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A sub-seasonal to seasonal prediction system with MPI-ESM

Vimal Koul[1], **Sebastian Brune**[1], Cristian Febre[1], Daniela I.V. Domeisen[2,3], and Johanna Baehr[1]
[1]Institute of Oceanography, CEN, Universität Hamburg, Hamburg, Germany
[2]Institute for Atmospheric and Climate Science, ETH Zürich, Zürich, Switzerland
[3]University of Lausanne, Lausanne, Switzerland

Current sub-seasonal prediction systems are traditionally based on models developed for numerical weather prediction. We present a different approach wherein we develop a sub-seasonal prediction system using a coupled Earth system model, the Max-Planck-Institute Earth system model (MPI-ESM), developed primarily for the use in climate prediction. We present results from initialized sub-seasonal reforecasts for the time period 1993-2017 from a 1st generation (CMIP5) seasonal-turned-sub-seasonal prediction system based on MPI-ESM including different components of the Earth system: atmosphere, land surface, ocean, and marine ecosystems. With our system we find (1) that atmospheric variables can be predicted with a quality and prediction horizon similar to what is found within the range of current sub-seasonal to seasonal prediction systems, (2) that extreme events as diverse as heatwaves over land, storm severity over Europe, and sudden stratospheric warmings can be skilfully predicted one to a few weeks ahead, (3) that sea surface temperatures can be skilfully predicted in the majority of large marine ecosystems for several weeks ahead, and (4) that sea ice area in the majority of Arctic seas can be skillfully predicted several weeks ahead. Our findings indicate that a coupled Earth system model like MPI-ESM can already be seamlessly used for sub-seasonal to seasonal (to decadal) climate predictions of different domains of the Earth system. Ultimately these results ask for the seamless approach to be embedded into the development of future coupled Earth system models.