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How El-Nino affects Ethiopian summer rainfall

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Ethiopian economy and society are strongly dependent on agriculture and therefore rainfall. Reliable forecasts for the rainy seasons are important to allow for agricultural planning and drought preparations. The operational seasonal forecasts for Ethiopia are based on analogue methods relying mainly on sea surface temperature (SST) indices. A better understanding of the physical links between Ethiopian rainfall and SST may help to improve forecasts.
The highest rainfall rates are observed in the Kiremt season (defined as JJAS), which is the rainy season in Central and Northwestern Ethiopia. Kiremt rainfall shows clear negative correlation with Central Pacific SST, linking dry Ethiopian summers with ENSO-like warm SST anomalies. We use the atmosphere general circulation model Echam5.3 to investigate the physical link between Pacific SST anomalies and Kiremt rainfall.
We compare a historical simulation with a T106 horizontal resolution ($\sim 1.125°$), forced with reconstructed SST data, to gauge-based rainfall observations for the time period of 1961 to 2009. Composite analysis for model and observations show warm SST anomalies in the Central Pacific and a corresponding large-scale circulation anomaly with subsidence over Ethiopia in dry Kiremt seasons. Horizontal wind fields show a slow-down of the whole Indian monsoon system with a weaker Tropical Easterly Jet (TEJ) and a weaker East African Low-Level Jet (EALLJ) in these summers.
We conducted a sensitivity experiment with El Nino like SST anomalies in the Central Pacific with the same Echam version. Its results show that warm Pacific SST anomalies cause dry summer conditions over Ethiopia. While the large-scale subsidence over East Africa is present in the experiment, there is no significant weakening of the Indian monsoon system. We rather find an anomalous circulation cell over Northern Africa with westerlies at 100-200 hPa and easterlies below 500 hPa.
The anomalous easterly flow in the lower and middle troposphere might reduce the moisture inflow from the Atlantic and Congo basin into Ethiopia. This and the general subsidence over the region can explain the reduction in Kiremt rainfall.