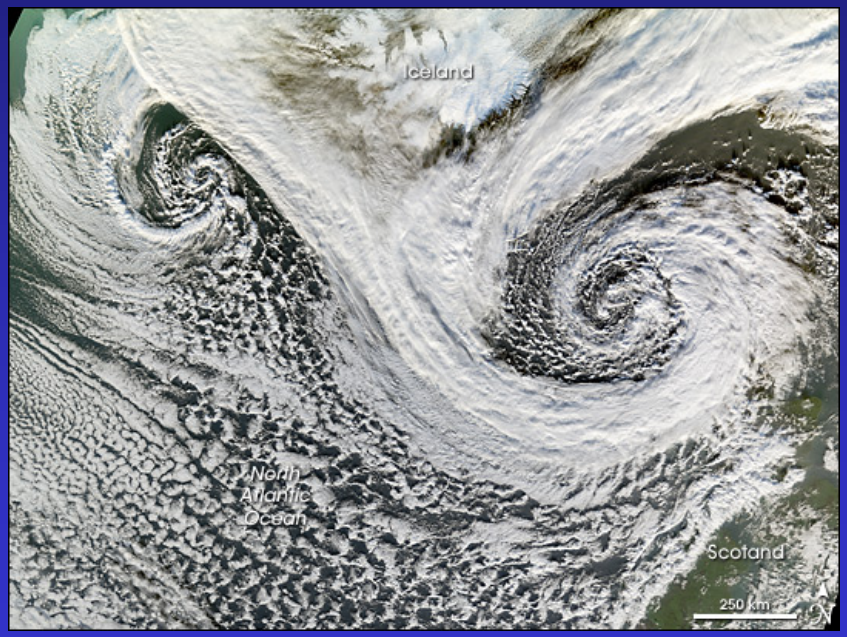
Uni. of Exeter / Met Office Workshop on European storms 5-7 September 2011

David Stephenson, **Theo Economou**, Renato Vitolo, Chris Ferro (U. of Exeter)
Lyndsey McColl, Simon Brown, Ruth McDonald, (Met Office)



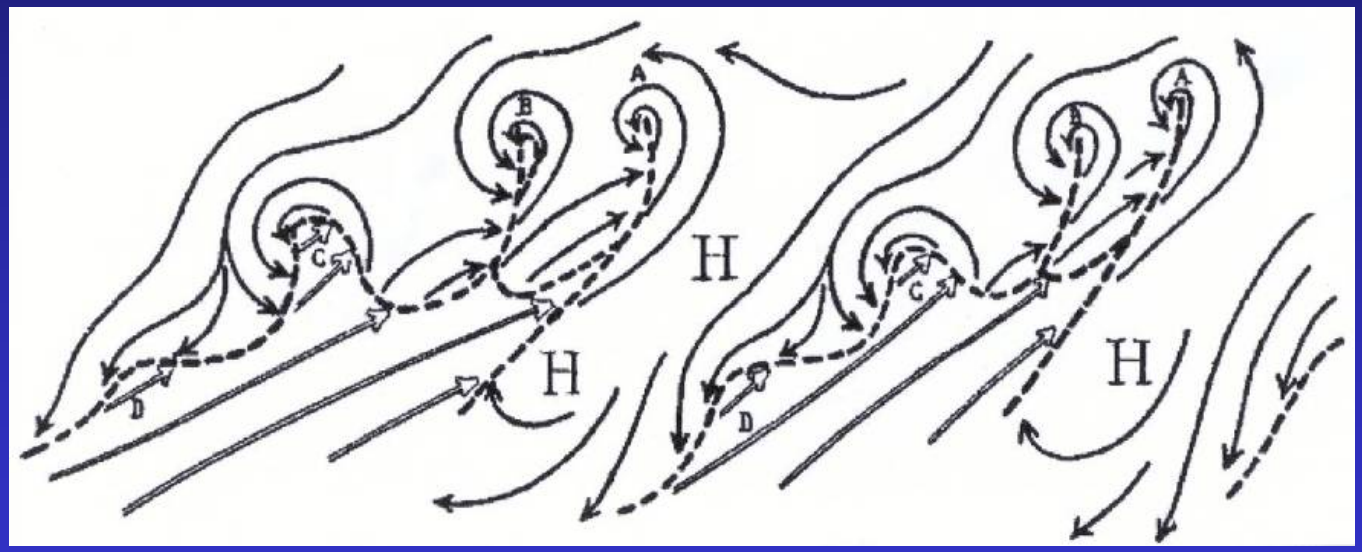
Organised by the AXA RACEWIN project

AXA RACEWIN project

Regional Assessment of Climate change impact on European WINdstorms: Track Clustering and Multi-Peril Dependency **(Oct 2010-Sep 2013)**

This project aims to better understand and model dependency between

- successive European windstorms ("clustering")
- storm-related extremes of precipitation and surface wind speed ("multi-peril").



AXA Research Fund
Through research protection

http://www.axa-research.org

http://emps.exeter.ac.uk/mathematics-computer-science/research/xcs/interests/xstor/racewin/

RACEWIN workpackage 5:

European Windstorm Research Network EUWIRN

Create a *European Windstorm Research Network* EUWIRN to help integrate European research effort in this important area of climate research:

- Compile a database of scientists working on European windstorms;
- Invite these experts to windstorm workshops in 2011 and 2013*;
- Create online tools to share ideas: https://forums.exeter.ac.uk/euwire/

It is hoped that the network will help stimulate ideas and interactions between ongoing storms projects e.g. TEMPEST, DIAMET, RACEWIN, …

* In Sep 2012, Dr Peter Knippertz will organise a similar workshop in Leeds as part of his AXA storms project

Admiral Robert Fitzroy CB FRS, 1805-1865

- Appointed in 1854 as chief to deal with the collection of weather data at sea, with the title of ***Meteorological Statist to the Board of Trade*** and a staff of three. This was the forerunner of the modern Meteorological Office;

- A terrible storm in 1859 that caused the loss of the *Royal Charter* inspired Fitzroy to develop charts to allow predictions to be made, which he called *"forecasting the weather"*, thus coining the term weather forecast.

- 15 land stations were established to use the new telegraph to transmit to him daily reports of weather at set times. The first daily weather forecasts were published in *The Times* in 1860, and in the following year a system was introduced of hoisting storm warning cones at the principal ports when a gale was expected.

- Many fishing fleet owners objected to gale warnings, requiring that fleets not leave the ports and under this pressure, Fitzroy's system was abandoned for a short time after his death.

Monday 5 September

12:00-14:00: **Registration:** arrive, register and meet over a buffet lunch

Talks 1: Fundamental mechanisms (Chair: Simon Brown)

14:00-14:05 Julia Slingo: *Welcome note*

14:05-14:15 David Stephenson: *Introduction and aims of the workshop.*

14:15-14:20 Lynsey McColl: *Housekeeping information*

14:20-14:40 David Brayshaw: *The Atlantic and Mediterranean storm tracks: understanding their basic structure.*

14:40-15:00 Gwendal Riviere: *A new dynamical interpretation of the role played by the left-exit region of the large-scale upper-level jet.*

15:00-15:20 Helen Dacre: *Quantifying the sensitivity of North Atlantic cyclone development to atmospheric precursor fields.*

15:20-15:40 Geraint Vaughan: *The DIAMET project: DIAbatic influence on Mesoscale structures in ExTratropical storms.*

15:40-16:00 Sue Gray: *A regional climatology of sting jets and the extratropical cyclones in which they occur*

16:00-16:30 Tea/coffee/biscuits

16:30-17:30 Organisation of the breakout groups

18:00- Dinner in Exeter town centre – Strada Italian restaurant

Tuesday 6 September

Talks 2: Historical storm characteristics (Chair: Renato Vitolo)

09:30-09:50 Paul Della-Marta: *NE Atlantic and western European storminess since 1880.*

09:50-10:10 Margarida Liberato, Isabel Trigo and Ricardo Trigo: *Climatology of Extratropical Complex Systems using a SLP based cyclone detecting and tracking method*

10:10-10:30 Christoph Raible: *Comparison of different mid latitude cyclone detection and tracking methods using ERA interim*

10:30-10:50 Gregor Leckebusch: *Detection and assessment of severe, damage prone wind fields caused by severe cyclones in mid-latitudes, tropics and polar regions*

10:50-11:10 Theo Economou: *Extreme storminess: how deep can a low become?*

11:10-11:40 Tea/coffee/biscuits

11:40-12:40 1st Breakout group discussions

12:40-13:30 Lunch

Talks 3: Future predictions (Chair: Lynsey McColl)

13:30-13:50 Uwe Ulbrich: *Seasonal predictability of extra-tropical cyclones*

13:50-14:10 Adam Scaife: *Climate Change in the Storm Tracks: are projected changes about to change?*

14:10-14:30 Tim Woollings: *Ocean-atmosphere interaction in the Atlantic storm track response to greenhouse gases*

14:30-14:50 Joaquim Pinto: *European windstorms: diagnostics, downscaling and climate change*

14:50-15:10 Peter Knippertz: *A seamless approach to assessing model uncertainties in climate projections of severe European windstorms*

15:10-15:40 Tea/coffee/biscuits

15:40-16:40 2nd Breakout group discussions

18:30- Dinner in Exeter town centre – The Old Firehouse

Wednesday 7 September

Talks 3: Remaining talks (Chair: David Stephenson)

10:00-10:20 Michael Graf: *The synoptic and mesoscale environment associated with European tornadoes*

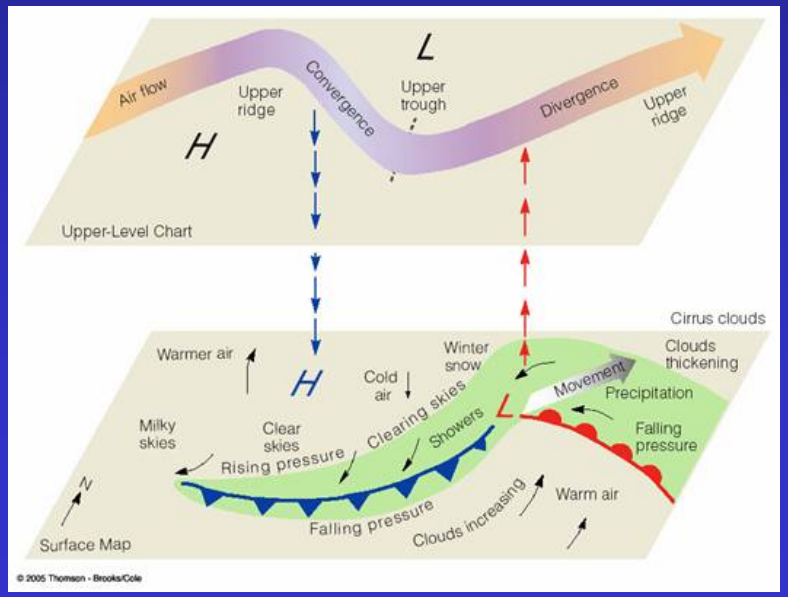
10:20-10:40 Additional talk TBC

10:40-11:10 Tea/coffee/biscuits

11:10-12:30 **Breakout groups: reporting back**

12:30-13:30 Lunch

13:30 End of workshop



Breakout group ideas …

We will split into 4 smaller groups A-D to discuss specific topics and then the Rapporteurs will report back on Wed morning. Possible topics:

A. How best to define a European windstorm catalogue?
(*Chair: Angelika Werner. Rapporteur*)
What measures and parameters can we use to define extreme EU windstorms? Classification of windstorms? Usage of the catalogue? Multi-peril AM: FG-4 PM: FG-5

B. Extreme storms: definition, dynamics. Multi-peril *(Chair: Gregor Leckebusch. Rapporteur) HERE*

C. How to represent and understand the main characteristics of non-extreme storms? Weather-Climate interaction and storm track dynamics. *(Chair: David Brayshaw. Rapporteur) HERE*

D. What are the key physical processes in future projections of storminess? CMIP5 *(Chair: David Stephenson. Rapporteur) AM: FG-3 PM: FG-1*

- TOMORROW:
  - 10-11am poster session & coffee
  - 11 – 12.30pm breakout groups feedback

- Any taxis?

RACEWIN objectives

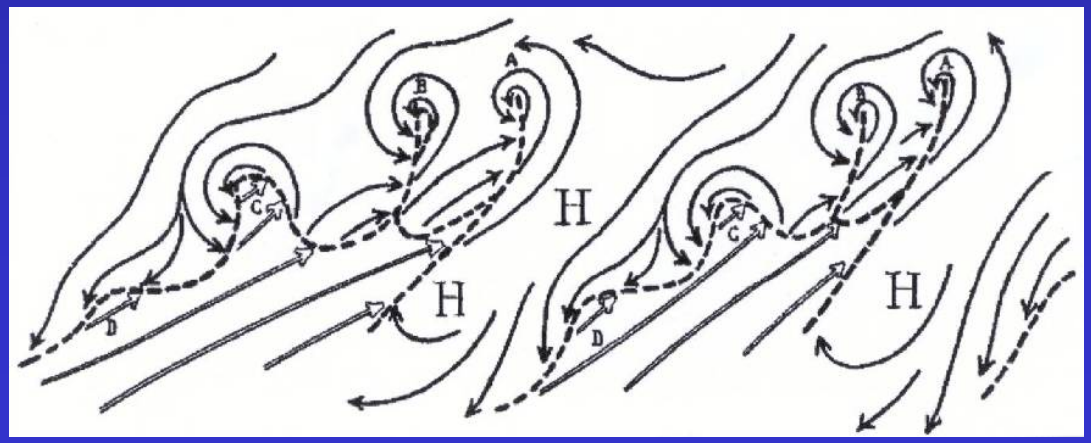
Main aims:

To better understand dependency between

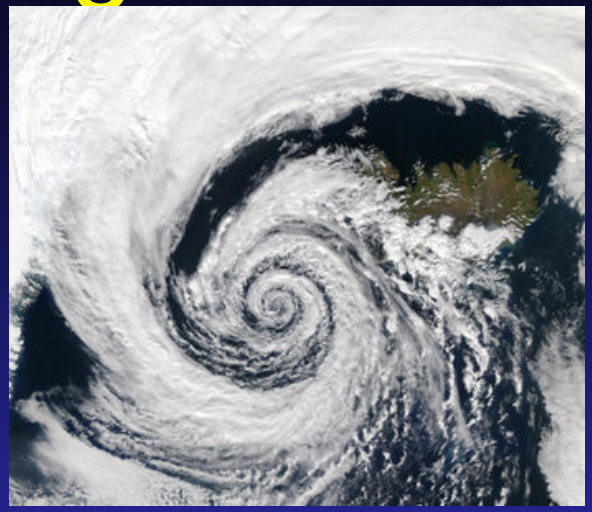
- successive European windstorms ("windstorm clustering")
- storm-related extremes of precipitation and surface wind speed ("multi-peril dependency").

Our specific objectives are:

- to understand the large-scale changes likely to take place in the North Atlantic storm track and how these will influence windstorm landfalls over Europe;
- to understand how storm clustering might change in the future;
- to understand the relationship between storm-related wind and precipitation extremes and how it might change in the future;
- to build capacity on European windstorm research by creating a European windstorm research network (EUWIRN) that will be able to provide useful expert advice on windstorms to industry and policymakers.



Start up workpackages

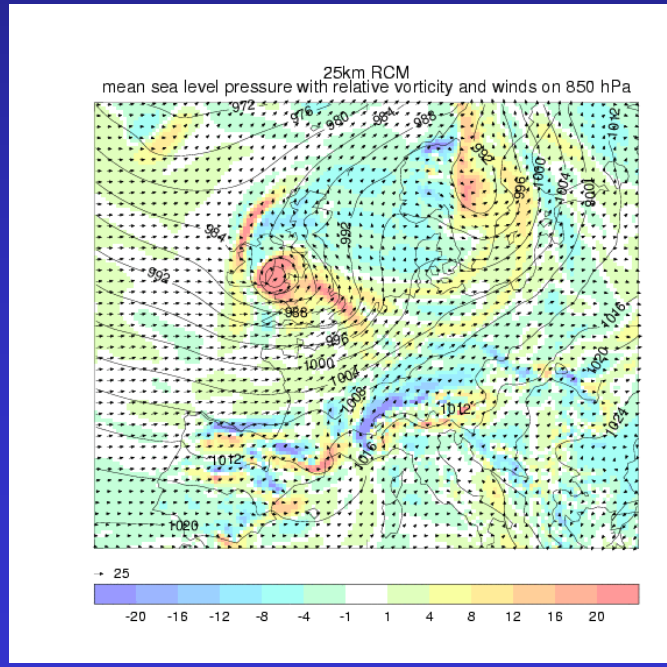


WP 1: Critical review of storm track & climate change studies (Lead: Prof David Stephenson)

WP1 will undertake a comprehensive and critical review of previously published studies on how European storminess is likely to change due to climate change and any observational trends seen. Particular attention will be focussed on aspects of direct relevance to European losses such as extremes in surface wind speeds and precipitation.

WP 2: Analysis of multi-model storm track datasets and large scale flow diagnostics (Lead: Dr Ruth McDonald)

Storm tracks using objective tracking techniques for reanalyses and Met Office 25km resolution regional climate change simulations will be extracted and explored.



Statistical dependency modelling

WP3: Exploratory diagnosis of dependency in European wind storms (Lead: Dr Simon Brown)

This work package will use a variety of techniques to explore dependency both between successive storms (storm clustering) and between different extreme variables related to storms (multi-peril dependency of wind and rain) both in the reanalyses and in the present and future RCM simulations.

WP4: Statistical modelling of clustering and multi peril dependency (Lead: Dr Renato Vitolo)

This work package will develop and apply novel statistical models in order to model the key drivers behind the dependencies found in WP3.

Powerful statistical models such as non-stationary compound renewal processes with extreme value marginal distributions will be used to quantify the clustering in cyclone transits and to analyse the influence of the large-scale flow. These models will be used to identify the effect of climate change on these processes. Extreme value models will be tested for modelling the dependency between storm-related wind and precipitation extremes. Use of these statistical models will also allow us to quantify the associated uncertainties. The statistical models will be applied to the future climate projections, to understand changes in the clustering behaviour and multi-peril dependence under future climate conditions.

Spatial models for extremes have been recently developed through max-stable processes (Coles, 1993). We will study how such models can be used to capture the physical size of extreme windstorms affecting more than one European country.

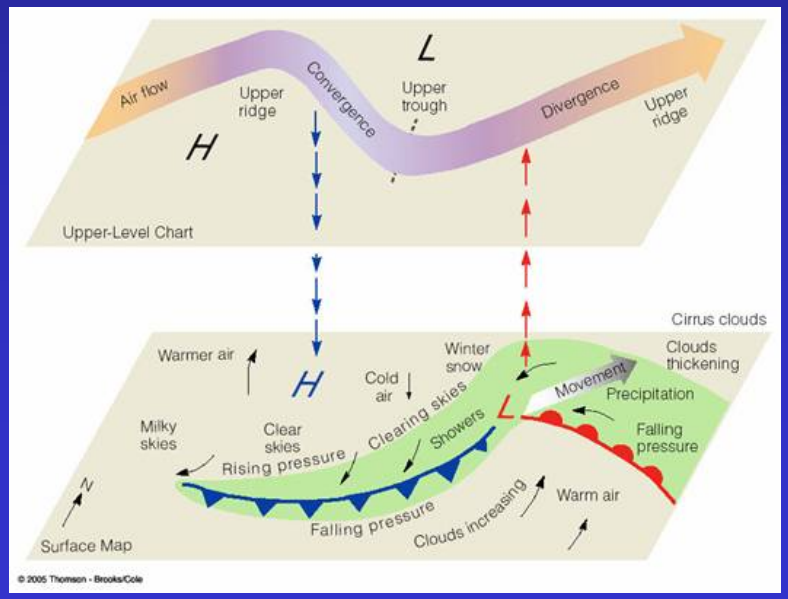
Workpackage 5: EUWIRN

European Windstorm Research Network (Lead: Dr. Lyndsey McColl)

We will create a *European Windstorm Research Network* to help integrate European research effort in this vitally important area of climate research. Planned activities include:

- creating a comprehensive database of leading scientists working on European windstorms;
- inviting these people to our windstorm workshops in years 1 and 3;
- creating online tools that will help this community share ideas (e.g. website, online forum, wiki pages).

It is envisaged that the network will live on much longer than this proposed project and will help stimulate new developments and larger-scale collaborative proposals (e.g. EU FP7) for funding in this important area of climate research.



Exeter Storm Risk Group

David Stephenson, Renato Vitolo, Chris Ferro, Mark Holland
Alef Sterk, Theo Economou,
Alasdair Hunter, Phil Sansom

Key areas of interest and expertise:

Mathematical and statistical modelling of extratropical and tropical cyclones and the quantification of risk using concepts from extreme value theory, dynamical systems theory, stochastic processes, etc.

Current projects and partnerships

- Willis Research Network (which D. Stephenson helped start in 2006)
  - Clustering of tropical cyclones (with U. Reading)
  - Hybrid GCM-CAT model for tropical cyclones (U.Reading and Met Office)
  - Clustering of storm-related losses (Alasdair's CASE PhD project)
  - Storm-related flooding with U. Newcastle
  - Storm-related flooding with U. Princeton
  - ...
- Axa RACEWIN project – clustering and dependency of ETC
- EU PREDEX project – predictability limit for extreme events (e.g. ETC)
- NERC TEMPEST project – trends in future ETC
- NCAR NSF project on extremes (Lead: Greg Holland)
- MAPFRE project with IC3
- Joint work with Met Office on catastrophe risk
- Zurich Financial Services, Natural Catastrophe Advisory Council
- IPCC 5th assessment Chapter 14 parts on ETC and NAO etc.

For more details or if you wish to visit us in Exeter,
please email d.b.stephenson@exeter.ac.uk

NERC project TEMPEST:

Testing and Evaluating Model Predictions of European Storms

Lead: Len Shaffrey

NCAS, Reading*
Len Shaffrey
Tim Woollings
Mike Blackburn

NCEO, Reading
Kevin Hodges

Oxford University
Tim Palmer

ECMWF (Partner)
Thomas Jung

Met Dept, Reading
Brian Hoskins
Helen Dacre

Exeter University
Renato Vitolo
David Stephenson

Met Office (Partner)
Simon Brown
Ruth McDonald

**Plus David Brayshaw as Co-I Researcher at Reading*

Questions to be addressed:

Overarching Aim: *An improved understanding of how climate change and natural variability will affect the generation and evolution of extra-tropical cyclones.*

Q1 How will climate change affect the generation and evolution of extra-tropical cyclones? How large are these effects compared to natural variability? ***WP1*** *Assessing changes in extra-tropical cyclones*

Q2 Which physical processes are most important, and which predicted changes are most robust? ***WP2*** *Quantifying key processes*

Q3 How important are the features and processes that climate models poorly represent due to their limited resolution? ***WP3*** *Impact of resolution*

WP4 *Developing community, integration and pull-through*

TEMPEST Summary and Key Outcomes

- First systematic assessment of how intense extratropical cyclones are predicted to change in the CMIP5 climate models

- An integrated set of sensitivity experiments with the Met Office Unified Model, which will lead to improved understanding of the spread in climate model projections

- Analysis of the impact of climate change on intense extratropical cyclones in very high-resolution global atmospheric model experiments capable of capturing mesoscale structures

- Guidance and advice for the climate impacts assessment community and policy-makers regarding the trustworthiness of climate predictions

- Developing an integrated research community and wider impacts

EU complexity network project PREDEX
PREDictability of EXtreme Weather Events
Lead: Renato Vitolo

Objective:
To deliver & apply new methods for quantifying the predictability of extreme events in complex dynamical systems.
With particular emphasis on extreme extra-tropical storms

Questions:
1. What are the deterministic time limits of predictability for extreme weather events?
2. How can we use emergent dynamical patterns to enhance predictability of extreme weather events?
3. What is the role of spatial scale interactions in the physical processes leading to extreme weather?

Approach:
combination of ideas from dynamical systems, statistics, meteorology & atmospheric physics.

More info:
http://empslocal.ex.ac.uk/people/staff/rv211/predex.html

"Butterfly effect for extremes"
-How to quantify the role of"chaos" for
-extreme events?
-Do extreme return periods and values make sense for dynamical weather?