The use of high-resolution global climate models for climate risk assessment

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Supported by Willis Analytics: Matthew Foote, Kirsten Mitchell-Wallace, Taro Hosoe, Claire Crerar
1) Introduction to the Willis Research Network

2) Two-way communication between academic researchers / catastrophe modellers / Willis Clients

3) The use of high-resolution global climate modelling to simulate weather/extreme events in a global climate context

4) Initial focus- driven by insurance industry interests
   – Western Pacific Typhoon

5) Use of a tracking methodology

6) Aim to integrate results into catastrophe modelling
The Willis Research Network (WRN)

• A major long term partnership between leading international scientific institutions and Willis.

• To evaluate the frequency, severity and impact of catastrophes such as hurricanes, earthquakes, floods and terrorism.

• Coordinated by Willis Analytics - to focus research and activities of the network towards the needs of its clients and the international insurance and reinsurance market.

• Encourages focused, multi-disciplinary research keeping in mind the insurance industry as the end user.
Willis Research Network – Cornerstone members

Consists of seven cornerstone members: leading academic institutions across the earth sciences, engineering and mathematics. Each cornerstone member is represented by a leading Professor supported by a Willis Research Fellow.

Around this cornerstone group Willis supports an international network of experts and institutions that bring specialist or local knowledge of hazards or the human environment.

<table>
<thead>
<tr>
<th>University</th>
<th>Departments</th>
<th>WRN Leader</th>
<th>Disciplinary Focus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reading</td>
<td>Meteorology</td>
<td>Professor Julia Slingo</td>
<td>Regional Weather Systems, Global Atmospheric Modelling, Data Assimilation, Weather Events</td>
</tr>
<tr>
<td>Exeter</td>
<td>Mathematics</td>
<td>Professor David Stephenson</td>
<td>Climate Change &amp; Weather Regimes, Climate Analysis, Statistical Verification, Extreme Events</td>
</tr>
<tr>
<td>Imperial</td>
<td>Civil Engineering, Geotechnics</td>
<td>Professor Julian Bommer</td>
<td>Ground Motion Prediction, Seismic Hazard Assessment, Building Codes, Earthquake Loss Est.</td>
</tr>
<tr>
<td>Durham</td>
<td>Geography, Institute of Hazard &amp; Risk Research</td>
<td>Professor Stuart Lane</td>
<td>Earth Processes, Flood Modelling, Landslides, Hazards of Technology and Infrastructure.</td>
</tr>
<tr>
<td>Bristol</td>
<td>Geography</td>
<td>Professor Paul Bates</td>
<td>Flood Modelling, Volcanology, Remote Sensing, Spatial Modelling, Climate Change</td>
</tr>
<tr>
<td>Bristol</td>
<td>Civil Engineering</td>
<td>Professor Colin Taylor</td>
<td>Hydrology &amp; Water Management, Earthquake Engineering, Coastal Engineering, Soil Mechanics</td>
</tr>
<tr>
<td>Cambridge</td>
<td>Architecture</td>
<td>Professor Robin Spence</td>
<td>Building Stock Vulnerability, Structures &amp; Risk, Loss Estimation, Remote Sensing</td>
</tr>
<tr>
<td>City</td>
<td>GIS</td>
<td>Professor Jonathan Raper</td>
<td>Geographic Information Systems, Multi-Dimensional Surface Modelling, Geo Visualisation</td>
</tr>
</tbody>
</table>
• **Uncertainty**: quantifying and explaining modelling uncertainty
• **Exposure Data**: understanding impact on model results and exploiting new sources
• **Interpretation**: Increasing sophisticated interpretation of model results
• **Hazards**: Peril specific research across flood, storm, earthquake and accumulation themes and balanced assessment of emerging concerns
• **Correlation and Seriality**: Multi-peril models and correlations between events and hazards
• **Climate Change & Climate Variability**: the impact of climate change on extreme events and model outputs
• **Communication**: new means of communicating, illustrating and describing loss estimation
Resolution of global models used in the IPCC Assessment Reports

1990 FAR
~500 km (T21)

1995 SAR
~250 km (T42)

2001 TAR
~180 km (T63)

2007 AR4
~110 km (T106)
High resolution global climate models

60km grid model = comparable to the resolution of the Met Office weather forecast models a few years ago

We can start to simulate weather events in global climate context
...can now simulate tropical cyclones

NUGAM 60km model simulation snapshot
visualisation produced by NASA Earth Observatory
QuickTime™ and a H.264 decompressor are needed to see this picture.
Intensity of tropical cyclones in global climate models

- Distribution shift: more intense storms as resolution is increased.
- N96 (135km) climate model inadequate for tropical cyclone work.
How does this help the catastrophe modelling and insurance industry?

We need to concentrate on parameters of importance to the insurance industry:
- Use tracks to determine landfall
- Maximum near-surface wind speed
- Precipitation output may be used to assist the modelling of flood associated with landfalling TC

- Use good science to back up Catastrophe Models and their output
- Allow insures and their clients to be better informed about climate change and how it may affect their business
- Inform academics about the insurance industry and allow future research to be more tailored for the end user