A Niño-like mode of variability in the tropical Atlantic

Heat Flux Correction improves simulated variability

Predicting the Atlantic Niño 2-3 months ahead

• Atlantic Niño: Mode of coupled interannual variability. Manifestation in the onset and magnitude of the equatorial cold tongue [1] → Phase-locked to boreal summer [1, 2] (Figs 1, 2)

• Dynamics: Similar to the Pacific, but seasonally active [1]

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Fig. 1: Observed seasonal cycle (top) and variance (bottom), 1981-2012. 1988-1992 was the most positive (negative) Atlantic Niño. The Atlantic Niño index is the Atl3 SST anomaly averaged for May-July. An event occurs if the index exceeds one standard deviation.

Fig. 2: Evolution of the Atlantic Niño pattern (shading) as positive minus negative composites. Composites are based on the Atlantic Niño index. Contours show climatological SSTs, 1981-2012: solid: >25°C, thick: 25°C, dashed: <25°C, the contour interval is 1°C. Box: Atl3-region.

Fig. 3: (Top) Evolution of Atl3 SSTs in observations (black line, same as in Fig. 1), the heatflux corrected experiment (blue, FLX), and the standard experiment (red, STD). (Bottom) Anomaly correlation coefficient (ACC) between observed and simulated Atl3 SST. Simulations are for the assimilation runs, i.e. for the initial conditions of the forecast. Blue: FLX, red: STD. Circles indicate correlations that are significantly different from 0 at the 95% level. Grey background shading denotes the restart months.

• Produce initial conditions for forecasts via partial coupling [3] with the Kiel Climate Model (KCM). Partial coupling forces the ocean-sea ice component of the KCM with observed wind stress anomalies. Surface heat fluxes, SST, and the wind field remain fully prognostic. Hence, the modelled balance between wind stress and the ocean pressure gradient is not disturbed [3].

• Two experiments:
  - STD: Standard partial coupling
  - FLX: Apply additional surface heat flux correction, i.e. strong SST bias alleviation (Fig. 3, top)

• Results (Fig. 3, bottom):
  - Strong improvement of simulated variability in boreal summer and fall → Atlantic Niño peak season well captured in initial conditions
  - Pitfall: Still no skill in May → problematic for Niño event forecasts

• Implications for forecasts started from these initial conditions?

Summary

• SST bias alleviation systematically improves both the initial conditions and the forecasts (Figs 4, 5).

• Incorporating persistence skill allows for useful forecasts 2-3 months ahead.

• The presence of two predictability barriers (Fig. 6) and the seasonal nature of the Atlantic Niño suggest that potential predictability does probably not persist for more than a few months.