What Drives Spatial and Temporal Variability of Evaporative Demand Across CONUS?

Michael T. Hobbins[1]
UCAR, National Integrated Drought Information System, NOAA/Earth System Research Laboratory

Abstract. Estimating atmospheric evaporative demand (Eo) using physically appropriate forcings is essential to reduce extraneous modeling uncertainty and incorporate key sources of variability. As Eo is used as an upper limit in the quantification of evapotranspiration (ET) in hydrologic analyses, limiting epistemic uncertainties has significant implications for irrigation scheduling, streamflow prediction, drought monitoring, and climate change impact assessment. However, in some of these sectors, Eo-estimation approaches employ temperature-driven schemes that either omit or only indirectly parameterize the influence of other physically appropriate drivers of Eo variability.

To fully describe the sensitivity of Eo-variability to its drivers, we present a mean-value, second-moment uncertainty analysis applied to a 30-year, CONUS-wide dataset of daily reference ET (ETrc), a commonly used estimator of Eo. For drivers, we use four North American Land Data Assimilation System (NLDAS) variables—temperature, specific humidity, wind speed, and downward shortwave radiation—in the ASCE Standardized Reference Evapotranspiration Equation. This methodology accounts for both the sensitivity of ETrc to its drivers and their observed variabilities, and permits the decomposition of ETrc variability across CONUS at various time scales into contributions from each driver.

We find that, contrary to the assumption of much hydrologic practice, temperature is not always the most significant driver of temporal variability in either ETrc in particular or Eo in general, particularly at intra-annual time scales. Instead, depending on region and season, different drivers dominate; in fact, in many regions, temperature-based parameterizations should be avoided at all time scales.

In this presentation, I will outline the methodology and results of this uncertainty analysis and outline some implications for operational hydrology and climate change analyses of this and other studies.

[1] UCAR Visiting Scientist at National Integrated Drought Information System
NOAA/Earth System Research Laboratory
325 Broadway
Boulder CO 80305