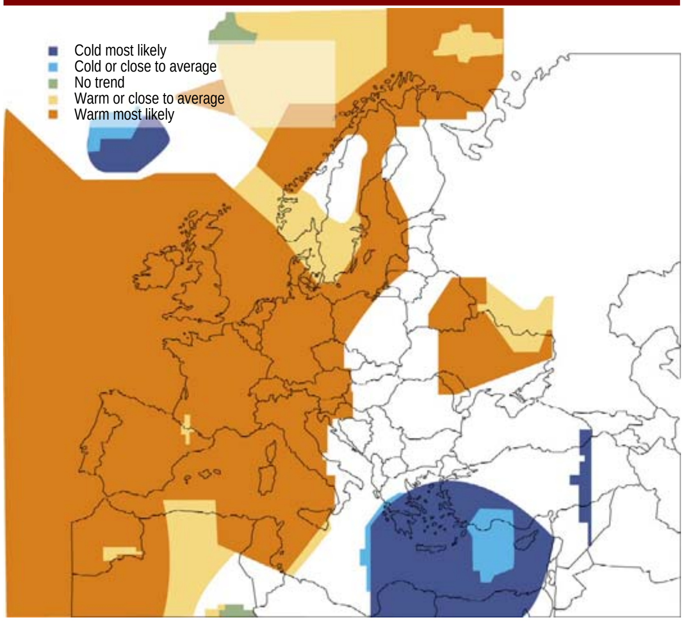
3 or 6 month weather forecasting

Seasonal forecasting sees further into the future

Over the last few years, we have been hearing more and more about seasonal forecasting. Although this concept includes the term forecasting and uses the same basic tools as standard weather forecasting, the end product is quite different and is not always easy to understand. This is a detailed review of a promising product under development.

Most likely temperatures for winter 2006-2007 as estimated in November 2006 *(fig. 1)*



Last October, seasonal forecasts were predicting temperatures above the seasonal average in France for the December 2006 - January 2007 - February 2007 period. Afterwards, Météo France confirmed that this winter was indeed the warmest in 50 years, 2.1°C above the average.

Unlike standard weather forecasts, which provide estimates expressed as figures (eg.: temperature of 17°C expected in two days time), seasonal forecasts give trends compared with the average (calculated on the last 30 years) for the forthcoming 3 or 6 months. Temperature and rainfall are the two parameters considered.

Results are sorted in different categories, depending on whether they are above, close to, or below the average. The trend produced *(figure 1)* does not mean that temperatures are necessarily above the average every day. Nor does it give any idea of the scale of difference compared with the average.

Ocean temperature used as a basis for seasonal forecasting

This type of forecasting is based on the same models as standard forecasting, but with a lower resolution, in order to reduce calculation time: the atmosphere is divided in 200 to 300 km grid boxes, instead of 20 km as in the Arpège model.

Forecasting for the forthcoming months is possible because the atmosphere is subjected to phenomena that have an impact on its long-term evolution.

Ocean temperatures take a long time to change because water has a greater capacity than the atmosphere to store heat or cold.

Forecasting the weather for the next 3 or 6 months could have benefits for some agronomical models based on medium term forecasting.

The main factor is sea surface temperature. It changes very slowly due to the great thermal inertia of the oceans compared with the atmosphere.

Some factors, and in particular sea water temperature, have an impact on long-term changes in the atmosphere.

Knowing this temperature is useful in order to achieve accurate forecasting, especially in the tropics where it becomes essential.
In mid-latitudes, forecasting is more complex as other factors come into play, like the area covered by sea ice, soil moisture content or snow cover. Those variables help to simulate a North Atlantic Oscillation (NAO) index, based on the seasonal forecast for Western Europe *(see insert)*.

The North Atlantic Oscillation has an impact on our winters

At a seasonal level, the NAO partly explains the variations encountered in winter for the North Atlantic zone. The NAO is a difference in pressure between the Azores High and the Iceland Low. As a rule, a positive NAO index is linked to stronger westerly winds. Northern Europe tends to be warmer and wetter than average and weather conditions in southern Europe are colder and dryer than average. A negative NAO index indicates opposite conditions. We do not yet understand which factors generate a positive or a negative phase. Some NAO phases which have remained constant for several years seem to indicate that the ocean plays an important part in their formation.

A multi-model approach to refine results

To lengthen the forecasting range by several months, the models used take account of the interaction between ocean and atmosphere temperatures. Seasonal forecasts are improved through the use of the ensemble forecast method or multi-model approach. The ensemble forecast method consists of introducing slight modifications to the initial state of a model (ocean temperature, snow cover…) and analysing the impact that those changes have on the final forecast.

The multi-model approach is based on using several models: Météo-France, in association with other international organisations, has six models at its disposal.

This helps take account of model related errors as well as of those due to the lack of accurate data concerning the model initial state.

In the end, the average of all the simulations helps improve seasonal forecasting, in particular for the multi-model approach.

Presenting the results in a probabilistic way reinforces confidence in the scenario most likely to happen. Our example shows that spring 2007 will be mainly warmer than the average.

Forecast of temperatures expected in France for the April-May-June 2007 period (on 20th March 2007) – Source Météo France *(tab. 1)*

Model	Mainland France	French West Indies	French Guyana	Reunion Island	Mayotte	New-Caledonia	Wallis andFutuna	Polynesia	St Pierre et Miquelon
European Centre for Medium-Range Weather Forecasts									
International Research Institute for Climate and Society									
Météo France – forced model									
Météo France – Atmosphere ocean coupled									
Met Office									
Japan Meteorological Agency (JMA)									
Summary	(4/6)	(6/6)	(4/6)	(6/6)	(5/6)		(5/6)	(6/6)	
Météo France's trend									

■ T below average (cold) ■ T close to average ■ average (warm) ■ No trend

Results are sorted according to three scenarios:
"Above average", "close to average" and "below average".
The limits between two scenarios have been set so that on average all three scenarios have the same probability of occurrence of 33.3%. If the forecast does not point to any of the scenarios, the corresponding box appears shaded.

Still difficult to utilise in Western Europe

For further information, three Internet sites offer global seasonal forecasts.

- Météo France in France: http://www.meteofrance.com/FR/index.jsp
- The Met Office in the UK: http://www.metoffice.gov.uk/
- Et IRI (International Research Institute for Climate and Society) in the United States: http://iri.columbia.edu/

At a global level, seasonal forecasting seems more accurate between the tropics and around the Pacific Ocean, both for temperatures and rainfall. In addition to geographical variations, there are also variations depending on the season, the year or the parameters being considered.

In Western Europe, forecasting is difficult to achieve *(table 1)*. It is better for temperatures than for rainfall, and winter forecasting is more successful than for summer. Some sectors (insurance, energy, agriculture…), whose activity is highly dependant on the weather, can be tempted to use this product to improve weather risk management and prediction. In practice, this data actually seems difficult to use. Before this type of product becomes widely used, specialised tools able to utilise this probabilistic information will have to be developed, and return on investment will have to be quantified.

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