Storm Clustering over Europe

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Intense extra-tropical storms are a major weather hazard affecting Europe. Under particular large-scale atmospheric conditions, several storms may affect Europe within a short time period. The occurrence of such “cyclone families” (clustering) leads to large socio-economic impacts and cumulative losses (Fig. 1). Recent studies showed that clustering of extra-tropical storms is a robust feature in Reanalysis (meteorological datasets created by reprocessing observational data over an extended historical period using a constant model formulation). This project aims to analyse in detail the large-scale atmospheric dynamics associated with the occurrence of storm clusters affecting Western Europe. The various factors leading to the occurrence of storm clusters include an extended and intensified upper-level jet stream, Rossby Wave Breaking (an upper tropospheric wave which amplifies and overturns), steering from large-scale variability modes (like the North Atlantic Oscillation) and secondary cyclogenesis over the Eastern North Atlantic. There is recent evidence that storm clustering may decrease over North Atlantic storm track area and Western Europe under future climate conditions. In this project, the representation clustering in global circulation models (GCMs) and possible changes under future climate conditions will be assessed from a multi-model perspective. This project will use state-of-the-art climate models to address these questions to better quantify climate change impacts and associated uncertainties for Europe not only in meteorological but also in socio-economic terms. Main questions are as follows: (i) How well are the physical large-scale processes leading to the occurrence of storm clusters represented in GCMs? The representation of these processes is compared between GCMs and Reanalysis to understand biases (systematic errors) in clustering identified in GCMs. (ii) Is storm clustering expected to change significantly under future climate conditions? The project will also investigate how far the dynamical processes associated with clustering may change under future climate conditions. The related changing risk of the occurrence of cumulative events and implications for the European Reinsurance market will be quantified.

Training opportunities:
The project will include possibilities for extended stays in Aon Benfield London City office, the possibility to work with their state-of-the-art operational windstorm risk model, and to interact with the wide insurance industry, thus going beyond the traditional subject boundaries and addressing genuinely interdisciplinary work.

Student profile:
This project will be suitable for students with a degree in mathematics or physics or a closely related physical or environmental science.

Funding particulars:
The project will feature a CASE partnership with Aon Benfield Impact Forecasting

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