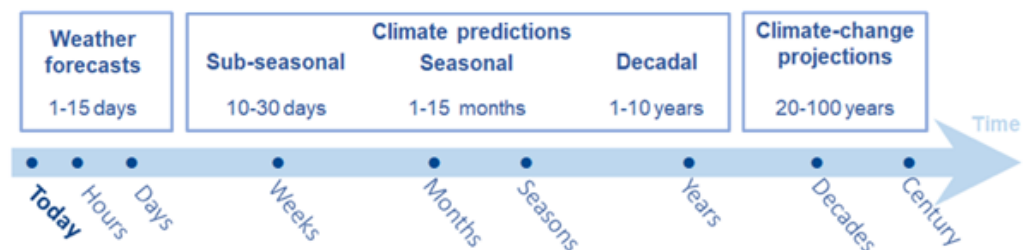


A BRIEF INTRODUCTION TO DECADEAL PREDICTIONS

Climate predictions and projections

Forecasts can be split into different categories according to the timescale: weather forecasts, climate predictions and climate projections, each stretching further into the future than the previous one. A clear understanding of the differences between these timescales helps understand how this information can specifically support particular decisions that need to be made in the field.

Weather forecasts look into the short-term changes in weather conditions for a particular moment and location for the next 15 days. Climate predictions provide climate information in timescales covering the next weeks to decades, and include *sub-seasonal* (1-4 weeks), *seasonal* (1-15 months) and *decadal* predictions (1-10 years). By contrast, *climate projections* provide the predicted changes in the climate in the next decades and centuries based on scenarios of future greenhouse gas emissions and socio-economic development.



Time scales of climate information. Source: BSC-CNS.

What are decadal predictions?

Decadal climate predictions have been developed recently in an attempt to fill the gap between seasonal predictions and climate change projections, i.e. from 1 to 10 years. These predictions are typically produced using global climate models, which are mathematical representations of the Earth's climate (typically covering the atmosphere, ocean, sea ice and land), and are built using the laws of physics and thermodynamics. Observation-based data are introduced in the model to set the initial state of the climate system, and then the model is run for a period of up to 10 years. External forcings (such as the rising greenhouse gas concentrations) are also introduced in the model, similar to those considered in climate projections.

A new set of decadal predictions for the forthcoming 1-10 years are produced at the end of each year by a number of European institutions (BSC, CMCC, DWD, and Met Office). These predictions are probabilistic in nature, which means that they provide a range of possible future conditions instead of a single value. The quality of the predictions can be evaluated by looking at their associated skill scores.

How can socio-economic sectors benefit from decadal predictions?

Climate predictions have an enormous potential for helping a wide range of end-users in their investment and management decisions for the forthcoming years. The field of decadal prediction has grown significantly in recent years, in part due to the large socio-economic interest generated by these predictions. However, research on decadal predictions is still on-going, and few services are currently operational.

In our project, we aim to explore the added value of decadal predictions in decision-making by providing use cases in four different sectors: agriculture, water management, energy and infrastructure.

Uses of decadal predictions in agriculture

The agricultural sector is heavily influenced by changes in the frequency and severity of extreme weather events. The climate can affect crop management, amount and quality of yield, and the development of crop diseases and pests. Future climate information is thus essential for adaptation to climate variability in order to improve production quality and quantity.

In the short-to-medium term, weather, sub-seasonal and seasonal forecasts can help inform on the plantation and harvest dates, and make decisions on the selection of crops, use of fertilisers and crop rotations. In the long term, climate predictions and projections can help decide if new crop varieties should be developed, or if new water management and irrigation infrastructure might be needed in the future.

While decadal predictions are still not widely used in the field of agriculture, they are recognized as potentially important in supporting planning decisions that require several years to be implemented, such as decisions in terms of equipment purchase (irrigation plants), emergence of new pests/diseases, use of new varieties etc. Climate information for the next 2-5 years can also be useful for planning supply chain contracts. Finally, decadal forecasts can have an impact on strategic policies related to agriculture, from regional to the EU's common agricultural policy (CAP).

This work was supported by the Copernicus Climate Change Service (C3S) as part of the C3S_34c contract, and the CLINSA project (CGL2017-85791-R) funded by the Spanish Ministerio de Economía y Competitividad (MINECO).

For more information on the decadal prediction research performed at the Barcelona Supercomputing Center (BSC), please visit: www.decadal.bsc.es