

Climate change

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"...no compelling evidence to indicate that... extra-tropical storms have changed."

Should we be designing for future increases in wind speed?

There is a common perception among the public, and probably among designers, that the effects of climate change are bound to result in stronger winds that occur more frequently. The argument goes that global warming adds energy to the atmosphere, which drives the winds, causing wind speeds to rise. However, there is not much evidence of this in the records of the meteorological office or, indeed, in the report of the Intergovernmental Panel for Climate Change.

Intergovernmental Panel for Climate Change

The IPCC was established to develop a broad consensus view on what the effects of climate change will be, where they exist at all. It was formed by the United Nations Environment Programme and the World Meteorological Organisation and is open to members from both.

Acknowledging the difficulty of looking for trends in extreme events, which are rare by definition, the Panel concludes that there is "no compelling evidence to indicate that the characteristics of tropical and extra tropical storms have changed." They do, however, consider it likely that the extreme wind speeds in tropical cyclones will increase in some areas.

This information from the IPCC is interesting but not very useful for design. We are still left with uncertainty over whether we should expect UK extreme wind speeds to increase in the future. So, perhaps we should turn to an analysis of UK storm data over the past 30 years to look for trends that might help.

Analysis of UK strong wind data

Nicholas Cook, Director of RWDI-Anemos Associates, has carried out an analysis of 50 Met stations around the UK, mostly having 30 years of continuous records of wind speed. The sites (shown in Figure 1) are well spread across the country and exist at a range of altitudes.

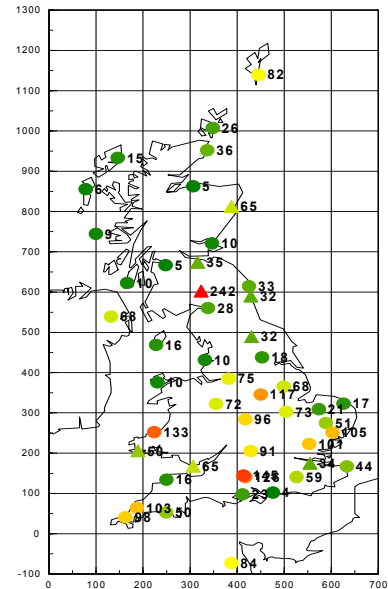


Figure 1 - Unacceptable thresholds

Analysis of extremes is commonly done just with the annual extreme wind speed but this necessarily limits the number of data points available for analysis. Clearly, within each year there are numerous strong wind events, independent of one another, that could be considered. To overcome this restriction the Improved Method of Independent Storms (IMIS) was used. This takes any wind event where the wind speed exceed a certain threshold to be a strong wind event. The threshold used is that the 10-hour running mean must exceed the 'c' parameter of the Weibull probability distribution for wind speeds at that same site. The 'c' parameter is a spread parameter for the distribution and is representative of the most likely range of

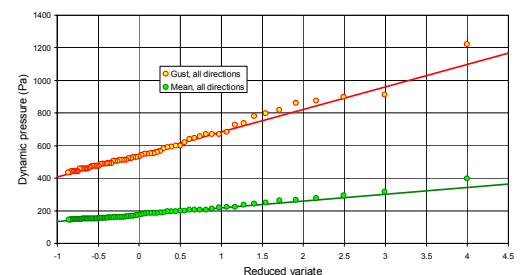


Figure 2 - Coltishall IMIS data fitted to Fisher Tippett Type I

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Tornado damage in the UK

“...analysis of recent data shows only marginal trends one way or the other...”



Storm damage

wind speeds so, loosely, the IMIS definition identifies wind events with stronger than average winds.

The data for each site were corrected for topographic and terrain roughness to standard, open country exposure to make them directly comparable. They were then fitted to a Fisher Tippett Type I distribution for extremes and the fits are remarkably good. Figure 2 shows an example for Coltishall. Note how there are points at the upper end which do not lie directly on the fitted line - as one would

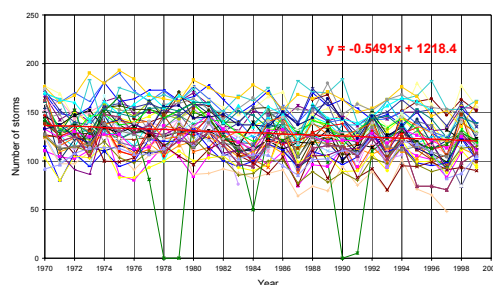


Figure 3 - Frequency of strong wind events at 50 UK locations

expect because these are the biggest recorded values in 30 years and nobody knows whether they are actually a 30-year value or perhaps a 200-year value that just happens to have occurred during the measurement period. Importantly, these extreme points are not always bigger than the fitted line would predict.

Frequency of strong wind events

The number of strong wind events identified by IMIS is plotted in Figure 3, with a trendline shown. There is considerable scatter but the trendline that does exist is downwards. The suggestion is that the frequency of strong wind events is, if anything, reducing by half an event per year.

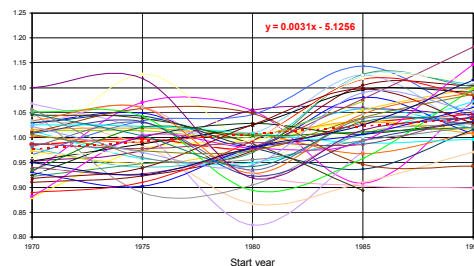


Figure 4 - 10-year extreme gust wind speed

Magnitude of strong wind events

Taking the analysed data for all 50 sites and plotting them over the 30-year period 1970-2000, as in Figure 4 there are two striking conclusions. The plot shows the decennial (10-year) extreme gust wind speed normalised by the mean over the full 30-year period. Firstly, there is wide variation between the sites and from year to year. Secondly, there is a slight upward trend in this parameter. This suggests an increase in decennial mean of about 0.3% per annum.

The figure in the left panel shows a colour plot of each location, where reds indicate worsening conditions and greens indicate improving trends over time. Again, there is no apparent pattern.

Conclusion

Overall then, the analysis of recent data shows only very marginal trends one way or the other, set against a background of considerable scatter. It is difficult to conclude from this that there is any basis for including an allowance for global warming in future design wind speeds, or for worrying about those trends with existing designs.

The IPCC report tends to support this cautious view. Trends may develop in line with the increased surface temperatures and atmospheric energy but so far there is no real evidence of it for the UK.

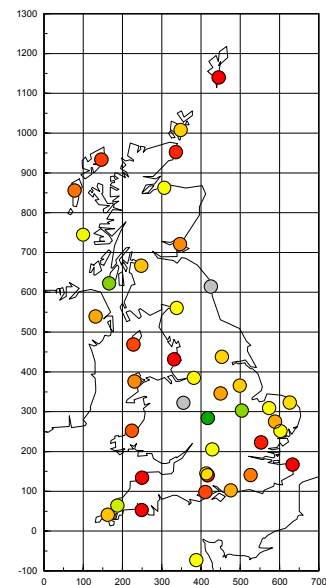


Figure 5 - Long term trends red=worse, green=better