Project: **802**
Project title: **COSMO-CLM simulations with 2-way nesting**
Project lead: **Andreas Will**
Report period: **1.1.2016 - 31.12.2016**

The current status of the project

In 2016 the results of COSMO-CLM simulations with different configurations and ERA-Interim initial and boundary conditions were further analysed A substantial bias in mean precipitation was identified as the key problem. This problem could be fixed and the coupling physics improved. The reason was the difference in saturation adjustment in COSMO and ECHAM. Based on these results the physical consistency of the two-way coupling was further investigated and improved. The results are shown in Figure 1. The figure TWC v5 exhibits a strong negative bias within the coupling region Central America to North Atlantic (CANA). The bias in other regions is similar to that of MPI-ESM stand alone (OWC) simulation. The additional precipitation bias of TWC vanishes nearly completely if the humidity variables are not exchanged between the models. A further improvement is found by introduction of the iteration of the vertical interpolation in both directions, visible in particular in PMSL (Fig. 2) in the simulation TWC i2dco.

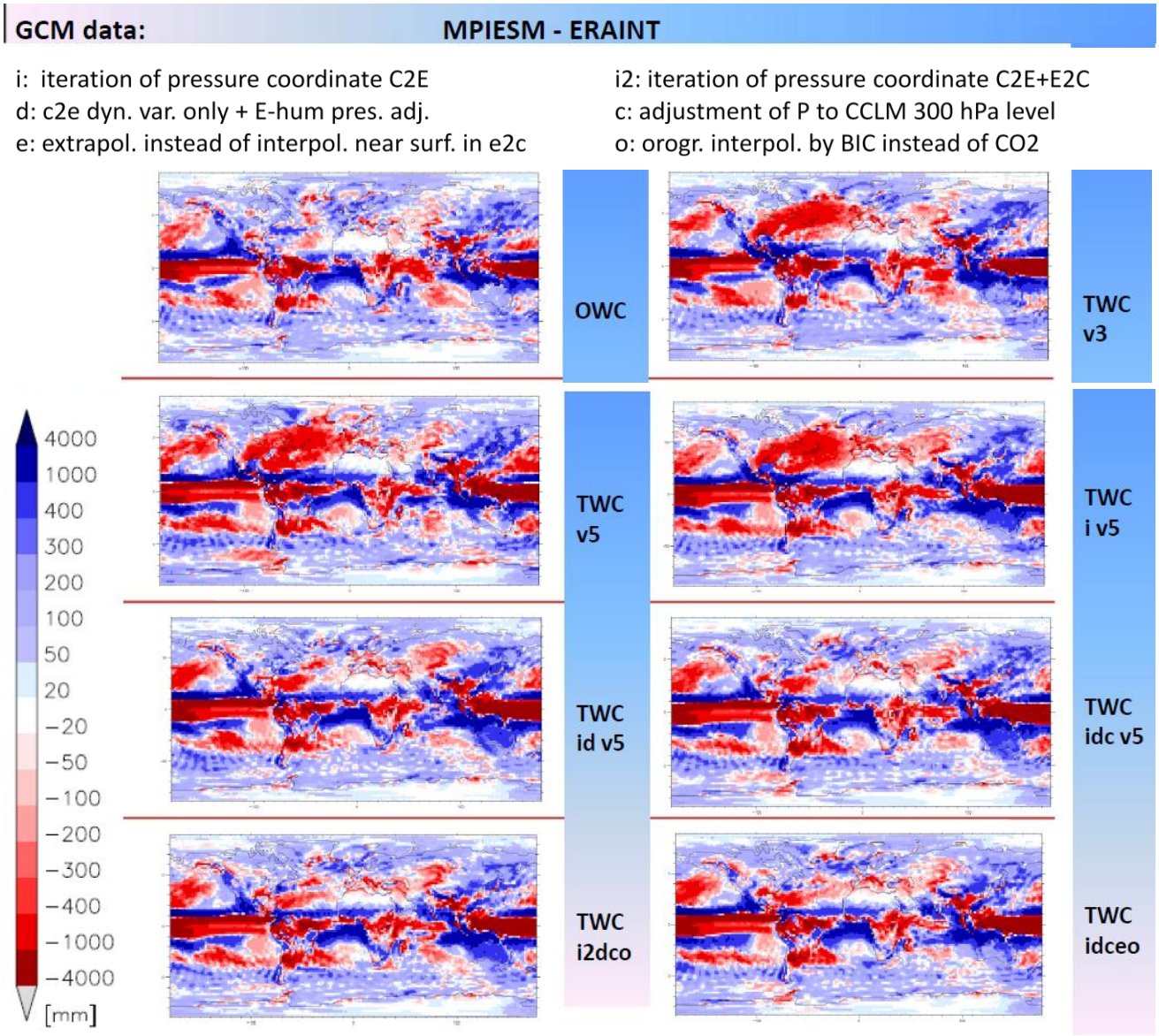

Figure 1: 2001-2002 mean Total precipitation difference MPI-ESM – ERAINT for different configuration of the two-way coupling given right of the corresponding figure. The acronyms are explained in the legend located on top of the picture.

The quality of the TWC achieved depends on the quality of the vertical interpolation. The results obtained are promising, since no obvious artefact is found in the results. Up to the knowledge of the author, there is no other two-way coupling between atmospheres, which has this level of accuracy and allows for a local increase of vertical resolution.

The same method of coupling (via OASIS3-MCT) is now being implemented in ARPEGE as well. This allows (in near future) to compare the results of CCLM+MPI-ESM coupling with those of CCLM+ARPEGE.

Furthermore, the performance of the CCLM+MPI-ESM coupling has been investigated in a systematic way. The results are published in Will et al. (2017). They exhibit negligible cost of coupling (horizontal interpolation +communication) by OASIS3-MCT. The total cost are high due to lack of parallelization of the computation of horizontal derivatives in MPI-ESM and usage of an expensive vertical interpolation method (spline interpolation) in CCLM. There are standard solutions for both and thus, the cost of TWC is potentially small in comparison with the cost of CCLM plus MPI-ESM.

The relevance of this TWC modeling approach in comparison with local grid refinement thus depends on the relevance of the increased horizontal and vertical grid refinement. This shall be investigated in 2017.

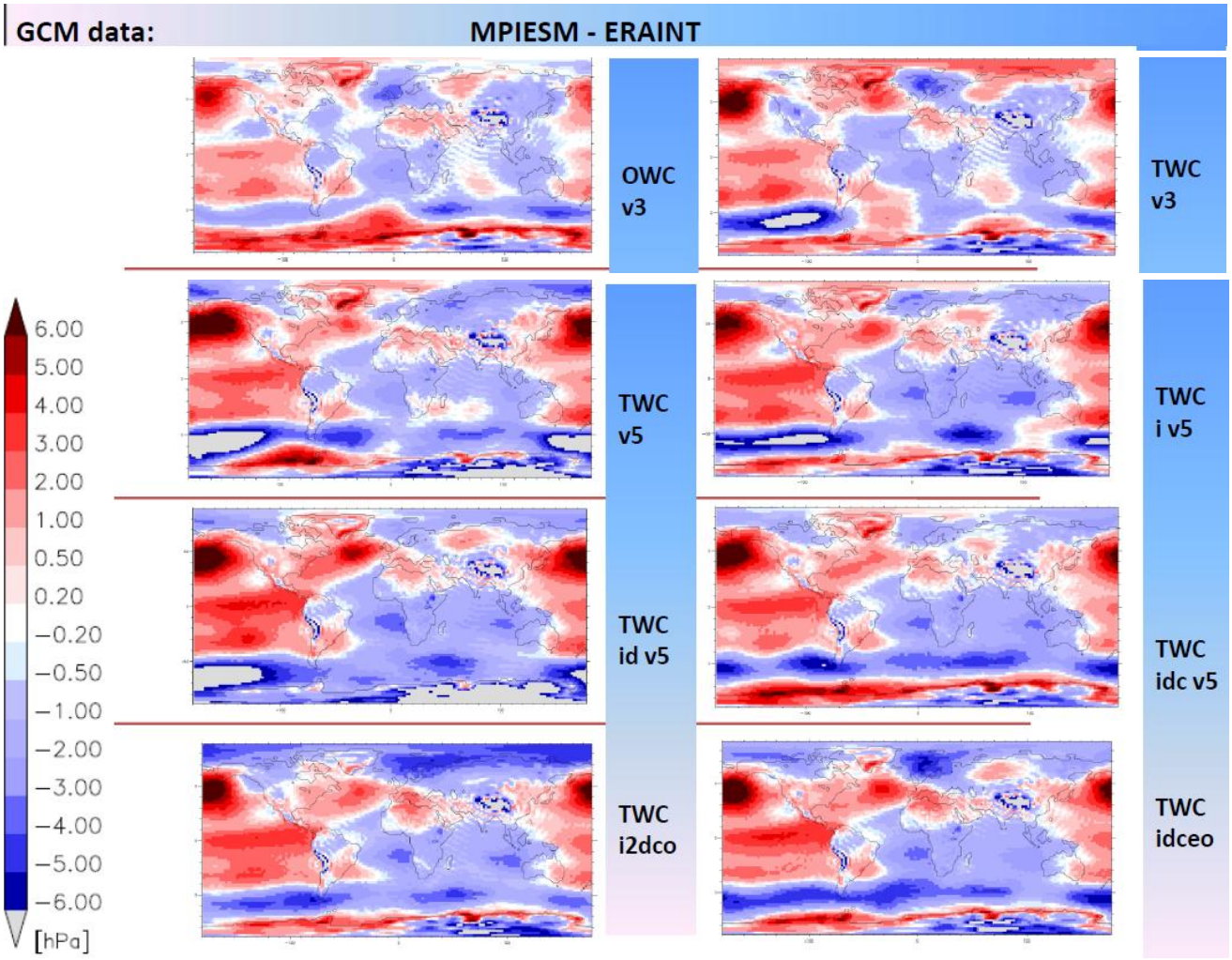

Figure 2: As Fig.1 but for mean sea level pressure (PMSL).