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Freshwater Input Impacts on Sea Surface Temperature Mean State and Interannual Variability at the Southeastern Tropical Atlantic

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The Southeastern Tropical Atlantic (SETA) coastal region has an immeasurable socio-economic and food security importance for southwestern African coastal countries since it sustains large marine ecosystems and highly productive fisheries. It is characterized by the convergence of tropical warm waters from the north and cool subtropical waters from the south, forming the so-called Angola-Benguela Front (ABF). Sea Surface Temperature (SST) interannual variability within SETA is modulated by Benguela Niño/Ninã events, which are extreme warm/cold events that pose severe consequences to local communities due to their impact on rainfall, flooding, and fisheries. Here we highlight the role of the previously overlooked mechanism of freshwater input, mainly from the Congo River, for both the SST mean-state and interannual variability within SETA. To achieve this, a diverse range of datasets is utilized, including satellite measurements, ship-based in-situ observations, reanalysis products, and model simulation outputs. First, we show that the presence of low salinity waters from the river discharge increases the mean state SST in the SETA coastal fringe by about 0.26°C on average and by up to 0.9°C from south of the Congo River to the ABF. North of the Congo River, this input significantly reduces the mean state SST by more than 1°C. The impact of river discharge on SST is associated with a halosteric effect, which modifies the sea surface height gradient, the along- and cross-shore coastal geostrophic currents, and generates upwelling and downwelling north and south of the River’s mouth, respectively. In terms of SST variability, we demonstrate that sea surface salinity (SSS) variability acts as a local forcing that amplifies Benguela Niño and Niña events by changing the water column stratification and consequently the subsurface mixing. The mixed layer turbulent heat loss during an extremely warm episode with unusually low SSS is nearly 3x lower than during a cold event with an anomalously high SSS. In addition, we demonstrate that turbulent heat flux variability in early boreal spring off Angola is mainly driven by SSS interannual fluctuations, and that this turbulent mixing is a significant contributor to altering mixed layer temperatures. These results draw attention to the freshwater impact on SSTs and ocean surface dynamics, especially in the projected climate change scenario of continuously increasing land-to-ocean discharge.