University of Reading

IMPACT CASE STUDY

Sting Jets

Predicting destructive winds

In the early hours of the 16 October 1987, a now infamous storm caused a swathe of damage across southeast England and northern France, resulting in the deaths of 18 people in England and at least four in France. Between 2001 and 2003, observations of the October 1987 storm were re-examined in considerable detail to study what had occurred and, in particular, explain the pattern of the very strong wind gusts.

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Research

The storm which occurred on the 16th October 1987 was estimated to be the most damaging storm to hit southern England since the Great Storm of 1703, causing widespread structural damage to buildings and downing an estimated 15 million trees (a figure provided by the Met Office). Rail and road transport were disrupted, and power supplies were not fully restored for more than two weeks.

A special report by Risk Management Solutions, a company which evaluates weather risks, estimated that the cost to the insurance industry in the UK was £1.4bn, making the 1987 storm the second most expensive UK weather event on record. Motivated by a second, 'near-miss' storm on 20th October 2000, where the strongest winds were over the North Sea, and realising that studies of the 1987 event had focussed on the larger-scale structure rather than the smaller-scale phenomena within the storm, researchers from the University of Reading re-analysed the data from the night of the 1987 event. The research focused on identifying and understanding the element of the 1987 storm which had made it so damaging, namely the extreme wind gusts; the strongest of these recorded over UK land on the night of 16th October 1987 were 115 mph at Shoreham on the Sussex coast.

This work formally categorised the phenomenon of a 'sting jet' for the first time and identified the evolution of the cloud pattern associated with these sting jets in satellite imagery as a useful tool for 'nowcasting' (which is forecasting the current weather).

This research has identified where and how the most damaging winds formed in the destructive storm which occurred on the 16th October 1987. Because meteorologists from Bergen had previously noted the cloud had the characteristic appearance of a scorpion's tail, the researchers used the term 'sting jet' to describe the associated winds. Importantly, the researchers discovered that the most damaging winds were found to be at the very end of the jet, meaning they were located in a region different from the commonly-understood areas where strong winds were expected. Furthermore, the most damaging winds were shown to last for a relatively short time, just a few hours, compared with the lifetime of the storm as a whole. This information is very useful when issuing severe weather warnings.

A diagnostic was developed based on the understanding gained from the research. This calculation can be performed on climate or global numerical weather prediction model data, and indicates whether a sting jet is likely to form.

Impact

This research led to the understanding that sting jets are a feature of many, but not all, rapidly developing storms. The ability to predict these sting jets is very important because of the potential loss of life and property damage that can occur as a consequence of the extremely high wind speeds. Prediction enables early warnings to be made and alerts to be given in the locations they will be needed.

The realisation that the most destructive winds were associated with a characteristic cloud formation produced an immediate benefit in terms of enabling the identification of potential sting jets from satellite images. This means that warnings can now be issued to locations likely to be in the path of the storm, with about one or two hours advance notice. Predicting the intensity of the sting jet is crucial, and joint work with the Met Office has established both what is needed to predict the severity of such events, and how to predict them further in advance.

This research has been transferred to the National Severe Weather Warning Service (NSWWS), which is the operational warning system of the Met Office. Importantly, forecasts and warnings of such events have been made possible by this research, and those that have been issued have undoubtedly saved lives and contributed to the level of readiness of the emergency services.

The storms affecting Scotland which took place on December 8th 2011 (extratropical cyclone Freidhelm) and January 3rd 2012 (Ulli) gave the clearest examples to date of the benefits that this research has given. In both cases, the Met Office forecast that a particularly ferocious Atlantic storm would affect parts of Scotland and issued a Red Severe Weather Warning, the highest possible category, on the basis that these were identified as sting-jet storms. Agencies acted on this advice: schools were closed, police warned people not to travel unless absolutely necessary, emergency services were put on alert. The Kingston, Erskine, Tay and Forth bridges were all closed and many bus, rail and ferry services cancelled. This preventative action undoubtedly minimised the impacts of the storms, which brought gusts of up to 164mph and widespread disruption. Importantly, there was no loss of life associated with the storms.

The significance of this impact is large. Many of the deaths in high wind events are caused by trees falling onto cars and so warnings to avoid all unnecessary journeys can save lives. Warnings can greatly increase the effectiveness of the emergency services who can be mobilised to the necessary level in the required places. Although the path of the destruction can be surprisingly narrow (in Ulli it was about 30 km wide), the trail of destruction can cover several countries.

The impact for this example reaches beyond the UK: the Met Office forecasts during these two storms were incorporated into warnings issued by the European Storm Forecast Experiment (ESFE) and the Swedish Meteorological Institute, which for example, triggered the cancellation of Scandinavian North Sea ferries services and the closure of some bridges.

The October 1987 Great Storm was exceptionally devastating, in part, because it occurred in a region of high population density in southern England. Loss of life had been limited by the lucky chance that the most damaging wind gusts were in the small hours of the morning. However, damaging sting-jet storms are relatively frequent. In a report published in 2007, Risk Management Solutions estimates that if the Great Storm of 1987 had recurred in 2007, it would have caused between £4 billion and £7 billion in insured loss Europe-wide. Over 70% of this loss would be generated in the UK, with the majority of the remaining loss in France.

The findings from this research are therefore of great use to the insurance and re-insurance industry. Although there is no difference between the damage caused by a sting jet and non-sting jet storm, the damage from the sting jet itself will occur in a part of the storm where we don't normally see strong winds, so inclusion of this in the models used by these sectors would be of great value.

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NATURAL ENVIRONMENT RESEARCH COUNCIL

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