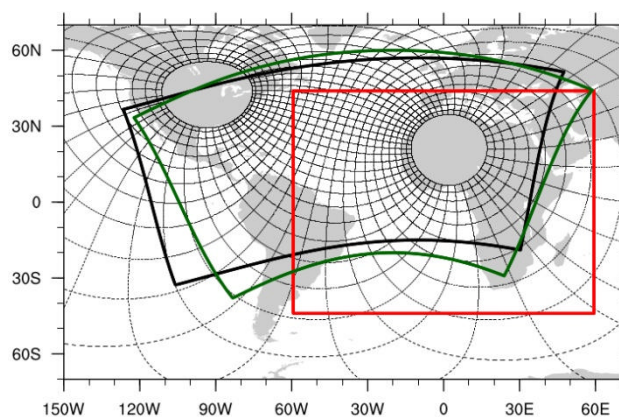


# The role of the South Atlantic Anticyclone in the Tropical Atlantic climate variability.

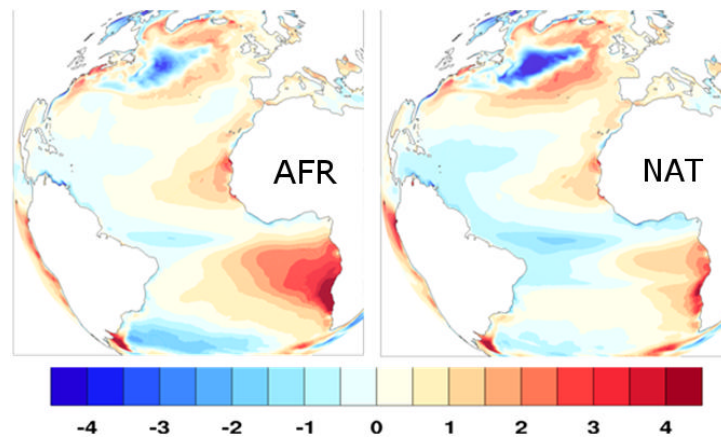
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The climate simulated by coupled atmosphere-ocean general circulation models (CGCMs) has shown warm biases in the sea surface temperature of both the tropical Pacific and Atlantic, particularly in their eastern part (Richter et al 2012). Coupled regional climate models (RCAOM) enable a more detailed analysis of regional climate conditions and variability in specific areas, allowing to include or exclude key sources of variability for the region of interest. We propose to take advantage of this feature and use the ROM RCAOM (Sein et al 2015) to examine the key role of the South Atlantic Anticyclone (SAA) on the seasonal cycle of the tropical Atlantic ocean and the role it plays in the generation of the biases in the southern Tropical Atlantic. Our strategy is based on the comparison of RCAOM simulations with different model setups with various domain placements. Three sets of simulations that differ in the region of coupling will be carried out. In all three cases, the coupled domain includes the equatorial Atlantic and a large region of the northern Tropical Atlantic. In the first setup the coupled model domain includes all relevant regional atmospheric features for the STA dynamics in the model domain, namely the ITCZ and the SAA. In the second setup, the coupled domain is shifted towards the Northern Hemisphere to explicitly exclude the core, covering the northern branch of the SAA. Finally, in the third set of simulations the coupled domain has an intermediate extension, including completely the Angola Benguela Frontal Zone, cutting the SAA just south of its core (see Fig.1). In such a way, we can investigate the role of the SAA as an internal vs external forcing and the importance of a correct simulation of SAA for the STA biases. Two of these domains, the AFR and the NAT have been used to test the hypothesis that the SST biases at the equator and at the south eastern Tropical Atlantic can be strongly related to errors in the simulation of the South Atlantic Anticyclone by keeping the core of the Anticyclone outside the coupled region (Cabos et al, SUBMITTED). The effects of the location of the domain on the simulated SST can be seen in Figure 2, when a significant reduction of the biases for the NAT domain is apparent.



**Fig.1** Red, black and green bold lines mark the different REMO domains. Every 24th line is shown for MPIOM (gray lines)

Further insight on the impact of ocean-atmosphere interaction processes for the SAA and SST zonal gradient will be provided by the consideration of stand-alone simulations with the ocean and atmospheric components of our regional coupled model. We also propose to explore the role of vertical and horizontal resolution of the atmospheric component on the simulated climate. For this, we will carry out simulations with 50 and 25 km in the horizontal and 27 and 40 vertical levels.



**Fig. 2** Mean SST bias (K) for 1980-1999. The same ocean and the same REMO parameterization were used. In the AFR setup the coupled region covers the whole SAA. The NAT setup only includes the Northern part of the SAA

Thus, within the frame of this project we will try to answer the following scientific questions:

- (i) Which is the impact of the SAA location and strength on the simulation of the southern tropical Atlantic seasonal cycle and model biases
- (ii) the impact of the SAA location and strength on the simulation of the southern tropical Atlantic interannual variability
- (iii) the role of atmosphere-ocean coupling in the seasonal cycle and interannual variability
- (iv) the impact of the horizontal and vertical resolution of the atmospheric model on the simulation of the seasonal cycle

## References.

1. Sein, D. V., U. Mikolajewicz, M. Gröger, I. Fast, W. Cabos, J. G. Pinto, S. Hagemann, T. Semmler, A. Izquierdo, and D. Jacob (2015), Regionally coupled atmosphere-ocean-sea ice-marine biogeochemistry model ROM: 1. Description and validation, J. Adv. Model. Earth Syst., 7, 268–304, doi:[10.1002/2014MS000357](https://doi.org/10.1002/2014MS000357)
2. Sein, D. V., Koldunov, N. V., Pinto, J. G. and Cabos, W. (2014): Sensitivity of simulated regional Arctic climate to the choice of coupled model domain, Tellus A, 66, p. 23966. doi: 10.3402/tellusa.v66.23966
3. Richter, I., S.-P. Xie, A. T. Wittenberg, and Y. Masumoto, 2012b: Tropical Atlantic biases and their relation to surface wind stress and terrestrial precipitation. Climate Dyn., doi:10.1007/s00382-011-1038-9
4. Lübbecke, J. F., C. W. Böning, N. S. Keenlyside, and S.-P. Xie, 2010: On the connection between Benguela and equatorial Atlantic Niños and the role of the South Atlantic Anticyclone. J. Geophys. Res., 115, C09015.
5. Cabos, W, Sein, D. V., A. Izquierdo., N. S. Keenlyside, Pinto, J. G., F. Alvarez. and D. Jacob. Importance of the South Atlantic Anticyclone for the Tropical Atlantic annual cycle. Submitted to J. of Climate