Session: B2 Oral presentation

Understanding the U.S. east-west differential of heat extremes in terms of record temperatures and the warming hole

Gerald Meehl [†]; Julie Arblaster; Grant Branstator
[†] NCAR, USA
Leading author: meehl@ucar.edu

A linear trend calculated for observed annual mean surface air temperatures over the U.S. for the second half of the 20th century shows a slight cooling over the southeastern part of the country, the so-called "warming hole", while temperatures over the rest of the country rose significantly. This pattern of average temperature change has contributed to the observed pattern of changes of daily record temperatures with a comparable east-west differential of the ratio of daily record high temperatures to record low temperatures. Ensemble averages of 20th century climate simulations show a slight west-east warming gradient, but no warming hole, suggesting that it is not the product of external forcing but is internally generated. A warming hole that appears in one ensemble member of simulated 20th century climate in CCSM3 is analyzed as a case study to show that it is a product of internal decadal timescale variability originating mainly from the equatorial central Pacific associated with the Interdecadal Pacific Oscillation (IPO). Analyses of a long control run of the coupled model, and specified convective heating anomaly experiments in an atmosphere-only model, trace the forcing of the warming hole to positive SST, precipitation and convective heating anomalies in the central equatorial Pacific Ocean near the Dateline. Different processes related to the teleconnections from the tropical western Pacific occur in different seasons, with cold air advection into the southeastern U.S. in winter, and low level moisture convergence in that region in summer, contributing most to the warming hole in those seasons. Projections show ongoing fluctuations of this pattern superimposed over warming from increasing greenhouse gases, implying a future larger increase in the ratio of daily record high temperatures to record low minimum temperatures in the southeastern U.S. compared to the past 50 years.