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Evolution of dynamic and thermodynamic fields during the Indian summer monsoon onset in the initialised atmosphere-ocean seasonal forecasting model of the UK Met Office

Arathy Menon (1), Andrew Turner (1), and Gill Martin (2)

(1) University of Reading, NCAS-Climate/Department of Meteorology, Reading, United Kingdom (a.g.turner@reading.ac.uk), (2) Met Office Hadley Centre, FitzRoy Road, Exeter, Devon, United Kingdom

The onset of the Indian summer monsoon has significant influence on the agricultural planning that affects food production and the gross domestic product of the country. Hence understanding and prediction of the monsoon onset is of paramount importance. Here we use hindcast simulations from the Met Office fully coupled atmosphere-ocean Global Seasonal Forecast System 5 (GloSea5) to study the monsoon onset over India. The GloSea5 hindcast simulations are produced for three different start dates in late April or early May prior to the monsoon season and the atmosphere and ocean components are both initialized. Rather than focus on skill metrics of the performance at simulating the onset timing, we use common objective indices of the onset circulation and wind shears in the meridional (Wang-Fan) and vertical (Webster-Yang) directions to determine the monsoon onset over India. We find that the dynamic indices obtained from GloSea5 ensemble mean are consistent with those from the ERA-Interim reanalysis dataset. GloSea5 is also very effective in capturing the spatial pattern of the monsoon rainfall progression following the onset. We next analyse the composite evolution of various dynamic and thermodynamic fields associated with these indices, focusing on recent findings suggesting the importance of dry air incursions above the surface from the northwest. We further extend our analysis by looking at the physical mechanisms leading to onset in the GloSea5 simulations, and examine case studies comparing late and early onset years in both the model hindcasts and reanalysis data.