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The Heartbeat of the Boreal Heat Engine: Planetary Wave Breaking, Cold Air Outbreaks and Coupled Atmosphere-Ocean Responses – Relevance to the Hemispheric Climate

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Planetary-scale Rossby waves drive weather and climate on the Earth through myriad physical processes. Potential vorticity (PV) gradients in the midlatitudes act as a restoring force for Rossby waves and episodic planetary wave breaking events (PWB), characterized by an irreversible overturning of PV isentropes, force intrusions of high PV air equatorward. Cold air outbreaks (CAO) of very cold, stably stratified continental air flowing out over warm western boundary currents such as the Kuroshio and Kuroshio Extension Currents (with air-sea differences in excess of 15K) are linked to PWB and result in high impact weather locally and at downstream locations. The satellite-era NCEP-NCAR Reanalysis (1979-2012) dataset is utilized to identify RWB events, define a Marine cold air Outbreak Index (MOI), and estimate surface sensible and latent heat fluxes. We will assess how RWB location and magnitude impacts CAO and the associated heat fluxes. Results from a three year, 0.6° resolution numerical modeling experiment using the Weather Research and Forecast Model (WRF) over the Pacific Basin are compared to the Reanalysis data and observations at buoy and radiosonde locations. Implications for the global heat budget on weather and climate scales and future climate modeling experiments will be discussed.