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How well is the intertropical discontinuity (ITD) represented in different reanalysis products?

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Reanalysis and operational analysis products are routinely used as the best estimates of the atmosphere at a given time. They are used to initialise both operational forecasts and research simulations and are also one of the most useful tools available for examining the state and behaviour of the atmosphere. Differences in the atmospheric models and data assimilation methods used to generate analysis data can lead to substantial differences, particularly in areas with a sparse observational network. Here we analyse such differences in the distribution of low-level water vapour to estimate the position of the intertropical discontinuity (ITD) during 11 West African Monsoon (WAM) seasons (2000-2010).

The ITD is an important feature to capture. Northward bursts of the ITD are associated with the production of meso-scale convective systems (MCSs), as they require a sufficiently deep monsoonal flow. This way the ITD is a strong factor in the temporal and spatial distribution of rainfall over the region. The ITD is a highly dynamic front with its position being affected by a number of synoptic- and meso-scale forcings. These include: waves on the subtropical jet, mid-level African easterly waves (AEWs) and deformation by convective cold pools.

This work identifies periods when there is a large degree of disagreement as to the position of the ITD (sometimes over 5 degrees of latitude) between the NCEP-NCAR, NCEP-DOE, MERRA, CFSR and ERA-Interim reanalyses as well as the GFS and ECMWF operational analyses. These periods appear to coincide with northward excursions of the ITD and the production of rainfall in the Sahel and Sahara, i.e. times when accurate analyses and forecasts are particularly desirable.

It is thought that the sparse nature of observations over much of West Africa mean that the models are poorly constrained by observations. Therefore, much of the analysis is produced by the models. The relatively coarse resolutions used by global models means that meso-scale processes have to be parameterised. This can produce problems as parameterised convection struggles to produce cold pools and their forcing of the position of the ITD.

It is hoped that this work will inform the community of reanalysis and operational analysis users over West Africa that the use of different products: (1) has implications for operational forecasting of rainfall and research work and (2) will strongly influence the outcome of limited area modelling in the region.