Together, we can do more

Forecasting the months and seasons ahead

Long-range forecasts make predictions of the upcoming likely changes in the climate, e.g. over a month or a season.

Working together

How do you use environmental information to make decisions?

This type of information is key for developing effective long-range forecasts, so we can deliver the service you need to reduce your exposure to changes in the climate.

Each application is different, so we need to find out the decision thresholds that are important to each customer, in order to tailor the forecasts into usable products.

Long-range forecasts and managing risk

Changes in the climate have a significant impact on the environment, and affect a range of human activities, from leisure to business.

As predictions of the weather are limited by its chaotic nature, it is not possible to forecast individual weather events beyond about 10 days, but we can predict the likelihood of short-term climate events, such as the chances of a very dry or a very cold season.

This is useful for managing risk, and long-range forecasts can be of significantly more value than assuming the coming months and seasons will be 'normal' or similar to recent years. In the context of a changing climate, these forecasts will become increasingly important.
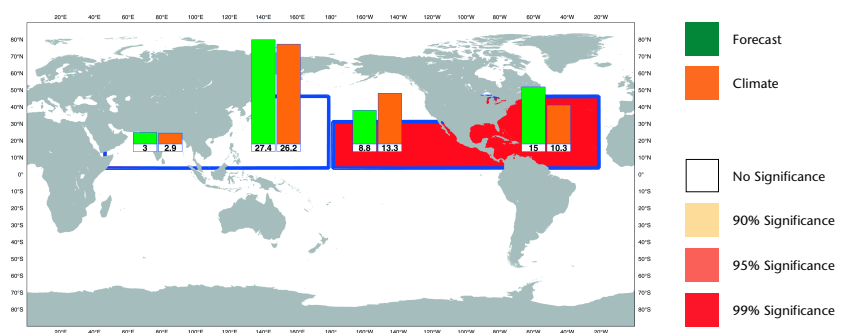
Tropical storms cause huge human and infrastructure losses. The figure above shows the likely number of tropical storms predicted for July to November 2005, in collaboration with the European Centre for Medium-Range Weather Forecasts (ECMWF). Long-range forecasts can be used to manage the risks posed by an active hurricane season.

The science behind the long-range forecast

Ocean and land conditions change more slowly than those in the atmosphere, and provide an ongoing 'flywheel' for the climate as they interact and influence the weather.

Observations of the world's oceans, land surface and atmosphere are analysed by climate scientists in order to gain understanding of the underlying physical processes. The results are used to construct models for predicting the future climate.

ea-surface temperature is a major factor in the climate system, and observed changes can also be used to make predictions for the following seasons.

Predictions can never be perfectly precise because the system is chaotic. By making many forecasts with different assumptions, the probability of an event can be calculated, and such information is vital to decision making.

-5 -3.75 -2.5 -1.25 0 1.25 2.5 3.75 5
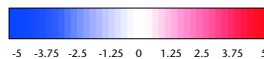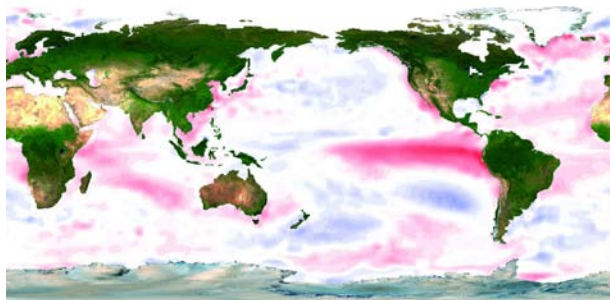
The so called 'mega-El Niño' of 1997–1998 had a huge impact on the world climate. The warm sea-surface temperatures in the east Pacific Ocean can be clearly seen on this ocean surface temperature anomaly analysis, as used in our coupled forecast model.

Would knowledge of weather conditions several months ahead help your organisation's planning?

"Each time a drought occurs, this affects how water companies assess their assets and how customers behave. This, in turn, influences their long-term strategic planning, of which we need to have an understanding in order to be able to regulate it."

Water Supply Manager

A deterministic forecast predicts one precise outcome for an event — it either happens or it doesn't; for example, the mean temperature for November will be 9°C.

A probability forecast provides information about the likelihood of something happening, such as the chance of getting below-average rainfall this winter. These forecasts are often derived from a number — an ensemble — of models that explore the possible futures. Long-range forecasts are usually probabilistic.

Logistics

World-leading capability using climate models and supercomputers

In order to make our forecasts, the laws of physics governing the climate system are represented in mathematical models that can be solved on a computer. We use the latest atmosphere-ocean-land-sea-ice climate models, together with some of the world's most powerful supercomputers, to produce long-range forecasts that currently look up to a year ahead, with global coverage. Many forecasts are combined to take account of uncertainties in the methods and the chaotic nature of events.

As part of the European Seasonal to Inter-annual Prediction (EURO-SIP) long-range forecasting consortium, the Met Office, the ECMWF and Météo-France are working together to reduce uncertainty in climate forecasting by producing climate forecasts each month, from three models, for six months ahead.

Forecasts of the most likely event distil the wide range of information into maps that are useful to many users as a first view of the coming season. In the figure below, the most likely of three categories of temperature (below normal, normal and above normal) are forecast globally for December 2005 to February 2006.

"There would certainly be tangible benefits from improved forecasting of cash flow and better targeting of scenarios for operational planning. The main benefit would be for the UK as a whole if early warning of a severe winter enabled good preparation in advance."

Operational Research Analyst

Met Office: More likely 2m temperature tercile categories
Dec/Jan/Feb Issued: September 2005

Cold more likely
Cold or average more likely
Average more likely
Warm or average more likely
Warm more likely
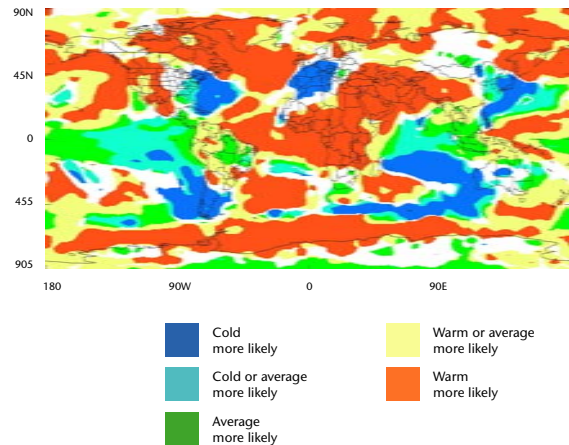
Long-range forecasts

Global capability
— El Niño forecasting

Our global capability to forecast future changes in the upcoming climate is driven by the large scale impact of climate events on local weather. This means that a forecast for an El Niño is important to those in India and Africa and not only to those in the Galapagos Islands or Borneo.

The figure below shows a sampling of the range of possible futures; in this case, a forecast of sea-surface temperature (SST) in the central Pacific for 2004. Forecasts like these are used to monitor El Niño. Note how the actual temperatures followed a less probable scenario and went up.

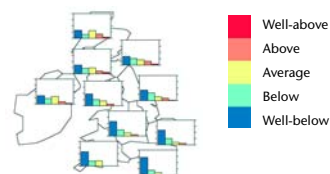Ensemble Forecast of SST anomaly for region Niño3.4 from 01/04/2004
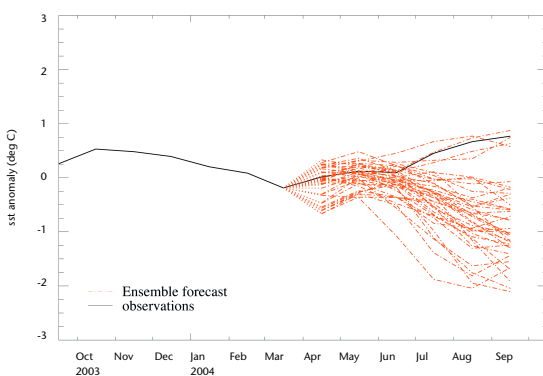
Forecasting the month ahead

Long-range forecast methods also allow the user to assess the likelihood of changes in the weather for the coming month. For example, in February 2005, a change to a very cold run of weather in the UK was forecast two weeks in advance. Our global monthly forecasts are updated every week and provide an assessment of the next two weeks and then the following fortnight's likely climate, including detailed information for ten UK districts.
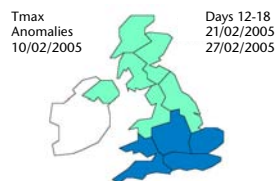
Example UK 12 - 18 day temperature forecast for 10 climate districts
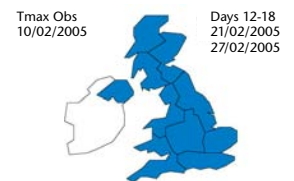Probability forecast

- Well-above
- Above
- Average
- Below
- Well-below

Deterministic forecast
(based on most probable category or ensemble mean)

Verification

Tmax Anomalies 10/02/2005   Days 12-18 21/02/2005 27/02/2005

Tmax Obs 10/02/2005   Days 12-18 21/02/2005 27/02/2005

Forecasts of European summer and winter

For some seasons and events, forecasts from dynamical models and empirical methods are combined. For example, our European winter long-range forecast is based on understanding of the climatic situation in the north Atlantic together with an empirical prediction involving the North Atlantic Oscillation and on data from our EURO-SIP dynamical multi-model.

Insurance risk management

Forecast skill

The relative skill of the forecasts varies with the location, the time of year, the range of the forecast, and the quantity being predicted. In some cases, forecasts for rarer, 1 in 5-10 year events are possible, as these are often associated with significant and predictable climate shifts. Given that the climate is changing under global warming, our ability to forecast such events will become ever more critical.
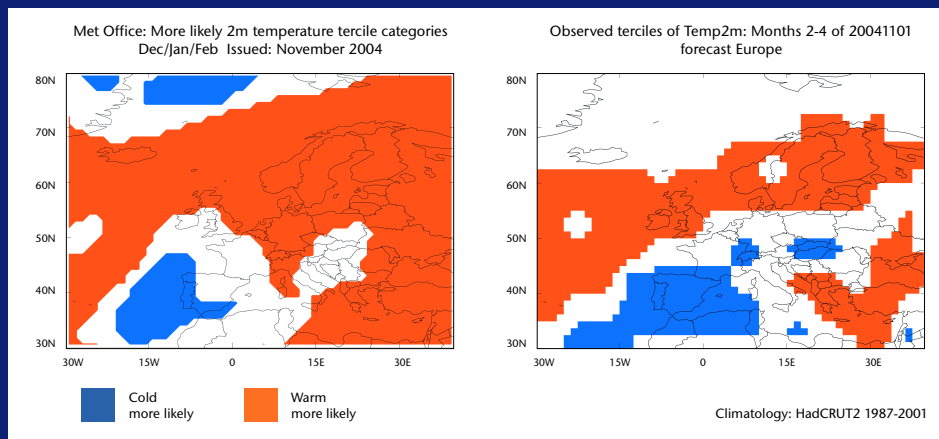
The most skilful long-range forecasts are for the tropics and other areas that are linked to the powerful influence of El Niño. There is, however, also some skill in forecasting for other parts of the globe, including the UK and European region.

Extensive tests are done involving retrospective forecasts for previous decades to assess the performance of the models. We can then work with users to find out how our forecast data can best benefit them. There may an environmental threshold — e.g. a specific temperature which, if exceeded, has a significant impact on their activity — that can be used to enhance the value of the forecasts.

Following international standards set by the World Meteorological Organization (WMO), information about the performance of our forecasting system is available online at
www.metoffice.gov.uk/research/seasonal

The winter forecast for 2004 (below) showed that warmer-than-average temperatures were most likely for Northern and Eastern Europe, with some chance of colder weather on the Iberian peninsula. Observations of the temperatures in December, January and February (right) show that the broad pattern of the forecast was correct.

In the last 12 months, have there been any weather situations that have caused your organisation problems?

Met Office: More likely 2m temperature tercile categories
Dec/Jan/Feb Issued: November 2004

Observed terciles of Temp2m: Months 2-4 of 20041101
forecast Europe

Cold
more likely

Warm
more likely

Climatology: HadCRUT2 1987-2001

"Our observation
is that gas is now
an EU issue, not just
a UK one. Information
about the whole of
the EU, or regions
such as Southern and
Central Europe,
would be useful."

Gas Supply Manager

We are helping already
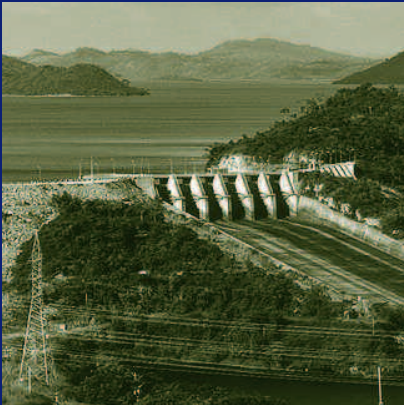
Hydroelectric forecasting in Ghana

The summer rainy season is the one chance each year for replenishing the water behind the Akosombo Dam on Lake Volta, which serves 50% of Ghana's electricity consumption. We are providing more accurate and longer-range forecasts of inflow volumes into the lake, which are helping the Volta River Authority manage its hydro-electric power generation.

Energy forecasting at Sempra Energy Europe Ltd (SEEL)

Long-range forecasts provide an essential tool in the analysis of likely energy needs over the coming season. SEEL is pioneering the use of long-range forecasts in energy markets and use long-range temperature and precipitation forecasts from the Met Office to give a probabilistic view of the weeks and months ahead.

Making an important contribution in Africa

In many parts of rural Africa, the life and livelihood of whole communities can hinge on the success or failure of the seasonal rains. Along with other international centres, the Met Office is helping by providing seasonal forecasts for the African rainy seasons. Issued forecasts are prepared at Regional Climate Outlook meetings where regional experts combine forecasts from different centres, including the Met Office, into a single 'consensus' outlook. This outlook is issued to users in the regions and helps farmers to choose the most appropriate agricultural strategies, and planners to assess and mitigate potential food security risks.
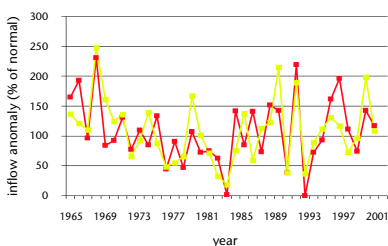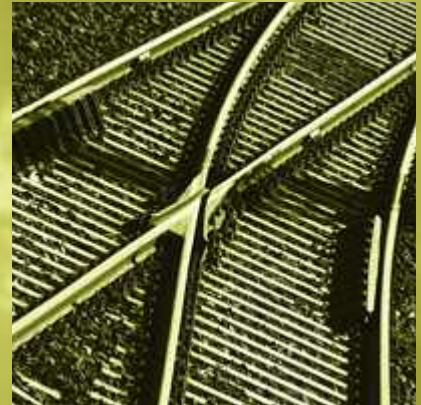

Forecast – Red
Actual inflow – Yellow

The June forecasts of total July–October inflow into Lake Volta have been improved markedly by using our long-range forecasts (above), with forecast correlation increasing from 0.3 to 0.7 and root mean square error decreasing from 60% to 40%.

"Long-range temperature and precipitation forecasts are very useful for a probabilistic view of the coming weeks and months."

Analyst, Sempra Energy Europe Ltd

The Met Office is committed to providing forecasts and engaging users to help businesses reduce their exposure to changes in climate, to avert humanitarian disasters and to improve environmental and agricultural planning worldwide.

Research

- Research is ongoing to find the best way to present long-range forecasts and increase their utility to our customers

- Long-range forecasts are produced as part of the UK's Hadley Centre for Climate Research and Prediction

- The Hadley Centre was a major contributor to the hugely successful EU DEMETER project on long-range forecasting, and is now leading the 72-partner follow-on project, ENSEMBLES, to develop better long-range predictions and applications for more market sectors

- We play a key role in programmes within the World Meteorological Organization and the World Climate Research Programme

- We are involved in UK Natural Environment Research Council projects to advance knowledge of the climate system and its impacts

Together, we can do more

Call 01392 886982
to discuss how our forecasts can help you

Met Office