Long-Range Forecasts

Help your organization manage risks and opportunities with advanced meteorological techniques

MeteoGroup

Introduction

This eBook is an invite to think about the usability of long-range forecasts for your organization.

Long-range forecasts potentially unlock new opportunities to become more cost-efficient. Effectively, you can save - or even 'make' - money with reliable long- term forecasts. It all comes down to being prepared and optimizing the decision-making processes.

How it long-range forecasting different?
Traditional weather forecasting extends to about 10 to 14-days in the future. Looking beyond this time frame is considered long-range, or long-term, forecasting; it covers forecasts for up to 6 months ahead.

It's not possible to predict the exact temperature three weeks ahead, let alone three months ahead. Therefore, long-term forecasting is probabilistic, with a confidence measure also included on the forecasts: low, moderate or high. In other words, it's all about 'forecasts of opportunity'. When the forecast has a high probability of occurring and also high confidence, and you can take actions based on this forecast with reduced risk. If the forecast confidence is low, and the outcomes are less specific; it's tougher to use it as a basis for decision making. However, even low confidence, less precise forecast is, in itself, useful information for decision-makers.

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Chapter 1:

Why the time is now for long-range forecasting

The concept of the 7 to 14 days forecast has been widely available for many years. As the world and industries have become more and more comfortable with those forecasts, they are starting to look beyond that time horizon. There is an inherent awareness that it is now possible to obtain skillful forecasts beyond the traditional time horizon. And it sure is.

We are at a point where increased knowledge and techniques, as well as vast amounts of data, are becoming more available to enable long-range forecasts. This change is partly because of the advancement of science and partly because of increased computing power. We analyze a range of worldwide teleconnections; meteorological, oceanographical, and other environmental phenomena. We can also see how these interact on a large spatial scale. These interactions are becoming more understood, even in a larger time frame.

It's the advancement of computing power that allows us to create the tools to find relationships and find methodologies that we would otherwise not have. Large and powerful supercomputers and results of meteorological research are also enabling to us extend the forecasting horizon. New and improved forecast models that more effectively link atmospheric processes with ocean and sea ice process, improving their long-range predictions.

The techniques and intelligence are available. So how might you, as a company, benefit from long-range forecasts. If you recognize yourself in the following situations, then long-range forecasts might be just what you need:

• Your work is influenced by the weather and the climate

• Your people's deployment is (partly) weather dependent

• You have to comply with regulations

• You have to avoid fines (the government heavily regulates your work, including penalties if you don't conform with strict targets.)

• You have to prepare as a company, they want you to be even more cost-effective

• You have to meet ever challenging customers demand

• You have to be profitable

• You have to monitor for potentially disruptive events, linked to weather/climate

• You want to manage the consequences of climate change, be pro-active instead of responsive.

The weather nowadays has become more and more uncertain; the probability of severe and extreme weather patterns has increased. We have entered a period in which there is a more significant risk of long-lasting weather patterns, like prevailing warmth and drought. Also, with rising global temperatures, might more easily generate extreme rainfall events, as well as rapidly intensifying and impactful tropical cyclones.

Finally, most companies want to be sustainable and environmentally friendly; so it's essential not to waste resources. This element might even be in your corporate responsibility code.

If you recognize yourself in one or more of these situations, then read on and discover how long-range forecasts could help you to face these challenges.

"There is nothing absolute in long-range forecasting. There are only probabilities of what is most likely to happen which means there are probabilities of business outcomes. In those terms, long-term forecasts can be relied upon."

Matt Dobson,
senior meteorologist, MeteoGroup.

Chapter 2:

Organizations that use long-range forecasts successfully

Many organizations can benefit from long-term prognoses. Some use them to plan well in advance, others to assess certain dangers. The reason they all do it is clear: to save or make money through these advanced meteorological techniques. Let's take a look at some examples to see how other companies are already unlocking the benefits of long-range forecasts.

South West Water, England

South West Water is a water and wastewater service provider, serving 1.7 million people in southwest England. They also provide water services in the Bournemouth Water region to approximately 0.5 million. South West Water is the only water supplier in the region, but it's accountable to a stringent set of regulations. Therefore, they're always planning strategically to be prepared. Mark Webber, Alarm Team manager at South West Water, says: "We cannot do anything about the weather, but we can have all people on stand-by and resources ready. The summer of 2018 was a perfect example of how we were prepared. Already in March, we were informed about the risk of a dry and warm summer. In April, all the signals were unified. Then we looked at our stock water and our reservoirs. We knew we had to be careful, monitoring what we would extract, what we could use, what we would have in storage, and what we could have as a backup. We always have to meet the demands. Because of the perfect sub-seasonal and seasonal forecast, we had enough water to cope."

For South West Water, being prepared for droughts and heatwaves in advance are as crucial as knowing cold spells and thunderstorms in advance. "Wintry weather might bring us to strategically put water in a location where we feel it might be critical," as Mark says. "The main element remains to get our resources ready, incident support managers available, and having the right number of technicians."

"With having knowledge. We were able to prepare, to a degree" - Mark Webber, South West Water.

Food and Agriculture Organization of the United Nations

UN FAO

Desert Locusts have the potential to damage the livelihoods of one-tenth of the world's population. A swarm, the size of Bamako (Mali) or Niamey (Niger), can consume what half the population of either country would eat in a single day. While many factors contribute to a Desert Locust outbreak, precipitation is a critical ingredient.

The UN FAO Desert Locust Information Service (DLIS) mission is to monitor, forecast, and warn of the development of Desert Locust populations across a significant portion of the face of the Earth. Keith Cressman of the UN FAO DLIS surveys many sources of weather information to see what has happened and is happening on a day-to-day basis. The sub-seasonal forecast, which provides forecasts 2 to 6 weeks in advance, and the companion seasonal product, which provides forecasts for 1 to 6 months in advance, help Mr Cressman better understand the risks of higher than average precipitation that could potentially lead to the development of Desert Locust outbreaks.
Keith Cressman: "The probabilistic forecasts allow us to evaluate risk in the sub-seasonal and seasonal time frames which improves communication to our partners."
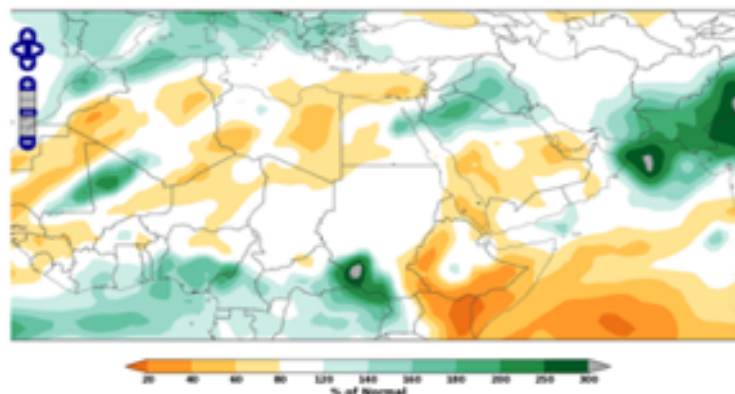

Figure. An example week 3 precipitation forecast for northern Africa and the Middle East.

"We use sub-seasonal and seasonal forecast information to assist with our monitoring and decision making." - Keith Cressman of the UN FAO

Chapter 3:

Long-range forecasting by industry

Being informed and knowing the trends in advance can be a big help. It empowers you to prepare (at least to some degree) for the expected conditions. Manage your risks and opportunities, and you'll be way ahead of the competition. For some sectors, it is undoubtedly about opportunities; an accurate and timely long-range forecast can really make money.

Utility companies

Utility companies must know the likelihood of sustained and impactful climate anomalies well in advance. This insight is particularly useful if a season is likely to see a higher number of wind storms, increased episodes of heat and drought, or if snowfall and cold weather are likely to fall outside of seasonal averages.

They can make sure their backup teams are ready, and there is enough manpower available to deal with the issues. The more familiar they become with using these types of weather forecasts, the better they are prepared. The long-range forecast, therefore, becomes an integral part of the contingency plans. It means they can refine their strategic planning and are therefore able to meet water, electricity, or gas demand throughout a whole season.

Energy traders and analysts

Energy traders and analysts are typically familiar with the benefits of long-range forecasts. They need to know if there could be a significant cold spell coming next winter or a significant heatwave in summer. These variables can have significant impacts on the demand and, therefore, the price of gas and electricity. For example, if winter starts very mild, then demand for gas will be lower than average, as people switch on their heating less or have the thermostat set at a lower temperature. The price of gas will fall, with excess gas being stored up.

A long-range forecast for the second half of winter, warning of colder conditions to come offers traders the opportunity to make money. They can purchase gas at the lower price, and then sell it back once prices rise as demand grows in the colder weather.

Renewable energy

Wind and solar power are incredibly variable and very weather sensitive. However, as the demand for renewable energy sources grows, we are also seeing a rapid increase in the use of these types of energy production. While predicting wind and solar at long forecast lead times is often more challenging than predicting temperature, these companies can still benefit hugely from accurate, probabilistic, seasonal and sub-seasonal forecasts. When they get a view on the likely trends for the coming month or season, for instance, if it will be windier or sunnier than average, this allows them to make money or offset losses.

Agriculture

Reliable seasonal and sub-seasonal forecasts make it easier for food producers to monitor the whole growth process. It also enables them to provide a correct estimation of the harvest: both in terms of quantity as quality.

Estimating harvest time is essential because of the impact it has on downstream logistics, such as when trucks or planes have to be available. It also allows food producers to communicate when the products are likely to reach the shops or the auction.

Emergency Services

Governments and emergency services want to keep weather-related risks to a minimum. Floods, lightning strikes, heat waves and cold spells cause disturbances and, without adequate preparation, can result in fatalities. In the event of extreme weather events, it might even lead to a state of emergency. As a safety organization or (sub)government, you have to be prepared. Long-range forecasts can play a significant role in this preparation. It's all about risk management, often accompanied by scenario planning, to be ready before the weather event occurs.

Travel agencies and holiday planners

Knowing the likely weather conditions can help travel agencies sell holidays. For example, if a tour operator knows there is a lovely (warm, dry) period ahead on the long-term, they can use this long-range information for special offers and promotions. These campaigns are innovative and help to enable sales.

Retail

A clothing store must buy and sell their stock. A pivotal part of success is having the right inventory, and the right time. If they are aware of long-range developments in the weather, they might optimize this workflow to reflect the likely conditions. For example, if you know that a cold snap is expected to occur earlier than usual, retailers can take advantage of this by stocking up on jumpers and coats. It saves money, it makes money, and it makes you stand out in the crowd. This same thinking also applies to food and drink companies (including beer, ice, and ice cream), as well as events companies.

> **"With long-range forecasts you can take action to mitigate risk. You can make decisions that positively impact the bottom line or at least minimize damage to it. Users don't necessarily have to wait for the short-term forecasts to see an opportunity or a risk developing."**
>
> *Dr Jan Dutton,*
> *CEO, Prescient Weather.*

Chapter 4:

How to choose a reliable provider
No black box but, an open box

It is crucial to join forces with a supplier that transparently delivers forecasts. Ask for information on how their forecasts are made. If no insight is available, alarm bells should ring. Many free websites are offering all kinds of long-range prognoses. But they do not give any insight into how forecasts were created or review how they are verified.

Insight into global correlations

Fundamentally, reliable seasonal and sub-seasonal forecasts require knowledge and skills about all kinds of drivers and teleconnections that influence the weather. These include relationships between atmospheric, oceanographic and other physical phenomena. For example, sea surface temperatures in the southern hemisphere can affect the large-scale air pressure patterns in the northern hemisphere. What happens in the higher layers of air around the North Pole might -after a few weeks- bring a severe cold spell to the USA, Europe and northern Asia. Discovering, identifying, and continuously learning about how different global weather patterns interact is of great importance for increased predictability and skillful forecasts, rather than just relying on the computer model output. When choosing a provider, consider the extent to which they have this knowledge and can exhibit it.

Database of historical weather observations and re-analysis.

Observations are crucial for dependable forecasts. It's no different when it comes to seasonal and sub-seasonal forecasts.

Suppose that ENSO (El Niño Southern Oscillation) is currently very active, which means warmer than average sea waters over a large portion of the central and eastern Tropical Pacific. Having a database of climate index values allows meteorologists to search for similar occurrences in the past. Having a visualization tool enables them to create a probability distribution map of how El Nino typically influences global weather patterns. A sophisticated tool also allows them to analyze the combined result of El Nino, and other teleconnection patterns, such as the North Atlantic Sea Surface Temperatures.

If several teleconnection patterns suggest similar climate anomalies are likely in your area of interest, then forecast confidence can increase. Creating skillful statistical forecasts based on previous data is a robust methodology for enhancing long-range weather forecasts. A reliable and extensive re-analysis database is vital if a provider's ambition is to provide reliable long-range forecasts.

Calibration of model data

If a provider is serious about long-range forecasting, they need model information. Each reputable supplier will run or purchase a numerical weather model as starting point for the long-term predictions. Correct observations and continuous refinement are crucial to run a useful model. More sophisticated providers will create their own model mix, crafting an effective combination of two or more models. In other words, they create a statistically optimized combination, which generates the most reliable outcomes. The best suppliers calibrate their purchased models, meaning they are analyzing the past performance of the model, and add corrections to make it more accurate for future predictions by removing biases etc. They look back over previous data in and compare it to what really happened. This process is designed to ensure that they can be confident in forecasts that they make. It's a 'reliable' calibration, making sure the forecast probabilities are correct.

Working with probabilities

When setting a weather forecast for the next 3 days, you can talk about the expected highs and lows. If you look at 3 weeks from now, realistically, you'll only be able to talk about trends and opportunities. A long-range forecast is, therefore, embedded into opportunities; it offers an indication where the possible disruptions may be found.

The extent to which a chance can come true varies. A sincere provider, therefore, links a confidence measure to the long-range forecast, for example: low, medium, high. After all, there is definitely something to be said about reliability. The probability of the forecast coming true depends, among other things, on: the number of model options that choose a particular direction, the extent to which they do so, the extent to which different teleconnections show the same trends, the succession of weather events (worldwide) has occurred more often in history, and the season in which we find ourselves.

Support by meteorologists

A seasonal or sub-seasonal forecast can be offered in different ways. In-house meteorologist at energy trading firms, for instance, may not need a lot of extra help interpreting the forecast - but may occasionally wish to speak with the forecast provider to test their forecast confidence or firm up on the detail. But, in general, the provider will assist to make sure users understand the complete weather story, including the most likely scenario, the critical impacts expected, and the risks and confidence level. Also, the long-range forecaster can focus on just the parameters that are most crucial for your organization and help you at interpreting all the information correctly. This additional communication is often provided by telephone consultancy, screen share video calls or email/instant messenger.

Skill

Any self-respecting provider of long-term forecasts will be able to demonstrate the skill of the method used. This will clarify to what extent the forecasts will useful. If in doubt, ask for verifications.

Chapter 5:

A case story, predicting a hot spell 25 days in advance

August 2019 was unusually warm across much of Western and Central Europe. The United Kingdom experienced its hottest ever August Bank Holiday Monday, with Heathrow registering 33.2°C. The Netherlands has never had a heatwave so late in summer before, and Germany was soaring hot as well. The sun has no competition with clouds and was strong enough to harm the skin. Southward facing windows catch so much heat, causing the indoors to warm up to unpleasant temperatures.

In this hot week, air conditioning used a lot of electricity, as did data centers and cold stores. More drinking water was consumed, and soda drinks and ice creams were sold in volume. On the other hand, it was quite empty in a lot of shops, as people tried to enjoy the final part of summer.

What if you knew this all in advance? What if you could have prepared your business way earlier? Well, customers of MeteoGroup did know it beforehand. While other weather companies mentioned they predicted this heat spell 10 days in advance, MeteoGroup forecasted this outbreak of unusual warm weather 25 days ahead. Clients of the sub-seasonal forecasts received the prognoses on Tuesday 30th July.

The sub-seasonal outlook for UK & Ireland issued on the 30th July, as all long-range outlooks, was the result of a thorough path of investigation by senior-meteorologists. Using the World Climate Service (WCS) online tool, which makes it possible to investigate all kind of interactions in the atmosphere and oceans, the meteorologists produced a forecast embedded in risk factors and the confidence levels. Experienced long-range meteorologists found out the trend was unmistakably going to result in a drier, warmer, and calmer weather pattern in the final parts of August. This was still just a trend, as time proceeded, the signals became more convincing, and the temperature anomalies were adjusted upwards. But, even as the forecast became more confident, MeteoGroup customers had the advantage of early warning through long-range forecasts.

Week 34 (Monday 19 to Sunday 25 August)

Table below gives the MeteoGroup forecaster's best view on the expected weekly mean weather anomalies.
Maps are based on an optimised blend of ECMWF and CFSv2 Sub-Seasonal model data, updated on a TUE and FRI.

	Central & Eastern half of England	Wales & Western half of England	Ireland & Northern Ireland	Scotland
Temperature Anomaly	3C above average	2C above average	1C above average	1C above average
Precipitation	▼	↔	▲	▲
Wind Speed	↔	↔	▲	▲
Lowland Snowfall/ Line Icing Threat	N/A	N/A	N/A	N/A
Forecast Discussion & Impacts	Our latest forecast remains consistent for a drier, warmer and calmer weather pattern to gradully extend into the UK from the south. Latest model guidance, especially from ECMWF, supports our statistical forecast findings on page2, for high pressure to expand across the UK (especially southern half in Wk34 and then potentially more sustained and more widely Wk35). Impacts will be for wet / windy anomalies to be less extensive and weather than previous 2 weeks, with dry / warm anomalies more of a feature. Reducing wind speed.			

Getting to know more:

Please get in touch with:

Prescient Weather

www.prescientweather.com

info@prescientweather.com

MeteoGroup

www.meteogroup.com

Contact Us