SEASONAL FORCASTING OF TROPICAL CYCLONES

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Presentation Overview

1. Overview
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   - *Research Objectives*
2. Relevance to the Insurance Industry
3. Project Status
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4. Academia/Insurance Industry Collaboration

Who We Are

- **Benfield Greig Hazard Research Centre**
  - *Launched in 1997.*
  - *First Multidisciplinary Hazard Research Centre in Europe.*
  - *Over 30 Staff with Expertise in All Major Perils.*
  - *Sponsored by Benfield Greig but Independent.*

University Department

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Research Objectives

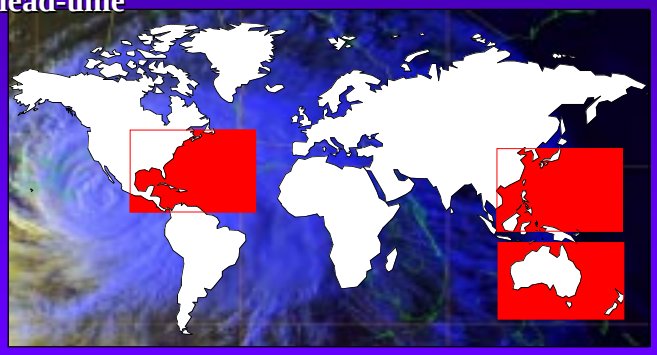
- To offer the (re)insurance industry competitive advantage by skillfully forecasting at long-range (out to 12 months) the extreme weather events causing greatest loss
  - *Work funded by the Benfield Greig Group, the TSUNAMI Initiative, St Paul Re., and Risk Management Solutions.*

Seasonal Prediction of Tropical Cyclones

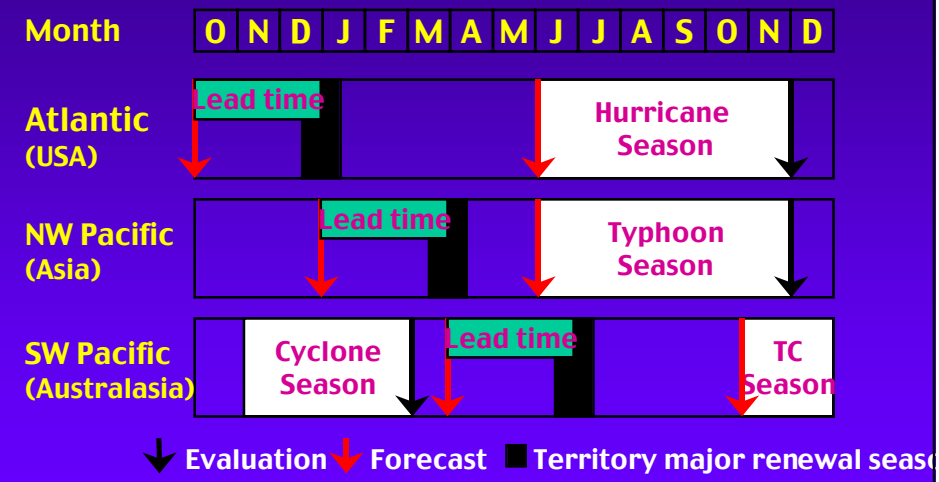
… increasing your assessment of risk

Project Definition

- Establish a methodology, with increased skill level, for the seasonal forecasting of:
  - landfalling tropical cyclones
  - at a useful lead-time
- Territories
  - Atlantic
  - NW Pacific
  - SW Pacific



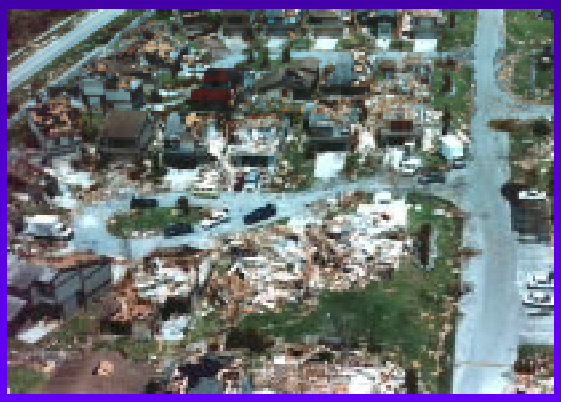
Deliverables



2. Industry Relevance

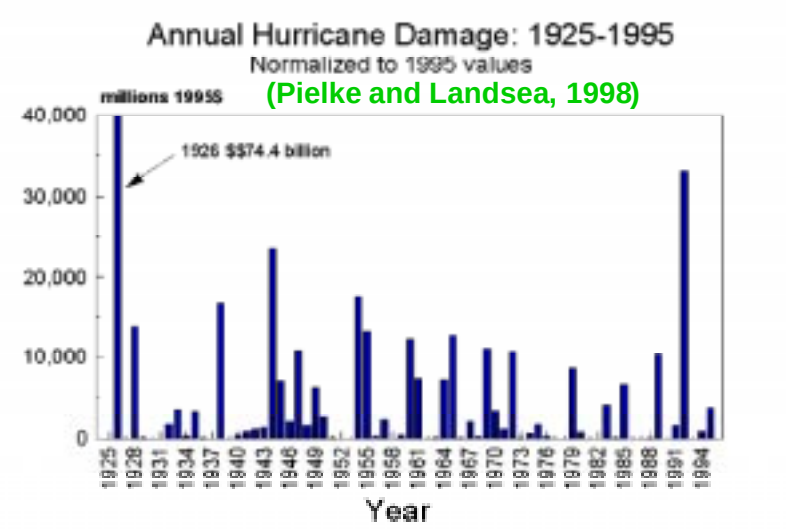
US Hurricanes

Hurricanes are the United States' costliest Natural Disaster. (Damage bill: £3.1 billion per year since 1925).



Hurricane Andrew Destruction: August 1992

Industry Relevance - Variability

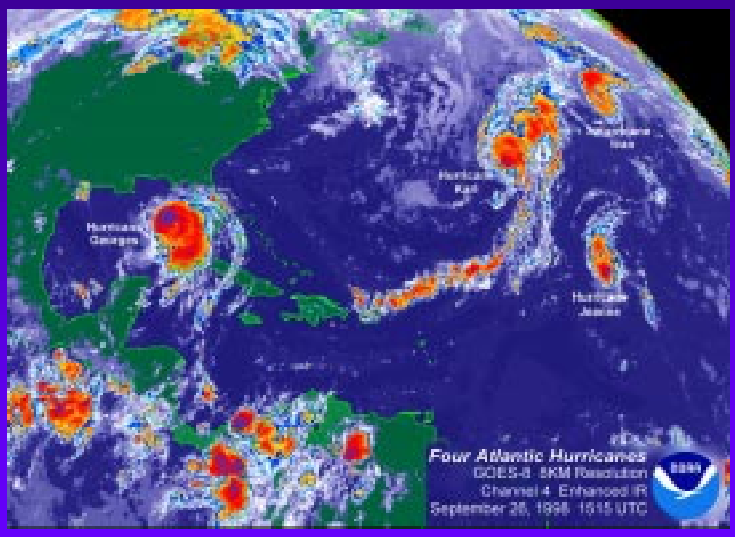


Industry Relevance -Variability

Atlantic Hurricane Losses 1998 (Munich Re, 1999)		
Tropical Cyclone	*Economic Loss ($million)*	*Insurance Loss ($million)*
Hurricane Bonnie	1,500	360
Tropical Storm **Charlie**	50	?
Hurricane Earl	80	50
Tropical Storm **Frances**	500	?
Hurricane Georges	10,000	3,000
Tropical Storm **Hermine**	20	?
Hurricane Mitch	5,000	150

Industry Relevance -Variability

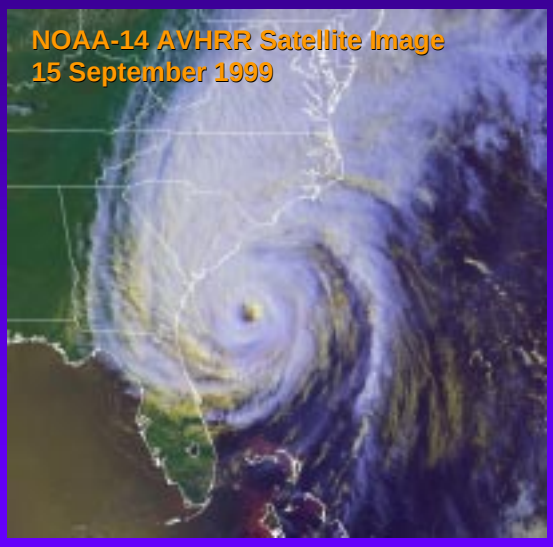
1995-1998 saw the highest 4-year total number of Atlantic hurricanes (33) on record.



Hurricane Floyd

- Largest peace-time evacuation in US history
- Winds of 150mph
- Rainfall of 30-50cm
- 4 times the size of Andrew

Could have been much worse!



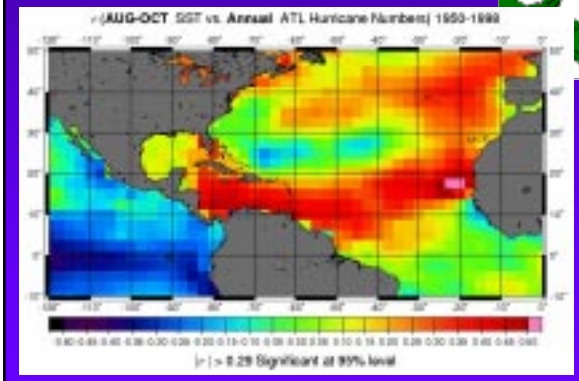
Intrinsic Predictability

As Measured by Proportion of Variance Explained
Based on 1951-1998 Data

Theoretical Predictability (%)			
Region	Tropical Cyclones	Hurricanes	Intense Hurricanes
Main Development Region	43 ± 13	50 ± 13	32 ± 18
Caribbean	13 ± 21	-11 ± 27	8 ± 26
Gulf of Mexico	-6 ± 24	-11 ± 29	10 ± 38

Project Methodology

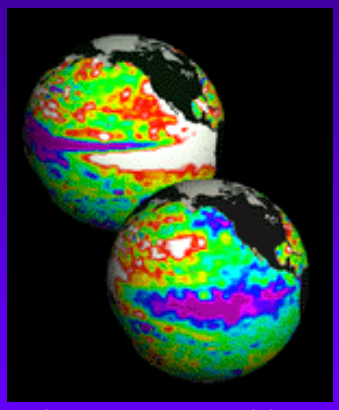
- Statistical methods are used to identify predictors in 4 regions



- Dynamical and statistical models are used to forecast the predictor values.

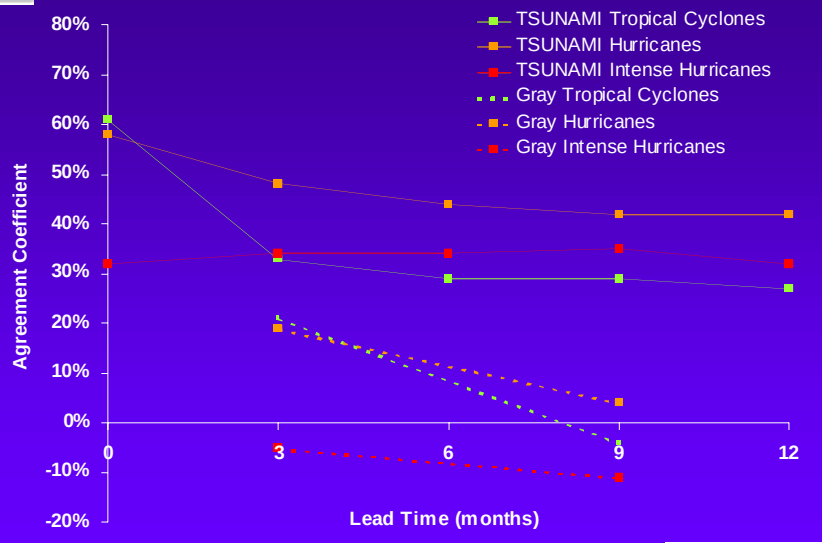
Progress

- Implemented
  - Generalised Linear Poisson Model
  - (Gray uses ordinary least squares)
- Examined
  - All long-range predictors
  - Atlantic SST and ENSO
  - 1951-1998 Data
- Hindcast Testing
  - Calculated 'Skill' 1984-1998
  - Comparison with Gray



(Courtesy, Jet Propulsion Laboratory)

Hindcasting Skill



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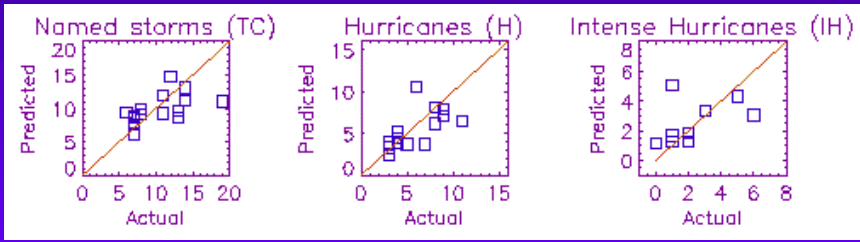
TSUNAMI Forecast
Skill (1984-1998, exc. IH)

9 month lead, cf Gray's DEC Forecast



Prop. Var.	0.30	0.33	0.04
Ag. Coeff.	0.29	0.42	0.35

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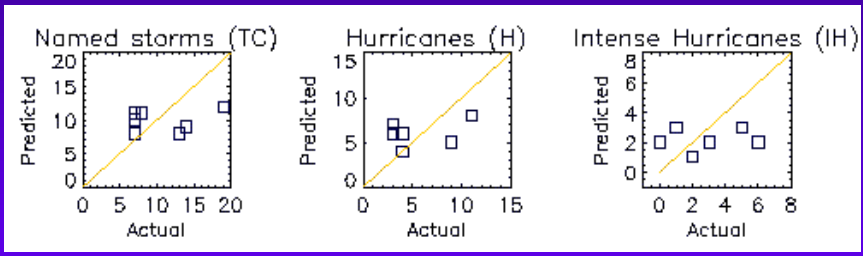
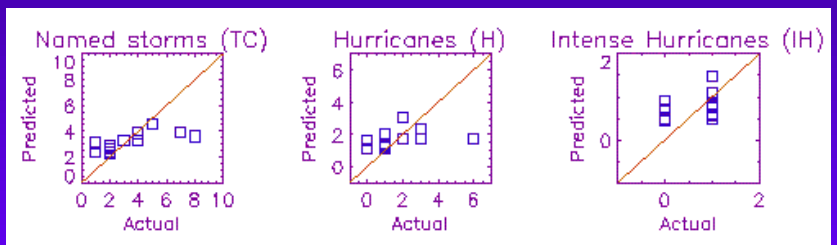
Gray's December Forecast
Skill (1993-1998)



Prop. Var.	0.03	-0.01	-0.13
Ag. Coeff.	-0.04	0.04	-0.11

TSUNAMI Forecast
US Landfalling Skill (1984-1998)

0 month lead, perfect predictors



Prop. Var.	0.37	0.16	0.19
Ag. Coeff.	0.32	0.21	0.16

1999 Season Update

Individual Storm Summary

Winds in knots, pressure in millibars, category based on Saffir-Simpson scale.

No	Name	Dates	Wind	Pres	Cat	Landfall
1	Tropical Storm ARLENE	11-18 JUN	50	1000	-	
2	Hurricane BRET	18-23 AUG	120	945	4	3
3	Hurricane CINDY	19-31 AUG	120	944	4	
4	Hurricane DENNIS	24 AUG-05 SEP	90		2	TS
5	Tropical Storm EMILY	24-28 AUG	55	1004	-	
6	Hurricane FLOYD	07-17 SEP	135	921	4	2
7	Hurricane GERT	11-20 SEP	130	930	4	Active
8	Tropical Storm HARVEY	19-20 SEP	40	1002	-	Active

Atlantic Total Numbers

		IH	H	TC
Average	1951–1998	2.4	5.8	9.8
Actual	1998	3	10	14
Gray June Forecast	1999	4	9	14
TSUNAMI June Forecast	1999	2 (±1)	7 (±3)	12 (±3)

- Numbers of events forming between Africa and the Caribbean will be below average.
- Numbers forming in the Caribbean, Gulf of Mexico and extra-tropical North Atlantic will be above average.

US Landfalling Activity

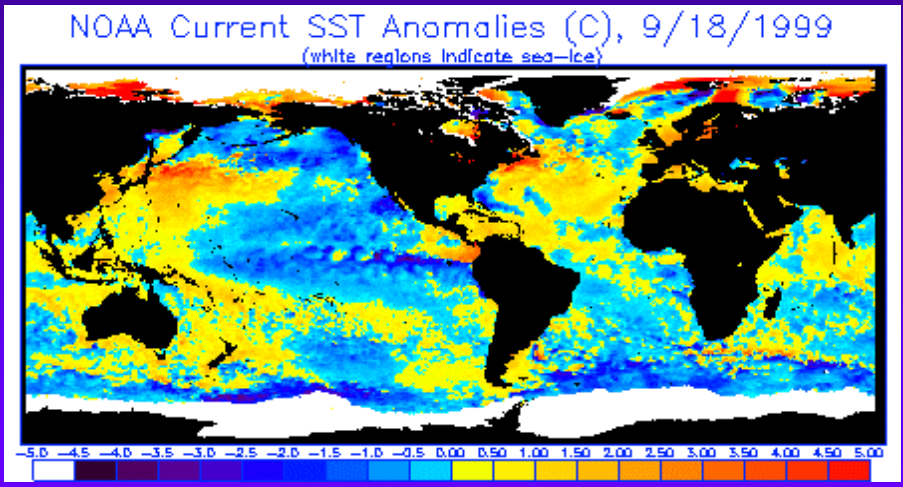
		IH	H	TC
Average	1951–1998	0.6	1.5	3.1
Actual	1998	0	3	7
Dec. Forecast	1999	1 (±1)	2 (±1)	4 (±2)
June Forecast	1999	1 (±1)	2 (±1)	4 (±2)

Chance of at least 1 intense Hurricane strike:
19±7% for the U.S. East Coast (average is 20%)
39±5% for the U.S. Gulf Coast (average is 33%)

- Forecast USA Hurricane Loss: $8.3Bn (60% increase in average loss).

Factors Influencing Forecast

1. Moderate La Nina (ENSO Cold Phase) 2. Warm North Atlantic Sea Temperatures



The Future

Priority for Improving Forecast Model

Better Prediction of Atlantic Sea Surface Temperature (and ENSO).

Forthcoming Forecasts

1st October 1999: TSUNAMI Long-Range Forecast for 2000 Atlantic Season.

1st January 2000: TSUNAMI Long-Range Forecast for 2000 NW Pacific Typhoon Season.

4. Academia/Insurance Industry Collaboration

- Enormous scope for strategic meteorological research relevant to (re)insurance.
- Many academics are unaware that they are working on problems beneficial to industry!

Benefits: Competition for funding less 'political' than in academia.
Knowledge that one is doing 'useful' research!

Disadvantages: Funding usually for 1-2 years (max).
Strict deadlines to be met!