The Pan-tropical Response of Soil Moisture to El Niño

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The 2015-16 El Niño event ranks as one of the most severe on record in terms of the sea surface temperature (SST) anomalies generated in the tropical Pacific Ocean. Corresponding global impacts on terrestrial hydrology were thus expected to rival, or even surpass, those of the 1997-98 severe El Niño event, which had SST anomalies that were similar in magnitude and extent. However, the terrestrial hydrologic response to a strong El Niño, even in those areas that are expected to receive well above or below normal precipitation during such events, is not always consistent. We investigate where the soil moisture response to severe El Niño events is strongest by highlighting areas in the humid tropics (-25° to +25° latitude) according to the Köppen climate classification system that experience consistent changes in soil moisture magnitude and direction during the three most recent major El Niño events of 1982-83, 1997-98, and 2015-16. We use gridded data from the Global Land Data Assimilation System (GLDAS) where the soil moisture response is measured according to October to December (OND) and January to March (JFM) changes in volumetric soil moisture relative to the previous OND and JFM seasons. The strongest declines were found in South America and Oceania with a mean change of -42% and -31%, respectively, over both seasons. The strongest increase of 24% was observed in East Africa during JFM. Confidence in these estimates was assessed by comparing the 2015-16 El Niño soil moisture response from in-situ observations to modeled estimates from the GLDAS grid cells that encompassed those measurements. Our work improves the understanding of El Niño impacts on soil moisture estimates in models and offers insight on the expected spatial differences of these impacts to improve water resource management efforts for regions where changes are expected to be most severe.