

14: Applied Climatology

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Headlines about climate are dominated by global warming, sea level rise, and melting ice caps; threatening catastrophe in fifty or a hundred years. These pages address more immediate climate issues with tangible effects next month or next year.

Climate research benefits the following industries.
We discuss climate prediction and case studies from wind energy and insurance.

- Insurance
- Tourism
- Construction
- Energy
- Transport
- Agriculture
- Sport
- Health
- Retail Food
- Retail Clothing

Climate Prediction

This chart demonstrates some of the problems with climate prediction. The data are for the northern UK and show the number of days in a year with severe gales (winds strong enough to uproot mature trees) from 1881 to 1997. The number of gale days is indicated by the red columns. The heavy green line is a *smoothed* version of the data, highlighting major changes in time. At least one commercial consultant I know of uses the smoothed line to predict climate up to one year ahead. This is essentially predicting the mean. It is clear from the chart that the method would normally give a correct forecast of rising or falling trend. But prediction of a single annual value would often be wildly inaccurate.

Another popular method of prediction is using *cycles* in the data. Cycles imply that the data oscillate with a regular periodicity that apparently makes forecasting simple. For example, between 1970 and 1997, the gale frequency appears to be periodic with three peaks at roughly ten-year intervals. This periodicity is absent in the rest of the record and is almost certainly a chance phenomenon that will vanish in the near future. Such pseudo-periodicity is common in climate data and should not be used for prediction.

Having indicated that reliable prediction of particular climate variables is extremely difficult, it remains to answer the question: what can be predicted, and how? A good example of responsible forecasting can be found at the Climate Prediction Center in the United States. This site gives an assessment of likely hurricane activity in the coming season, with full scientific background, cautionary notes on using the forecast, and frank discussion of its limitations. The method uses empirical associations between particular global climate conditions, including large-scale vertical wind shear, and subsequent hurricane activity. A more academic and experimental approach is described at the [Experimental Climate Prediction Center](#). The forecast

is for El Nino, the cold water episode off South America that relates to climate all over the globe, and uses a highly innovative prediction scheme combining a statistical atmosphere with a numerical ocean model.

Reliable prediction of local climate conditions rests on combining computer forecasts of large-scale climate, such as these, with the detailed relationships identified by statistical climatology, as described below.

Wind Energy



Wind Energy is still a relatively under-used resource in the UK. The high capital costs of installation make it essential that the wind energy potential of the site is understood and favourable. There is little point in erecting £2,000,000 worth of wind turbine if mean monthly wind speeds are low and have been declining for years. CRU has long been recognised as a prime source of expertise in this field and is currently involved in an EU-funded project to evaluate the offshore wind resource for all the coasts of Europe.

Our preliminary studies indicate that a substantial proportion of the coastline of the EU has experienced increasing wind speeds over the last few decades. This may not be a good thing in the more northerly countries since wind speeds there are already high. Wind turbines cut-out if wind speeds get too high for safe operation, so a trend towards increasing wind speeds could mean more turbine down-time in some regions, and a longer pay-back period.

Offshore wind farms have many advantages over land-based sites, including:

- potentially more reliable winds
- fewer planning and vandalism problems
- no land charges
- no problems with "*nimbyism*"

Disadvantages include:

- higher costs of erection, maintenance, and connection
- navigation problems

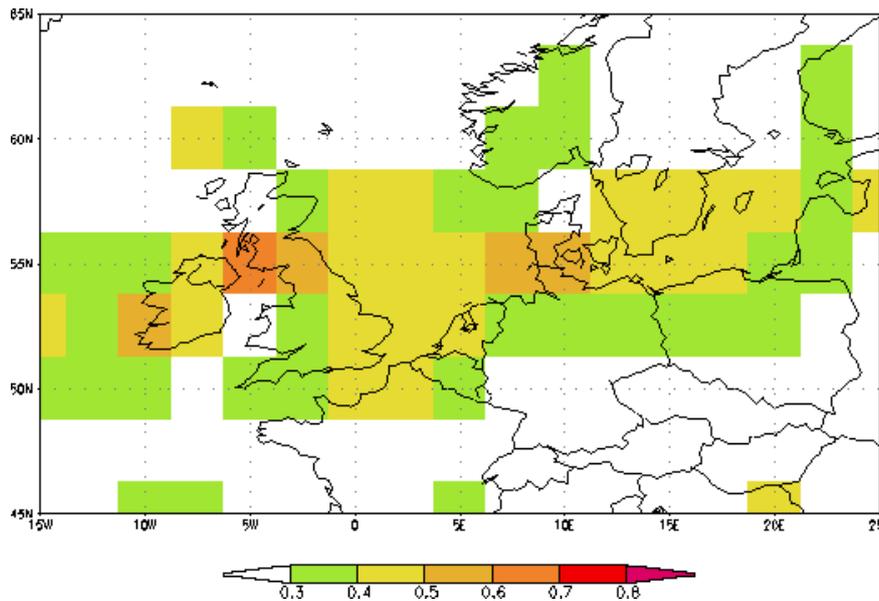
To find out more about wind energy development try the Danish Wind Turbine Manufacturer's Association Web site. It's great fun and slightly biased, but they probably know more about the subject than anyone else.

Insurance and Climate

The insurance industry offers financial protection against climate-related damage. This includes direct impacts from damage due to flood, frost, wind, snow, and drought, but also indirect factors such as subsidence, effects on tourism, health, and forest fire. Climate research can help reduce the costs to insurers by:

- quantifying the probability of extreme events
- identifying trends
- providing year-ahead forecasts
- identifying vulnerable regions

CRU is currently involved in research under the [TSUNAMI Initiative](#) that is examining the risks to the insurance industry of wind and rainfall extremes over Northern Europe. For example, the diagram below shows the pattern of correlation between the North Atlantic Oscillation (NAO) in one winter season and exceedences of the 99th percentile of average winter wind speeds in Europe in the following winter season. The scale is the correlation coefficient r ; $r = 0.0$ indicates no relationship, $r = 1.0$ indicates a perfect correspondence.



The results suggest that the NAO, essentially an index of windiness over the whole northeast Atlantic (see the [NAO Information Sheet](#) for more detail), is a reasonable predictor of wind speeds over northern England/southern Scotland and Denmark in the following year. This is important since the forecast winds are the highest 1%, those most likely to be associated with severe damage.

This is just one of many relationships identified between wind speeds and a number of predictors. The graphical results will be incorporated into an equation that can be used to predict wind speeds a year ahead over different parts of Europe.

The work described above indicates how the study of climate can be usefully applied to very real problems that influence us all, now. Climate change is not something esoteric that may, or may not, affect our grandchildren. It happens all the time and has immediate impacts, costs and benefits, that can be avoided, exploited, or possibly, managed.

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