Project: **371**
Project Title: **High resolution Initialized decadal PREDictions of Atlantic and European climate variations (HIPRED-II),**
follow-up project of „Initialization of a global climate model from oceanic reanalyses"

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Abstract

As part of the BMBF-funded program "Regional Atlantic Circulation and Global Change" (RACE), the aim of this project is to investigate the interannual-to-decadal variability and predictability of the North Atlantic circulation and of the surrounding continental regions (Europe, Nordic Seas) using a coupled model system with an extremely high resolution in the ocean component. Sensitivity studies and analyses of existing model simulations (hindcasts and forecasts) are carried out to investigate the role of the oceanic processes and of the ocean-atmosphere interactions in coarse-resolution, "eddy-permitting", and "eddy-resolving" ocean model configurations. It is expected that an improved representation of the ocean dynamics as well as of the gyres and frontal regions will lead to better climate predictions over the next decade.

Towards a high resolution MPI-ESM1.2 initialized decadal hindcasts

HIPRED-II aims at developing a high-resolution decadal prediction system with the Max Planck Institute for Meteorology Earth System Model (MPI-ESM1.2) employing both the MPI-ESM1.2-XR (T255L95/TP04L40) and MPI-ESM1.2-STORM (T127L95/TP6ML40) grid configurations. Compared to the current state-of-art MPI-ESM1.2-HR grid configuration (T127L95/TP04L40) used for the on-going decadal prediction experiments performed within CMIP6 DCPP and MiKlip-II projects, the MPI-ESM1.2-XR exhibits a double horizontal resolution in the atmospheric component (~50 km). As the intense investigations and tuning efforts in collaboration with the H2020-project PRIMAVERA have shown, however, this configuration exhibits a strong decline in the strength of the North Atlantic Meridional Overturning circulation and related pole-ward heat and salt transports owing to rather weak surface winds in the ECHAM6.3 T255 atmospheric component. Compared to its counterpart at T127 atmospheric resolution, the surface wind stress over the North Atlantic is weaker by about a factor of 2/3. Such a bias would negatively impact the realism of climate predictions over the North Atlantic/European sector. In collaboration with PRIMAVERA, HIPRED-II has developed and successfully tested a momentum flux adjustment, in which the mean coupling wind stress over water is multiplied by a factor of 3/2. This set-up shows a state of the North Atlantic ocean and atmosphere comparable to that of the MPI-ESM1.2-HR grid configuration. Applying the momentum flux adjustment, a historical simulation with the MPI-ESM1.2-XR setup covering the period 1950 to 2014 is currently performed, which will be used to assess the benchmark predictive skill due the radiative forcing only (uninitialized predictive skill, compared to predictive skill based on initialized high-resolution prediction experiments) and constitute the base for the assimilation experiment from which high resolution decadal hindcasts experiments will be initialized. Additionally, joint efforts with PRIMAVERA consortium are undertaken for the development of a stable and potentially with a better scalability MPI-ESM1.2-STORM (T127L95/TP6ML40) coupled configuration. A frontier decadal prediction system based on such an "eddy resolving"

coupled model represents the ultimate goal of the HIPRED-II and would allow us to investigate the predictability of not only large scale phenomena (like AMOC or North Atlantic heat content), but also of regional and small scale oceanic processes.
HiPRED-II Experiments still to be performed in 2017:

- Assimilation experiment over the period 1990-2014 employing the flux-adjusted MPI-ESM1.2-XR (T255L95/TP04L40) in which the initial conditions are provided by the ERA Interim (atmos.)/ORA-S5(ocean)/NSIDC(sea-ice).