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Objective Analysis of the Observed Spatial Structure of the Tropical Indian Ocean SST Variability

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The observed interannual Indian Ocean sea surface temperature (SST) variability from 1950 to 2008 is analyzed in respect to the spatial structure of the variability. The analysis is based on an objective comparison of the leading empirical orthogonal function (EOF)-modes against the stochastic null hypothesis of spatial red noise (isotropic diffusion). Starting from this red noise assumption, the analysis searches for those structures that are most distinct from the red noise hypothesis. This objective approach will put previously well and less known modes of variability into the context of the multivariate SST variability.
The leading modes of variability are the El Nino Southern Oscillation (ENSO) variability and the warming trend, which both project onto the basin wide monopole structure. Other more characteristic spatial patterns of internal variability are much less dominant in the tropical Indian Ocean, which is quite different from all other ocean basin, where characteristic teleconnection patterns exist.
The remaining, ENSO independent, detrended variability is dominated by multi-pole patterns from the southern Indian Ocean reaching into the tropical Indian Ocean, which are probably primarily caused by extra-tropical atmospheric forcings. The large scale tropical Indian Ocean internal variability itself has no dominant structure. The currently often used Dipole Mode Index (DMI) does not appear to present a dominant teleconnection pattern of the Indian Ocean internal SST variability. In the context of the objective analysis presented here, the DMI index partly reflects the ENSO variability and is also a representation of the multi-dimensional, chaotic spatial red noise (isotropic diffusion) process. As such the DMI index cannot be interpreted as a coherent teleconnection between the two poles.