
CIMSS
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Atlantic Hurricane Impacts: Some Ideas and Recommendations
Greg Holland
TROPICAL DEPR
TROPICAL STORM
CATEGORY 1
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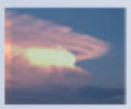
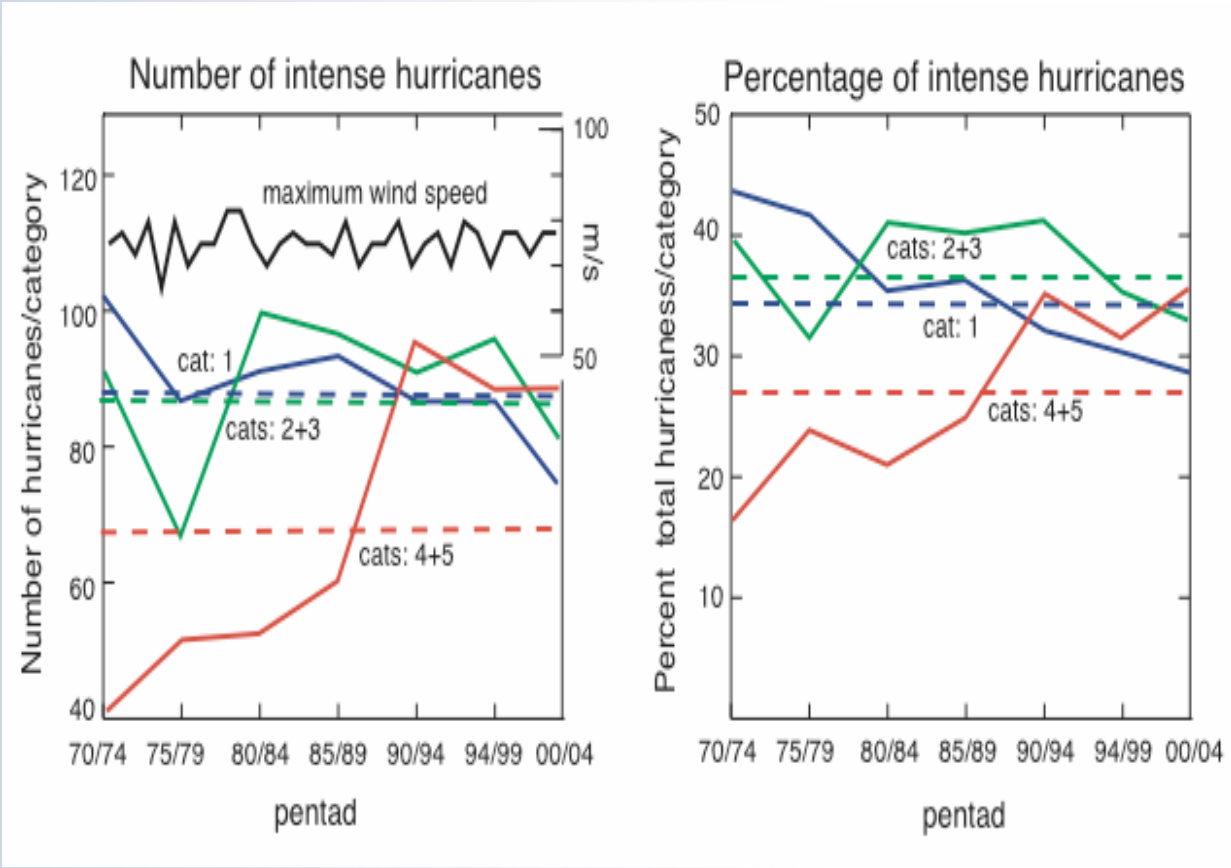
NOAA
1 MONTAGE OF CHARLEY GOES-12/INFRARED UW-CIMSS McIDAS

# Summary

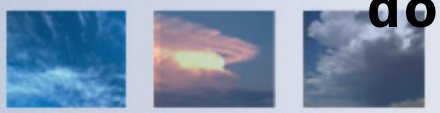
- **The growing threat to coastal and inland communities;**
- **Next generation forecasting**
  - ***Improved Forecast Systems***
  - ***Predicting Impacts***
- **Recommendations**


# Global Change in Hurricane Intensity




**Between 1970-1985 and 1985-2005, the number and proportion of category 4 and 5 storms has doubled, and they are living longer**



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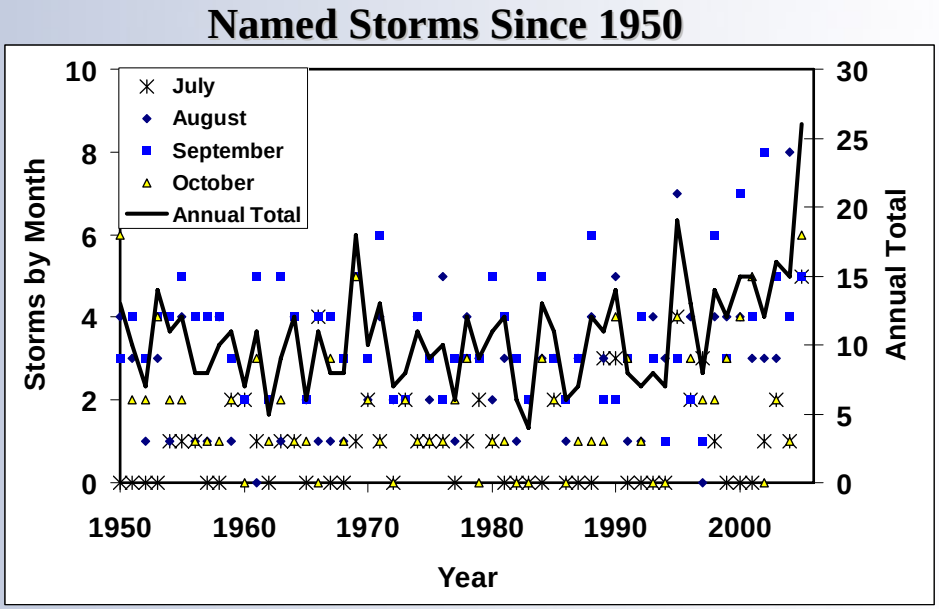
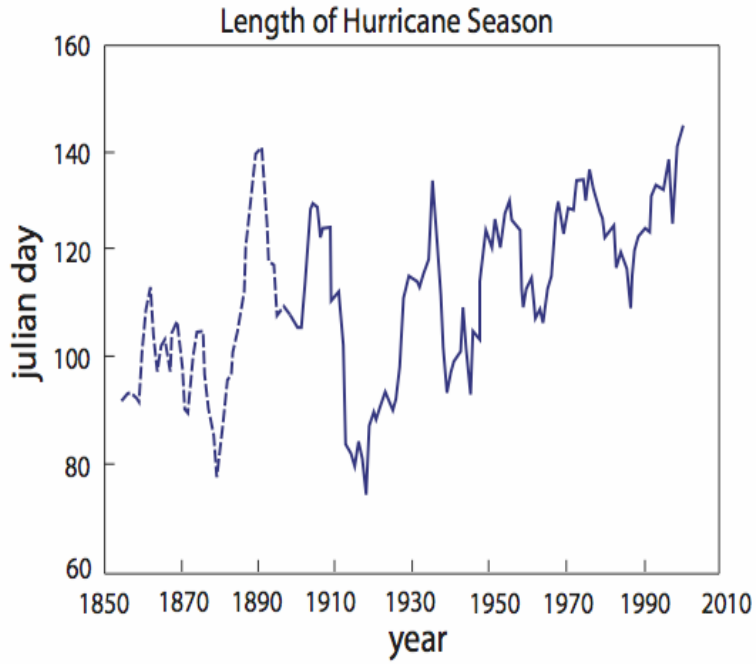
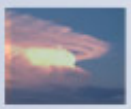
# The Record Breaking 1995-2005 Period




2005 broke every record: 28% more storms than ever before, the largest number of intense hurricanes, the most intense hurricane on record, unprecedented damage, and part of an unprecedented decade of hurricane activity and impacts.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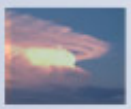
# Is There a Trend?
# Global Warming?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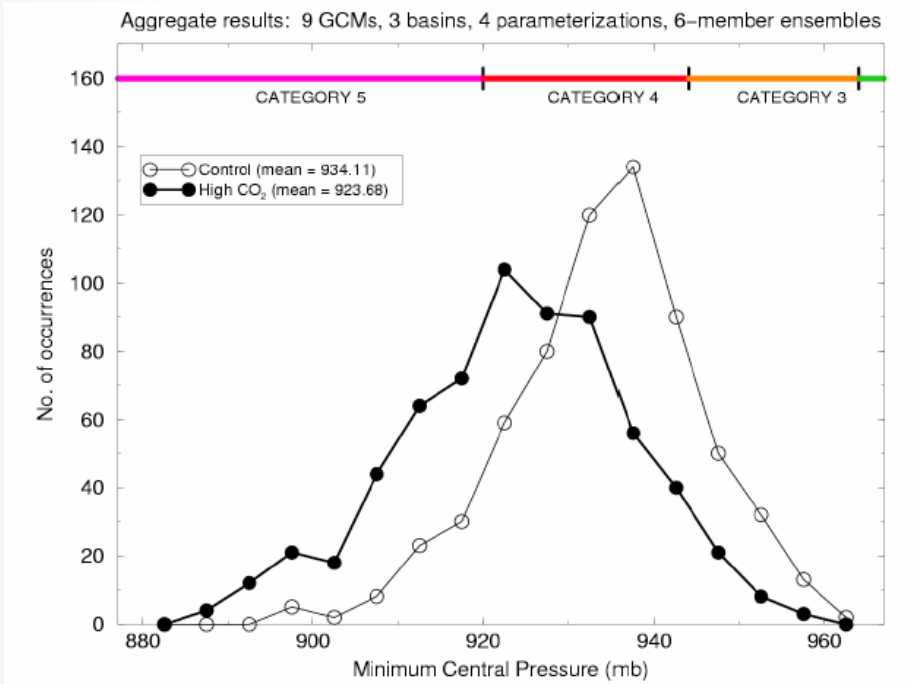
# Climate Signal is Too Small?

- **Expect ~10% increase in hurricane intensity from 2K global warming (Henderson-Sellers etal, 1998, Knutson and Tuleya, 2005)**
- **Therefore any change to date is in the noise level.**




Knutson and Tuleya (2005)

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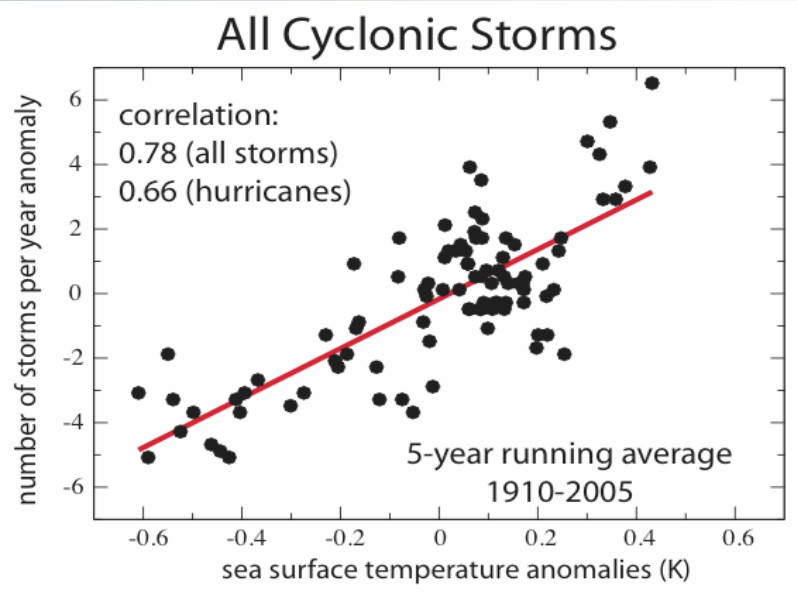
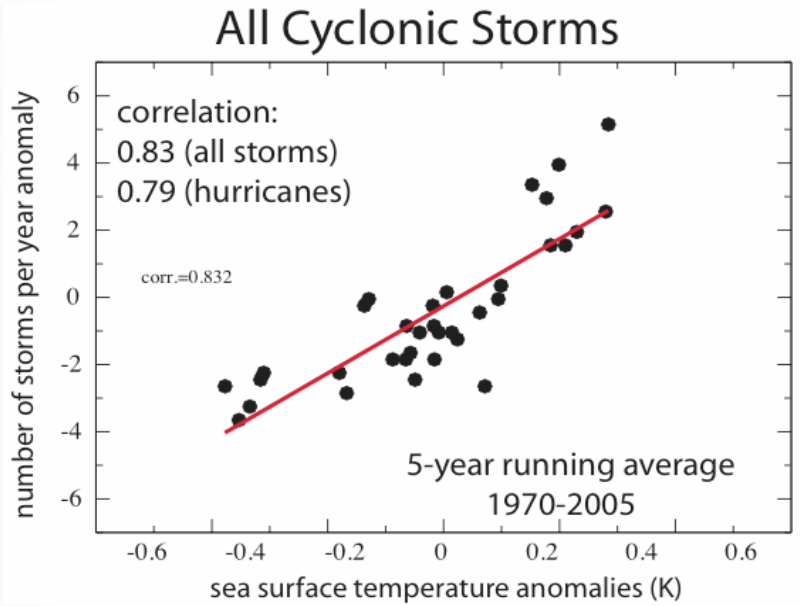
# Hurricane Frequency and SST

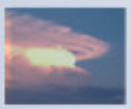
**1910-2005**




**1970-2005**




Note that the relationship is not direct, but arises from the atmospheric response to the SST changes (Shapiro and Goldenberg, 1998)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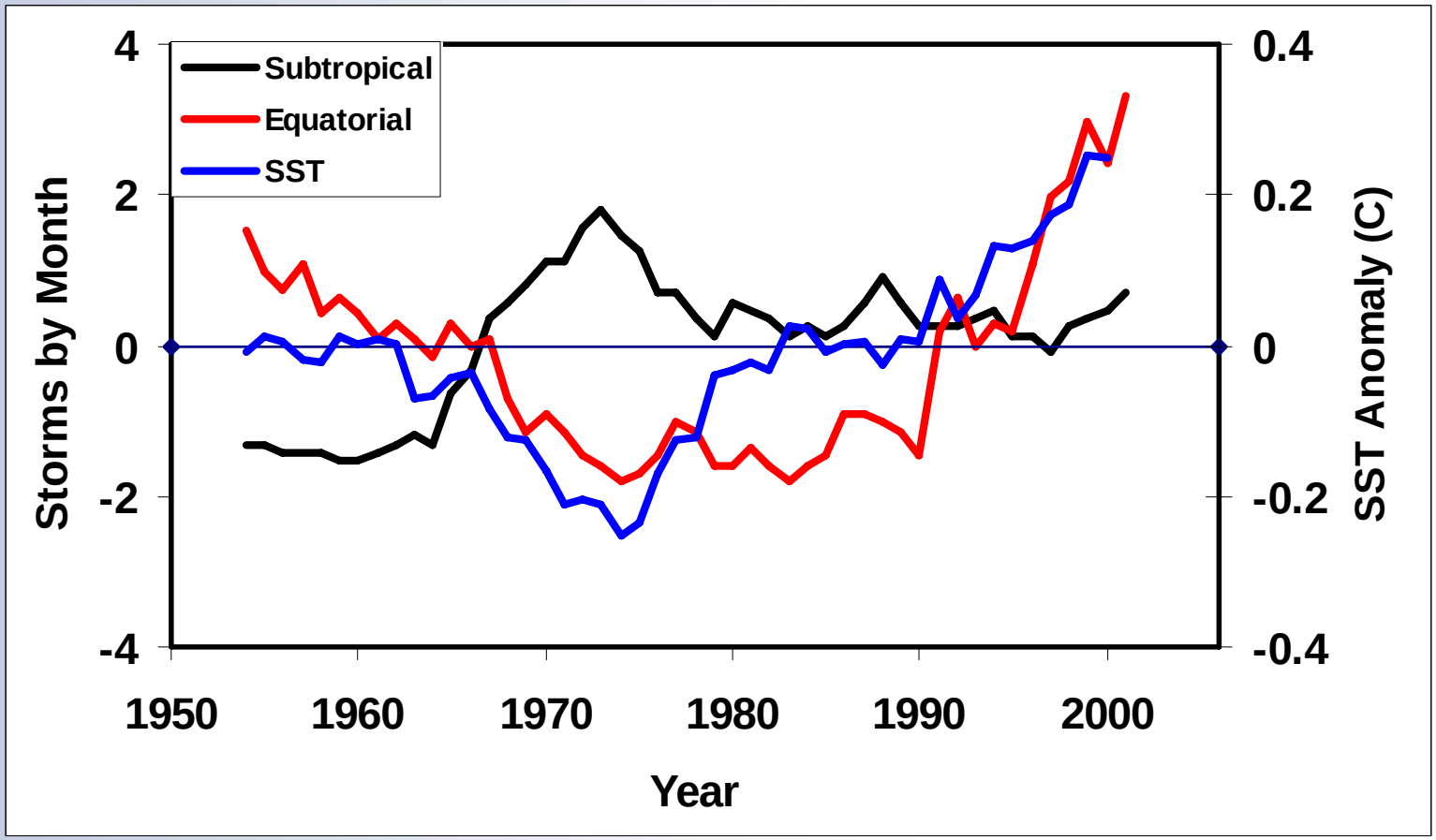
# Breakdown into Subtropical and Equatorial Development




Subtropical >25N, Equatorial <25N, Only July-October
With 9-y running mean

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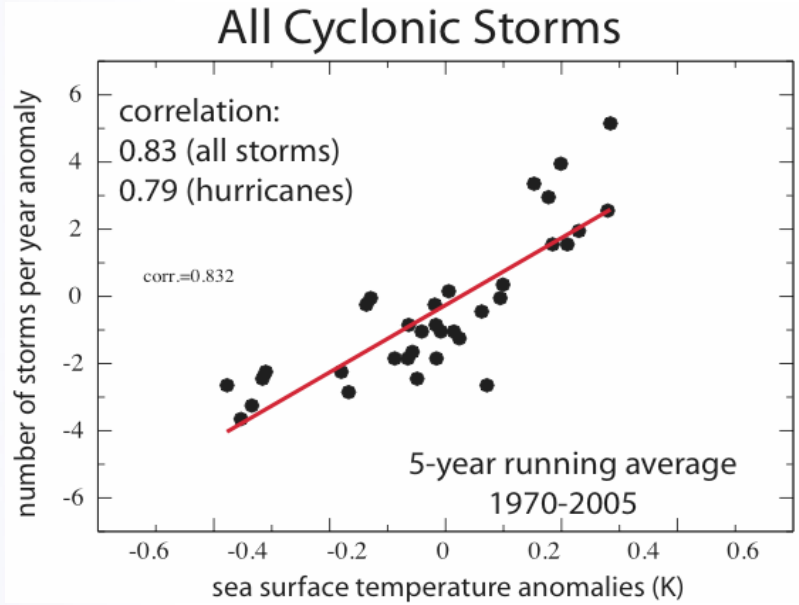
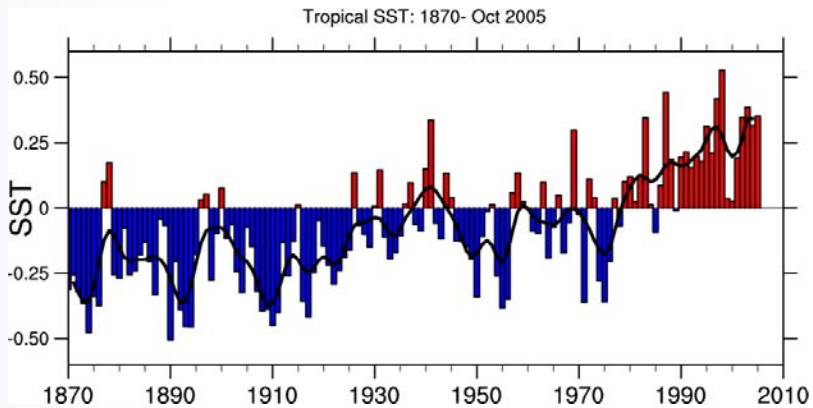
# Conclusions: Trend or Variability?

- **Atlantic cyclone occurrence and intensity is strongly related to SST**
- **The recent increases in SST cannot be attributed entirely to natural variability**
- **The increases in hurricane frequency and intensity may be directly attributed to an increase of wave genesis resulting from this SST increase**

**You can make your own conclusions**

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# Next Generation Prediction Approaches:

# The NCAR Advanced Research WRF; Predicting Impacts.

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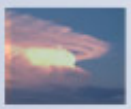
# The NCAR Advanced Research WRF Community Model

| | 1/9/06 Registered Users | June 2005 Workshop Participants |
|---|---|---|
| **Principal Partners** | | |
| NCAR | 108 | 38 |
| NCEP | 22 | 4 |
| FSL | 26 | 10 |
| AFWA | 19 | 4 |
| Navy | 17 | 4 |
| U.S. Universities | 702 | 59 |
| U.S. Government Labs | 274 | 25 |
| Private Sector | 378 | 22 |
| Foreign | 1947 | 53 |
| | --- | --- |
| Total | 3510 | 219 |
| | | |
| Institutions represented | | 117 |
| Foreign countries | 72 | 18 |

**Operational Use:**

**US Air Force, Korea, Taiwan, Beijing, China, India, Antarctic, NCAR.**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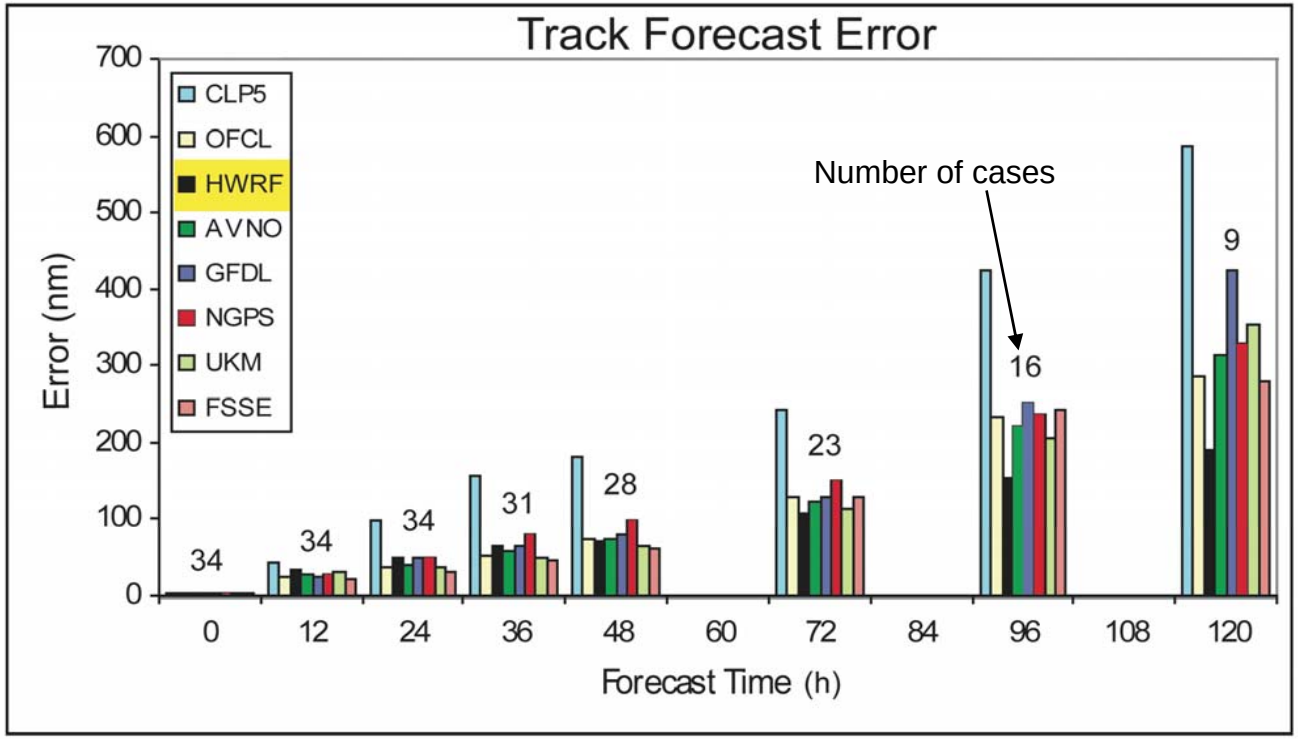
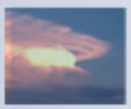
# 2005 Season Track Forecasts

Same-Forecast Statistics for Comparison with 12 km WRF-ARW




- **CLPR is a climatology and persistence forecast**
- **OFCL is the official forecast**
- **HWRF is the 12 km WRF-ARW model**
- **AVNO is the global NCEP Aviation Model**
- **GFDL is the 9 km GFDL hurricane model**
- **NGPS is the Navy Global Prediction System**
- **UKM is the UK Met office Global Model**
- **FSSE is the Florida State Super Ensemble**


Statistics prepared by Mark DeMaria (NOAA/NESDIS)

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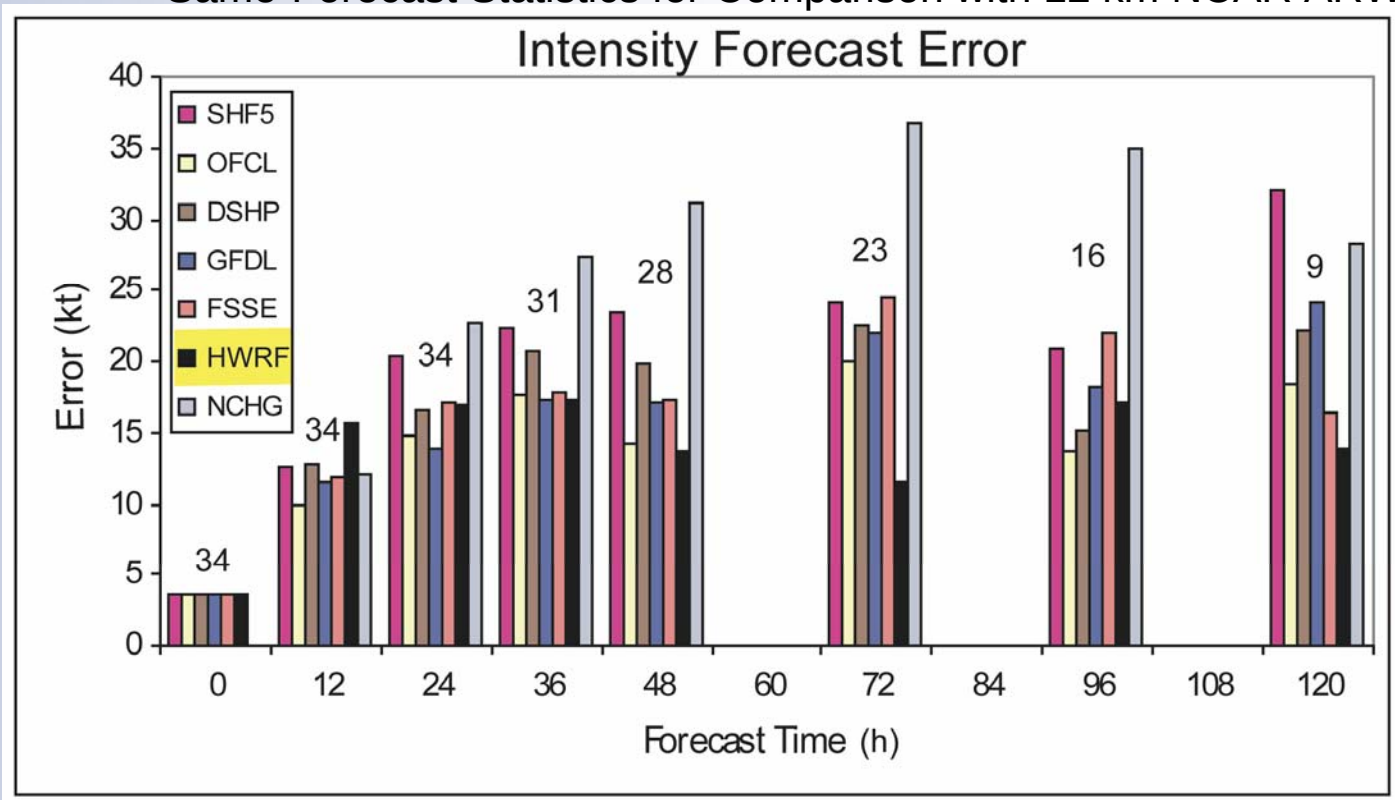
# 2005 Season Intensity Forecasts

Same-Forecast Statistics for Comparison with 12 km NCAR ARW




- **SHF5 is a statistical forecast scheme**
- **OFCL is the official forecast**
- **DSHP is a statistical forecast scheme**
- **GFDL is the 9 km GFDL hurricane model**
- **FSSE is the Florida State Super Ensemble**
- **HWRF is the 12 km NCAR ARW model**
- **NCHG is straight persistence**

Statistics prepared by Mark DeMaria (NOAA/NESDIS)

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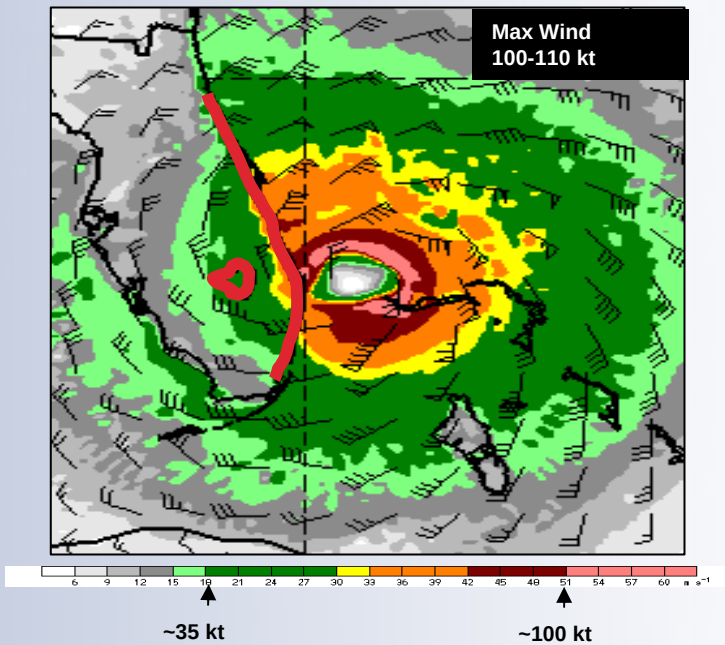
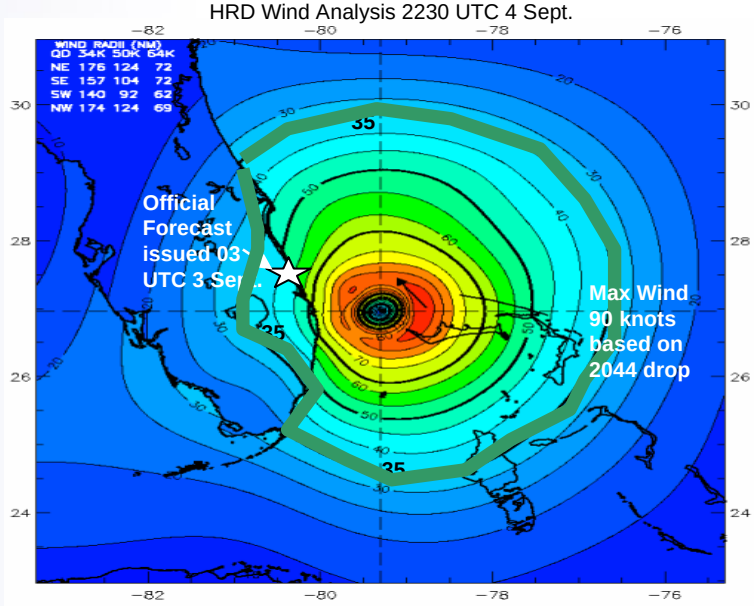
# 48 h Forecast, Hurricane Frances

10-m Wind; 48 h Fcst valid 00 UTC 5 Sept.




ARW 48-h Forecast 10 m wind

HRD Wind Analysis 2230 UTC 4 Sept.




NOAA/HRD 10-m HWind Analysis

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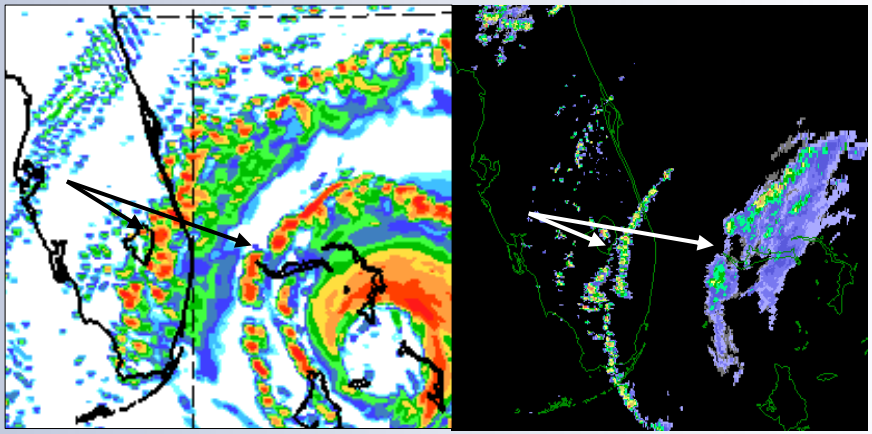
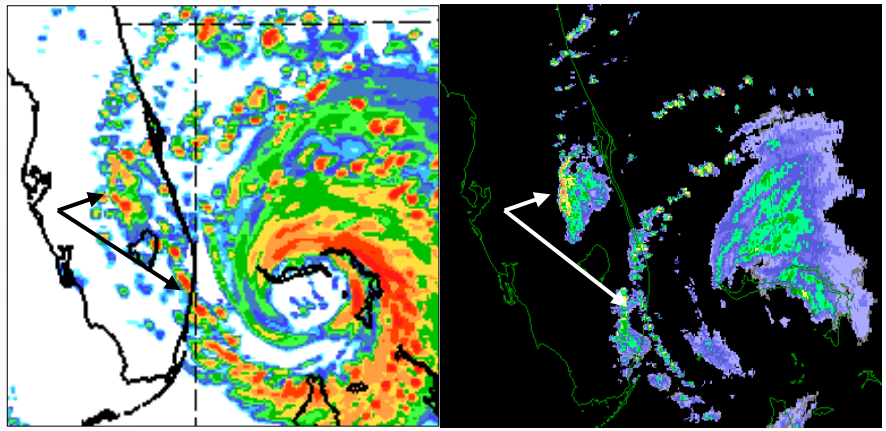
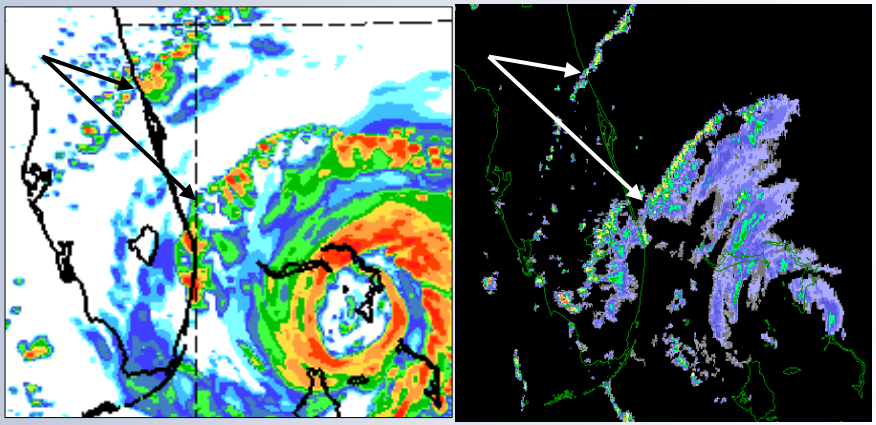
# Precipitation Features in Frances



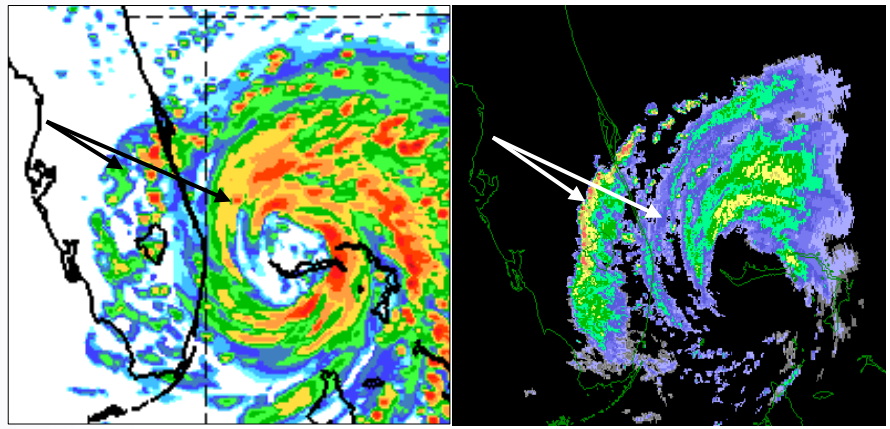
17 UTC 3 Sept (17 h fcst)



06 UTC 4 Sept (30 h fcst)



22 UTC 3 Sept (22 h fcst)



11 UTC 4 Sept (35 h fcst)

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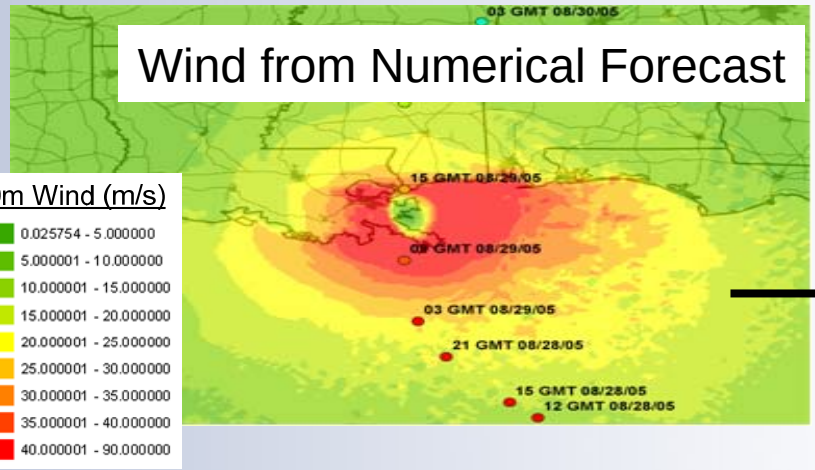
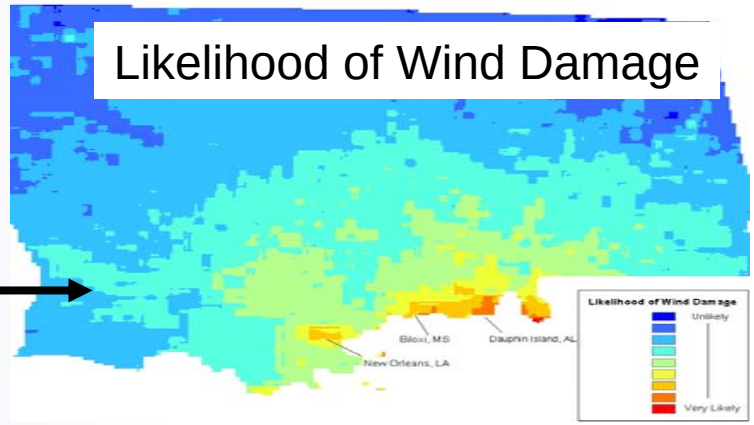
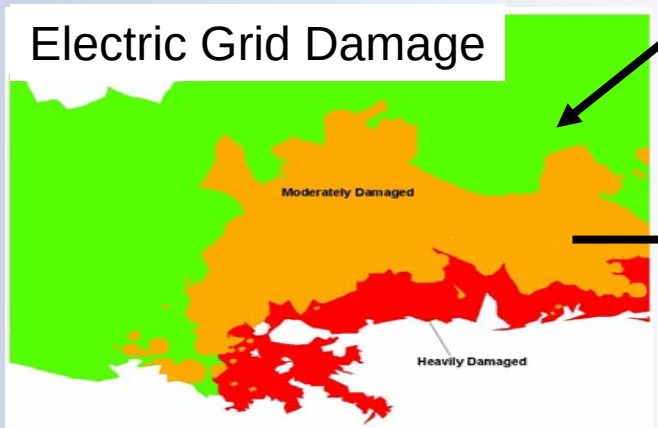
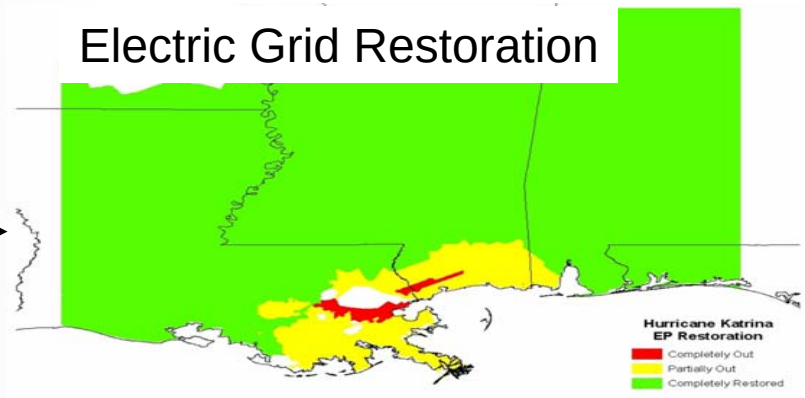
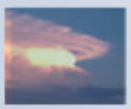
# Experimental Hurricane Impact Prediction



Brian Bush pc 2005

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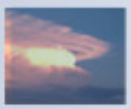
# Summary: 1. Needs

- **Careful and unbiased assessment of the hurricane threat an whether it is growing:**
  - ***Research into environmental impacts on hurricane characteristics***
  - ***Couple Weather and Climate models***
- **Improved Data Assimilation**
  - ***Radar, Satellite, ad-hoc data***
- **Capacity to run a coupled ocean/atmosphere hurricane forecast system at high resolution**
  - ***Computing facilities***
  - ***Supporting research (RAINEX, Predictability, Vortex Core Processes)***
- **Move away from traditional forecast approaches**
  - ***Bring together atmospheric, oceanic, societal and engineering groups***
  - ***Explicit forecasts of Impacts***


# Recommendation for a Hurricane Demonstration Project

- **Phase 1: Research and System Development:**
  - ***Focus on hurricane impacts***
  - ***Bring together atmospheric, oceanic, societal and engineering expertise***
  - ***Define the requirements and needs***
- **Phase 2: Forecast Demonstration:**
  - ***Multiple modeling approaches***
  - ***Demonstrate effectiveness of use of leading edge computing facilities***
  - ***Demonstrate new approaches such as impacts forecasting and communicating risk and vulnerability***

Much of the groundwork has already been done by the US Weather Research Program, but never properly implemented!