The potential for increases in damage due to more thunderstorms and lightning

4th November 2008

Insuring Future Climate Change
Oslo, 4th November 2008

Outline

1. The link between climate change and thunderstorms / lightning
2. The impact of thunderstorms / lightning
3. What is this likely to mean for reinsurers
4. Available tools to assist in the quantification of the risks

Climate change and thunderstorms / lightning

1. The link between climate change and thunderstorms / lightning
2. The impact of thunderstorms / lightning
3. What is this likely to mean for reinsurers
4. Available tools to assist in the quantification of the risks

IPCC

Extremes

Conditions conducive to strong convection

Increase in convective storms

Climate change and thunderstorms / lightning

"There is insufficient evidence to determine whether trends exist in tornadoes, hail, lightning and dust storms which occur at small spatial scales."

Technical summary of the 4th Assessment Report of the IPCC

Climate change will influence the key risk factors

Climate change and extreme events

The scientific consensus is that climate change is likely to impact on **frequency**, **severity** and **location** of **extreme events**

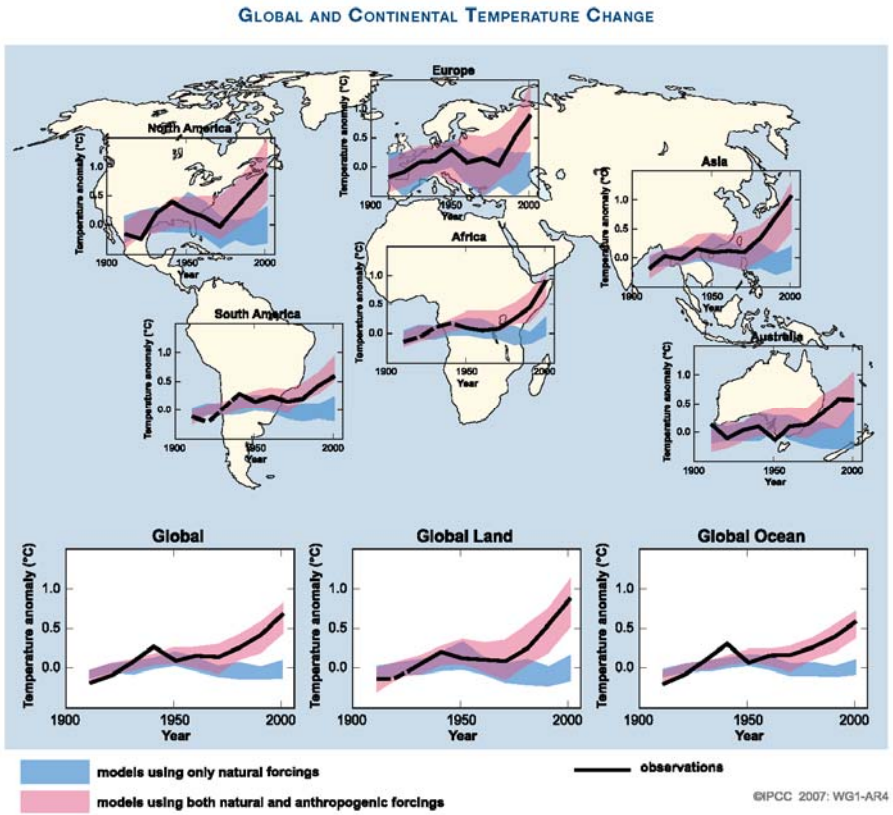
Insurers are concerned with the **impact** of extreme events

- Potential for catastrophic loss
- Threaten the stability and solvency of insurers

Climate change can influence:

- Magnitude
- Frequency
- Geographic local of extreme events

But – uncertainty in how **local impacts** will develop under climate change



IPCC AR4 2007

Willis

Climate conducive to development of thunderstorms

Conditions for deep convection and the development of thunderstorms;

- High values of moist static energy near the surface
- Cool air above

As the climate warms, the maximum increase of moist static energy occurs near the surface

Increases in convective storms

"warmer/colder climates is prone to more/less intense thunderstorms and hence lightning activity"

Price & Rind, 1994

Will climate change impact lightning frequency?

- Increased sea surface temperatures have been linked to increased cloud-to-ground lightning activity

De Pablo & Soriano, 2002

- Changes in lightning activity also correlated with land wet-bulb temperature

Reeve & Toumi, 1999

- 30% increase in global lightning activity can be expected from a 4.2°C warming in global temperature

Price & Rind, 1994

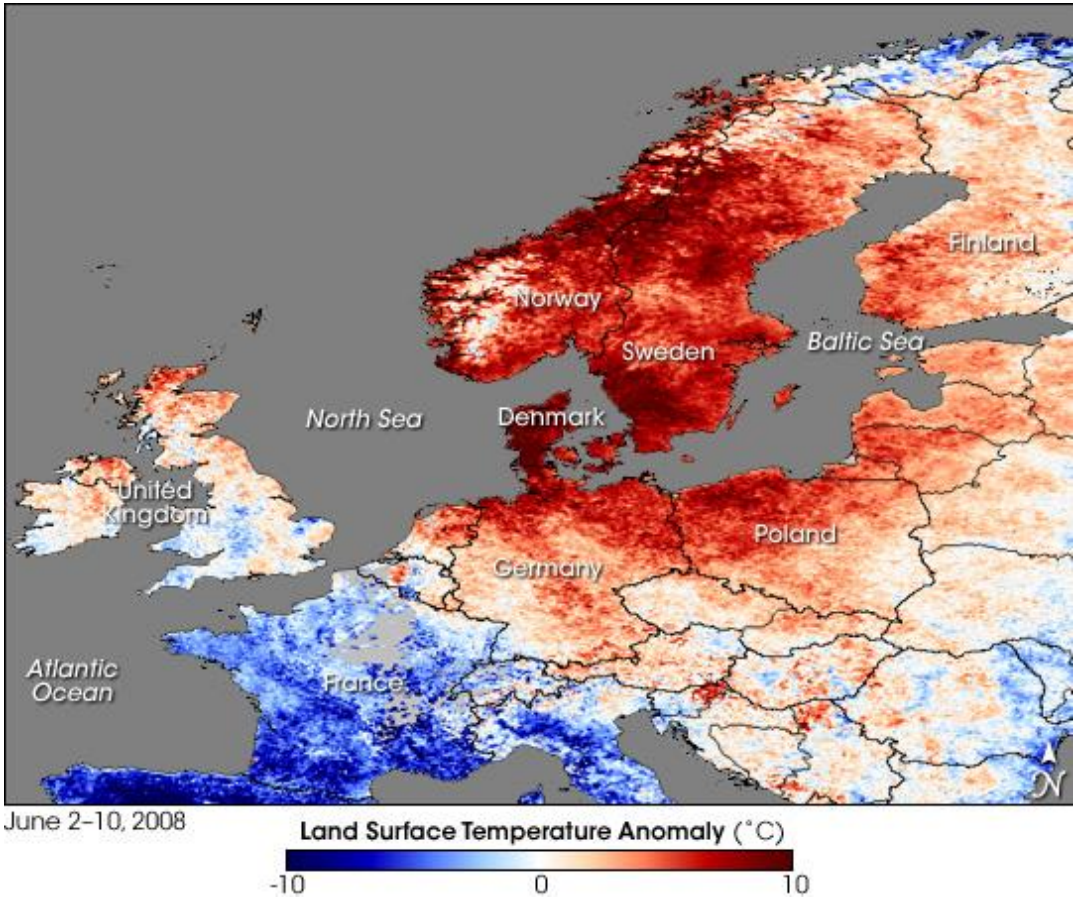
Link between surface temperature, lightning and tropospheric ozone?

- 5-6% change in global lightning activity for each 1 degree change in global surface temperature

  Price & Rind, 1994

- Positive forcing. Lightning is a source of NO3 and therefore of tropospheric ozone, a greenhouse gas

  Sinha & Toumi, 1997



Source: http://feww.wordpress.com/2008/06/25/heat-wave-in-northern-europe/

The key risks associated with thunderstorms / lightning

1. The link between climate change and thunderstorms / lightning
2. The impact of thunderstorms / lightning
3. What is this likely to mean for reinsurers
4. Available tools to assist in the quantification of the risks

Fire

Flash flooding

Hail

Damage to electricity network




Fire

- Lightning is the cause of 17,400 fires each year in the USA

  U.S. Fire administration

- October 2008 forest fires in California caused insured losses of $1.1bn

- August 2007 forest fire in Greece, insured loss Euro 1.2bn

- June 2008 forest fire in Norway caused approx $10m damage

Flash flooding

- Lightning is associated with extreme rainfall

Petersen and Rutledge, 1998

- Lightning observations have been used to show a strong link between the occurrence of regional flash flooding and major thunderstorm outbreaks

Ntelekos et al, 2006

Hail

- Agriculture
- Motor
- Property

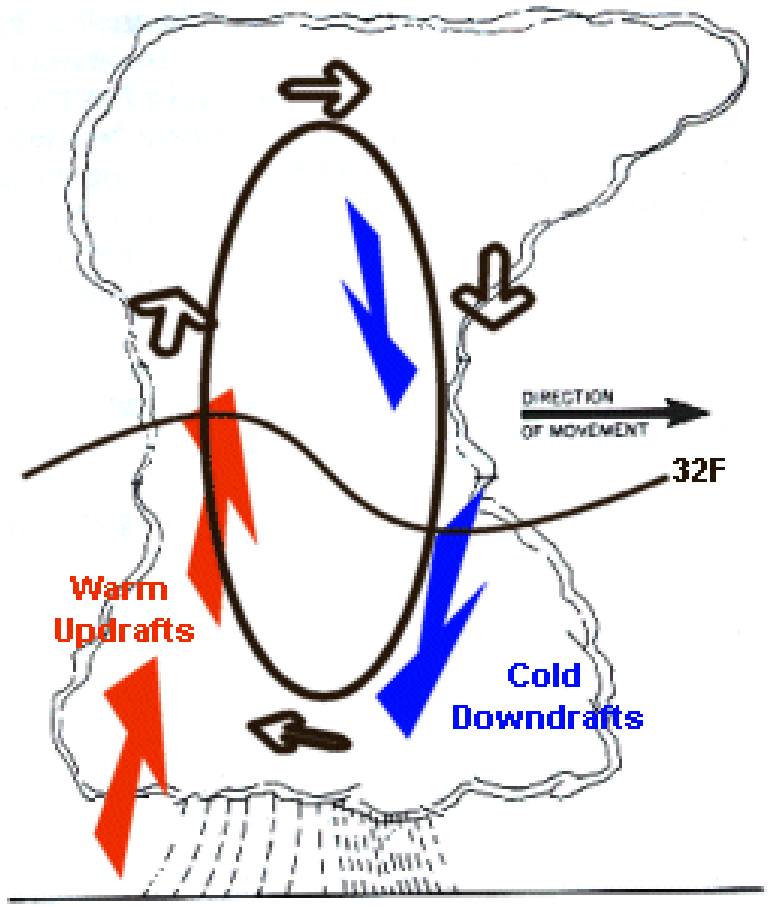


Image source: http://www.erh.noaa.gov/cae/svrwx/hail.htm

Willis

Damage to electricity network

- In lightning prone areas of the USA, lightning is the single largest cause of outages in Transmission and Distribution systems

Bernstein et al, 1996

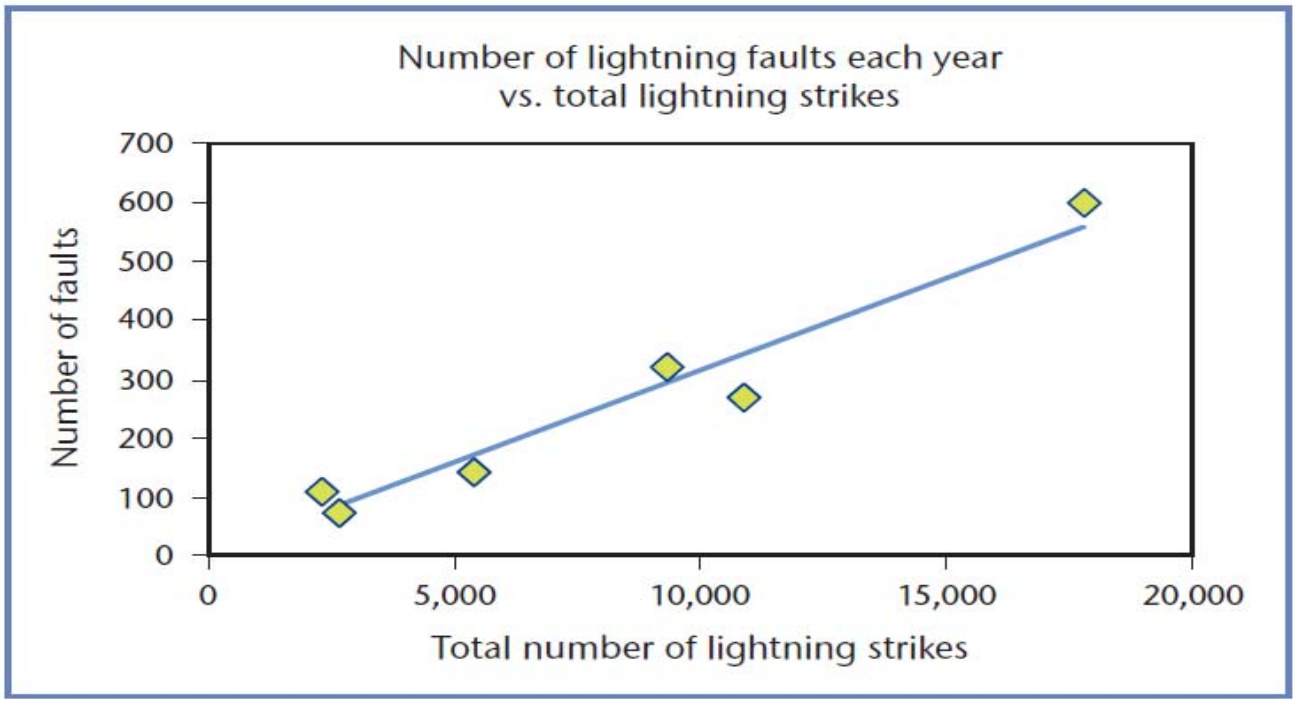
- Business is increasingly sensitive to power fluctuations and disruptions

- Transmission and Distribution systems tend to have the damage, but the majority of T&D infrastructure in Europe is not insured.

- Traditional insurance coverage for T&D risks, has become very expensive

Link between lightning and faults on T&D network?

UK Met Office study on behalf of Central Networks showed that there are correlations between lightning, extreme gusts of wind and faults in the distribution network.



"Weather related faults in high voltage power lines", Met Office 2006

Willis

What will this mean for the reinsurers?

1. The link between climate change and thunderstorms / lightning
2. The impact of thunderstorms / lightning
3. What is this likely to mean for reinsurers
4. Available tools to assist in the quantification of the risks

Higher losses

Closer analysis

Demand for more detail

By 2040s-2060s, weather damage in the UK during a “normal” year, is likely to be double that of current years

Association of British Insurers, 2007

How will reinsurers respond?

- Since the early 1990s the international insurance industry has adopted an increasingly analytical approach to the assessment and evaluation of risk. This will continue.

- Catastrophe loss models will play an increasingly important role

- Demand for new models – of hail, urban flood, wildfire

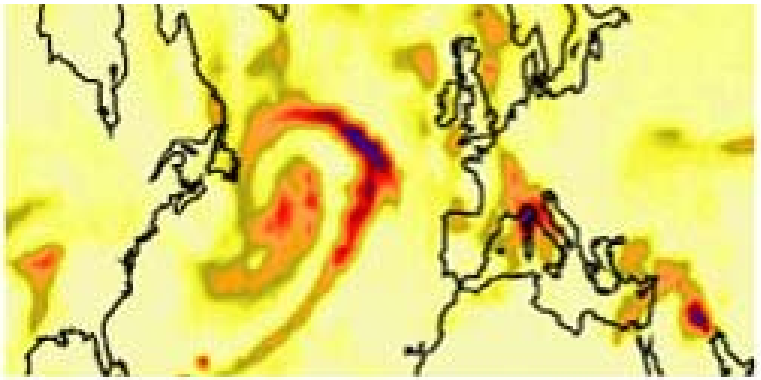
- Demand for closer integration between climate models & catastrophe loss models

Detailed data capture required

- insurance exposure data:
  - capture and reporting limited by legacy systems
  - quality and type has not been standardised
  - trans- and multi-national policies mean location identification is confused
  - potentially largest source of error in modelling
- extensive data auditing essential to reduce systemic error
- “aggregated” data should be confined to history
- full capture of in-force exposures with all attributes is most sound basis for modelling

Climate models combined with catastrophe models

- Catastrophe models:
  - Attempt to model weather events and associated losses
  - Do **not** model ‘climate’
  - But – provide the means of quantifying loss potential from extreme events
- Climate models (GCMs):
  - Attempt to model the long term global climate and key parameters (e.g. temperature, precipitation, wind, oceanic currents) through simulation of physical earth system processes (e.g. atmosphere, ocean, earth)



HiGEM – High Resolution Global Environmental Modelling
UK-Japan Climate Collaboration >>

We need to combine the two

Quantification of the risks associated with thunderstorms and lightning

1. The link between climate change and thunderstorms / lightning
2. The impact of thunderstorms / lightning
3. What is this likely to mean for reinsurers
4. Available tools to assist in the quantification of the risks

Catastrophe models

GIS based analysis

Scientific research

What tools are available?

Commercial catastrophe loss models are available for ;

- Hail
  RMS Hailcalc model covers Austria, Belgium, France, Germany, Italy, Luxembourg, the Netherlands and Switzerland

- Severe Convective Storm (Tornado/hail)
  RMS, Eqecat and AIR models covers USA and Canada

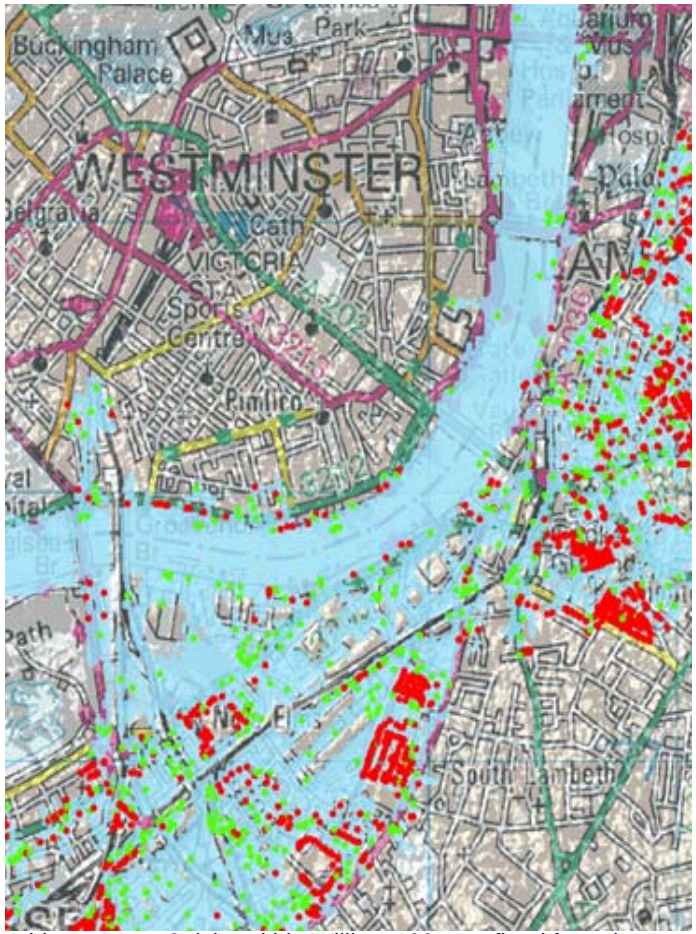
- Wildfire
  Eqecat and AIR models cover USA

What tools are available?

GIS based tools and analysis helpful for

- forest fire
- flash flooding
- power outages

Bushfire risk mapping in Australia



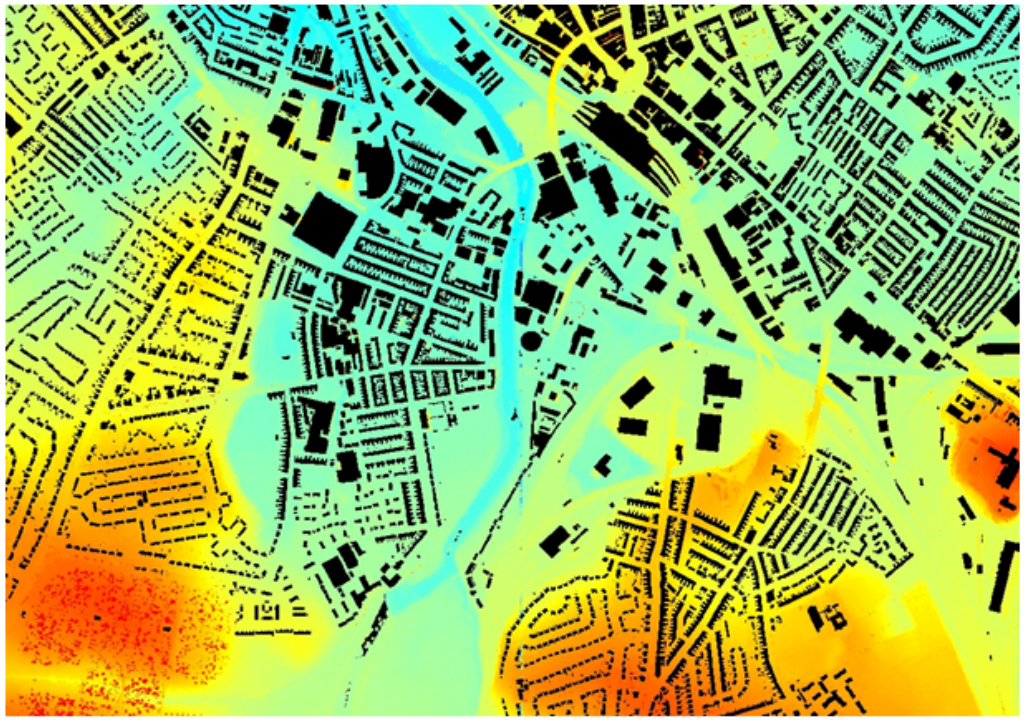
Address-Layer 2 risks within Willis 1:100 year flood footprint – red points are dwellings, green are non-residential locations.

Willis

Willis Research Network – urban flood risk modelling

- The Willis Research Network includes academic organisations actively researching ways of representing complex urban topography in computationally efficient ways.
- Urban flooding requires detailed representation of the pathways and barriers to flood flows and complex modelling of the hydrodynamic processes which determine the flood extent.
- The WRN will be progressing the development of new techniques which will enable urban flood risk to be modelled effectively for the first time in a probabilistic/stochastic environment.

Fused LiDAR and GIS



University of BRISTOL

Willis

Willis Research Network

2 key themes for the WRN

- “forecasting” – storms, extreme events – annual, seasonal forecasting skill

- “extreme weather” – linking climate to weather extremes – present and future

WRN: Core Research Stream

- Major research area – extreme weather events – frequency and severity

Climate Change, Extreme Events, Weather Perils

- Extreme Event Clustering, Correlation of Climate Perils
- Climate Model Regional downscaling
- Socio-economic impacts of climate change, Mega city impacts of climate perils
- Hail Risk Modelling, Bushfire Modelling

Conclusions

1. Climate change is creating conditions conducive to the increased frequency of thunderstorms / lightning
   however, more research is needed to confirm the nature of the correlation.
2. An increase in thunderstorms will lead to increases in lightning ignition of forest fires, hail damage and damage to electricity networks

3. Reinsurers will demand more detailed analysis of the risks, utilising a scientific approach to the analysis

4. Catastrophe models & GIS can aid risk quantification but further tools are needed for emerging risks e.g. forest fire, hail and flash flood particularly in Europe.

The potential for increases in damage due to more thunderstorms and lightning

4th November 2008

Insuring Future Climate Change
Oslo, 4th November 2008