PREFACE Milestone Report

Milestone#: MS29

Milestone name: Conclusion of all WP9 experiments

WP#: WP9

Lead beneficiary: UCM

Delivery date from annex I: 30.04.2016 (achieved 12.11.2016)

Milestone achieved: YES

Comments:

The milestone was achieved. It consisted in finishing the new experiments proposed in WP9. In this WP there were 5 different experiments:

1. "Subtropical anticyclones-Equatorial mode: Sensitivity experiments with OGCM (NEMO) using prescribed appropriate winds focusing on the Atlantic basin (UCM)". These experiments consist in a long inter-annual simulation with the tropical Atlantic configuration of NEMO model, ATLTROP025 (http://forge.ipsl.jussieu.fr/nemo-atltrop) for the period 1958-2011. NEMO-ATLTROP presents a ¼° horizontal resolution and 46 z-levels ranging from 5 m thickness in the upper 30 m to 200 m thickness at the bottom. Atmospheric parameters as air-sea fluxes, wind speed at 10 m, air temperature, humidity, shortwave and long-wave radiations and precipitation from the so called DRAKKAR forcing sets, version DFS4.4, are considered as external forcing. The experiments are currently being analysed.

2. "Impacts of the Equatorial Mode: Sensitivity experiments with AGCM (UCLA AGCM, Speedy AGCM) with appropriate prescribed SST boundary conditions in the Atlantic basin (UCM)." These experiments consisted in 3 different sets: The aim of the first set was understanding the impact of the Equatorial Mode in a warmer climate: SPEEDY v. 40 AGCM was used at t30 resolution and an anomalous SST pattern in the Tropical Atlantic superimposed on different SST climatologies related with the present and a future warmer climate. In whole, approximately 900 years of simulation were performed. The results were published in Mohino and Losada (2015). In the second set, both, the UCLA v.7.3 AGCM (resolution 2º lat x2.5º lon) and SPEEDY v.40 at t30 were used to evaluate the impact of the different structure of the Equatorial Mode before and after the 1970's. In whole, approximately 210 years of simulations were used. The results were published in Losada and Rodriguez-Fonseca (2015). The third set was aimed at understanding what effect does the change of climatology (1950-60 vs 1975-1985) has in the impacts of the Equatorial Mode. Simulations using the UCLA v.7.3 and SPEEDY v.40 were performed (approximately 240 years of simulation). UiB also performed this third experiment with CAM4. Results are currently being analysed.

3. "SAOD: Partially coupled AOGCM (ICTP Speedy + mixed layer ocean) simulations: Prescribed conditions in the Atlantic region, fully coupled elsewhere (UNN)".The initially planned experiment has been slightly modified drawing from our experience in the project during the past three years; in particular, our recent analysis of interannual to decadal equatorial Atlantic variability using observational data sets. The redesigned experiments conducted are as follows: [1] SPEEDY v.41.5 atmospheric model coupled to NEMO ocean model, [2] SPEEDY coupled to ocean mixed layer model and [3] uncoupled SPEEDY model experiments with prescribed observed SST anomalies in the tropics and then extratropics. The length of these experiments ranges between ~150 and ~250 years. These

experiments are aimed at investigating the robustness of equatorial Atlantic decadal variability, the roles played by the extratropics versus tropics and the related physical processes.

4. “Two-way Atlantic-Pacific: Partially coupled AOGCM (ICTP Speedo and/or UCLA-MIT) sensitivity experiments (UCM)”. These consist in three experiments preformed with the ICTP Speedo (SPEEDY v.40 AGCM+1.5 layer ocean model) for the 1871-2002 period: two partially coupled runs with prescribed SSTs varying in the Atlantic and Pacific basins, respectivelly and one with fixed climatological SSTs. In total, there are approximately 1980 years of simulations. Results from these simulations were published in Martín-Rey et al. (2014). UiB in collaboration with GEOMAR also provided analogous 5 member ensemble of simulations with the ECHAM5/MPIOM model and observed SST prescribed in the Atlantic and covering the period 1950-2005. These simulations are being jointly analysed.

5. “Atlantic subpolar gyre-TAV: Coupled model (AGCM+Mixed Layer Ocean and AGCM+flux corrected OGCM) experiments with active stratosphere (UiB)”. The experiment design was changed following analysis of Atlantic Multi-decadal variability (AMV) in a high-top ECHAM6/MPIOM simulation. In particular, while we found the model is able to reproduce the observed warm North Atlantic SST - negative phase of the NAO relation, it was weaker than observed, particularly at the surface. Results from this work are published in Omrani et al. (2015). Thus instead of following the original plan, we performed a sets of experiments with the ECHAM6 high-top model that account for the weak simulated response. In particular, we applied much larger extra-tropical SST anomalies than those observed during AMV, and we decided to instead focus on the potential impacts associated with global warming. Global warming simulations indicate that the subpolar gyre region of the North Atlantic will warm much less than the rest of the global oceans, and there is some evidence for this already from observations. We performed four AGCM simulations each of 60 years length with the following surface boundary conditions: (1) SST and sea ice conditions from present day ECHAM6/MPIOM coupled simulation, (2) SST and sea ice conditions from a future ECHAM6/MPIOM coupled simulation, (3) as in (1) but with future changes in the SST structure added over the extra-tropical North Atlantic, and (4) as in (2) but with future changes in the SST structure removed over the extra-tropical North Atlantic. Comparison of these experiments provides an assessment of the impact of the North Atlantic “warming hole” under present and future conditions on the tropical Atlantic and the rest of the globe.

The milestone contributes to WP9, mainly to Objective 1 and its correspondent deliverable D9.1 (experiments 1, 2 and 3). There is also a contribution to Objective 2 and milestone D9.2 (experiment 5).

REFERENCES (PREFACE)

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Omrani, N.-E., J. Bader, N. S. Keenlyside and E. Manzini, 2015, Troposphere-stratosphere response to large-scale North Atlantic Ocean variability in an atmosphere/ocean coupled model, Clim. Dyn., 46: 1397-1415, doi:10.1007/s00382-015-2654-6