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A first look at wind stress sensitivity experiments with CNRM-CM5.2 within the framework of PREFACE WP6 coordinated experiments

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Introduction

- Coupled general circulation models have systematic biases in the tropical Atlantic.
- Most research so far has focused on the equatorial Atlantic region, however biases in this region are strongly model dependent. For example, in the CNRM model the bias is strongly linked to the missing spring cooling.
- The biases in the South-East tropical Atlantic have been poorly studied so far, even though they are very robust among models.
- The aim of PREFACE WP6 is to identify possible sources of bias development and to assess similarities and differences between different models by performing coordinated sensitivity experiments in order to try to improve our understanding of the formation of SST biases, especially focussing on the South-East tropical Atlantic.

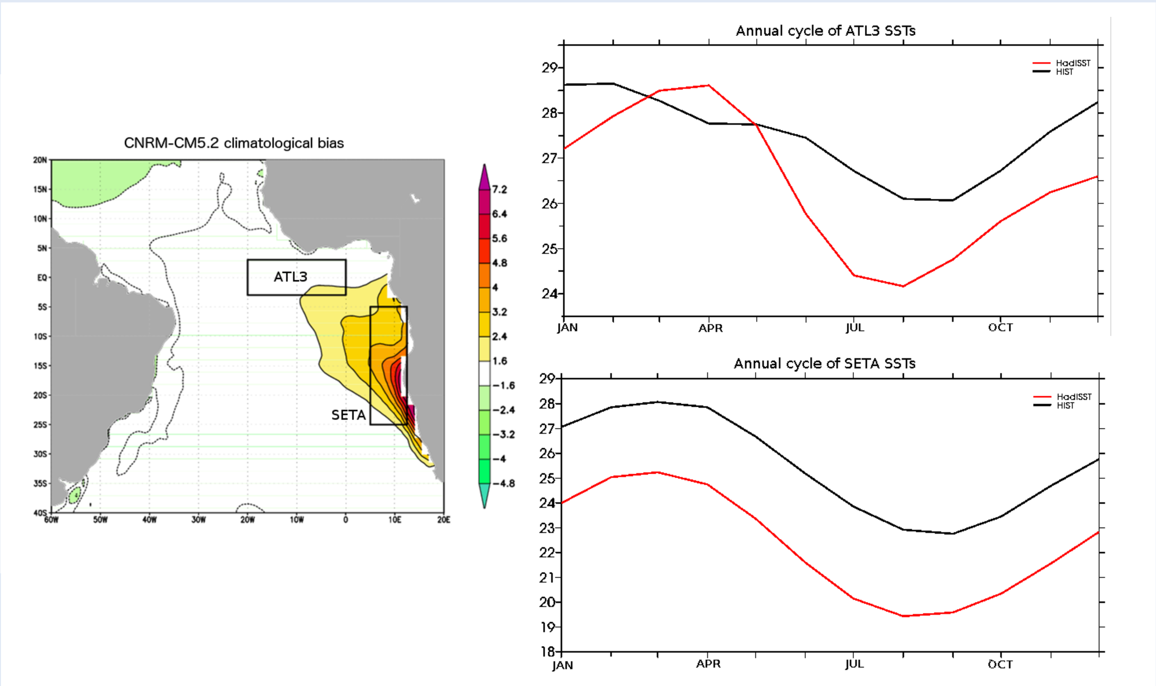

Figure 1 : Climatological mean bias and and mean annual cycles of SST in the ATL3 and SETA regions for the coupled model CNRM-CM5 historical run (HIST) compared to HadISST [K].

Experiment setup

- **Model**: CNRM-CM5.2 (1.4° horizontal resolution in the atmosphere, ocean on ORCA 1° grid)
- **Initialization**: Atmosphere – ERA-Interim, Ocean – ORAS4
- **Forcing**: ERA-Interim daily wind stress data
- **Experiments**: initialized hindcast experiments starting on the 1st of February and 1st of May for the years 2005-2007, 3 members, 3 months

CTL	control experiments
WATL30	wind stress prescribed over the whole Atlantic from 30S-30N with a 5° tapering zone
WATL5	wind stress prescribed over the whole Atlantic from 5S-5N with a 5° tapering zone
WSETA	wind stress prescribed over the South-East tropical Atlantic from 30S-10S, 0E-coast with a 5° tapering zone

Table 1 : Overview of the experiments performed.

Monthly mean SST biases 2007

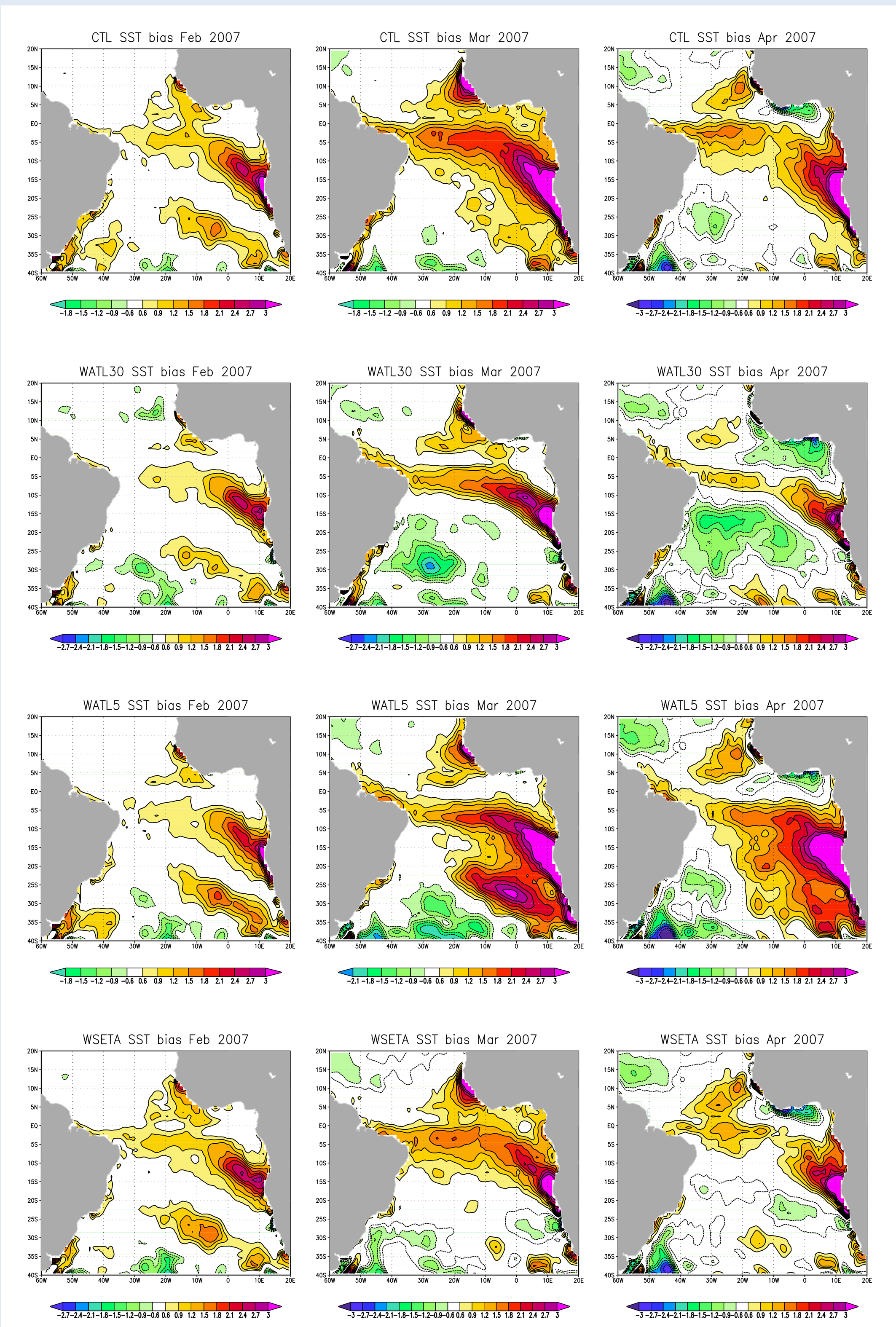

Figure 2 : Monthly mean SST biases with respect to HadISST [K].

Box average monthly mean biases

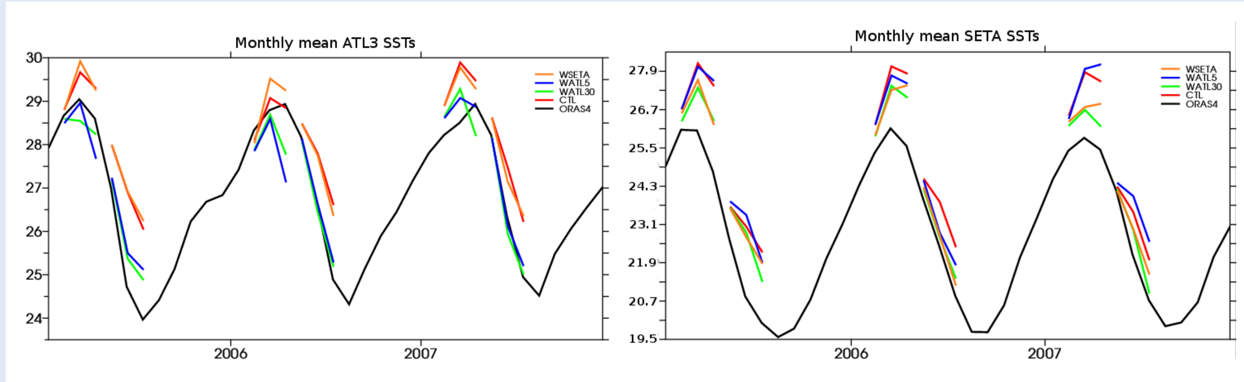

Figure 3 : Monthly mean SSTs for the hindcast experiments (ensemble mean) compared to ORAS4 [K].

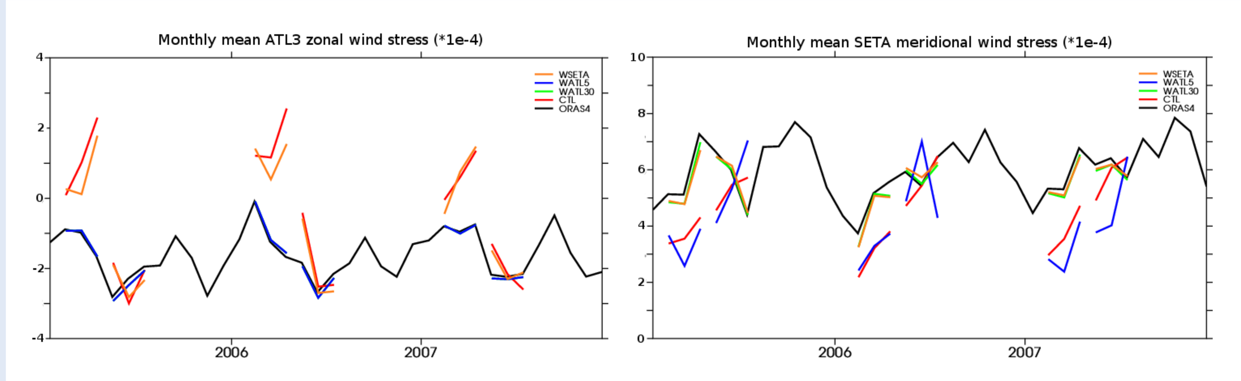

Figure 4 : Monthly mean zonal wind stress over the ATL3 region and meridional wind stress over the SETA region for the hindcast experiments (ensemble mean) compared to ORAS4 [N/m2].

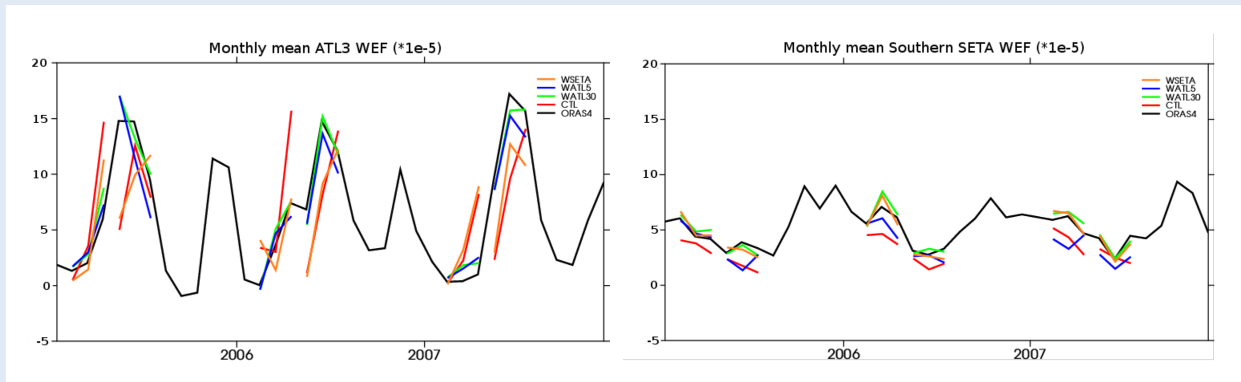

Figure 5 : Monthly mean wind energy flux (WEF) for the hindcast experiments (ensemble mean) compared to ORAS4. Instead of the SETA box the average is taken from 20S-30S [N/(ms)].

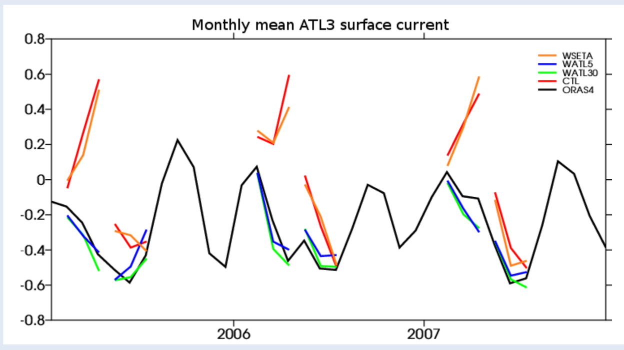

Figure 6 : Monthly mean zonal surface current for the hindcast experiments (ensemble mean) compared to ORAS4 [m/s].

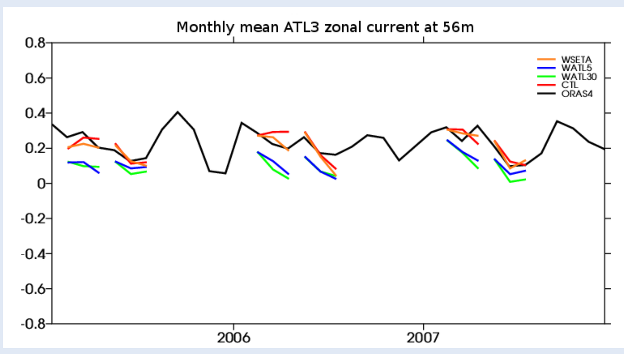

Figure 7 : Monthly mean current at 56m depth for the hindcast experiments (ensemble mean) compared to ORAS4 [m/s].

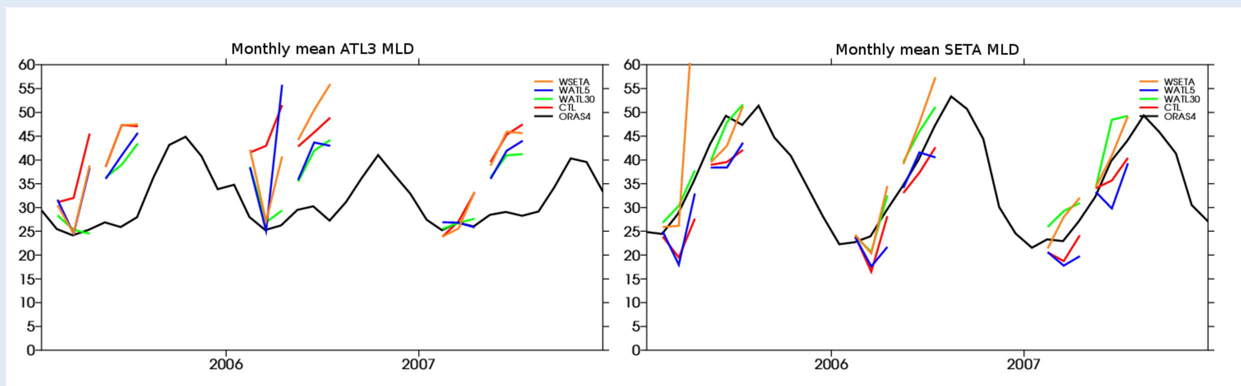

Figure 8 : Monthly mean mixed layer depths (MLD) for the hindcast experiments (ensemble mean) compared to ORAS4 [m].

Box average daily bias evolution

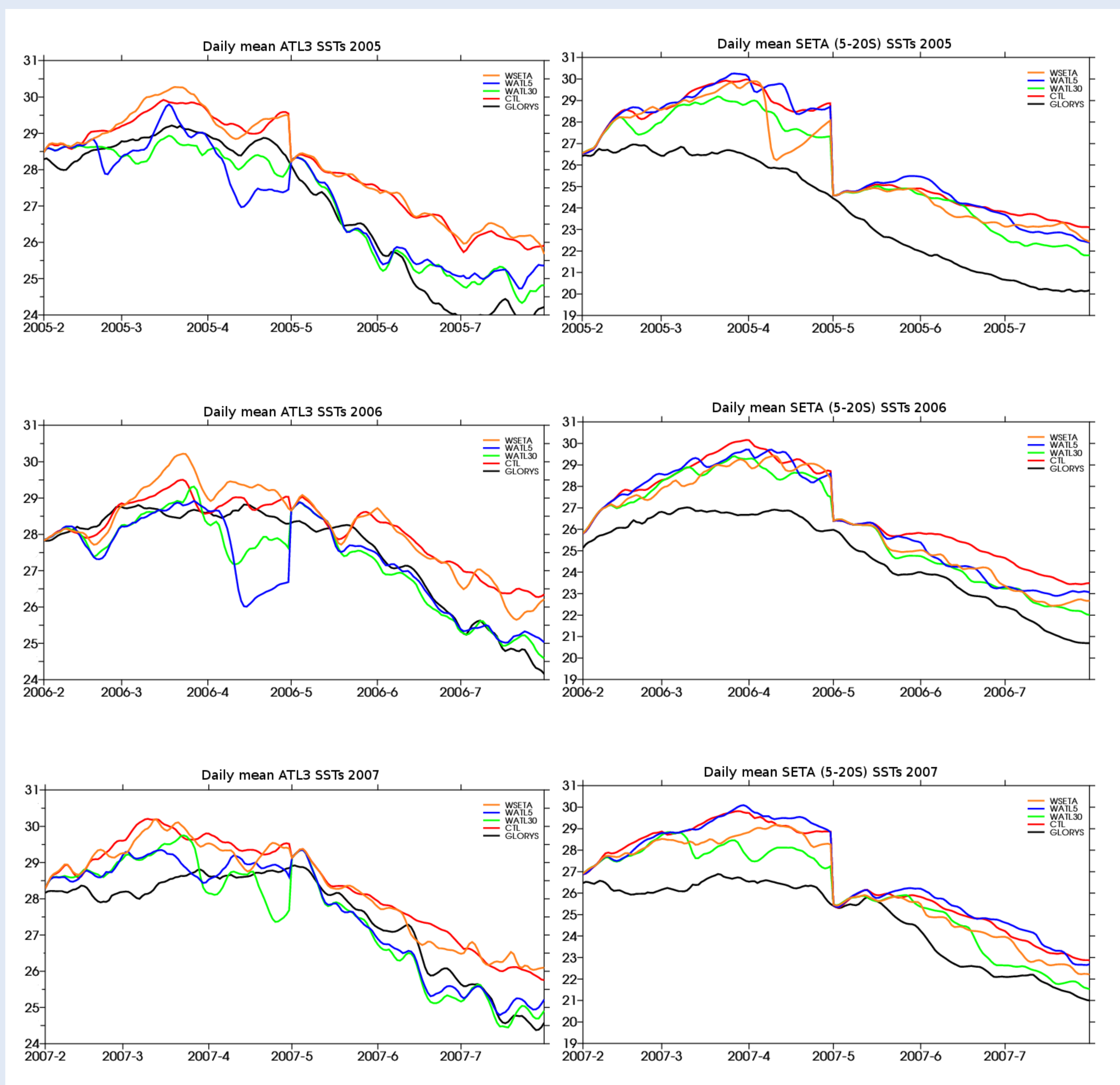

Figure 9 : Daily mean SST evolution for the hindcast experiments (ensemble mean) compared to Glorys. Please note that the SETA box size is reduced to 5-20S [K].

Daily biases continued

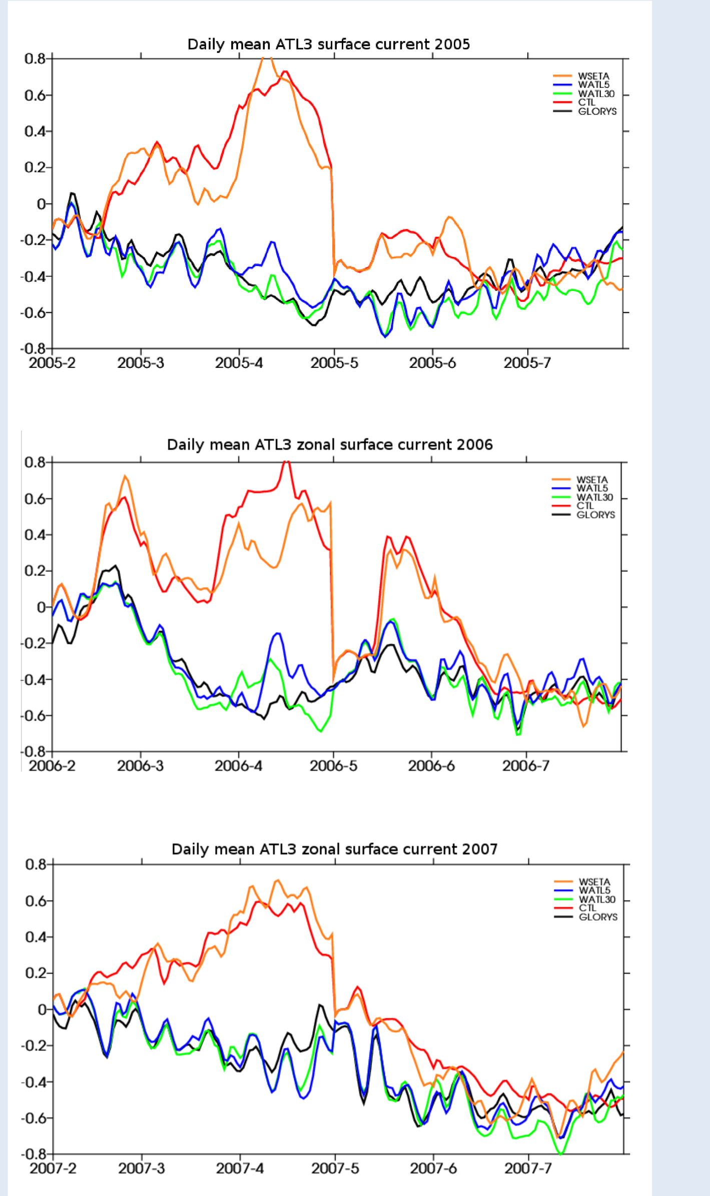

Figure 10 : Daily mean surface zonal current evolution for the hindcast experiments (ensemble mean) compared to Glorys [m/s].

Conclusion

- Prescribing the wind stress over the equatorial Atlantic reduces the bias in this region and greatly improves the spring cooling in the ATL3 region for the experiments starting in May.
- For the February starts not so clear picture → need to run the experiments for longer.
- In the SETA region improvements when prescribing wind stress over the region, but no remote impacts from correcting the wind stress over the equatorial Atlantic.
- The bias directly off the African coast around 15°S is only weakly impacted by the wind stress forcing.

Outlook

- Complete the experiment set for all the years from 1993-2009.
- Increase the length of the experiments to 6 months?
- Perform additional experiments initialized from GLORYS to study possible impacts of different initial conditions.
- In addition to the experiments presented here additional CTL experiments with an atmosphere-only model and if possible experiments with SST restoring to observations are planned to study the role of the coupling.
- A further possible experiment is the same as CTL but with a solar heat flux correction over the SETA region.

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