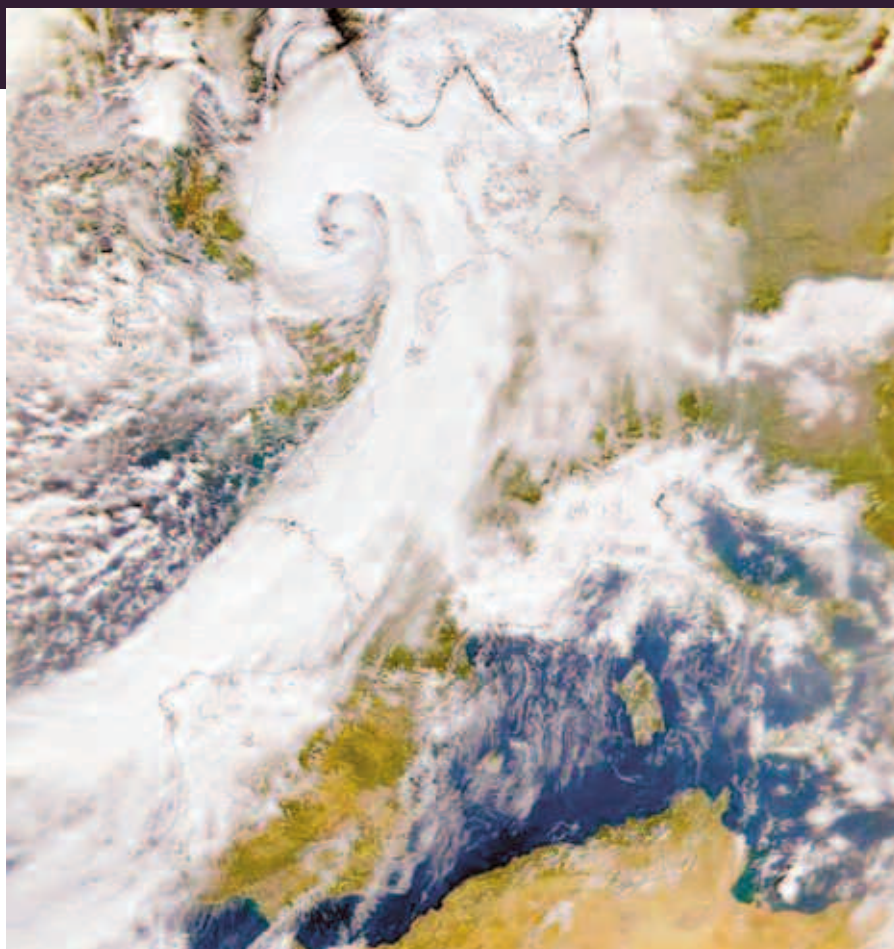


Storm gangs

In Europe, bad weather comes in bouts. Pascal Mailier explains why.

If you think winter storms in western Europe come thick and fast, you're not alone. Clusters of storms can push economic damage to levels you'd expect from a catastrophic hurricane, and the insurance companies that carry the cost are worried about recent trends. For example, in December 1999 a series of devastating storms left an estimated bill of £13 billion (€18.5 billion euros), and killed at least 160 people. Two of these storms (named Lothar and Martin), accounted for more than 80% of the total cost, and hit the continent only 36 hours apart. Ten years earlier, in the winter of 1989 to 1990, eight consecutive storms had inflicted similar losses. The damage comes from the floods that follow repeated spells of heavy rain, as well as the very strong winds. These two examples are extreme cases, but it's easy to find others, such as the rapid succession of storms that gave insurers in the UK a cold sweat in October 2002.

Despite the huge costs, storm clusters have received surprisingly little scientific attention. They were first recognised in the years immediately following World War One by Jakob Bjerknes and a small team of Scandinavian meteorologists based in Norway – the famous 'Bergen School'. They discovered that most cyclones in our latitudes (the midlatitudes) are spawned in an extended zone across the North Atlantic where cold and warm air masses appear to be fighting a permanent battle for supremacy. Using



This image shows the storm of October 2000 after it brought torrential rain and hurricane-strength winds to Britain. It spawned at least three tornadoes before continuing on toward Scandinavia.

the military analogue, they named this zone the polar front (meteorologists now prefer to use the term 'storm track'). They also proposed that instead of being solitary, cyclones propagate along the polar front in groups that they named 'cyclone families'. Our knowledge of midlatitude cyclones has come a long way now, thanks to many years of intensive research, but somehow the idea of cyclone families does not seem to have raised much interest – until it reappeared in insurance statistics.

I've been investigating whether the storm clusters Bjerknes spotted, and that the insurance companies worry about, have definite causes, or whether they happen just by chance. If it's not pure

chance, then many hazard models in use nowadays are probably underestimating storm-related risks. First, I compiled a database of more than half a century of cyclone trajectories for the whole Northern Hemisphere. Then I focused my attention on the storm tracks,

On our side of the Atlantic, storms strike in packs.

particularly in the North Atlantic. Storm tracks are like 'highways' that mid-latitude

storms follow to cross the oceans from west to east. I looked at the 'storm traffic' on these highways, using the same principles used to monitor traffic flow on real roads. I counted and timed the passage of the storms for many different locations. The difference is that instead of putting cables on the tarmac, I had to write a computer programme to do the



job! A statistical analysis of the data was very revealing. In the west – the entrance region of the storm track off the east coast of Canada – storm traffic is very dense, but regular. The same thing happens on the roads when the traffic gets very busy: vehicles tend to come closer to one another while trying (hopefully!) to observe a minimum braking distance. This region is literally a ‘storm production line’. In winter, the northeast of the American continent is very cold while the warmer waters of the Gulf Stream close to the shore carry heat and humidity. This sharp, permanent contrast provides the energy that feeds almost uninterrupted storm production.

Things are quite different at the European end of the storm track. On our side of the Atlantic, storms strike in packs. In Western and Northern Europe, we experience this as spells of stormy weather that can last from just a few days to more than a month during which the

weather may be very unsettled and mild. These periods of stormy weather have long been associated with the North Atlantic Oscillation (NAO), a phenomenon experienced as a north-south shift (or vice versa) in the track of storms and depressions across the North Atlantic Ocean and into Europe. But my analysis suggests the NAO is only part of

the story, and that other factors are important too.

Periods of frequent storms are indeed driven by distinct and independent

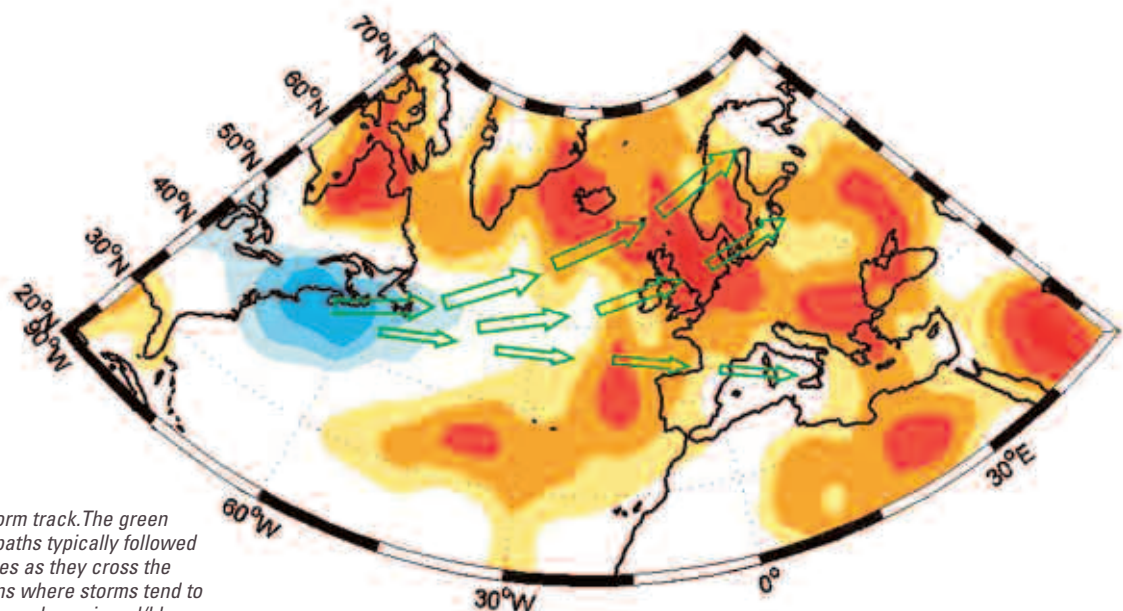
mechanisms. The first one is when storms are steered by a vigorous upper-air flow and move more swiftly than usual across the Atlantic. This mechanism is closely linked with the NAO. Another mechanism is when new storms are suddenly generated in the middle section of the storm track, and then make their way towards Europe. On top of this, traffic conditions along the Atlantic storm track change with time. For example,

high pressure can develop in the way of the storms, diverting them from their usual path, and causing more storms than usual in some places that would not normally expect them. I couldn't resist the temptation to perform the same analysis on the North Pacific storm track and the North American west coast, and a comparison of the results confirms Europe as the hot spot for storm clusters.

In the last leg of this research project I intend to tackle the difficult problem of prediction. One important question that deserves special attention is how storm clusters will respond to a changing climate. I hope that this potentially nasty behaviour won't get any worse!

Devastating storms left an estimated bill of £13 billion, and killed at least 160 people.

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The North Atlantic storm track. The green arrows illustrate the paths typically followed by midlatitude cyclones as they cross the North Atlantic. Regions where storms tend to be clustered/regular are shown in red/blue.