Prediction and projection with anomaly coupling

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Current state-of-the-art models exhibit large climatological errors in the tropical Atlantic. Such unfavourable errors degrade the skill of climate predictions and introduce uncertainty in climate projections. Here we investigate (1) seasonal predictions and (2) climate projections with a standard and an anomaly coupled configurations of the Norwegian Climate Prediction Model (NorCPM). Correcting momentum and SST fields exchanged between oceanic and atmospheric models significantly reduces the climatological errors in the anomaly-coupled version. The mechanisms for equatorial Atlantic variability are better represented, but the variability is reduced in strength. This enhances the ability of the model to assimilate ocean observations in this region. A set of seasonal predictions with both standard and anomaly-coupled models indicates that together this leads to a significant improvement in the skill in predicting the Atlantic Niño mode.

Regarding climate projection, the standard model shows a rather uniform warming of around 2.5 degrees Celsius over the equatorial Atlantic. In contrast, the corrected model shows greater warming in the east, reaching 3 degrees Celsius in the eastern equatorial Atlantic. These changes are reflected in quite different rainfall response patterns. The standard model shows that climate change will lead to wetter conditions over central Africa and the western Atlantic, and drier conditions over eastern equatorial South America and the south equatorial Atlantic. The corrected model, in contrast, shows greater rainfall changes in the east and over central Africa, and less drying over South America. The underlying mechanisms will be discussed. This result illustrates the potential impact of mean state errors in future climate change in this region.

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