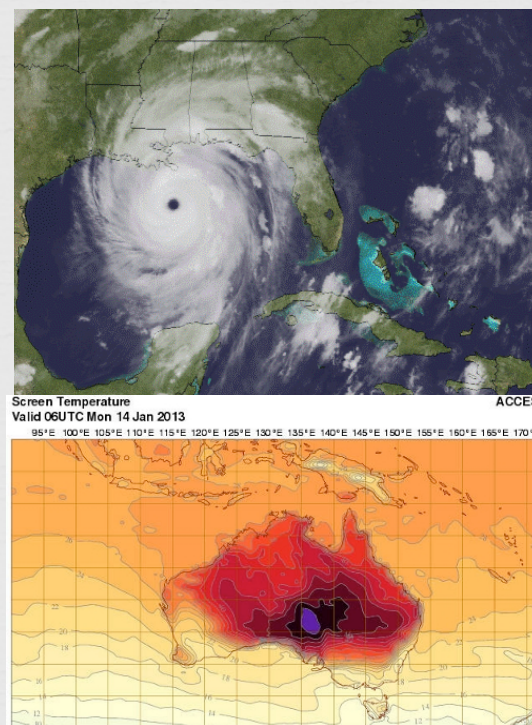


Severe Weather Response to Climate Change: A Transient Increase then Saturation?

Greg Holland

**Regional Climate Research Section
NCAR Earth System Laboratory**

**Collaboration with Cindy Bruyere
and Mari Jones**

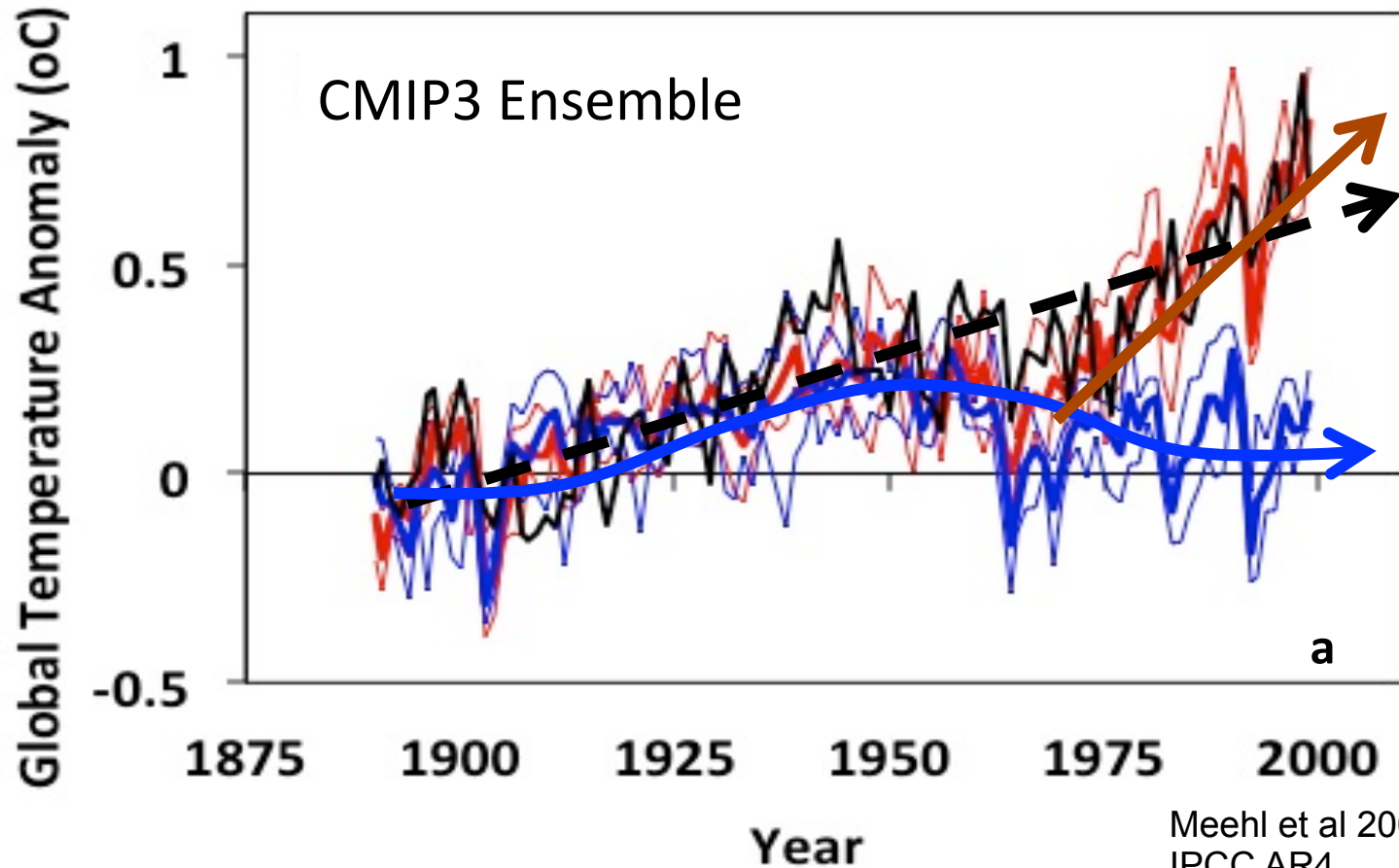


NCAR is Sponsored by NSF and this work is partially supported by the Willis Research Network, the DOE Research Program to Secure Energy for America and NSF EASM Grants 1048841 and 1048829

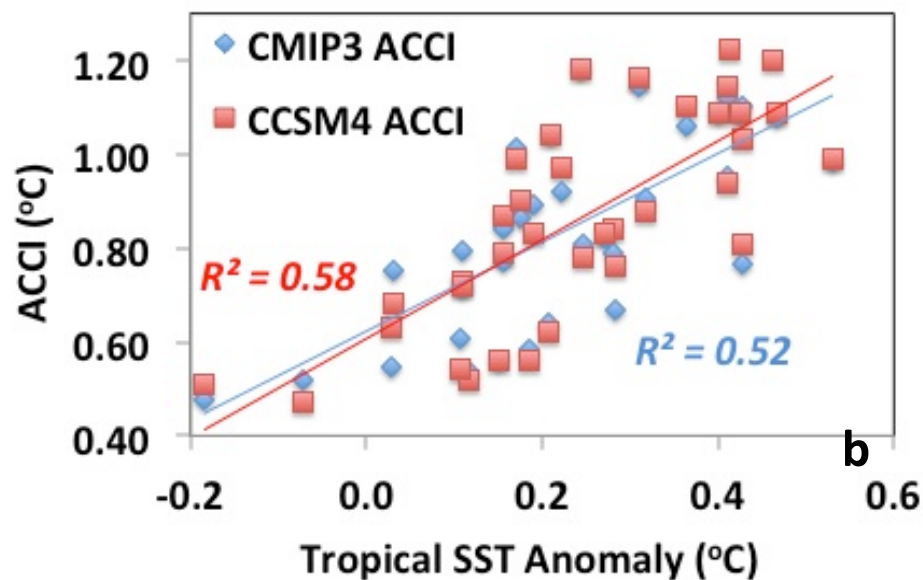
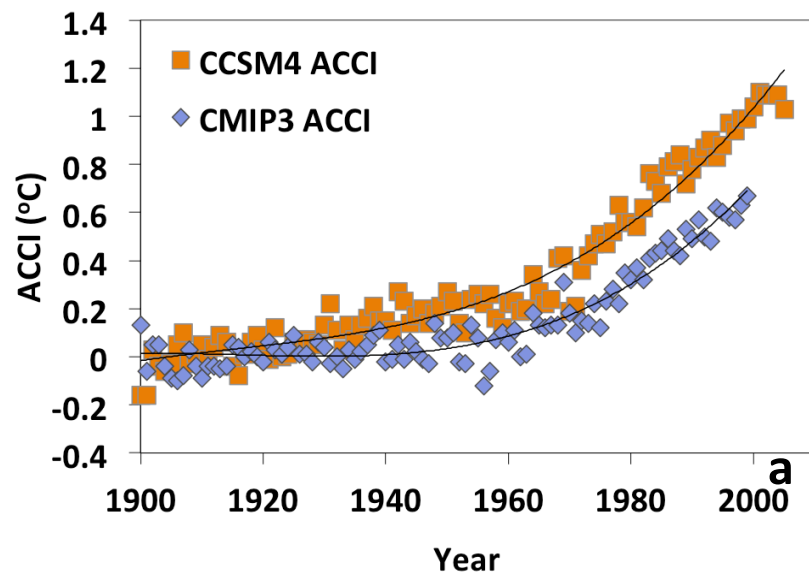
Summary

- Working Hypothesis:
 - *Absolute extremes are capped by available energy*
- *Thus, for Climate Change*
 - *The PDF becomes bimodal or skewed with climate variability and change*
 - *These changes may saturate after an initial rapid response*
- Definition of Climate Change
- Hurricane response
- Temperature Response.

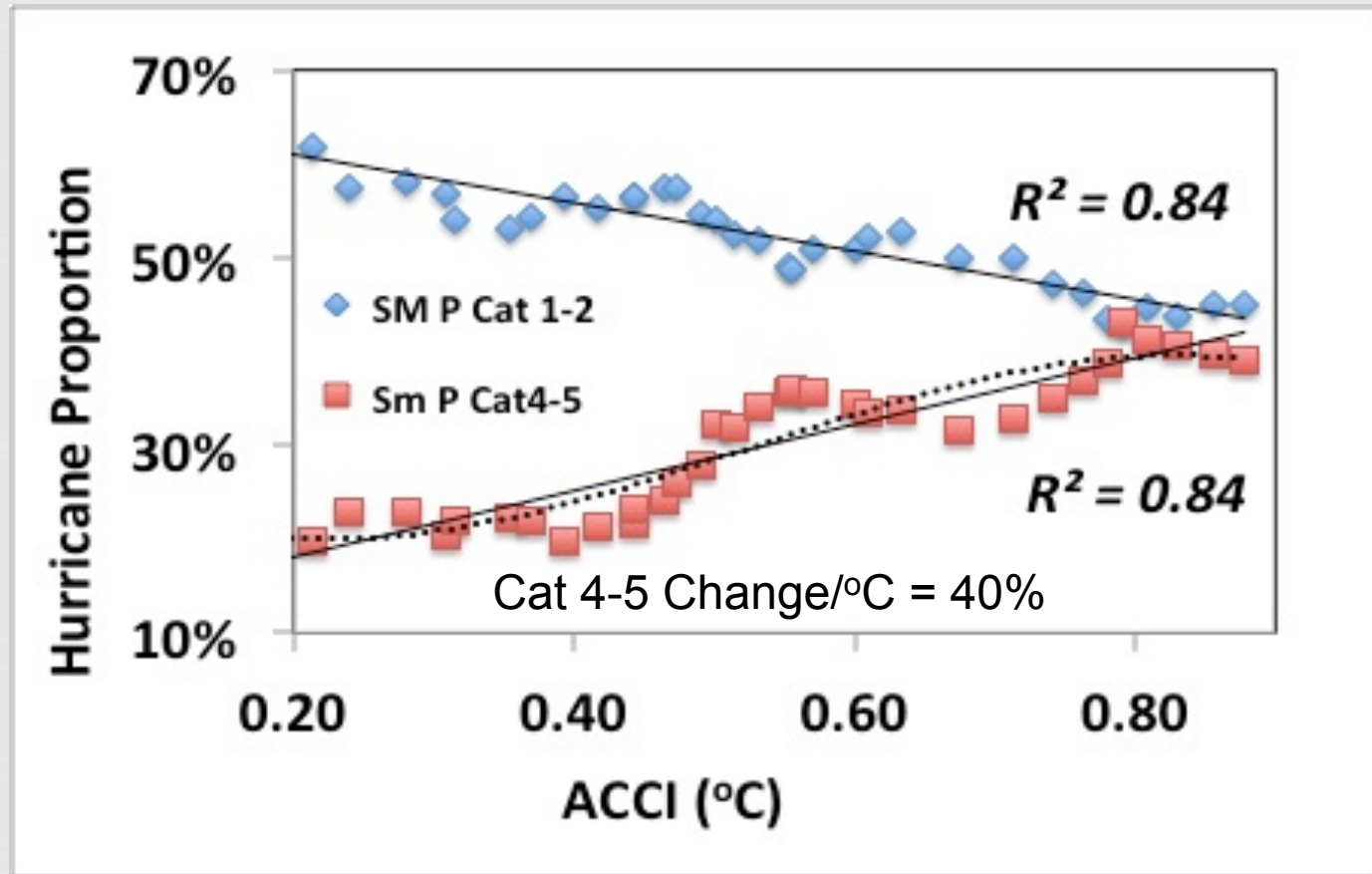
The Anthropogenic Climate Change Index ACCI



The Anthropogenic Climate Change Index ACCI



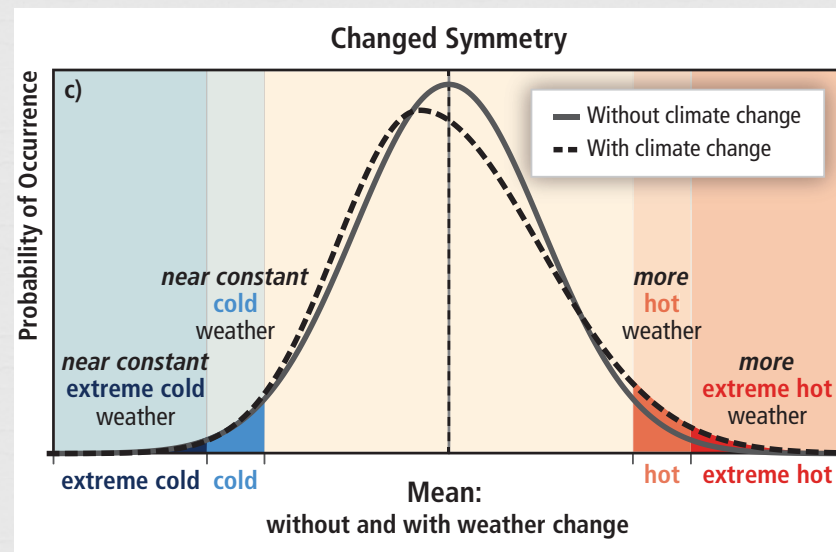
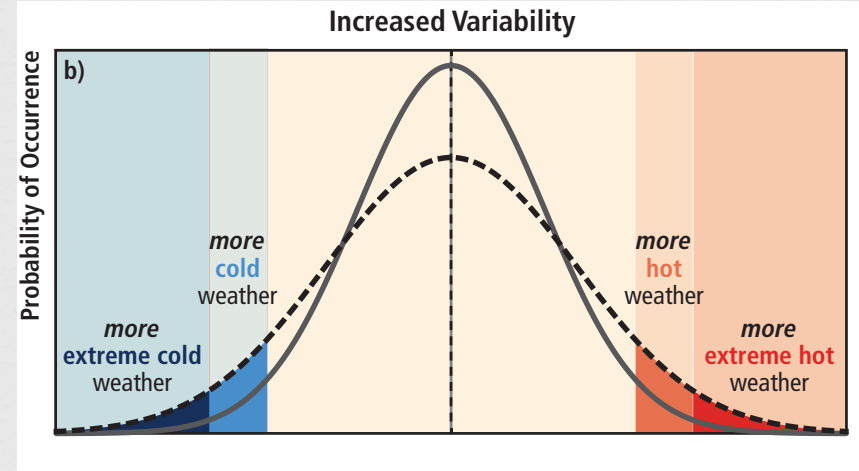
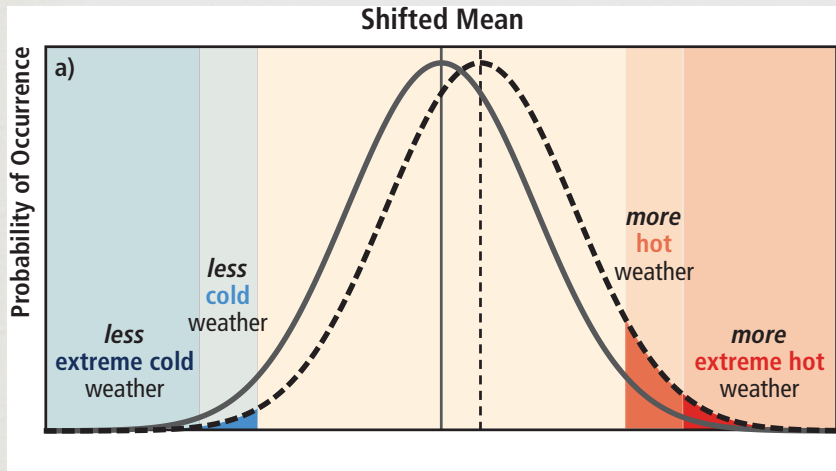
Global Intense Hurricane Response



- SH Cyclones are in year season commenced
- All Cyclones no Change
- Saffir-Simpson Categories used.

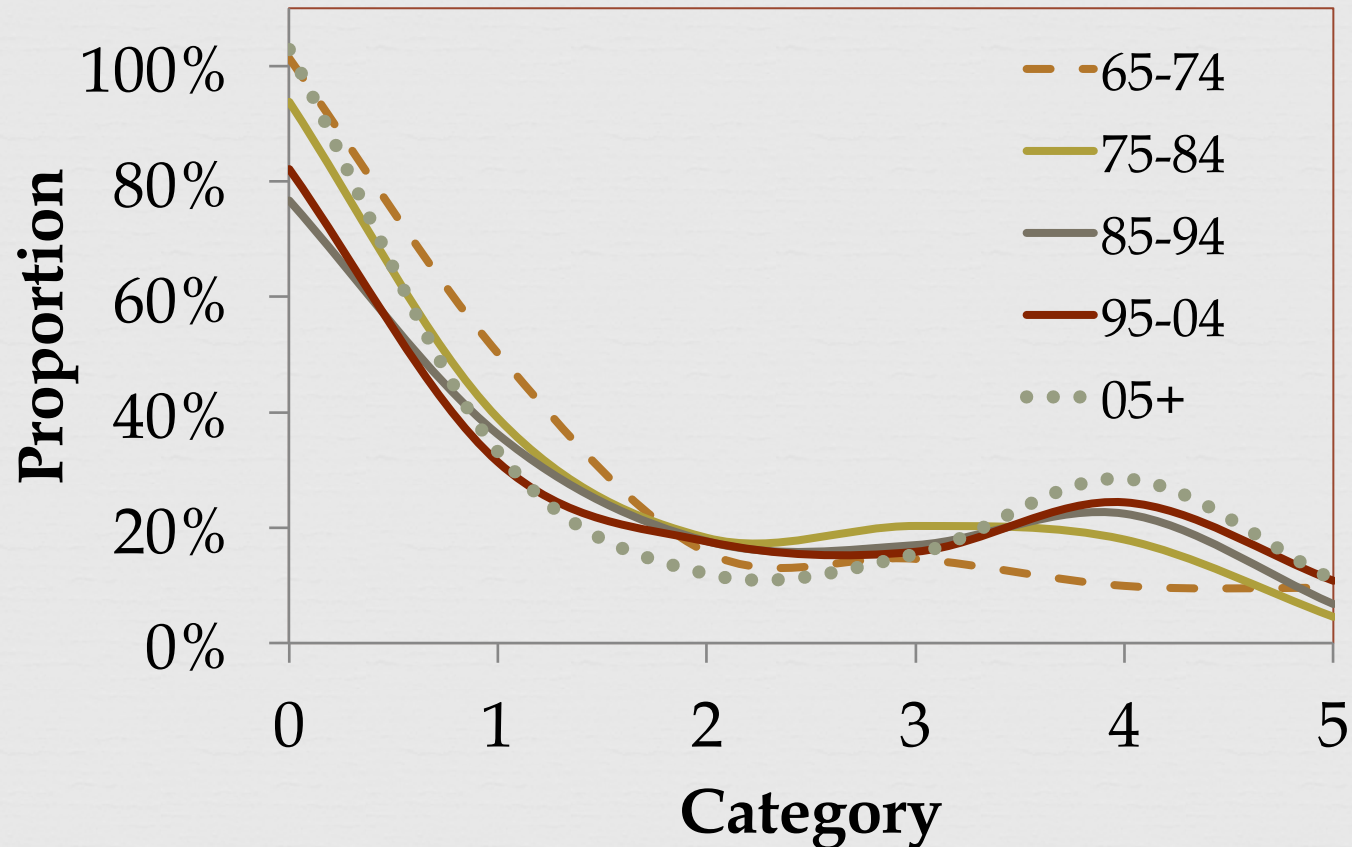
(Holland and Bruyere 2013)
(Holland and Webster 2007)
(Elsner et al 2009)

Sensitivity of Extremes



(IPCC SREX 2012)

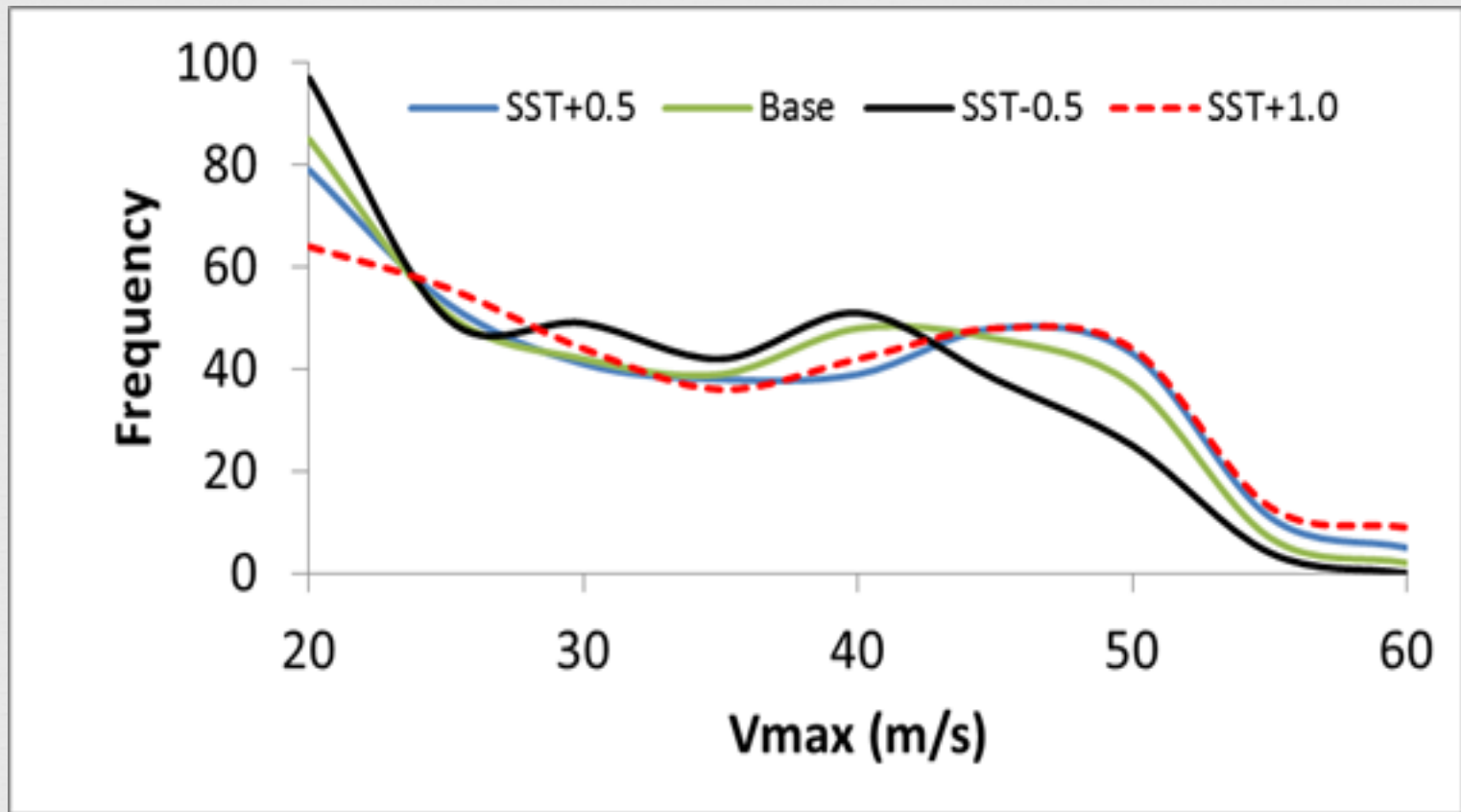
Character of the Observed Tropical Cyclone Changes



Proportion is relative to all hurricanes

(Holland and Bruyere 2013)

Model Assessment

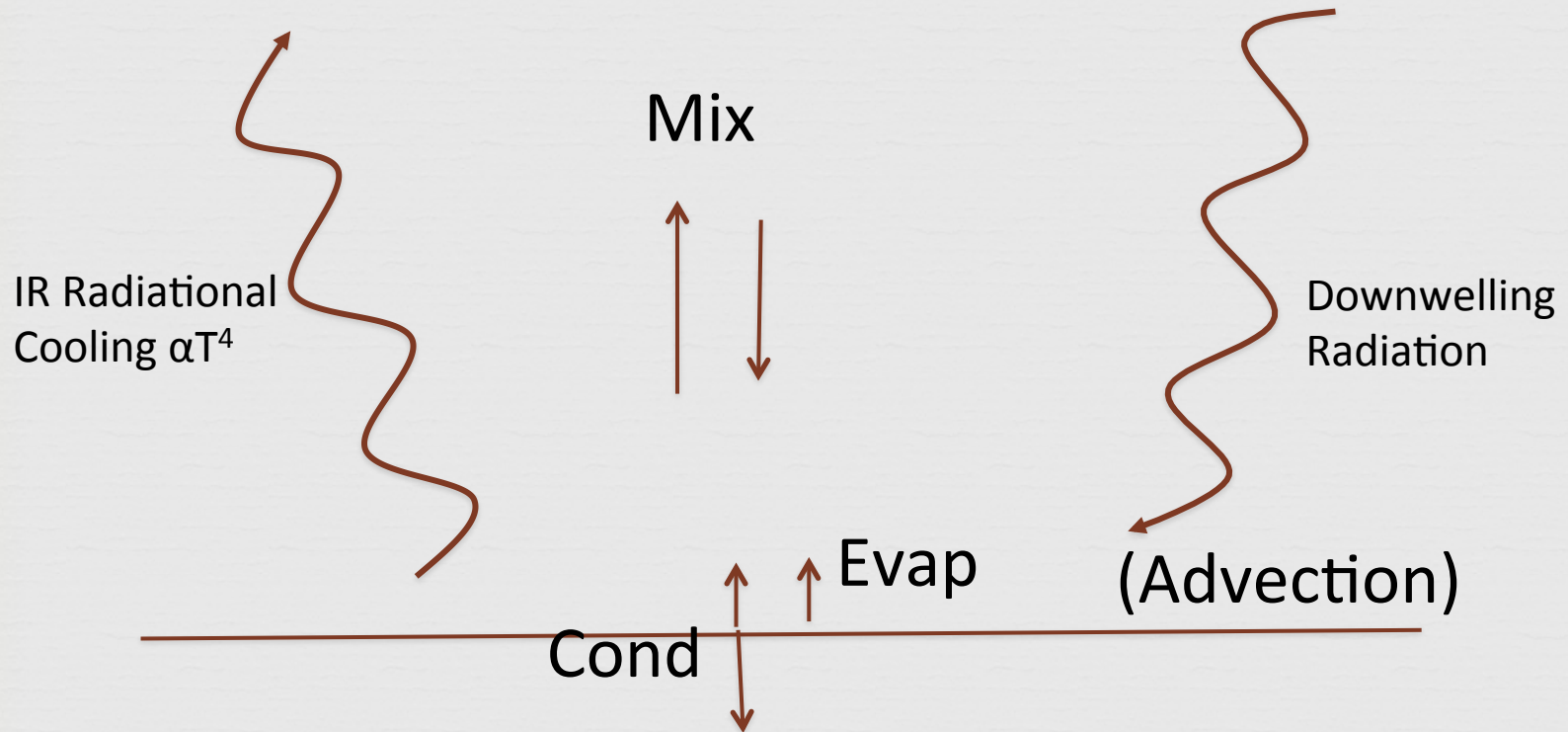


Nested Regional Climate Model 36 km plus embedded WRF Hurricane Model 4 km.

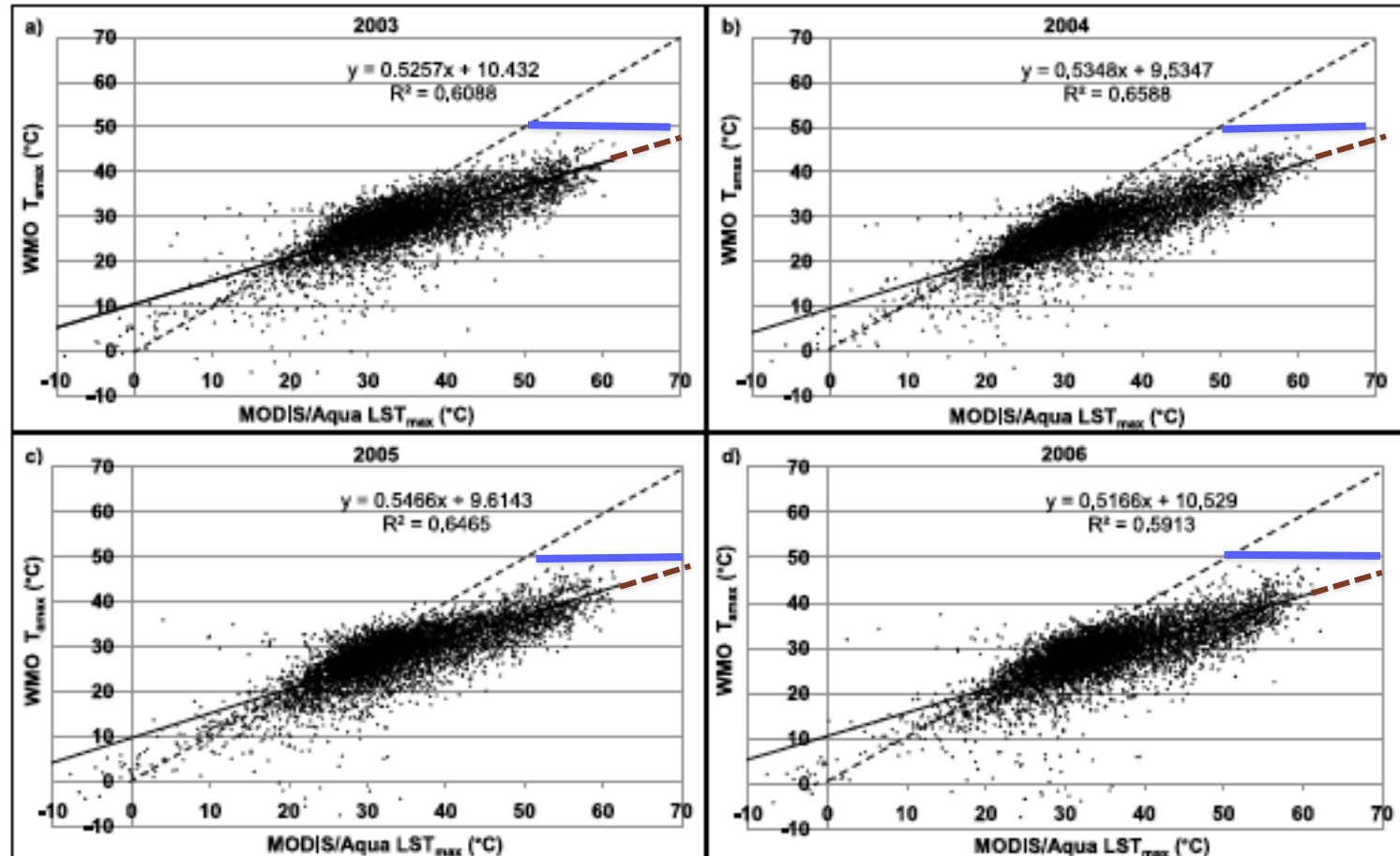
Base is 2012 North Atlantic Hurricane Season.

Temperatures?

Diurnal Timescale

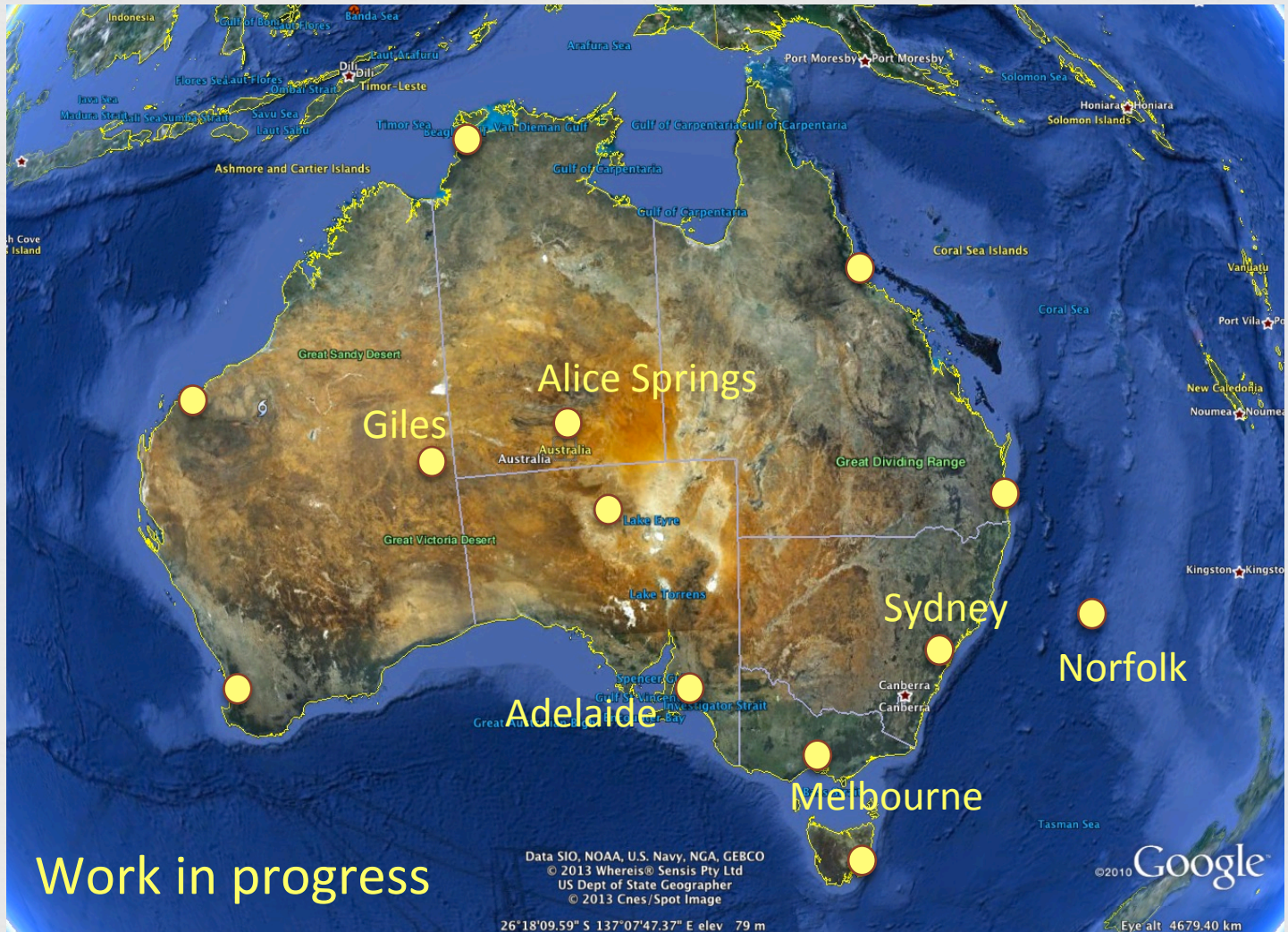


MODIS Skin vs Air Temperature

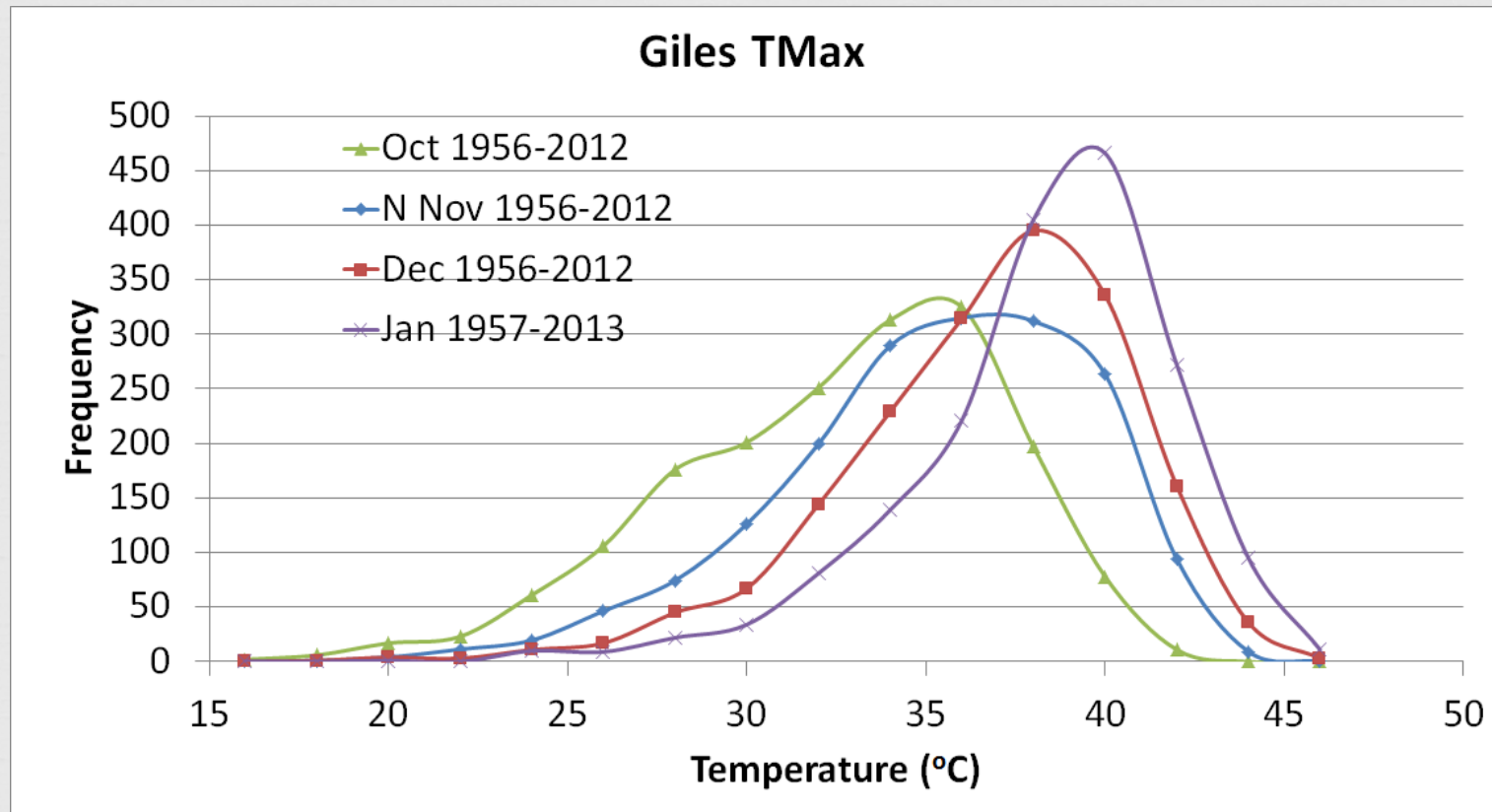


(Mildrexler et al 2011)

Temperature Stations

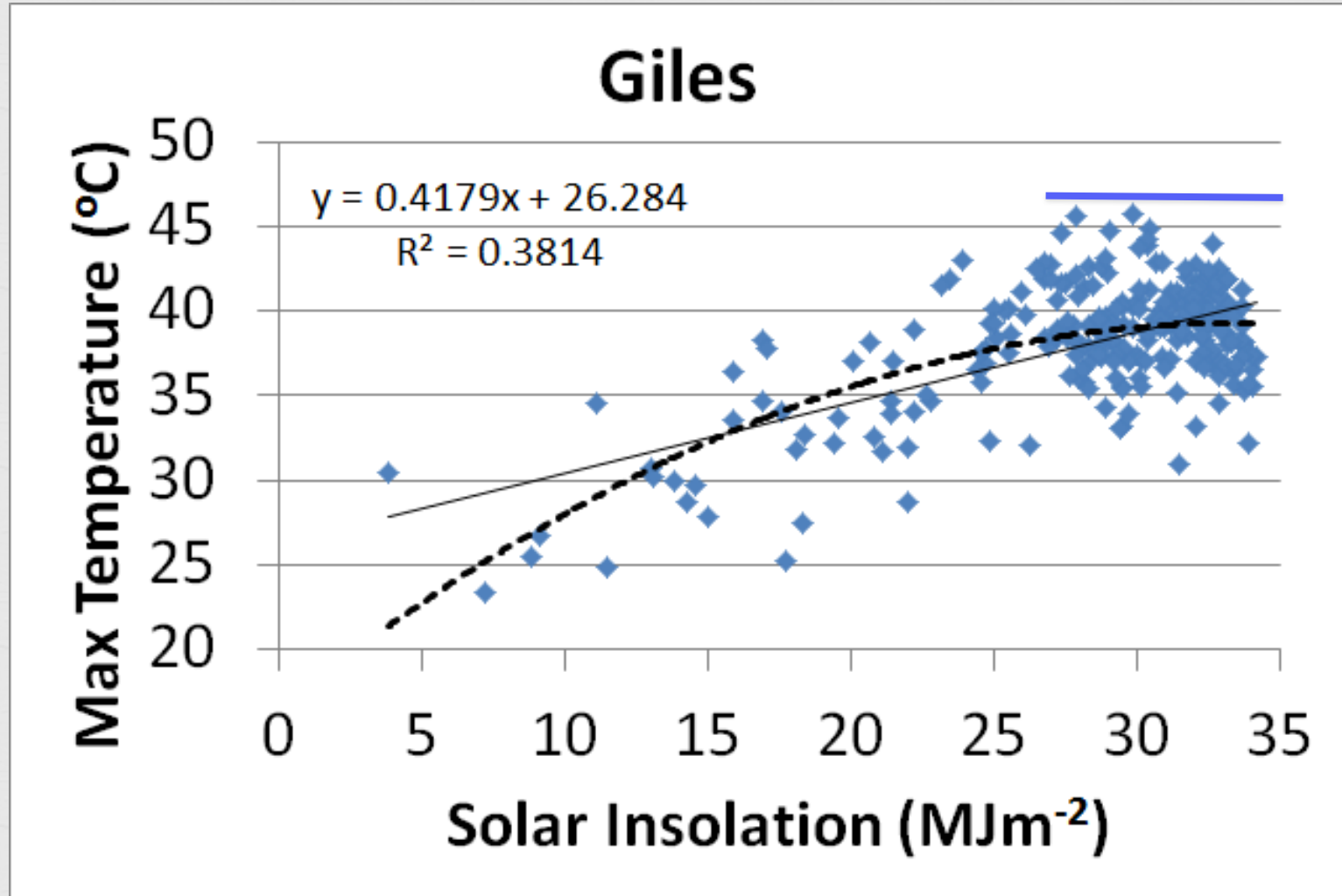


Seasonal: Desert In Situ Temperatures

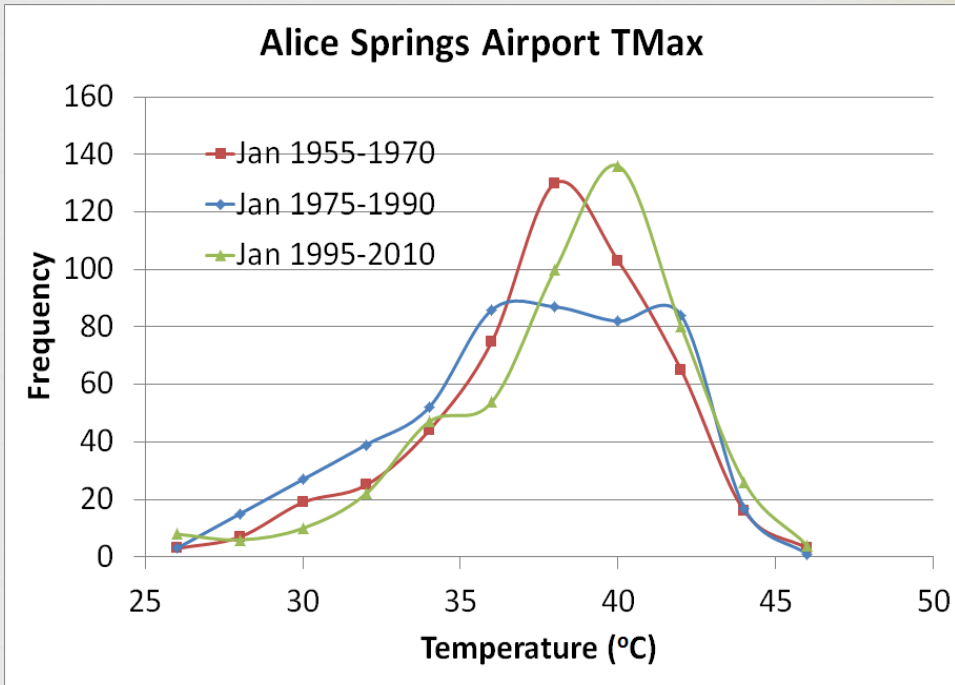
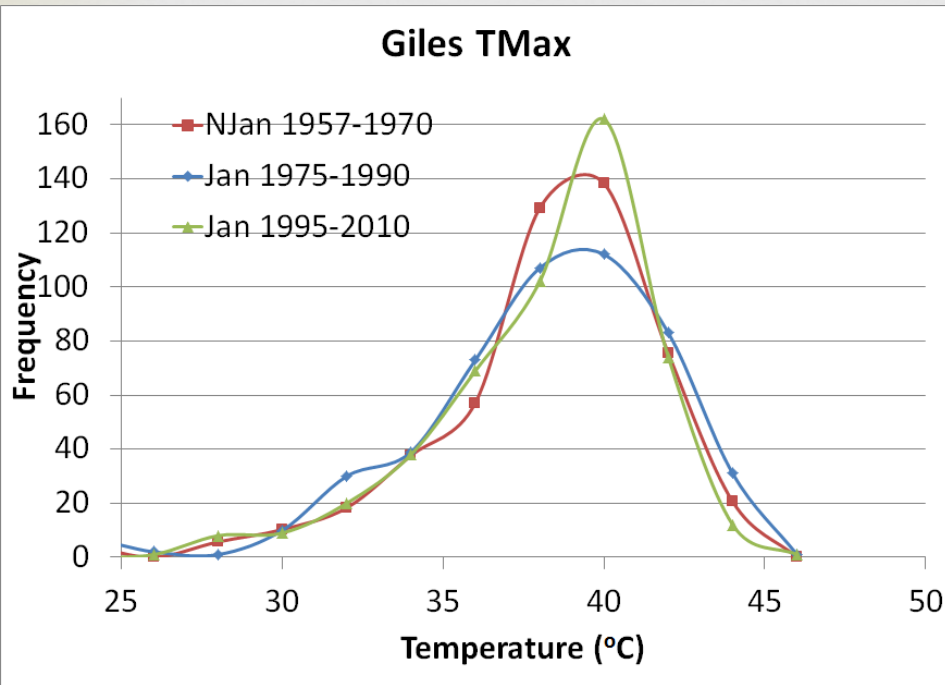


- Extremes bumping up against the maximum possible
- Skewed distribution develops

Giles Maxima

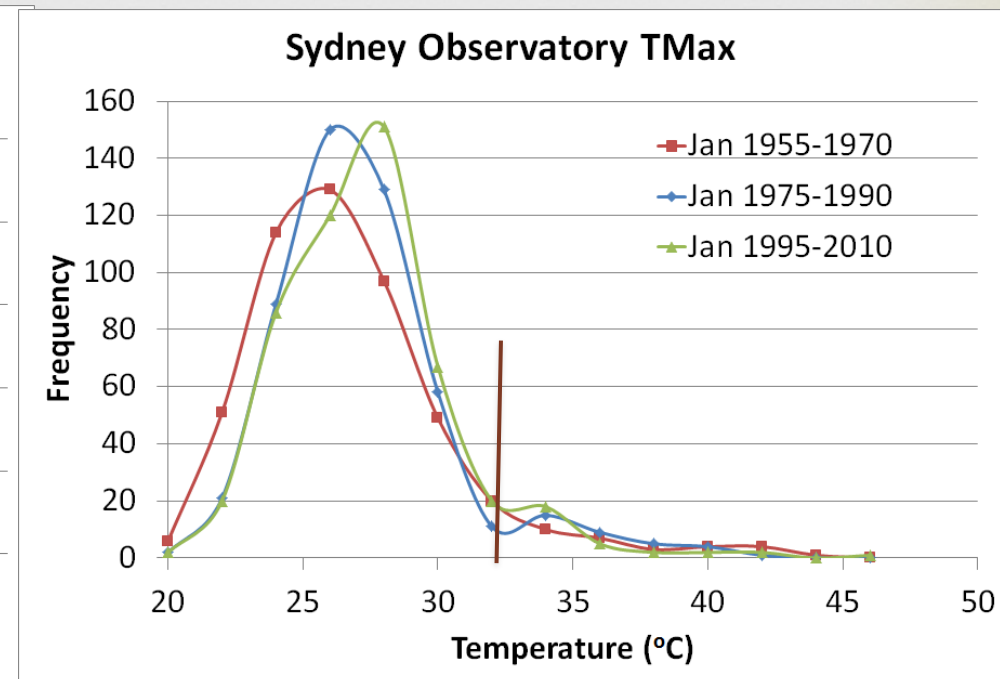
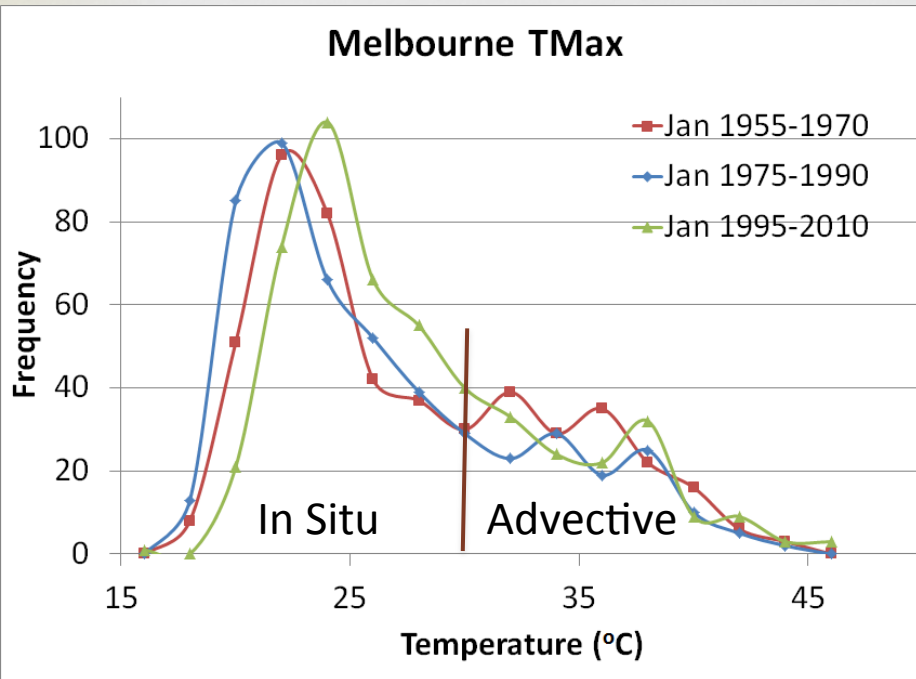


Climate Change: In Situ Temperatures



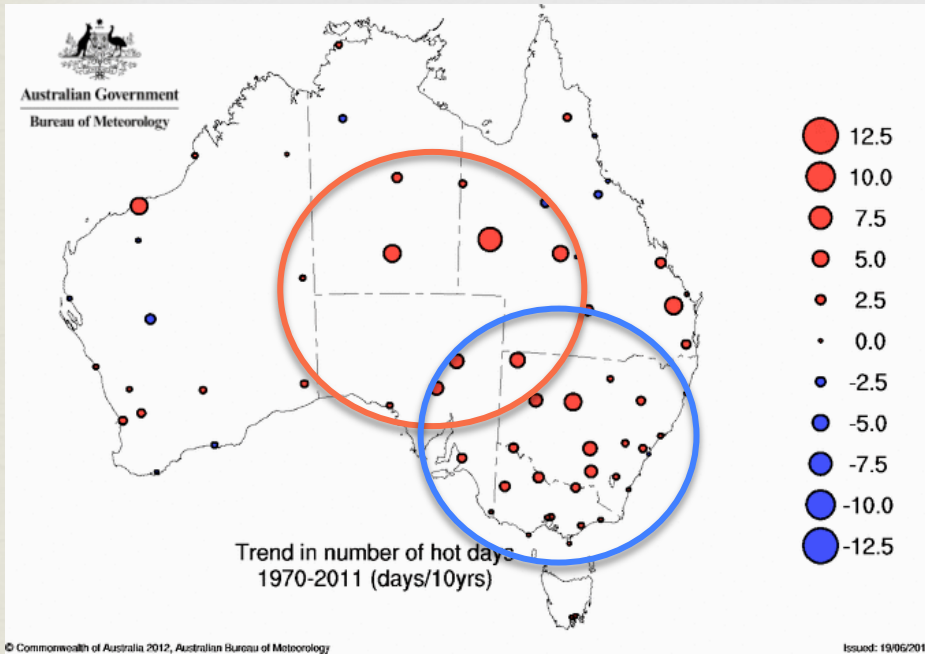
Variable, but marked increase in hot days and no change in extremes.

Climate Change: In Situ and Advective Temperatures



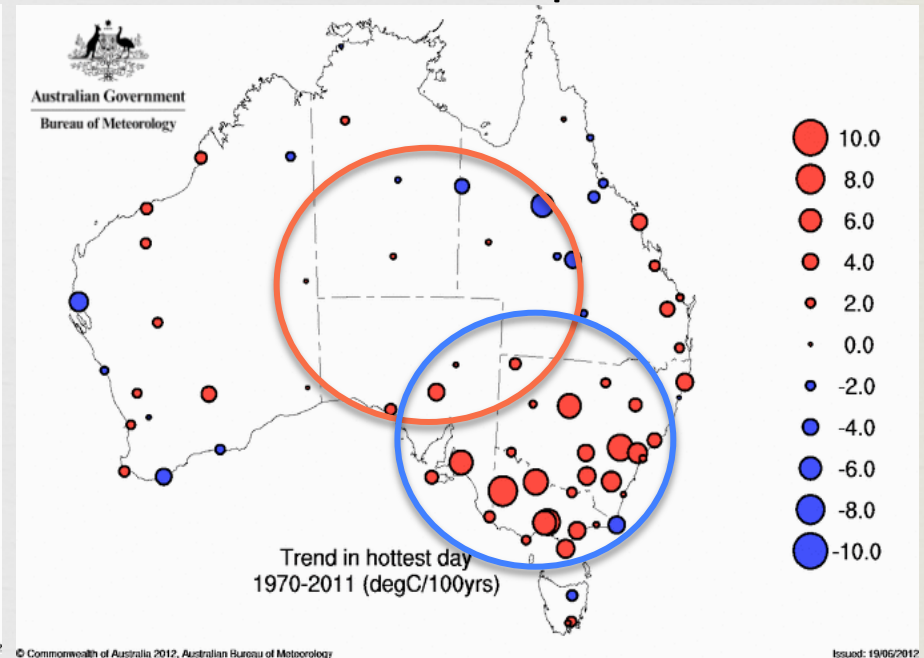
Summary: Trend 1970-2011

>35°C



In Situ

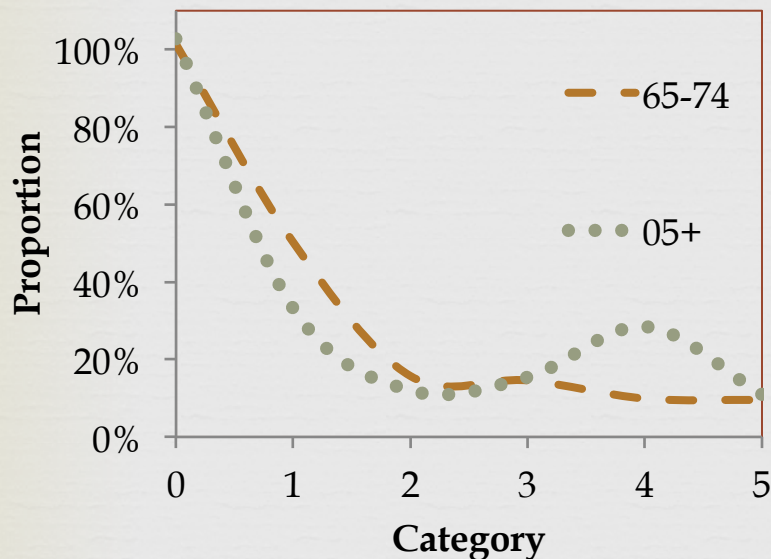
Maximum Temperature



Advective

(Bureau of Meteorology 2013)

Summary



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