# Decadal Climate Prediction at the BSC

Simon Wild[#1] and Roberto Bilbao[#]

[#]*Barcelona Supercomputing Center*

[1]simon.wild@bsc.es

***Decadal Prediction, Climate Prediction, Climate Variability***

## *A. Introduction*

Initialised decadal climate predictions have been made available for users as a potential source of near-term climate information with the aim of supporting climate-related decisions in key economic and societal sectors such as energy, agriculture and insurance. Observed climate variability on the decadal timescale can be described as the superimposition of an anthropogenically-driven trend on natural variability of the climate system. The trend can be considered to be driven by changes in anthropogenic emissions (mainly greenhouse gases and anthropogenic aerosols). Natural variability is generated internally by interactions between and within different components of the climate system (atmosphere, ocean and sea ice) or by external factors such as volcanic eruptions and solar activity. The variability modes on timescales of several years and longer can then provide a source of potential predictability and thus lead to skill of decadal predictions. In this context, there is a growing interest from many stakeholders for climate services on 1-10 year timescales, but some efforts are still needed from the climate science community to assess the forecast quality on such timescales.

## *B. Study Overview*

This study will provide a quality assessment of the recently produced retrospective decadal forecasts (hindcasts) at the Barcelona Supercomputing Center (BSC) using the EC-Earth coupled global climate model. This set of ensemble hindcasts is BSC's contribution to the Decadal Climate Prediction Project (DCPP) Component A, comprising 10 members full-field initialised yearly on 1st November from 1960 to 2018 and covering 11 forecast years. In plain language we will assess the question whether our decadal predictions are any good or more precisely:

- Are the initialized decadal predictions better than the non-initialized simulations?
- Can we identify reasons if the answer was "no" for the questions above for a given geographical reason?

## *C. Results*

We will show typical measures for the quality of deterministic and probabilistic hindcasts, such as anomaly correlation coefficients of standard variables such as near surface temperatures, verified against observations and reanalysis products. In this context the effect on verification measures by mimicking observational products for near surface temperatures, combining sea surface temperatures with near surface air temperatures over land, will be discussed. We will also assess the impact of initialization on forecast reliability quantifying the statistical relationship between the predicted probabilities and the observed relative frequency of an event.

Initialized hindcasts will further be compared to an ensemble of non-initialized historical simulations assessing the potential added value of initializing the model towards the observed climate state in near-term climate predictions (one example is figure 1). Over few ocean regions initialized predictions show significant skill beyond the relation to trends due to external forcing. We will also discuss the possibility of an overestimation of the added value due to different behaviour from the observed climate in non-initialized historical simulations.

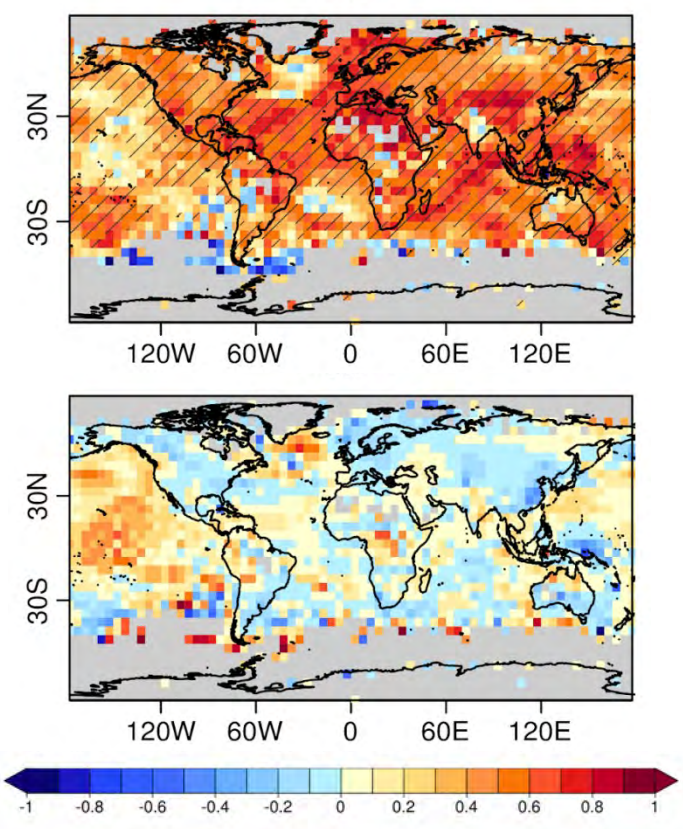


Fig. 1 Top: Anomaly correlation coefficient (ACC) between first forecast year of ensemble mean of initialized decadal predictions and observations for surface temperature and 1961-2018. Hatching indicates significant correlation ) at the 95% level. Bottom: Difference between ACC of initialized and non-initialized simulations

## *D. Summary*

The recently produced decadal predictions at the BSC show added value of initialization for some standard variables for some regions especially for early forecast years, e.g. for surface temperature over the Pacific in forecast year 1 (figure 1, bottom). Our hindcasts show however barely any benefit from initilization beyond the first forecast year. The ocean dynamics in the North Atlantic region in response to initialization can be shown to play a crucial role why the added value of initialization is limited.

## *E. ACKNOWLEDGEMENTS*

We are grateful for the contributions of Juan C Acosta-Navarro[#], Arthur Amaral-Ramos[#], Pierre-Antoine Bretonnière[#], Ruben Cruz-García[#], Francisco J Doblas-Reyes[#], Markus G Donat[#], Pablo Echevarría[#], Eduardo Moreno-Chamarro[#], Pablo Ortega[#], Yohan Ruprich-Robert[#], Valentina Sicardi[#], Etienne Tourigny[#], Javier Vegas[#], Deborah Verfaillie[#] who are all co-authors of this study.

This project received funding from the European Union's research and innovation programme under the Marie Skłodowska-Curie grant agreement no H2020-MSCA-COFUND-2016-75433 and the EUCP project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement no 776613.

## *Author biography*

**Simon Wild** was born near Munich, Germany, in 1985. He received his B.Sc in Meteorology in 2009 and subsequently his M.Sc in Meteorology in 2012 at the Freie Universitaet Berlin, Germany. Simon worked as a climate scientist at the School of Geography, Earth and Environmental Sciences at the University of Birmingham, UK from 2011 until 2018 where he also received his PhD (entitled *North Atlantic Winter Wind Storm Variability across different Time Scales)* in 2018. He then joined the Climate Prediction Group at the Barcelona Supercomputing Center where he has been working since.