

# TROPICAL CYCLONES IN A WARMER WORLD

Dr Mark Saunders

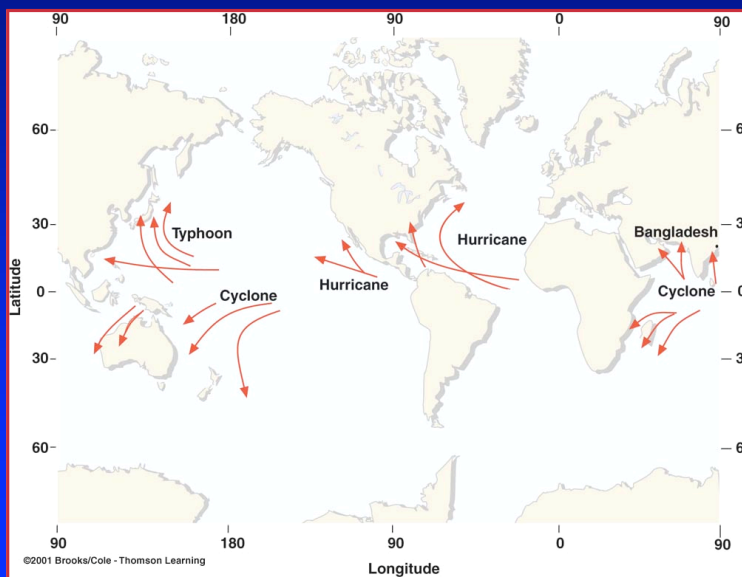
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Natural Hazards in a Warmer World  
Workshop for Under 35s Reinsurance Group  
14th October 2004



## Regional Occurrence



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## Relevance for (Re)Insurers



- U.S. and Caribbean. Rank as the region's **costliest natural disaster**.



- Asia. Rank as the **most costly and deadly natural disaster** affecting much of Japan, South Korea, Taiwan, the Philippines, and coastal areas in other SE Asian countries.



- Australia and SW Pacific. Rank as a significant cause of natural disaster loss.

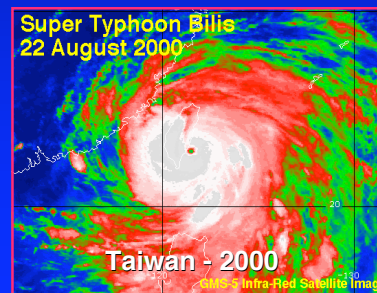
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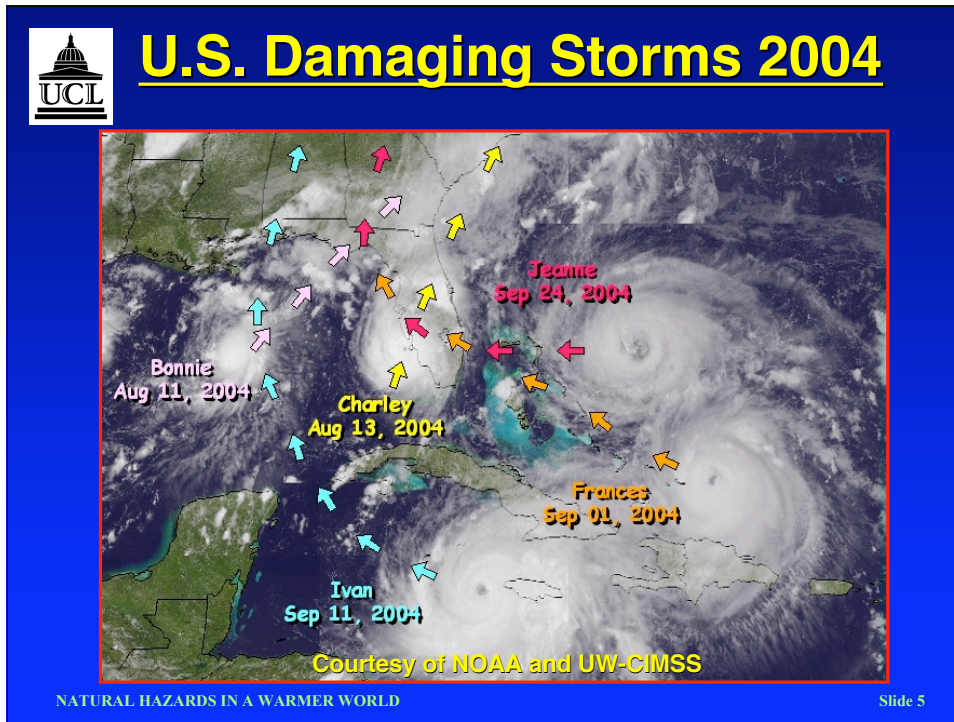
## Losses

- U.S. Hurricane annual damage bill 1950-2003 is estimated as US \$ 5.1 bn (economic), US \$ 2.6 (insured) at 2004 \$.
- Asia. Typhoon annual damage bill (1990-2001) is US \$3.5 bn (economic) at 2004 \$.



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**Where Does 2004 Rank?**

North Atlantic ACE (Accumulated Cyclone Energy) index:  
**3rd** highest (after 1950 and 1995) since 1950.

U.S. ACE index:  
**2nd** highest (after 1964) since 1950.

U.S. hurricane total insured loss:  
**2nd** highest (after 1992) since 1950.

Tropical storm strikes on Japan:  
**Equal 1st** for most (records since 1970).

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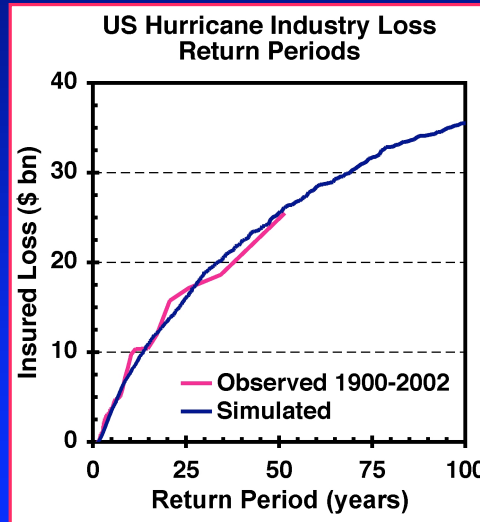


## Return Periods - 2004

**U.S. hurricane strikes  
(4 or more):  
17 years.**

**U.S. ACE index ( $7.5 \times 10^4$  kts<sup>2</sup>):  
40 years.**

**U.S. hurricane total  
insured loss (US \$  
22bn):  
37 years (see opposite).**



Hilti, Saunders and Lloyd-Hughes (2004)

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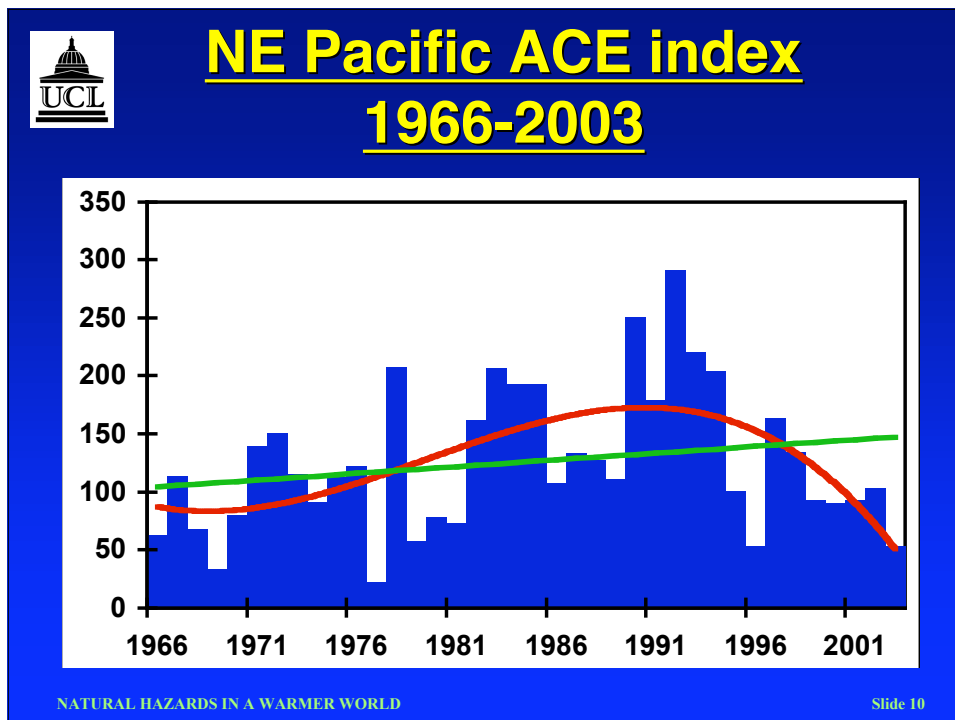
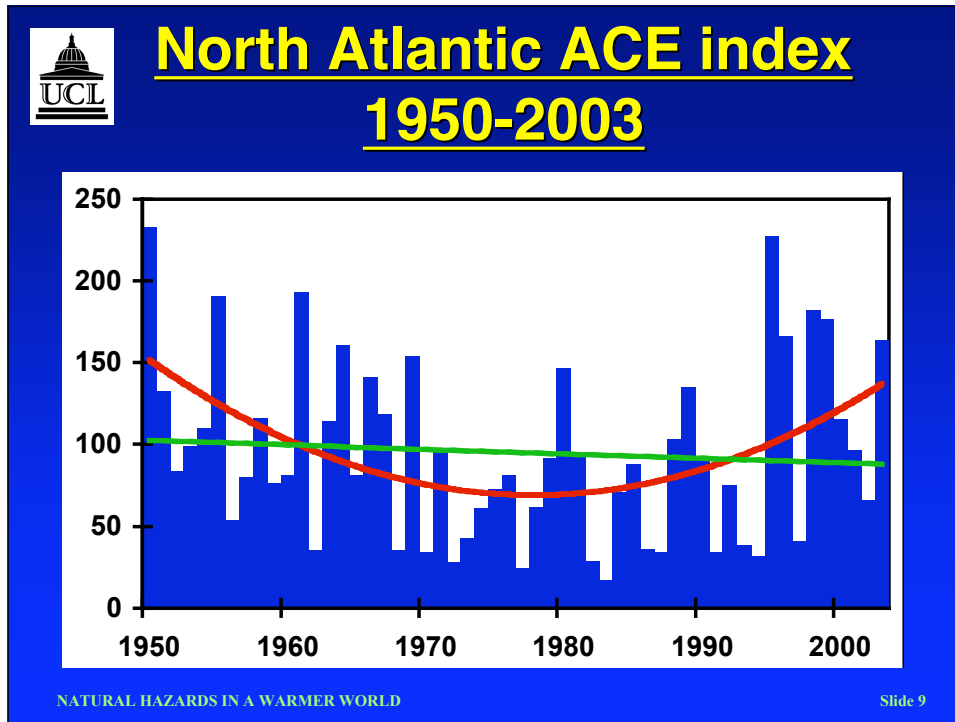
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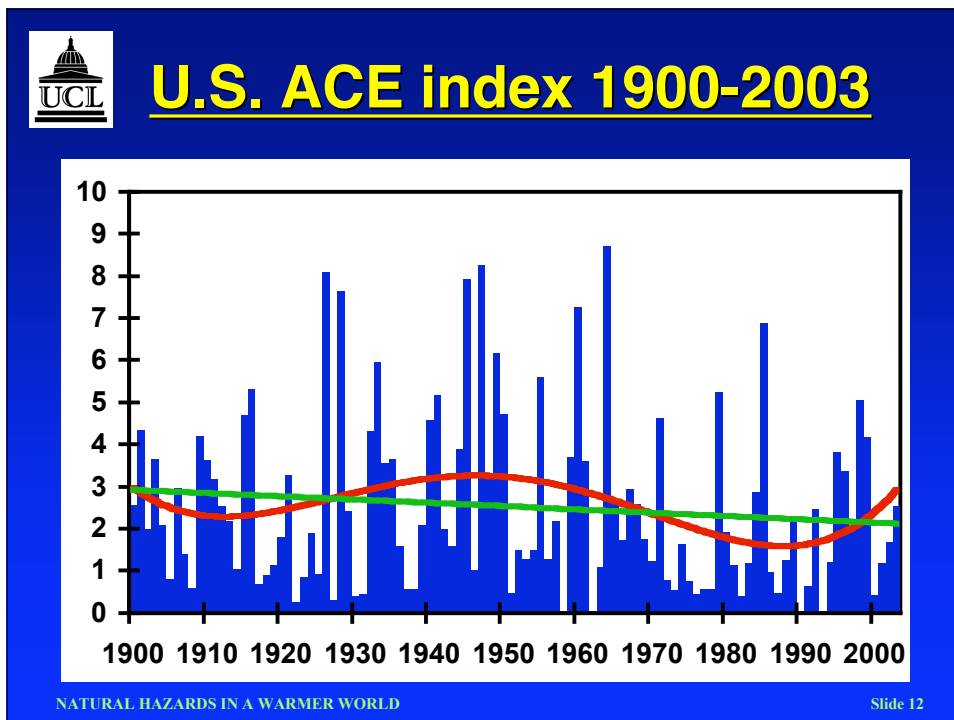
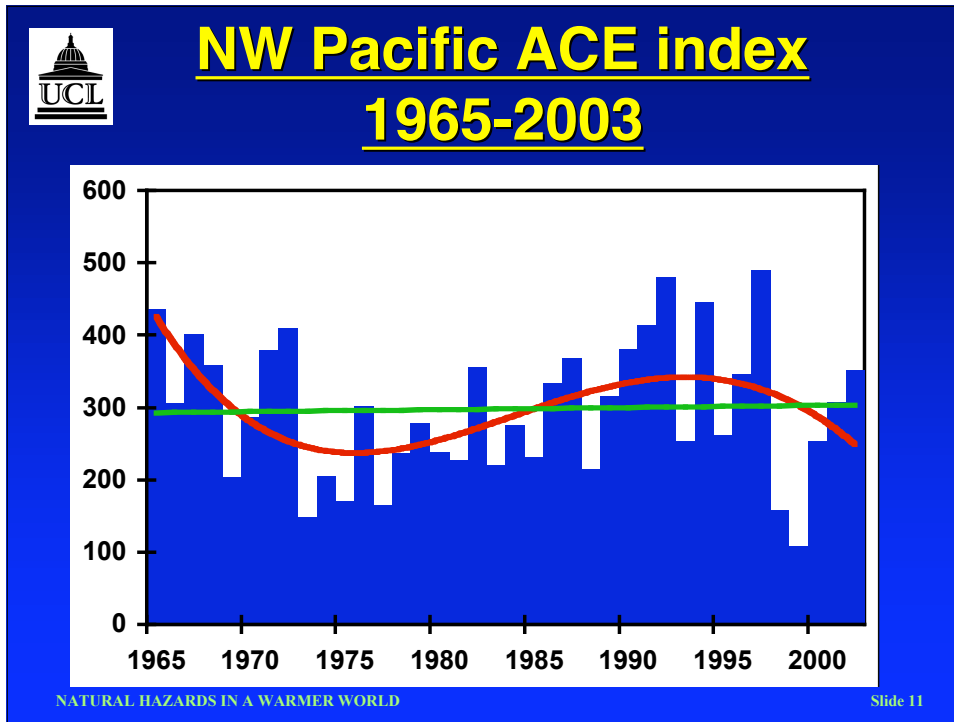


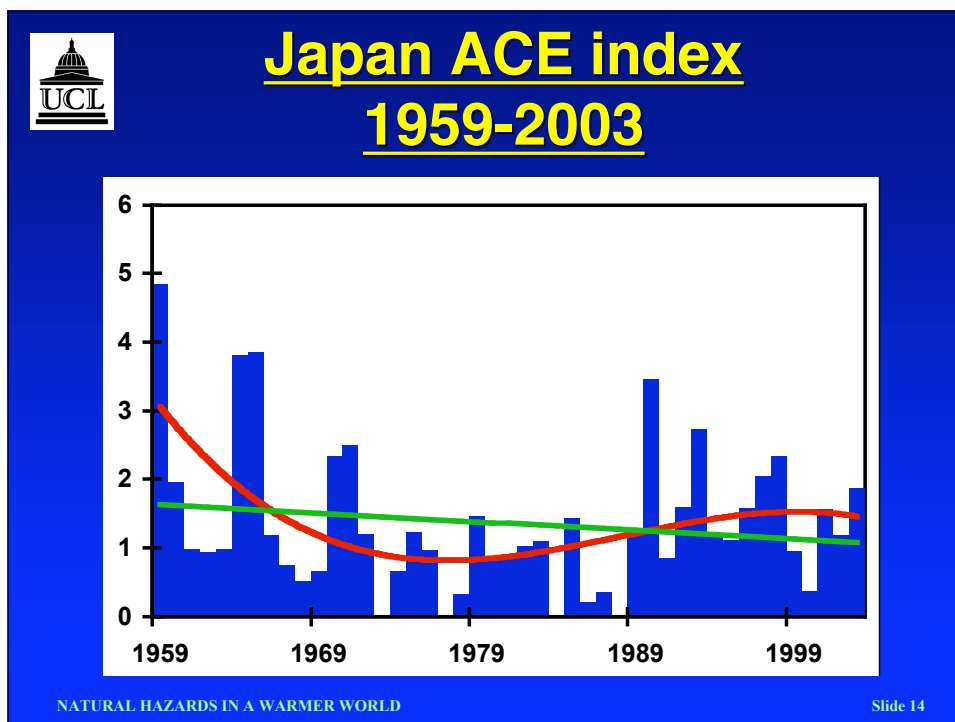
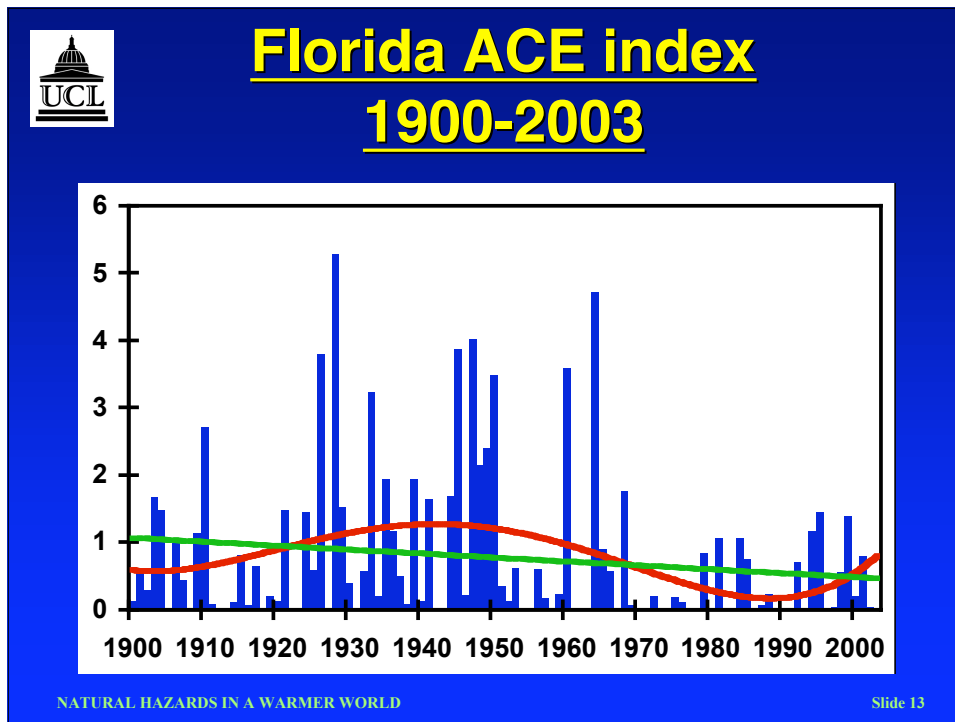
## How has Tropical Cyclone Activity Varied in the Past?

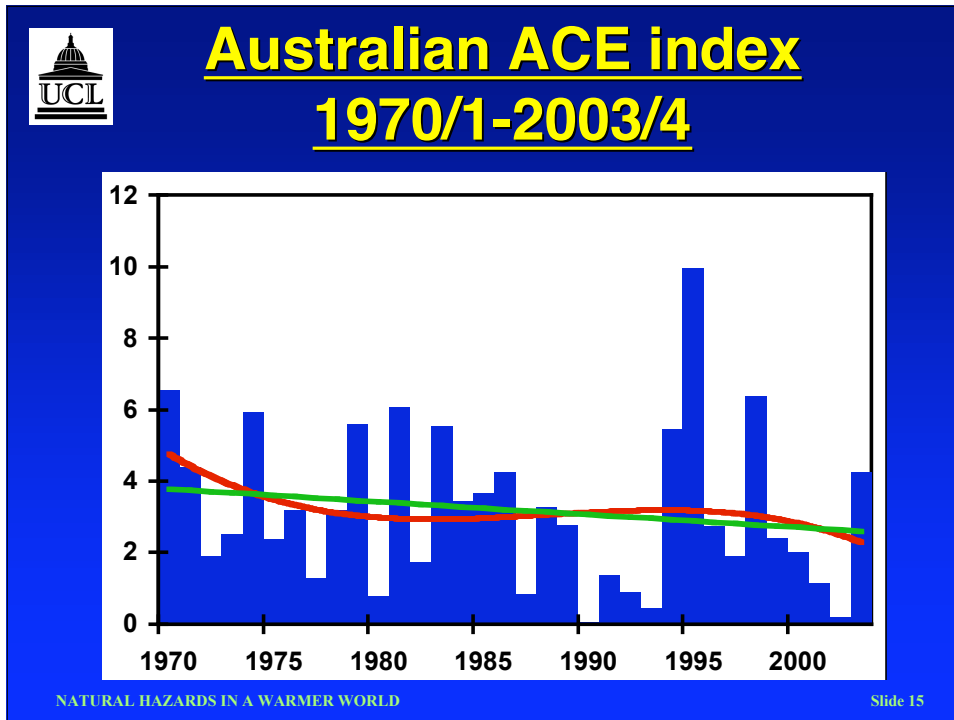
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- ## Significant Trend or Change in Variance?
- **No significant change in ACE index or ACE index variance is observed anywhere, either over the full period or, for the U.S., using the recent 1978-2003 period compared to prior 26-year periods.**
  - **The change in ACE index due to natural climate variability is everywhere an **order of magnitude greater** than that which may be attributable to trend in the historical record.**
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## Conclusions

1. Global warming has, at present, had **little or no increasing impact** on northern hemisphere tropical cyclone activity.
2. Observed changes in activity are due predominantly to **natural climate variability**.

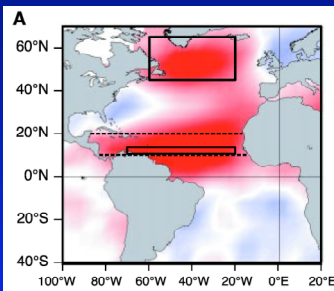
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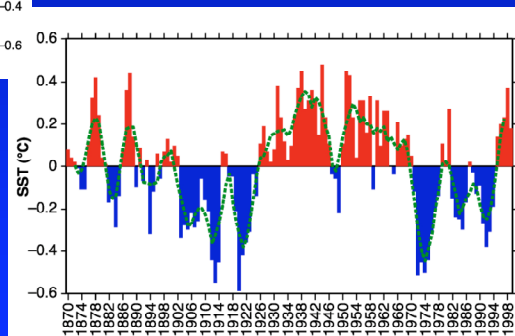
## Multi-Decadal Variability

(Goldenberg et al., Science, 2001)



Leading mode of Atlantic non-ENSO SST variability 1870-2000.

Temporal reconstruction of SST mode-related variability for hurricane main development region.



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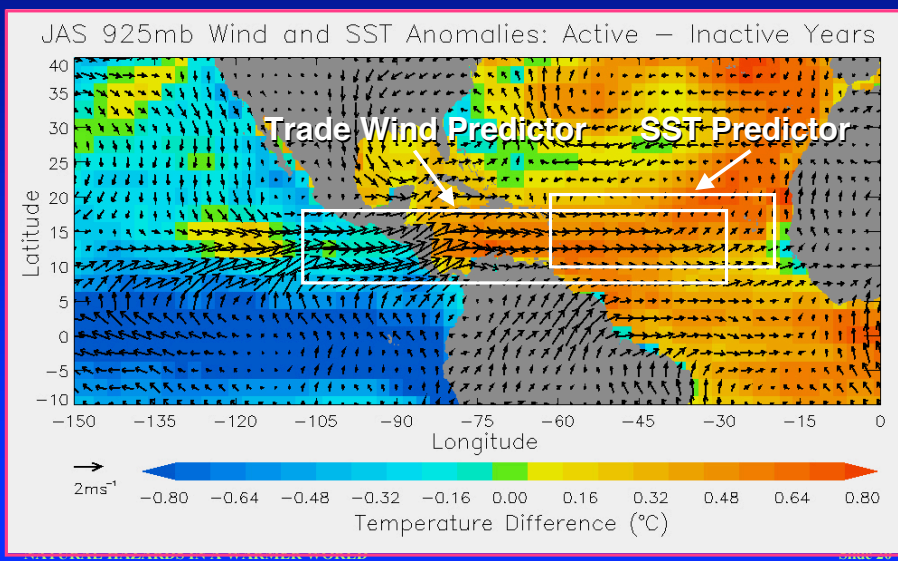
# What is our Current Understanding of How Tropical Cyclone Activity Will Vary in the Future?

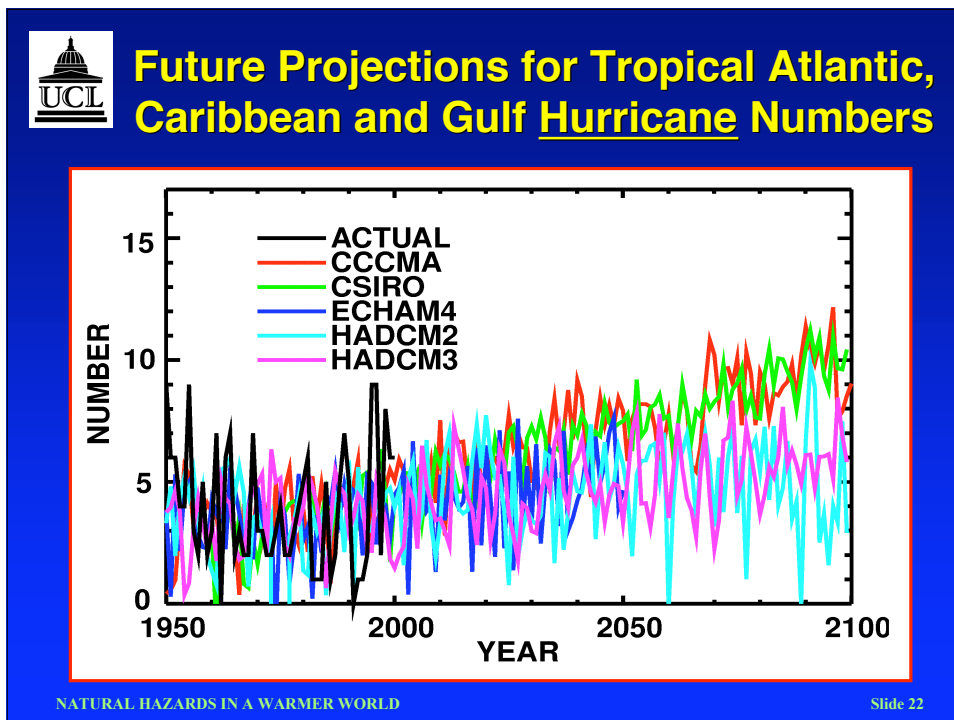
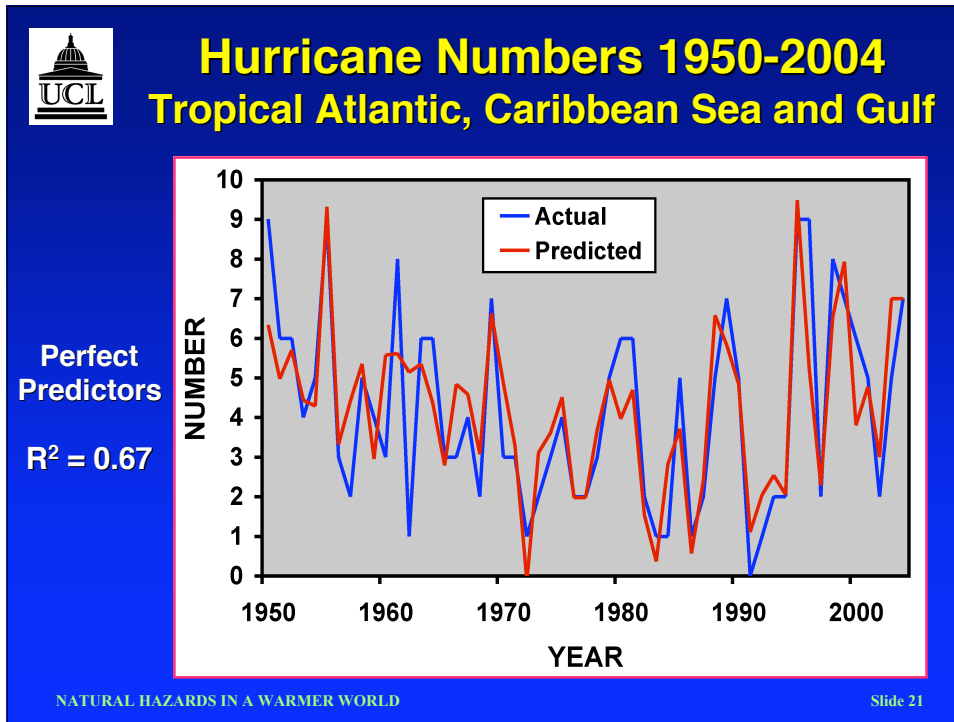
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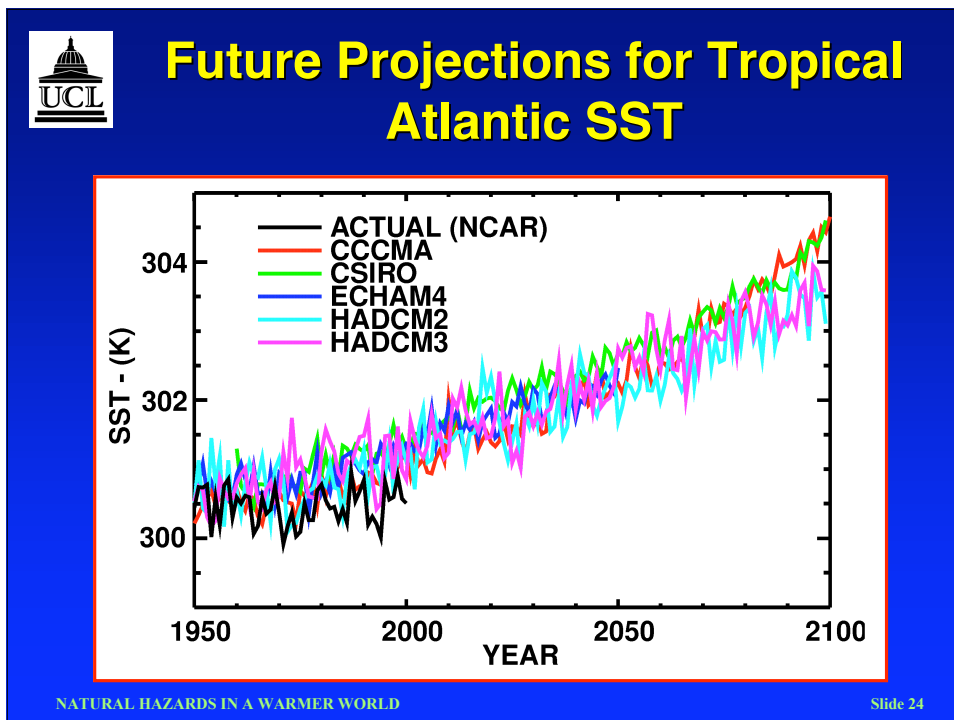
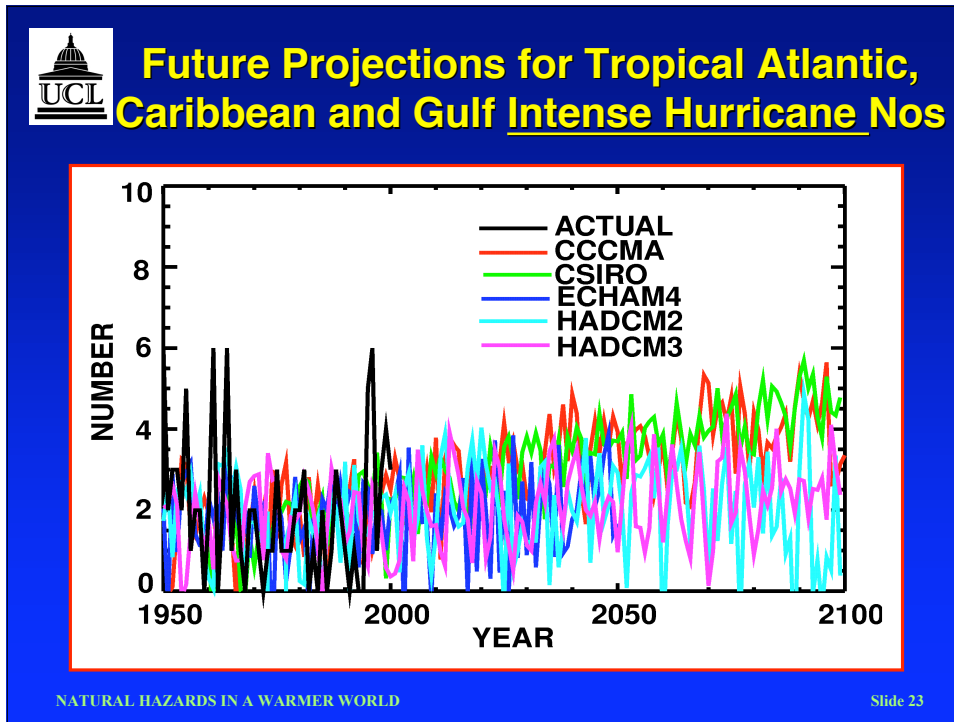
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## Atlantic Hurricane Predictors









## Hurricane Intensity

Knutson and Tuleya (2004) in a detailed GCM modeling study predict:

1. **6% increase in hurricane maximum intensity** with an 80% increase in CO<sub>2</sub>. This is line with theoretical estimates by Emanuel.
2. **18% increase in mean precipitation rate** within 100km of the storm centre.

*These changes may not be detectable for a few decades.*

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## Conclusions

1. The number of North Atlantic, U.S. and Caribbean hurricanes may **rise slowly** due to global warming.
2. However, the increase in the number of hurricanes and in hurricane maximum intensity over the next 100 years is **thought to be about 10%** and thus is small compared to the range of natural year-to-year variability.

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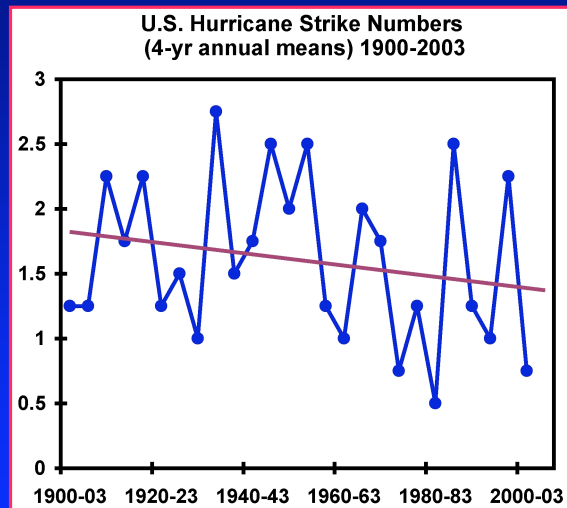
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## 2004 In Context

The historical record shows repeated quiet and active periods for U.S. hurricanes.

Since 1999, U.S. hurricane strikes have been running 50% below average and U.S. hurricane insured losses 80% below norm.



2004 has seen the recent hurricane 'dry spell' corrected.

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## Future Risk to (Re)Insurers?

Although uncertainties remain, the vast majority of future hurricane losses in the U.S. and Caribbean are thought to continue to result from natural interannual and decadal climate variability and not from global warming.

Since traditional insurance policies are set for the year ahead (or at most out to five years) the impact of global warming on risk over this timescale will be small or negligible.

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