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Drought in Africa: Understanding and Exploiting the Demand Perspective Using A New Evaporative Demand Reanalysis

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Drought is defined as sustained and impactful surface moisture imbalance between supply and demand. While the supply aspect has generally long been well characterized by precipitation, the same cannot be said for the demand side, which is a function of atmospheric evaporative demand (Eo) and surface moisture availability. Traditional drought analyses have neglected Eo entirely or poorly parameterized it using a climatological mean or temperature-based estimates. This is primarily due to (i) a deficient understanding of the role that Eo plays in both driving and exacerbating drought, and (ii) a paucity of data required to fully characterize Eo—temperature, humidity, solar radiation, and wind speed. These deficiencies are particularly acute over data-sparse regions that are also home to drought-vulnerable and food-insecure populations, such as across much of Africa. There is thus urgent need for global Eo estimates for physically accurate drought analyses and food security assessments such as those operationally conducted by the Famine Early Warning Systems Network (FEWS NET). Further we need an improved understanding of how Eo and drought interact and to exploit these interactions in drought monitoring and in support of famine early warning.

NOAA supports FEWSNET's food-security monitoring, early warning, and forecast efforts by providing a nearly 40-year long, daily, 0.125-degree, global dataset of Penman-Monteith reference evapotranspiration as a fully physical metric of Eo. This Eo dataset is driven by MERRA-2—an accurate, fine-resolution land-surface/atmosphere reanalysis—and is proving invaluable for examining and attributing hydroclimatic changes and extremes on secular time scales and in ongoing operations. An emerging drought index based on this dataset—the Evaporative Demand Drought Index (EDDI)—represents drought's demand perspective, and permits early warning and ongoing monitoring of agricultural flash drought and hydrologic drought, both crucial drivers of food insecurity.

Our goal in this presentation is to describe how these needs are increasingly being met by service of Eo data and value-added drought-monitoring and famine early warning products to regional scientists working in food-insecure countries within the FEWS NET framework. We will summarize the development of the E0 dataset and the results of a rigorous variability decomposition across Africa. Further, we will highlight the utility of the dataset by examining the attribution of extreme Eo anomalies associated with canonical droughts across the continent (e.g., the 2015 drought in Malawi, and the 2016 Horn of Africa drought) and by using EDDI in early warning. Together, these analyses will determine where, when, and to what relative degree each of the individual drivers of Eo affects the demand side of drought and greatly contribute to a more holistic understanding of drought and food-security across the continent.