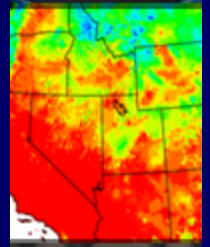





Nevada Infrastructure for Climate Change Science, Education, and Outreach

Component: Climate Modeling

Lead: Darko Koracin, DRI

Steering Committee Members:

Scott Bassett, UNR; Zhongbo Yu, UNLV

Faculty:

Douglas Boyle, UNR; Eric Wilcox, DRI

Postdoctoral Associate:

John Mejia, DRI

Graduate students:

Benjamin Hatchett, DRI; Michael Dolloff, UNR

Computer support:

Travis McCord, Ramesh Vellore, Paul Neeley, DRI

31 January 2011, Reno

NSF

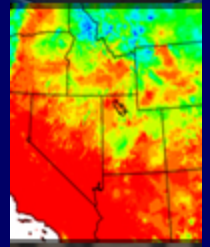
EPSCoR

Experimental Program to Stimulate Competitive Research

Nevada System of Higher Education

1865

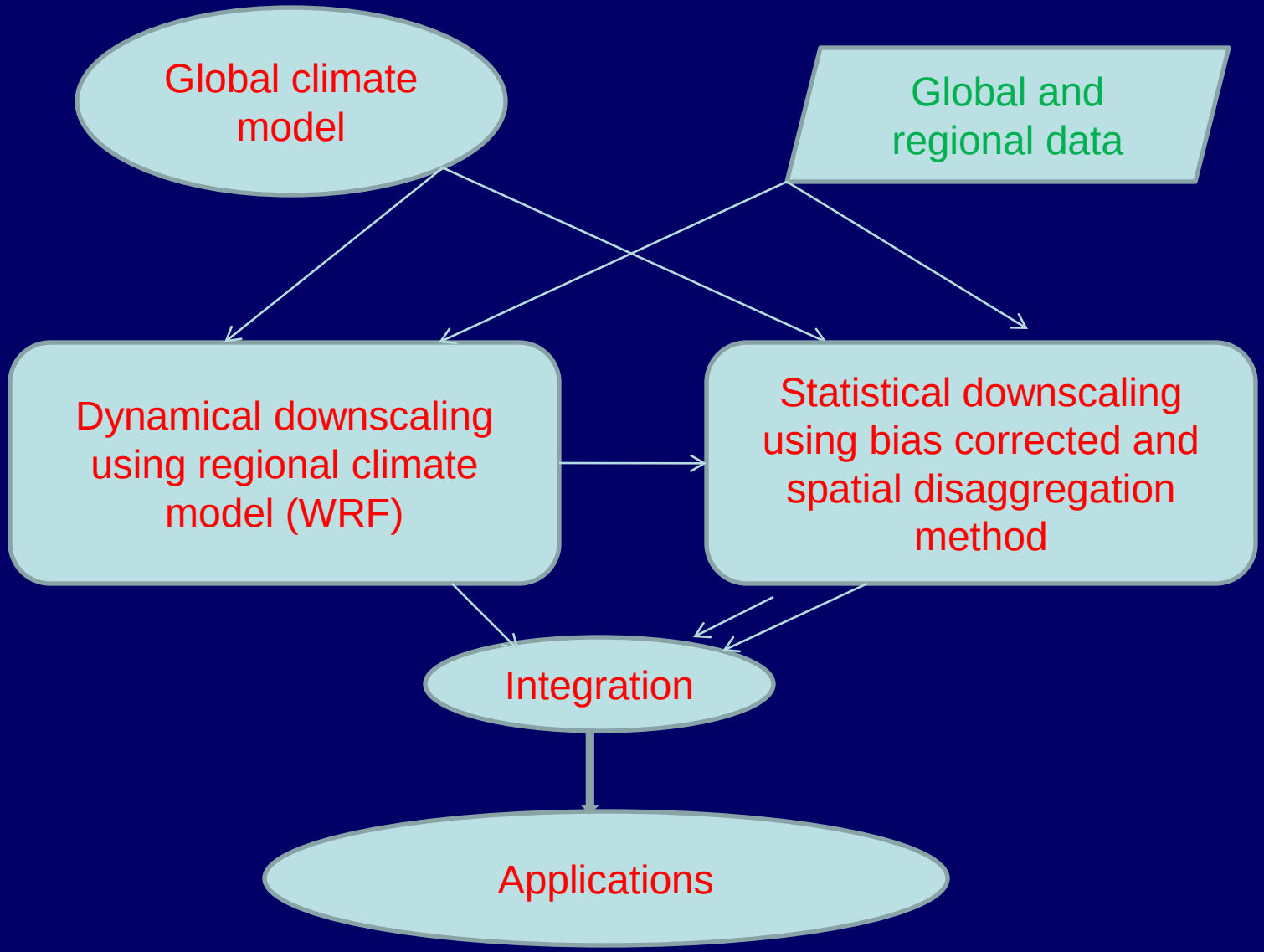




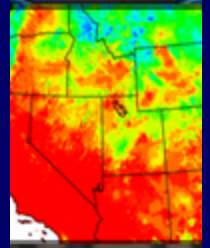

Research Goals

- Predict accurate climate trends in Nevada
- Provide inputs to hydrological models and assess future hydrological resources, their variability and uncertainty, and socio-economic impacts
- Test and improve parameterization of land-atmosphere interactions
- Investigate aerosol contribution to climate
- Study feedback interactions among atmosphere, hydrology, and ecological processes
- Provide an integrated GIS system (Geoinformatics) for water, energy, urbanization, and economic parameters

Climate modeling







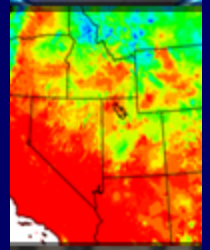

Major accomplishments - Overview

- Infrastructure – Human resources
  Support: Faculty, Postdoc, Students, Computer Programmers

- Infrastructure – Equipment
  Computer cluster, additional disk storage

- Science
  Analysis of climate observations
  Dynamical downscaling
  Statistical downscaling
  Hydrological modeling
  Global modeling, ecology, and aerosols
  Geoinformatics and urbanization






Overview - Infrastructure

- DRI - Infrastructure
  - Personnel
    - John Mejia – Postdoctoral Associate (Oct 2009)
    --- *Regional climate modeling and dynamical downscaling*
    - Benjamin Hatchett – M.S. graduate student (Jan 2009)
    --- *Statistical regional downscaling*
    - Eric Wilcox – Climate Modeler – faculty position
    --- Global observational networks and global and regional climate modeling

  - Computer system
    - SUN Fire system (8 chassis; ten blades with 16 GB of memory and 146 GB disk; total of 640 processors)
    - Data storage of 140 TB+140 TB
    - Rocks (5.2.2) Cluster Management

- UNR –Infrastructure
  -Personnel
    - Douglas Boyle – Associate Professor (August 2010)
    --- *Paleoclimate/paleohydrologic modeling*
    - Michael Dolloff—M.S. graduate student (June 2009)
    --- *Regional policy scenario downscaling and urban growth*

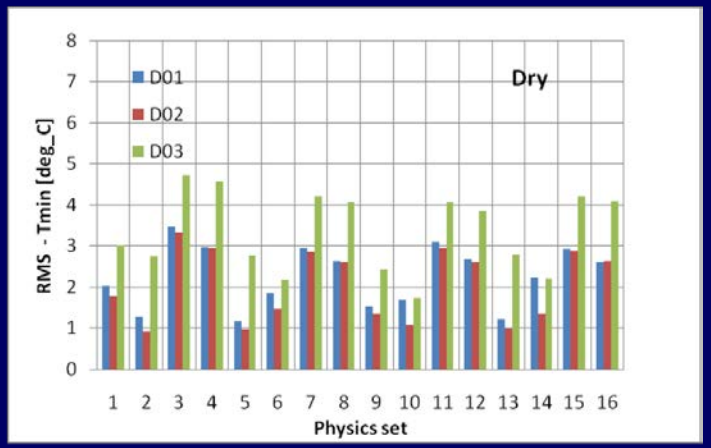
- Zhongbo Yu – UNLV, graduate student

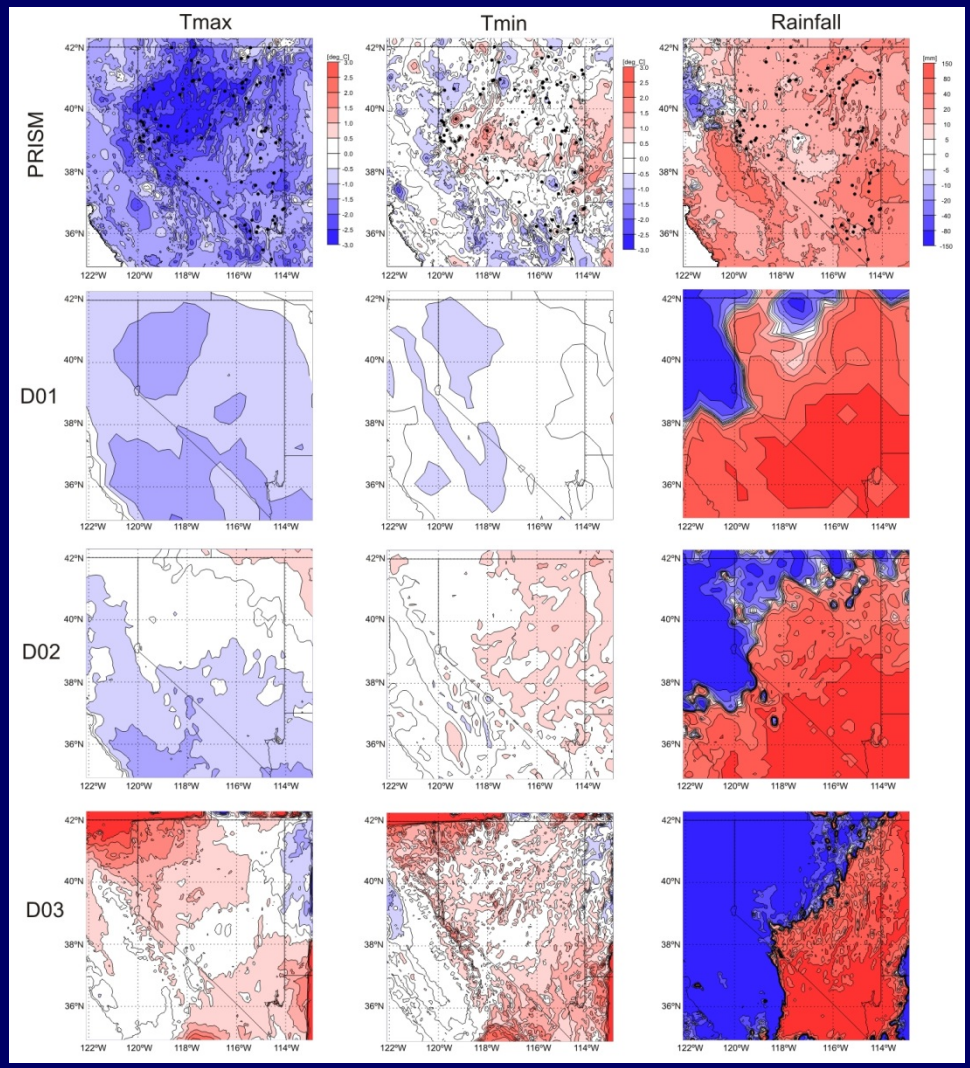
Component activities – Dynamical downscaling

- Computer cluster fully operational for WRF regional climate simulations
- Hindcast simulations completed for a “dry” year and a “wet” year using 36, 12, and 4 km resolution using CCSM3 for initial and boundary conditions
- Sensitivity tests completed using 16 various model option setups
- Over-estimation of precipitation led to analysis of biases in 20 global climate models
- One-way interaction between the WRF and UNLV regional hydrology models and between the WRF and local hydrology (GSFLOW) was completed

Component activities – Dynamical downscaling - Examples

- (Right) Wet –Dry years using the best physics configuration.



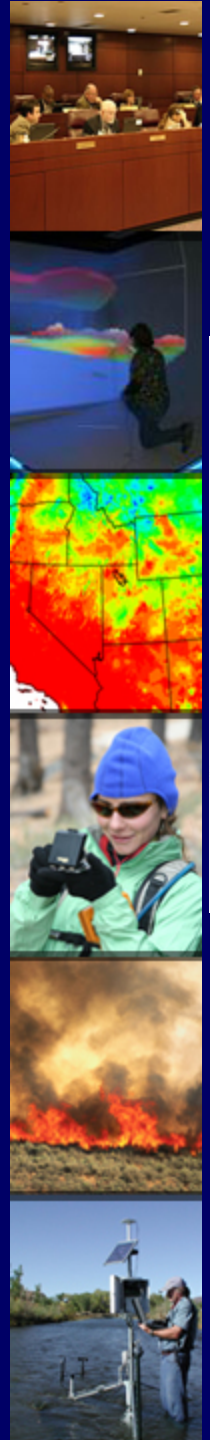


Component activities – Dynamical downscaling – Problem issues – plan changes

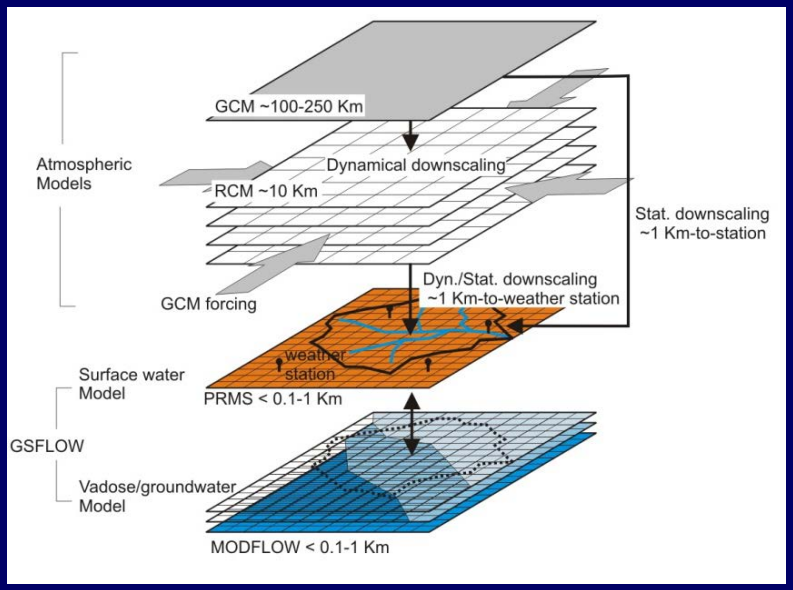
- Planned climate projection simulations were put on hold since we were waiting for CCSM4. Unfortunately, CCSM4 outputs are delayed. We are considering running the projections using CCSM3 which has known biases in many parameters including SST.
- Meanwhile, we obtained additional 140 TB of disk storage which will allow us to run various emission scenario projections.
- Regarding development of tasks related to atmospheric (dynamical and statistical) and hydrology modeling, we are in the process of hiring an additional student.

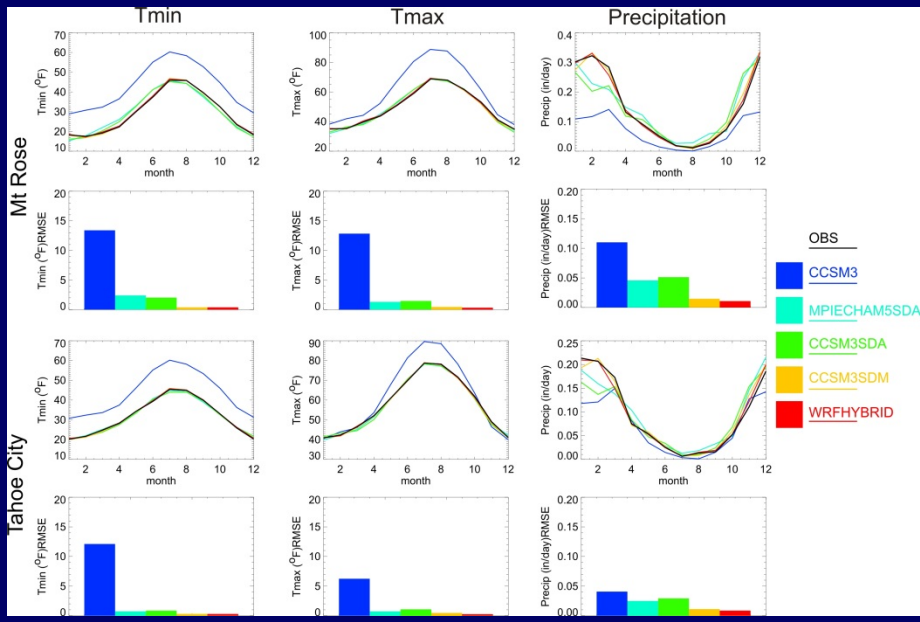
Component activities – Statistical downscaling

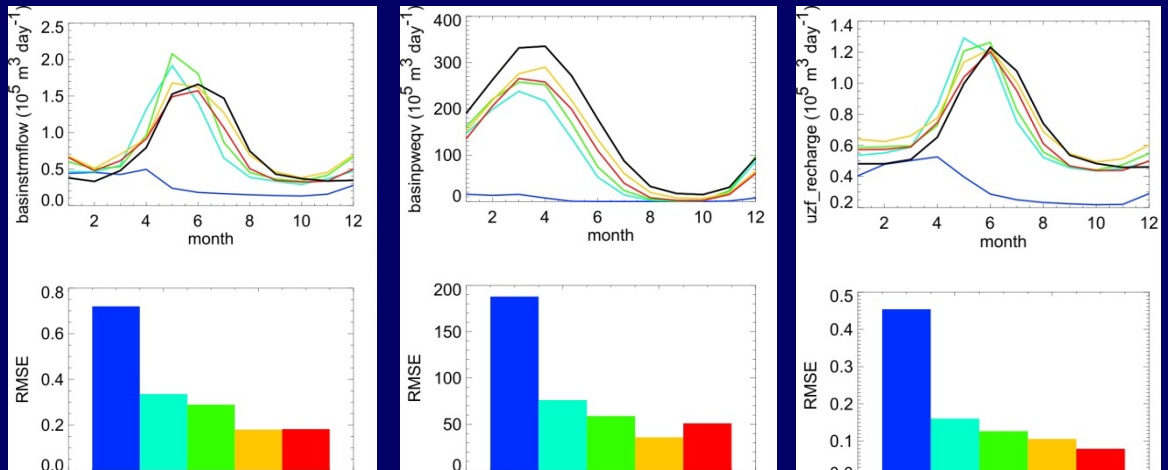
- Bias corrected, spatial disaggregation statistical downscaling method is operational for use.
- The method has been applied to Nevada (38 stations) for period of 1980-2008 and for the PRISM gridded data.
- Three global climate models were used for the correction of the climate projections.



Dynamical/Statistical downscaling: Applications







Component activities – Statistical downscaling – Problem issues – plan changes

- Stationarity of the climate not known
- Station record length
- Station data quality
- Global climate model performance…

Global Climate Modeling for Impacts Studies

- Implementation of CESM1.0/CAM5 is underway:

This leverages funding from other sources.

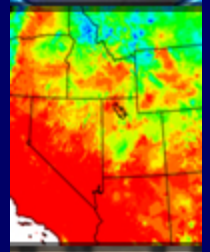
Resulting simulations will serve goals of this project as well as DOE cloud projects and NASA EPSCoR project on aerosol radiative effects.

- Evaluating model simulations:

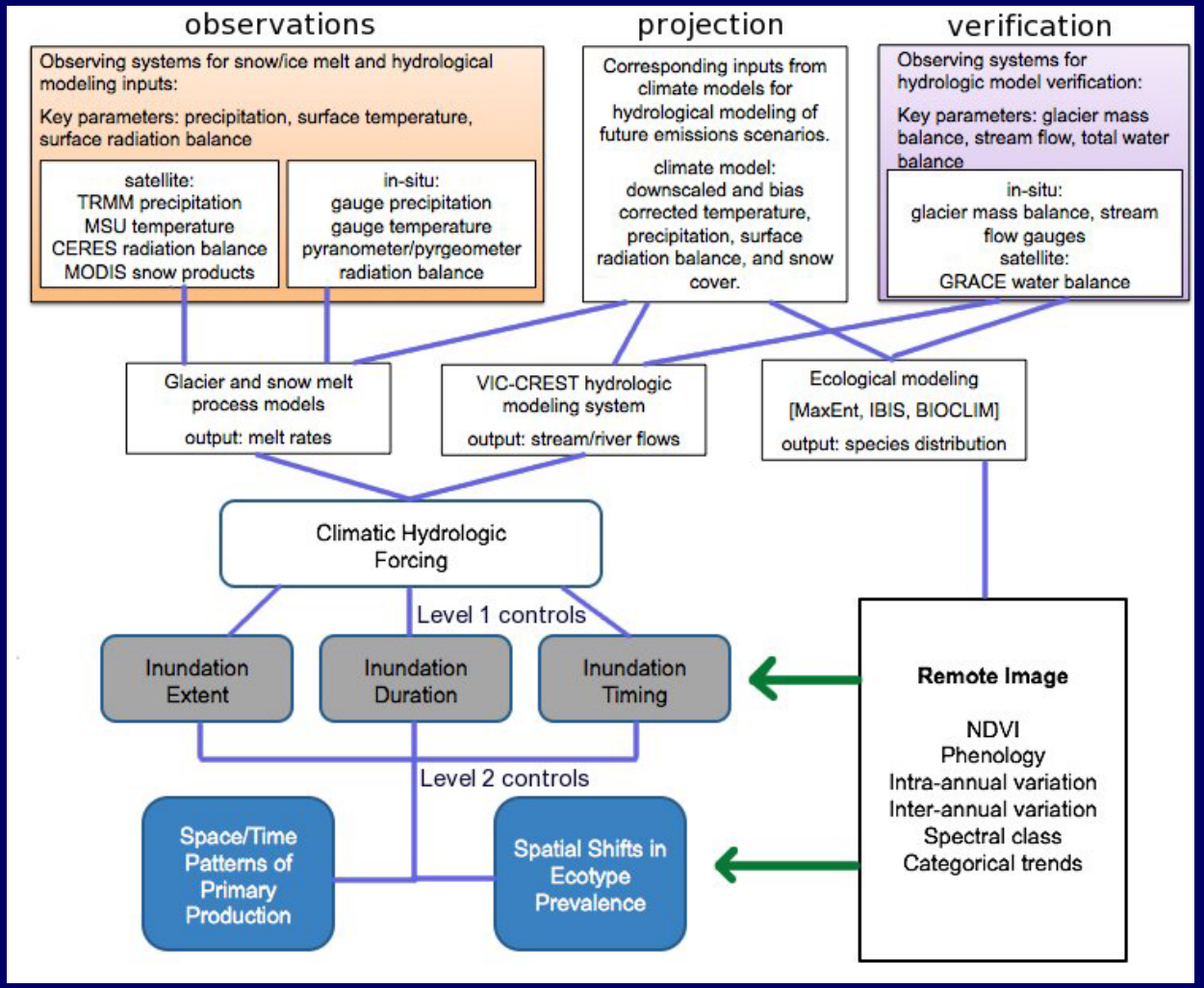
Assess biases in model precipitation physics using statistics of satellite data.

Assess impact of GCM biases on downscaled climate simulation.





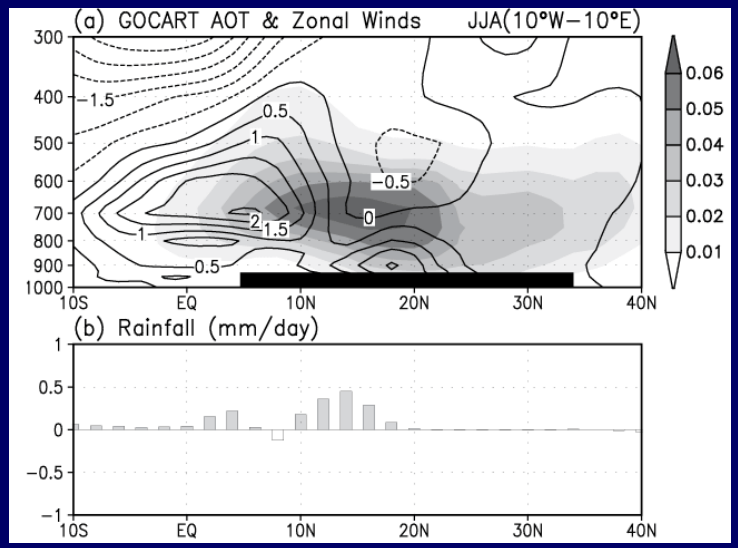

Impacts assessment



Process models driven by observations and model output for understanding future changes in the context of present variability.

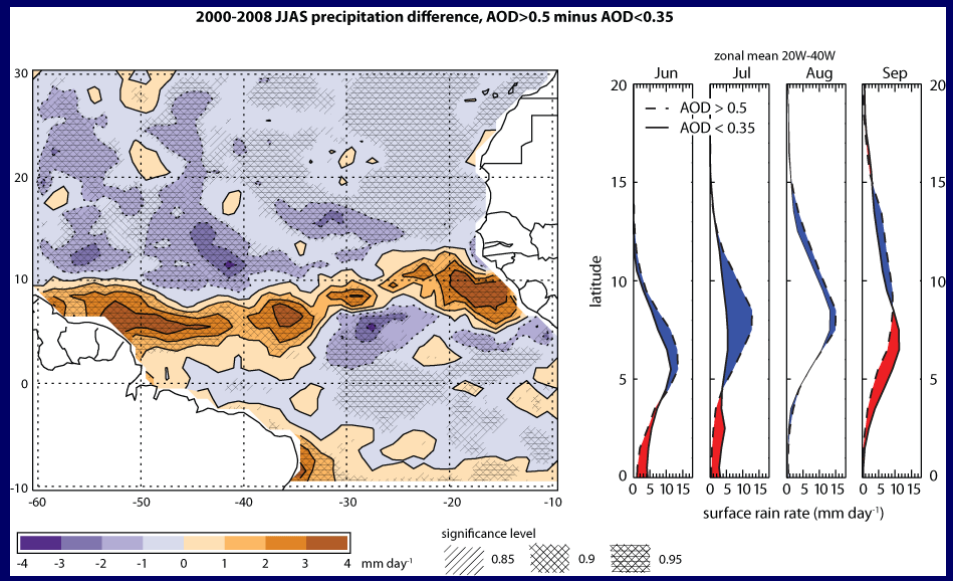
Sensitivity and process studies

GCM simulation



Lau et al. (2009)

Satellite observation

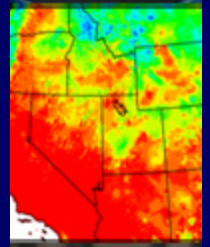


Wilcox et al. (2010)

Uncertainty in GCM projections of future climate is substantial. GCMs are arguably more useful as a means of performing controlled experiments on regional response to climate forcing agents.

GCMs help establish hypotheses to be tested empirically with data.






Integrating Urban Growth and Climate Change Modeling

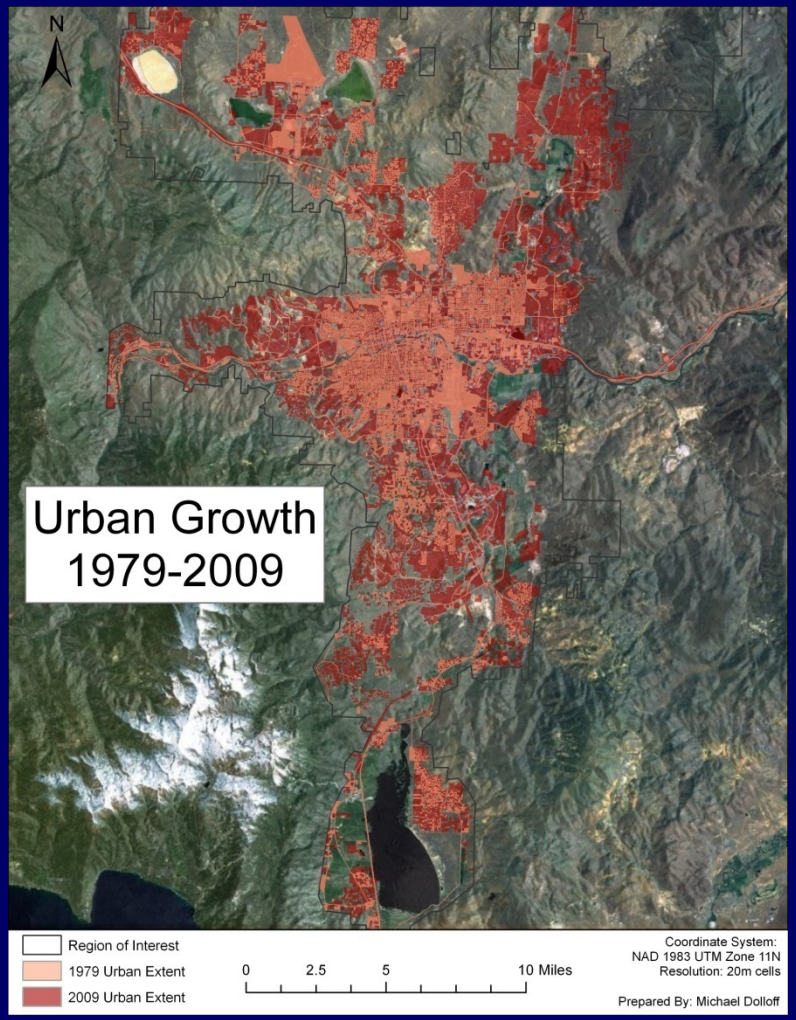
- The IPCC SRES emissions scenarios have been downscaled and interpreted into four regional policy and socio-economic scenarios affecting urban growth in the Truckee Meadows.

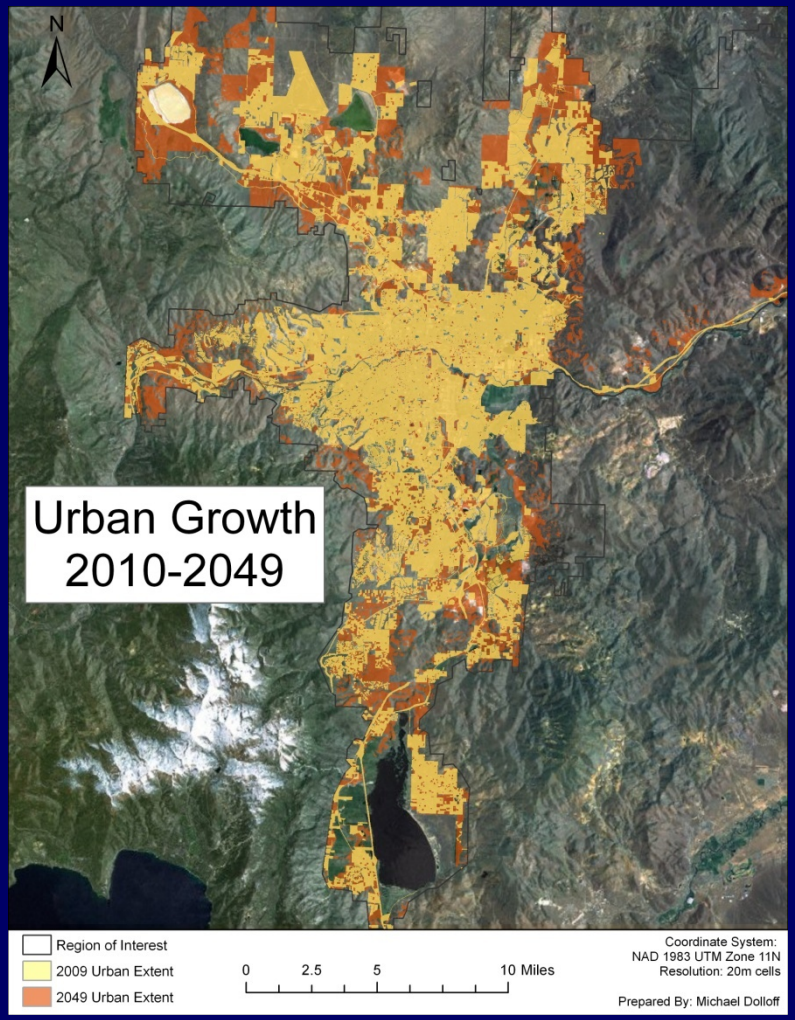
- Historic data is being used to calibrate an urban growth model to the Truckee Meadows region. This trend data and the future scenarios are used to adjust the spatial patterns and model input parameters of population growth rate and urban area per person. These urban growth scenarios are then spatially modeled out to 2049.

- The four modeled urban growth scenarios will utilize temperature and precipitation outputs from the downscaled climate models to assess the future land and water demand feedbacks and impacts in Truckee Meadows.

Integrating Urban Growth and Climate Change Modeling Example:

- Truckee Meadows 1979-2009 historic urban growth
- Future Scenario: A1 ("Diffuse Arterial")





Paleoclimate/Paleohydrologic Investigations

- Development of hydrologic modeling laboratory of pluvial lake systems in the Great Basin.
- Investigate paleohydrologic response of pluvial lakes in the Great Basin to abrupt changes in climate.
- Collaborative experiments with scientists from NCAR and Lamont-Doherty Earth Observatory of Columbia University to evaluate several new high resolution (0.5 degree) NCAR GCM paleoclimate runs with hydrologic models of pluvial lake systems.

Hydrological modeling (Zhongbo Yu)

- NCEP/NCAR reanalysis data were used to drive HMS(Hydrologic Model System), model performance was evaluated by comparing simulation results with natural flow in 27 gauges along Colorado River Basin (CRB).

- Bias Corrected and Downscaled (BCSD)
  WCRP CMIP3 Climate Projections (bccr_bcm2_0 under A1B) were temporally downscaled to drive the HMS to study 21st century streamflow in UCRB and its possible relationship with climate fluctuations.

- The total 112 BCSD contemporary climate projections over the contiguous United States is being downscaled for HMS to analyze the uncertainty of hydrologic responses under different climate projections (in progress).