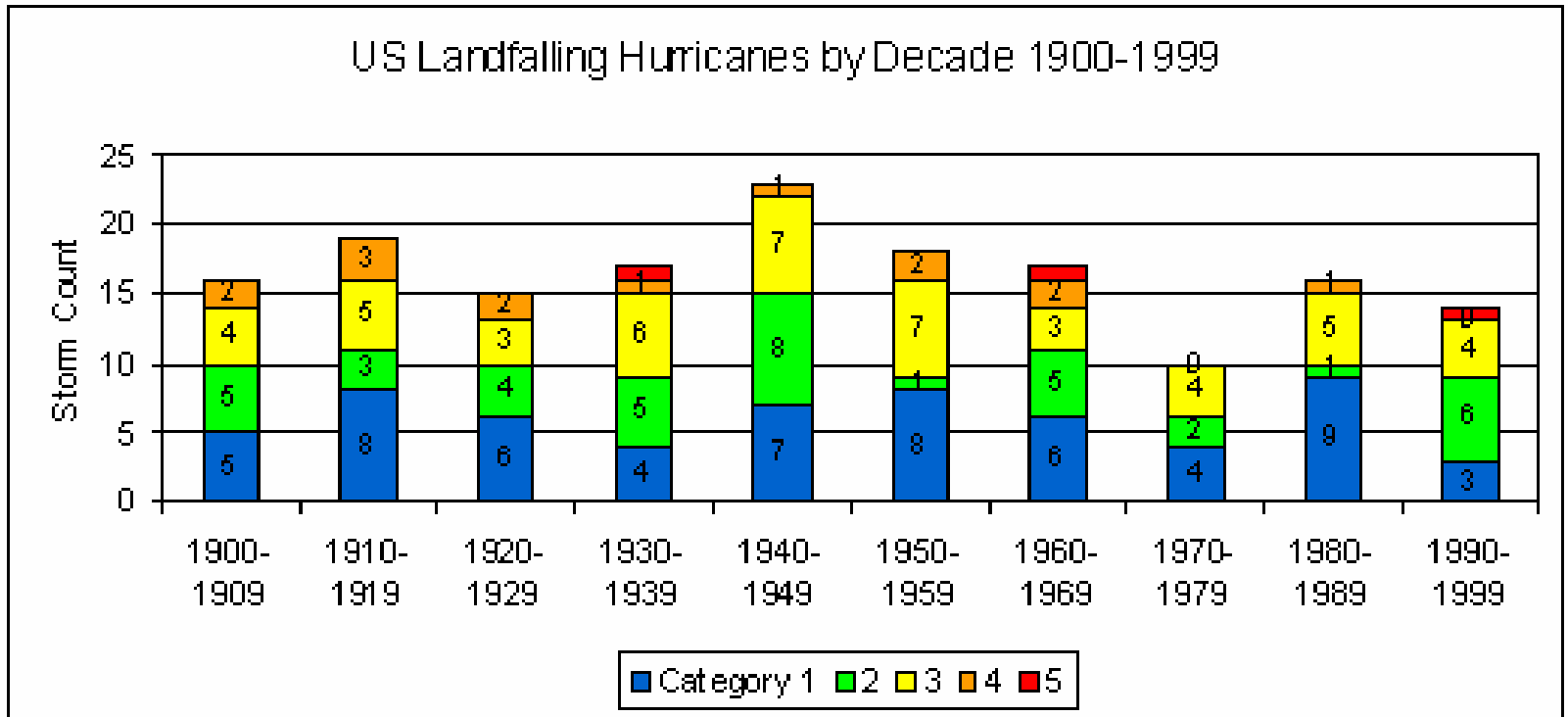


Changes in hurricane intensity in a warming environment

Judith Curry & Peter Webster
Georgia Institute of Technology

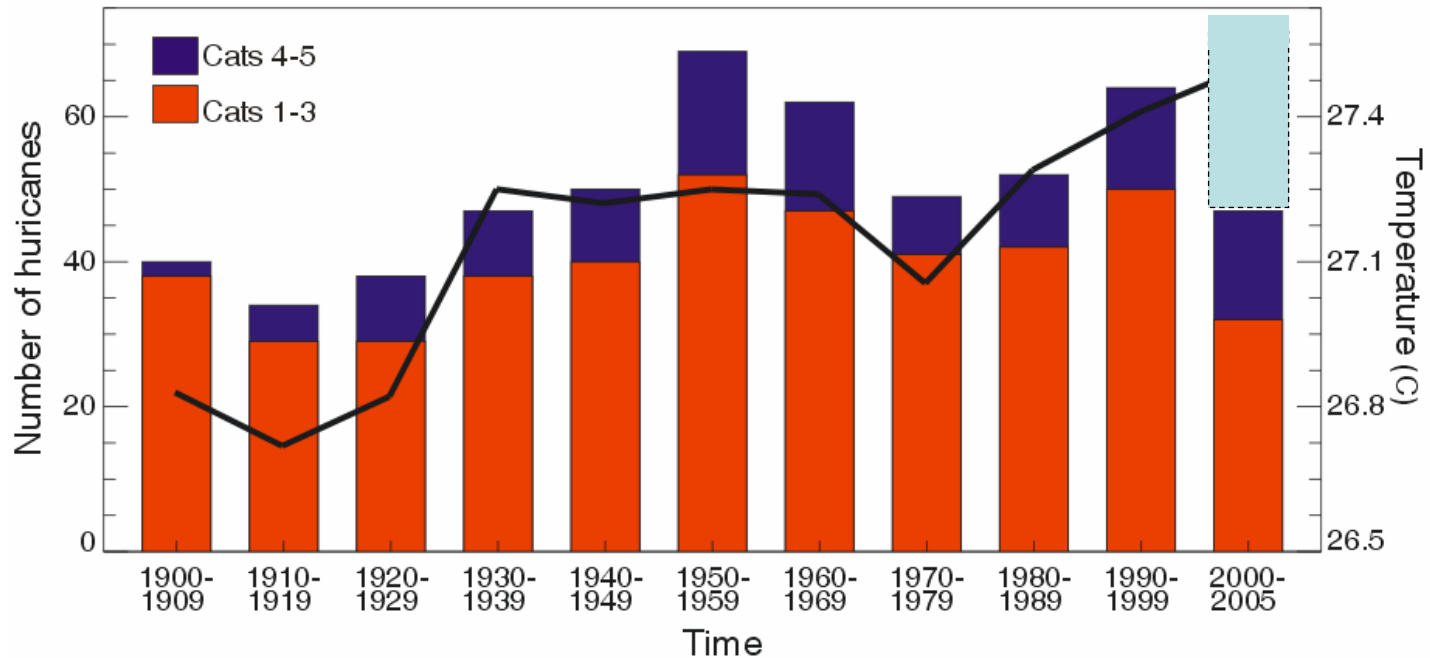
U.S. land falling hurricanes



"This is not supportive of the hypothesis that the globe is warming catastrophically or that there are more and more severe storms occurring."

--junkscience.com

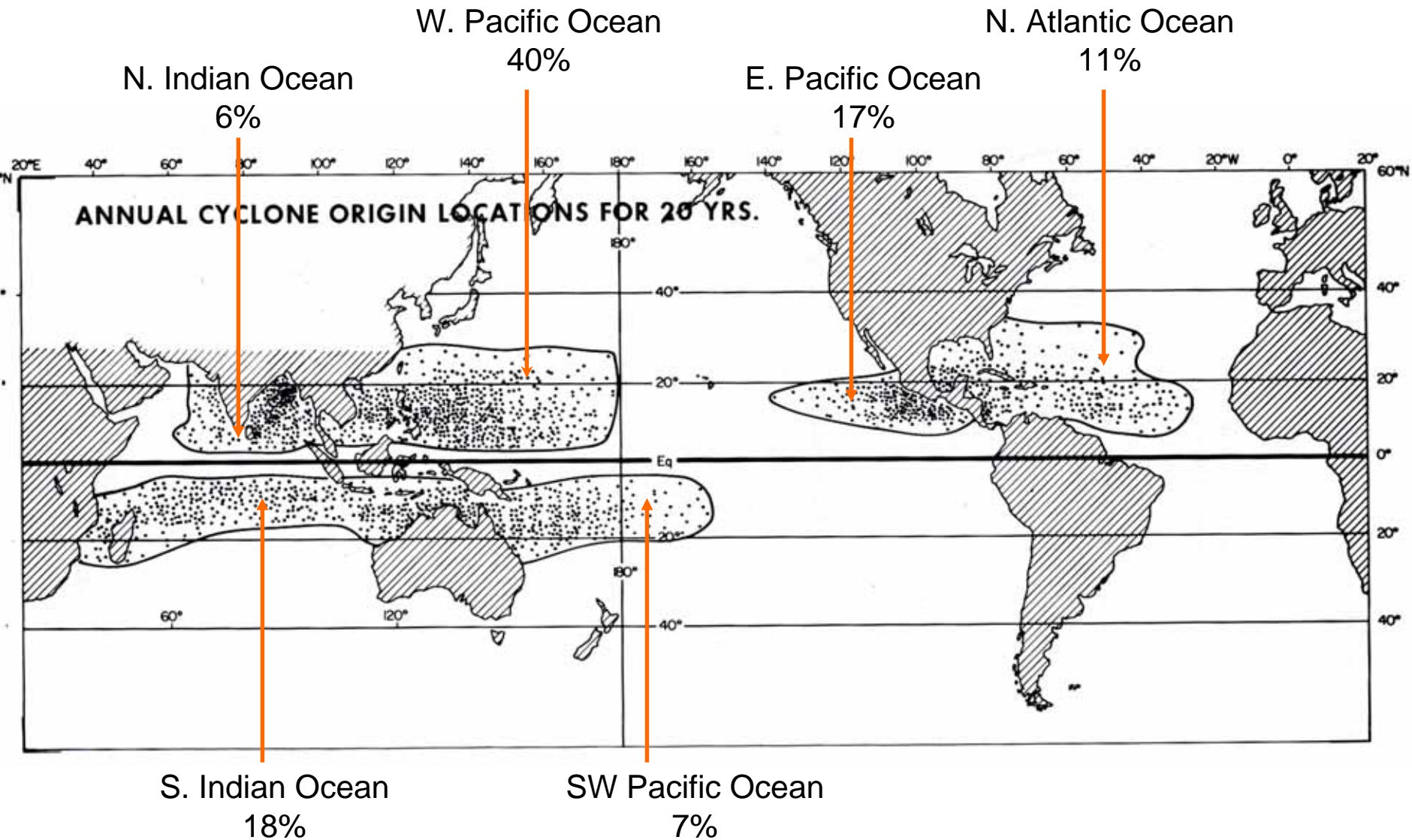
North Atlantic Hurricanes



"The increased activity since 1995 is due to natural fluctuations (and) cycles of hurricane activity driven by the Atlantic Ocean itself along with the atmosphere above it and not enhanced substantially by global warming..."

M. Mayfield

Number of tropical storms



Sampling Problem - analogy with U.S. voter preferences



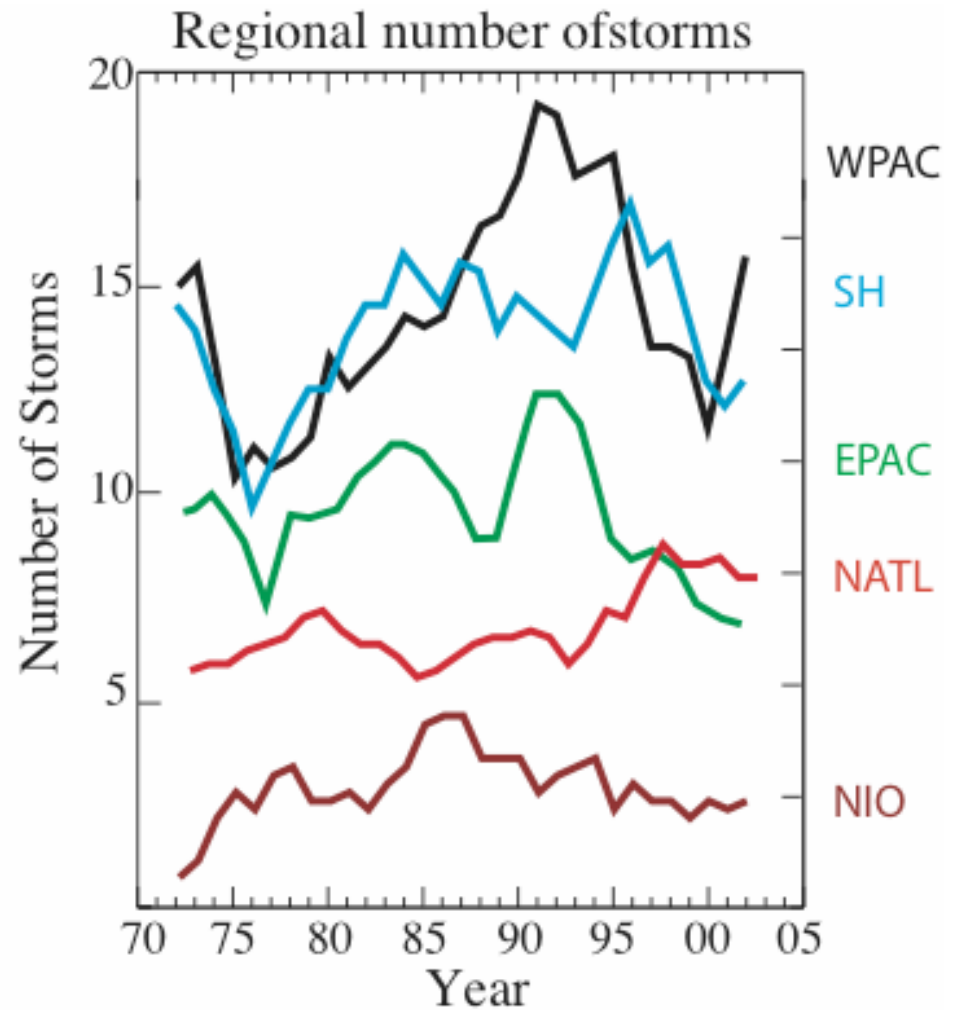
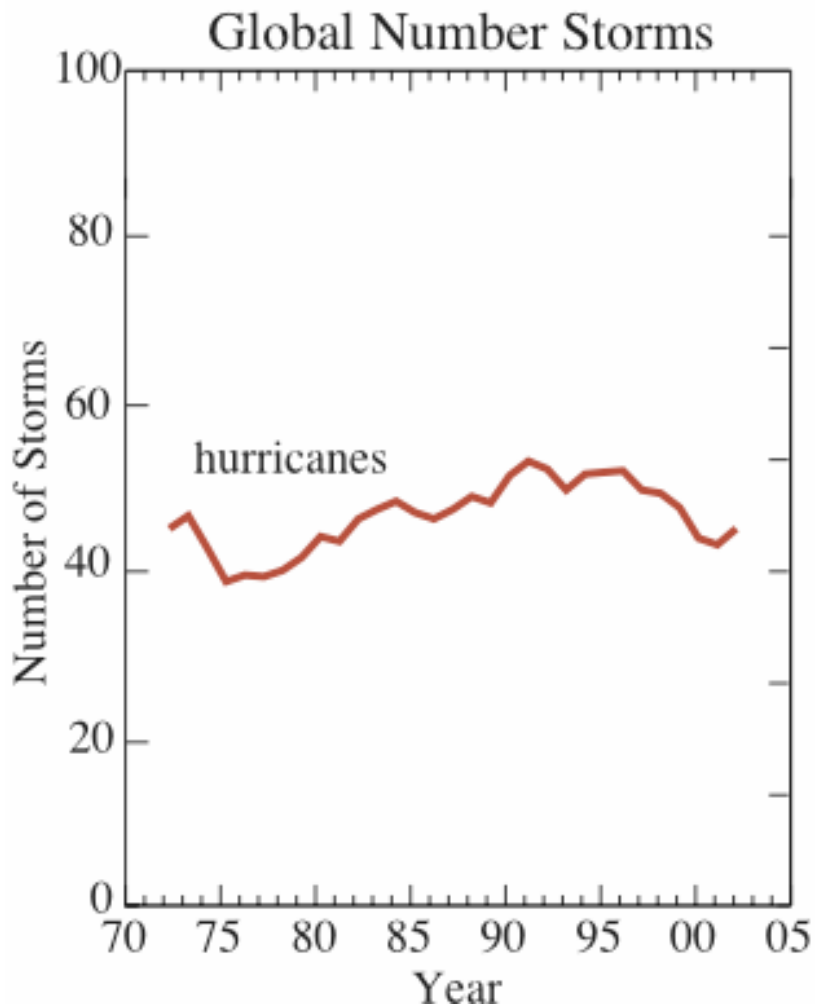
Looking only at NATL hurricanes is like only polling CA for voter preferences.

Looking only at U.S. hurricanes is like only polling CA senior citizens for voter preferences.

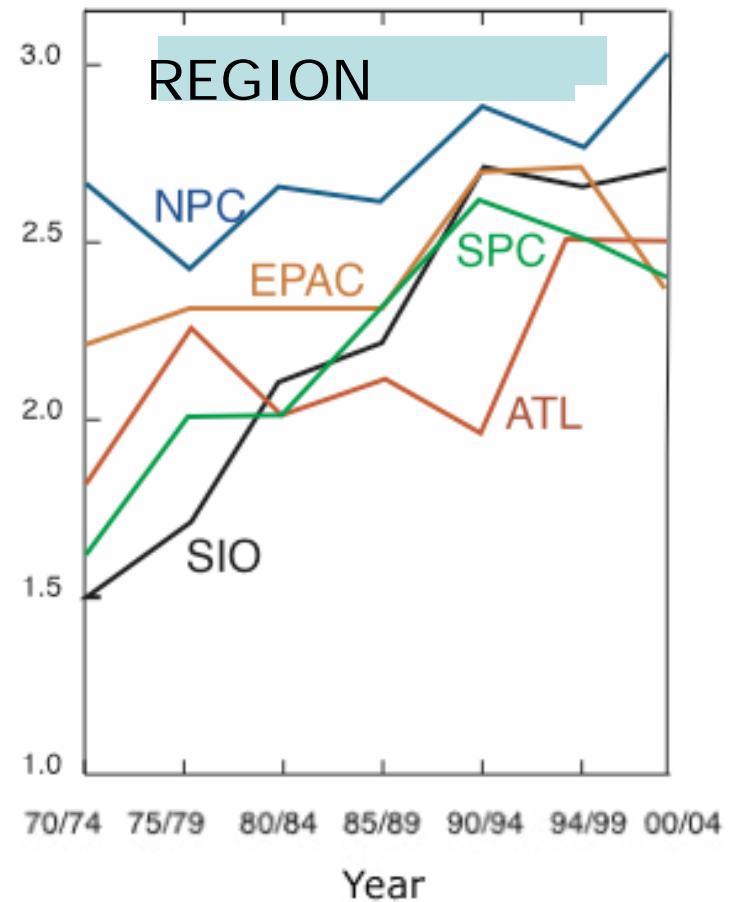
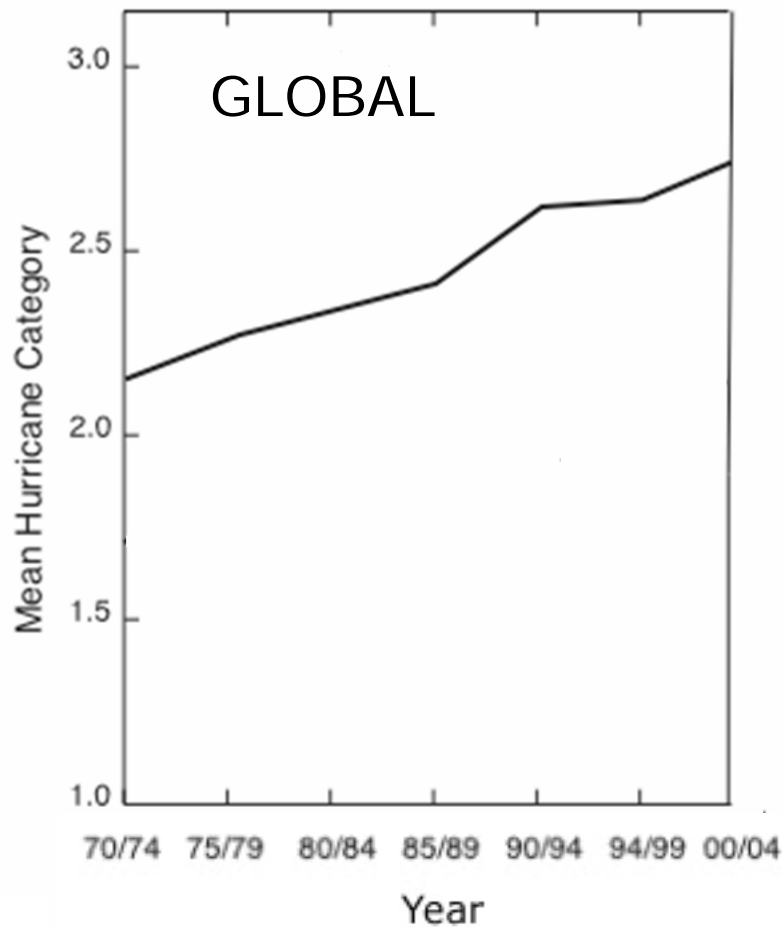
Data for global study

- Compiled data from hurricane/typhoon warning centers; we did not alter the data in any way
- We choose 1970-2004 which corresponds to the satellite era
- Satellite data corroborated by aircraft reconnaissance in Northwest Pacific (until 1987) and North Atlantic

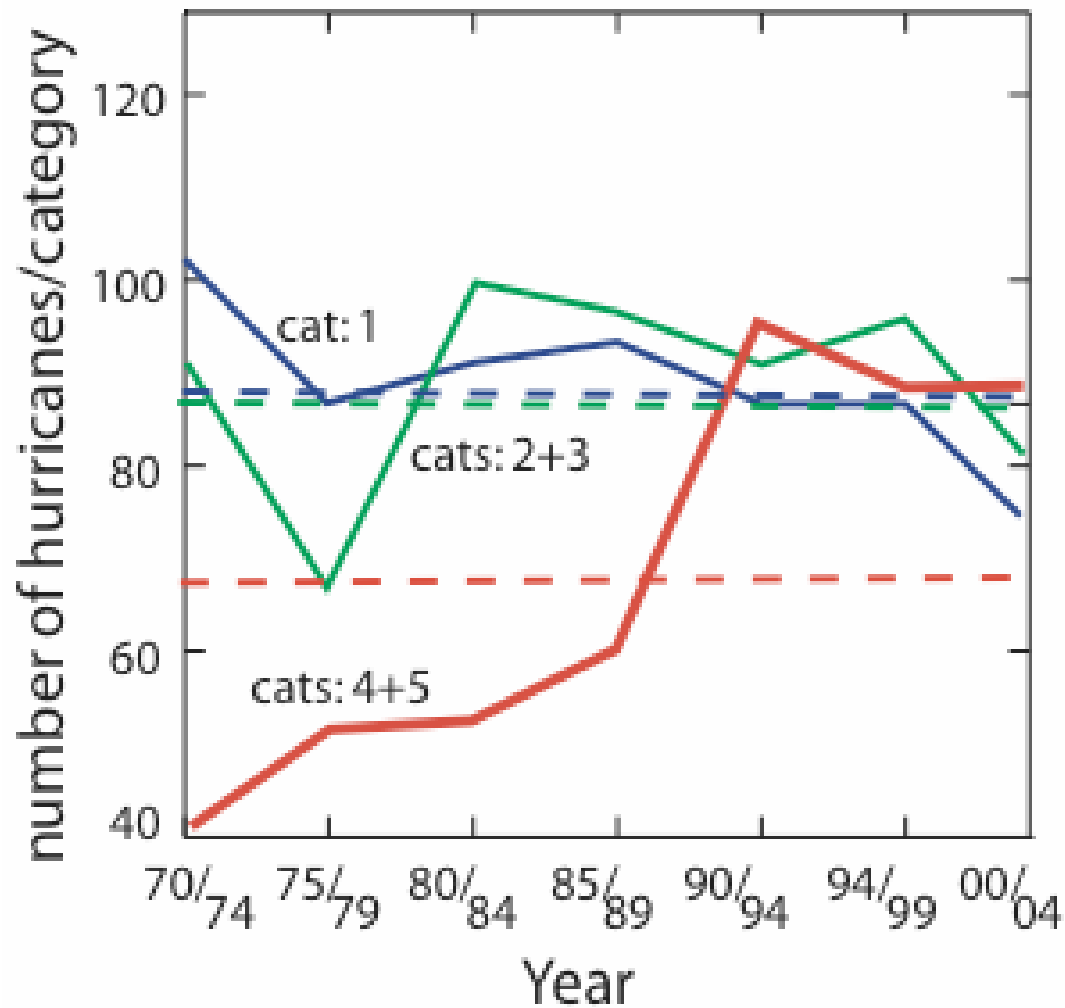
Global number of hurricanes



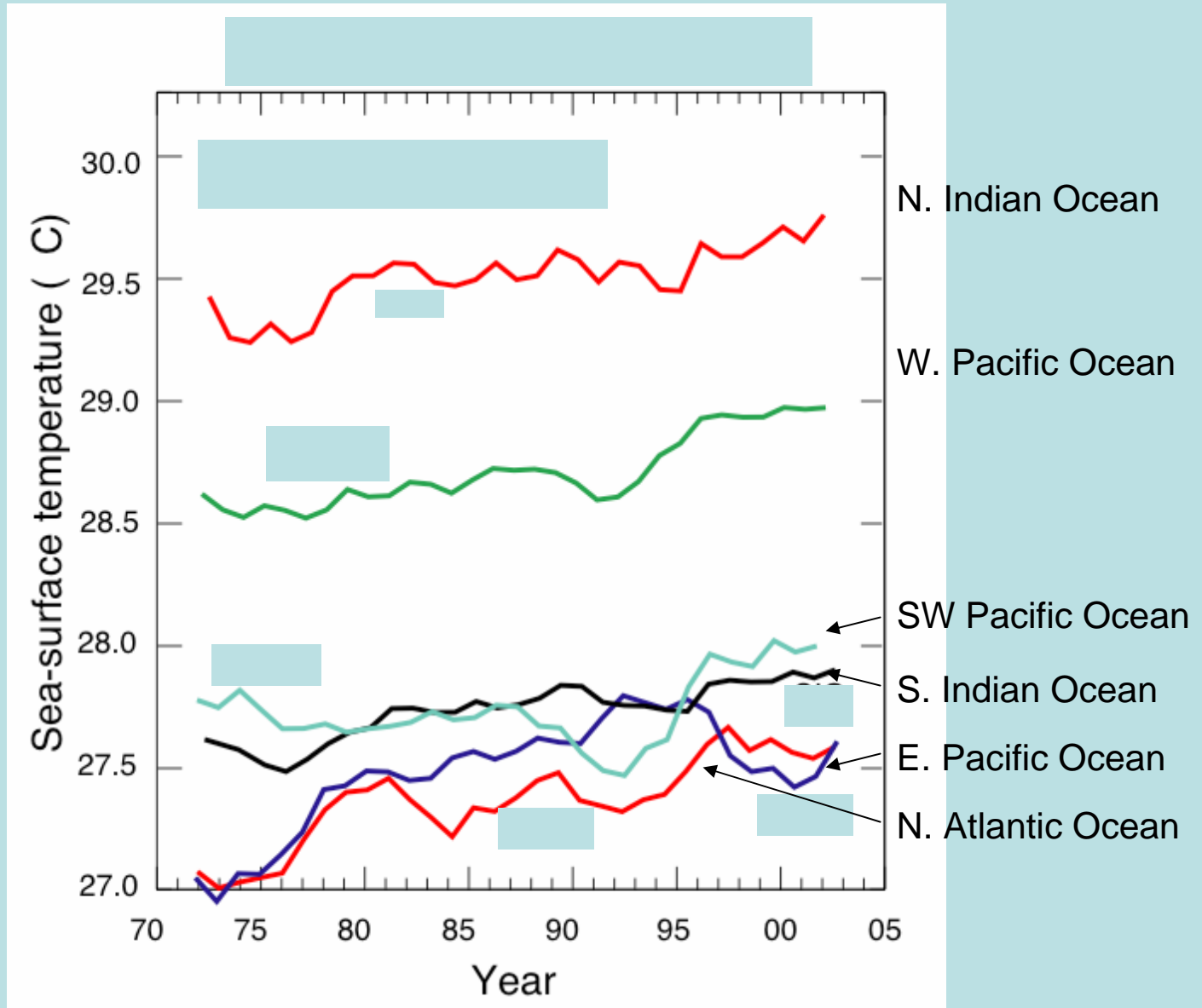
Increase in average hurricane intensity



Change in hurricane intensity




Hurricane Season Sea Surface Temperature



Is global warming causing an increase in hurricane intensity?

Consider the following causal chain:

4. Global hurricane intensity is increasing
 3. Global hurricane intensity increases with increasing sea surface temperature
 2. Global tropical sea surface temperature is increasing
 1. Greenhouse warming is contributing to the global tropical sea surface temperature increase
- 
- ```
graph BT; 1[1. Greenhouse warming is contributing to the global tropical sea surface temperature increase] --> 2[2. Global tropical sea surface temperature is increasing]; 2 --> 3[3. Global hurricane intensity increases with increasing sea surface temperature]; 3 --> 4[4. Global hurricane intensity is increasing];
```

# Two perspectives:

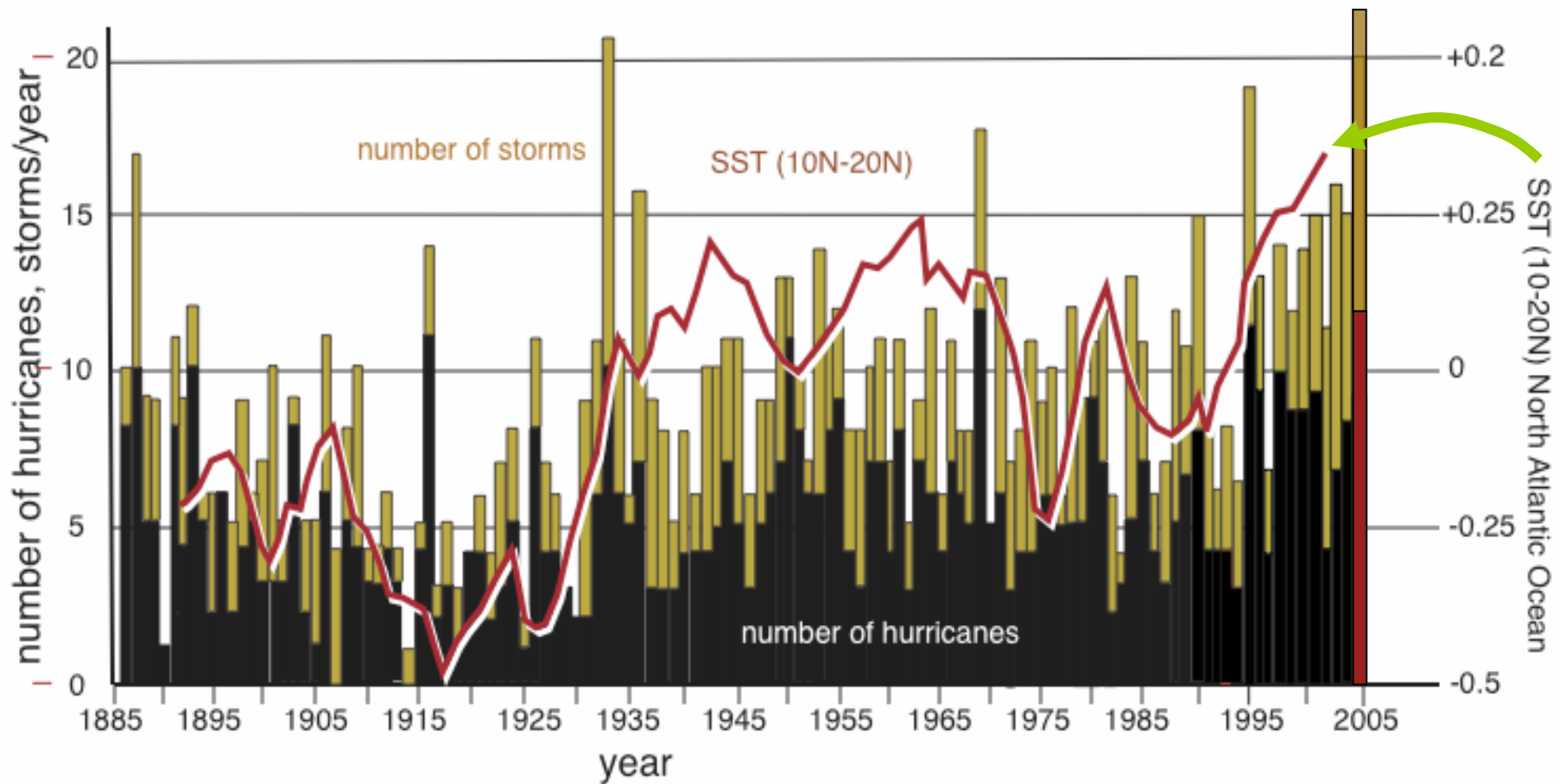
## 1. Hurricane forecasters:

- forecasting U.S. landfalling hurricanes
- empirically based seasonal forecasts of NATL hurricanes
- forecast verification
- hurricane data

## 2. Climate dynamics research scientists

- scientific method; hypothesis testing
- climate variability
- physical processes
- climate data records; data sampling

# Changes in hurricane frequency in the North Atlantic Ocean



# The story may be more complex . . .

Greenhouse warming may also influence hurricanes through changes in:

- natural internal cycles (e.g. El Nino)
- atmospheric circulation patterns
- ocean mixed layer depth

More research needed on the global climate dynamics of hurricanes !