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Skillful Dynamical-Statistical Predictions of European Summer Temperature

Juliette Mignot[1], Leonard Borchert[1], Vimal Koul[2,3], Björn Mayer[3,4], Matthew Menary[1,5], Giovanni Sgubin[6], and Didier Swingedouw[6]

[1]CNRS-IRD-MNHN, Paris, France (juliette.mignot@locean-ipsl.upmc.fr)
[2]Institute of Coastal Systems Analysis and Modeling, Helmholtz-Zentrum Geesthacht, Germany
[3]Institute for Oceanography, University of Hamburg, Germany
[4]International Max Planck Research School on Earth System Modeling, Hamburg, Germany
[5]Laboratoire de Météorologie Dynamique (LMD), École Normale Supérieure (ENS), Paris, France
[6]EPOC, Université de Bordeaux, Pessac, France

While decadal North Atlantic sea surface temperature (SST) variations are generally predictable, prediction skill of surface temperature over Europe is much more limited. We invoke here observed links of decadal European summer temperature variations to North Atlantic SST changes in the preceding months to produce skillful decadal predictions of European summer temperature variations.

We analyze the ERA5 reanalysis data set to re-assess the observed influence of North Atlantic SST on European summer temperature for the period 1960-2020. To facilitate possible merging activities of initialized decadal prediction simulations and climate projections in the future, we examine predictions for the target regions Northern Europe (NEU), Central Europe (CEU) and Mediterranean (MED) as are defined as the SREX regions for IPCC Assessment Report 5. Summer (June-July-August: JJA) temperature in NEU shows significant co-variability in a decadal spectral band with MAM SST in the Western North Atlantic (WNA), while JJA CEU temperature shows the same with JJA SST in that region. JJA temperature in the MED region shows significant decadal co-variability with the annual mean AMV index. SVD analysis illustrates that an atmospheric Rossby wave train connects North Atlantic SST to European summer temperature changes.

Dynamical retrospective forecasts from a suite of decadal prediction systems from the Coupled Model Intercomparison Project Phase 6 Decadal Climate Prediction Project are tested for their agreement with observations for the period 1960-2020. Dynamical predictions of JJA temperature in NEU, CEU and MED are mostly not skillful at lead years 1-10 in the CMIP6 simulations. Most models do, however, show skill in the SST regions that are connected to these summer temperature variations, identified above. We use these SST predictions to drive a simple statistical model that rescales the variance of the SST predictions according to observed SAT variance in the target region. This dynamical-statistical prediction is shown to be skillful at lead years 1-10 for summer temperature in the SREX regions. This skill, however, relies on the skill of the models in

predicting the respective SST index. Our work therefore indicates a promising avenue to produce skillful decadal climate predictions over land based on skillful predictions of the ocean.