Project: **1333**

Project title: **ASPECT**

Principal investigator: **Wolfgang Mueller**

Report period: **2023-01-01 to 2023-10-31**

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 utilisation 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

Multi-annual to decadal changes in climate and associated extreme events cause major impacts on society and severe challenges for adaptation. Early warnings of such changes are now potentially possible through operational decadal predictions. However, improved understanding of the causes of regional changes in climate on these timescales is needed both to attribute recent events and to gain further confidence in forecasts. On multi-annual to decadal timescales climate is potentially influenced by several factors: slow climate components such as ocean inertia, changes in external forcing such as greenhouse gas concentrations, anthropogenic and volcanic aerosols (e.g. Booth et al 2012, Bellucci et al 2017, Timmreck et al 2016, Ménégoz et al 2018), solar irradiance (Gray et al 2010), ozone (e.g. Thompson and Solomon 2002), or land-use (Findell et al 2007). ASPECT aims at the identification of how single forcing constitutes drivers for near-term climate predictability, by contributing to the WCRP Large Ensemble Single Forcing Model Intercomparison Project (LESFMIP, Smith et al., 2022). For this purpose, large ensemble with and without single forcing following the LESFMIP protocol are performed with the MPI-ESM-LR model.

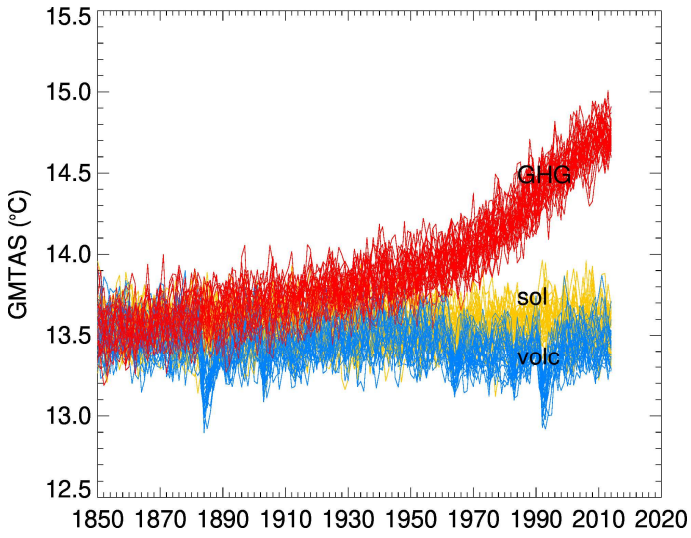

Figure 1: Time series of global and annual mean temperature at the surface (GMTAS) of 30 ensemble members from the hist-GHG (red), hist-sol (yellow) and hist-volc (blue) simulations.

A set of 30 ensemble members of CMIP6 historical-like sensitivity experiments with MPI-ESM-LR model over the period 1850-2014 have been performed with single forcing of only greenhouse gases (hist-GHG), only solar variability (hist-sol) and only volcanic aerosols (hist-volc). The internal variability and the external forcing are disentangled and their individual contributions to the overall variability are assessed by contrasting the scenarios to the CMIP6 historical simulations. As a first step, the global and annual mean temperature at the surface (GMTAS) is analysed (Fig. 1). The climate change signal is separated into contributions from the increase in greenhouse gases and variability due to volcanic emissions solar variability. The simulations are the basis for further detection and attribution studies in ASPECT with a focus on climate extremes.

3. Data Lifecycle

Central aim of ASPECT is the publication of the data in the Earth System Grid Foundation (ESGF). The historical-like sensitivity simulations performed in this project (hist-GHG, hist-sol, hist-volc) have been converted into the CMOR data format and are currently uploaded onto the ESGF server at the DKRZ.

https://www.wdc-climate.de/ui/cmip6?input=CMIP6.DAMIP.MPI-M.MPI-ESM1-2-LR.hist-GHG
https://www.wdc-climate.de/ui/cmip6?input=CMIP6.DAMIP.MPI-M.MPI-ESM1-2-LR.hist-sol
https://www.wdc-climate.de/ui/cmip6?input=CMIP6.DAMIP.MPI-M.MPI-ESM1-2-LR.hist-volc

References

Bellucci, A., Mariotti, A., & Gualdi, S. The role of forcings in the twentieth-century North Atlantic multidecadal variability: The 1940–75 North Atlantic cooling case study. Journal of Climate, 30(18), 7317–7337. https://doi.org/10.1175/JCLI-D-16-0301.1 (2017)

Booth, B. B. B., Dunstone, N. J., Halloran, P. R., Andrews, T., and Bellouin, N.: Aerosols implicated as a prime driver of twentieth-century North Atlantic climate variability, Nature, 484, 228–232, https://doi.org/10.1038/nature10946 (2012)

Findell, K.L., E. Shevliakova, P.C.D. Milly, and R.J. Stouffer, Modeled impact of anthropogenic land cover change on climate. Journal of Climate, 20(14), DOI:10.1175/JCLI4185.1. (2007)

Gray, L. J., Beer, J., Geller, M., Haigh, J. D., Lockwood, M., Matthes, K., et al. Solar influence on climate. Review of Geophysics, 48, RG4001. https://doi.org/10.1029/2009RG000282 (2010)

Ménégoz, M., R. Bilbao, O. Bellprat, V. Guemas, F. J. Doblas-Reyes, Forecasting the climate response to volcanic eruptions: Prediction skill related to stratospheric aerosol forcing. Environ. Res. Lett. 13, 64022 (2018)

Smith, D.M. et al. (2022), Attribution of multi-annual to decadal changes in the climate system: The Large Single Forcing Model Intercomparison Project (LESFMIP). Fron. Clim. 4:955414. doi: 10.3389/fclim.2022.955414

Thompson, D. W. J., and S. Solomon, Interpretation of recent Southern Hemisphere climate change, Science, 296, 895–899 (2002)

Timmreck, C., Pohlmann, H., Illing, S., & Kadow, C. The impact of stratospheric volcanic aerosol on decadal-scale climate predictions. Geophysical Research Letters, 43, 834–842. https://doi.org/10.1002/2015GL067431 (2016)