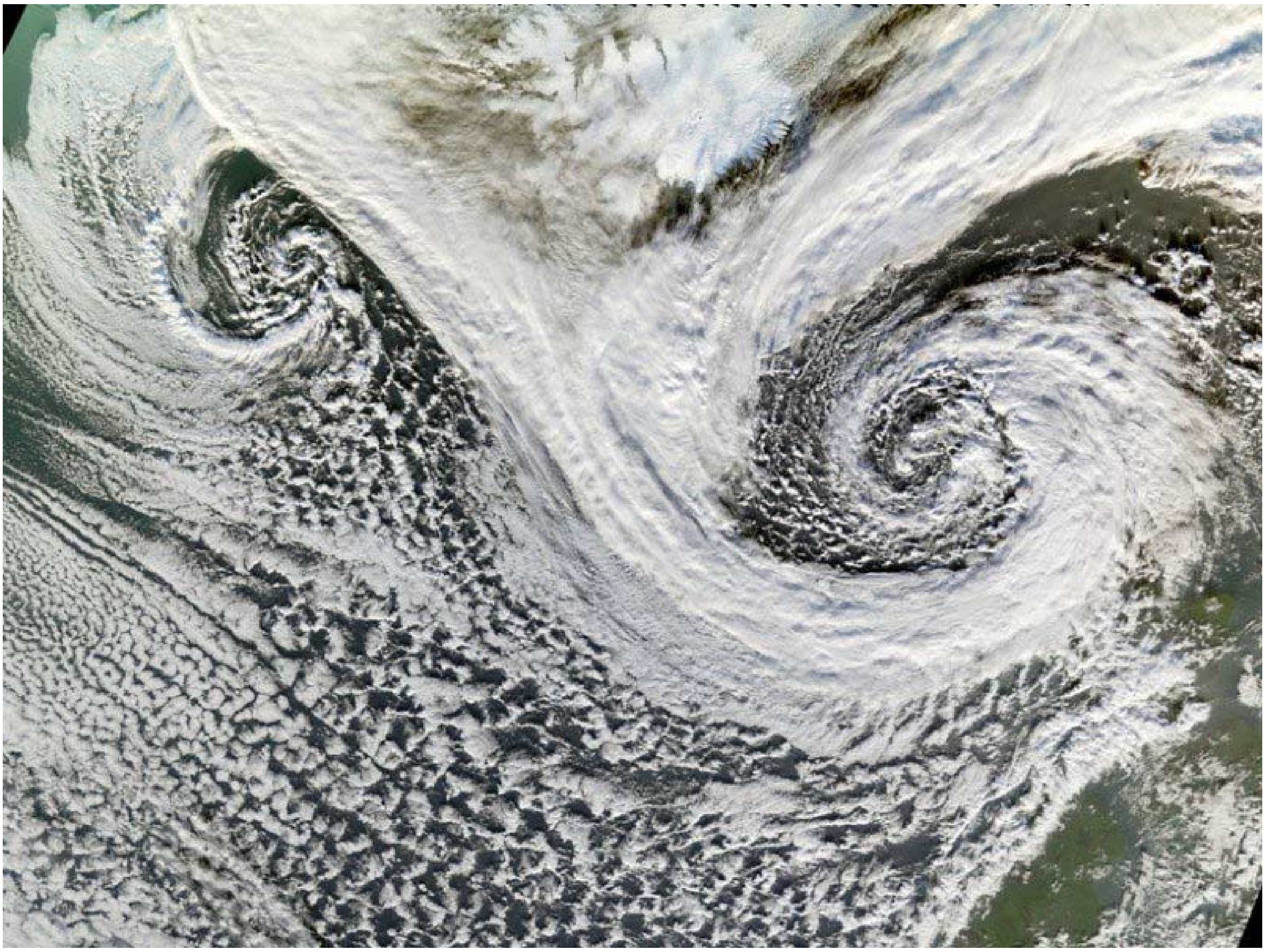
Predicting the Risks and Occurrence of Extratropical Cyclones

5th Workshop on European Storms: Impacts and Predictability; Bern, Switzerland, 31 August to 2 September 2015



Two extratropical cyclones formed south of Iceland on 20 November 2006, illustrating serial clustering, in which successive cyclones depend on previous ones. Credit: NASA

By Christoph C. Raible, David Stephenson, and Giovanni Leoncini 29 February 2016

Extratropical cyclones can have devastating effects on society. A cluster of more than 10 extreme European storms in the winter of 2013–2014, for example, claimed several lives, destroyed property, disrupted transportation and business, and caused total insured losses of more than $3.3 billion. Climate change–driven weather extremes and increasing population are expected to produce dramatic increases in losses from such events.

Several interdisciplinary storm workshops (http://www.stormworkshops.org/) have been organized since 2011 to address scientists' and stakeholders' need for better understanding of the risk and predictability of such extreme events. The 5th Workshop on European Storms, held at the end of the summer in Bern, Switzerland, brought together 80 dynamical meteorologists (https://en.wikipedia.org/wiki/Meteorology#Dynamic_meteorology), climatologists, statisticians, stakeholders, and risk model developers from insurance, model vendor, and engineering consultant companies.

One focus of the discussion was serial clustering of storms—the dependency between successive cyclones. Serial clustering occurs around the edges of the Atlantic storm track and over Europe. New results confirm that serial clustering is mainly due to modulation of storms by the North Atlantic Oscillation (https://www.ncdc.noaa.gov/teleconnections/nao/), and it is projected to decrease slightly under future climate change. However, the large natural variability of storm counts makes it unlikely that such changes will be detectable.

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events along the west coast of Europe.

Workshop participants also discussed mesoscale processes leading to high-impact wind and/or precipitation situations during the life cycle of extratropical cyclones (https://www.wunderground.com/hurricane/subtropical.asp). Extratropical cyclones have complex mesoscale structures, including fronts and conveyor belts that are affected by diabatic processes, in which heat is gained or lost. Recent results show that precipitation and wind extremes often occur simultaneously and that such compound extremes occur in as many as 35% of extreme weather events along the west coast of Europe.

Nevertheless, the resolution of global climate models and reanalysis products is not yet sufficient to accurately characterize mesoscale structures such as sting jets (https://en.wikipedia.org/wiki/Sting_jet). Hence, there is a need for dynamical downscaling to complement current efforts that analyze the large-scale patterns that potentially lead to such events.

Workshop presentations showed that downscaling can help in defining event sets appropriate for risk modeling. Because of the large uncertainties in the parameterization of wind gusts, there is still a need to carefully recalibrate the vulnerability curves in the loss models.

Another industry-relevant topic is how “extreme” a storm can become. Discussions on this topic centered around maximum precipitation and minimum central pressure of cyclones. A spatiotemporal statistical model suggests that at present, there is a high probability of experiencing substantially deeper central pressures than has been observed in the past 50 years.

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Finally, workshop participants examined the predictability of storms over seasonal and longer time scales. New results suggest a small, yet noticeable, increase in the ability to forecast cyclone-related losses for the North Atlantic European region. Other results discussed showed that the serial clustering of storms within a season is due to the memory generated by the climate system, possibly related to phenomena including ocean circulation and sea ice, although the physical processes have not been firmly established. This serial clustering suggests an unexplored source of predictability.

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