2013 Natural Catastrophe Year in Review
**Agenda**

<table>
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<th>Topic</th>
<th>Presenter</th>
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<tr>
<td>Welcome/Introduction</td>
<td>Bill Fellows</td>
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<tr>
<td>US/Global Natural Catastrophe Update</td>
<td>Carl Hedde</td>
</tr>
<tr>
<td>Economic Implications of Natural Catastrophe Losses</td>
<td>Dr. Robert Hartwig</td>
</tr>
<tr>
<td>Special Topic: Hurricanes, Typhoons and Tornados</td>
<td>Peter Höppe</td>
</tr>
<tr>
<td>Questions and Answers</td>
<td></td>
</tr>
</tbody>
</table>
You will have an opportunity to ask questions at the conclusion of the presentation.

To ask a question, please dial 14 on your phone.

An operator will facilitate your participation.

@Munichre_US    @lworters    @iii    #NATCAT2014
US/Global Natural Catastrophe Update

Carl Hedde, SVP, Head of Risk Accumulation
Munich Reinsurance America, Inc.
From 1980 until today all loss events; for USA and selected countries in Europe all loss events since 1970.

Retrospectively, all great disasters since 1950.

In addition, all major historical events starting from 79 AD – eruption of Mt. Vesuvio (3,000 historical data sets).

Currently more than 33,000 events
Insured losses in the United States in 2013 totaled $12.8 billion – far below the 2000 to 2012 average loss of $29.4 billion (in 2013 Dollars).

Quiet Atlantic hurricane season despite expectations for an active year; US drought of major hurricane landfalls is now 8 years, unprecedented in the reliable historical record.

Insured losses from thunderstorm events exceeded $10.0 billion, despite the lowest observed tornado count in a decade.

Colorado experienced record-setting wildfires in June, then record flooding in September.

Drought conditions ease in the Desert Southwest, but worsen in California.
### Natural Disaster Losses in the United States, 2013

<table>
<thead>
<tr>
<th>As of December 31, 2013</th>
<th>Number of Events</th>
<th>Fatalities</th>
<th>Estimated Overall Losses (US $m)</th>
<th>Estimated Insured Losses (US $m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Severe Thunderstorm</td>
<td>69</td>
<td>110</td>
<td>16,341</td>
<td>10,274</td>
</tr>
<tr>
<td>Winter Storm</td>
<td>11</td>
<td>43</td>
<td>2,935</td>
<td>1,895</td>
</tr>
<tr>
<td>Flood</td>
<td>19</td>
<td>23</td>
<td>1,929</td>
<td>240</td>
</tr>
<tr>
<td>Earthquake &amp; Geophysical</td>
<td>6</td>
<td>1</td>
<td>Minor</td>
<td>Minor</td>
</tr>
<tr>
<td>Tropical Cyclone</td>
<td>1</td>
<td>1</td>
<td>Minor</td>
<td>Minor</td>
</tr>
<tr>
<td>Wildfire, Heat, &amp; Drought</td>
<td>22</td>
<td>29</td>
<td>620</td>
<td>385</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td><strong>128</strong></td>
<td><strong>207</strong></td>
<td><strong>21,825</strong></td>
<td><strong>12,794</strong></td>
</tr>
</tbody>
</table>

Source: Munich Re NatCat SERVICE

© 2014 Munich Re
Loss Events in the U.S. 1980 – 2013

Number of events

2013 Total
128 Events

Source: MR NatCatSERVICE

© 2014 Munich Re
Loss Events in the US 1980 – 2013
Overall and insured losses

*Losses adjusted to inflation based on country CPI.

Overall losses (in 2013 values)*
Insured losses (in 2013 values)*
<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
<th>Estimated Economic Losses (US $m)</th>
<th>Estimated Insured Losses (US $m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>February 24 – 25</td>
<td>Winter Storm</td>
<td>1,300</td>
<td>690</td>
</tr>
<tr>
<td>March 18 – 19</td>
<td>Thunderstorms</td>
<td>2,200</td>
<td>1,600</td>
</tr>
<tr>
<td>April 7 – 11</td>
<td>Winter Storm</td>
<td>1,600</td>
<td>1,200</td>
</tr>
<tr>
<td>April 16 – 18</td>
<td>Thunderstorms</td>
<td>1,100</td>
<td>560</td>
</tr>
<tr>
<td>May 18 – 20</td>
<td>Thunderstorms</td>
<td>3,100</td>
<td>1,800</td>
</tr>
<tr>
<td>May 28 – 31</td>
<td>Thunderstorms</td>
<td>2,800</td>
<td>1,400</td>
</tr>
<tr>
<td>August 6 – 7</td>
<td>Thunderstorms</td>
<td>1,300</td>
<td>740</td>
</tr>
<tr>
<td>September 9 – 16</td>
<td>Flooding</td>
<td>1,500</td>
<td>160</td>
</tr>
<tr>
<td>November 17 - 18</td>
<td>Thunderstorms</td>
<td>1,300</td>
<td>931</td>
</tr>
</tbody>
</table>
Nine significant natural catastrophes occurred in the United States in 2013.
There has not been a major hurricane landfall in the US since Wilma in October 2005.

Number of US Landfalling Tropical Cyclones
1900 – 2013

Source: NOAA
2013 US Tornado Count

United States Annual Trend of LSR Tornadoes*

Year (count thru Dec. 31)
- 2013 (943)
- 2012 (1116) YR:1116
- 2011 (1897) YR:1897
- 2010 (1525) YR:1525
- 2009 (1304) YR:1304
- 2008 (2194) YR:2194
- 2007 (1276) YR:1276
- 2006 (1296) YR:1296
- 2005 (1216) YR:1216
- 05-12 Avg. (1478) YR:1478

*Preliminary tornadoes from NWS Local Storm Reports (LSRs)
Annual average is based on preliminary LSRs, 2005-2012
Average insured thunderstorm losses have increased sevenfold since 1980.

2013 Total: $10.3 bn
Global Natural Catastrophes in 2013
## Natural Catastrophes Worldwide 2013

### Significant events

<table>
<thead>
<tr>
<th>Event Type</th>
<th>Event Description</th>
<th>Affected Area</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Typhoon Haiyan, Philippines</td>
<td>Super typhoon making landfall with record-breaking wind speeds over central Philippines</td>
<td>Philippines</td>
<td>With over 6,000 fatalities and many people still missing it was the deadliest event in 2013</td>
</tr>
<tr>
<td>Hailstorms, Germany</td>
<td>Two severe hailstorms affecting southwestern and northern Germany within two days</td>
<td>Germany</td>
<td>With insured losses of US$ 3.7bn, it was the largest insured loss event in 2013</td>
</tr>
<tr>
<td>Floodings in Central Europe</td>
<td>Torrential persistent rainfalls caused the rivers Danube, Inn, and Elbe to reach record water levels</td>
<td>Central Europe</td>
<td>With est. US$ 15.2bn it was the costliest direct economic loss event in 2013</td>
</tr>
<tr>
<td>Series of tornadoes, USA</td>
<td>Despite the weakest tornado season in a decade, three very severe tornado outbreaks happened in the USA</td>
<td>USA</td>
<td>With US$ 10.3bn of insured losses in the USA it was the 6th costliest thunderstorm season on record in the USA</td>
</tr>
</tbody>
</table>

Source: Geo Risks Research, NatCatSERVICE – As at January 2014 © 2014 Munich Re
## Loss Events Worldwide 2013

Five costliest natural catastrophes for the insurance industry

<table>
<thead>
<tr>
<th>Date</th>
<th>Region</th>
<th>Event</th>
<th>Fatalities</th>
<th>Insured losses US$ m</th>
</tr>
</thead>
<tbody>
<tr>
<td>27-28.7.2013</td>
<td>Germany</td>
<td>Hailstorms</td>
<td>-</td>
<td>3,700</td>
</tr>
<tr>
<td>June 2013</td>
<td>Central Europe</td>
<td>Flooding</td>
<td>25</td>
<td>3,000</td>
</tr>
<tr>
<td>18-22.5.2013</td>
<td>USA</td>
<td>Severe storms, tornadoes</td>
<td>28</td>
<td>1,800</td>
</tr>
<tr>
<td>18-19.3.2013</td>
<td>USA</td>
<td>Severe storms, tornadoes</td>
<td>2</td>
<td>1,600</td>
</tr>
<tr>
<td>19-24.6.2013</td>
<td>Canada</td>
<td>Flooding</td>
<td>4</td>
<td>1,600</td>
</tr>
</tbody>
</table>

Source: Geo Risks Research, NatCatSERVICE – As at January 2014

© 2014 Munich Re
Number of events: 880

- The number is well above the 10-year average (2003–2012): 790

Fatalities: 20,000

- The number is very low in comparison with previous years (2003–2012): 106,000
- The deadliest event was Typhoon Haiyan in the Philippines, with more than 6,000 deaths

Overall direct losses: US$ 125bn

- 2013 is below the 10-year average (2003–2012): US$ 184bn (adjusted to inflation)

Insured losses: US$ 31bn

- The insured losses are below the 10-year-average (2003–2012): US$ 56bn (adjusted to inflation)
Loss Events Worldwide 1980 – 2013

Number of events

Source: Geo Risks Research, NatCatSERVICE
– As at January 2014

© 2014 Munich Re
Global Natural Catastrophe Update

Loss Events Worldwide 1980 – 2013
Overall and insured losses

*Losses adjusted to inflation based on country CPI.

Source: Geo Risks Research, NatCatSERVICE
© 2014 Munich Re
Loss Events Worldwide 2013
Geographical overview

- **Natural catastrophes**
  - Severe storms, tornadoes
    - USA, 18–22 May
  - Earthquake (series)
    - Pakistan, 24–28 September

- **Geophysical events**
  - Earthquake
    - China, 20 April
  - Meteorite impact
    - Russian Federation, 15 February

- **Hydrological events**
  - Floods
    - Europe, 30 May–19 June
    - India, 14–30 June
    - Australia, 21–31 January

- **Meteorological events**
  - Severe storms, tornadoes
    - USA, 18–22 May
  - Winter Storm Christian (St. Jude)
    - Europe, 27–30 October
  - Heat wave
    - India, April–June

- **Climatological events**
  - Typhoon Haiyan
    - Philippines, 8–12 November
  - Typhoon Fitow
    - China, Japan, 5–9 October

- **Extraterrestrial events**
  - Flash floods
    - Canada, 8–9 July
  - Meteorite impact
    - Russian Federation, 15 February
  - Floods
    - Canada, 19–24 June
    - USA, 9–16 September
  - Severe storms, tornadoes
    - USA, 28–31 May
  - Hurricanes Ingrid & Manuel
    - Mexico, 12–19 September
  - Floods
    - India, 14–30 June
  - Winter Storm Christian (St. Jude)
    - Europe, 27–30 October
  - Floods
    - India, 14–30 June
  - Heat wave
    - India, April–June

- **Selection of significant loss events**
  - **Earthquake (series)**
    - Pakistan, 24–28 September
  - **Floods**
    - Europe, 30 May–19 June
    - India, 14–30 June
    - Australia, 21–31 January
  - **Severe storms, tornadoes**
    - USA, 18–22 May
  - **Winter Storm Christian (St. Jude)**
    - Europe, 27–30 October
  - **Floods**
    - Canada, 19–24 June
    - USA, 9–16 September
  - **Severe storms, tornadoes**
    - USA, 28–31 May
  - **Hurricanes Ingrid & Manuel**
    - Mexico, 12–19 September
  - **Floods**
    - India, 14–30 June
  - **Winter Storm Christian (St. Jude)**
    - Europe, 27–30 October
  - **Floods**
    - India, 14–30 June
  - **Heat wave**
    - India, April–June

Source: Geo Risks Research, NatCatSERVICE, 2013

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In total the USA had to bear insured losses of US$ 12.8bn (2003-2012-average: US$ 35bn).

With insured losses over US$ 6.6bn, Germany was the second largest contributor to worldwide insured losses of US$ 31bn.

In the Philippines super typhoon Haiyan produced record wind speeds higher than 300 km/h, destroyed more than half a million homes and left over 6,000 people dead.

The Atlantic hurricane season was one of the most inactive seasons in decades.

Compared to the long-term average the year 2013 was clearly below average in both, loss of life and loss of assets.
Market & Financial Impact of Catastrophe Losses: 2013 Summary

Insurance Information Institute
January 7, 2014

Robert P. Hartwig, Ph.D., CPCU, President & Economist
Insurance Information Institute ◆ 110 William Street ◆ New York, NY 10038
Tel: 212.346.5520 ◆ Cell: 917.453.1885 ◆ bobh@iii.org ◆ www.iii.org
WINTER STORM LOSSES:
HOW BAD ARE THEY?

Losses from Snow, Ice, Freezing
and Related Causes Typical Cost
Insurers Between $1 Billion and
$2 Billion Annually
Inflation Adjusted U.S. Catastrophe Losses by Cause of Loss, 1993–2012

1. Catastrophes are defined as events causing direct insured losses to property of $25 million or more in 2012 dollars.
2. Excludes snow.
3. Does not include NFIP flood losses.
4. Includes wildland fires.
5. Includes civil disorders, water damage, utility disruptions and non-property losses such as those covered by workers compensation.

Source: ISO’s Property Claim Services Unit.

Winter storm losses totaled $27.8B or $1.4B/yr. on average from 1993-2012 accounting for 7.1% of all CAT losses; 2013 losses totaled $1.895B.
Industry’s Financial Strength and Overall Performance Improved During 2013 Due in Part to Materially Lower Catastrophe Losses
P/C Net Income After Taxes
1991–2013:Q3 ($ Millions)

- 2005 ROE\(^\ast\) = 9.6%
- 2006 ROE = 12.7%
- 2007 ROE = 10.9%
- 2008 ROE = 0.1%
- 2009 ROE = 5.0%
- 2010 ROE = 6.6%
- 2011 ROAS\(^1\) = 3.5%
- 2012 ROAS\(^1\) = 5.9%
- 2013:9M ROAS\(^1\) = 9.5%

Net income is up substantially (+54.7%) from 2012:Q3 $27.8B

Sources: A.M. Best, ISO, Insurance Information Institute
Profitability Peaks & Troughs in the P/C Insurance Industry, 1975 – 2013:Q3*

History suggests next ROE peak will be in 2016-2017

1977: 19.0%
1984: 1.8%
1975: 2.4%
1987: 17.3%
1992: 4.5%
1997: 11.6%
2006: 12.7%
2012: 5.9%
2001: -1.2%
2013:Q3 8.9%

A 100 Combined Ratio Isn’t What It Once Was: Investment Impact on ROEs

A combined ratio of about 100 generates an ROE of ~7.0% in 2012, ~7.5% ROE in 2009/10, 10% in 2005 and 16% in 1979

Combined Ratios Must Be Lower in Today’s Depressed Investment Environment to Generate Risk Appropriate ROEs

* 2008 - 2012 figures are return on average surplus and exclude mortgage and financial guaranty insurers. 2012 combined ratio including M&FG insurers is 103.2, 2011 combined ratio including M&FG insurers is 108.1, ROAS = 3.5%.  
Source: Insurance Information Institute from A.M. Best and ISO data.
Top Eight States for Insured Catastrophe Losses, 2013

- **Oklahoma**: $1,995
- **Texas**: $1,509
- **Colorado**: $907
- **Minnesota**: $845
- **Nebraska**: $773
- **Georgia**: $762
- **Illinois**: $661
- **Louisiana**: $593

*Source: The Property Claim Services (PCS) unit of ISO, a Verisk Analytics company.*
Industry Claims Paying Capital Stands at Record High in Late 2013

(Re)Insurance Industry is Well Positioned to Manage Large Scale Catastrophe Losses in 2014
Policyholder Surplus, 2006:Q4–2013:Q3

($ Billions)

2007:Q3 Pre-Crisis Peak

Drop due to near-record 2011 CAT losses

The Industry now has $1 of surplus for every $0.78 of NPW, close to the strongest claims-paying status in its history.

Surplus as of 9/30/13 stood at a record high $624.4B

*Includes $22.5B of paid-in capital from a holding company parent for one insurer’s investment in a non-insurance business in early 2010.

Sources: ISO, A.M. Best.

The P/C Insurance Industry Entered 2014 in Very Strong Financial Shape
Depressed Yields Will Necessarily Influence Underwriting & Pricing
Investment Income Fell in 2012 and is Falling in 2013 Due to Persistently Low Interest Rates, Putting Additional Pressure on (Re) Insurance Pricing

1 Investment gains consist primarily of interest and stock dividends.

*Estimate based on annualized actual net investment income earned through Q3:2013 of $34.338B.

Sources: ISO; Insurance Information Institute.
Underwriting Results in 2013 Were Helped by Lower Catastrophe Losses

Was 2013 Only a Respite from High Catastrophe Loss Years Like 2011/2012?
As Recently as 2001, Insurers Paid Out Nearly $1.16 for Every $1 in Earned Premiums

Heavy Use of Reinsurance Lowered Net Losses

Relatively Low CAT Losses, Reserve Releases

Relatively Low CAT Losses, Reserve Releases

Avg. CAT Losses, More Reserve Releases

Higher CAT Losses, Shrinking Reserve Releases, Toll of Soft Market

Cyclical Deterioration

Sandy Impacts

Lower CAT Losses


Sources: A.M. Best, ISO.
Large Underwriting Losses Are NOT Sustainable in Current Investment Environment

* Includes mortgage and financial guaranty insurers in all years.
Sources: A.M. Best, ISO; Insurance Information Institute.
Combined Ratio Points Associated with Catastrophe Losses: 1960 – 2013*

Combined Ratio Points

Avg. CAT Loss Component of the Combined Ratio by Decade

- 1960s: 1.04
- 1970s: 0.85
- 1980s: 1.31
- 1990s: 3.39
- 2000s: 3.52
- 2010s: 6.1E*

The Catastrophe Loss Component of Private Insurer Losses Has Increased Sharply in Recent Decades

*2010s represent 2010-2013.

Notes: Private carrier losses only. Excludes loss adjustment expenses and reinsurance reinstatement premiums. Figures are adjusted for losses ultimately paid by foreign insurers and reinsurers.

Source: ISO (1960-2011); A.M. Best (2012E) Insurance Information Institute.
Premium Growth

Catastrophe Losses Impact Trajectory of Premium Growth

(Percent)

1975-78

1984-87

2000-03

Net Written Premiums Fell 0.7% in 2007 (First Decline Since 1943) by 2.0% in 2008, and 4.2% in 2009, the First 3-Year Decline Since 1930-33.

Shaded areas denote “hard market” periods
Sources: A.M. Best (historical and forecast), ISO, Insurance Information Institute.

2013:Q3 growth was +4.2%
Sustained Growth in Written Premiums (vs. the same quarter, prior year) Should Continue through 2014

Sources: ISO, Insurance Information Institute.
Earthquakes: Jan. 17, 2014 is the 20th Anniversary of the Northridge Earthquake

Northridge Remains the Most Costly Earthquake in Terms of Insured Losses in US History
10 Most Costly Earthquakes in U.S. History (Insured Claims)

Many of these earthquakes caused extensive damage that wasn’t insured (and so doesn’t show in this chart)

*inflation adjustments to 2013 dollars using the CPI; adjustment for 1906 is based on CPI in 1913—earliest available.
Sources: MunichRe; Insurance Information Institute.
Estimated Insured Losses from the Top 10 Historical Earthquakes in U.S. Based in Current (2011) Exposures

$ Billions*

Potential insured losses are much higher today due development and higher property values. Few property owners have earthquake coverage in most areas.

While the Majority of Costly Earthquakes Are Likely to Occur in California, the New Madrid and Charleston, SC, Areas Have Significant Exposure As Well.

*Analysis conducted in 2012 based on exposures as of 12/31/2011.
Sources: AIR Worldwide; Insurance Information Institute.

Earthquake premium volume increased by 35.8% by 1996, but then fell.

Earthquake premium volume is well of its 2010 peak.
Flood Risk and Public Opinion

Most Americans Believe Flood Premiums Should Reflect Risk

Yet They Are Reluctant to Eliminate Subsidies
I.I.I. Poll: Flood Insurance

Q. Do you think it is fair that flood insurance premium increases are higher if people who live in high flood risk areas and rebuild their homes do not elevate them?

Almost two-thirds of Americans think that it is fair that flood insurance premiums be raised for people who live in high flood risk areas and rebuild their homes after a flood but do not elevate them.

I.I.I. Poll: Flood Insurance

Q. Do you think flood insurance premiums should reflect the risk of flooding no matter what the cost or do you think the government should subsidize the cost of flood insurance with taxpayers’ dollars?

Almost two-thirds of Americans think flood insurance premiums should be raised to reflect the risk of flooding.

I.I.I. Poll: Flood Insurance

Q. The federal government provides insurance coverage at taxpayer-subsidized rates for damage from floods through the National Flood Insurance Plan. A new law eliminates the subsidy and raises rates. Do you think the rate increase should be repealed?

More than half of Americans polled for the November 2013 Pulse thought that hikes in National Flood Insurance premiums should be repealed.

I.I.I. Poll: Flood Insurance

Q. If the costs were similar, would you prefer to buy flood insurance from a private insurance company or from the federal government through the National Flood Insurance Program?

Six out of ten Americans would prefer to buy flood insurance from a private insurance company as opposed to the federal government, if costs were similar.

Insurance Information Institute Online:

www.iii.org

Thank you for your time
and your attention!

Twitter: twitter.com/bob_hartwig
2013 – A Special Year in Several Respects
Record Hailstorm in Europe – Weak Tornado Season in the US
Less Hurricanes – More Typhoons

Peter Hoeppe
Munich Re
Hailstorm on 27 and 28 July 2013 in Germany
Most expensive loss event caused by hail worldwide!
Most expensive insured nat cat loss in 2013 worldwide!

Hailstones with diameters up to 8 cm (tennis ball ≈ 7 cm)

<table>
<thead>
<tr>
<th>Region</th>
<th>Overall losses</th>
<th>Insured losses</th>
<th>Fatalities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Southwestern and Northern Germany</td>
<td>US$ 4.8bn</td>
<td>US$ 3.7bn</td>
<td>0</td>
</tr>
</tbody>
</table>
Weak 2013 US Tornado Season

United States Annual Trend of LSR Tornadoes*

*Preliminary tornadoes from NWS Local Storm Reports (LSRs)
Annual average is based on preliminary LSRs, 2005-2012
Unusual weather pattern over the US in spring 2013 led to low convective activity

Reasons for lack of tornado activity during spring:

- Strong high pressure anchored over the northeast Pacific Ocean
- Polar jet stream forced much further north than normal into Alaska before diving southward across the eastern United States
- This pattern allowed cool Arctic air masses to dive south over the central United States, keeping the atmosphere stable.
2013 sixth year in a row with insured losses caused by convective storms above US$ 10 bn

Average thunderstorm losses have increased sevenfold since 1980.

2013 Total: $10.3 bn

Source: Property Claims Service Munich Re NatCatSERVICE © 2014 Munich Re
New scientific publication by Munich Re researchers on trends of convective loss events in the US

Rising Variability in Thunderstorm-Related U.S. Losses as a Reflection of Changes in Large-Scale Thunderstorm Forcing*

J. Sander

German Aerospace Centre, Institute of Atmospheric Physics, Oberpfaffenhofen-Wessling, and Munich Reinsurance Company, Munich, Germany

J. F. Eichner, E. Faust, and M. Steuer

Munich Reinsurance Company, Munich, Germany

(Manuscript received 17 April 2012, in final form 18 December 2012)

Published in Journal “Weather, Climate and Society“ of the American Meteorological Society
Major Results of New Munich Re Convective Storm Study

- The study examines convective (hail, tornado, thundersquall and heavy rainfall) events in the US with losses exceeding US$ 250m in the period 1970–2009 (80% of all losses)
- Past losses are extrapolated to current socio-economic conditions using a normalization technique
- After normalization there are still increases of losses which cannot be explained by changes in exposed values
- They are, however, correlated with the increase in the meteorological potential for severe thunderstorms and its variability

For the first time it could be shown that climatic changes have influenced US thunderstorm losses!
Water content of the atmosphere has already increased

Decadal changes of Specific Humidity of the lower atmosphere between 1973 and 2012

Black dots: regions with significant trend

New study suggests future increases in convective storm risk

Robust increases in severe thunderstorm environments in response to greenhouse forcing

Noah S. Diffenbaugha,1, Martin Scherer, and Robert J. Trappb

1Department of Environmental Earth System Science and Woods Institute for the Environment, Stanford University, Stanford, CA 94305; and bDepartment of Earth, Atmospheric, and Planetary Sciences, Boston University, West Labrador, MA 02170

We find that the Coupled Model Intercomparison Project, Phase 5 global climate model ensemble indicates robust increases in the occurrence of severe thunderstorm environments over the eastern United States in response to further global warming.
### Number of tropical storms in the Northern Atlantic

<table>
<thead>
<tr>
<th></th>
<th>Named storms</th>
<th>Hurricanes</th>
<th>Cat 3-5 Hurricanes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>2013</strong></td>
<td>13</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td><strong>2012</strong></td>
<td>19</td>
<td>10</td>
<td>2</td>
</tr>
<tr>
<td><strong>2011</strong></td>
<td>18</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td><strong>2010</strong></td>
<td>19</td>
<td>12</td>
<td>5</td>
</tr>
<tr>
<td><strong>2005</strong></td>
<td>28</td>
<td>15</td>
<td>7</td>
</tr>
<tr>
<td>Climatology 1950-2012</td>
<td>11.0</td>
<td>6.3</td>
<td>2.7</td>
</tr>
<tr>
<td>Warm phase 1995-2012</td>
<td>15.2</td>
<td>8.0</td>
<td>3.7</td>
</tr>
</tbody>
</table>

2013 the first year since 1982 (31 years) with only 2 hurricanes!
2013 the first year without a Cat 2 hurricane since 1968 (45 years)!
Unusual Dry Conditions over Tropical North Atlantic at Peak Hurricane Season

- Abnormally strong high pressure off the coast of Spain drove dry continental European and Saharan air south into the Tropical Atlantic.
- Dry environment causes evaporation and cooling within thunderstorms.
- Cool air is sinking and thus chokes off the hurricane’s source of energy.
### Number of tropical storms in the Northwest Pacific

<table>
<thead>
<tr>
<th></th>
<th>Named storms</th>
<th>Typhoons</th>
<th>Super Typhoons*</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>2013</strong></td>
<td>29</td>
<td>16</td>
<td>5</td>
</tr>
<tr>
<td><strong>2012</strong></td>
<td>25</td>
<td>15</td>
<td>4</td>
</tr>
<tr>
<td>Climatology 2003 – 2012</td>
<td>22.9</td>
<td>14.3</td>
<td>3.9</td>
</tr>
<tr>
<td>Climatology 1960 – 2012</td>
<td>26.8</td>
<td>17.0</td>
<td>4.1</td>
</tr>
</tbody>
</table>

Source: JTWC

*Maximum one-minute wind speed ≥ 235 km/h
Natural decadal variability of typhoon activity

Number of typhoons + tropical storms in the WNP Basin

Number of typhoons (red) in the WNP Basin

The linear trend in typhoon frequency.
Severe Weather in Eastern Asia
Natural climate decadal variability: Typhoon activity

Annual numbers of landfalls of typhoons and normalised overall typhoon losses in Eastern Asia split into regional loss contributions.

From 2013 onwards a future scenario of the smoothed landfall curve was inserted.

Source: Munich Re NatCatSERVICE, Weinkle et al. (2012): Historical Global Tropical Cyclone Landfalls © 2014 Munich Re
First analysis published in scientific literature: In active phase mean annual losses have been 46% higher, in inactive phase 39% lower relative to the long-term annual loss average from 1980 to 2012 (US$ 11.2bn).

Assuming the continuation of the approx. 30-year oscillation period found in past observation typhoon data, one might expect a new relative maximum of the oscillation in the early 2020s.

This scenario would translate into a transition to a new positive half-swing of typhoon activity and average loss level within the coming five years.
What do the 2013 tornado and tropical storm anomalies mean for the next years?

**Tropical storms**

- 2013 hurricane activity dominated by unusual short term effects
  - such short term effects cannot be predicted on a seasonal basis
  - no reason to believe to see a repetition next year
  - 2014 starts again with the odds of the current Atlantic warm phase.
- Typhoon activity will rise in the next years due to a natural oscillation
  2013 a first indicator of this?

**Convective storms**

- US Tornado season 2013 dominated by short term air pressures patterns
- No reason to expect another season like 2013 in 2014
- On the long term climate change most probably will increase activity of convective storms, events like in Germany 2013 may become more frequent.
Question and Answer
Press Question and Answer Process

To ask a question, please dial 1 4 on your phone.

An operator will facilitate your participation.
Press Inquiries

Terese Rosenthal
Phone: +1 (609) 243-4339
E-mail: trosenthal@munichreamerica.com

Bill Fellows
Phone: +1 (609) 243-4264
E-mail: wfellows@munichreamerica.com
NatCatSERVICE Downloadcenter for statistics and analyses on natural disasters

The downloadcenter provides **free access:**

- Annual statistics
- Long-term statistics
- Information on significant natural disasters
- Focus analyses
- NatCatSERVICE methodology, info brochure
- Publication Topics Geo

www.munichre.com/natcatservice/downloadcenter/en
## More Information

<table>
<thead>
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<th>Connect with Munich Re</th>
<th>Connect with I.I.I.</th>
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<td><strong>Twitter</strong></td>
<td>@Munichre_US</td>
<td>@iiiorg</td>
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<td></td>
<td>@Munichre</td>
<td></td>
</tr>
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<td><strong>LinkedIn</strong></td>
<td>munich-reinsurance-america-inc.</td>
<td>Insurance Information Institute</td>
</tr>
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<td><strong>Google+</strong></td>
<td>Munich Re (US)</td>
<td>Insurance Information Institute</td>
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<td><strong>Flickr</strong></td>
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<td>iiiorg</td>
</tr>
</tbody>
</table>
Describe the impact of severe weather and how individuals, businesses, government, and insurers can work together to prepare for and mitigate weather risks.

Will include data, publications, preparation tips and other useful information for the press.

Available in First Quarter 2014
Thank you very much for attending

January 7, 2014
US Tropical Cyclones in 2013

Tropical Storm Andrea

- Landfall on June 6 near Cedar Key, Florida as a tropical storm with sustained winds of 65 mph.
- Minor wind damage in Florida, storm and its remnants causes localized flooding along length of eastern seaboard.

Source: NOAA

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The current 5-year average (2008 - 2013) insured tropical cyclone loss is $5.6 billion per year.
May 18-20: Large outbreak of over 60 tornadoes across the Midwest and southern Great Plains. Moore, Oklahoma, was hit by an EF5 tornado (5th tornado strike of EF2 or above in the town since 1998). Thousands of homes, 2 schools, and a hospital destroyed. Overall insured losses from the outbreak are estimated at US$ 1.8 billion.
May 28-31: Another large outbreak occurred over the southern Plains. The area near El Reno, Oklahoma, was hit by an EF3 tornado (downgraded post-survey from EF5) that possessed the largest diameter ever observed in a tornado, over 2.6 miles. Overall insured losses from the outbreak are estimated at US$ 1.4 billion.
**November 16-17:** The largest tornado outbreak ever observed in November (136, based on preliminary counts) caused extensive damage in Illinois, Indiana, and neighboring states. Fall tornado outbreaks are not uncommon, but usually occur further south. Estimated insured losses from the event are US$ 900 million.
Current US Drought Conditions

U.S. Drought Monitor

December 31, 2013
(Released Thursday, Jan. 2, 2014)
Valid 7 a.m. EST

Drought Conditions (Percent Area)

<table>
<thead>
<tr>
<th>Current</th>
<th>None</th>
<th>D0-D4</th>
<th>D1-D4</th>
<th>D2-D4</th>
<th>D3-D4</th>
<th>D4</th>
</tr>
</thead>
<tbody>
<tr>
<td>54.20</td>
<td>45.80</td>
<td>26.01</td>
<td>13.96</td>
<td>3.31</td>
<td>0.31</td>
<td></td>
</tr>
</tbody>
</table>

One Year Ago:

<table>
<thead>
<tr>
<th>1/1/2013</th>
<th>None</th>
<th>D0-D4</th>
<th>D1-D4</th>
<th>D2-D4</th>
<th>D3-D4</th>
<th>D4</th>
</tr>
</thead>
<tbody>
<tr>
<td>28.57</td>
<td>71.43</td>
<td>51.44</td>
<td>35.18</td>
<td>17.82</td>
<td>5.64</td>
<td></td>
</tr>
</tbody>
</table>

Drought Impact Types:

- Delineates dominant impacts
- $S=$ Short-Term, typically less than 6 months (e.g. agriculture, grasslands)
- $L=$ Long-Term, typically greater than 6 months (e.g. hydrology, ecology)

Intensity:

- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
- D4 Exceptional Drought

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

Author: Matthew Rosencrans
CPCEP/NWS/NOAA

http://droughtmonitor.unl.edu/
Number of Acres Burned in Wildfires, 1980 – 2013

Source: National Interagency Fire Center

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Notable Wildfires in 2013

- **Colorado**: “High Park” fire near Fort Collins destroyed 257 homes and “Waldo Canyon” fire near Colorado Springs destroyed over 300 homes, becoming the most damaging fire in state history. Insured losses from both fires are estimated at $450 million.

- **California**: “Rim” fire near Yosemite National Park lasted nine weeks over August to October, scorching 257,000 acres and destroying 111 buildings. Due to remote location, insurance impacts were minimal.
Colorado Floods – September 2013

- Stalled frontal system and ample moisture combined to produce up to 17” of rain over parts of the Colorado Front Range over a 4 day period, almost the region’s expected annual rainfall total.

- Heaviest rainfall event ever observed in Colorado.

- 1,500 houses were destroyed, and another 19,000 damaged.

- Economic Losses are estimated at $1.5 billion; insured losses (excluding NFIP) of $160 million.
### Typhoon Haiyan, Philippines
**8 – 12 November 2013**

<table>
<thead>
<tr>
<th>Region</th>
<th>Philippines, Vietnam, China</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall losses</td>
<td>US$ 10bn</td>
</tr>
<tr>
<td>Insured losses</td>
<td>US$ 700m</td>
</tr>
<tr>
<td>Fatalities</td>
<td>6,095</td>
</tr>
</tbody>
</table>

**Deadliest event of 2013**

Source: Geo Risks Research, NatCatSERVICE

Source: Reuters

© 2014 Munich Re
Hailstorms, Germany
27 – 28 July 2013

<table>
<thead>
<tr>
<th>Region</th>
<th>Southwestern and Northern Germany</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall losses</td>
<td>US$ 4.8bn</td>
</tr>
<tr>
<td>Insured losses</td>
<td>US$ 3.7bn</td>
</tr>
<tr>
<td>Fatalities</td>
<td>0</td>
</tr>
</tbody>
</table>

Costliest insured loss of 2013

Source: Geo Risks Research, NatCatSERVICE – As at January 2014
### River Floods in Europe
30 May – 19 June 2013

| Region            | Central  
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Overall losses</strong></td>
<td><strong>US$ 15.2bn</strong></td>
</tr>
<tr>
<td><strong>Insured losses</strong></td>
<td><strong>US$ 3bn</strong></td>
</tr>
<tr>
<td><strong>Fatalities</strong></td>
<td><strong>25</strong></td>
</tr>
</tbody>
</table>

Costliest direct economic loss of 2013

Source: Reuters
Loss Events Worldwide 2013

Percentage distribution

<table>
<thead>
<tr>
<th>880 Loss events</th>
<th>20,000 Fatalities*</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Overall losses</strong> US$ 125bn</td>
<td><strong>Insured losses</strong> US$ 31bn</td>
</tr>
</tbody>
</table>

- **Geophysical events** (Earthquake, tsunami, volcanic eruption)
- **Meteorological events** (Tropical storm, extratropical storm, convective storm, local storm)
- **Hydrological events** (Flood, mass movement)
- **Climatological events** (Extreme temperature, drought, forest fire)

*Number of fatalities without famine.

**in 2013 values

Source: Geo Risks Research, NatCatSERVICE
– As at January 2014

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880 Loss events

- 24%
- 7%
- 15%
- 9%
- 38%
- 7%

20,000 Fatalities*

- 2%
- 2%
- 5%
- 5%
- 86%
- <1%

*Number of fatalities without famine.

Overall losses** US$ 125bn

- 30%
- 1%
- 18%
- <1%
- 48%
- 3%

Insured losses** US$ 31bn

- 56%
- <1%
- 29%
- <1%
- 10%
- 5%

**in 2013 values

Source: Geo Risks Research, NatCatSERVICE

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Loss Events Worldwide 2013
Overall and insured losses per continent

Source: Munich Re, NatCatSERVICE, 2014
Loss Events Worldwide 2013
Insured losses 2013 vs. 2012 – percentage distribution per continent

<table>
<thead>
<tr>
<th>Continent</th>
<th>Insured Losses US$ m*</th>
</tr>
</thead>
<tbody>
<tr>
<td>North America</td>
<td>16,500</td>
</tr>
<tr>
<td>South America</td>
<td>Minor</td>
</tr>
<tr>
<td>Europe</td>
<td>8,600</td>
</tr>
<tr>
<td>Africa</td>
<td>Minor</td>
</tr>
<tr>
<td>Asia</td>
<td>3,000</td>
</tr>
<tr>
<td>Australia/Oceania</td>
<td>1,600</td>
</tr>
</tbody>
</table>

Source: Munich Re, NatCatSERVICE, 2014