Project: **1333**
Project title: **ASPECT**
Principal investigators: **Wolfgang A. Müller, Holger Pohlmann**
Report period: **2026-01-01 to 2026-10-31**

1. Project overview

ASPECT is an EU Horizon Europe project aiming for the setup and demonstration of a seamless climate information (SCI) system with a time horizon up to 30yr, accompanied by underpinning research and utilization of climate information for sectoral applications ('middle-ground level'1). The goal is to improve existing climate prediction systems and merge their outputs across timescales together with climate projections to unify a SCI as a standard for sectoral decision-making. The focus is on European climate information but also to look more widely where there is a policy interest (e.g., disaster preparedness) and in regions of European interest. A strong link is maintained into an exploit learning from the WCRP lighthouse activities on explaining and predicting earth system change.

2. Achievements

We have extended the historical-like simulations with the climate model MPI-ESM-LR for the large ensemble single forcing model intercomparison project (LESFMIP; Smith et al. 2022). The following historical-like 30 members ensemble simulations are extended over the period 2015-2020: greenhouse gases-only (hist-GHG) and anthropogenic aerosols-only (hist-aer). The historical-like simulations are published in the World Data Center for Climate to be available for multi-model comparison studies within the WCRP lighthouse activity Explaining and Predicting Earth System Change (Müller et al. 2026a,b).

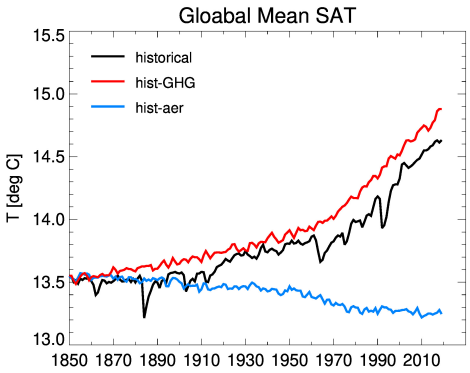


Figure 1: Global and annual mean surface air temperature (SAT) of the ensemble mean from the extended LESFMIP historical-like simulations with the MPI-ESM-LR model.

Additionally, we have systematically optimized atmospheric parameters in the ICON XPP earth system model (Müller 2025a,b). The optimization approach reduces the ENSO cost function by 30% in the optimized atmosphere-only runs. Key improvements include reduced precipitation bias and strengthened atmospheric feedbacks such as the Bjerknes and thermal damping feedbacks. These results demonstrate the effectiveness of the method in improving ENSO metrics within the atmosphere-only configuration (Yu et al. 2026). The Eastern Pacific coastal warm bias is identified as a key control on the ENSO nonlinearity in climate models (Yu et al. submitted). We further optimized a set of atmospheric tuning parameters in the coupled atmosphere and ocean climate model ICON XPP. This has led to substantial improvements in large-scale SST amplitude, pattern, seasonality, non-linear behaviour, Bjerknes and cloud feedbacks and contributed to improved ENSO simulations (Dommenget et al. submitted). Additionally, the application of flux corrections of the mean tropical state can be beneficial for ENSO variability to help improve seasonal and decadal climate prediction (Dommenget et al. submitted).

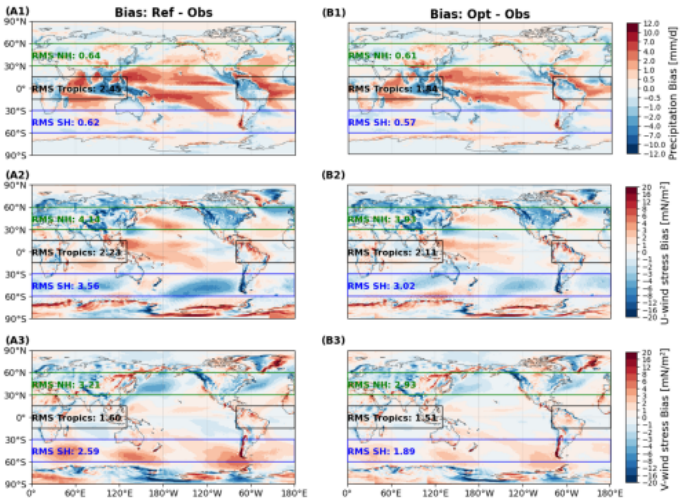


Figure 2: Biases in precipitation (A1, B1), zonal (A2, B2) and meridional (A3, B3) wind stress for the ICON XPP atmosphere-only reference run (A1-A3) and the optimized atmosphere-only run (B1-B3) relative to observational datasets together with RMS in the tropical and the northern and southern extra-tropical regions. Decreases in the regional RMS metrics denote improvement (Yu et al. 2026).

3. Data Lifecycle

The tuning of the parameters in the ICON XPP model helped to develop the ICON XPP earth system model for the BMFTR CAP7 project to perform the climate simulations for the Coupled Model Intercomparison Project in its 7th phase (CMIP7, Dunne et al. 2024). Additionally, the LESFMIP historical-like simulations are published in the World Data Center for Climate to be available within the WCRP lighthouse activity Explaining and Predicting Earth System Change (Müller et al. 2026a,b).

References

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