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Pacific SST influence on spring precipitation in Addis Ababa, Ethiopia

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In Ethiopia and other parts of East Africa, interannual variability of seasonal precipitation is dependent on variations in sea surface temperature (SST) and atmospheric circulation on both regional and global scales. The majority of research into large-scale atmospheric controls and predictability has focused on the heavier summer rains and the establishment of links to large-scale modes of climate variability such as ENSO. By contrast, relatively little work has focused on the potential for predictability of rainfall during the spring months, which is of great importance to much of southern Ethiopia. Additionally, failure of the spring rains may have important agricultural implications, particularly for crops requiring the full extent of the spring-summer growing season.

Here, we analyse the links between Pacific SST and precipitation in Addis Ababa, Ethiopia for a century-long period (1900-2004). A tripole correlation pattern between spring precipitation and SST is found in the Pacific basin. We develop regression-based models to estimate spring precipitation from Pacific SST with a lead time of 2-3 months. When subject to a rigorous cross-validation, models based on principal component multiple linear regression (PC-MLR) calibrated on Pacific SST during December show good skill in reproducing observed temporal variability in Addis Ababa precipitation during February (r = 0.48) and March (r = 0.40), and the period spanning February to April (r = 0.44). Reconstructed precipitation is correlated with temperature and specific humidity in the surrounding region; estimates of heavy spring precipitation are associated with anomalously warm, moist conditions across the western Indian Ocean.

Our findings suggest that inclusion of Pacific SST in predictive models may benefit drought forecasting across Ethiopia. The relationships identified provide a potential basis for forecasting models for spring rainfall and further analysis may focus on drought forecasting using ROC and RPSS validation scores.