Project: 1394
Project title: Horizon Europe project IMPETUS4CHANGE (I4C)
Principal investigator: Dr. Daniela Matei
Allocation period: 2026-01-01 to 2026-12-31

Achievements in 2026

Hindcast prediction experiments with the MPI-ESM1.2 ocean-eddy-resolving climate prediction system

Main focus of MPI-M's contribution to project bm1394 is the performance and analysis of a recent case study with the MPI-ESM1.2 ocean-eddy-resolving climate prediction system: record-strong marine heat wave in the North Atlantic in summer 2023.

Progress in the performance of the relevant hindcasts initialized in November 2022 has been slower than expected due to many down times of Levante, long queueing time of batch jobs and a delay in availability of ECMWF's ocean reanalysis version 6 initially targeted for extending the prediction system horizont till the record warm years of 2023/2024.

The status at hand-in of this report is as follows:

We are currently extending the so-called assimilation run from project bm1190 (used to initialize the hindcasts as well as to derive desired quantities for analysis not available from observations) from November 2018 to November 2023. As ECMWF's ocean reanalysis version 4 (ORAS4) is not available beyond year 2018, we apply the follow-up version ORAS5 for oceanic initialization. We have also extended the multi-year initialization hindcasts initialized in November every other year from project bm1190 (used to bias-correct hindcasts initialized in November 2022) from 2014 to 2018. The reason for limiting the multi-year initialization hindcasts up to year 2018 is the change in the oceanic initialization strategy afterwards. We aim to perform also some of the hindcasts initialized in November 2022 in the current allocation period, but the remaining hindcasts will need to be finalized in early 2027 (see application).

The extreme summer of 2026 in observations and existing historical simulations

While the experiments are running, we have investigated sea surface temperature (SST) anomalies during the extremely hot summer in western Europe in existing historical simulations.

The observed SST anomalies in the North Atlantic from late spring of this year onwards resemble the SST anomalies observed in the European heat wave summer of 2015, with anomalously cold conditions in the subpolar North Atlantic and anomalously warm conditions surrounding western Europe (first panel in Figure 1). Thus, the extreme heat waves during this summer were potentially predictable.

Interestingly, the ocean-eddy-resolving MPI-ESM1.2 historical simulations performed within project bm0944, the high-resolution ICON historical simulation performed within project bm1313 and the MPI-ESM Grand Ensemble of historical simulations all reproduce both strength and extent of the observed summer SST anomalies within recent decades (Figure 1). Assessing the predictive skill of this summer's extreme heat waves over western Europe with the MPI-ESM1.2 ocean-eddy-resolving climate prediction system is an impact-relevant topic for future projects.

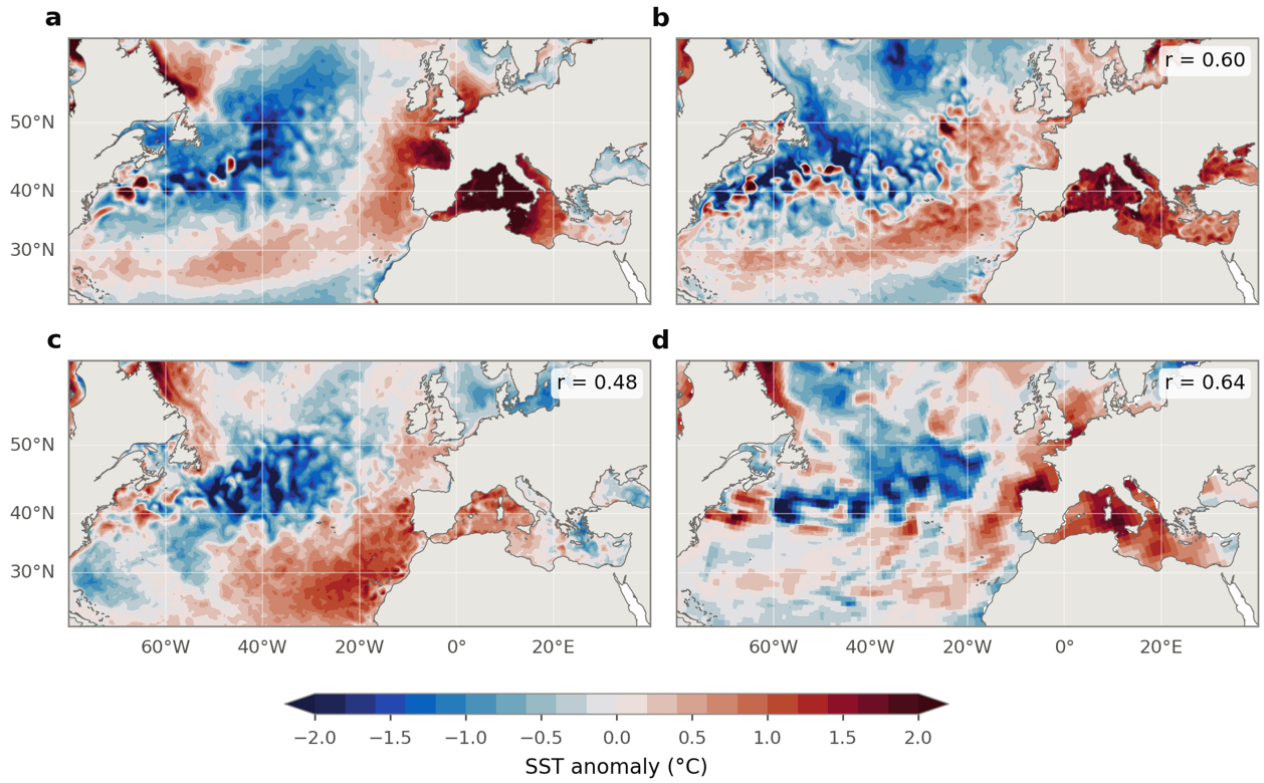


Figure 1: First panel: Observed SST anomalies in the North Atlantic. Second to fourth panel: Individual summer SST anomalies in the North Atlantic in selected MPI-M historical simulations (MPI-ESM-ER, ICON-EPOC, MPI-M Grand Ensemble).