The Sting Jet that Roared – A Remarkable Windstorm Crosses Scotland

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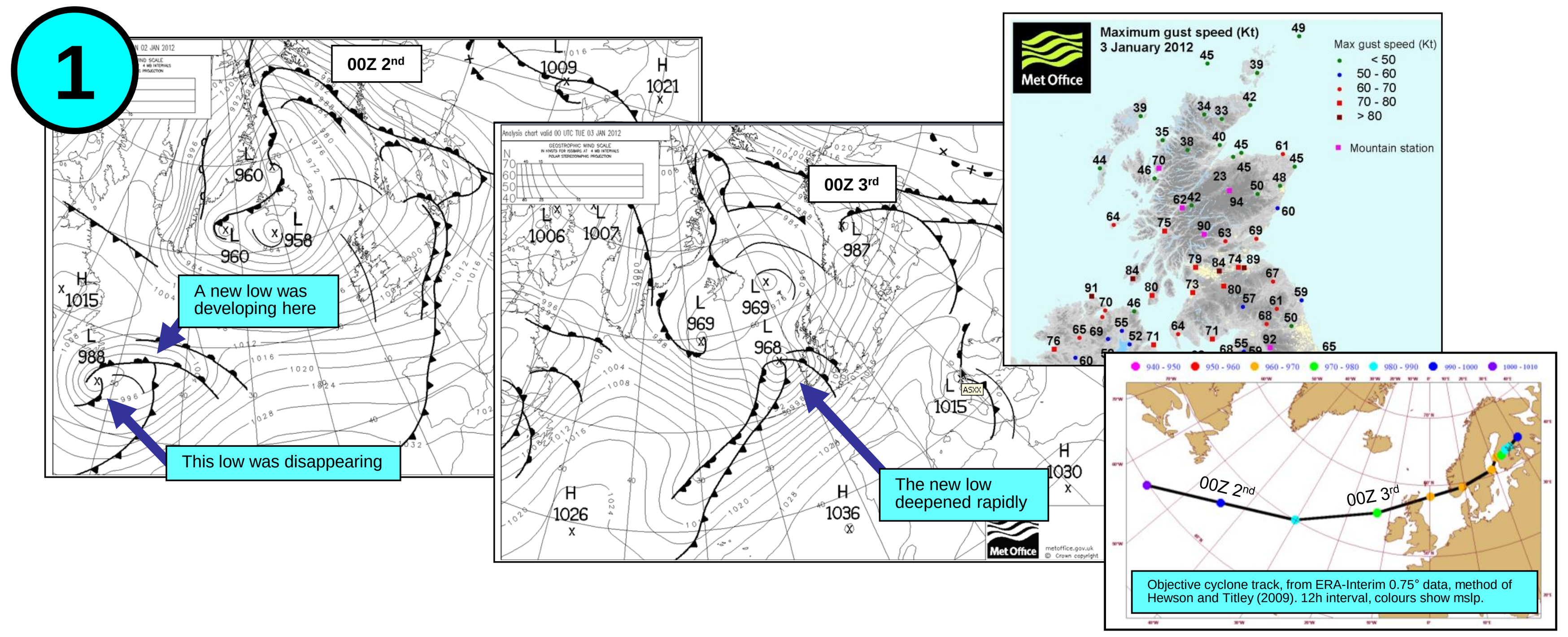
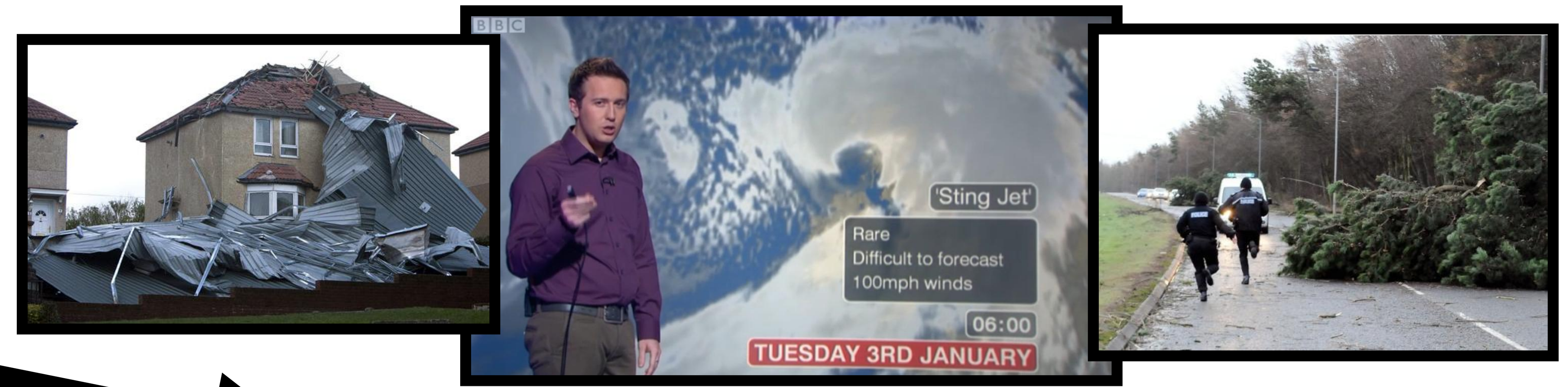
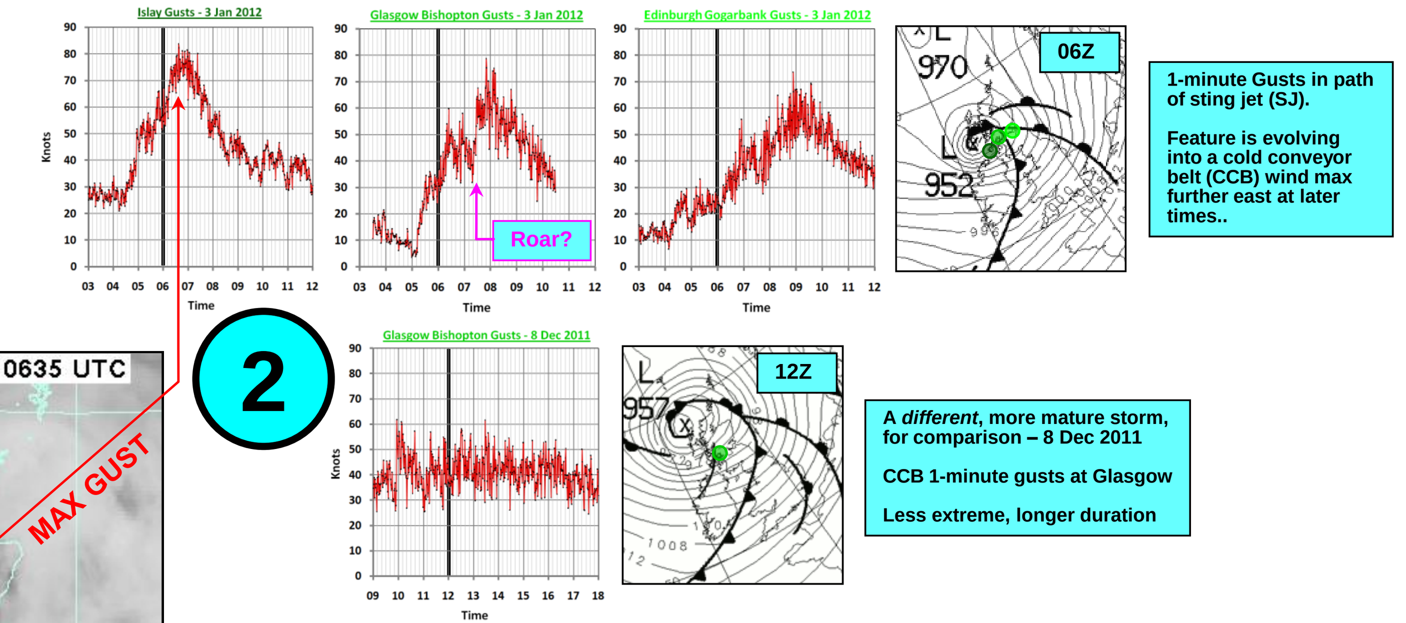
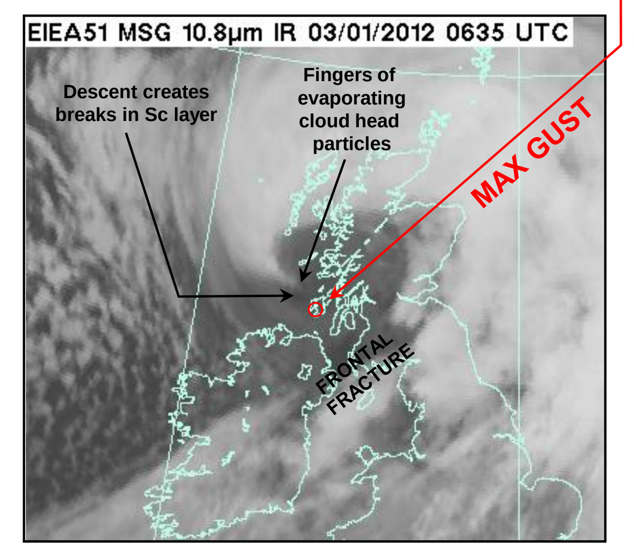








•On the morning of 3 Jan 2012 eyewitnesses across southern Scotland reported a 'roar' – like a jet engine – just before the onset of a major windstorm. Gust return periods in the highly populated Edinburgh and Glasgow areas were of order 20 years.

•The responsible phenomena appears to have been the 'sting jet', a term coined by Keith Browning in his analysis of the Great October storm of 1987 that hit southeast England and northern France.

•Sting jets are associated with some rapidly developing cyclones. In this instance the cyclone developed from a cold front wave, or triple point, in the western N Atlantic (1). The phase of most rapid deepening occurred just west of Scotland. Peak gusts in the central belt of Scotland were widely in the extreme 70 to 90kt range (1). Damage to property was widespread, with virtually ever high-sided vehicle in Glasgow overturned, though casualties were limited due to darkness and a public holiday.

•Peak gusts migrated eastwards across Scotland over a 2-hour period (2), occurring in the sometimes cloud-free area just ahead of tip(s) in the (cold-topped) cloud head, consistent with other cases such as October 1987.

•Evaporation of ice particles is believed to partly fuel the sting jet – heavy snow was reported over NW Scotland around this time.

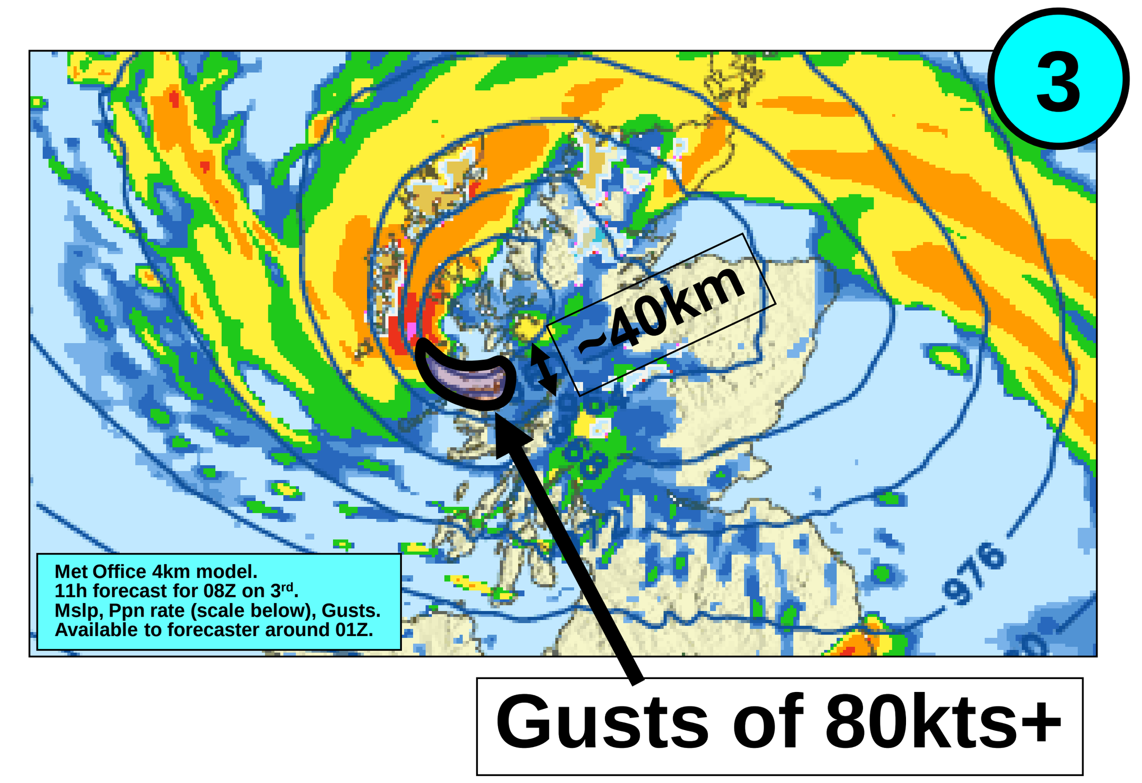
•Relative to another windstorm that hit a similar area about a month before (2) the 3 Jan event was more extreme, at least in the main population centres, though was also of lesser duration. In the earlier case the sting jet phase may have been focussed on seas to the west. Note how the 8 Dec synoptic chart shows a more mature low affecting Scotland.

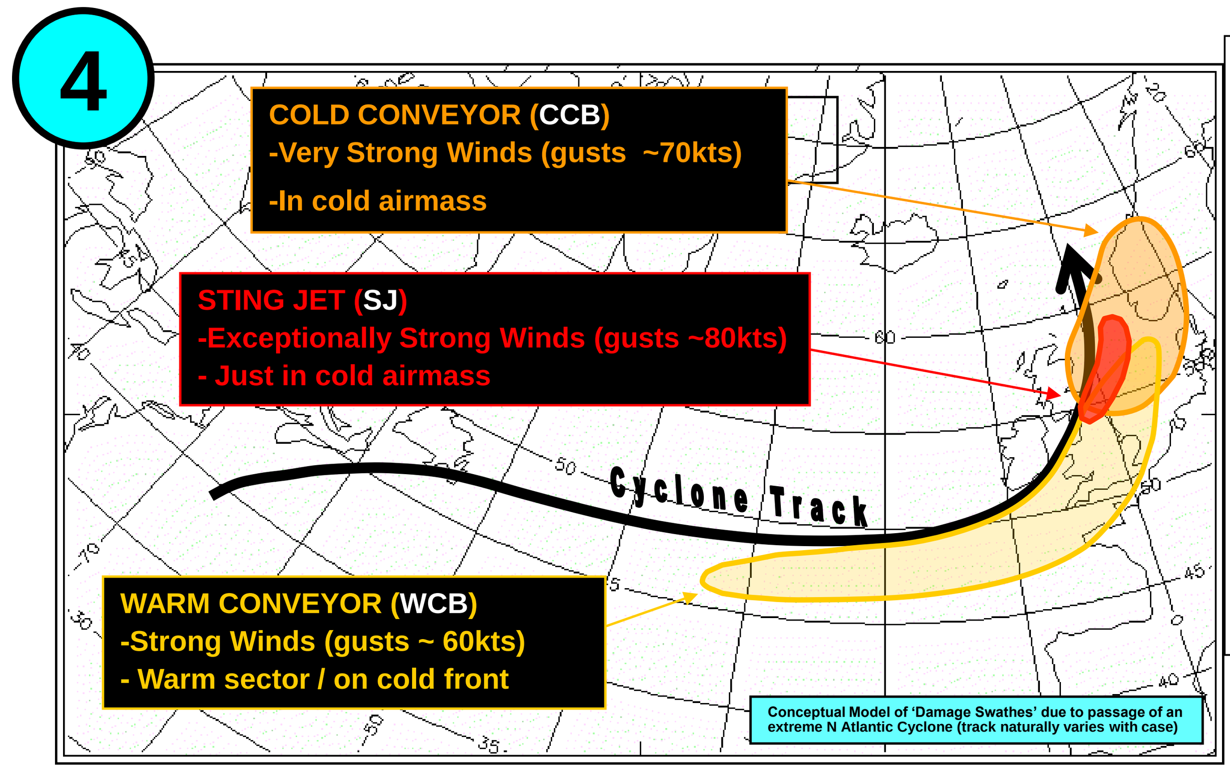
•The 3 Jan event provided a huge forecasting challenge, in spite of forecasters having at their disposal high resolution Met Office models capable of representing the sting jet phenomena. The key difficulties were (i) deciding if the sting jet would materialise (it is rare) and (ii) if it did materialise where it would hit.

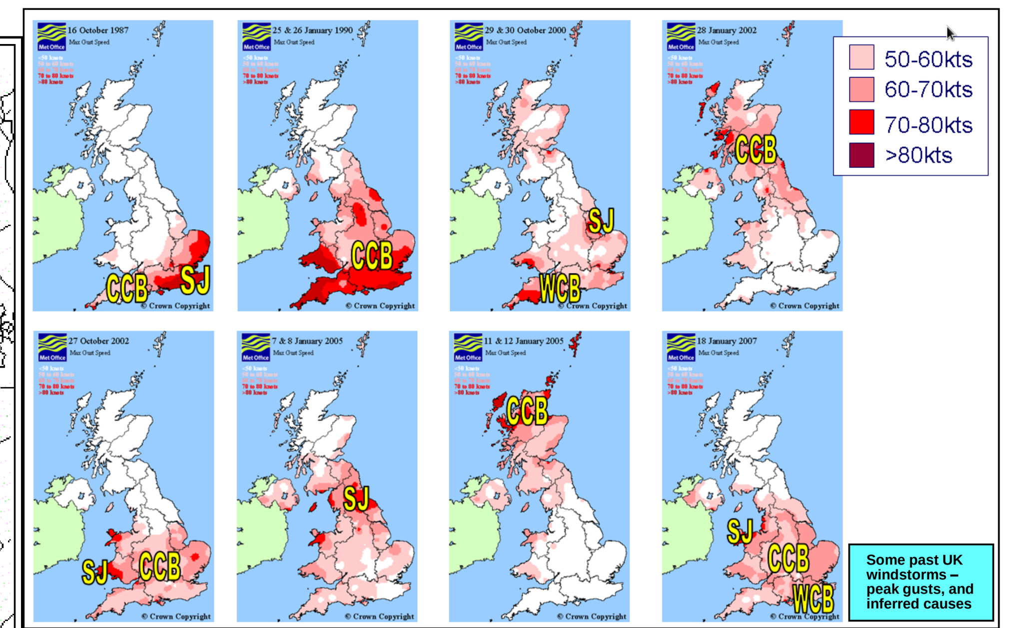
•4km model output provided assistance, though placed peak gusts about 100km too far north (3). Note how tiny the zone of extreme winds is.

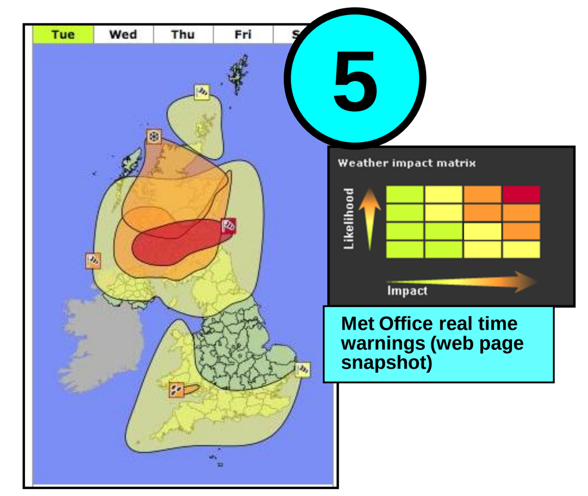
•Forecasters also used conceptual models and experience of past events in the forecasting process (4). Again note how the sting jet damage swathe can be extreme, but geographically very small.

•Warnings of severe weather were issued, and upgraded as sting jet development and track became clearer. This was a truly multi-hazard event, with warnings for rainfall and snow, as well as for winds in the SJ, WCB and CCB regions (5)! Warning focus nowadays is on impacts; a ticked box on the risk matrix (5) informs customers and public of likelihood and possible impact level.









•Operational forecast models are now capable of capturing the salient features of sting jets, thanks to high resolution. Note how the sting jet region profile looks 'anticyclonic', except, of course, for the wind (6)! Note also how the sting jet lies downstream of intense precipitation (3), supporting the role of evaporation.

•This may be the first genuine sting jet case to fall in the domains of Met Office high resolution models. As such it provides an excellent case to compare handling (7). Note that this plot consists of very short range forecasts, to highlight just resolution impact; at longer leads there were many forecast disparities.

•Central pressures, gradients and gusts are handled quite well, for this case, at horizontal resolutions of ≤25km, in both ECMWF and Met Office models. The gust parametrisations are all based on the work of Panofsky et al (1977), though are not identical. At 1.5km resolution gust output is complicated by resolved convection - more work is needed here.

•Studies into windstorm climate commonly use state-of-the-art re-analysis datasets, such as ERA-Interim. Although not a new result this case clearly illustrates how its intrinsic 80km resolution is not sufficient to resolve the sting jet (7). It is also clear that even within the 'ERA-Interim world' this was not a particularly extreme cyclone, certainly not a 1 in 20 year event (8). Projects such as IMILAST (Inter-comparison of MId-LAtitude STorm track diagnostics), Neu et al (2012), need to be fully aware of such limitations.

•Strategies for addressing ERA-Interim weaknesses, to aid windstorm study, include diagnosing CSI as in Martinez-Alvarado et al (2011), or downscaling using a high resolution model run from ERA boundary conditions. There may also be scope for using extreme deepening rates, provided the tracking employed performs well for extreme cases.

Acknowledgments

Thanks to Fernando Prates and Gary Davies for their assistance. Peter Sloss reported the roar in Bishopton.

References

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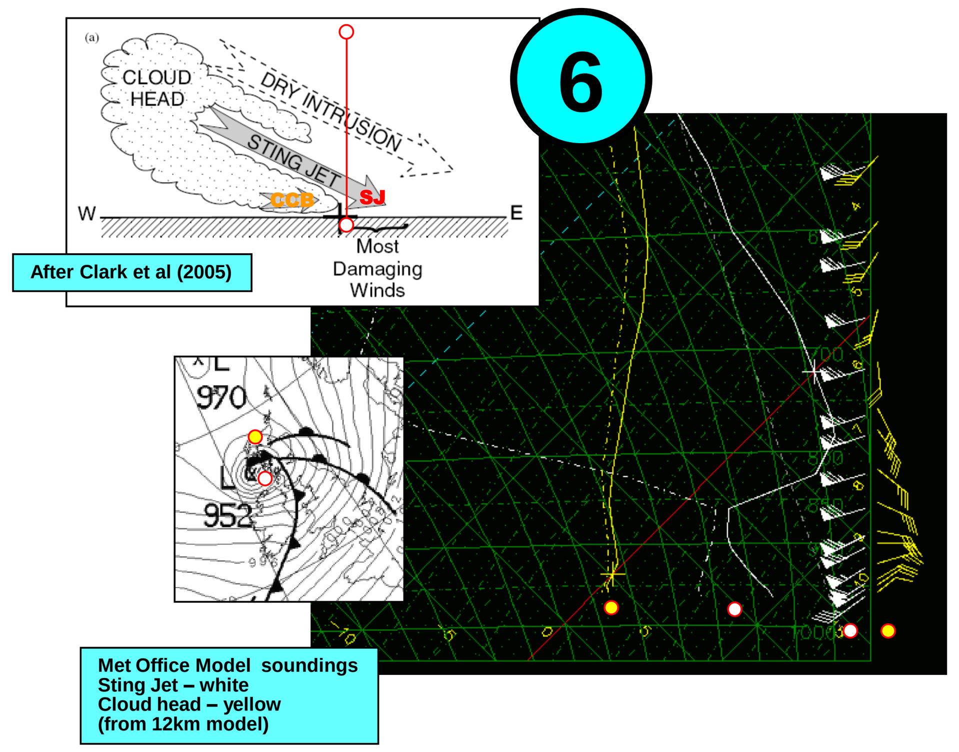

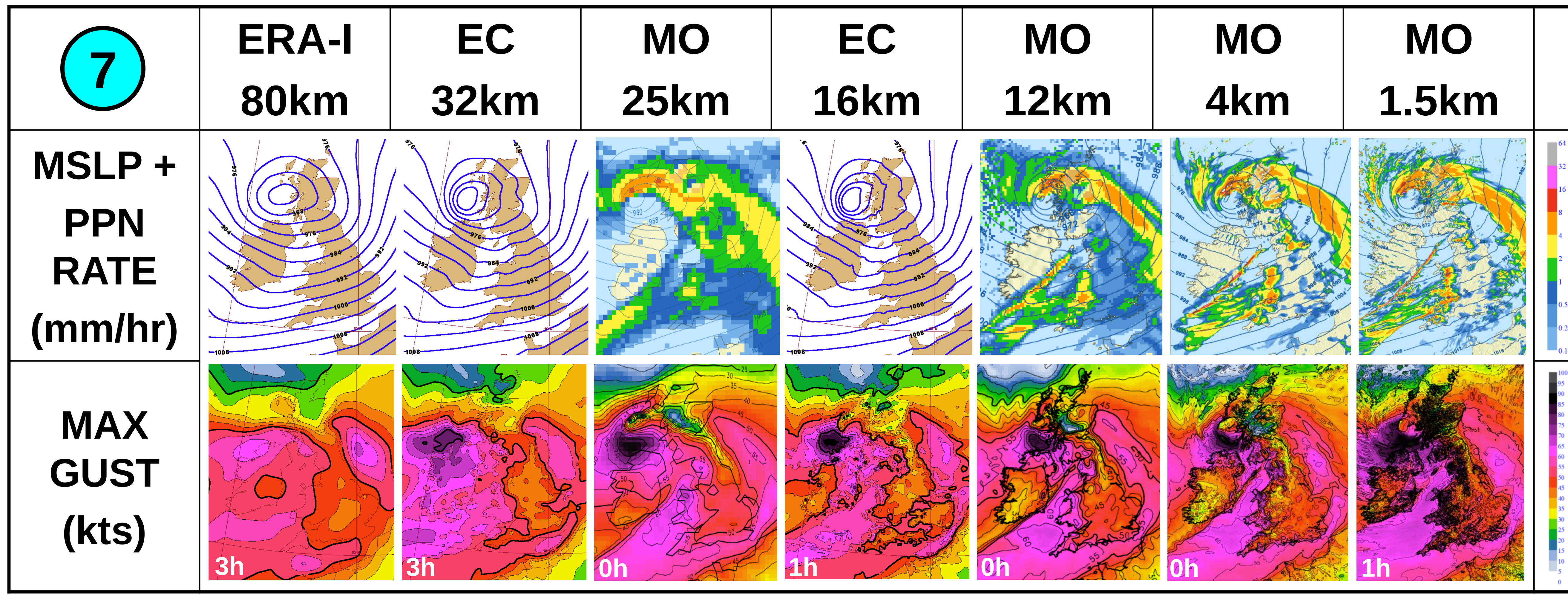

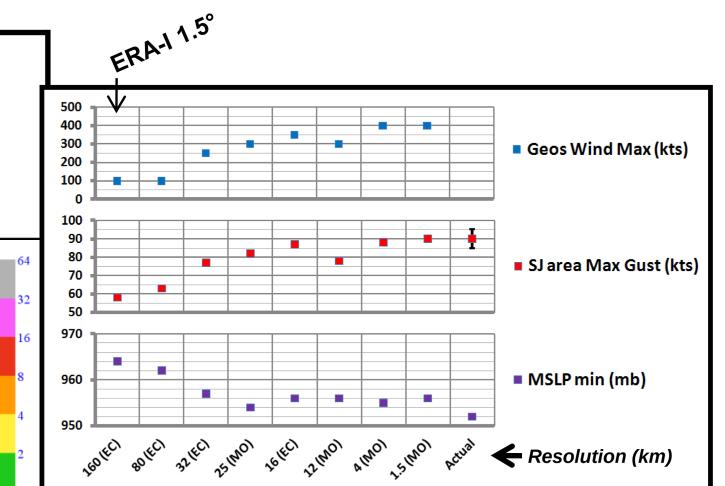

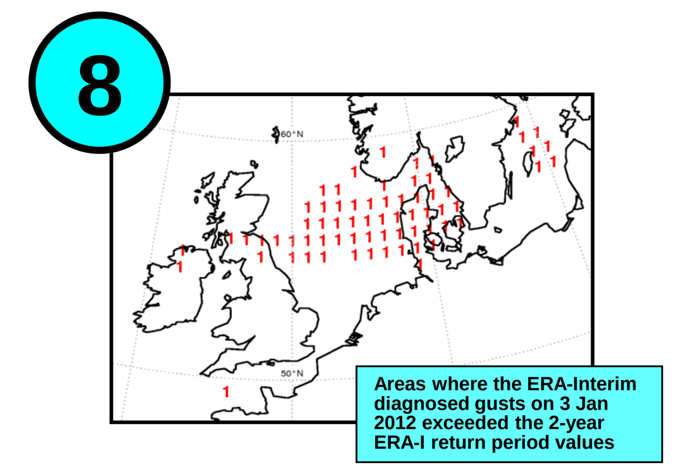

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