How critical is knowing the spatial pattern of ocean temperature change for attribution of the last 20 years of regional drought?

Joseph Barsugli*†[1,2], Andrew Hoell[2], Martin Hoerling[2], Xiao-Wei Quan[2,3], Don Murray[2,3], and Dave Allured[2,3]

[1]Cooperative Institute for Research in Environmental Sciences – University of Colorado, 216 UCB Boulder, CO 80309, United States

[2]NOAA Physical Sciences Laboratory – 325 Broadway, Boulder, CO 80305-3328, United States

[3]Cooperative Institute for Research in Environmental Sciences – 216 UCB, Boulder, CO 80309, United States

Abstract

East Africa and the Western United States have seen a period of enhanced drought since the turn of the millennium, largely driven by decreased precipitation. Previous studies have linked these precipitation trends to changes in sea-surface temperature, primarily in the Tropics. However, it is unclear the extent to which observed trends in SSTs are due to multidecadal natural variability or to anthropogenically forced trends. Given that uncertainty, we ask how sensitive the drought response is to the details of prescribed and simulated long-term SST trends.

We examine large ensembles of coupled model runs, and compare those with experiments where SST and sea-ice boundary conditions are specified (so-called AMIP-style experiments). In addition, we also remove an estimate of the trends in SSTs from the AMIP simulations in two ways: in the first set only the zonal mean SST trends are removed, in the second a full spatial pattern of the long-term trends are removed. These so-called "counterfactual" simulations allow empirical attribution subject to assumptions about the trends in SSTs.

For the Western US the drought trends are found to be relatively insensitive to two assumptions of historical SST change. For East Africa, considerable sensitivity is found – AMIP and CMIP ensembles yield largely non-overlapping histograms of precipitation change, and the change attributable to long-term SST trends is more sensitive to assumptions of historical change patterns.

Keywords: Drought, Climate Change, Attribution, Western US, East Africa, Sea, Surface Temperature Trends

*Speaker

†Corresponding author: joseph.barsugli@colorado.edu