional lead | Nick Lancaster | DRI | 1 | | White |
| Co-PI/Institutional lead | Tom Piechota | UNLV | 1 | | White |
| Co-PI/Institutional lead | Scott Mensing | UNR | 1 | | White |
| Climate Modeling Lead | Darko Koracin | DRI | 1 | | White |
| Climate Modeling Steering Committee | Scott Bassett | UNR | 1 | | White |
| Climate Modeling Steering Committee | Zhongbo Yu | UNLV | 1 | | Asian |
| Ecological Change Lead | Franco Biondi | UNR | 1 | | White |

| | | | | | |
|--|---------------------|---------|---|---|-------|
| Ecological Change Steering Committee | Brett Riddle | UNLV | 1 | | White |
| Ecological Change Steering Committee | John Arnone | DRI | 1 | | White |
| Water Resources Lead | Lynn Fenstermaker* | DRI | | 1 | White |
| Water Resources Steering Committee | Dale Devitt | UNLV | 1 | | White |
| Water Resources Steering Committee | Laurel Saito | UNR | | 1 | Asian |
| Policy, Decision Making, and Outreach Lead | Helen Neill | UNLV | | 1 | White |
| Policy, Decision Making, and Outreach Steering Committee | Mahesh Gautam | DRI | 1 | | Asian |
| Policy, Decision Making, and Outreach Steering Committee | Derek Kauneckis | UNR | 1 | | White |
| Education Lead | E. Michael Nussbaum | UNLV | 1 | | White |
| Education Steering Committee (K-12) | Paul Buck | DRI/NSC | 1 | | White |
| Education Steering Committee (Grad. & UG) | Michael Collopy | UNR | 1 | | White |
| Undergraduate Research | John Farley | UNLV | 1 | | White |
| K-12 Instructors | Jacque Ewing-Taylor | UNR | | 1 | White |
| K-12 Instructors | Lawrence Rudd | NSC | 1 | | White |

*Appendix 2, Template B shows 5 members of RII Leadership Team as Lynn Fenstermaker acted as interim Co-PI when Nick Lancaster was on sabbatical for part of the project year.

4. Technical Assistance by other outside agent, e.g. consultants.

The project contracts with Dr. Lisa Kohne (SmartStart Educational Services) for providing services as the external evaluator. Project Web site maintenance is provided by Laura Mercer, an independent contractor (consultant).

D. Jurisdictional and Other Support.

Financial and administrative assistance to the project is provided by the Nevada EPSCoR Office (NEO), which administers all of the state EPSCoR programs. Key personnel within the Administrative Management Team include: Marcie Jackson (full-time NSF EPSCoR Project Administrator) responsible for budget administration, coordination with the NSHE institutions' research offices, collecting baseline information, documenting accomplishments of project milestones, RII evaluation activities and general administration of sub-awards. Michele Casella (full-time NSF EPSCoR Research Administrator) coordinates education outreach programs, and statewide student solicitations, and works with faculty to increase diversity for project components. Mirna Mejia, full-time Diversity Coordinator, and full-time Communications Specialist, Martha Delgado, are responsible for information and updates for the Web developer, designs brochures for specific projects, works with the NSHE PR office for all press media relations, and works with the campus PR staff to incorporate NSF EPSCoR highlights for

faculty, staff, and students. NSHE has video conferencing facilities that also allow file sharing and display of software presentations simultaneously between parties remotely located. Jurisdictional support for the individual project components include:

Climate Modeling Component: The Climate Modeling component has six faculty members (three at DRI, two at UNR and one at UNLV) participating in the climate modeling research efforts. In addition to the computational equipment purchased as part of this RII project, each of these individuals' institutions provides computational infrastructure and software expertise that is available to RII. In addition, DRI maintains the high performance computing cluster, and network access to this cluster.

Ecological Change Component: The department of Geography recently gained a new research laboratory to support Dr. Tom Albright's research (Dr. Albright was hired with NSF EPSCoR Track 1 funds in year three of the project). In addition, the department hosts laboratories for dendrochronology (DendroLab) and for palynology (also used for packrat midden studies) together with the State Climate Office and a computer laboratory for Geographic Information Science with 24 networked PCs. The computer laboratory runs ESRI software under a system-wide license. The DendroLab is fully prepared for field sampling, specimen preparation and preservation, tree-ring measuring, and data processing. Analytical equipment consists of digital image analysis systems, tree-ring measuring devices, microtomes, stereo-zoom binocular and compound microscopes, and extraction lines for stable isotope analysis. Field sampling gear includes a dedicated Toyota four-wheel drive truck, Trimble GeoExplorer3 Geographic Positioning Systems, lower-end GPS units, and tree coring and measuring equipment. Advanced statistical and graphical analyses are performed using programs running on DendroLab computers or the UNR Citrix server. Additional campus facilities most relevant to the project are the NOAA funded Western Regional Climate Center (WRCC) and the Nevada Bureau of Mines and Geology (NBMG). WRCC is located at the Desert Research Institute in Reno, and acts as a repository of historical weather and climate data for the western United States. WRCC has extensive links to the research and applications community on climate behavior and its impacts throughout the mountainous West. NBMG, which includes a new Great Basin Science Sample and Records Library, is a research and public service unit of the University of Nevada and is the state geological survey. NBMG scientists conduct research and publish reports on mineral resources, engineering geology, environmental geology, hydrogeology, and geologic mapping.

Water Resources Component: Specific resources available to Track 1 program include networking connections to NevCAN, NevCAN data being archived on the Nevada Climate Change Portal, and component member participation and support in the Data Portal Task Force. This task force is providing input to the Cyberinfrastructure component on data portal enhancements and interface with NevCAN data.

Policy, Decision Making and Outreach Component: UNLV has provided space in the Science and Engineering Building for the GIS and Remote Sensing Laboratory. The Assistant Director (Zhongwei Lui) of this lab 50% is supported through EPSCoR. This is a collaboration with the Harry Reid Center for Environmental Studies at UNLV.

Cyberinfrastructure Component: Support for the NV Climate Change Data Portal has been received from the UNR Research Grid, where our group's data portal servers, storage units and compute nodes are stored. Support from this facility includes setting up the network and the system for us to use, as well as providing storage and basic administrative services for data portal's servers, storage units, and compute nodes. An agreement has been worked out with the UNR Seismology Department, which will support our project through their existing network infrastructure. The CI group has continued to leverage previously-purchased hardware and shared facilities to support its development efforts. Utilizing and extending the UNR Nevada Seismology Laboratory TCP/IP network has simplified the collection of data logger data and web camera imagery, providing a managed, reliable network for communication. This collected data is made available using the high-speed connectivity afforded to UNR by the CENIC, NEON, and Internet2 networks.

Servers continue to be located in temperature-controlled rooms across campus. Specifically, primary storage and virtualization servers are located in the "Fish Bowl" server room on the southern end of the UNR campus, while computing nodes and backup storage are kept in the "Central Services" server room on the northern end of the UNR campus. The only required hardware purchases have been replacement UPS components to ensure data validity and tolerance of power failures.

In addition, leveraging existing agreements between UNR and Microsoft, important pieces of software were acquired at no cost to the project, specifically: (a) Microsoft Windows Server 2008 – Web Server, Datacenter Edition, (b) Microsoft SQL Server 2008–Enterprise, (c) Expression Studio, and (d) Visual Studio. Other minor pieces of software purchased include an SSL certificate and software development tools from Telerik.

Computer facilities in UNR's Department of Computer Science and UNLV's Department of Electrical and Computer Engineering are made available to the project participants. In addition, the College of Engineering at UNR provides office space for project faculty, graduate students, and the two administrative faculty (computer specialists) that were hired in fall 2009 to develop and build the data portal and software frameworks.

Education Component: UNLV provides large office that is shared by the Policy and Outreach and Education Components. This space is large enough to support several graduate fellows, and a post-doctoral scholar, along with their research equipment, computers, copier, printer, a plotter and other resources. The space is also equipped as a tech classroom, and will be used to develop curricular materials and carry out educational workshops.

SBIR: The Nevada SBIR Program is housed within the facilities of the Nevada Small Business Development Center and its satellite offices. Information about SBIR is provided to many clients of Nevada Small Business Development Center through NSBDC, SCORE counselors and others.

E. Planning Updates.

The project's Strategic Plan was revisited by team members and updated on December 31, 2011 and can be found at: <http://epscorspo.nevada.edu/nsf/climate1/library.html>. The project is on track to meeting the goals and milestones outlined in the updated plan.

There were no updates to the State Science and Technology Plan in year four. The plan can be found at: <http://epscorspo.nevada.edu/docs/nevadascience.pdf>.

F. Unobligated Funds.

Of the \$12,000,000 budgeted for years 1-4 of the project, \$11,915,811 was obligated as of May 31, 2012. Therefore, \$84,189 of year 4 funds are unobligated, or 2.8% of the \$3,000,000 Year 4 budget. The unobligated funds are held at the Prime, NSHE, for travel and other operating expenses.

G. Strategic Plan Progress.

Please see E. above.

H. Jurisdiction Specific Terms and Conditions.

Nevada's Track 1 project has two jurisdiction specific terms and conditions (JSTCs), 7.1.a and 7.1.b. They are addressed separately below by the project's components.

Jurisdiction Specific Terms and Conditions 7.1.a. The annual and final reports must specially report on the impacts of climate change on the water supply of Nevada's rural areas.

Climate Modeling Component: Although the ISP research that the Climate Modeling component is participating on is primarily focused on urban water supply projections, the results of this effort will also provide insights on the potential impact of climate change on rural water supplies.

Ecological Change Component: A proposal was by Ecology component lead Franco Biondi and PhD student and project research scientist Scotty Strachan to the NSF Geography and Spatial Sciences program entitled "Refinement of historical variability and the baseline for hydroclimatic conditions within the Walker Basin, Nevada/California". If funded, this proposal will contribute significant new data on the fluctuations in past water supply to rural western Nevada.

Water Resources Component: The Snake Range environmental transect (part of NevCAN) is providing data critical to our understanding how climate variability and change impacts the hydrological cycle within this arid region. During this past year runoff collectors were installed at all sites compatible with the method used and drainage sensors were installed at the western Snake transect stations. Drainage sensors will enhance our understanding of the relationship between precipitation and groundwater recharge to rural Nevada basins. Permits submitted by the Southern Nevada Water Authority for groundwater extraction in several of these basins are currently pending.

Policy Component: In addition to the video (mentioned earlier in the report) documenting efforts by the Policy Component in rural areas, a paper was published in Risk Analysis on perceptions of ranchers and farmers in rural areas of Nevada on Climate Change.

Cyberinfrastructure Component: The work being performed by the CI component does not directly relate to an assessment of climate change impacts on rural water supplies. However, the data portal that has been developed by this component serves as an archive for NevCAN monitoring data, which already contains over 385 million data points, and will soon archive

results from regional climate modeling that will aid in the development of hydrological models for rural Nevada areas.

Two of the 2010 seed grants awarded concern rural areas of Nevada. These include studies to evaluate the vulnerability of Pyramid Lake Paiute Indian Water Rights under climate change scenarios and to assess the range of interannual variation in vegetation as a function of climate variability.

Jurisdiction Specific Terms and Conditions 7.1.b. The annual and final reports must document progress on efforts to leverage engagement with organizations at the national level on initiatives in hydrologic modeling, climate change modeling and cyberinfrastructure for data management and interoperability.

The *Climate Modeling component* is actively collaborating with other CUASHI members on downscaled regional climate models. This group continues its engagement with NCAR and Scripps Institute of Oceanography in several areas of hydroclimatology, including coupling of climate predictions with hydrological models and predictions of water resources in Nevada and the western USA.

The *Water and Ecology components'* environmental transect is entered in the Critical Zone Exploration Network (CZEN; <http://www.czen.org>), which is mainly supported by NSF and includes the Critical Zone Observatories (CZOs) that have recently been established in the western USA. We have registered NevCAN with the CUASHI HIS and are providing data to Mesowest to improve National Weather Service forecast models in Nevada, where the number of monitoring stations are limited.

Members of *Cyberinfrastructure, Water and Ecology components* will be hosting a workshop about the Nevada Climate Change Portal (NCCP) and the Nevada Climate-ecohydrological Assessment Network (NevCAN) at the 2012 Biennial Science Meeting that will be held July 14-19 in Boulder CO. A workshop on CUASHI's Hydrologic Information System (HIS) program was taught to a group of faculty, staff and students from NV, ID and NM during Tri-State Consortium Meeting in New Mexico in April 2011.

I. Reverse Site Visit (RSV) Recommendations.

Nevada's year four NSF Reverse Site visit (RSV) occurred just prior to the start of year four, on August 12, 2012. Nevada provided NSF with detailed responses to all the RSV recommendations. In the time since the RSV, team members have been implementing the recommendations made by the RSV panel. Following is a brief response to each recommendation.

Recommendation 1. The project should develop a plan for salient data products for rural stakeholders as per their previous needs assessment.

Following are some specific examples of current and future interactions with rural stakeholders by our project.

- The Policy, Decision Making and Outreach Component studied two of Nevada's rural Native American tribes (Summit Lake Paiute and Pyramid Lake Paiute Tribes), as well as tribal environmental managers across the State. Investigations involving these tribes and their perceptions, policy preferences, and observations regarding climate change,

as well their natural resource management regimes and cultural practices, have resulted in proposals for joint research and outreach on the sustainability of lake levels and trout populations in the context of climate change.

- The Climate Modeling group at DRI is providing dynamically and statistically downscaled climate model output for a range of future scenarios for use in hydrologic models for rural watersheds in western and central Nevada. These models will be used in water resource planning by the Bureau of Reclamation, the Department of Energy, and regional and local water providers.
- The project's Interdisciplinary Science Project "Effects of climate change on spring ecosystem hydroecology as a guide to developing alternative water policies" has shown from analyses of paleoecological data that sufficient water may be available to expand urban and agricultural land uses in rural northeastern Nevada.

Recommendation 2. Nevada EPSCoR should leverage and adopt/adapt more Tri-State Consortium CI activities. In addition, links to NEON and CZO sites and their impacts should be made more explicit in annual reports.

Nevada greatly values and benefits from our Tri-State Consortium collaborations, and our engagement with the Tri-State Consortium may not have been apparent during the Reverse Site Visit session since we did not present this information explicitly. Below we summarize how Nevada EPSCoR is fully engaged and integrated with all Tri-State Consortium CI activities via five main mechanisms.

- Nevada is a full partner in the Tri-State CI Working Group
- Nevada is a full partner in the Tri-State data and software interoperability efforts
- Nevada is a full partner in the Tri-State Cyberlearning efforts
- Nevada is a full partner in the Tri-State Connectivity efforts
- The lead PI for the Tri-state Consortium Track 2 award is Dr. Gayle Dana, Nevada's NSF EPSCoR Project Director

In addition, links to NEON and CZO sites and their impacts should be made more explicit in annual reports.

These links have been made explicit in this annual report.

Recommendation 3. The project team should create and implement a plan that integrates the Nevada Observatory data with the ecology, groundwater, surface water and policy issues of the region. The plan should include appropriate modeling of the systems, including the coupling among the component processes. Appropriate consideration should also be given to the utilization of observatories in the California Sierras (feeding the Tahoe Basin and the Walker River) as well as the Colorado River Basin (feeding Lake Mead) to fully enable evaluation of the hydroclimatic future of the state/region.

Nevada is addressing this recommendation through the project's two Integrated Science Project.

Recommendation 4. CI sustainability must be part of the Sustainability Plan, and the project leadership should revisit the dependence on graduate students for

software development as well as further develop integration with NV university computer science departments.

The CI project component doesn't rely on graduate students for professional software development. For professional software development purposes we rely on two full-time software developers, Mike McMahon and Eric Fritzing (both working at UNR full-time on the CI component at UNR since October 2009), who are in charge of all Nevada Climate Change Portal (NCCP) and related software tools' design, development, testing, and operation.

Recommendation 5. Sensor network evolution should strongly consider a move towards a more open system providing service-based access (with the option of real-time access to promote use of the data) both to the network and via the portal using a standards-based approach.

We have already moved in that direction, with plans to implement a number of features that supply service-oriented data in years 4 and 5 of the project. Our plans for the portal are to expose our data using standard access methods such as SOAP and REST.

Recommendation 6. For robust and diverse stakeholder engagement, use cases need to be developed in a well-articulated and consistent manner, especially to drive data product generation and CI development.

Through the development of the Nevada Climate Change Portal, a significant effort is currently taking place to develop data products that are consistent for stakeholder engagement. To further address this, Dr. Lynn Fenstermaker has been appointed Stakeholder Engagement Coordinator; she will be working quarter time on this between now and the end of the project. Additionally, the Urban Water Integrative Science Project will be developing specific data products in terms of downscaled climate output for stakeholders to use. This downscaled data will also be integrated into water system models.

Recommendation 7. Robust metrics for data product access and use need to be established and evaluated based on the value obtained by a wide range of users.

We already capture raw anonymous access information, which is simple, but useful. Such information consists of IP address, browser type, browser capabilities, and specific resources accessed. In year 4 we will also capture other metrics, including size and type of data downloaded, time periods and locations (sites) of the data downloaded, and time taken to download the datasets. Furthermore, the functionality and usability of the Nevada Climate Change Portal and the data downloaded therefrom will be evaluated using a voluntary online survey developed by Lisa Kohne (project external evaluator) in collaboration with the CI groups from the Tri-State Cyberinfrastructure Consortium of Nevada, Idaho, and New Mexico.

Recommendation 8. Elements of the new CI management plan, including more detail on management and development, should be added to the strategic plan.

The CI plan was revised and updated in October 2011, and again in March 2012, and key elements of its detailed management and development activities have been included in the project's strategic plan.

Recommendation 9. Additional application implementations of "Losing the Lake" type should be pursued, as should connections with New Mexico researchers working on similar toolboxes.

The Losing the Lake project has been well accepted and is in the process of being implemented in public places. It is an educational tool designed to inform the general public and kids about climate change and water issues of the region. As part of the Urban Water ISP, an additional tool is being developed that is more sophisticated and meant for direct interaction with stakeholder and decision makers. We have connected with New Mexico researchers who are in the early stages of developing toolboxes related to water resources and climate (Lorie Liebrock and New Mexico Tech). We will share results with New Mexico as the Nevada ISP toolbox development progresses over years 4 and 5 of the project.

Recommendation 10. The design of the Summer Institute for teachers should be revisited to explore a shorter time commitment, as well as the involvement of alums as liaisons or ambassadors to other teachers.

The Summer Institute program leaders conducted an evaluation of the program and results were analyzed and reported by the external evaluator in her Year 3, Quarter 4 report to the project. Summer institute teacher participants completed three pre/post surveys: Summer institute evaluation form, self-efficacy skills and knowledge assessment, and a content knowledge test. All program components were rated *good* to *excellent* and statistically significant gains were noted in all areas on all assessments. The evaluator did not recommend that the 10-day summer institute be shortened because teachers did not indicate that the institute was too long or that there was any wasted time or days. The evaluator felt the involvement of alumni as liaisons or ambassadors to other teachers is a worthy recommendation as long as alumni participants are in addition to the seven teachers per site. The evaluator feels alumni should not use any of the seven teacher positions allocated to each site.

Recommendation 11. The Community College Faculty Fellowship program should also be revisited for ways of increasing the numbers of faculty served.

In our original proposal we allocated funds to support two Community College Faculty Fellowships per year. Since project funds are fully allocated over the remaining two years of the project, we do not have the resources to increase the numbers of fellows per year. However, what we can try and do is diversify the faculty that we do fund. We implemented a number of mechanisms in year four targeted at this effort.

Recommendation 12. Given the changes in external evaluation that have occurred, the assessment plan should be revised to reflect process and outcomes components. These should also cover the outreach and education components of the project as a way of identifying steps that limit the achievement of the outcomes of project initiatives and activities. The plan should also identify an internal evaluator who focuses on assessing activities and collecting detailed reporting data.

In year 4 the external evaluator revised the assessment plan by incorporating process and outcome evaluation strategies and metrics for all outreach and education components.

Recommendation 13. The EPSCoR Management should create mechanisms to ensure that the data are being made available in useful formats to a broad spectrum of stakeholders, both in terms of their agency use as well as with the potential for garnering sustained partnerships.

The Stakeholder Engagement Coordinator will be working quarter time on this between now and the end of the project. Additionally, the Urban Water Integrative Science Project will be developing specific data products in terms of downscaled climate output for stakeholders to use.

Recommendation 14. A mechanism should be created for determining the effectiveness of support systems such as the technical writing assistance, mentoring and Seed Grant programs, as a way of building the case for sustainability beyond EPSCoR funding.

The project's external evaluator currently works with the leaders of all Nevada EPSCoR programs and has developed evaluation instruments and metrics to assess process and outcome components. The following programs are currently being conducted and evaluated:

- Seed Grant programs
- Climate Change Seminar Series
- Community college faculty summer fellowships
- Innovation Working Groups
- Summer Institute for Middle School Teachers
- Undergraduate Research Opportunity Program
- Technical Writing Assistance Service
- Online CC course for Middle School Teachers
- Annual Nevada Undergraduate Research Symposium
- Annual NV Climate Change Conference
- Curriculum Development Programs
- Climate Change Portal development and implementation

Recommendation 15. The Management Team should be proactive in their outreach to educational stakeholders such as the State Board of Education and Colleges of Education. The involvement of members of these groups on the advisory committee might provide some useful strategies, including faculty from Colleges of Education on other committees.

Our Summer Institute instructors work very closely with at least two Colleges of Education. Larry Rudd is on the education faculty at Nevada State College School of Education in Henderson (Las Vegas), and Jacque Ewing-Taylor is Director of the Raggio Research Center for STEM Education in the College of Education at UNR. Our Las Vegas EPSCoR Education component member (Paul Buck) works closely with Clark County School District, especially the K-12 science coordinator for the district, and the Reno EPSCoR Education component member (Ewing-Taylor) works closely with Washoe County School District and the district's science coordinator. Both Ewing-Taylor and Buck also work closely with the State Department of Education, especially Dr. Richard Vineyard who is the science consultant. Additionally, Ewing-Taylor is on the Nevada Department of Education's STEM initiative project.

Recommendation 16. The project Strategic Plan should be updated.

The project Strategic Plan was updated in May 2011, and again in December 2011.

Recommendation 17. Reasons for, and implications of, changes in the Strategic Plan should be described in the annual reports.

The reasons and implications for changes in the Strategic Plan are included in the Strategic Plan updates, which have been reviewed by our Cognizant NSF Program Director.

J. Experimental/Computational Facilities.

The *Climate Modeling component* continues to use the high-performance computer system (Computer Cluster) purchased with project funds in previous years. This cluster consists of 640 cores of high-performance processing power arranged in units of AMD Opteron 2384 quad-core processors with 16GB of memory, and one 146GB disk drive. The storage system consists of an X4540 Storage Server with forty-eight 1TB disk drives (48TB), and five J4400 Storage Arrays with each array consisting of twenty-four 1TB disk drives. Although physically located at DRI (Reno), the cluster is available to all NSHE faculty and is currently being used by Dr. Yu (UNLV) for hydrologic modeling.

Water and Ecology Components: All NevCAN monitoring stations were completed in early Fall 2011, including the Great Basin National Park Subalpine station, with the exception of the Sheep Subalpine station, which is being installed in early September 2012. Real time communication networks were completed in Fall 2012. In addition, other sensors will be added in summer 2012 to enhance the NevCAN sensor by providing three-dimensional temperature monitoring and a better assessment of precipitation distribution between stations. Facilities at DRI, UNLV, and UNR have been used to test the field sensors before deployment. Data transmission is mainly through the TCP/IP network operated by the Nevada Seismological Laboratory and (in the case of the northern site in the Snake Range) routed through Great Basin College, part of the NSHE system. Access to the transects for field study is open to all scientists within the NSHE system, as well as those outside pending communication with and approval from the leadership team. Dr. Albright's team is using NSF-EPSCoR resources to augment the NevCAN with thermochron iButton temperature sensors in order to understand local variations in lapse rate, temperature ranges, and the occurrence of cold air drainage in topographically complex terrain. Dale Devitt augmented the NevCAN with a set of sensors to measure cold air drainage between tower stations at the southern transect site in the Sheep Range.

During year four, the *Cyberinfrastructure Component* utilized previously purchased equipment to support the NCCP and significantly benefited from the Nevada Seismological Laboratory (NSL) network backbone that is providing real-time communication with several of the NevCAN monitoring stations. The NSL real-time communications has been provided to the project at no additional cost other than some initial hardware purchases that enabled the NSL backbone to accommodate the significant increase in data flow from the NevCAN stations, i.e., there are no usage fees. Some hardware upgrades and additions will be performed during summer 2012, before the end of year 4. In particular, network upgrades are planned to increase bandwidth and build capacity for future growth. Component members are currently evaluating whether to purchase Infiniband or 10-gigabit Ethernet network cards and switches. New storage servers will also be purchased to enhance future

storage capacity needs. Although the CI team will continue to have exclusive access to all NCCP hardware components, the NCCP is accessible by all project members for project communication, education and data storage. The portal is fully accessible to the general public, including access to all data archived on the system at no cost.

The Education Component and the Policy Components continue to use the Climate Change Policy, Outreach, and Education Lab, purchased with project funds in previous years. The Lab is housed at 3214 Greenspun Hall on the UNLV Campus. This facility houses four graduate students and two post-doctoral scholars supported by NSF-EPSCoR, and will continue to be available for projects with other funding.

K. Publications.

Project members were published in 17 journal articles and 14 books or other one-time publications in year four (as of April 2012).

Journal Publications:

Biondi, F., Jamieson, L., **Strachan, S.**, Sibold, J., Dendroecological testing of the pyroclimatic hypothesis in the central Great Basin, Nevada, USA, *Ecosphere*, 2011, art5, 20 pp., 2(1), DOI:10.1890/ES10-00068.1. Published.

Biondi, F., **Strachan, S.**, The Nevada NSF-EPSCoR Instrumented Transects: A Tool for Mountain-to-Valley Ecohydrology, *Mountain Views*, 2011, 2-4, 5(1). Published.

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Culbert, PD, VC Radeloff, V St-Louis, CH Flather, CD Rittenhouse, **TP Albright**, & AM Pidgeon, Modeling broad-scale patterns of avian species richness across the Midwestern United States with measures of satellite image texture, *Remote Sensing of Environment*, 2012, 140-150, 118, DOI:10.1016/j.rse.2011.11.004. Published.

Kauneckis, D. , Tosun, M. S., Examining the theoretical linkages between climate change, food security and migration, *Border-Lines: Food Security and International Migration*, 2011, 69-89, 5. Published.

Kleppe, J. A., Brothers, D. S., Kent, G., **Biondi, F.**, Jensen, S. E., Driscoll, N., Duration and severity of Medieval drought in the Lake Tahoe Basin, *Quaternary Science Reviews*, 2011, 3269-3279, 30(23-24). Published.

Lamb, K.W., **Piechota, T.C.**, Aziz, O.A., Toottle, G.A., A Basis For Extending Long-Term Streamflow Forecasts In The Colorado River Basin, *Journal of Hydrologic Engineering*, 2011, 1000-1008, 16, DOI: 10.1061/(ASCE)HE.1943-5584.0000153. Published.

Li, Z, Q Dong, **TP Albright**, & QF Guo, Natural and human dimensions of a quasi-wild species: The case of kudzu, *Biological Invasions*, 2011, 2167-2179, 13, DOI:10.1007/s10530-011-0042-7. Published.

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L. Honors and Awards.

The following awards and honors were given to RII participants in year four:

- Dr. Franco Biondi (Ecology Component Lead) received the Fulbright Senior Specialist Award.

- Dr. Laurel Saito (Water Component Steering Committee Member) has been invited to serve on the Independent Science Advisory Board for the Columbia River Basin. This will provide an opportunity to share information and expand her knowledge of hydrological issues in other regions.
- Ahmad Safi (Policy Ph.D. student) received the 2011 *Risk Policy and Law Student Merit Award* from the Society for Risk Analysis. The award is based on his dissertation and is titled “Nevada Ranchers and Farmers: Perceived Risks of the Impacts of Climate Change.”
- Dr. Derek Kauneckis received the 2012 *Outstanding Undergraduate Research Faculty Mentor Award*, University of Nevada, Reno.
- Dr. Frederick C. Harris, Jr. (CI Component) received a professional acknowledgement- ACM Senior Member (since Fall 2011);
- Dr. Shahram Latifi (CI Component, UNLV) and Ershad Sharifahmadian (PhD student & GRA, UNLV) received a Travel Grant from National Aeronautics and Space Administration (NASA), 2012, awarded to increase collaboration between UNLV and NASA. Travel consisted of visits to NASA Johnson Space Center, NASA Ames, and NASA JPL.
- Dr. Sergiu Dascalu (CI Component Lead) was nominated for the Nevada Regents’ Teacher Award 2012 (did not receive the award).

III.Highlights

Highlight Number 1

Native American Tribes Address Climate Change

Outcome: Nevada’s Policy team built relationships with researchers and Native American tribes in rural Nevada who are vulnerable to climate change impacts. These Native American tribes have witnessed climate change impact the natural resources they depend on. Therefore, the Policy team worked to create collaborations between Native American tribes and stakeholders to develop future mitigation and policy strategies.



“Without a deep mutual understanding among stakeholders, Nevada will never come to grips with climate change mitigation and adaptation.” - Dr. Bill Smith (UNLV)

Impact: Efforts were documented in the video, “Nevada’s Native American Tribes and Climate Change,” to educate the general public, educators, and policymakers. Visit <http://epscorspo.nevada.edu/native-american-indian-video/> to find the link to this documentary film. A Spanish version of this video was broadcast over TV and Internet to further outreach and educate the public. Since its debut on YouTube earlier this year, the video has been viewed over 1,000 times in more than 30 countries.

Explanation: Misconceptions about tribal life makes it difficult to collaborate and maintain resource management. The efforts by the Policy team provided a planning process to assess and monitor the impact of climate change to the Native Tribes. The creation of a video to document this historical collaboration will be used for educational purposes at local, national and international conferences on climate change.



PhD candidate Ahmad Safi (UNLV), presenting to the Tribal Council of the Summit Lake Piute Tribe in Nevada.

“There are no bad guys. Every stakeholder has a legitimate need and want and it is very difficult within the framework of water policies to meet all of those needs.” - Kiersten Wild -Bustos (she completed an M.S. degree in December as a result of her work with this project).

Authors: W.J. Smith, Jr.¹, Karletta Chief², Ahmad Safi¹, Zhongwei Liu¹, Mahesh Gautam² (University of Nevada, Las Vegas¹, Desert Research Institute²)

Highlight Number 2

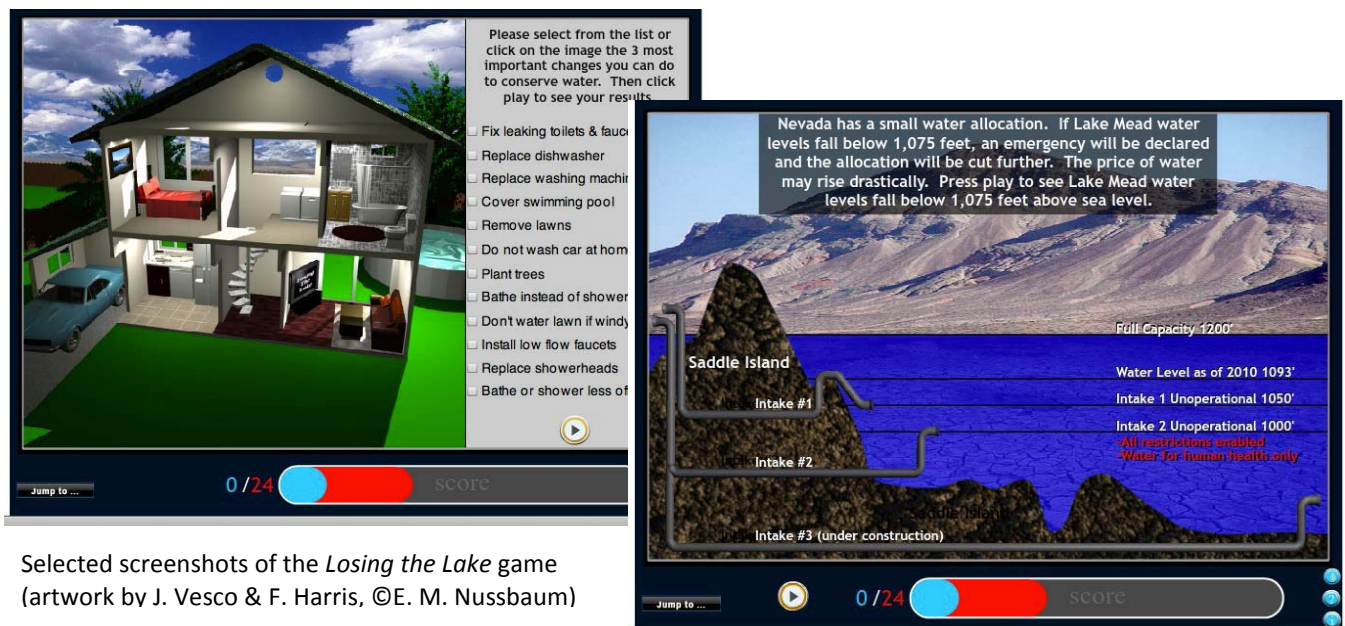
Virtual Game Technology Improves Understanding of Climate Change Impacts on Lake Mead, NV

Outcome: An educational computer game was created and pilot tested for teaching middle and high school students, as well as the general public about the reasons Lake Mead water levels are dwindling. The game explores the serious implications for the region's water supply, the contributions of climate change, and possible solutions.

Impact: The game has been installed in the Las Vegas Natural History Museum and will be installed at the Alan Bible Visitor Center at Lake Mead. These sites are visited annually by thousands of patrons. The game has been field tested at three middle schools and is now available on the web for other schools to use.

http://www.cse.unr.edu/~fredh/LosingTheLake/LosingTheLake_V2.swf

Explanation: Climate change has a direct impact on the low levels of water in Lake Mead. To measure and assess how much change is occurring and the impact these changes will have on Lake Mead as a water resource, this virtual game takes scenarios of current water levels and provides data to assess what can happen in the future from various conservation options. It is a tool for science education in an easy-to-use interactive platform that the public will understand.



Selected screenshots of the *Losing the Lake* game (artwork by J. Vesco & F. Harris, ©E. M. Nussbaum)

Authors: E. M. Nussbaum, G. M. Sinatra, S. Ahmad, and M.C. Owens, University of Nevada, Las Vegas; F. Harris, S. Dascalu, and J. Vesco; University of Nevada, Reno

Highlight Number 3

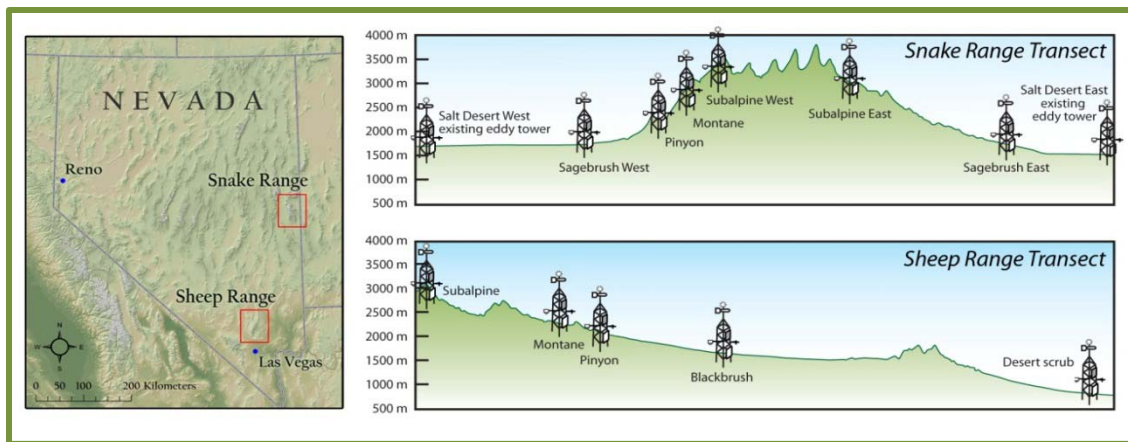
A Powerhouse of Climate Change Data - NevCAN

Outcome: The Nevada Climate-ecohydrological Assessment Network (NevCAN), located at sites along two elevation gradients, is now acquiring and archiving data from sensors measuring environmental parameters including air temperature, precipitation, wind speed and direction, solar radiation (net and PAR), relative humidity, soil moisture and temperature, runoff* and plant water use* and growth*. A webcam provides information on phenology, snow depth and general conditions at each site. Data are transmitted to the Nevada Climate Change Portal: <http://sensor.nevada.edu/NCCP/Default.aspx>.

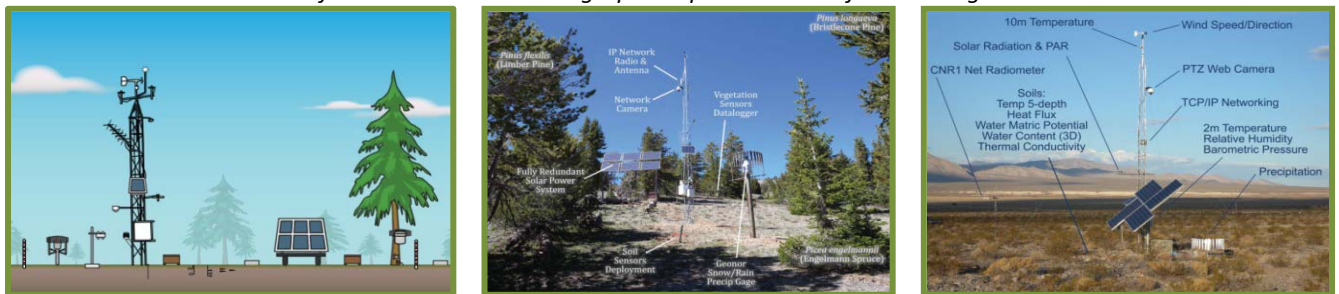
(* These sensors are only installed at a subset of sites where conditions meet method thresholds and for key tree species.)

Impact: NevCAN is a unique network acquiring data within key vegetation zones from valley to mountain top in the Great Basin and northern Mojave Deserts. It fills a monitoring void by providing real-time climate, soil and plant data for this region, particularly at higher altitudes where snow plays an important role in groundwater recharge.

Explanation: NevCAN data are providing researchers with the first ever ability to assess the impact of climate variability and change along elevation gradients within the most arid regions of the U.S. The resulting data will also allow teachers to educate students and the public about the impact of climate variability on key variables such as precipitation and temperature, and how this effects water availability and ecosystem function within this dry region.



Location of NevCAN transects and graphic representation of elevation gradients



Typical sensor deployment (left) at the Snake Range Subalpine West site (center) & the Sheep Range Desert Shrub site (right)

Authors: L. Fenstermaker¹, F. Biondi², D. Devitt³, J. Arnone¹, L. Saito², S. Strachan², B. Bird³, B. Lyles¹, G. McCurdy¹ and R. Jasoni¹ (¹Desert Research Institute, ²University of Nevada, Reno and ³University of Nevada, Las Vegas)

Highlight Number 4

Trees and the Water Cycle: How Climate Change Could Impact Transpiration and Groundwater Recharge in the Great Basin

Outcome: Data recorded from the Nevada Climate-ecohydrology Assessment Network indicated that air and soil temperature strongly modulated patterns of transpiration especially in the spring (Figure 1). Incoming radiation determined the daily periods, but not magnitude of active transpiration. Declines in topsoil (0-30 cm) volumetric water content during the growing season by >20% appeared to have no effect on sap flow, which suggests that soil water availability did not limit water uptake.

Impacts: If the timing and extremity of air and soil temperature patterns are shifted with changes in climate, transpiration patterns could be altered which would influence the amount of water available for groundwater recharge and human use.

Explanation: Transpiration, the process by which water that is absorbed through plant roots is evaporated from plant leaves, is an important part of the water cycle in mountain ecosystems. These ecosystems contain “recharge” zones beneath the rooted soil layer where water can flow into the groundwater system, which is then available for naturally occurring vegetation, agriculture and human consumption. If climate change causes trees to transpire more water from the soil layer, less water may flow into the groundwater system. This study is developing a quantitative understanding of the response of transpiration, as measured through sap flow (Figure 2), to environmental factors including air and soil temperature, incoming photosynthetically active radiation, vapor pressure, and soil moisture. Comprehending the interaction between these factors will help determine which factors most influence transpiration rates and how rates may be affected by shifts in these factors under anthropogenic climate change.

Authors: Brittany G. Johnson^{1,2}, Richard L. Jasoni¹ and John A. Arnone III¹ (Desert Research Institute¹ and University of Nevada, Reno²)

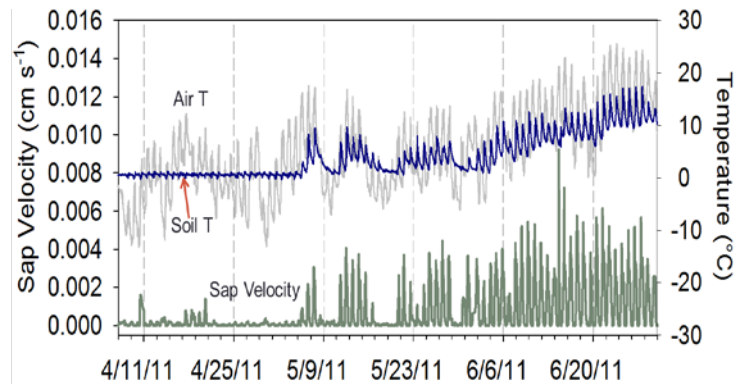


Figure 1: Sap velocity (measure of transpiration; green line), soil (blue line) and air temperature (gray line) for White Fir during the growing season.



Figure 2: Sap flow probe.

Highlight Number 5

Graduate Assistant's Research Leads to New Visualization Capabilities for 3D Environment – Sohei Okamoto

Outcome: In December 2012, the first graduate research assistant hired in the Cyberinfrastructure group, Sohei Okamoto, received a PhD degree in Computer Science and Engineering from the University of Nevada, Reno. His dissertation, entitled “SUNPRISM: A Software Framework for Climate Change Research,” was based on work done as Research Assistant for the project.

Impact: Sohei's research has led to a new software framework that provides a visual, user-friendly object-based interface for scenario configuration; a software engineering solution that allows code generation and dataflow scenario execution; and data visualization capabilities for 3D environments. These capabilities include immersive virtual environments such as CAVE (CAVE automatic virtual environment). For more information about the Desert Research Institute's CAVE project, visit: <http://www.dri.edu/cavcam-facilities>

Explanation: Currently, Sohei works as a postdoctoral scholar in the Computer Science and Engineering Department, contributing to the research and development of the Cyberinfrastructure group's advancements. Based on Sohei's work, two new conference papers have been accepted for publication and two journal articles are under preparation.



Sohei Okamoto in academic attire (photo by S. Dascalu)

Authors: Sergiu M. Dascalu and Frederick C. Harris, Jr., University of Nevada, Reno

Highlight Number 6

Understanding Regional Projections of Climate Change Scenarios

Outcome: Nevada Climate Modeling efforts are focused on the implementation and development of fine-scale datasets (“downscaling”), based on Global Climate Modeling products at spatial scales relevant to regional and local impact studies. Further efforts include contrasting and evaluating our products against observed data and other nationwide downscaling initiatives to quantify and understand uncertainty in climate change projections.

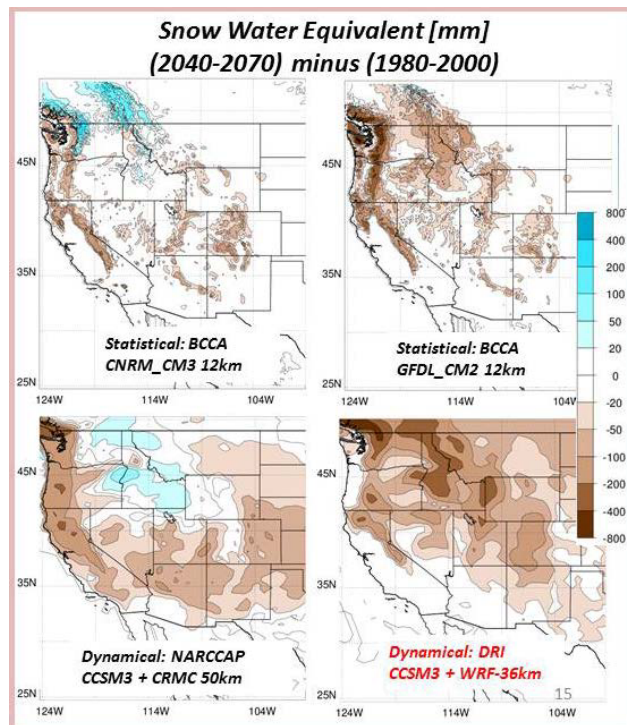
Impact:

The synthesis and interpretation of these results will increase understanding and provide information of value to decision-makers. Our emphasis has been to create the framework and to explore and explain future climate change signals in Nevada and the U.S. southwest intermountain region.

Explanation:

Despite using the same Global Climate Models, downscaling these data with different dynamically-based approaches can create substantial differences (see figure); which can also happen if using different downscaling approaches (e.g., statistically-based), or different Global Climate Models (e.g., CNRM, CCSM3, and GFDL). Recognizing and understanding these differences as part of the uncertainty evaluation process is crucial for climate change tendency and attribution assessment.

Authors: John F. Mejia, KC King, and Darko Koracin, Desert Research Institute-Reno and Nevada USGS, Carson City, Nevada



Snow Water Equivalent as a function of daily mean surface temperature and precipitation projections for different CMIP3 GCM output and downscaled using statistically-based and dynamically-based downscaling approaches.

IV. Appendices

- A. Appendix 1 – 2012 ERTAB Report with Nevada Response**
- B. Appendix 2 – Report Appendices**

Appendix 1 – 2012 ERTAB Report with Nevada Response

To: Gayle Dana, Director, Nevada NSF EPSCoR Program

From: Michael Campana; Fred Choobineh; Jim Coleman (Chair); Jim Gosz; Jeff Gray; Ruby Leung; Mark McCaffrey; Young-Doo Wang

Re: Comments from the site visit of the Nevada NSF EPSCoR External Research and Technical Advisory Board (ERTAB), February 13-14, 2012

Date: March 10, 2012

The Nevada NSF EPSCoR External Research and Technical Advisory Board (ERTAB) conducted a site visit and meeting at the University of Nevada, Las Vegas on February 14, 2012 to review the progress to date on Nevada's NSF EPSCoR cooperative agreement, "Nevada Infrastructure for Climate Change Science, Education and Outreach." Additionally, ERTAB members attended the State EPSCoR Climate Change meeting on February 13, 2012. Members present at the review meeting included Dr. Michael Campana, Dr. Fred Choobineh, Dr. James Coleman (Chair), Dr. Jeff Gray, Dr. Jim Gosz, and Mark McCaffrey. Dr. Young-Doo Wang and Dr. Ruby Leung were unable to make the meeting, but they provided significant input into this report. The agenda of the meeting consisted of presentations by the Nevada team on their EPSCoR program, including detailed reports of the progress made to date in the major focus areas of climate, water, ecology, cyberinfrastructure, policy and outreach, and education. We were also given an update of the progress made on interdisciplinary science projects (ISPs). ERTAB members were also given a tour of UNLV's new interdisciplinary science building and geospatial visualization laboratory. Several ERTAB members also attended a workshop on the EPSCoR developed data portal held on February 13, 2012.

The project is now about 70% through its five year funded period. ERTAB members are impressed with the progress made on the construction of transects, climate modeling, education activities, policy activities and the data portal. The infrastructure that the Nevada team has put in place could have a lasting impact on the research capacity of the state. The ISPs also have started strong and provide the kind of integrated science questions that the ERTAB was hoping would be a result of the evolution of the project.

The Nevada team has been responsive to a number of ERTAB recommendations as well as to the recommendations received from the NSF reverse site visit. In addition, the project team has adapted reasonably well to changes in personnel and leadership in the project. There was a great deal of enthusiasm among Nevada's participants at the climate change meeting on February 13, 2012 and we were impressed with several of the presentations, particularly by some of the EPSCoR supported graduate students.

There is a commitment by the program leadership to evolve the project in very positive ways and thus far many accomplishments have been made. However, the ERTAB members remain very concerned about the sustainability of the infrastructure beyond the award period. Our overall recommendations intentionally expresses a sense of urgency for the leadership of the EPSCoR program and for the leadership NSHE institutions to focus on optimizing/maximizing some important initiatives of the project (e.g., data portal; k-12 programs) and developing a clear strategy and plan to sustain the infrastructure created with the EPSCoR award.

Appendix 1 – 2012 ERTAB Report with Nevada Response

Our comments build upon comments from previous years, as well as reinforcing some comments made at the NSF reverse site visit in 2011, and focus on three main points: (1) Suggestions of elements that might help in the creation of a plan for sustaining the project after the EPSCoR award ends;(2) Importance of articulating a vision for how the infrastructure created in this project can provide a foundation for transforming the field of climate change science; (3) Potential for the data portal to be a signature element of infrastructure, supporting a wide range of stakeholders such as the national and international scientific community; local, state and federal agencies responsible for managing energy, water, land and other natural resources; policy makers; K-12 education and the general public; and (4) We also make a few additional comments and recommendations on the education and policy/outreach components.

The ERTAB members appreciated the detail that was presented to them on the various projects. Yet, our comments are not focused on details of research, education, and policy activities, but rather on more global issues that could maximize the long-term impact of this project on the State of Nevada and climate change science. These comments are meant as *suggestions* to the Nevada team on possible ways they can take maximum advantage of the time left in the cooperative agreement.

(1) Sustainability Planning

The ERTAB was disappointed that the Nevada team has made little progress on developing a strategy and a plan for sustaining the infrastructure that is being built with EPSCoR funds. We have a strong sense of urgency in our recommendation that developing a sustainability strategy and plan needs to be a priority for the leadership of Nevada EPSCoR, and the leadership of the NHSE institutions. During our discussion, the Nevada EPSCoR team asked ERTAB to make some suggestions as to elements that could be included in the sustainability plan and whether there were any particular good models to which we can direct them. The NSF EPSCoR office should be a good resource for identifying other EPSCoR projects where a strong sustainability plan was created and implemented.

Response:

Dr. Dana met with the NSF EPSCoR Office Head, Dr. Denise Barnes, in Arlington, VA on March 20th, 2012 and asked if she could recommend a good model for a sustainability plan. Dr. Barnes said there was no one plan she could recommend. She recommended looking into various approaches including writing new proposals, recharge centers, and marketing products resulting from the project.

Dr. Fenstermaker has spoken to a couple LTER Site Managers (Bonanza Creek, Sevilleta, and Niwot Ridge) about business, management and sustainability plans. In each case the Site Managers and/or their meteorological station managers stated that they do not have any plans of this type. Their common response was to ensure that there was continuous employment of a person who “knows what is going on” with field sensors is critical.

Appendix 1 – 2012 ERTAB Report with Nevada Response

Below we articulate a few ideas that we believe might help lead to a sustainability plan and strategy.

The sections that follow the discussion on “sustainability planning” -“transformational science” and “data portal” - contain several of our recommendations that could be considered in a sustainability strategy. But, in general, the key to sustainability is engaging stakeholders in a manner that highlights why the stakeholders need the infrastructure and how the infrastructure adds value to them.

1.1 Some general elements that might be helpful in creating a sustainability plan include:

- **Identify and prioritize key stakeholders** (e.g., state and local agencies; the broader scientific community) and identify the individuals in the stakeholder organizations that need to be targeted. The project has, in a largely *ad hoc* way, engaged with potential users but perhaps not in a robust dialogue process. The ERTAB feels that the failure to form a user needs task force is a significant oversight that may prove detrimental in the long run. Rather than “build it and hope they will come” (whether with ranchers, teachers, federal or state agencies, scientists, the interested public), the project must in the limited window of time remaining in the project aggressively, effectively and efficiently cast a wide net. While this will not necessarily be sufficient to guarantee success in finding financial support for the continuation of many project elements, it will identify important partners, collaborators, users and possibly funders;

Response:

The Project Management Team will identify a Stakeholder Engagement Coordinator to lead the process identifying, prioritizing and engaging key stakeholders. As part of the process, this Coordinator, in conjunction with the external evaluator, will survey key project members to identify and prioritize the key stakeholders (Spring 2012). Once the stakeholders are identified, a needs survey, with regards to Climate Change information and data, will be conducted (Summer 2012).

Additionally, we will build on the stakeholder connections individual project members have made with a subset of stakeholders. Some of these stakeholders include: Fish and Wildlife Service, Long Now Foundation, Southern Nevada Water Authority, Natural Resources Conservation Service, Great Basin National Park, Nevada Land Conservancy, Bureau of Land Management, Nevada Division of Water Resources and Truckee Meadows Water Authority.

Identify the likely reasons that those stakeholders will want to support continued functioning of the infrastructure. A key result of engaging stakeholders should be a clear understanding of how the EPSCoR infrastructure can be a strong value-added. One additional idea that was discussed by the ERTAB was to have a conference, held in Nevada, with the

Appendix 1 – 2012 ERTAB Report with Nevada Response

involvement of the Brookings Institute, focusing on the climate, water and energy nexus in the intermountain west and the relevance of related science to society could be a potential organizing principle. Whether it is a day-long event or something more ambitious, perhaps modeled after the tri-agency climate change conference, the conference might be best considered as a conversation or dialogue and less as a series of presentations and talks. While select keynote talks would be important, it is imperative that there would be plenty of time for networking and self selected breakout discussions. A specific outcome based on input from the workshop may include a vision document and/or proposal. The conference/conversation could be co-hosted at UNLV with Brookings, which has a facility with capacity to stream and archive the conference talks. Participants could potentially participate remotely through blogs of the breakout discussions, Skype or other video conferencing tools. Through the process of developing the conference and identifying potential participants, additional stakeholders might also be identified. These should include key, ideally high level leadership from agencies involved with the US Global Change Research Program including NOAA, NASA, NSF as well as EPA, and the Departments of Interior, Defense, and Energy. NEON and Western Governor's Association as well as Tri-state partners, and experts from the Western Water Assessment, intermountain, and other non-EPSCOR states (specifically California, Colorado, and Arizona) should be invited if not involved in the planning process. This is just one idea for a conference, but the key message from ERTAB is that Nevada be proactive in taking a leadership role in engaging key stakeholders in climate change science and its translation to resource management and policy.

Response:

The project PIs think these are good ideas have already had initial discussions on putting on such a workshop/conference. Since our project budget does not include funds for a larger national workshop/conference, one of the first steps was to determine how and where we can reallocate funds in the existing budget to accomplish this. The PD, in concert with the Project Administrator has identified areas where resources can be freed up to cover the costs of the workshop. The PD also spoke with our project's Program Office at NSF about submitting a Workshop Proposal to help with funding. The PO was enthusiastic about the concept and encouraged the PD to proceed with developing a proposal. Our Tri-State partners, ID and NM, have indicated they would like to participate.

While having the workshop sooner (e.g., fall 2012), rather than later, we think it would not be feasible to plan for a national workshop to occur in the fall 2012. Rather, we are currently thinking of putting on the national workshop during winter or spring 2013, which would take the place of the 2013 Annual State

Appendix 1 – 2012 ERTAB Report with Nevada Response

Climate Change Meeting, and the 2013 Annual Tri-State Consortium Meeting. The external evaluator will develop an evaluation form to assess implementation and achievement of goals and objectives of the workshop.

In the meantime, we are looking for other opportunities to showcase our infrastructure to targeted stakeholders. One such opportunity is 2012 CUAHSI Biennial Science Meeting and Workshops (<http://www.cuahsi.org/biennial2012.html>), which will take place July 16-20, 2012, in Boulder CO. This meeting, "Fusing Science and Solutions," seeks to foster dialogue on how to bridge gaps between research and practice, and how to best use environmental observatories in this effort. The organizers were enthusiastic about having us put on a half-day workshop in conjunction with the meeting. We submitted a proposal to conduct the workshop on Thursday, July 19th, 2012 entitled: "The NCCP and NevCAN: Infrastructure for Acquiring and Accessing Climate Change Research Data in Nevada". (<http://www.cuahsi.org/biennial2012/workshop-nev.html>)

- **Identify the individuals on the Nevada team that will have responsibility for engaging the key individuals in the stakeholder groups.** For example, this might be scientist to scientist, or the Nevada team might also need an institutional President to reach out to the CEO of one of the stakeholder organizations. In any case, the plan should lay out a strategy for how to effectively engage stakeholder groups. This plan should also include a strategic government and private sector relations effort. Most universities have a process and strategy for engaging federal and state government and agencies, as well as corporations, foundations and private NGOs that support research. NSHE, UNR, DRI, and UNLV should make sustaining the research infrastructure created with NSF EPSCoR a priority and should assist the EPSCoR leadership with engaging appropriate individuals in federal and state agencies, and individuals in the for-profit and not-for-profit private sector, who could benefit by the climate change science program.

Response:

As described above, the Stakeholder Engagement Coordinator and evaluator will survey project participants (scientists) to identify, prioritize stakeholders to engage, followed by contacting the stakeholders to conduct a needs survey. The Project Director and Institution CoPIs will identify the appropriate level of individuals within NSHE and UNLV, UNR, and DRI and enlist their help to engage stakeholders at the higher levels of the stakeholder organization.

- **Identify the time frame for when individuals will engage stakeholders and the time frame for follow up discussions.** The Project Director needs to ensure that timelines for follow-through are orchestrated and occur on schedule.

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Response:

The Project Director has tentatively identified the following timeline:

March – June 2012

- Appoint a Stakeholder Engagement Coordinator (SEC).
- The SEC will work with the external evaluator to survey project members to identify and prioritize stakeholders.
- The SEC will work with the Water and Ecology Component Leads, COPIs and external evaluator to survey Department Heads, Deans and/or VPRs at the three NSHE campuses to identify other disciplines (e.g. renewable energy) that would find the current transect data valuable. <Addresses 3.3 below>
- CO-PIs meet with appropriate NSHE individuals and entities regarding project sustainability and identify and prioritize stakeholders to contact.
- PD will contact appropriate project leads to initiate preparation of 10-year financial plans for each major piece of infrastructure.
- Start planning process for Winter 2013 National Workshop/Conference

July – August 2012

- Higher level NSHE individuals, CoPIs, project members contact stakeholders to determine stakeholder needs from Nevada's Climate Change Science program.
- From needs survey (stakeholders), prepare a "marketing plan" for promoting use of project infrastructure by specific stakeholders
- From relevance survey (disciplines), prepare a "marketing plan" for promoting use of project infrastructure (e.g., transect data) by specific disciplines <Addresses 3.3 below>
- Finalize financial plans for key pieces of infrastructure
- Finalize structure, session topics, key note speakers for 2013 National Workshop
- Start promoting 2013 Winter National Workshop

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- Implement marketing plan to stakeholders
- Implement marketing plan to researchers in identified disciplines
- Flesh out additional speakers/participants for 2013 National Workshop

April 2013

- Hold National Workshop
- **Identifies the kind of support that is reasonable and needed from the different stakeholders.** This may include developing a range of “proposals” that include grant proposals, gift proposals; contracts; menus of services that can be provided; etc.

Response:

This will be part of the marketing plan described above.

1.2 **Optimize appropriate activities in the existing EPSCoR grant so that they can be built upon in future EPSCoR grants.** The current EPSCoR grant is building a range of activities in addition to research in climate change science. Some of these activities include K-12 education and outreach; creating a data portal that can be used by a wide array of stakeholders; and partnerships with other proximal EPSCoR states. Although the next round of EPSCoR funding is unlikely to provide ongoing support for the climate change science infrastructure, there may be funding to build on other aspects such as the K-12 programs or the data portal. The Nevada team should focus some attention, for example, on how to shape the K-12 programs such that they are optimally effective and can be built upon in the next EPSCoR grant. Additionally, the data portal may very well be a strong component of the next research infrastructure plan as access to data by a wide range of stakeholders can be beneficial in building most research infrastructure. Thus, a key strategy is to make sure that programs that can be carried over into a new EPSCoR grant are evaluated and adjusted in a manner that makes them an obvious foundational component of the next grant.

Response:

Major aspects of the Data Portal have been selected to include in the next Track 1 proposal for Nevada. This will build on the portal’s capabilities, extend its applicability to other research in Nevada, and promote sustainability.

Dr. Mike Collopy has taken the lead on an education and outreach pre-proposal for the next Track 1 NSF EPSCoR proposal. A number of the faculty involved

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with this pre-proposal are currently involved with the Climate Change project education activities. The pre-proposal takes an “Integrated Life Cycle” approach and builds on some of the more successful aspects of the current project’s education and outreach activities.

Additionally, the external evaluator is continuing efforts to evaluate all of EPSCoR Track 1 programs to improve their implementation, achievement of project goals, and impact on participants. It is expected that as programs become more effective they will also become more embedded in the framework of the community, and will therefore be sustained after the project ends. It is important that program coordinators have opportunities to share information about their programs with other program developers throughout the state and nationwide so the successful programs can be disseminated and replicated.

1.3 Create a financial plan that details the ongoing expenses and revenues needed to sustain the infrastructure and the climate change science program at least for the next ten years. Such a plan can guide the priorities for stakeholder engagement and for the identification of funding resources.

Response:

Some of the project components are already starting to prepare this information (e.g. for the transects). The Project Director will contact the leads for each main piece of infrastructure to initiate preparation of a financial plan. See above for timeline.

(2) Transformational Science

The current activities aimed at the development of the environmental monitoring program, data capture, analysis and availability on the portal is an excellent step toward creating a base of knowledge extremely valuable to climate change science and educational programs for this area. The elevation gradient data captured by transects provide an important measure of the variables and forcing functions on resources (e.g., hydrology) and ecosystem services in Nevada’s complex terrain. It was not clear, however, how the data would be valuable outside of Nevada, or at most the regional Basin and Range environments. There is some danger that the studies will be site specific (two mountain ranges) if not coordinated with other regions to develop larger scale questions and models.

Clearly the region’s scientists and stakeholders/decision makers will benefit from results of larger scale models that are transformational. The National Science Board defined transformative research as "research that has the capacity to revolutionize existing fields, create new subfields, cause paradigm shifts, support discovery, and lead to radically new technologies." By its very nature, transformative research often is challenging to conduct and frequently crosses disciplines. It questions the status quo by proposing new (sometimes radically new) ways of approaching a fundamental scientific question. While it is difficult to define transformational research, below are some examples of how the current investments could lead to those results.

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2.1 Scaling in space and time is a clear option. The paleoecological work is excellent for looking backward in time and it likely represents a large spatial scale influence. Also, scaling up climate and ecosystem response data locally and regionally could lead to desired transformational research. Nevada should be organizing and participating in national workshops, conferences and other activities designed to facilitate integration of local/regional information into transformative research questions. Obtaining funds to organize or participate in these kind of activities may require the submission of more proposals (e.g., NSF MacroSystems Biology). The aim of such activities should be to address innovative, large scale questions that require all of the participant's information. MacroSystems Biology research questions are typically on understanding emergent, macroscale properties that occur at these large scales; local data will not show them. The review team suggests working with colleagues ("Big Thinkers"), both in the state and in other states, to develop these emergent property questions. Awards made by NSF in their MacroSystem program could provide a good starting point for examples. Nevada should also consider working with other states (including non-EPSCoR states) and regions on major experiments that test these macroscale questions. Projects like STREON (see the NEON web site) are well regarded as an example.

Response:

We detail below a number of mechanisms we are using to promote the transformational aspects of the project

1. As noted earlier in this response, we have organized a half day workshop at the 2012 CUASHI meeting to showcase the transects and data portal and engage scientists at the national level working on climate change in complex terrain. We will use this workshop to encourage use of the data, collaboration on projects that use the transects, and discussion of large-scale questions that can be addressed using the infrastructure. We will also be registering our data within the CUASHI HIS so that the data will be more readily available to broader constituency.
2. Dr. Franco Biondi has organized a session for the AGU Annual Meeting, December 2012 in San Francisco, entitled "From the past to the future: the value of combining proxy records with observational networks (control id 1367448)." This session will showcase interdisciplinary contributions that quantify how mountain ecosystems regulate water resources under changing climates. We welcome studies that combine proxy records with either remote sensing data, field observations and experiments, or simulation models. Emphasis is on western North America because of its unique combination of complex topography and climate variability, relatively short and sparse instrumental data, abundance of proxy

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records of environmental change at annual or seasonal resolution, and recent establishment of new field observatories.

3. We are communication with organizers of the MTNCLIM workshop to be held in October, 2012. This workshop brings researchers from across the country interested in climate, hydrology and ecology of montane ecosystems. We will be presenting our research at this meeting and will have a breakout session or organized meeting time for discussing research opportunities with researchers at the meeting.
4. At the 4th Annual Tri-State NSF EPSCoR meeting (April 2012 in Sun Valley ID) Dr. Dale Devitt networked with faculty from Boise State that are interested in jointly comparing and contrasting results from multiple mountain transect systems in the west. We think this would allow our group to begin addressing scaling issues that are more regionally relevant. Dr. Lynn Fenstermaker also participated in the CUASHI HIS workshop at the Tri-State meeting and shared information about NevCAN data.
5. We are planning to write an initial paper that introduces the transect systems to the scientific community, describes the available dataset, and provides examples of the studies already accomplished using the data. This will be gleaned from previously presented posters and talks as well as data mining from the initial datasets.
6. We are working on a number of new funding proposals that not only take advantage of the transects, but propose additional research. One is through the NSF - MacroSystem program (Dr. Jay Arnone and Dr. Franco Biondi). Two proposals have been submitted to NASA EPSCOR from members of our Ecology (Dr. Tom Albright) and Water Components (Dr. Lynn Fenstermaker). A proposal has been submitted to the NSF
7. The P2C2 program (Franco Biondi and Scotty Strachan) links data from the transects with tree-ring studies to extend the spatial scale of the transect data to the larger landscape scale. A proposal has been submitted for an MRI workshop on "The Value of Long-term Instrumented Sites in Mountain Regions" (Franco Biondi and Jay Arnone).
8. Regarding efforts to address problems of scaling in space and time, ongoing efforts using remote sensing will clearly play a role in addressing this topic due to the ability of these platforms to acquire repeat synoptic data over large regions. We currently have historic Landsat data (188 scenes) for the Snake Range from the mid 1970's to present; we will be acquiring the same set of Landsat data for the Sheep Range from the USGS EROS Data Center. We also have one-point-in-time (2006) 15 cm aircraft data for all Snake

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Range transect stations acquired by SNWA and 1 meter NAIP data for both the Snake and Sheep Range. Efforts are planned to compare these time series data with modern transect data to link the fine scale sensor data with larger landscape level processes.

2.2 Nevada should participate in national programs like NEON, to whatever degree is possible, in order to broaden the scale and impact of the research. Working with the Cyberinfrastructure efforts of DataOne, NEON, etc. and setting up the data portal to contribute to national program questions will make the Nevada data more powerful. It also may be possible to take advantage of NEON capabilities such as the Airborne Observatory Platform (AOP). AOP will have flight paths designed for the NEON core sites but there are opportunities for imagery acquisition in the off seasons (outside the greenup periods) or as the flights go between the core areas. This would likely require proposals to fund these acquisitions but NSF and NEON are open to this. Future proposals should indicate these requests and work with NEON management on opportunities. The data acquired is valuable to both NEON and Nevada, especially if the data portal provides that information to the broader community. Nevada information would “fill in” gaps between NEON domains. There is a pending Research Coordination Network (RCN) proposal on Complex Mountain Landscapes (no more information available at this time) that would be a natural project for Nevada participation. It is both national and international and would provide the base for developing collaborative research proposals. A funded RCN proposal for Urban Systems may be another opportunity for Las Vegas work to be put into a national perspective if you have not already done so. The team should contact Dan Childers at Arizona State University for details. This research team had their first meeting on February 24, 2012.

Response:

Airoborne Observatory Platform (AOP): Dr. Fenstermaker contacted the Assistant Director for the NEON AOP (Dr. Tom Kampe) requesting information about when the platform would be completed and if we could request data acquisition for our NevCAN sites. The following is the response we received from Dr. Kampe:

“We appreciate your interest in the NEON Airborne observation Platforms - We are currently completing the integration of the first AOP remote sensing payload and will be conducting test/calibration flights in May. We are also planning a pathfinder campaign at Harvard Forest this summer to collect an initial remote sensing data set over a NEON site. Since we are still early in the construction of the NEON observatory, these flight campaigns are directed at developing flight operations protocols and obtaining data sets that will be used by NEON for validation purposes and prototype data product development. It is important to understand that we are not in operations at this time and all data being collected during construction (next several years) is preliminary in nature and has not been fully vetted through the NEON data product validation procedures. We do intend

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to post these data to our prototype data site (<http://neoninc.org/pds/>) but emphasize the preliminary nature of this data.

The second and third imaging spectrometers are currently under development and will be delivered to NEON in 2013. Within the next several years, one of the AOP platforms will be available to be tasked by researchers for directed scientific campaigns. The mechanism for tasking this AOP platform is currently under development, so it is premature to discuss the utilization of this asset at this time. The attached references should give you a good idea of our overall approach, instrumentation, and acquisition strategy for the NEON sites. We appreciate your interest in our evolving capabilities and are happy to keep you informed as we progress to full operations. Please feel free to contact me if you have additional questions.

Sincerely,

Tom Kampe



Thomas Kampe, PhD

Assistant Director, Remote Sensing

NEON, Inc.

1685 38th St., Suite 100

Boulder, CO 80301”

We will continue to track the NEON AOP development. We also have another potential opportunity to schedule high spatial resolution hyperspectral and LiDAR data acquisition at NevCAN through the University of Texas’s “Experimental and Scientific Collaboratory for Earth Surface Assessment and Research” (UTEXAS CEaSAR). The Associate Director for Environmental Systems within the Jackson School of Geosciences at the University of Texas (Dr. Michael Young, formerly the Water Component lead for the NV NSF EPSCoR project) has stated that they “if we can get funding to test the system for alpine environments, would be super happy to try NevCAN.” The UTEXAS CEaSAR AOP is scheduled to be ready to start acquiring data this summer.

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Research Coordination Network (RCN): Dr. Piechota is contacting Dan Childers about the existing NSF-funded Research Coordination Network (RCN) at Arizona State University “Urban Sustainability: Research Coordination and Synthesis for a Transformative Future.” There is potential for research from our project (particularly the urban water vulnerability ISP) to be connected to this national effort.

DataOne: We thank you for these very good points and suggestions. Nevada has planned participation in larger-scale data acquisition and data collection systems for the past 2 years, during which time we have architected, designed, and implemented our hardware, software, and networking infrastructure. Now that Nevada has an operational system for data acquisition, storage, and curation, it is in a position to meaningfully contribute high-quality data to these entities and participate in the regional, national, and global scientific data communities. Further, Nevada can avail itself of extended data acquisition and scientific research that may be enabled or enhanced by these entities.

With regard to these larger organizations, Nevada has three primary options (non-exclusive) for participation:

1. Become an independent data contributor to larger-scale efforts (e.g., DataOne and NEON).
2. Organize itself as, and apply to be, a full member to larger-scale efforts (e.g., DataOne Member Node).
3. Utilize data collection and research infrastructure and opportunities made available by larger-scale efforts (e.g., NEON).

Contributing data to larger organizations (e.g. DataOne and NEON) has been planned by Nevada throughout the project, and this goal is directly achievable. For one or more appropriate large-scale organizations, Nevada can establish appropriate systems and policies to ensure that the data collected are made available to those entities. This option benefits Nevada and its stakeholders by making data available to the regional, national, and global scientific audiences for review and future use. The larger organizations benefit from not only the additional data from a geospatial area they do not likely have, but also greatly from the fact that the data produced under the Nevada data and infrastructure model is of both high quality and resolution.

Full membership within one or more of these larger organizations (i.e., as a DataOne Member Node) is also achievable. Whereas contributing data to larger organizations is a one-way exchange, membership in most larger-scale entities involved a two-way exchange of data and subscription to established policies and

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practices. To the extent that the additional data exchange and policies do not conflict with the existing Nevada goals and infrastructure – specifically, how Nevada is able to collect high-quality, high-resolution data – membership within such organizations is possible. Depending upon the level of software development and/or infrastructure expansion required, additional funding opportunities may be needed.

Utilizing the services and facilities of other large-scale organizations to create, facilitate, or improve research efforts related to Nevada and larger communities is also a planned, as a long-term extension to the Nevada systems. Similar to efforts to establish membership within a larger organization for data exchange, these efforts are contingent upon maintaining the unique data quality characteristics of the Nevada infrastructure while carrying out such data collection/incorporation extensions. Some extensions, such as the inclusion of raw aerial or satellite imagery, are natural to include within the Nevada data systems as they frequently do not involve unknown data manipulations or the introduction of potential error. Extensions involving additional monitoring stations, for example, will likely involve additional collaboration between Nevada and the external entities to properly match the requirements of both organizations, but is certainly possible and may provide additional opportunities to demonstrate the advantages of the Nevada infrastructure.

Recently, in April 2012, at the 4th Annual Western Tri-State Consortium Meeting in Sun Valley, ID we met with with Dr. Bill Michener, PI of the DataOne project, who provided information on Data One activities. As a result, Nevada CI members will attend the coming DataOne Users Group Meeting in Madison, Wisconsin, July 15-16, 2012.

Although ERTAB strongly encourages the forward-looking approach above, this approach should not be taken in lieu of using the data being generated to produce impactful publications. Some foundational studies using existing data (even if they are only from two transects) can go a long way in getting stakeholders interested in sustaining the infrastructure, and put Nevada on stronger footing for proposing new research or linking with national programs like NEON. We suggest that the team continue to brainstorm regarding key questions that can be answered with data from the two transects, particularly looking at questions that intersect climate, hydrology, and ecosystem may be useful.

Response:

The water and ecology components are engaged in an integrated science project (ISP) that is addressing the following overarching science question: *How do climate variability and climate change impact ecosystems and water in the Great Basin (including the northern Mojave Desert)?*

The overarching goal for the ISP is to demonstrate the quality and utility of the NevCAN data via analysis of multiple datasets from network instruments and

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observations in a collaborative interdisciplinary environment, and communication of these results to the scientific and land management communities.

Specific ISP objectives include:

1. Determine temporal and spatial relationships between key climate and ecohydrological variables
2. Assess causal linkages among climatic, hydrologic, and ecologic processes using the RHESSys Model
3. Assess the extent to which Nevada CAN data are representative of a wider spatial and temporal framework and develop methods to extrapolate Nevada CAN observations to larger temporal and spatial scales
4. Publish initial results from the Nevada CAN, including documentation of transect instrumentation and datasets
5. Conduct outreach to scientific community and land management agencies to attract additional projects that use Nevada CAN infrastructure and data

We will schedule a meeting in May 2012 among the Climate Modeling, Ecology and Water components to discuss additional collaborations and foundational studies to use NevCAN data in an interdisciplinary effort.

(3) Data Portal:

ERTAB was unanimously enthusiastic about the progress that has been made over the past year by the data portal team. The data portal represents a facet of the overall RII project that could have broad impacts in terms of extending to additional domains and contexts. Although there are many strategic opportunities and technical considerations still to be considered, it was obvious that much effort was expended to realize the current state of the portal. A summary of our comments follows, which are recommendations regarding the front-end issues of the portal, as well as suggestions for considering future funding to sustain and further develop the capabilities and impact of this project.

Improvement of the Front-End Interface: The ERTAB understands that the most significant effort and complexity of the project is on the back-end, with interactions to the portfolio of sensors and the organization and storage of the collected data. The architecture of the collection and persistence layers of the portal are designed very well to accommodate the needs for “Big Data” among a cadre of researchers. The area that many felt needed additional work was the front-end interface. Although this does not represent the core technical concerns of the project, it does represent the “face” of the portal as observed by its future users. The skill sets for designing this interface may not be within the specific expertise of the data portal team. The ERTAB suggests two actions for consideration over the next year:

- 3.1 Those team members who are experts in the domain of climate change should help to make contact and arrangements for the data portal team to interact with the real stakeholders who will be using the portal. The community of stakeholders

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seems to be absent from a discussion of the requirements of use. The data portal team does not have the direct connections to the targeted users, so assistance from the overall team is needed.

Response:

Cyberinfrastructure efforts to engage project stakeholders to elicit use requirements have been made throughout the project. Domain experts from each of the project components have been present in many working groups and meetings formed within the project to ensure that the needs of stakeholders are being addressed properly. These domain experts have been very helpful, providing a good set of requirements, as well as many examples of the differing needs and opinions that domain experts have with regard to the same features and data.

The CI group has made efforts to ensure that the needs of stakeholders are addressed in a manner that is advantageous to the larger (i.e., national and global) scientific community of researchers, yet does not represent a personalization of features based solely upon the views of those domain experts. These efforts have the advantage of making the data and infrastructure developed applicable to the largest possible current and future scientific audiences, the trade-off being that the personal preferences of some domain experts and stakeholders may not be met in the initial versions of the portal. Frequent meetings of the project's Data Portal Task Force, initiated in May 2011, have ensured that the core needs of stakeholders and domain experts are being solicited, evaluated, and implemented as appropriate.

Through the use of user surveys, the CI group has begun the process of validating its efforts by querying the larger project membership, as well as the larger scientific community. The results of these surveys are guiding the implementation of features designed around "user preferences" that address the data preferences of various stakeholders in a manner that meets their needs without compromising the use by the larger scientific community. Based upon feedback from the surveys completed in February 2012 in Las Vegas, the CI group has implemented several new "user preference" features to address common requests expressed by users. The group also noted a wide degree of feedback and opinions regarding the features made available, as well as the requirements of the data portal. This collection of balanced, sometimes conflicting views indicates to CI that although users and stakeholders have differing opinions on what should or should not be made available or how interfaces should be organized, the systems developed so far meet the core needs of the stakeholders. Further data portal workshops to elicit input from the user community will be scheduled, as for example the one already scheduled at the CUAHSI Annual Meeting in Boulder, Colorado (July 2012).

As recommended by the ERTAB, the CI component will request assistance from the overall project team for connecting with stakeholders. The CI group will

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contact the leads of the other project components, the project PIs and the new Stakeholder Engagement Coordinator for help to make contact and arrangements for the data portal team to interact with the stakeholders who will be using the portal. Indeed, as indicated in the ERTAB report, “the data portal team does not have the direct connections to the targeted users, so assistance from the overall team is needed.”

- 3.2 The data portal team may need to seek out those who are experts in web design layout in terms of large-formatted data entry interfaces. Observing the approaches taken by other data portals and advanced search engines also may be instructive. The primary obstacle we see is the overwhelming number of “knobs” that must be selected on the main configuration screen in order to compile a collection set. Perhaps a mode of interaction where users drill-down through a series of repeated interactions may help to reduce the cognitive load for understanding all of the interface options.

Response:

The CI component has performed extensive surveys of existing data portals in search of user interface designs that facilitate the efficient location of data by users. While we have utilized the services of web designers to provide a general “look and feel” for the data portal that was later revised and significantly improved, the potential for such designs to be applied to the highly-dynamic and self-updating data interfaces present on the portal has met with limited success. Further, the initial versions of the portal search interfaces have exposed a large number of search features in an effort to emphasize the many unique capabilities of the systems that have been implemented.

Following ERTAB’s recommendations, the CI group is currently expanding the user interface exposed on the portal in an effort to better address some of the well-known needs of researchers. Specifically, we are in the process of implementing interfaces that streamline the process of acquiring specific kinds of data (e.g., meteorological, hydrological, soil, etc.) with minimal user interaction. These interfaces will be added to the portal, with the existing search interface serving the role of an “Advanced Search.” Further, CI is planning to create pre-created groups of files to allow researchers to download large collections of data with minimal effort via FTP, addressing the common research need for “all the data.”

Strong Potential for Sustainability and Adaptation to Other Contexts: The architecture of the data portal has the potential to extend beyond the initial needs for climate change observation to offer core capabilities to researchers in other domains. There are several funding opportunities that seem very appropriate for seeking support that will continue the efforts of the project. Below are some suggestions for considering the future sustainability of this project:

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3.3 The present data collection effort is focused on collection of environmental data from the transects. It appears transects have the capability to collect useful data for disciplines outside the current scientific focus of the project. For example, the readily available wind speed and solar energy data could be made available on the portal for use by those interested in renewable energy. In addition, there may be multiple other sensors and devices that scientists may want to use as data sources for populating a portal (e.g., mobile device sensors from smartphones by scientists in the field, or other types of fixed sensors that are installed at key observation sites). Consideration for the future expansion of the portal could bring new interest and capability to the portal and add perceived value to stakeholders.

Response:

Making the portal relevant to other disciplines (e.g., renewable energy) will require identification of the relevant disciplines. We will do this via a survey and marketing plan as stated in the response to 1.1 above. In addition, the members of the data portal team will contact potential collaborators from other disciplines to inform them about the capabilities of our portal and related cyberinfrastructure and identify possibilities of joint grant applications. These efforts have been started by approaching former colleagues with expertise in power systems and renewable energy, and will be expanded to potential collaborators from other departments at UNR, UNLV, and DRI.

With regard to considerations for future expansion of the portal (e.g., other sensors, mobile device sensors...), the data portal and underlying cyberinfrastructure has been architected, designed, and implemented for reuse, extensibility, and cross-discipline data access. The addition of sensors and monitoring hardware within the layered CI architecture is expected and already possible as a part of future efforts to include additional disciplines and support expanded research. The CI group is currently in the process of formalizing the requirements, processes, and policies involved in expanding the system for additional data collection and will make them available to project stakeholders and other interested parties to support sustainability efforts.

3.4 There are several funding opportunities that seem to be a perfect fit for the data portal. Two specific programs seem relevant:

- a) The NSF's Computing Research Infrastructure (CRI) is focused on providing the resources and infrastructure that can be shared across institutions and disciplines. The priority of "supporting the creation, enhancement and operation of world-class computing research infrastructure." More specifically, the CRI supports "computing research infrastructure to enable world-class research and education opportunities **for broadly-based communities of researchers and educators that extend well beyond the awardee institutions.**" More information is available at: http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=12810

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Response:

Thanks for pointing to this program solicitation, which fits excellently our goals of impacting the larger scientific community and providing cyberinfrastructure that can be used by small- and medium-sized projects to collect, manage, and curate high-quality research data. Our efforts can easily scale to regional, national, and global levels. As the deadline for this proposal is October 23, 2012, the CI lead will invite collaborators to participate and set the focus of the proposal by June 1, 2012. An initial version of the proposal will be completed by August 15, 2012, with feedback from a selected group of advisors received by September 15, and the final version completed by October 15, 2012.

- b) The new Cyberinfrastructure Framework for 21st Century Science and Engineering (CIF21) program also has direct relevance to the data portal. The goal of CIF21 is to assist with “big data science and engineering, aims to advance the core scientific and technological means of managing, analyzing, visualizing and extracting useful information from large, diverse, distributed, and heterogeneous data sets so as to accelerate the progress of scientific discovery and innovation. [CISE will contribute \$16 million to CIF21, an increase of 33% over the FY 2012 Current Plan.” More information is available at: http://www.nsf.gov/about/budget/fy2012/pdf/40_fy2012.pdf

Response:

The CI group will watch for upcoming funding opportunities that come out of CIF21.

A major avenue for sustainability is to be in the forefront of cross disciplinary research. To take advantage of the data being generated there are many interesting computational ideas that could be explored. In particular, many scientists who are immersed in the overwhelming sea of “Big Data” often rely on data mining techniques to discover and unveil trends in the data that may not be noticeable by manual inspection by an individual. The potential for data mining to discover relations among data generated by different groups of scientists that do not have a history of collaboration could yield unexpected results and improve understanding of the systemic climate changes across the various collection of sensors and models.

Response:

Indeed, the internal database and data systems created by the Nevada Cyberinfrastructure group are extremely amenable to advanced data analyses, such as the application of data mining techniques. The CI group has been notified about the NSF BIGDATA program solicitation and is in the process of identifying the appropriate project participants and organizing an interdisciplinary proposal submission by the deadline of June 13, 2012. Another program solicitation to which we intend to apply is the NSF Computational and Data-

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Enabled Science and Engineering in Engineering (CDS&E-ENG), with a submission window between June 3 and July 3, 2012.

(4) Some additional comments and observations on the education and policy components

4.1 Education: The education efforts have had some success, particularly through the engagement of graduate students, but this component has suffered from a lack of continuity (three component leads since the project began) and deficit of detailed evaluation data or ability to scale the efforts. The summer institute, limited to seven participants in the north, seven in the south, and required online course, limited to 12 participants per course, may have been transformational for the teachers involved, as their comments at the end of the workshop suggest, but efforts to reach larger numbers of teachers and thereby students appears to be beyond the scope or vision of the project. It appears that the activities and efforts developed by the regional institutes are not coordinated between each other, nor are they linked to other tri-state (or other) climate education efforts, as far as we can tell.

Response:

The two north and south summer institutes operate on similar models. The two institutes do coordinate their respective curricula. For example, each year the same “central research question” and themes are addressed. There are variations on the field trips taken and guest speakers, but the differences are logistical, not substantive. In respect to coordination with Tri-State efforts, both institute directors regularly attend the Tri-State meetings and are aware of Tri-State (Track 2) activities. We will make an attempt during the last year of the project to integrate Track 1 education component activities with the Track 2 education and research activities currently led by P.G. Schrader at UNLV.

Jacque Ewing Taylor in her presentation noted that the program started focusing on middle school, but has been exploring expanding to high school and then elementary teachers and students. (A year ago there was concern that her STEM program was potentially going to be cut, but evidently that didn’t happen. She mentioned that the Next Generation science standards will better infuse climate and global change throughout K12 education, which is accurate. Nevada is not one of the states that is part of the Next Generation development efforts, and no states have adopted the standards yet since they have not yet been drafted.) Ideally, climate and global change (and related topics such as water and energy) should be infused throughout the curriculum, but this will require addressing substantial gaps, misconceptions and systemic issues including curriculum materials and professional development.

Can the teacher cohort be transformed into a viable learning community, sharing their insights gained in the workshops with their students and other students, but also helping the scientists calibrate their own outreach and teaching? Are there ways that the teachers can help guide the developed, testing and deployment of the portal? Are graduate students who are

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benefitting from EPSCOR funding involved with the workshops and/or follow-up, helping demystify the science and bring a human dimension and relevance to the research findings?

Response:

In response to the ERTAB's recommendation to use the teacher cohorts to further develop learning communities, we are planning to use some of our surplus funding for a school-based professional development program. We will target 1-2 schools in the Northern part of the state and 1-2 schools in the South, and provide funding for multidisciplinary teams of teachers at each school to attend the summer institutes, plus possibly a national conference (e.g., the Geological Society of America). Each team would then provide professional development available to the entire school faculty. This approach would augment the number of teachers impacted by the grant as well as develop the community of teachers providing climate change education at each school site.

We have also hired a graduate research assistant (GRA) to work on improving the accessibility of the data portal to teachers and develop lessons and activities that use the data in the portal. The GRA has been consulting with the teacher cohorts to assess their needs and gain their guidance in the design of the data portal interface.

There are GRAs assigned to the summer institutes to help provide follow-up and "demystify" the science and bring a human dimension. Also, graduate students assigned to the "Losing the Lake" (EPSCoR Interdisciplinary Science Team grant) have visited classes taught by two summer institute alumni in the South as part of the field testing for the game, and this has further helped to demystify the science. We will further consider involving the other education component GRAs in the summer institute activities.

Additionally, the external evaluator continues to evaluate all education programs. Most recently, evaluation efforts have focused on developing an "Attitudes toward Science" survey for curriculum development programs, a data portal survey and evaluation forms and surveys to assess implementation and impact of the Interdisciplinary Modeling Course. The results from these programs need to be shared with other program coordinators throughout the state and nationwide so efforts can be scaled up into more extensive programs that will have broader impacts.

As noted in previous ERTAB reports, videos have the potential for conveying the science to broader audiences, and while the videos on the EPSCOR YouTube channel are a start, much more marketing and wider promotion of the videos is necessary. A closer collaboration with UNLV TV could help more effectively communicate the project's relevance and findings. Highlighting articulate, enthusiastic EPSCOR related scientists through stories that highlight the importance of the research and describe the "story" of the science will potentially help enhance the project's visibility and viability.

Appendix 1 – 2012 ERTAB Report with Nevada Response

Response:

To clarify, all the videos posted on the EPSCoR YouTube channel were created by UNLV TV, in close collaboration with project members. As the result of this ERTAB suggestion, the Nevada EPSCoR Communications Specialist, Martha Delgado, has prepared a Strategic Communication Plan to *“increase the Nevada NSF EPSCoR value by strategically branding the Track 1 program as an innovative, educational, knowledge resource for program information and outreach support. A multi-channel approach will be pursued based on increased use of social and traditional media, outreach, and a strong internal and external communication plan.”* The full Communication Plan is attached to this report.

4.2 Policy Comments. The Policy Component (Policy, Decision Making, and Outreach) is more of an integrating agent for the other Components to understand institutional and societal aspects of climate change and to perform outreach to translate and communicate climate science to the affected parties including decision-makers, educators and the public. This Component has some success to interact and integrate with other Components (especially with Climate Modeling Component) and is successful in the implementation of its proposed initiatives and activities: stakeholder group surveys; two-way flow of multidisciplinary information between scientists and affected parties (including DVDs, public radio and newspaper); integration of Climate Change Lab with visualization infrastructure; and extensive outreach activities (including professional publication and the Nevada Climate Change Portal Workshop).

Based on the progress made in years 1-3, the Policy Component is ready to produce the outputs to meet its strategic goals in years 4 and 5. They include:

- The Policy Component considers to contribute to the future expansion of the data portal for funding opportunities by providing environmental data as well as policy-relevant data

Response:

Testing hypotheses related to the relationship between state environmental data and stakeholder data collected over a relatively short time period has been challenging. In the first couple of years of our project Dr. Riddel focused on researching willingness to pay dollar amounts for Climate Change in Nevada while other research lead by Dr. Smith focused on surveying different groups of stakeholders across the state. In general, the business community did not indicate much concern or willingness to support Climate Change mitigation efforts while other groups characterized by less resources and income did indicate both concern and support for mitigation. These data indicate a need for a targeted approach to public sector and some private companies with interest in environmental and/or stakeholder data to support continued collection of it.

- The Policy Component could help organizing a national/international conference focused on “transformational” climate change science by adding policy components (anyway, the Component plans to have a national conference in year 5)

Response:

Discussions are underway to partner with our Tri-State EPSCoR collaborators to organize a workshop bringing together policy experts, scientists, stakeholders, and policymakers at local, state, and federal levels (see page 4 above). This would provide an opportunity to showcase research from multiple components as well as bring in experts in policy from organizations such as Brookings Institution. Economists from Brookings Institution are known for their bi-partisan approach to working with policymakers to see the different sides of issues. This approach is expected to enable skeptical participants a chance to weigh important pros and cons to obtain more defensible and informed decisions.

- The stakeholder advisory group should be formed and made functional to identify possible funders

Response: The majority of the policy component participants focused on surveying multiple stakeholder groups and outreach. Participants in the policy component are somewhat skeptical that a broad group based including members from each stakeholder group surveyed will be successful in identifying future funding for project sustainability. Instead, efforts to build connections with possible funders include workshops with participants across components. This focused approach is expected to yield better results with respect to identifying funding sources than an expensive general stakeholder advisory group.

- The Policy Component needs to keep playing a role to transform scientific outputs from Climate Modeling and Ecology/Water Components into digestible formats to a broad spectrum of stakeholders, decision makers, and the public in collaboration with Cyberinfrastructure and Education Components.

Response:

The workshop mentioned above, as well as potential opportunities for additional research will require summarizing results from the different components. The summaries from the different components including policy can provide a basis for grant proposals and future research. Peer reviewed articles can be used as a basis for such summaries.

- The Climate Change Portal needs to be fully utilized to facilitate the display of climate and water data with decision makers as various scenarios are presented for feedback. For instance, products resulting from the Urban Water ISP project could be made available via the Climate Change Portal. A key strategy is to make climate and water results via an assessable, on-line data portal.

Response:

The products resulting from the two ISPs will be made available on the Nevada Climate Change Portal.

Appendix 1 – 2012 ERTAB Report with Nevada Response

- A clear linkage needs to be established between the climate change surveys, workshop(s), and interview data and policy studies scheduled in 4-5th year to explore the social, political, and economic dimensions of climate change.

Response:

Results from the climate change surveys, interviews, workshops, and policies studies will need to be summarized for different groups of stakeholders and policymakers to understand social, economic, and political impacts. Results from the policy component as well as other components can be used as a basis for new grant proposals including but not limited to utilizing quasi-experiments to better understand individual responses to environmental, social, and economic changes.

The accomplishments of this project must be documented in the next NSF EPSCoR proposal being submitted by Nevada. Since the results of this project would impact the success of the next proposal, ERTAB strongly suggests every effort be made to overcome challenges toward achieving and claiming a significant contribution from this project.

A. SALARY SUPPORT

Include detail regarding support for all faculty and equivalent listed as participants in the RII project during the current reporting period

| Institution | Department | Faculty Name (Last, First) | Faculty and Faculty Equivalent Individual Funded Effort (in months) | | | | Salary Funding for Group Member(s) (in \$K) | | | | Comments |
|---|------------|-------------------------------|--|--------------|--------------|----------|---|------------|------------|------------|--|
| | | | EPSCoR RII | Other NSF | Other Gov | Other | EPSCoR RII | Other NSF | Other Gov | Other | |
| NSHE | none | | 0 | 0 | 0 | 0 | \$0 | \$0 | \$0 | \$0 | All salaries for the Nevada System of Higher Education (the Prime) are supported by voluntary cost share. |
| Total for Institution 1 - NSHE (Prime) | | | 0 | 0 | 0 | 0 | \$0 | \$0 | \$0 | \$0 | |
| DRI | DHS | Dana, Gayle | 6.6 | 5 | 0 | 0 | \$71 | \$54 | \$0 | \$0 | Dana is the Project Director of the Track 1 RII award, as well as the Track 2 and C2 awards |
| | DEES | Lancaster, Nick | 0.88 | 0 | 2.4 | 0 | \$22 | \$0 | \$60 | \$0 | Lancaster is a Co-PI on the project. He is also the PI on a number of Dunes projects for various private companies as well as the PI on the NASA EPSCoR Planetary Surfaces project. |
| | DEES | Fenstermaker, Lynn | 3 | 0 | 2 | 0 | \$67 | \$0 | \$47 | \$0 | Fenstermaker is the Water Component Lead. She also receives funding from the DOI Desert Terminal Lakes project. |
| | DEES | Arnone, John | 1.5 | 0 | 0.9 | 3.17 | \$38 | \$0 | \$23 | \$81 | Arnone is Co-PI on DOI Walker Basin project and Desert Terminal Lakes project. |
| | DEES | Buck, Paul | 2.31 | 3.06 | 0 | 1.1 | \$19 | \$25 | \$0 | \$10 | Buck receives NSF funds for High School Science Fair Network and NASA remote sensing. |
| | DEES | Jasoni, Richard | 0.92 | 0 | 3.2 | 3.87 | \$14 | \$0 | \$49 | \$58 | Jasoni is Co-PI on DOI Desert Terminal Lakes and Walker Basin projects and Brownstein Hyatt Farber Schreck, LLP. |
| | DAS | Koracin, Darko | 2.37 | 0.85 | 2.6 | 0 | \$53 | \$19 | \$58 | \$0 | Koracin is the climate modeling component lead. He receives funds from NSF RII, DOE, NREL and DOD. He has a support team of Post Docs, Graduate Students, Technologists, and hourly employees. |
| | DAS | Mejia, John | 5.5 | 0 | 1.94 | 0 | \$111 | \$0 | \$19 | \$0 | Mejia also receives funds from DOI Bureau of Rec. |
| | DHS | Gautam, Mahesh | 0.5 | 0 | 6 | 0 | \$4 | \$0 | \$68 | \$0 | Gautam has coverage from USGS and USACE for time spent on water related projects. |
| | DEES | Tang, Guoping | 7.8 | 0 | 0 | 1.2 | \$119 | \$0 | \$0 | \$12 | Tang performs Ecosystem Modeling for the NSF EPSCOR project, Ecology Task and receives start-up funds as a new research faculty member. |
| | DAS | Wilcox, Eric | 4.3 | 0 | 7 | 0 | \$103 | \$0 | \$79 | \$0 | Wilcox also received funds from NASA |
| | DAS | Hoekman, Kent | 0.08 | 0 | 0 | 0 | \$2 | \$0 | \$0 | \$0 | Hoekman provides student mentorship. |

| | | | | | | | | | | | |
|--------------------------------------|-------------------|-----------------------|-------------|-------------|--------------|-------------|--------------|-------------|--------------|--------------|--|
| | DAS | Redmond, Kelly | 0.54 | 0 | 0 | 0 | \$11 | \$0 | \$0 | \$0 | Redmond is teaching a courses related to climate change. |
| Total for Institution 2 - DRI | | | 36.3 | 8.91 | 26.04 | 9.34 | \$634 | \$98 | \$403 | \$161 | |
| UNR | Geography | Mensing, Scott | 1.6 | 0.0 | 0.0 | 0.0 | \$32 | \$0 | \$0 | \$0 | Mensing is a RII co-PI. He handles management of UNR activities. |
| | Geography | Albright, Thomas P | 7.7 | 0.5 | 1.1 | 0.6 | \$114 | \$6 | \$12 | \$5 | Albright is a new investigator working on the Ecology component. He also receives funding from the UNR-VPR startup and ISP-Climate Solutions. |
| | Geography | Bassett, Scott | 0.0 | 0.0 | 3.6 | 0.0 | \$6 | \$0 | \$47 | \$0 | Basset does Climate Modeling work on RII. He is funded by DOI-BOR Nat'l Fish & Wildlife Fnd as well. |
| | Geography | Biondi, Franco | 0.8 | 0.0 | 2.9 | 0.0 | \$51 | \$0 | \$30 | \$0 | Biondi is the Task 3 Ecology Component Lead. He is funded by Southern Nevada Water Auth./Tree Ring Investigations as well. |
| | Geography | Boyle, Douglas | 7.7 | 0.0 | 3.6 | 0.0 | \$126 | \$0 | \$52 | \$0 | Boyle works for the Ecology Component, and is funded DOI-BOR Nat'l Fish & Wildlife Fnd. |
| | CABNR | Collopy, Michael | 1.0 | 0.0 | 2.3 | 0.1 | \$18 | \$0 | \$41 | \$1 | Collopy is the UNR Education lead. He receives other funding from DOI/BOR - "Walker Basin II Proj Admin"; DOE - "Integrated Sustainability Initiative"; DOA-FS "Tahoe Science Consortium Round 8"; DOIBOR - "Walker Tahoe 2-10"; Nevada Dept of Conservation and Natural Resources |
| | Computer Science | Dascalu, Sergiu | 1.0 | 0.5 | 0.3 | 0.0 | \$21 | \$9 | \$6 | \$0 | Dascalu is the Cyberinfrastructure Component Lead. He also receives Track 2 |
| | Education | Ewing-Taylor, Jacque | 2.4 | 0.0 | 0.0 | 6.8 | \$28 | \$0 | \$0 | \$59 | Ewing-Taylor leads the northern summer institutes for teachers, and receives |
| | Computer Science | Harris, Frederick C., | 1.0 | 0.5 | 1.6 | 0.0 | \$23 | \$11 | \$36 | \$0 | Harris works on EPSCoR Task 3, Track 2 & DOD-DON Intel. Robotic Decisions |
| | Political Science | Kauneckis, Derek | 3.6 | 0.0 | 0.0 | 0.0 | \$43 | \$0 | \$0 | \$0 | Kauneckis is the UNR Policy component task coordinator. |
| | CABNR | Saito, Laurel L. | 0.5 | 0.0 | 0.0 | 0.0 | \$10 | \$0 | \$0 | \$0 | Saito is the UNR Water Component lead. |
| Total for Institution 3 - UNR | | | 27.3 | 1.5 | 15.4 | 7.5 | \$470 | \$27 | \$224 | \$66 | |
| UNLV | VPR | Piechota, Thomas | 1.5 | 0 | 0 | 0 | \$21 | \$0 | \$29 | \$0 | Piechota is a Co-PI on the project. He is also the PI DOE project subaward through NSHE. |
| | SOLS | Devitt, Dale A. | 0.5 | 0 | 0 | 0 | \$130 | \$0 | \$18 | \$0 | Devitt also works on a DOE project. He has a technician working on the RII project. |
| | PHYSICS | Farley, John | 0.5 | 0.25 | 0 | 0 | \$12 | \$4 | \$0 | \$0 | Farely works on undergraduate research. He also has funding from a NSF - REU Site. |
| | ECE | Latifi, Shahram | 0.5 | 0 | 0.67 | 0 | \$12 | \$0 | \$12 | \$0 | Latifi works on cyberinfrastructure, and he also receives NASA EPSCoR funds thru NSHE.L17 |
| | ECE | Morris, Brendan | 6 | 0 | 0 | 0 | \$61 | \$0 | \$0 | \$0 | Brendan Morris is a new investigator on the project working on cyberinfrastructure. |
| | SEPA | Neill, Helen | 1 | 0 | 0 | 0 | \$65 | \$0 | \$44 | \$0 | Neill is the the policy component lead and has one technician on her team. She also receives funding from BLM. |

| | | | | | | | | | | | |
|---------------------------------------|-----------------------------------|-------------------------|--------------|--------------|--------------|--------------|-----------------|---------------|---------------|--------------|---|
| | EDU | Nussbaum, E. Michael | 1 | 0 | 0 | 0 | \$49 | \$0 | \$1 | \$0 | Nussbaum is the education component lead. He receives DOE and NPS funding. |
| | SEPA | Smith, William | 1 | 0 | 0 | 0 | \$24 | \$0 | \$0 | \$0 | Smith was the prior policy component lead. |
| | CIVIL | Stephen, Haroon | 6 | 0 | 0 | 0 | \$108 | \$0 | \$0 | \$0 | Stephen works on the water component |
| | GEO | Zhongbo Yu | 1 | 0 | 0 | 0 | \$11 | \$0 | \$0 | \$0 | Yu is the UNLV lead for Climate Modeling. |
| Total for Institution 4 - UNLV | | | 19 | 0.25 | 0.67 | 0 | \$493 | \$4 | \$104 | \$0 | |
| CSN | Science & Math | Charlet, David | 1 | 0 | 4.8 | 0 | \$7 | \$0 | \$35 | \$0 | Fellowship from NSF RII funding and receives funds from US Fish & Wildlife Service for the DNWR contract. |
| Total for Institution 5 - CSN | | | 1 | 0 | 4.8 | 0 | \$7 | \$0 | \$35 | \$0 | |
| WNC | SME | Sady, Michael | 0.63 | 0 | 0 | 0 | \$6.1 | \$0 | \$0 | \$0 | Sady received a fellowship for summer 2012 from RII. |
| Total for Institution 6 - WNC | | | 0.63 | 0 | 0 | 0 | \$6 | \$0 | \$0 | \$0 | |
| NSC | School of Education | Rudd, Lawrence | 1.50 | 0 | 2 | 0 | \$13 | \$0 | \$17 | \$0 | Rudd works with the teachers' summer institute. He also received funding from NeCoTIP |
| | School of Liberal Arts & Sciences | McAlister, William Juan | 5.00 | 0 | 0 | 0 | 32 | \$0 | \$0 | \$0 | McAlister works with the education component. |
| Total for Institution 7 - NSC | | | 6.5 | 0 | 2 | 0 | \$45 | \$0 | \$17 | \$0 | |
| Total for All Institutions | | | 90.73 | 10.61 | 48.93 | 16.84 | 1656.259 | 128.82 | 782.99 | 226.3 | |

Notes:

| <i>Institution or RII Totals</i> | <i>Category</i> | <i>Total individuals in category</i> | <i>Male</i> | <i>Female</i> | <i>Blacks or African Americans</i> | <i>Hispanics</i> | <i>Other Ethnic</i> | <i>Persons with Disabilities</i> | <i>New Investigators*</i> |
|----------------------------------|--------------------------------------|--------------------------------------|-------------|---------------|------------------------------------|------------------|---------------------|----------------------------------|---------------------------|
| | Non-technical support staff | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1 | Post docs | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Graduate students | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| | Undergraduate students | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| | RII Leadership Team | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Great Basin College | Faculty participants (or equivalent) | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| | Technical support staff | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Non-technical support staff | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2 | Post docs | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Graduate students | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| | Undergraduate students | 1 | 1 | 0 | 0 | 0 | 0 | 1 | |
| | RII Leadership Team | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Nevada State College | Faculty participants (or equivalent) | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Technical support staff | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 0 |
| | Non-technical support staff | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2 | Post docs | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Graduate students | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| | Undergraduate students | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| | RII Leadership Team | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Nevada RII total | Faculty participants (or equivalent) | 45 | 38 | 7 | 0 | 5 | 0 | 1 | 3 |
| | Technical support staff | 16 | 7 | 9 | 0 | 3 | 0 | 0 | 0 |
| | Non-technical support staff | 5 | 1 | 4 | 3 | 0 | 0 | 0 | 0 |
| 154 | Post docs | 4 | 3 | 1 | 0 | 0 | 0 | 0 | 1 |
| | Graduate students | 40 | 19 | 21 | 1 | 4 | 0 | 0 | |
| | Undergraduate students | 39 | 18 | 20 | 1 | 2 | 0 | 3 | |
| | RII Leadership Team | 5 | 3 | 2 | 0 | 0 | 0 | 0 | 0 |
| | Advisory Board(s) | 22 | 17 | 5 | 0 | 0 | 0 | 1 | 0 |

*New investigators are those at the faculty, junior faculty, and post doc level who are new to the RII project during the reporting period.

Notes:

C. COLLABORATIONS

Enter number of relationships for the current reporting period

| Category | <i>Within the Jurisdiction but Not Solely Among Participants</i> | | <i>External to the Jurisdiction-U.S. Domestic</i> | | <i>External to the Jurisdiction-Foreign</i> | |
|--|--|--------------------------------|---|--------------------------------|---|--------------------------------|
| | <i>Number of Institutions</i> | <i>Number of Collaborators</i> | <i>Number of Institutions</i> | <i>Number of Collaborators</i> | <i>Number of Institutions</i> | <i>Number of Collaborators</i> |
| Academic Research Institutions (without Minority Serving Institution status) | 3 | 34 | 11 | 18 | 0 | 0 |
| Primarily Undergraduate Institutions | 4 | 4 | 0 | 0 | 0 | 0 |
| Historically Black Colleges and Universities | 0 | 0 | 0 | 0 | 0 | 0 |
| Hispanic Serving Institutions | 0 | 0 | 1 | 2 | 0 | 0 |
| Tribal Colleges and Universities | 0 | 0 | 0 | 0 | 0 | 0 |
| National Laboratories | 1 | 2 | 0 | 0 | 0 | 0 |
| Industry | 2 | 2 | 1 | 3 | 0 | 0 |
| Other (Government) | 12 | 12 | 4 | 3 | 0 | 0 |
| Other (Sovergein Nation) | 2 | 2 | 0 | 0 | 0 | 0 |
| Total | 24 | 56 | 17 | 26 | 0 | 0 |

Notes:

D. EXTERNAL ENGAGEMENT

Enter number involved for the current reporting period

| | Academic Research Institutions (without Minority Serving Institution status) | | Primarily Undergraduate Institutions | | Minority Serving Institutions | | K-12 Institutions | | | Other (Specify) | Total |
|---------------------------|--|----------|--------------------------------------|----------|-------------------------------|----------|-------------------|---------------------------|---------------------------------------|-----------------|-------|
| | Faculty | Students | Faculty | Students | Faculty | Students | Teachers | Students Reached Directly | Students Reached via Teacher Training | | |
| Project Total | 25 | 63 | 0 | 0 | 0 | 0 | 27 | 145 | 9201 | 0 | 9461 |
| Male | 22 | 33 | 0 | 0 | 0 | 0 | 11 | 72 | 4605 | 0 | 4743 |
| Female | 3 | 30 | 0 | 0 | 0 | 0 | 16 | 73 | 4605 | 0 | 4727 |
| Underrepresented Minority | 2 | 5 | 0 | 0 | 0 | 0 | 4 | 104 | 5623 | 0 | 5738 |

Notes:

Academic Faculty--Mentors for scholarships and fellowships

Academic Students--Nevada Undergraduate Research Symposium participants and Communicating Science Workshop participants

Teachers--Summer Institute participants

Students reached directly--relates to classes where we field tested Losing the Lake.

Students reached via teacher training--Because teachers traqined in previous years continue to impact students, these estimates were multiplied by three.

The summer institutes have been offered four times over the life of the project. But because some teachers reenrolled in the institutes several times and/or were assigned to teach other subjects than science, in our judgment a coefficient of 3 reflects a more accurate multiplier.

E. OUTPUTS

| Category | Total for Current Reporting Period | | Cumulative Total for the Award | |
|--|---|-------------------------------|---------------------------------------|-------------------------------|
| Patents | <i>0</i> | | <i>0</i> | |
| Awarded | 0 | | 0 | |
| Pending | 0 | | 0 | |
| Licensed | 0 | | 0 | |
| Proposals / Grants / Contracts | <i>Number</i> | <i>Funds requested</i> | <i>Number</i> | <i>Funds requested</i> |
| Submitted | 47 | \$175,135,872 | 96 | 221351021 |
| Awarded | 11 | \$1,415,507 | 32 | 12862735 |
| Pending | 20 | \$56,545,859 | 37 | 80006620 |
| Published Publications | <i>31</i> | | <i>91</i> | |
| Primary RII Support | 20 | | 52 | |
| Partial RII Support | 11 | | 39 | |
| Total New Faculty Hired | <i>3</i> | | <i>8</i> | |
| Male | 3 | | 8 | |
| Female | 0 | | 0 | |
| Underrepresented minority | 0 | | 0 | |
| Disabled | 0 | | 0 | |
| Total Post Docs Involved | <i>4</i> | | <i>8</i> | |
| Male | 3 | | 7 | |
| Female | 1 | | 1 | |
| Underrepresented minority | 0 | | 0 | |
| Disabled | 0 | | 0 | |
| Total Graduate Students Graduated | <i>5</i> | | <i>14</i> | |
| Male | 2 | | 9 | |
| Female | 3 | | 5 | |
| Underrepresented minority | 0 | | 0 | |
| Disabled | 0 | | 0 | |
| Total Undergraduates Graduated | <i>3</i> | | <i>36</i> | |
| Male | 2 | | 15 | |
| Female | 1 | | 20 | |
| Underrepresented minority | 0 | | 1 | |
| Disabled | 0 | | 0 | |

Notes:

F. EXPENDITURES INCLUDING OBLIGATIONS

Summarize overall support levels for each of the major activities of the project

| <i>Expenditure Category</i> | Current Reporting Period | | Cumulative | |
|--|---------------------------------|---------------------------|--------------------|-------------------------------|
| | \$K | % of annual budget | \$K | % of cumulative budget |
| <i>Climate Change</i> | | | | |
| Salaries and Fringe Benefits | \$892.72 | 29.76% | \$2,549.08 | 21.24% |
| Seed Funding | \$0.00 | 0.00% | \$0.00 | 0.00% |
| Equipment | \$23.53 | 0.78% | \$2,283.46 | 19.03% |
| Other Research-Related Expenditures (specify) | \$87.15 | 2.91% | \$458.21 | 3.82% |
| Total Research | \$1,003.40 | 33.45% | \$5,290.75 | 44.09% |
| Diversity Plan | \$25.20 | 0.84% | \$0.00 | 0.00% |
| Workforce Development Plan | \$50.00 | 1.67% | \$0.00 | 0.00% |
| Cyberinfrastructure Plan | \$322.53 | 10.75% | \$1,072.10 | 8.93% |
| External Engagement Plan | \$570.71 | 19.02% | \$1,124.38 | 9.37% |
| Evaluation and Assessment plan | \$37.15 | 1.24% | \$198.00 | 1.65% |
| Sustainability Plan | \$36.84 | 1.23% | \$63.78 | 0.53% |
| Management Plan (include all administration expenses) | \$159.58 | 5.32% | \$709.98 | 5.92% |
| Indirect Cost | \$885.04 | 29.50% | \$3,099.22 | 25.83% |
| Other (specify) | \$0.00 | 0.00% | \$0.00 | 0.00% |
| Total | \$3,090.45 | 103.02% | \$11,558.21 | 96.32% |

Notes:

G. COST SHARING AND COST CONTRIBUTIONS

Enter values for the current reporting period

| Category | Cost Sharing (\$K) <i>(reported on line M)</i> | Cost Contributions (\$K) <i>(not included on line M)</i> |
|------------------------|--|--|
| University/Institution | 0.0 | 1334.59 |
| State Government | 0.0 | 0 |
| Local Government | 0.0 | 0 |
| Private Foundation | 0.0 | 0 |
| Industry | 0.0 | 0 |
| International | 0.0 | 0 |
| Other (specify) | 0.0 | 0 |
| Total | | 1334.59 |

Notes:

H. LEVERAGED SUPPORT

Include values covering the full current reporting period

| <i>Expenditure Category</i> | NSF RII Expenditures including Obligations (\$K) | Cost Sharing (\$K) | Cost Contributions (\$K) | Total of all sources of support (sum of 3 columns) |
|--|---|---------------------------|---------------------------------|---|
| <i>Climate Change</i> | | | | |
| Salaries and Fringe Benefits | \$892.72 | \$0.0 | \$193.39 | \$1,086.11 |
| Seed Funding | \$0.00 | \$0.0 | \$358.00 | \$358.00 |
| Equipment | \$23.53 | \$0.0 | \$0.00 | \$23.53 |
| Other Research-Related Expenditures (specify) | \$87.15 | \$0.0 | \$0.70 | \$87.85 |
| Total Research | \$1,003.40 | \$0.00 | \$552.09 | \$1,555.49 |
| Diversity Plan | \$25.20 | \$0.0 | \$0.00 | \$25.20 |
| Workforce Development Plan | \$50.00 | \$0.0 | \$0.00 | \$50.00 |
| Cyberinfrastructure Plan | \$322.53 | \$0.0 | \$81.70 | \$404.23 |
| External Engagement Plan | \$570.71 | \$0.0 | \$184.78 | \$755.49 |
| Evaluation and Assessment Plan | \$37.15 | \$0.0 | \$0.00 | \$37.15 |
| Sustainability Plan | \$36.84 | | \$0.00 | \$36.84 |
| Management Plan (include all administration expenses) | \$159.58 | \$0.0 | \$233.17 | \$392.75 |
| Indirect Cost | \$885.04 | \$0.0 | \$0.00 | \$885.04 |
| Other (fellowships) | \$0.00 | \$0.0 | \$292.85 | \$292.85 |
| Total | \$3,090.45 | \$0.00 | \$1,344.59 | \$4,435.04 |

Notes: