

Supplementary material for "Skilful prediction of cod stocks in the North and Barents Sea a decade in advance"

**Vimal Koul^{1,2,*}, Camilla Sguotti³, Marius Årthun⁴, Sebastian Brune², André Düsterhus⁵,
Bjarte Bogstad⁶, Geir Ottersen^{6,7}, Johanna Baehr², and Corinna Schrum^{1,2}**

¹Helmholtz Zentrum Geesthacht, Institute of Coastal Research, Geesthacht, Germany

²Institute of Oceanography, Center for Earth System Research and Sustainability, Universität Hamburg, Hamburg, Germany

³Institute for Marine Ecosystem and Fisheries Science, Center for Earth System Research and Sustainability, Universität Hamburg, Hamburg, Germany

⁴Geophysical Institute, University of Bergen and Bjerknes Centre for Climate Research, Bergen, Norway

⁵Irish Climate Analysis and Research UnitS (ICARUS), Department of Geography, Maynooth University, Maynooth, Ireland

⁶Institute of Marine Research, Bergen, Norway

⁷Centre for Ecological and Evolutionary Synthesis, Department of Biosciences, University of Oslo, Oslo, Norway

*vimal.koul@uni-hamburg.de

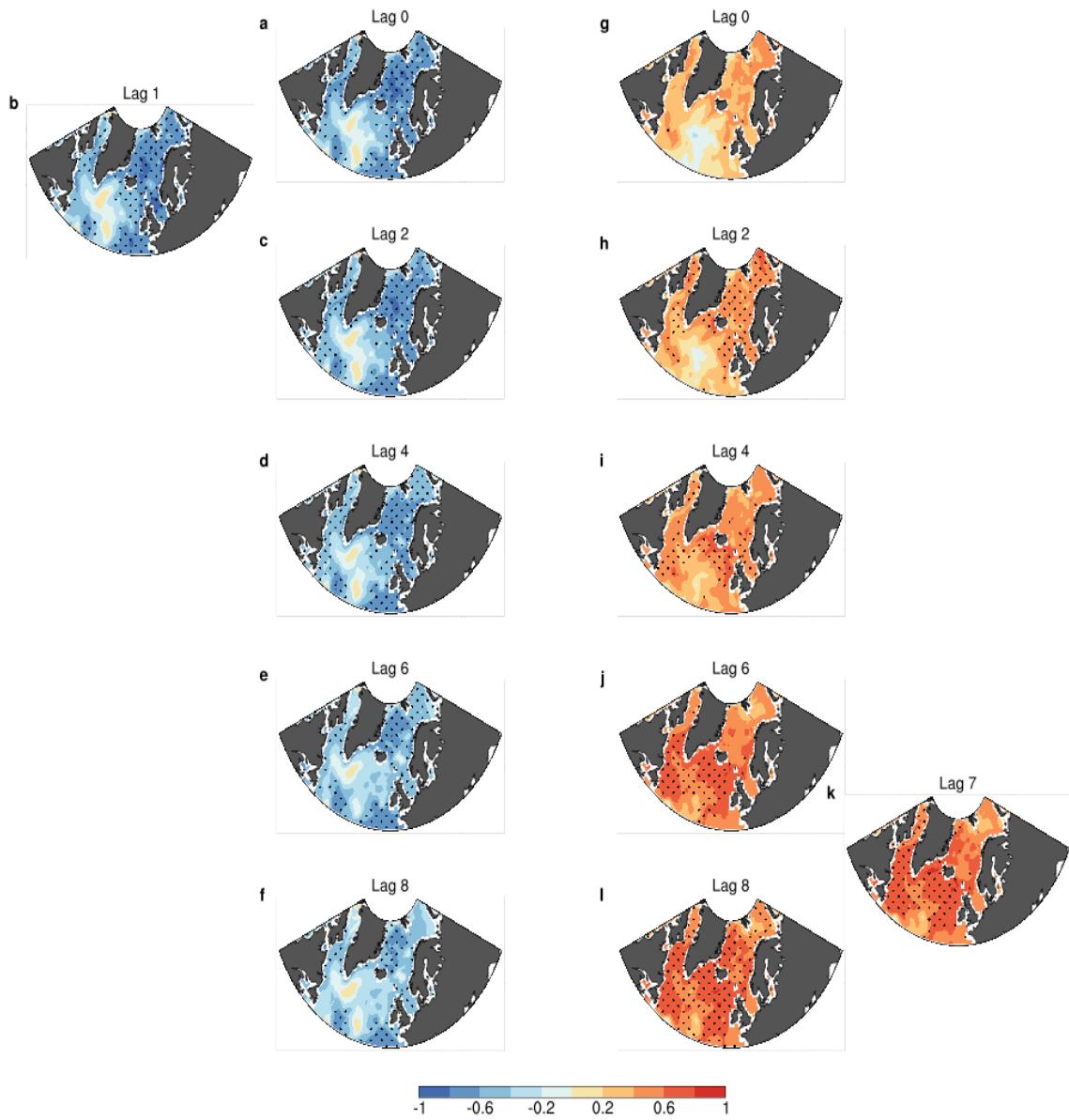


Figure S1. Temperature-cod biomass correlation maps. Correlation of total stock biomass and temperature at each grid point from the assimilation experiment at various lags (cod lags temperature) for (a-f) North Sea cod and (g-l) Northeast Arctic cod. The stippling indicates statistically significant correlation at 95% confidence. Linear trend was not removed prior to calculating correlation coefficients.

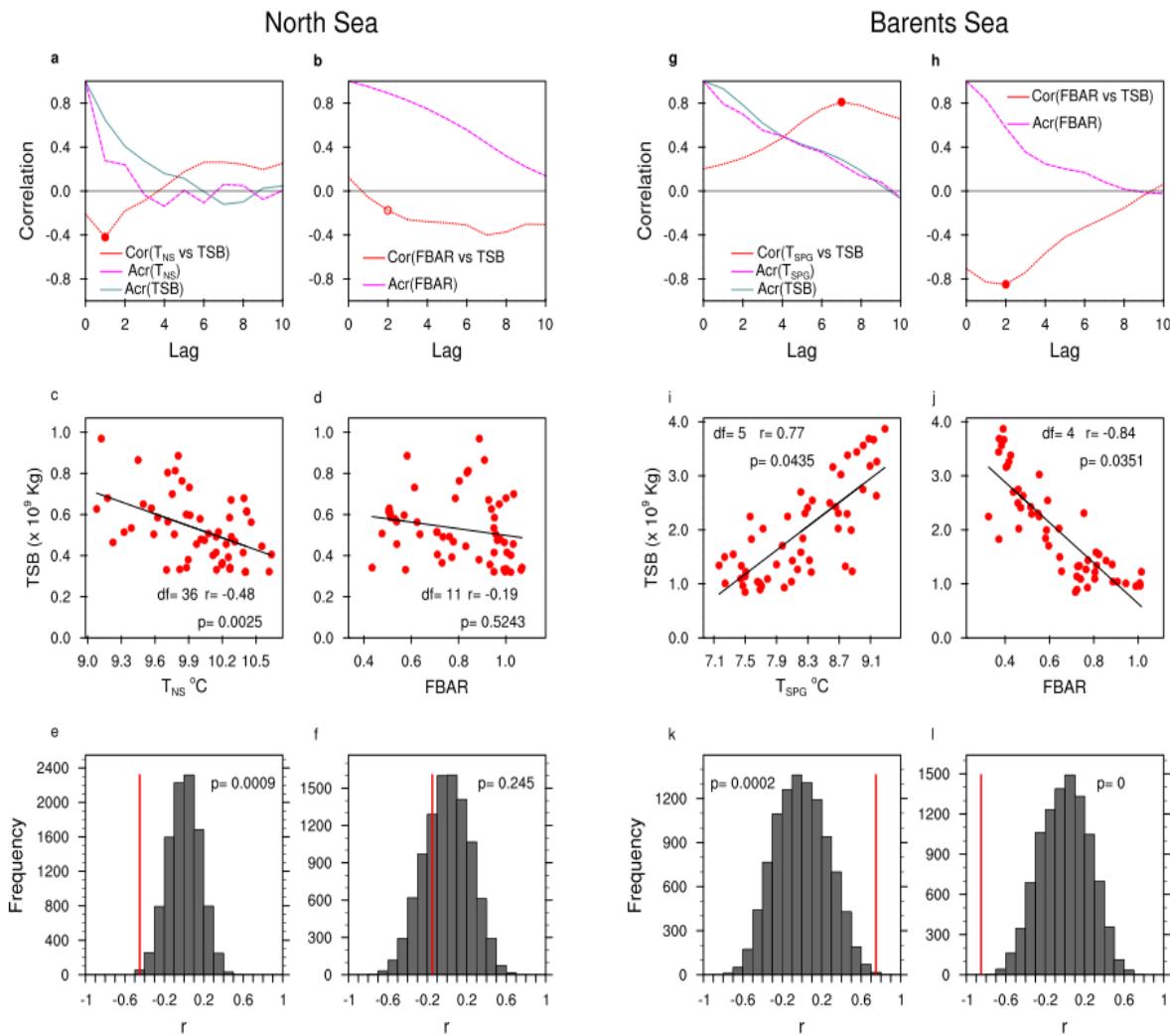
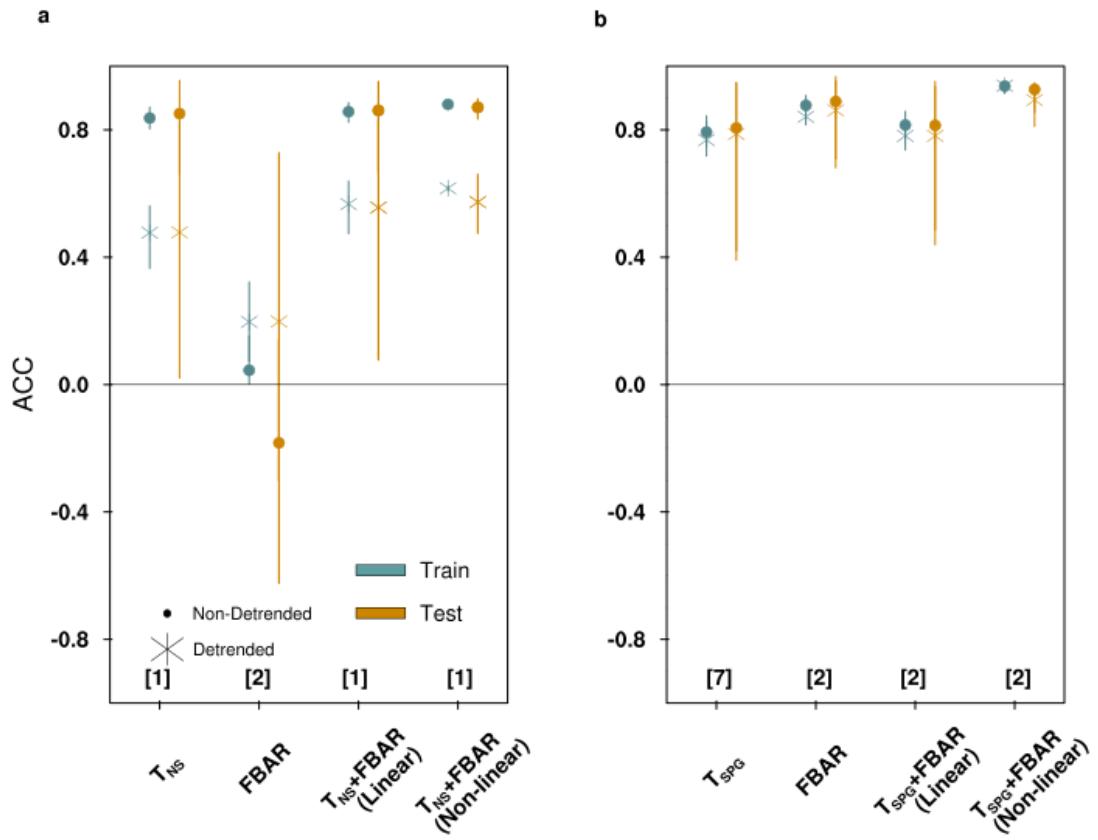


Figure S2. Statistical relationships. Auto correlation of cod-biomass, temperature and fishing mortality, and cross correlations between cod-biomass and two explanatory variables, temperature and fishing mortality for cod in **a**, **b** the North and **g**, **h** Barents Sea. For Barents Sea (i.e. Northeast Arctic cod), SPG-temperature is used as an explanatory variable. The red dots show the lag at which correlation is maximum, except for **b** where lag-1 is chosen based on **h** because none of the lag correlations in **b** are statistically significant. Scatter plot for **c** temperature versus cod-biomass and **d** fishing mortality versus cod-biomass for the North Sea, and **i**, **j** for the Barents Sea. Distribution of 10000 bootstrapped correlations between **e** temperature and cod-biomass and **f** fishing mortality and cod-biomass for the North Sea, and **k**, **l** for the Barents Sea from a random chance model. The vertical red line is the real correlation between respective variables. Linear trend was removed from each variable prior to calculating auto and cross correlations.



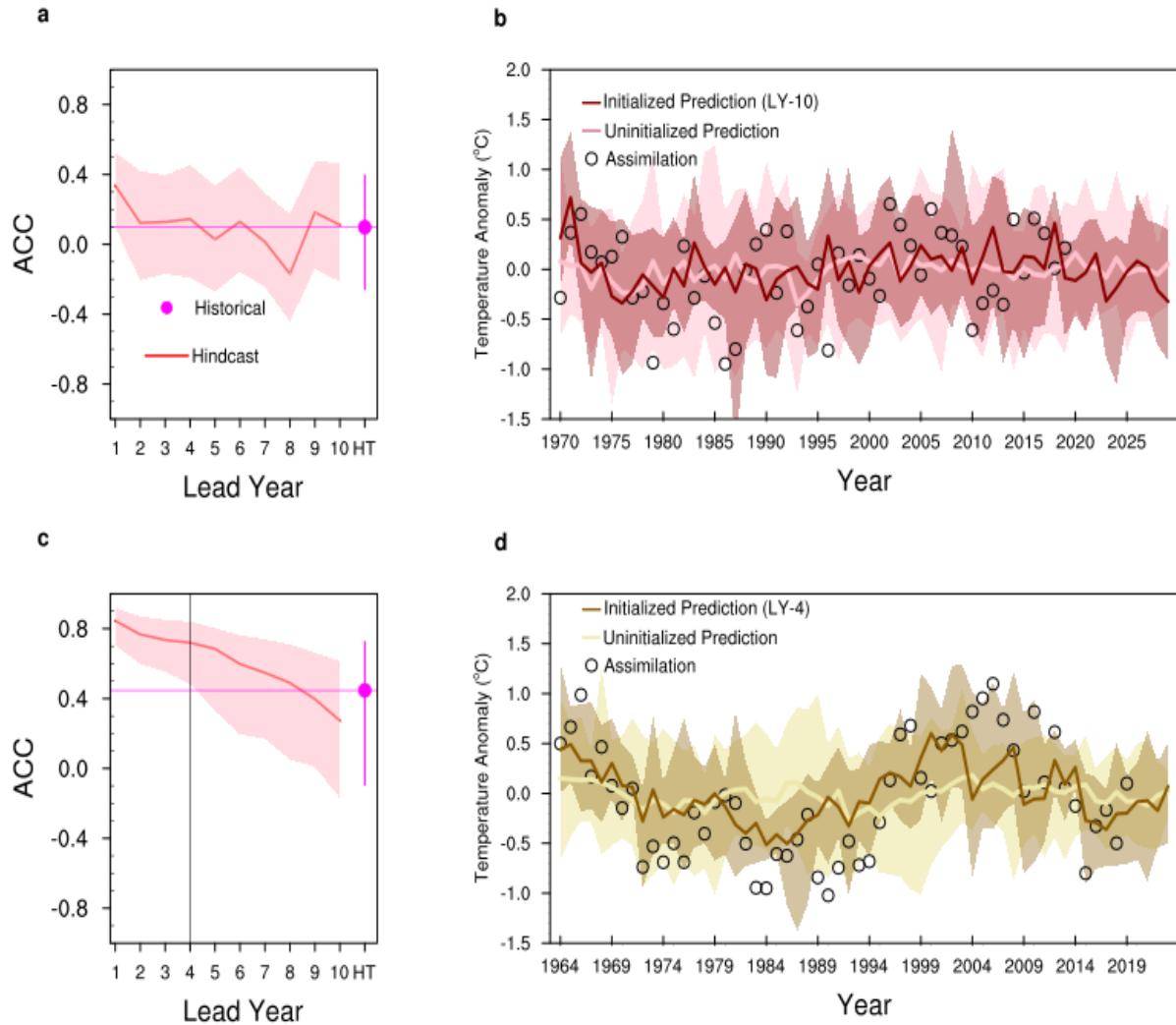


Figure S4. Dynamical prediction of detrended temperature. Retrospective dynamical prediction of North Sea and Subpolar gyre surface temperatures anomalies (with respect to 1970-2019 mean), same as Figure 3 in the main text but with linear trend removed. The vertical line in c shows the lead year beyond which the hindcast skill is not significantly different from the skill in historical simulation at 95% confidence level.