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Are short-range forecasts of precipitation sensitive to AEW-like moist singular vector perturbations?

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Moist singular vectors (MSV) have been applied successfully to predicting mid-latitude storms growing in association with latent heat of condensation. Tropical cyclone sensitivity has also been assessed. There is now considerable interest in its application for singular vector computation in the tropics and tropical perturbations for the ensemble system on a wider basis than targeting tropical cyclones. Extending this approach to more general tropical weather systems, MSVs are evaluated here for understanding African easterly waves (AEWs) and associated rainfall. These are arguably, the tropical systems that exhibit dynamical organization in a manner that is most similar to extra-tropical weather systems, and yet provide the context for convection that is of great importance both in their development and their subsequent behaviour, in their impact on society and in yielding ideas on the interaction between physics and dynamics in the tropical atmosphere that may have more general relevance.

The systematic errors that can plague the forecast skill in this region may be improved by process studies aimed at understanding the fundamental dynamics governing the WAM. Here we present results from a study that aims to use MSVs to build on our recently gained theoretical insights from normal mode studies of the moist AEJ-AEW system, and to learn for practical purposes, whether MSVs targeted on W. Africa could be suitable as perturbations to the ECMWF ensemble system for improving AEW prediction and associated rainfall. First results, without initial moisture perturbations, suggest MSVs may be used advantageously. Perturbations bear similar structural and energy profiles to previous idealised non-linear studies and observations. Strong sensitivities prevail in the metrics and trajectories chosen. The benefits of including initial moisture perturbations are appraised in the light of these findings with emphasis on perturbation growth mechanisms and the sensitivity of short-range forecasts for precipitation based on AEWs that developed during the AMMA SOP.