On the Causes of the Poor Simulation and Forecast of the Intraseasonal Oscillation by Numerical Models

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We evaluate the forecasted regional and local vertical structure of ISO-related anomalies from a numerical experiment using the fully-coupled ECMWF model from the monthly forecasting framework (Vitart 2004) compared to those in ERA40 data in different stages of the convective activity.

Winter Case
We computed latitudinally-averaged zonal winds and specific humidity anomalies in the 10°S-10°N latitude band relative to the mean during the TOGA COARE IOP and estimated the correlations and RMS between model forecasts and ERA-40 for 5-day averaged anomalies. The region considered spans between 60°E and 170°W and from 1500 to 100hPa.

There are states of the system for which the skill of the forecast is always low. Those states coincide with convective events, for which the skill of the forecast decreases regardless of the starting date of the forecast.

Forecasts of zonal winds were skillful up to about 13 days. Forecasts of specific humidity have no skill whatsoever.

Meridional Structure
Analysis of the meridional vertical structure of specific humidity anomalies presents an interesting feature different from the results during winter

The model does not reproduce the suppressed and active sequence, the result is a permanent active-like phase in the forecast over India. Given that the model is always forecasting an active-like phase of the monsoon, it will match the observations when actual active conditions are present over India, artificially increasing the skill in some phases.

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ERA-40 anomalies (top) show the growth of the convective event from the Indian Ocean. In general, the three control forecasts (bottom) suggest a dryer atmosphere than ERA-40.

Forecasts are about 1 degree cooler than ERA-40 near the surface and about 0.5 degree warmer around 500 mb. This feature, together with the drier atmosphere in the forecasts, result in a more stable atmosphere compared to ERA-40 data, limiting the development of deep convective events.

Series of 30-day forecasting integrations
Integrations include a control forecast and four ensemble members
Winter Case
TOGA COARE IOP November 1992/March 1993
Summer Cases
April 15/May 15, 2002
May 18/June 18, 2004

Time scale of skillful forecasts during summer is between 5-7 days while in winter it is at least double. While the analysis is not comprehensive, as it only includes three serial experiments, it suggests that the skill of the forecast is greater for winter cases than for summer events.

Average correlation and RMS error estimated from the vertical structure of the anomalies from 1000 to 200mb for the control run (black line) and all ensemble members (color lines). Dash-dotted line corresponds to the 99% statistical significance threshold

While the set of ensembles is small, the fact that the skill of all members is similar in all runs suggests that the spread of the ensembles is not sufficient to account for all degrees of freedom in the coupled system.

The increasing correlation and the decaying RMS for forecast lead times greater than 8 days would suggest that the forecasts become more skillful as the forecast window increases.

The model forecasted a positive specific humidity anomaly in the right location (~70°E) but not sufficiently deep, missing the convective event.

In a more mature convective stage the pattern of the forecasted zonal wind anomalies coincides well with ERA-40 in shape but not in magnitude (weak anomalies).

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