

Hurricane, Typhoon and European Windstorm Activity: the Next 10 Years

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Background

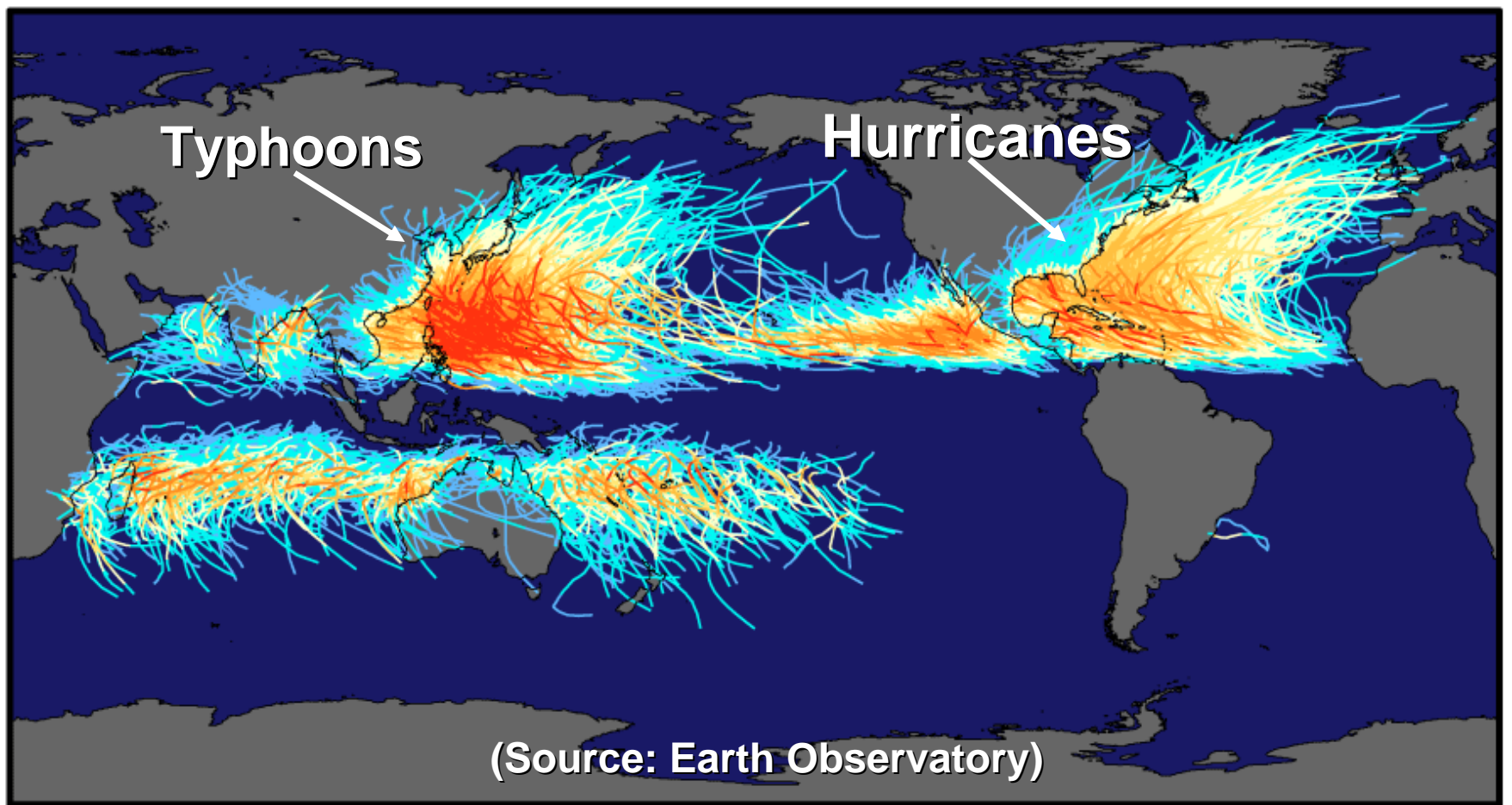
- Climate change is a very emotive issue.
- Interest in tropical cyclones and climate change fuelled by:
 - a) 10 tropical cyclones striking Japan in 2004.
 - b) The extremely active 2004 and 2005 North Atlantic hurricane seasons.
 - c) Publication of recent influential research papers (eg *Emanuel, 2005; Webster et al., 2005*) and climate change reports (Lloyds, 2006; WMO, 2006; IPCC, 2007).

Talk Structure

Focus on **Atlantic hurricanes**, **Northwest Pacific typhoons** and **European windstorms**.

1. **Introduction/impacts.**
2. **How unusual were 2004 & 2005 for Florida and Gulf hurricanes.**
3. **Recent trends in frequency/activity.**
4. **Outlooks for the next 10 years.**

Tropical Cyclone Tracks and Intensities

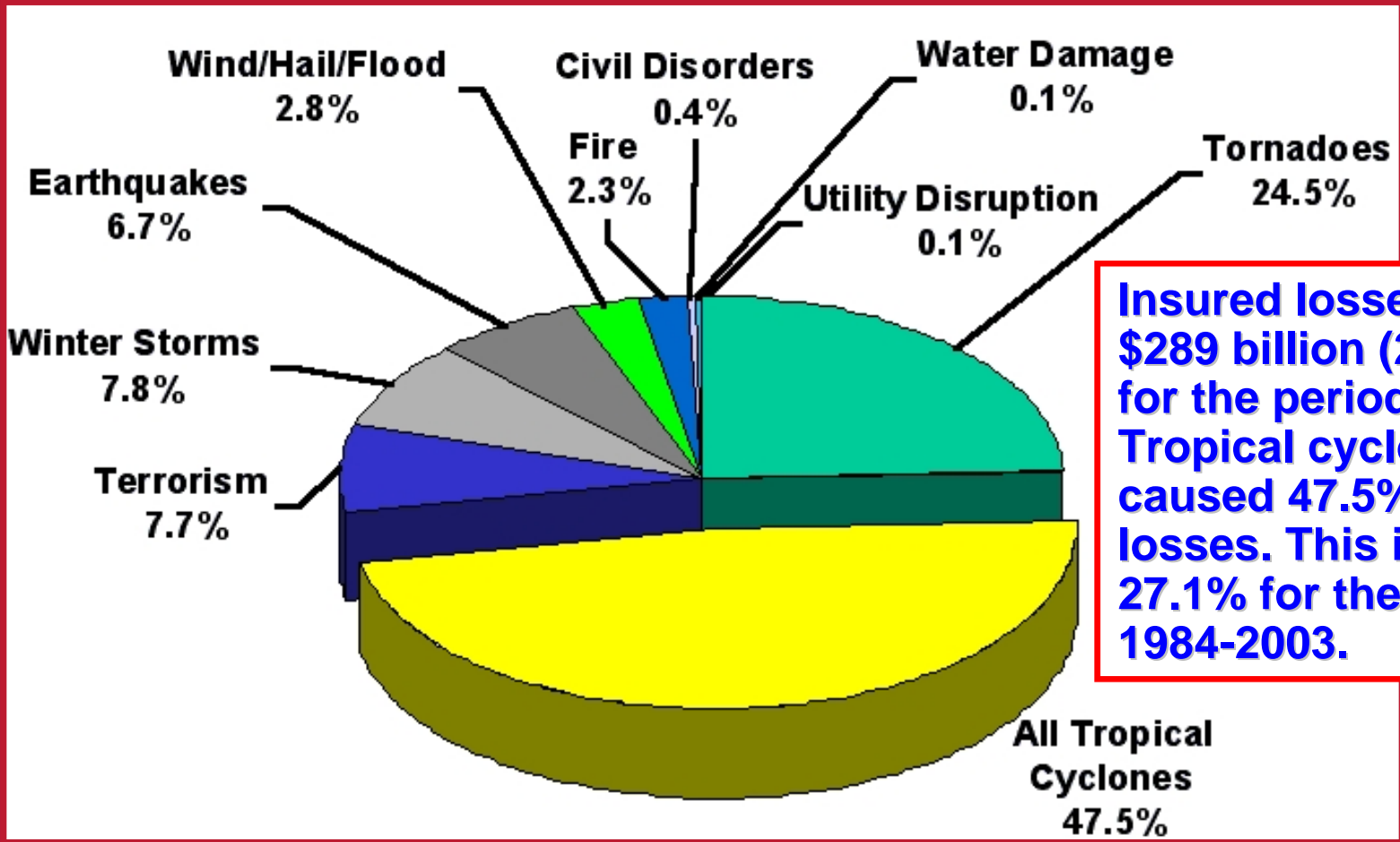


(Source: Earth Observatory)



Saffir-Simpson Hurricane Intensity Scale

Inflation-Adjusted U.S. Insured CAT Losses by Cause of Loss, 1986-2005¹



Insured losses totalled \$289 billion (2005 US \$) for the period 1986-2005. Tropical cyclones caused 47.5% of all CAT losses. This is up from 27.1% for the period 1984-2003.

¹ Catastrophes are events causing a direct insured loss to property of at least US \$25 million in 2005 US \$. Threshold changed from \$5 million to \$25 million in 1997. Source: Insurance Services Office (ISO).

European Windstorms

Responsible (since 1970) for 75-80% of all European catastrophe insured losses.

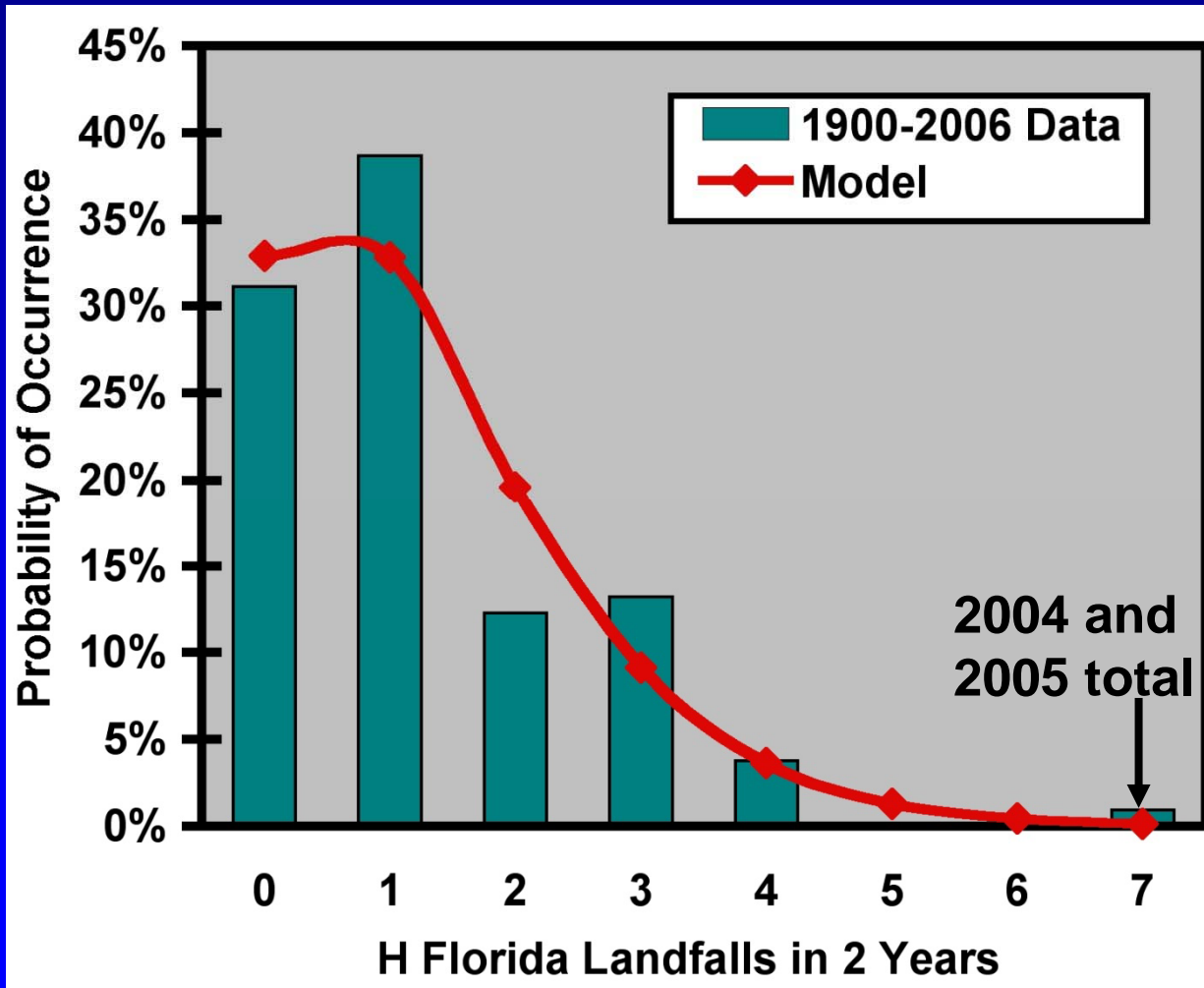
Account for 10 of the 14 most costly European insured loss events.



Porthleven, Cornwall: 4 Jan 1998 (Courtesy, Simon Burt)

2) How unusual were 2004 and 2005 for Florida and Gulf hurricanes?

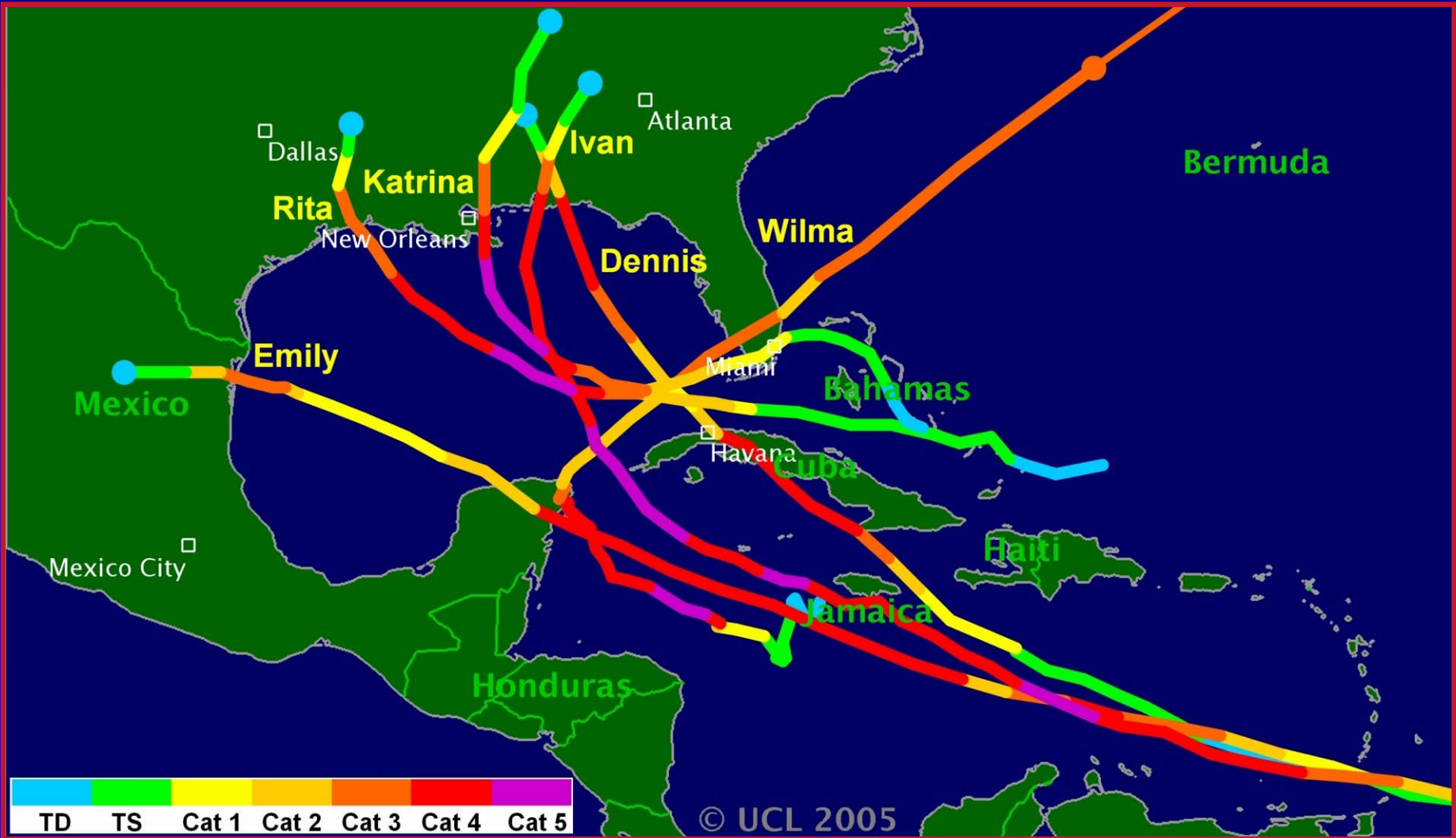
Number of Florida Hurricane Landfalls in 2 Years



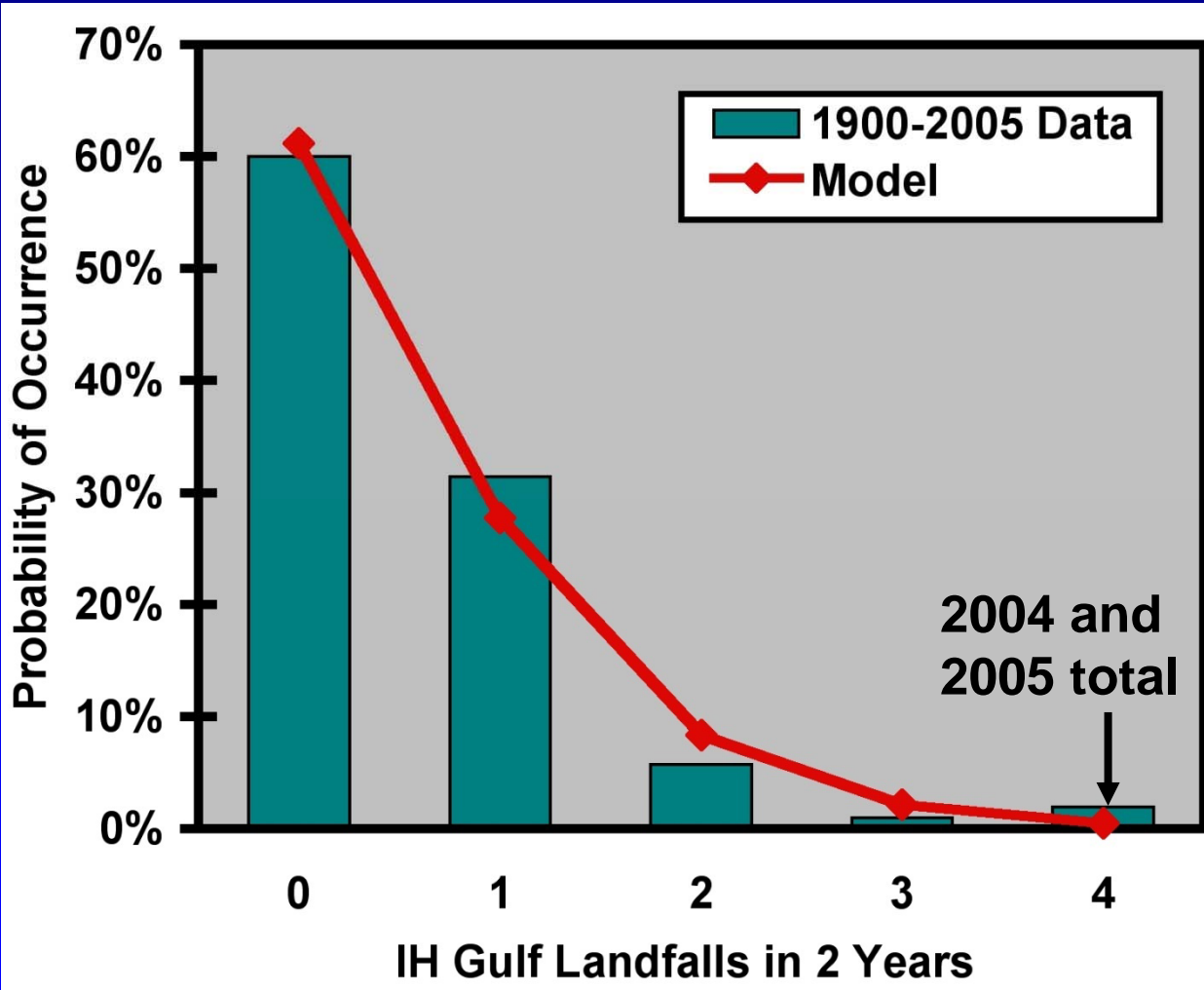
Seven hurricanes struck Florida in 2004 and 2005.

Model (negative binomial) probability of at least seven hurricane landfalls on Florida in 2 yrs is 1 in 700.

Major Gulf Hurricanes in 2004/5



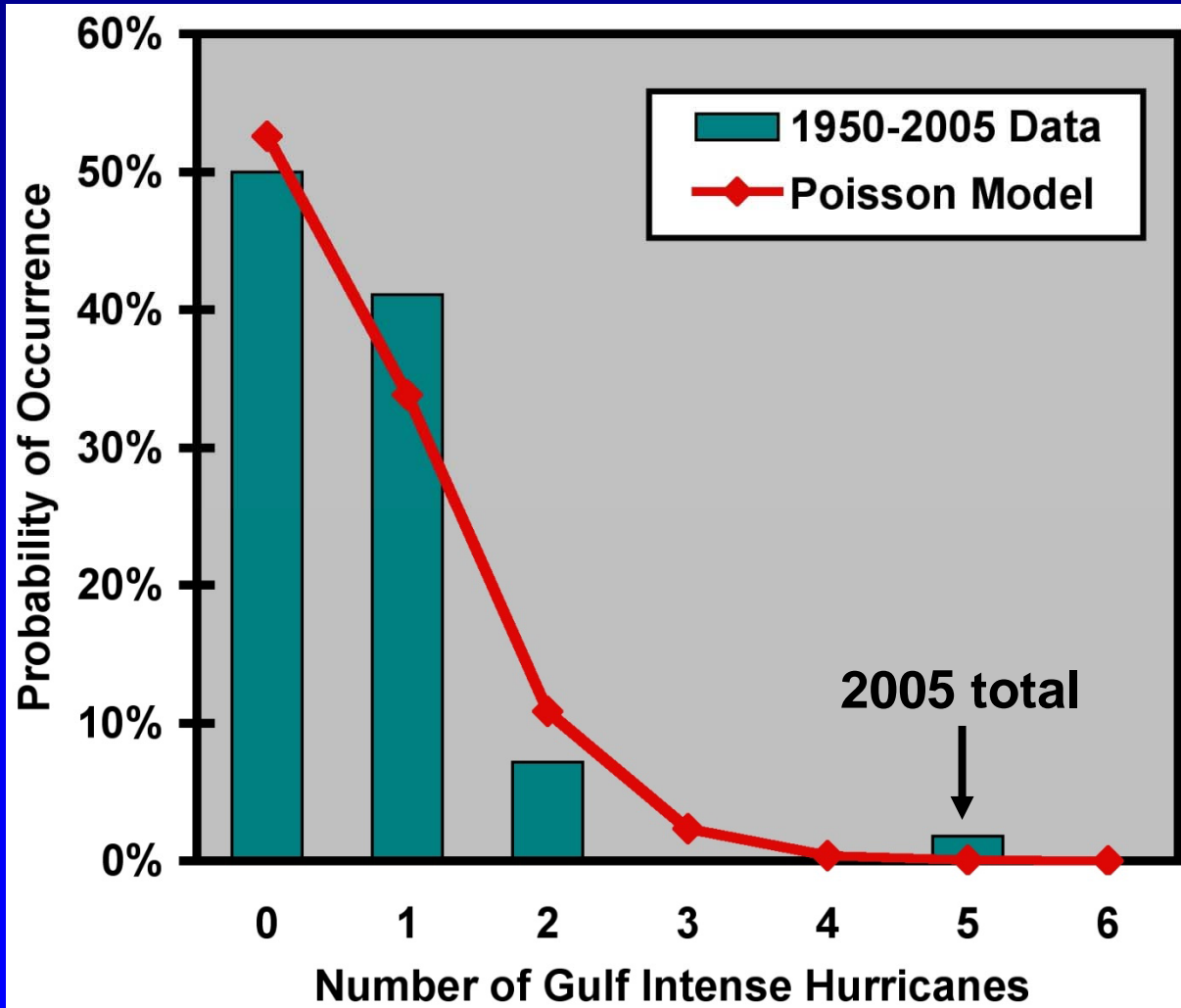
Number of Major Hurricane Gulf Landfalls in 2 Years



Two occurrences of four intense hurricane landfalls in consecutive years. These are **2004/5** and **1915/6**.

Model (Poisson) **probability** of four or more intense hurricane landfalls in 2 yrs is **1 in 200**.

Number of Gulf Major Hurricanes in 1 Year



2005 had **five** intense hurricanes in the Gulf of Mexico.

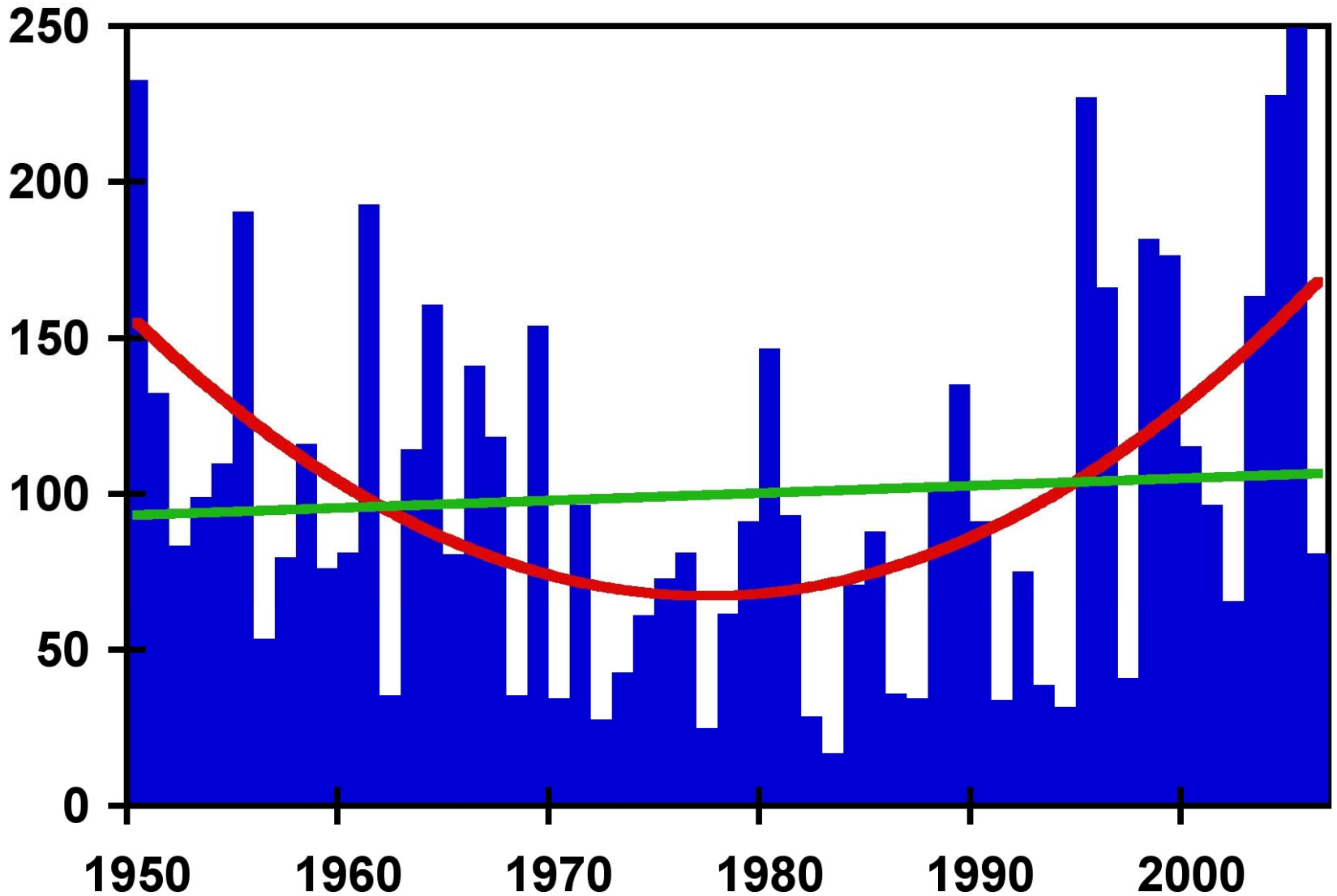
Model (Poisson) **probability** of five or more Gulf intense hurricanes in same year is **1 in 1000**.

Summary

- **Chance of seven hurricanes striking Florida in two years is ~ 1 in 700.**
- **Chance of four intense hurricanes affecting Gulf offshore industry in two years is just 1 in 200.**
- **A knee-jerk reaction to the high losses of 2004/5 should be avoided.**

2. Recent Trends

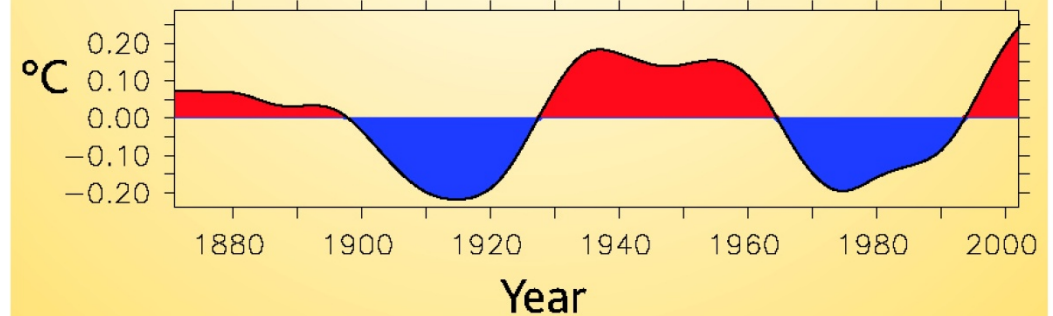
North Atlantic ACE index 1950-2006



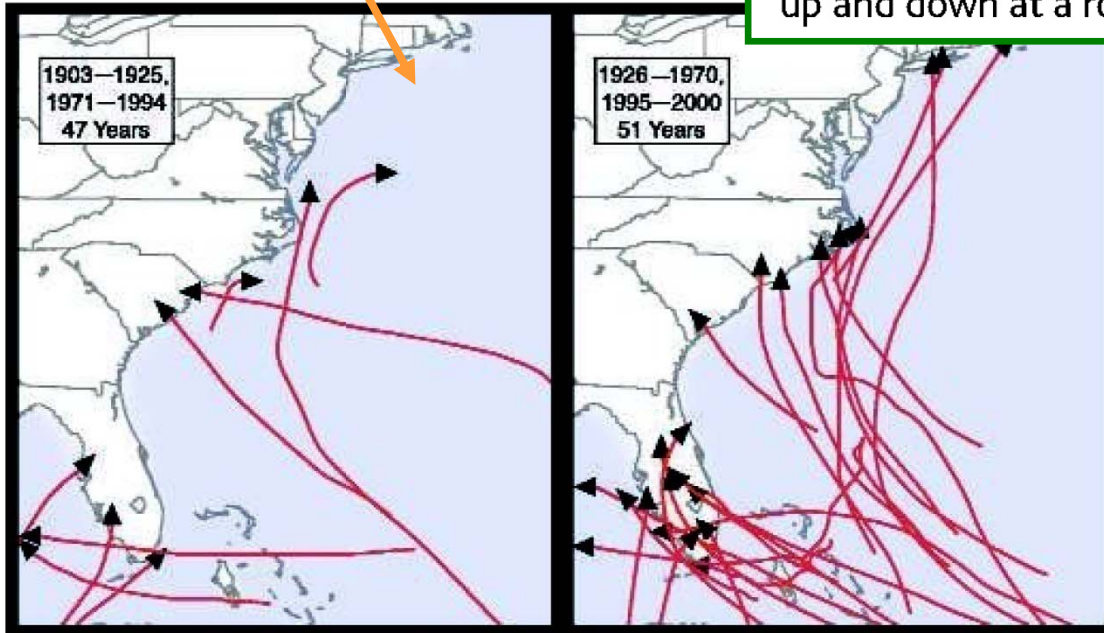
Atlantic Multidecadal Oscillation

AMO time series

AMO link to U.S. hurricane landfalls



Wobbly ocean. North Atlantic temperatures have wavered up and down at a roughly 60- to 80-year pace.

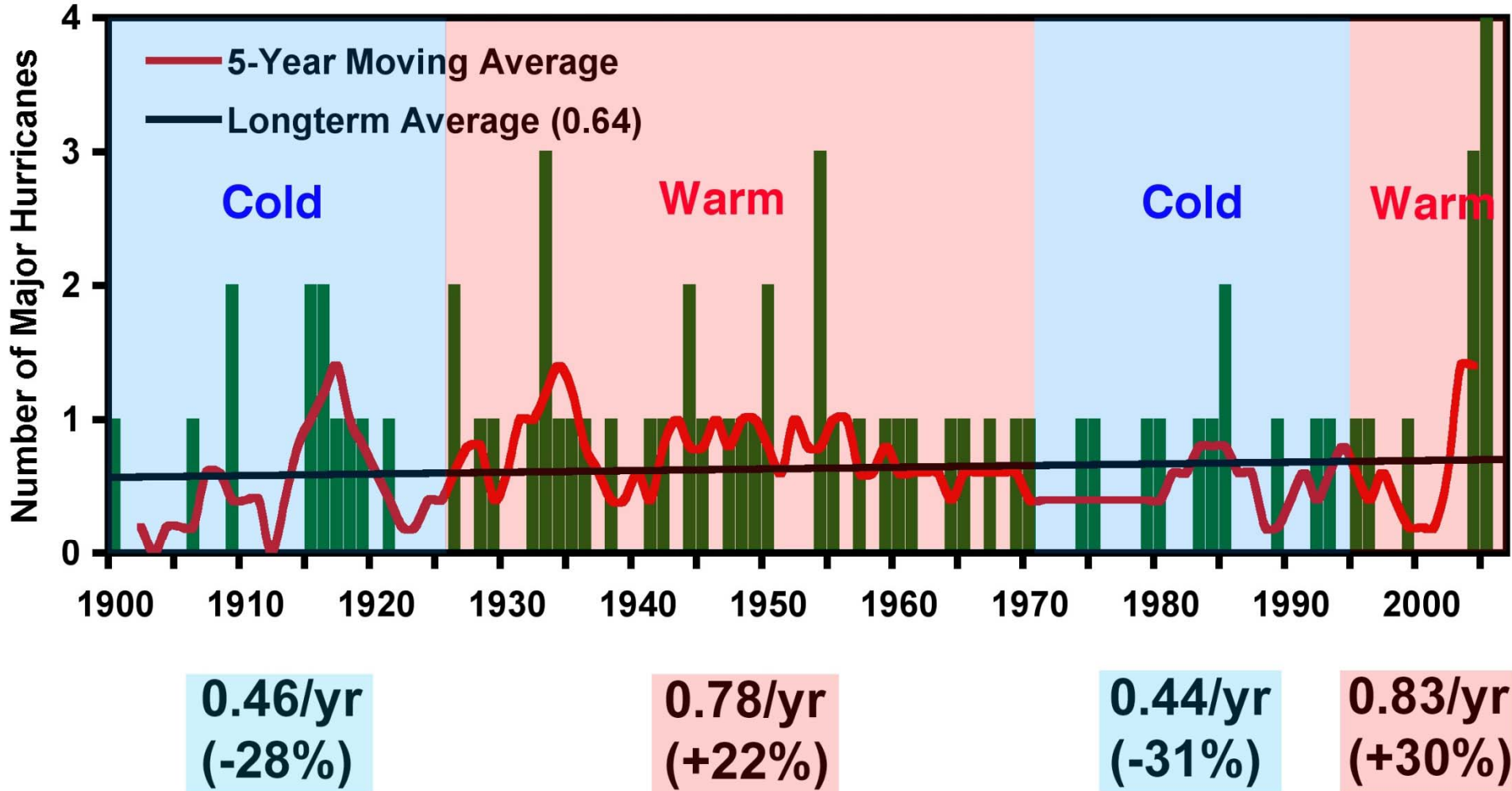


**Goldenberg et al.,
Science, 2001.**

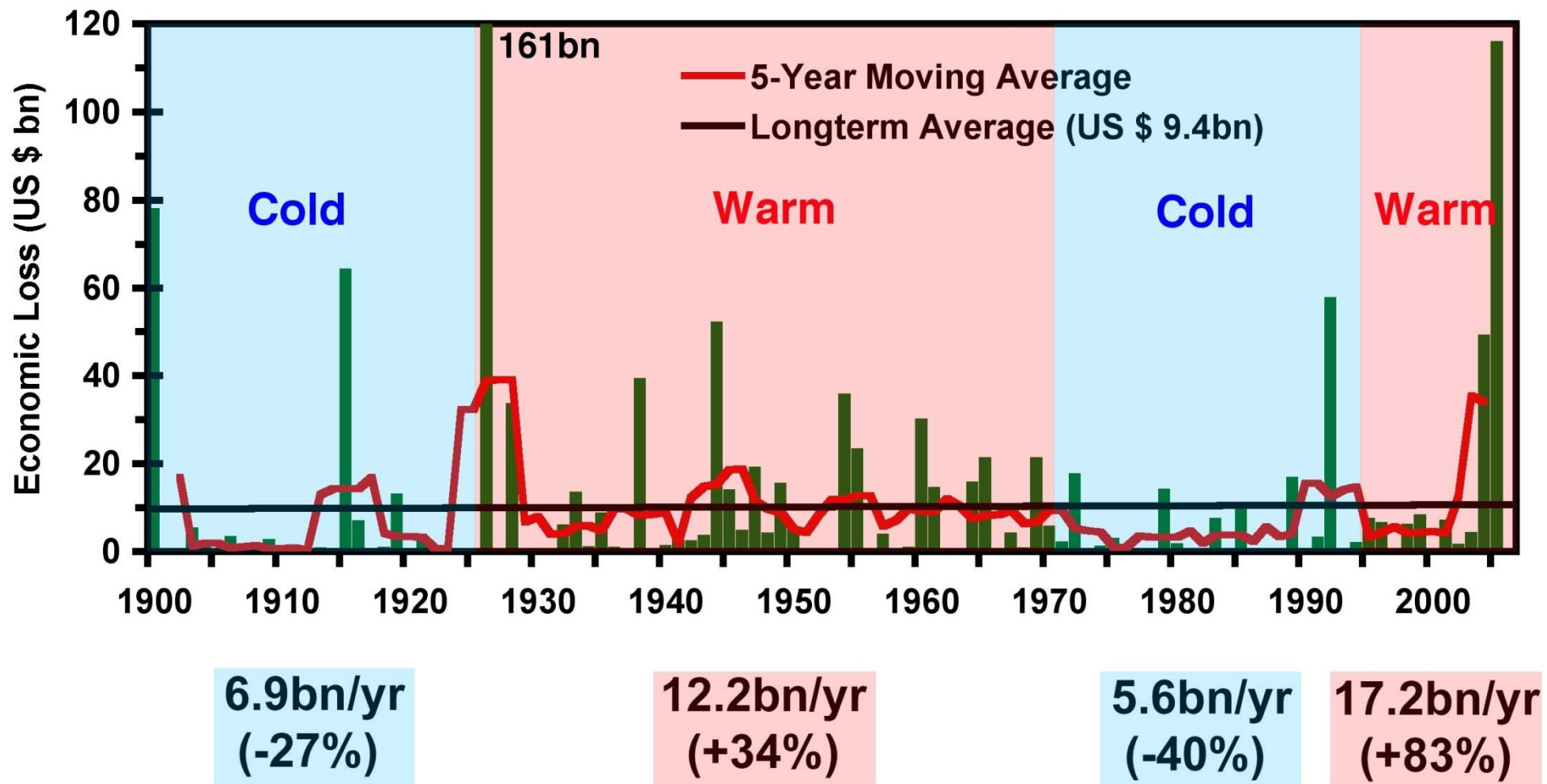
**Sutton and Hodson,
Science, 2005.**

Bad warmth. The AMO's warm years favor more U.S. hurricanes (*right*).

Major Hurricane (Cat 3+) US Landfall Numbers

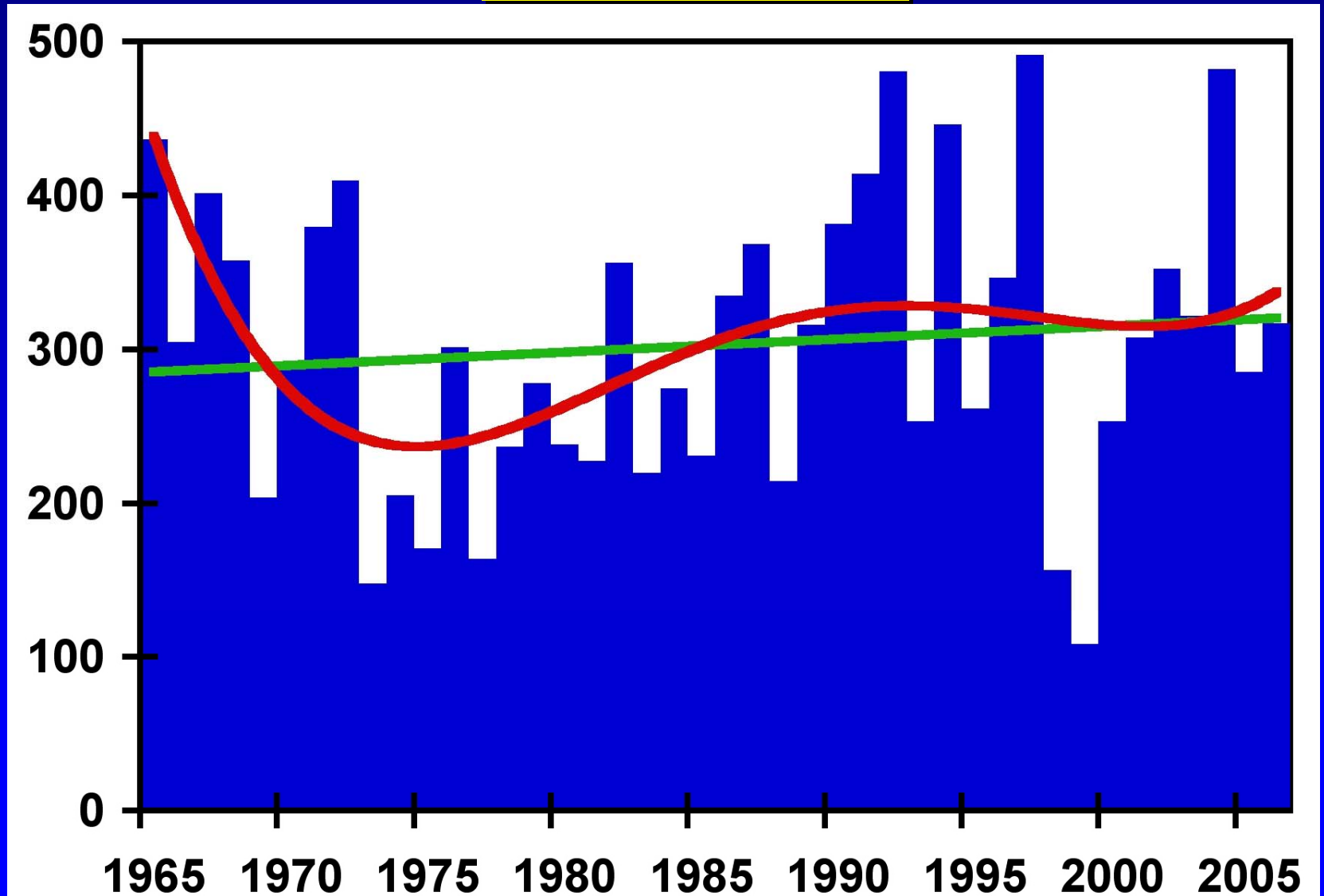


US Hurricane Economic Losses



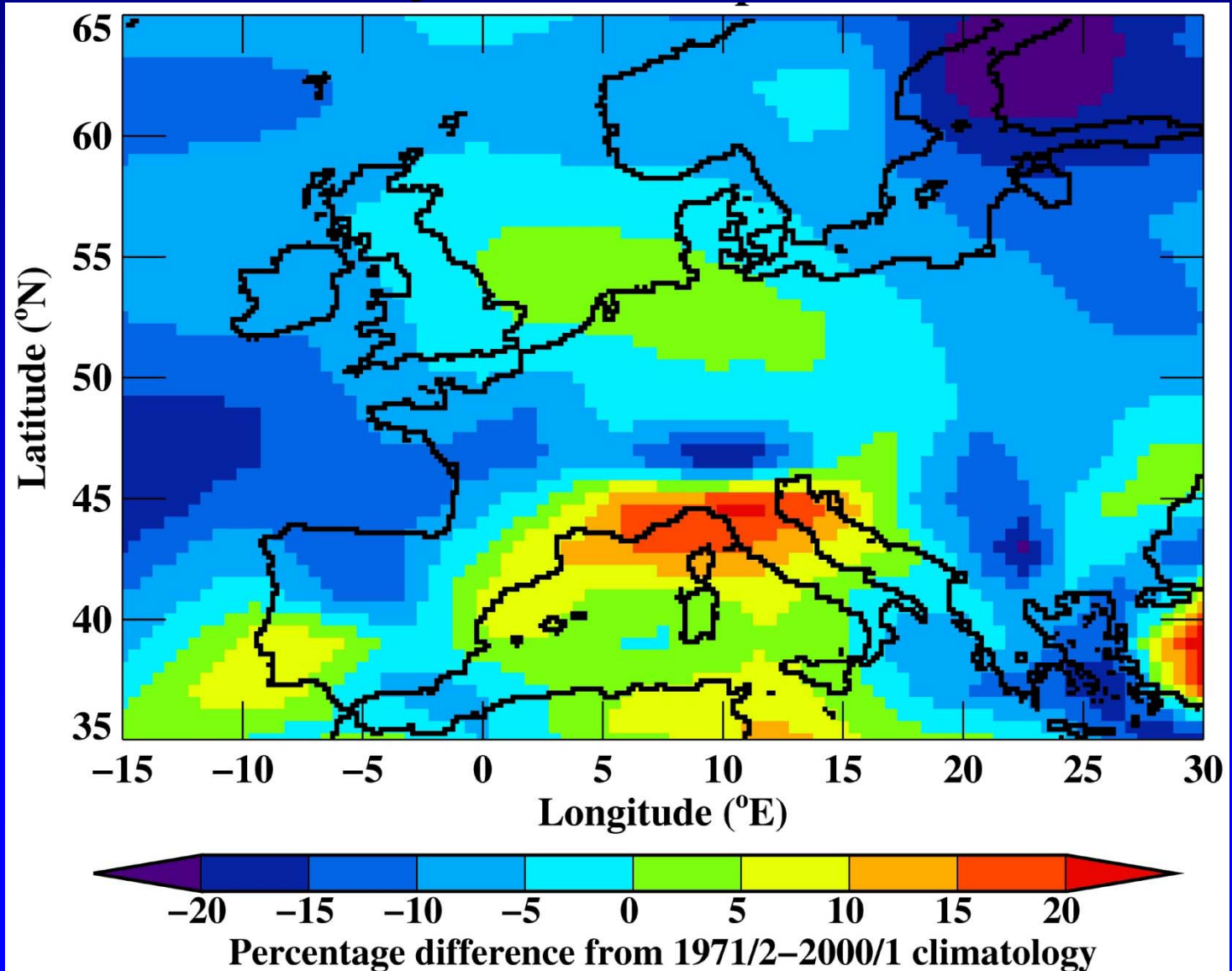
Loss Data Source: Pielke et al. (2007)

NW Pacific ACE index 1965-2006



European Winter Windspeed

Anomaly of 1995/6-2006/7 mean



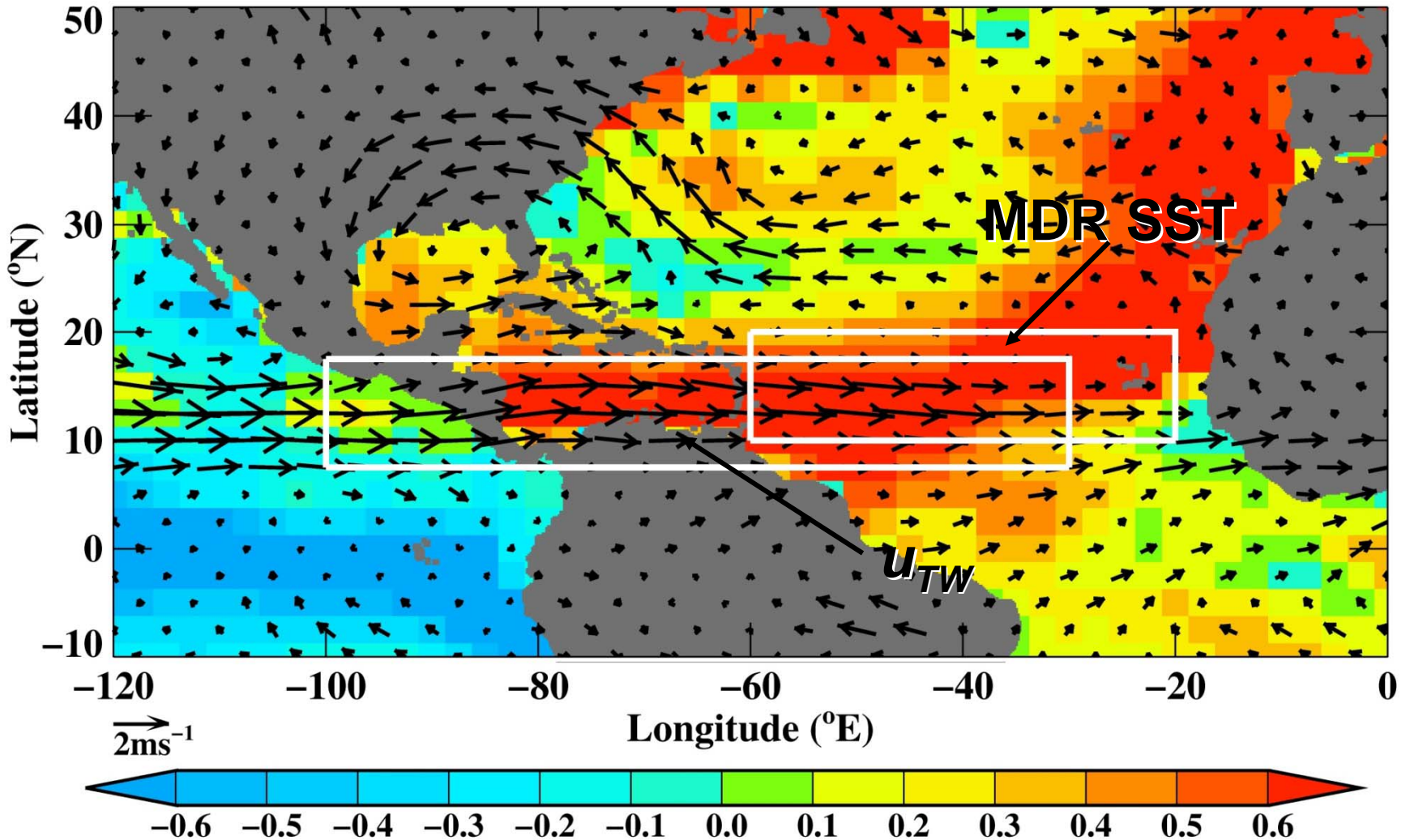
Summary

- **Hurricanes:** Sharp upswing in frequency and overall activity (basin and U.S. landfalling) .
- **NW Pacific typhoons:** Frequency and overall activity are fairly steady.
- **European windstorms:** Downswing in frequency of North Atlantic extra-tropical cyclones.
- **US tornadoes:** No long-term trends apparent.
- **Windstorm catastrophes worldwide:** NOT out of control.

3. Outlooks for Next 10 Years

Hurricane Activity: Key Fields

AS 925mb Wind and SST Anomalies: Active – Inactive Years





Factors Influencing Atlantic Hurricane 10-Year Outlook

Enhancing factors

1. Warm phase of AMO expected to last a further 10-20 years.
2. Global warming.

Suppressing factors

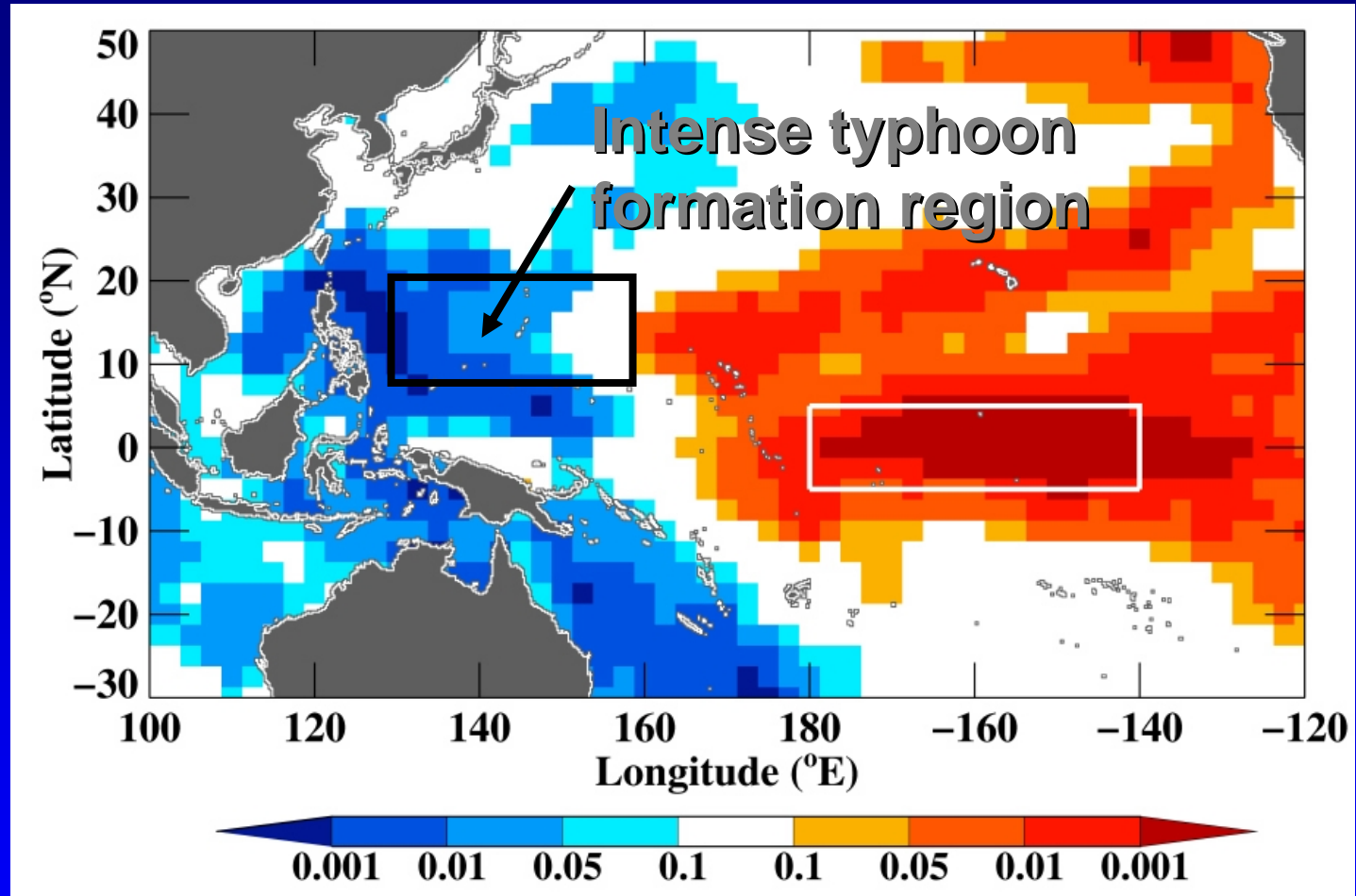
1. El Nino - expected in ~20% of years.
2. +ve North Atlantic Oscillation. (Unlikely).

Summary

Current enhanced hurricane activity to continue through to 2016.

ENSO Link to NW Pacific ACE index

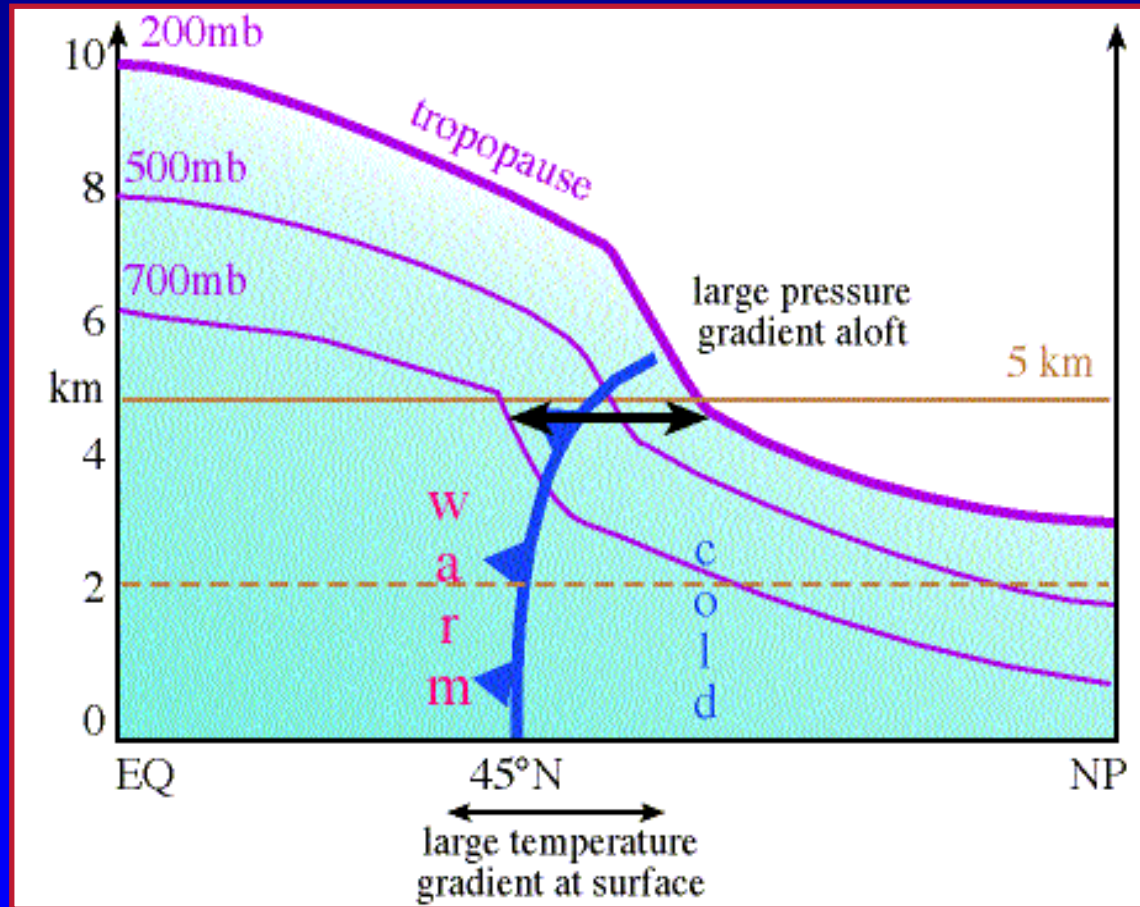
Significance of Aug-Sep SST link to NW Pacific ACE index 1965-2005.



Above average (below average) ENSO SSTs are associated with weaker (stronger) trade winds. These in turn lead to enhanced (reduced) cyclonic vorticity over the Northwest Pacific region where intense typhoons form.

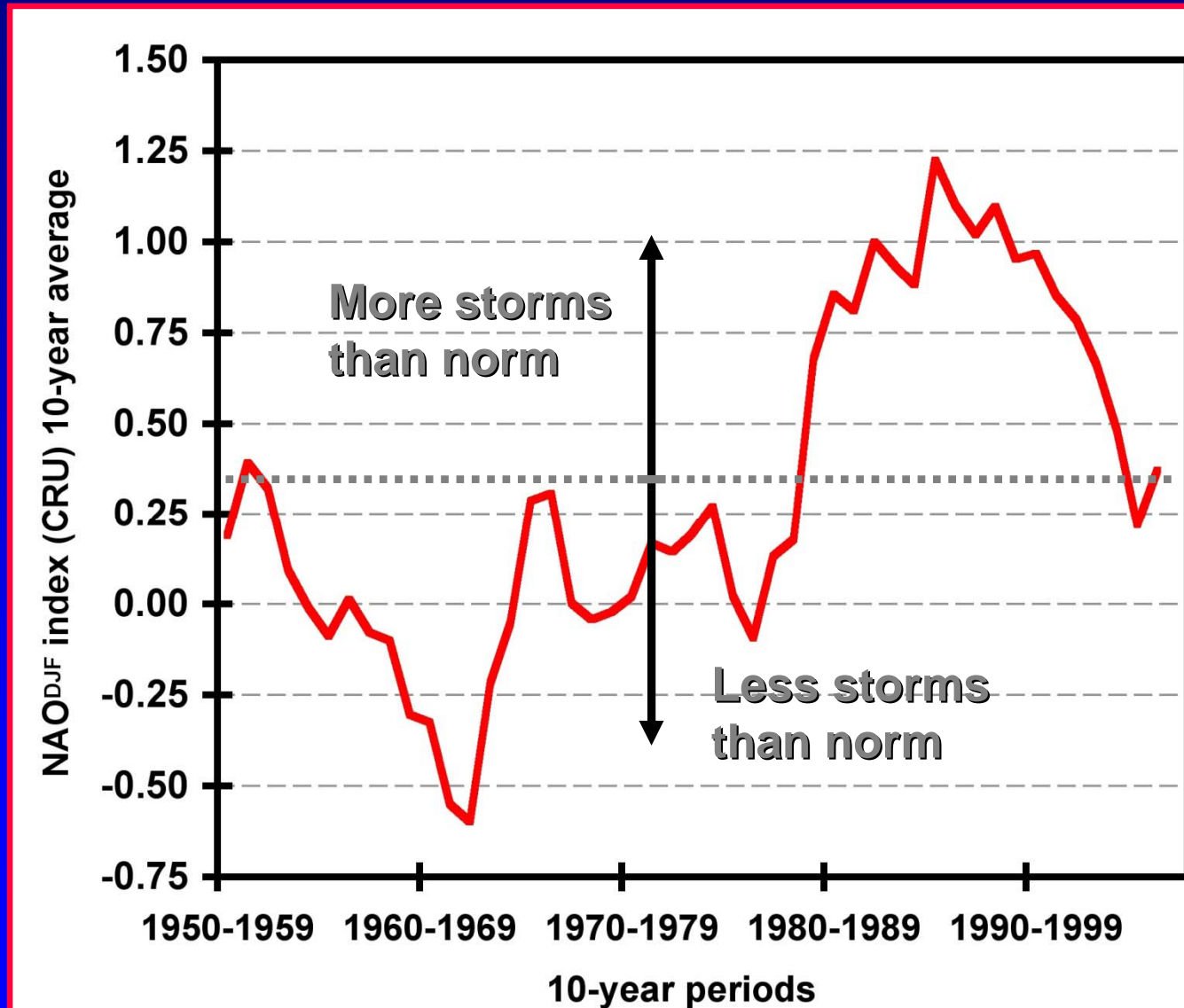
Extra-Tropical Cyclone Variability

- Extra-tropical cyclones **gain their energy** from latitudinal temperature contrasts between **cold**, polar air masses and **warm**, subtropical air masses.
- Since this temperature gradient is greatest in winter, the **frequency and intensity** of extra-tropical cyclones peaks in **winter**.



Winter NAO 1950/1-2005/6 (10yr running mean)

Interannual variability in North Atlantic extra-tropical cyclone occurrence is linked strongly to year-to-year variability in the **winter North Atlantic Oscillation (NAO)**.



Summary

10-Year Outlooks

| Windstorm Type | Description | Outlook (compared to long-term norm) | Likelihood of Exceeding | |
|---------------------|--|--|-------------------------|-------------------|
| | | | Long-Term Norm | 1997-2006 Norm |
| Atlantic Hurricanes | Current enhanced activity to continue | 50% above | 90% | 55% |
| U.S. Hurricanes | Current enhanced activity to continue | 40% above | 80% | 50% |
| NW Pacific Typhoons | Little change foreseen from long-term norm | 5% above | 55% | 55% |
| European Windstorms | Recent average/quiet activity to continue | 10% below | 40% | 40% |

2007 Outlook

- **Hurricanes:** Activity expected to be ~40% above 1950-2006 norm.
- **U.S. Hurricanes:** Activity expected to be ~20% above 1950-2006 norm.
- **NW Pacific typhoons:** Activity expected to be close to the 1965-2006 norm.
- **Winter NAO:** Expected to be slightly below-norm. European winter storminess expected to be 10-20% below-norm.