Impact of the initialization with different ocean reanalysis on forecast bias

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1. Motivation and open questions

Introduction: Strong systematic SST biases in Tropical Atlantic commonly develop in seasonal forecasts among most GCMs¹ ². In EC-Earth3, a strong warm surface temperature bias develops in less than a month in boreal winter or summer over Angola-Benguela Area (ABA), and a cold surface temperature bias develops, which is particularly strong in boreal winter, in ATI3 (Figs 1a and 2).

Research questions: What are the mechanisms responsible for the error growth in Tropical Atlantic? What is the impact of the initialization with different ocean reanalysis (ORAS4 and GLORYS) on the forecast bias?

Model: EC-Earth3.0.1, T255L91-ORCA1L46

Simulations: Initialized every 1st May and 1st November between 1993-2009, 4 month forecasts, 10 ensemble runs. Atmosphere and land initialized from ERA-interim. Ocean and sea-ice initialized from ORAS4 and GLORYS2v1 (interpolated to ORCA1L46 configuration).

2. Biases in near-surface temperature

3. In which start dates is the error stronger in ABA?

4. Is the temperature bias caused by erroneous surface fluxes?


6. Tentative remarks & Outlook

References:

Fig 1: Monthly mean bias (years 1993-2009) of sea surface temperature for simulations initialized from ORAS4 (top two rows) and GLORYS (bottom two rows), for the forecast initialized with ORAS4 and in the bottom row by GLORYS.

Fig 2: Time series of sea surface temperature anomalies of HadISST (black lines), and of the forecast anomalies (colored lines) with respect to HadISST climatology, for May (left column) and November (right column) start dates, averaged over ABA (box shown in Fig 1d). The forecasts shown in the top row are initialized by ORAS4 and in the bottom row by GLORYS.

Fig 3: Time series of near-surface heat flux anomalies of ERA-interim (black lines), and of the forecast anomalies (colored lines) with respect to ERAInterim climatology, for May (left column) and November (right column) start dates, averaged over ABA (box shown in Fig 1d). The forecasts shown in the top row are initialized by ORAS4 and in the bottom row by GLORYS.

Fig 4: Daily time series of the differences in surface heat fluxes (positive downwards) between model and ERAInterim for forecasts initialized from ORAS4 (top row) and GLORYS (middle row), for the forecast initialized in May 1995 (left column) and November 2000 (right column). Bottom row: biases in vorticity, for run initialized by ORAS4 (red) and GLORYS (gray), where dashed lines denote 15-days running means. All plots are for data averaged over ABA (box shown in Fig 1d).

Fig 5: Monthly mean bias (years 1993-2009) of sea surface temperature for simulations initialized from ORAS4 (top two rows) and GLORYS (bottom two rows), for the forecast initialized with ORAS4 and in the bottom row by GLORYS.

Detailed analysis and discussion of the mechanisms responsible for the error growth in Tropical Atlantic, and the impact of the initialization with different ocean reanalysis (ORAS4 and GLORYS) on the forecast bias.