TIME SCALES OF CLIMATE SERVICES FOR AGRICULTURE

Forecasts can be split into different categories according to the time scale: forecasts of the past, 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 time scales helps understanding how this information can specifically support particular decisions that need to be made in the field.

Relevant time scales of decision-making in the agriculture sector (adapted from Nissan et al. 2018)

FORECASTS OF THE PAST

In the field of climate prediction, forecasts of the past are called *hindcasts,* and are useful to assess the forecast quality of the climate model. *Hindcasts* are compared with observations to determine how well the prediction matches the observed results. Testing how the model performs in the past provides information about the quality of future forecasts. We also use *hindcasts* for the analysis of past events. In the field of climate projection, forecasts of the past are used to set the reference period the future projection will be compared against.

WEATHER FORECASTS

Limited to two weeks. They correspond to the weather forecasting information traditionally provided on the radio and TV, where meteorological phenomena are described in high detail for a particular moment and location. However, trust in weather forecasts is quickly lost after about a week, becoming less useful thereafter. Their ability to forecast weather comes from real-time measurements of the current conditions of the atmosphere.

CLIMATE PREDICTIONS

Extending from weeks to decades (sub-seasonal, seasonal and decadal predictions). Unlike weather forecasts, which use real-time measurements of the current conditions of the atmosphere, climate predictions use elements of the climate system that evolve slowly over time: oceans, sea ice, soil water content, snow, etc. Climate predictions make use of average conditions (e.g. average ocean temperature), whose evolution can be potentially anticipated over longer time spans. Therefore, the type of questions that we can answer with climate predictions is different from the ones that can be answered with weather forecasts. Thus, the interest of climate predictions is not in the amount of rainfall at a particular time and location, but in how the average monthly rainfall at that location could evolve, for instance.

CLIMATE PROJECTIONS

Extending from decades to centuries. Climate projections require scenario hypotheses, which are based on future estimated levels of greenhouse gases and socio-economic development. These scenarios are used to provide plausible descriptions of how the future climate may evolve (typically until 2100) with respect to a range of variables including socio-economic and technological change, energy and land use, and emissions of greenhouse gases and air pollutants. The current set of scenarios adopted by the Intergovernmental Panel on Climate Change (IPCC) are the Representative Concentration Pathways (RCPs).
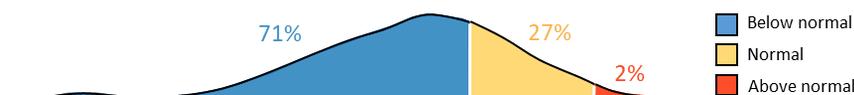
WEATHER FORECASTS

Weather forecast for Porto. Source: BBC Weather.

Weather forecasts provide **precise information** about atmospheric variables (e.g. temperature, rainfall, wind speed) for a specific location and for the following hours and days.
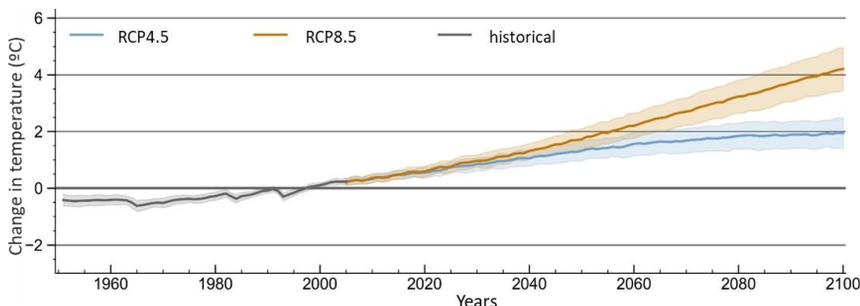
CLIMATE PREDICTIONS

71%   27%   2%

Below normal
Normal
Above normal

Climate prediction of the mean temperature in Porto for the next season (e.g. spring). The graph indicates 71% of probability that the temperature will be below normal (i.e. below the average of the mean temperature in spring of the last ~30 years), 27% of probability to be normal (i.e. the average mean temperature of the last springs) and 2% probability to be above normal (i.e. above the average of the mean temperature of the last springs). Source: BSC-CNS.

Climate predictions provide **probabilistic information** about atmospheric variables with reference to the average of past observations, e.g. last ~ 30 years (that is considered the *normal*). Information is often presented using three categories or *terciles*, each category corresponding to the probability of a particular variable (e.g. mean temperature) to be *below normal*, *normal* or *above normal* in the next months or seasons. To know if the prediction is good enough for decision-making, it is necessary to know whether it has *skill [see info sheet Climate predictions for agriculture]*.

CLIMATE PROJECTIONS

Climate projections of mean temperature in Porto for the period 1950-2100 relative to 1986-2005. The graph indicates an increase of temperature by the end of the century. Projections using RCP4.5 project an increase in temperature of around 2°C whereas those using RCP8.5 expect an increase of more than 4°C. Solid lines correspond to the multi-model mean (i.e. average results across different models). Shading corresponds to the standard deviation, indicating uncertainty. Source: BSC-CNS.

Climate projections provide information about the **variation of atmospheric variables** over the coming decades and centuries. They are often presented as a range of the results obtained using RCPs. Frequently used RCPs are RCP4.5 (intermediate greenhouse gas emissions) and RCP8.5 (high greenhouse gas emissions). Projections from many climate models should be analysed as they project different levels of warming and other changes in the climate system *[see info sheet Climate projections for agriculture]*.

WHICH TYPE OF QUESTIONS CAN BE ANSWERED WITH EACH TEMPORAL SCALE ?

Weather forecasts	Climate predictions	Climate projections
Temperature in Porto in the next few days in absolute values (°C)	Most likely category for next spring temperature in Porto in relative values or anomalies (either below normal, normal or above normal)	Variation of temperature expected in Porto during this century (°C change)

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