Where the Science Debate Stands Now

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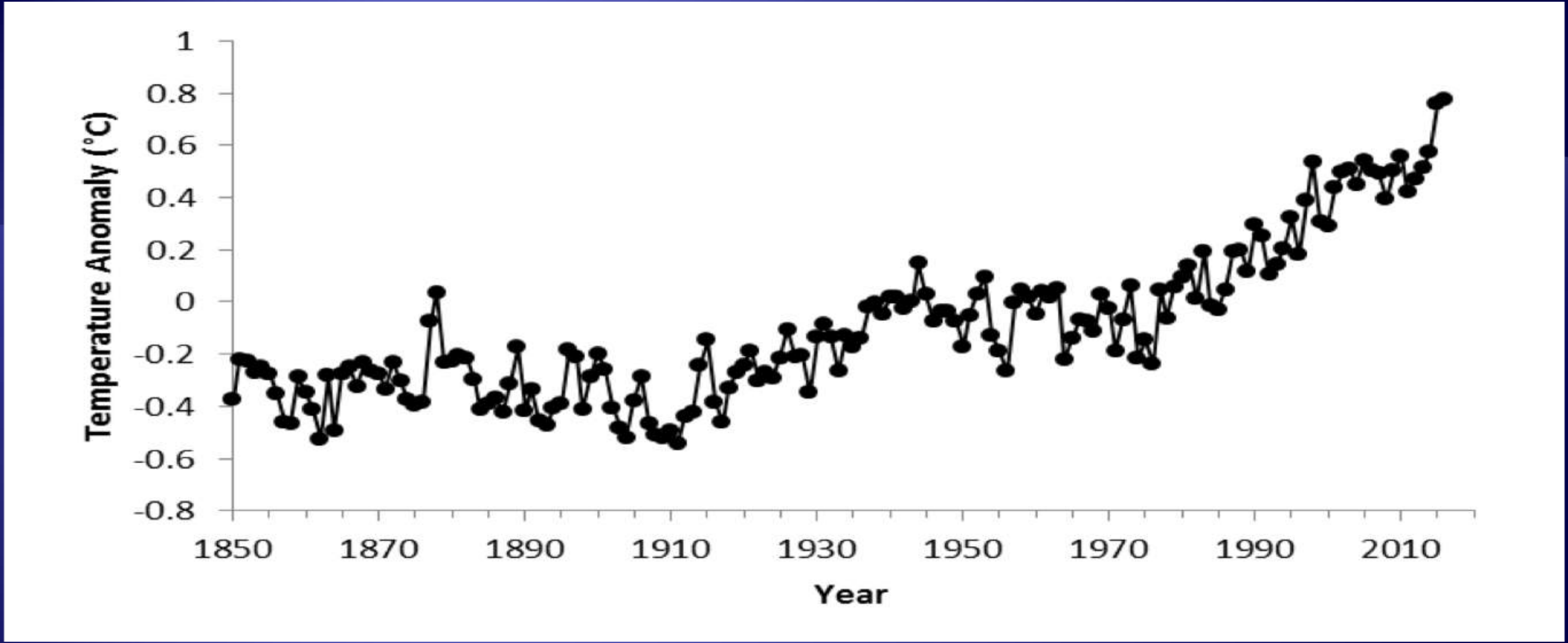
What Is To Be Done

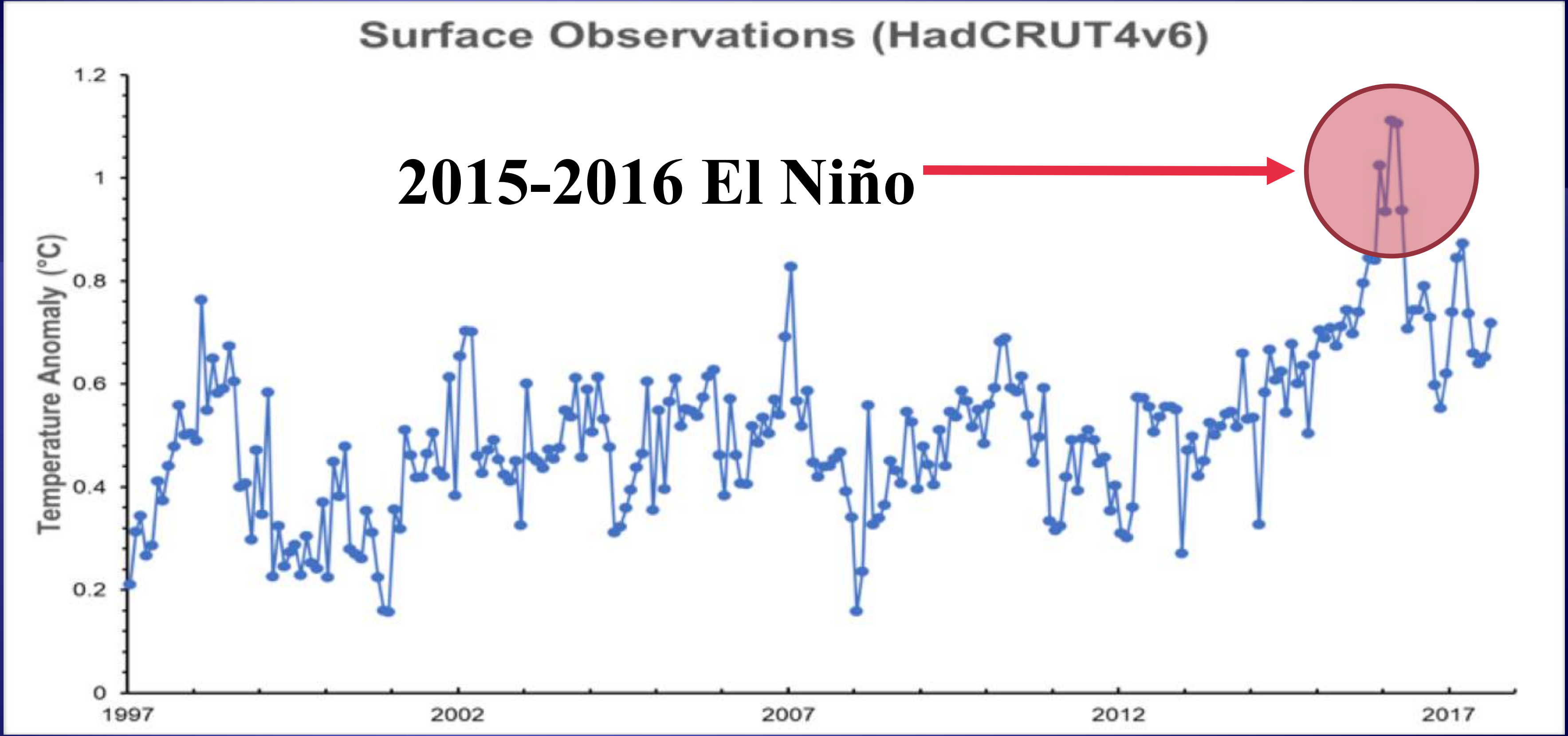
…and do we have the science to do it

Big Problems in Climate Science!

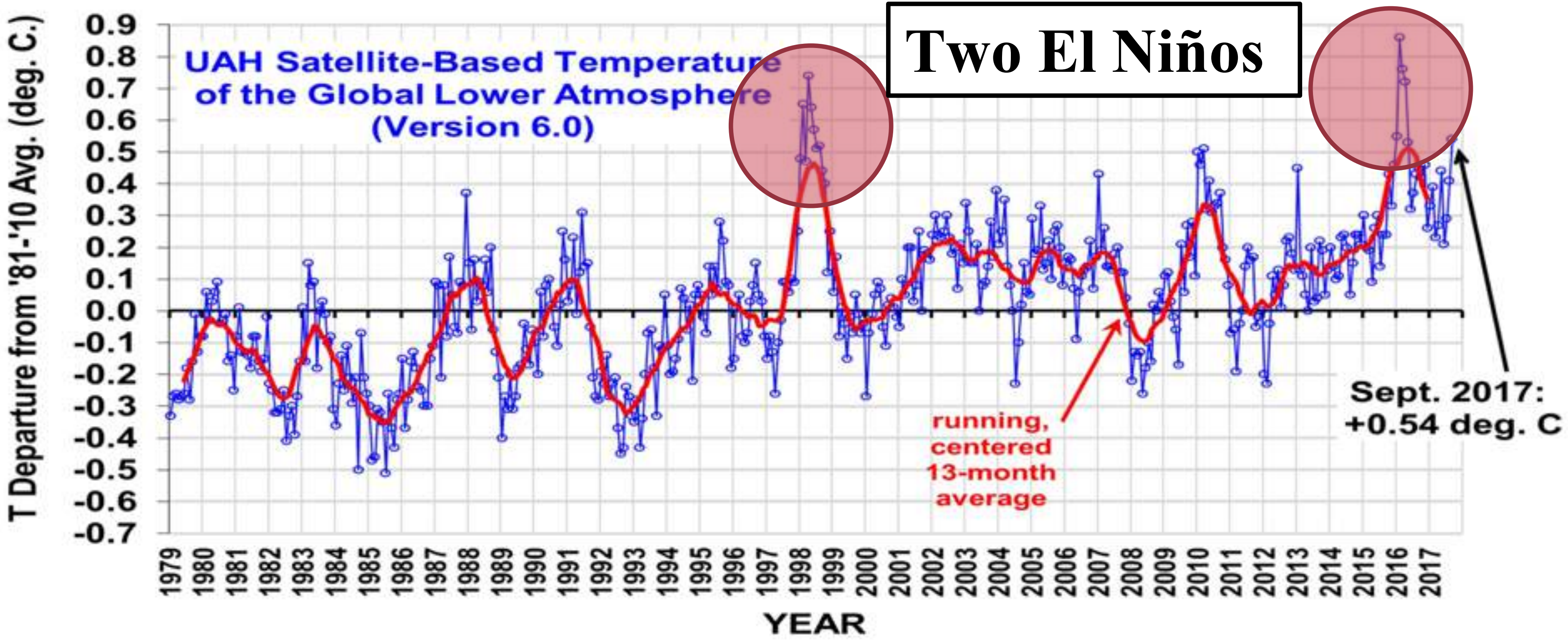


The Surface Temperature History (1850-2016)

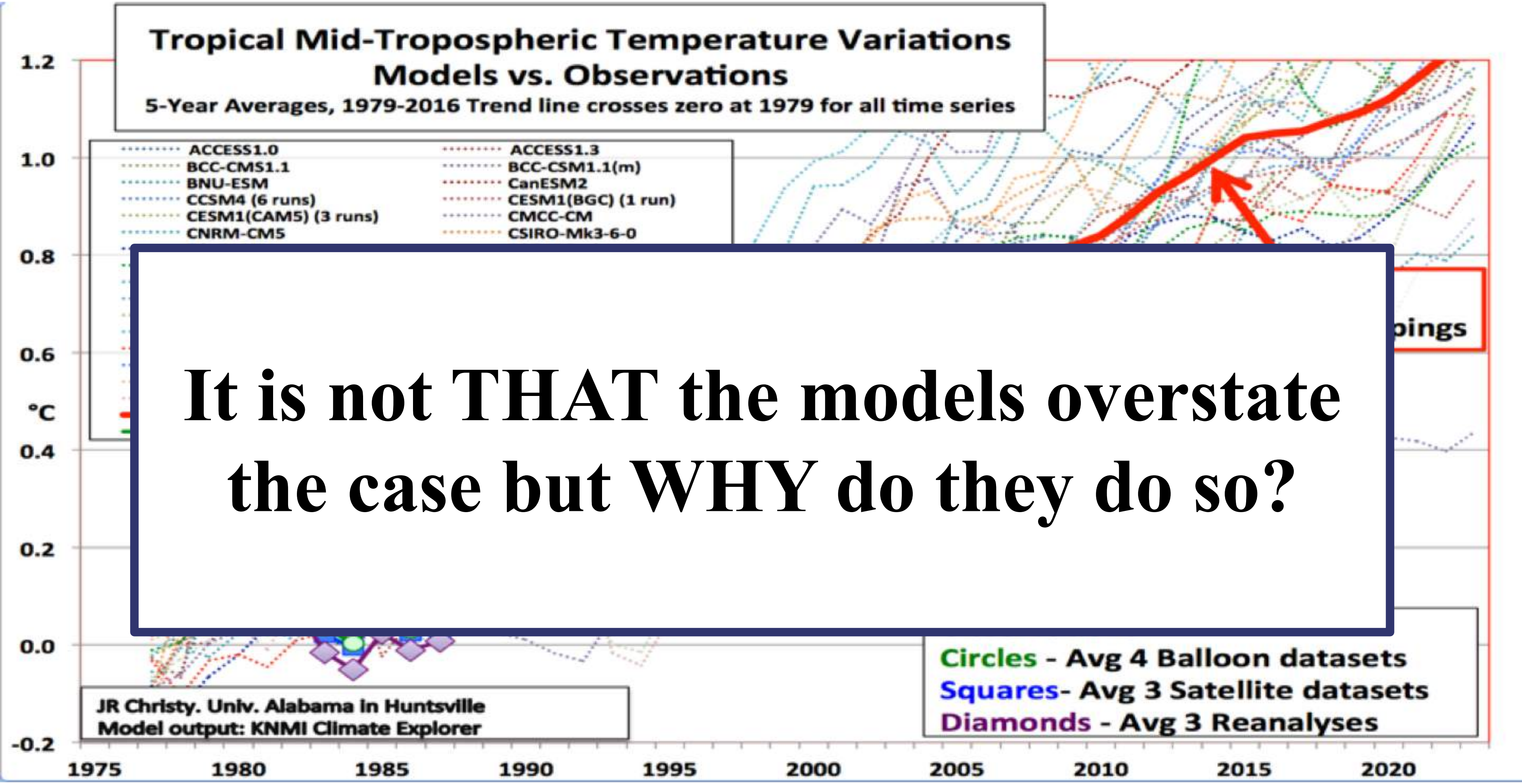
Many problems are associated with this record!



Recent changes in global temperatures show the effect of the development and subsequent decay of the 2015-2016 El Niño

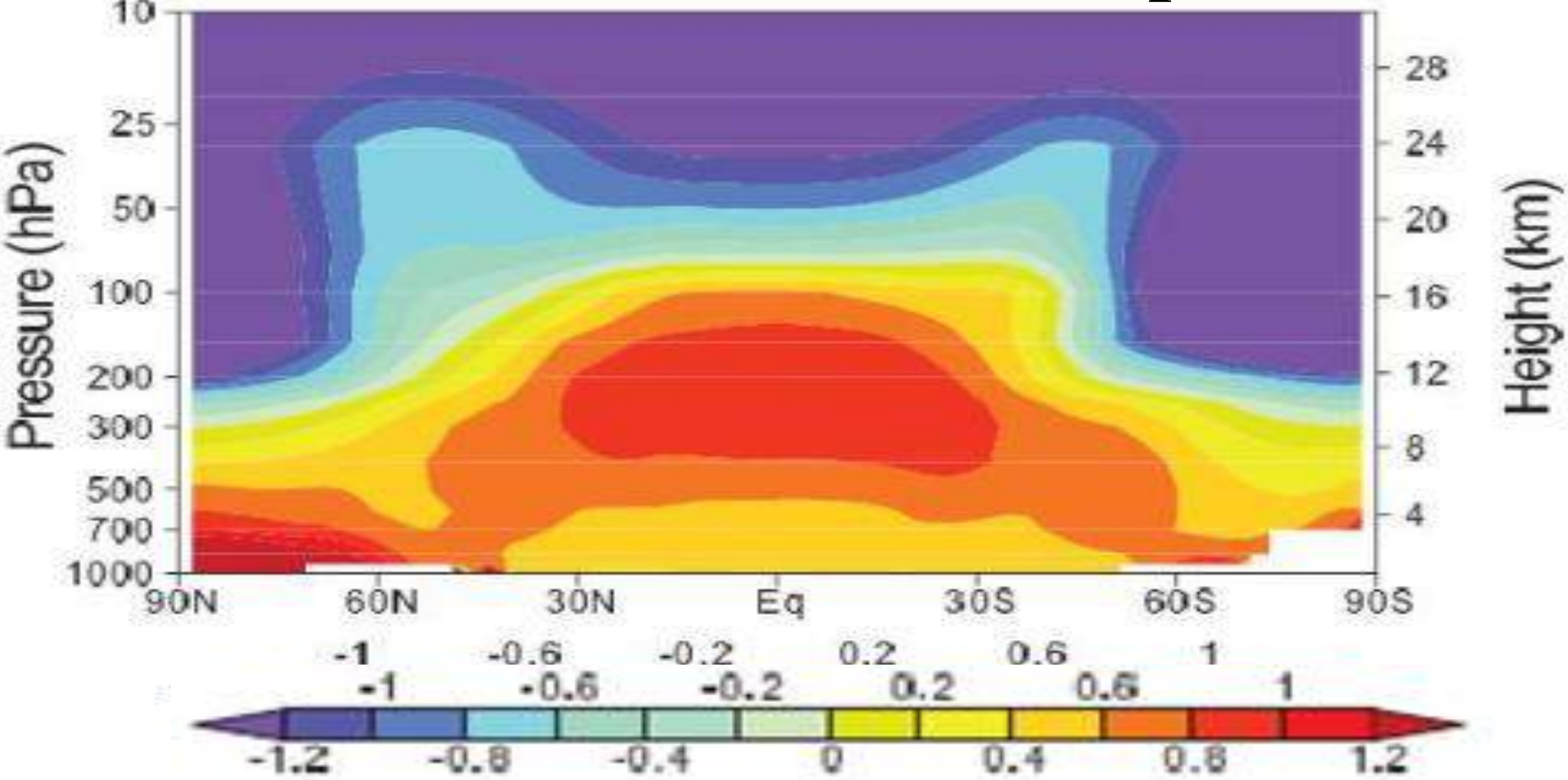


Satellite records show the effect of the two biggest El Niño events – 1998-1999 and 2015-2016

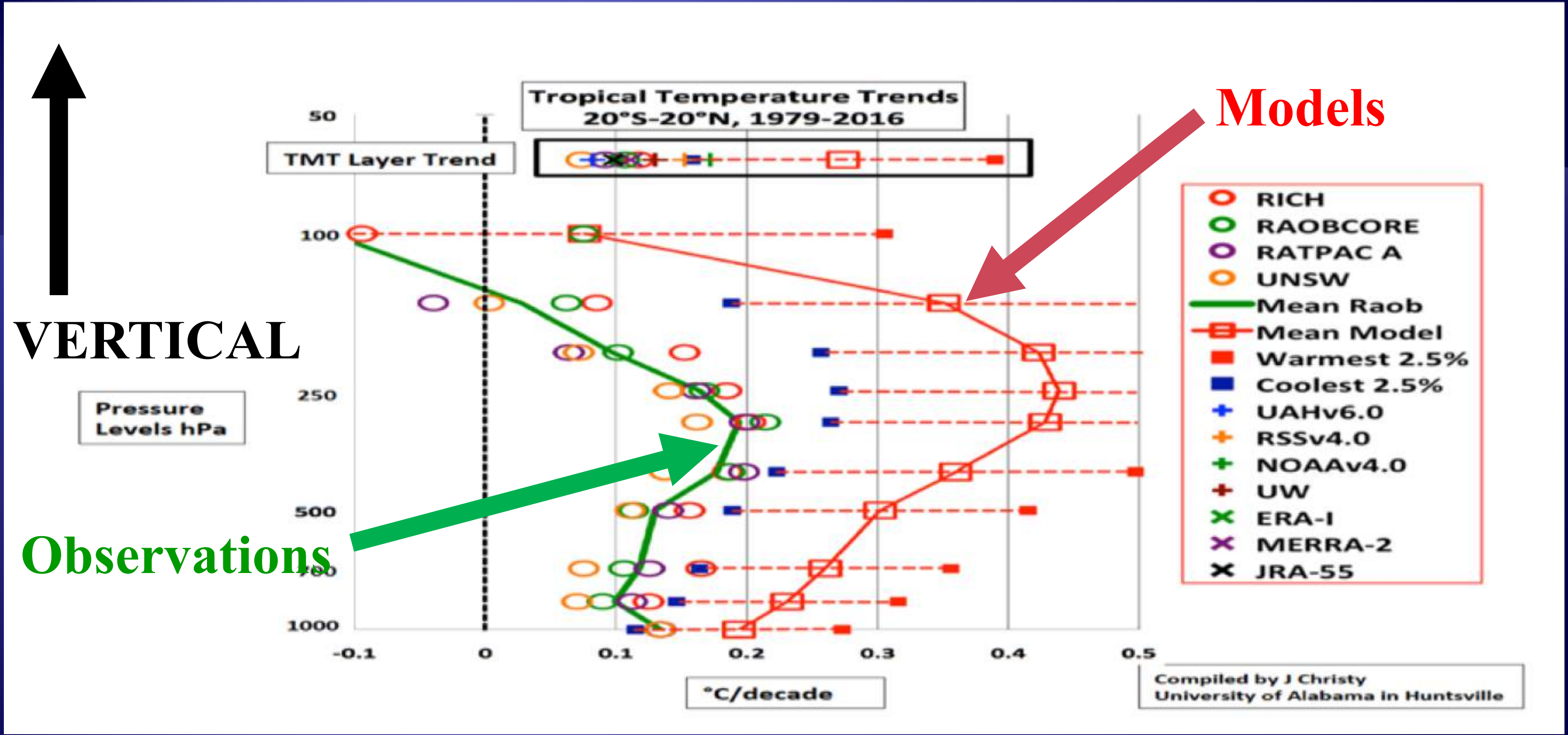


It is not THAT the models overstate the case but WHY do they do so?

IPCC 4th Assessment Report

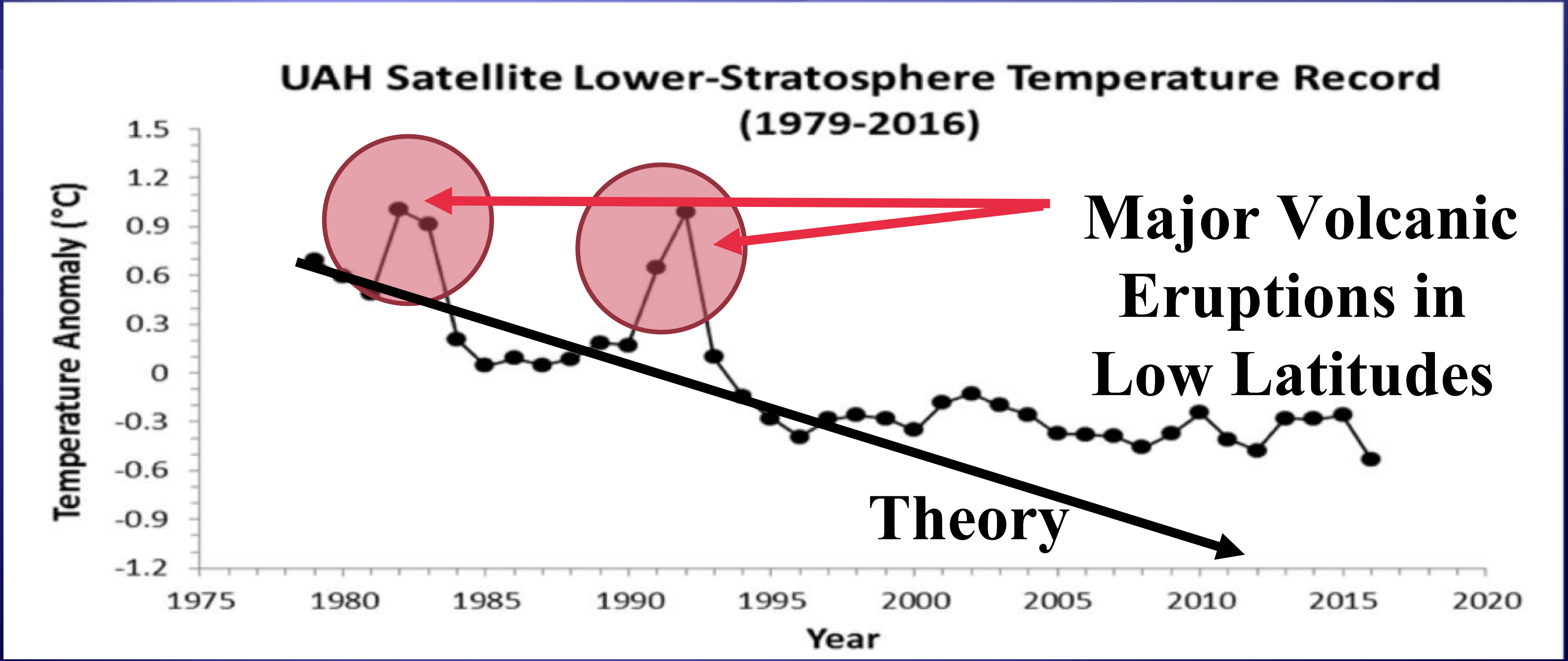


Well-mixed Greenhouse Gases



Comparison of climate model projections and observed temperature trends in the vertical

Lower Stratospheric Temperature History shows a “greenhouse” signal…and a “Hiatus”…



This is why we are very much encouraged to find that **the salient features of climate change distribution projected by the model [in 1989] are becoming evident in the observations.** In other words, the projections shown here were made before the observations confirmed them as being correct, **striking at the heart of the argument that modellers tune their models to yield the correct climate change results.**

– Stouffer and Manabe, "Assessing Temperature Pattern Projections Made in 1989", *Nature Climate Change*, March 2017

Voosen, Science, 2016

For years, climate scientists had been mum in public about their "secret sauce": What happened in the models stayed in the models. **The taboo reflected fears that climate contrarians would use the practice of tuning to seed doubt about [the] models…**

Indeed, whether climate scientists like to admit it or not, **nearly every model has been calibrated precisely to the 20th century climate records—otherwise it would have ended up in the trash.** "It's fair to say all models have tuned it," says Isaac Held, a scientist at the Geophysical Fluid Dynamics Laboratory…

– News item by Paul Voosen, *Science*, oct 28 2016

Storm clouds are too small for climate models to render directly, and so modelers must tune for them.

By Paul Voosen

It began with an unplanned leave of absence. But it has blossomed into a full-fledged transparency movement for climate science.

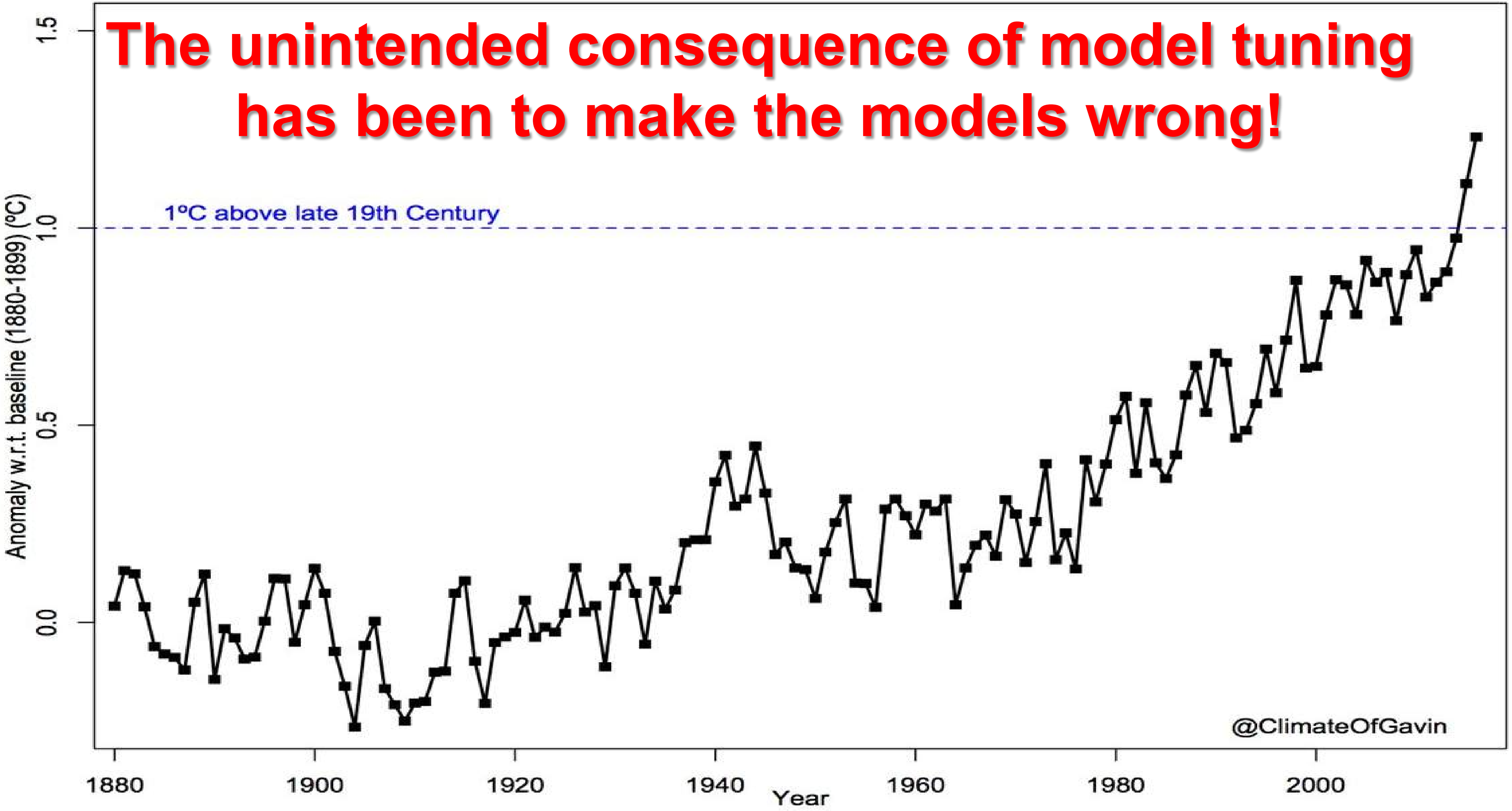
In 2010, Erich Roeckner, a longtime guru behind the global climate model at the Max Planck Institute for Meteorology

With Roeckner out of commission, a team of six people spent several months tuning the MPIM model to match the climate and eliminate the glitch. Their work, though laborious, was fairly routine. What was unusual was their decision, in 2012, to publish a detailed accounting of it. Roeckner's absence was random. But in hindsight, it was the butterfly flapping that

ted by year's end, six U.S. modeling centers will disclose their tuning strategies—showing that many are quite different. "Most groups take pride in calibrating their models in different ways," says Gavin Schmidt, who's coordinating the study and directs

the first try. And so scientists adjust these equations to make sure certain constraints are met, like the total energy entering and leaving the planet, the path of the jet stream, or the formation of low marine clouds off the California coast. Modelers try to restrict their tuning to as few knobs as possible, but it's never as few as they'd like. It's an art and a science. "It's like reshaping an instrument

The unintended consequence of model tuning has been to make the models wrong!

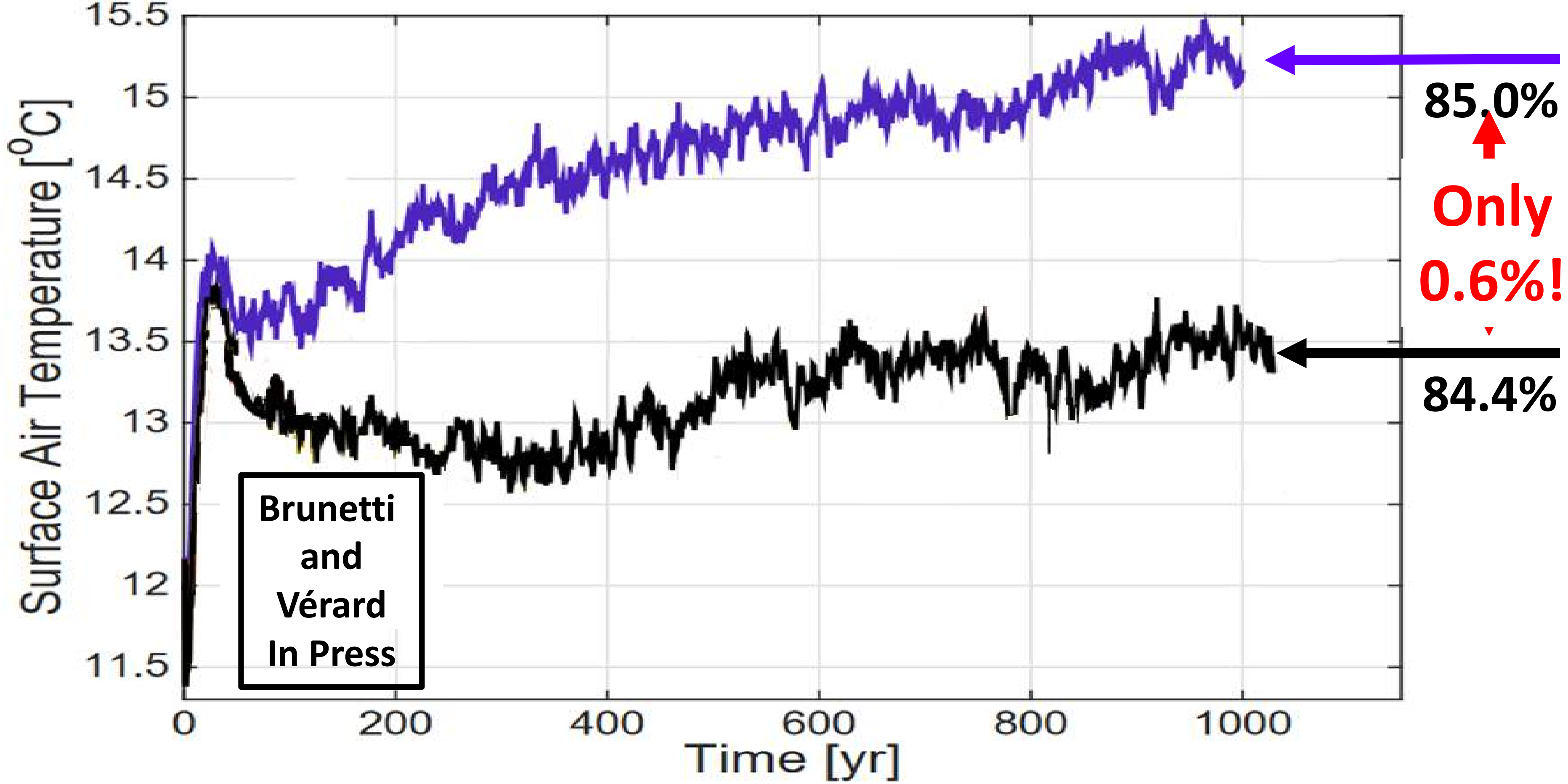


Bulletin of the American Meteorological Society (March 2017)

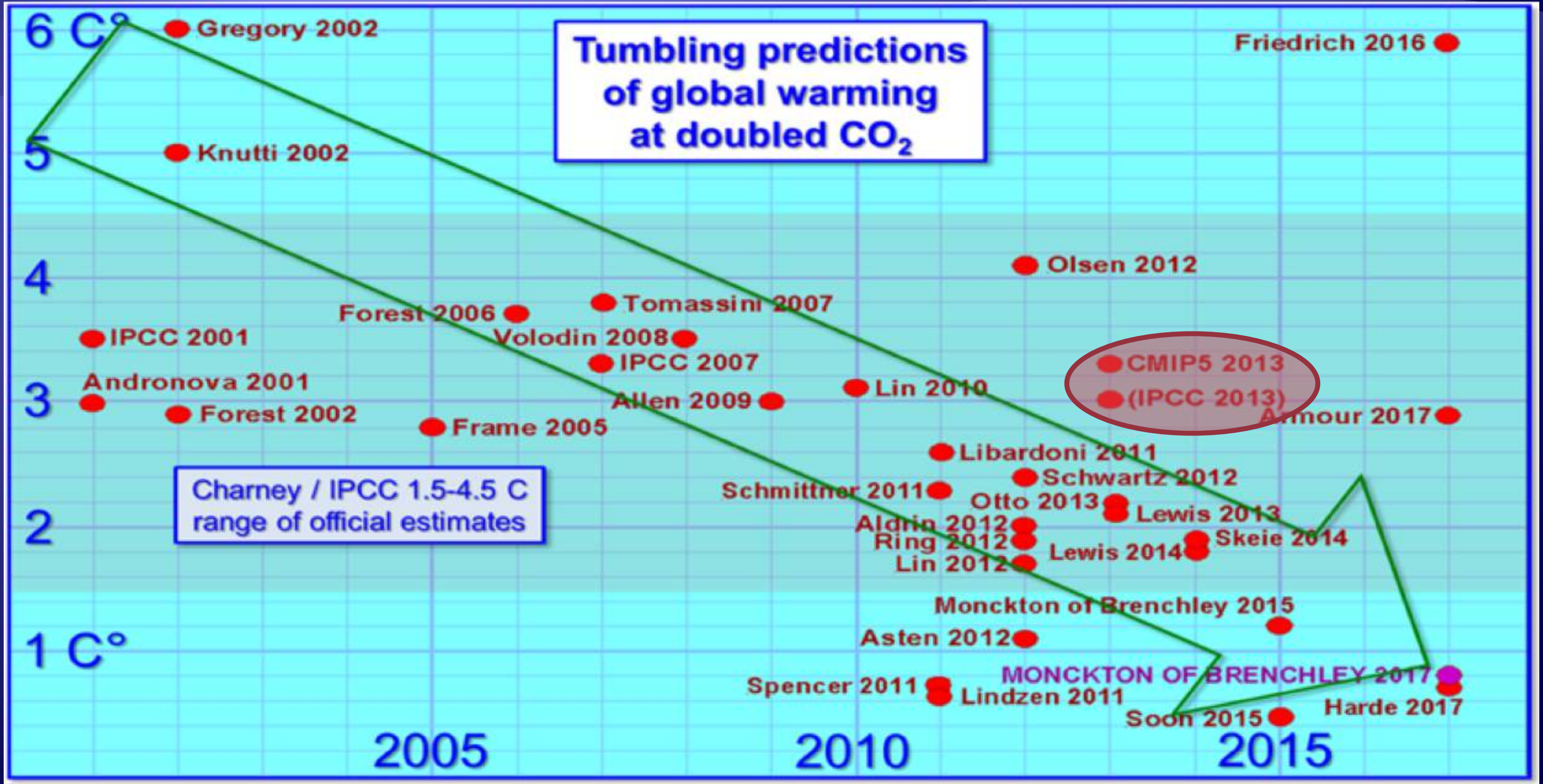
THE ART AND SCIENCE OF CLIMATE MODEL TUNING

THIS IS NOT SCIENCE!

Change in the Relative Humidity Threshold for Low Clouds



What is the true climate sensitivity for a doubling of carbon dioxide?



Bulletin of the American Meteorological Society (March 2017)

THE ART AND SCIENCE OF CLIMATE MODEL TUNING

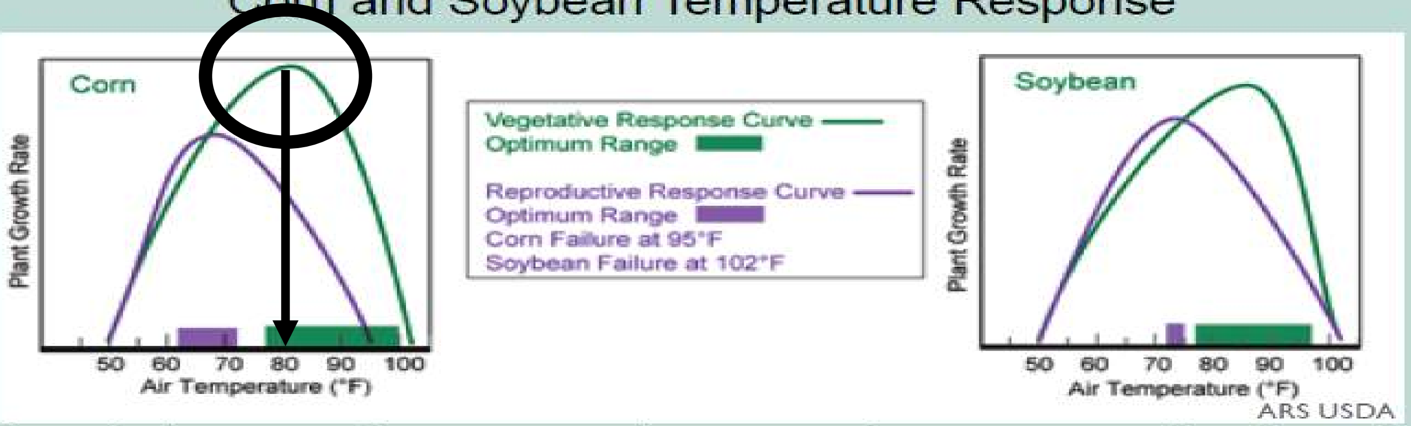
Either reducing the number of models or over-tuning, especially if an explicit or implicit consensus emerges in the community on a particular combination of metrics, would artificially reduce the dispersion of climate simulations. **It would not reduce the uncertainty, but only hide it.**

developed for numerical weather forecasting (e.g., Phillips 1956). The coupling of global atmospheric and oceanic models began with Manabe and Bryan (1969) and came of age in the 1980s and 1990s. Global climate models or Earth system models (ESMs) are nowadays used extensively to study climate changes caused by anthropogenic and natural perturbations (Lynch 2008; Edwards 2010). The evaluation and

Model Intercomparison Project (CMIP) constitute a large part of the material synthesized in the Intergovernmental Panel on Climate Change (IPCC) Assessment Reports. Beyond their use for prediction and projection at meteorological to climatic time scales, global models play a key role in climate science. They are used to understand and assess the mechanisms at work, while accounting for the complexity of the

The 2nd National Assessment completely misleads on temperature and plant growth

Corn and Soybean Temperature Response



For each plant variety, there is an optimal temperature for vegetative growth, with growth dropping off as temperatures increase or decrease. Similarly, there is a range of temperatures at which a plant will produce seed. Outside of this range, the plant will not reproduce. As the graphs show, corn will fail to reproduce at temperatures above 95°F and soybean above 102°F.

Their chart implies the relationship between growth and air temperature is independent of the CO_2 concentration

Growing Degree Days and Applications

Growing Degree Days

Just as soil temperature influences crop emergence, the soil and air temperature influence growth and development of the plant. Temperature is just one important factor. Moisture is important; light is important. Many other factors of the environment are important to crop development, but temperature is a very important

temperature, with the ideal temperature for crop growth, if everything else is satisfactory such as nutrition and water availability, being somewhere around 93 °F (34 °C) (Fig. 2.11). Common corn varieties will not grow below 49 °F (9.5 °C), will grow fastest at 93 °F (34 °C), will not grow above 115 °F (46 °C), and die at 118 °F (48 °C). The growth rate experienced responds to temperature in an "S-shaped" curve between 49 °F (9.5 °C)

search GO

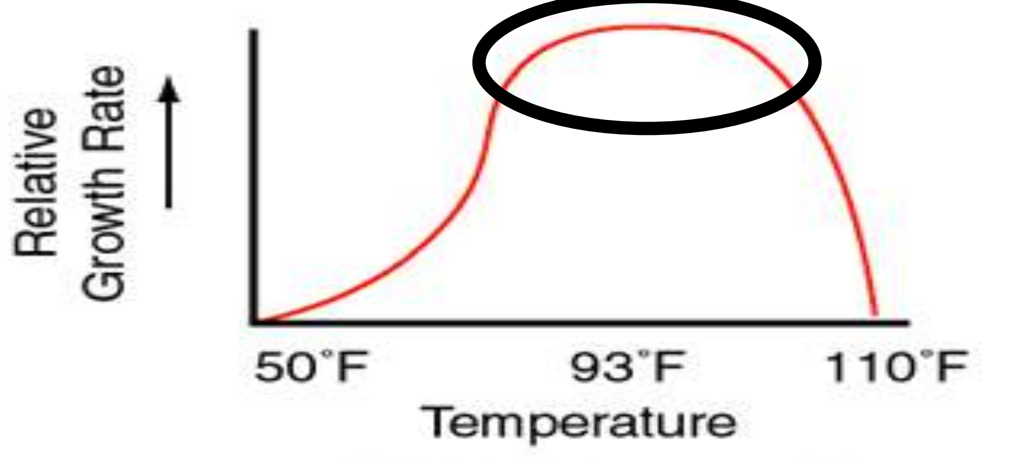
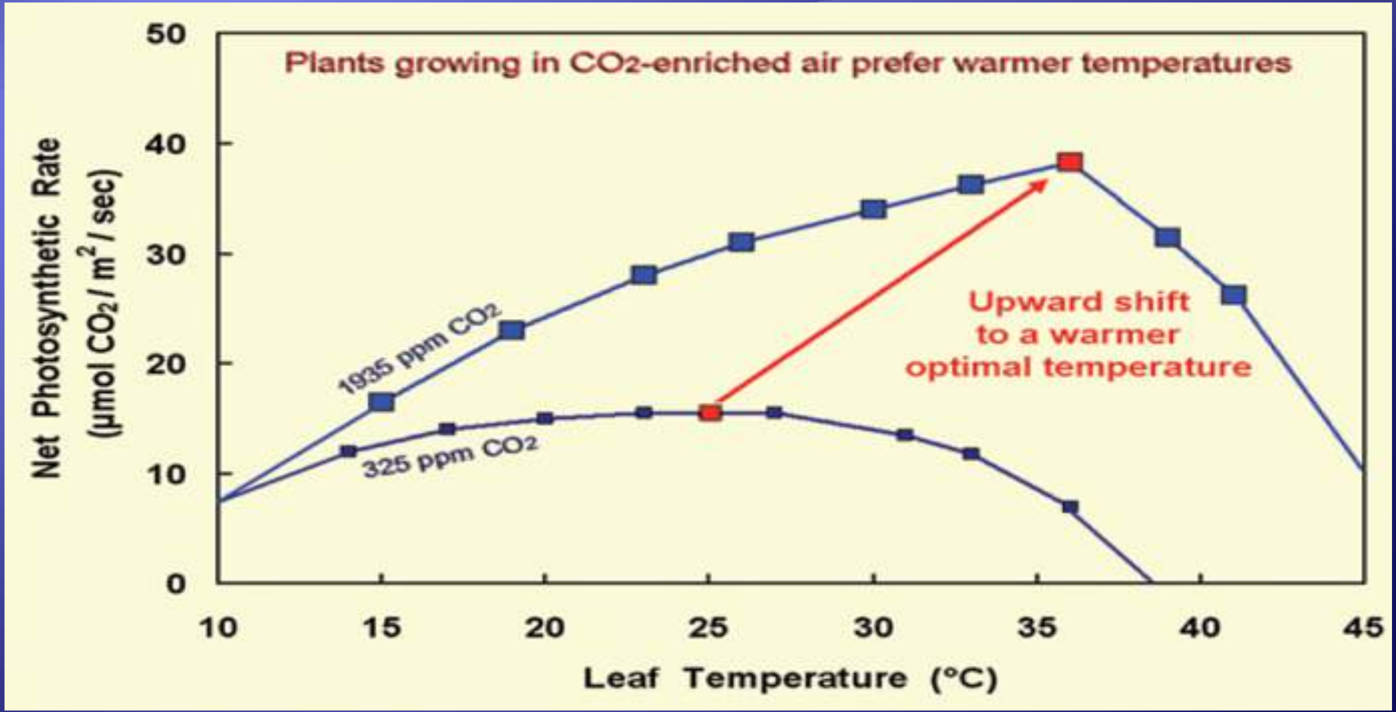


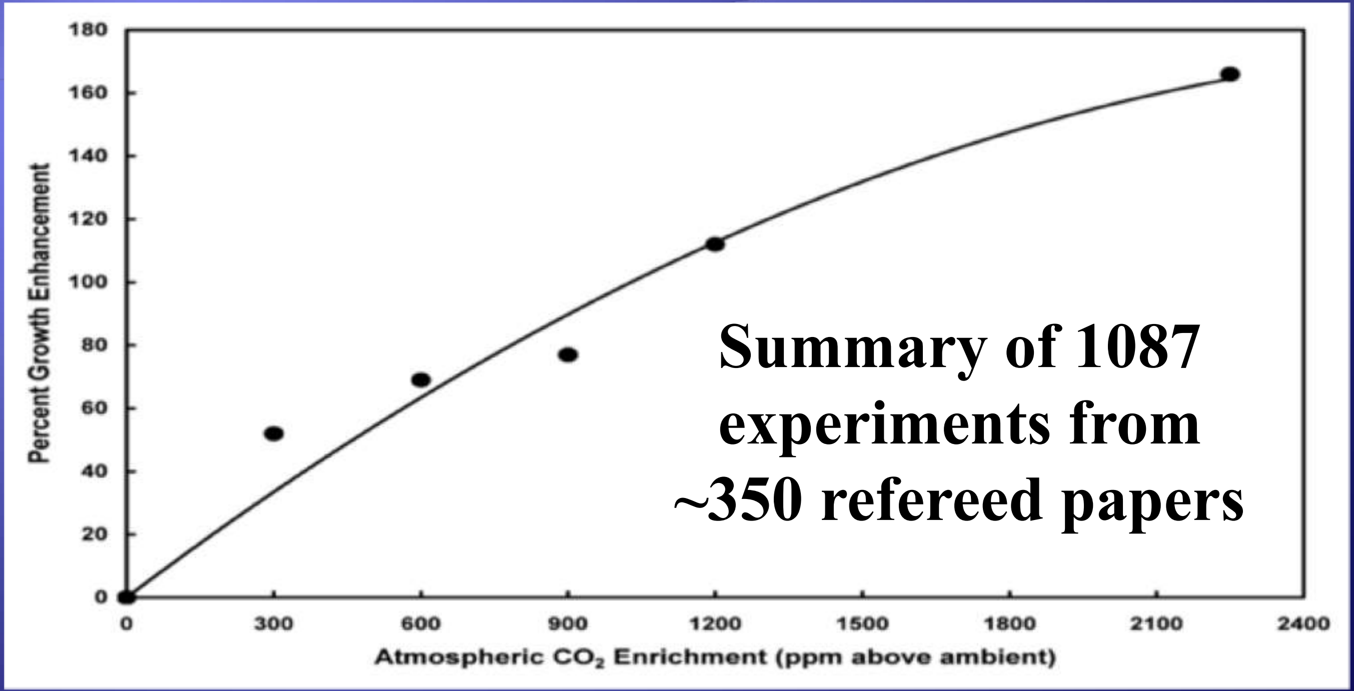
Fig. 2.12 Relative growth rate of corn as affected by air temperature.

The 2nd National Assessment completely misleads on temperature and plant growth



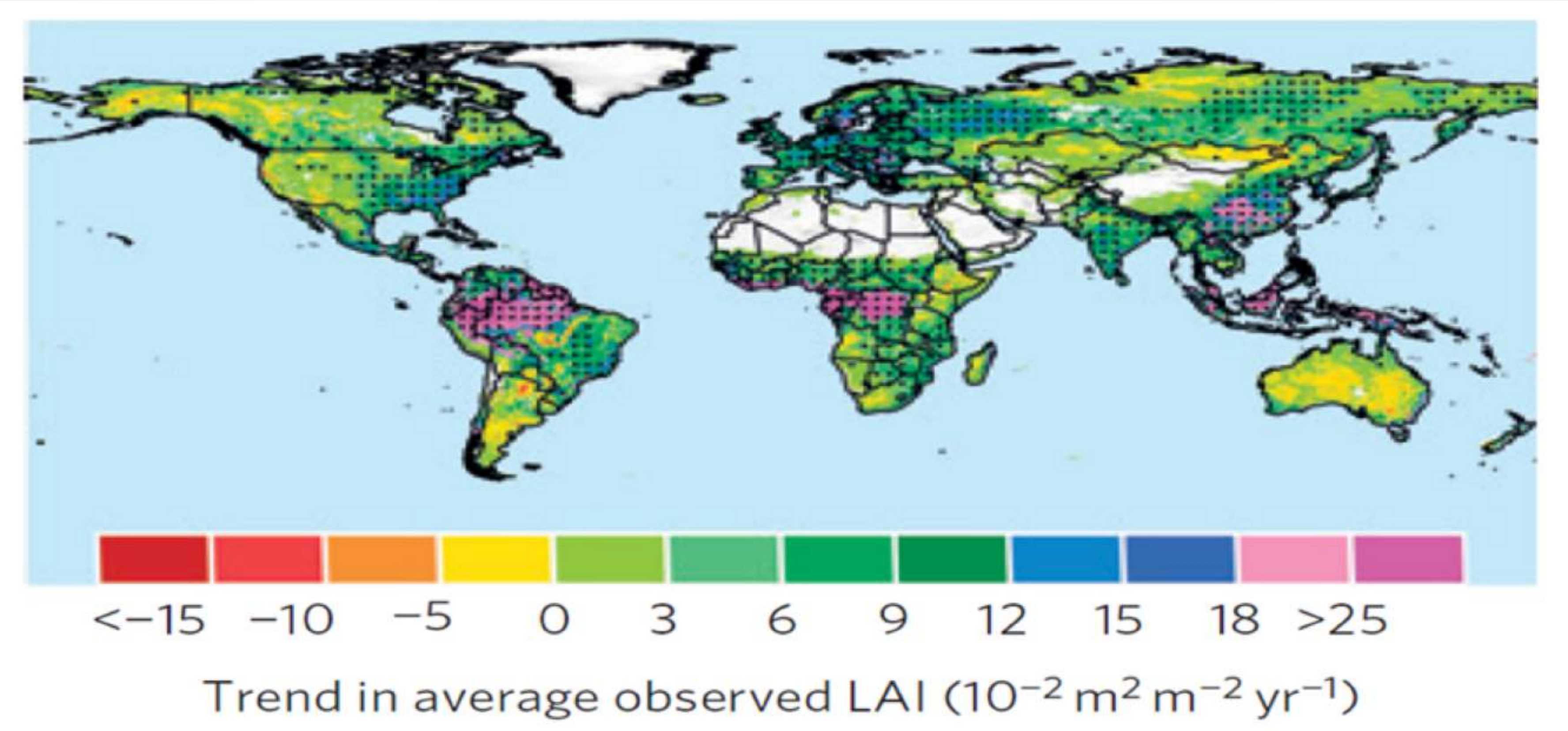
In reality, higher CO_2 dramatically *raises the optimum growth temperature*

Plant growth enhanced from elevated CO_2 concentrations



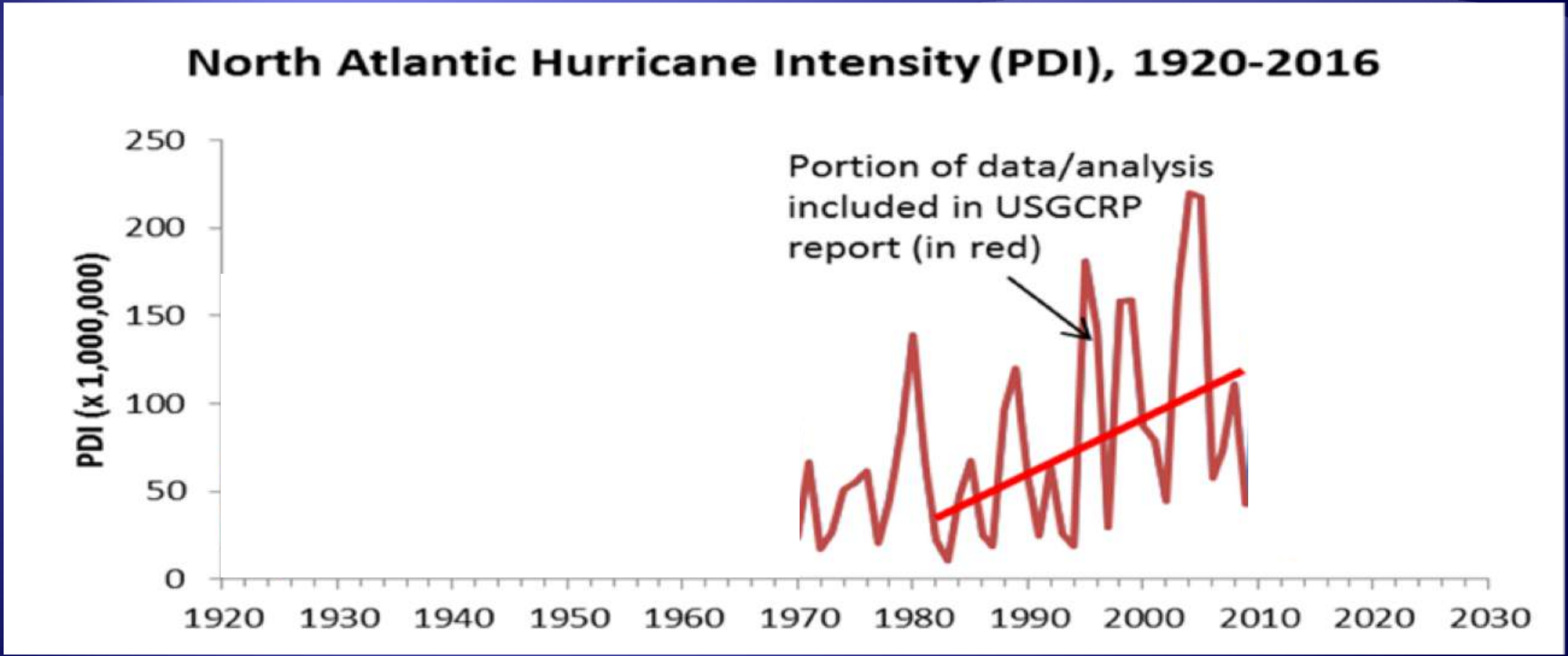
The net effect is that elevated CO_2 produces (1) *more food* and (2) produces a *greener planet*.

Spatial Trends in Leaf Area Index (1982-2009)



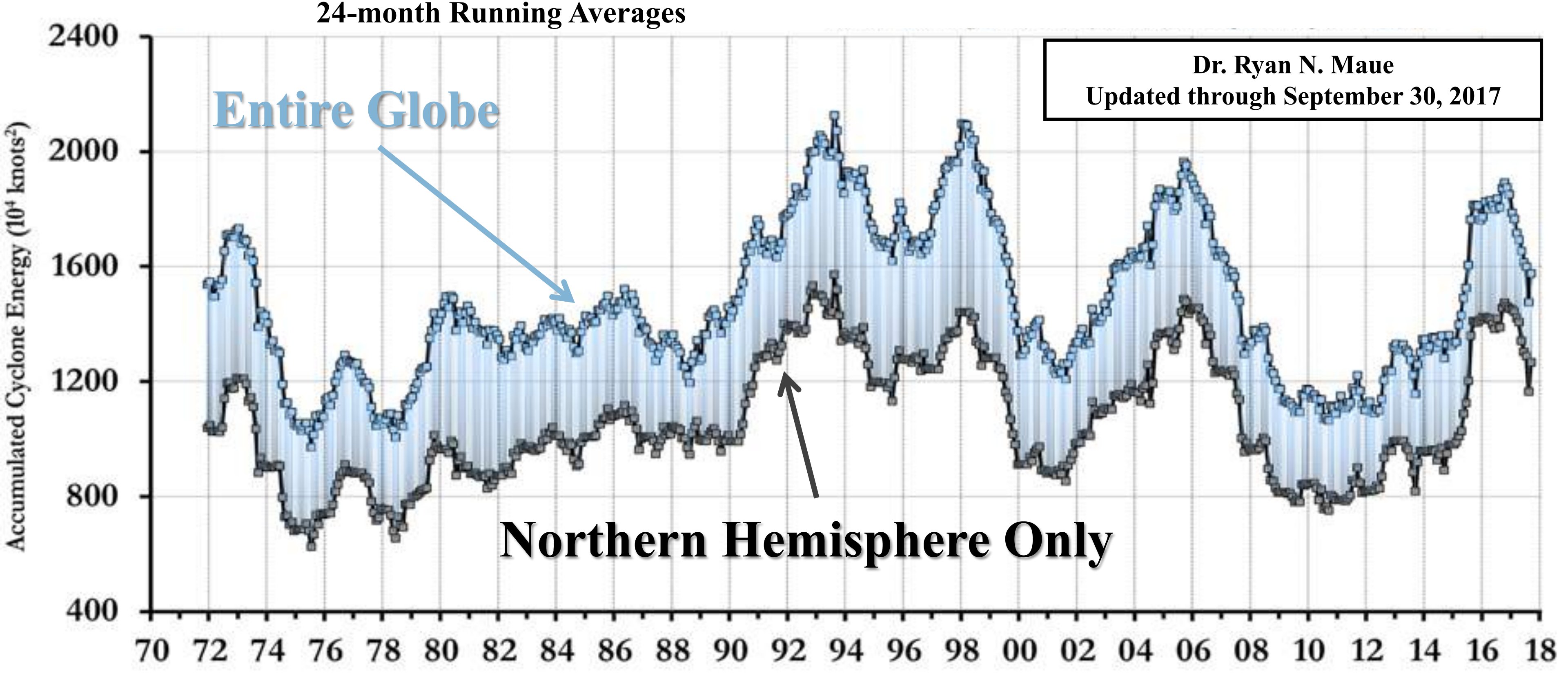

Are Storms Getting Worse?

The National Assessment (2014) provides misleading information



Complete history of the Atlantic Hurricane Power Dissipation Index

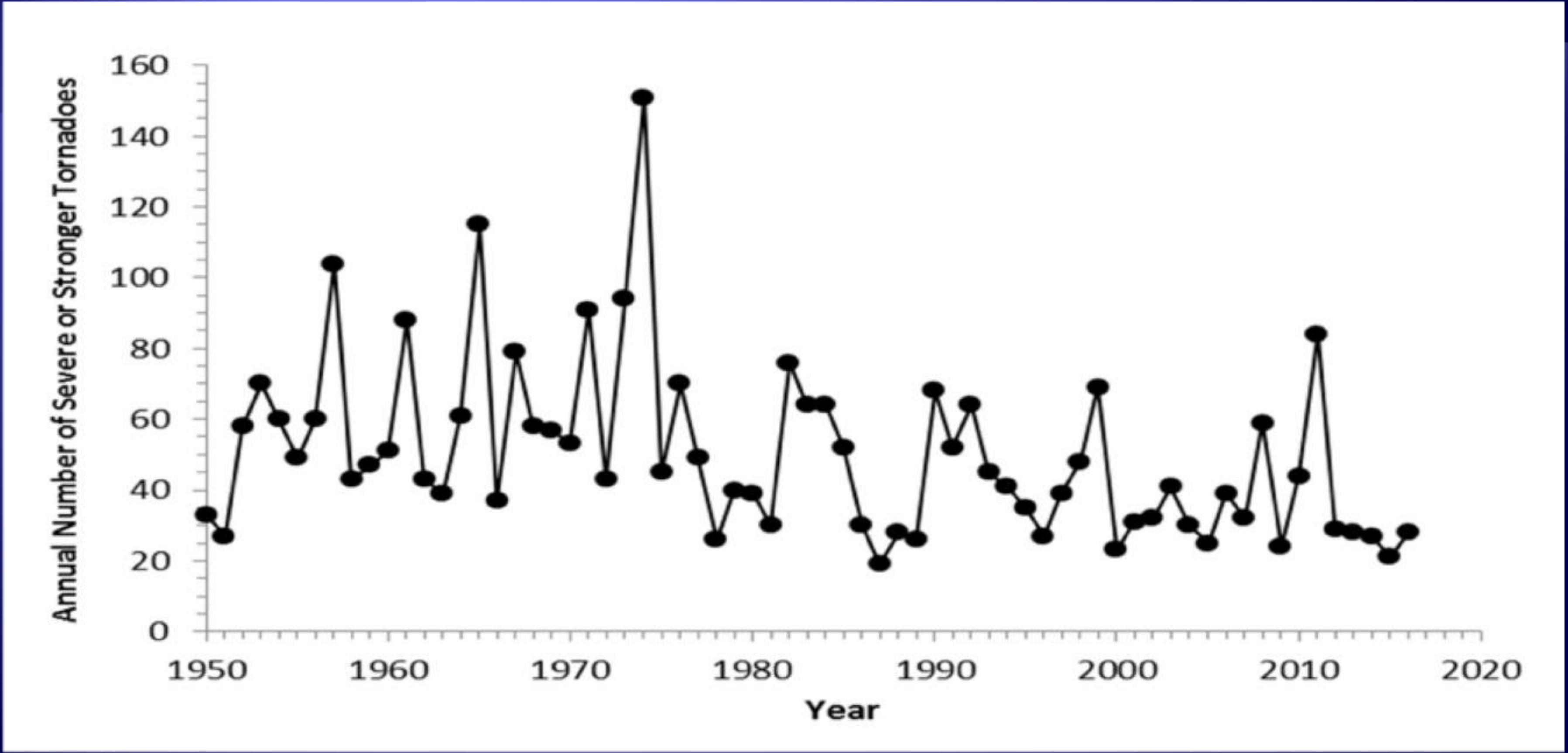
Tropical Cyclone "Accumulated Cyclone Energy" (ACE)



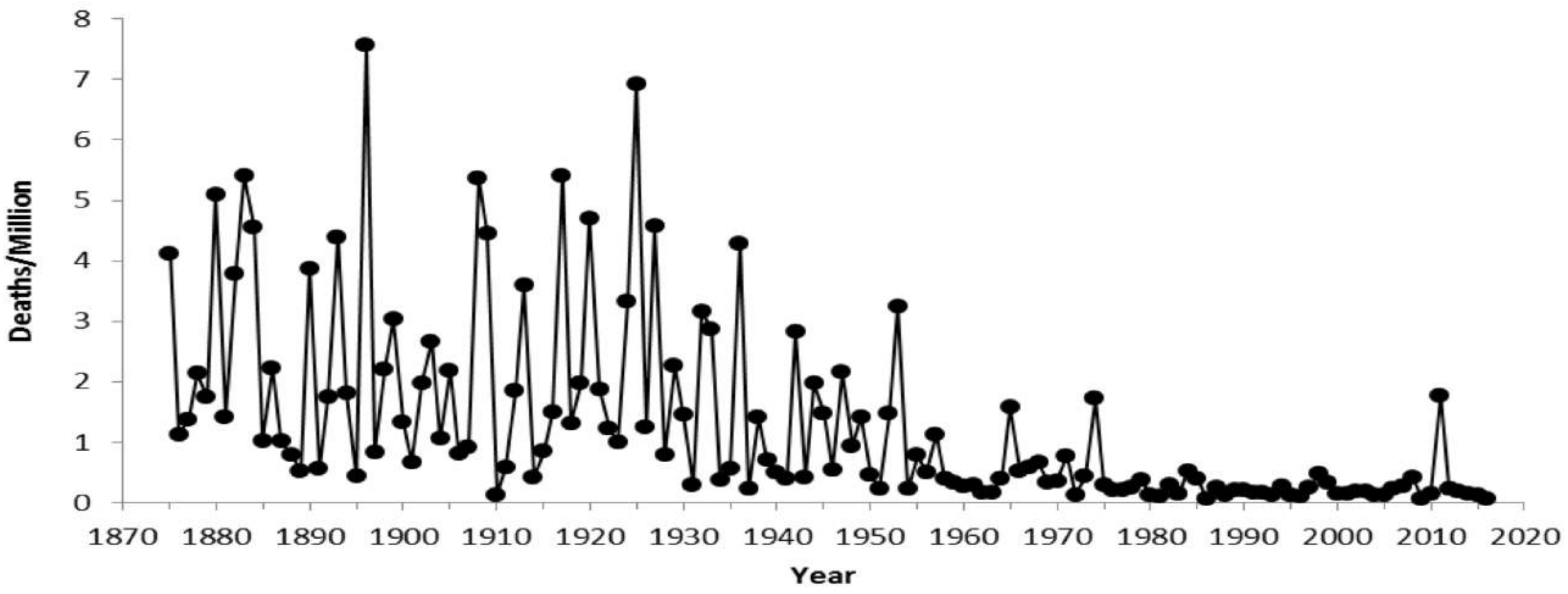
Integrated over ALL Tropical Cyclone producing basins

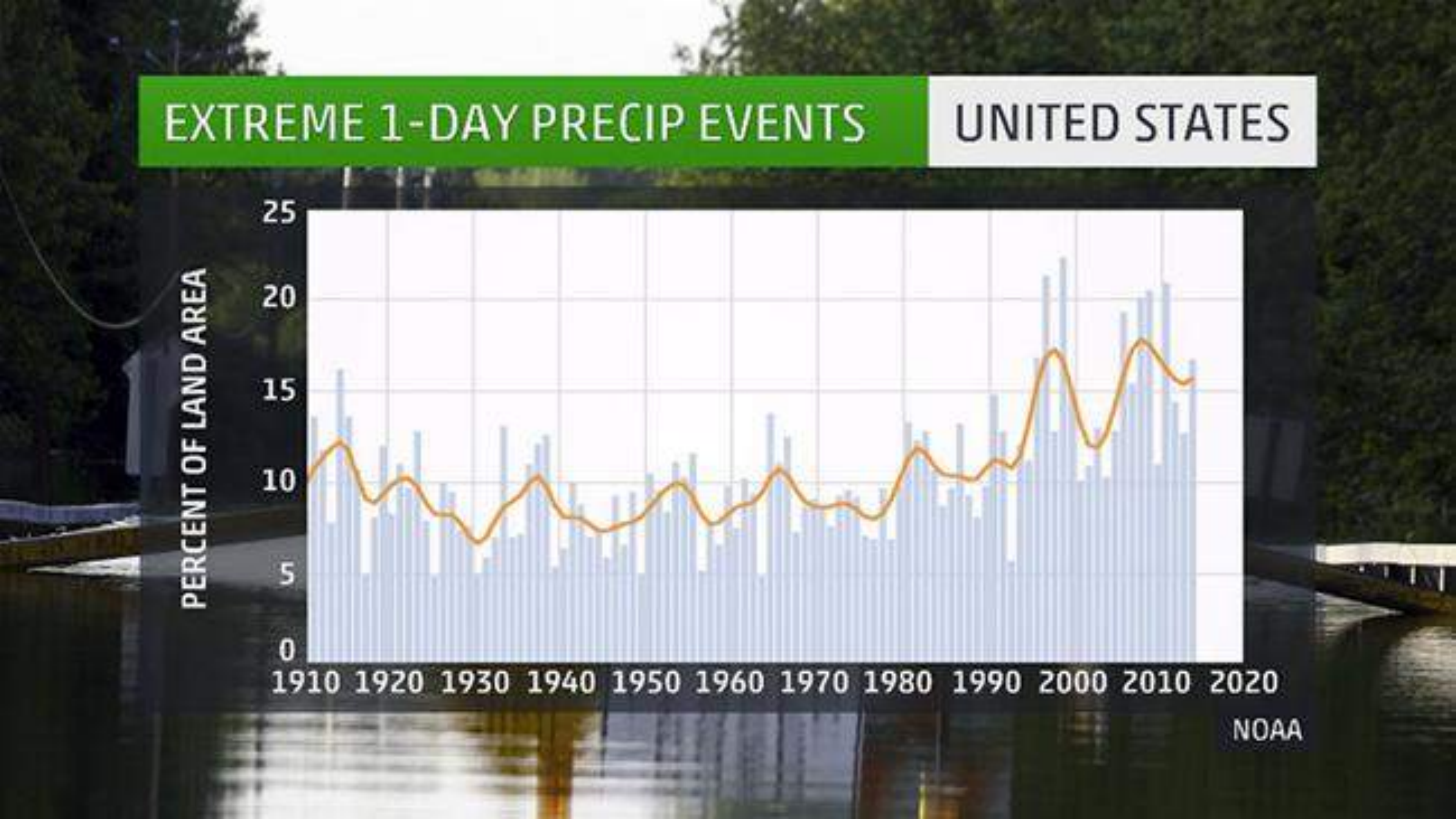
http://wx.graphics/tropical/global_running_ace.png

Annual Number of Severe (F3-F5) Tornadoes in the United States

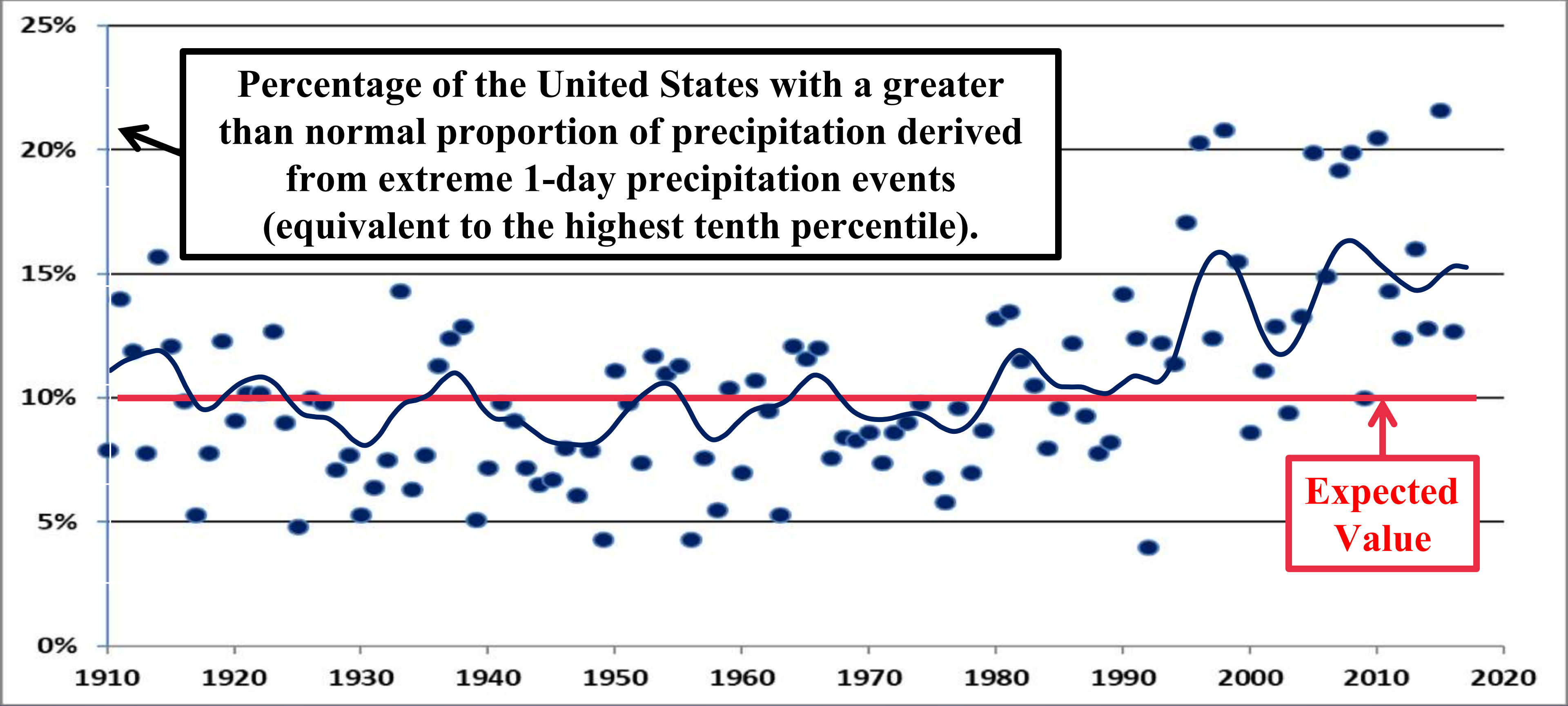


Annual United States Tornado Deaths



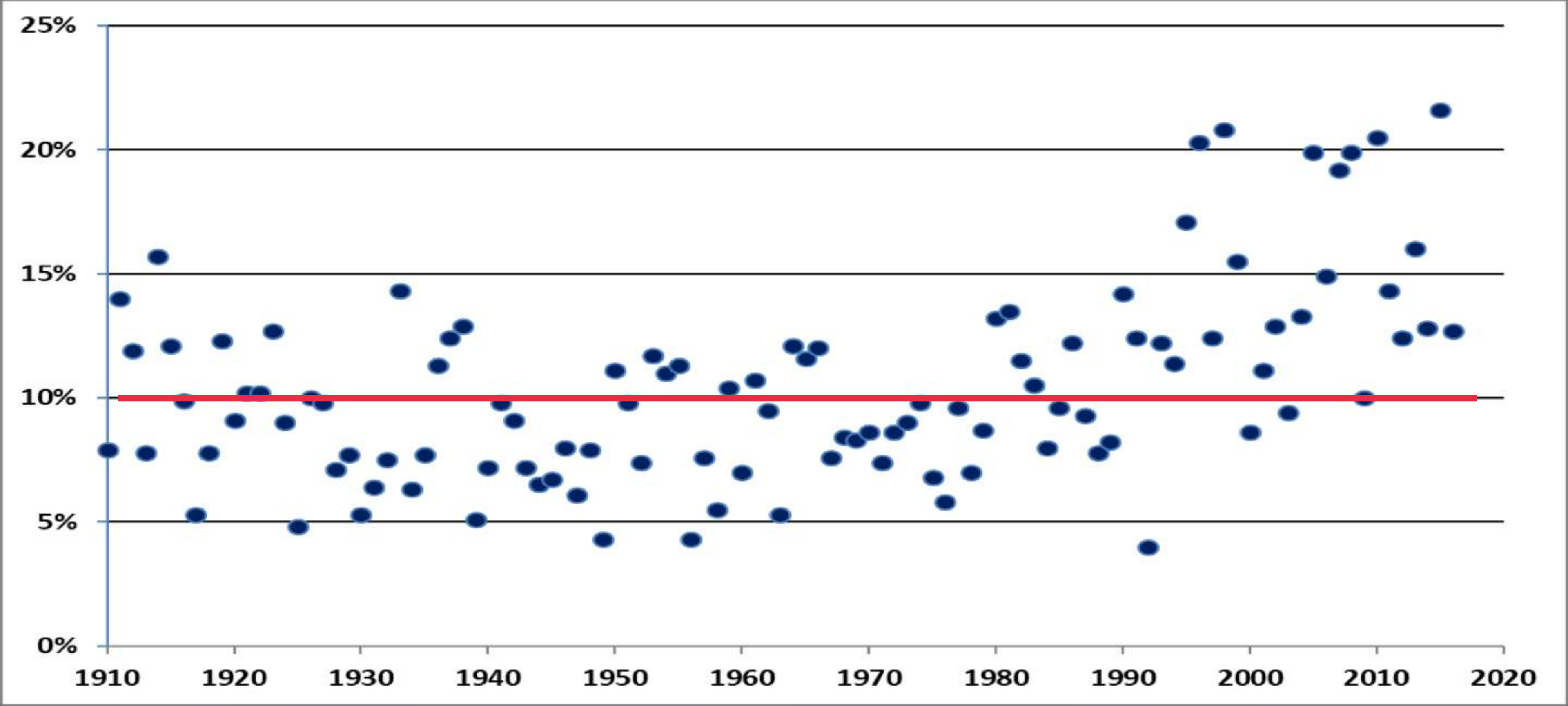

EXTREME 1-DAY PRECIP EVENTS
UNITED STATES
PERCENT OF LAND AREA
25
20
15
10
5
0
1910
1920
1930
1940
1950
1960
1970
1980
1990
2000
2010
2020
NOAA

Extreme 1-Day Precipitation Events for the United States



Data: 1910 to 2016

Extreme 1-Day Precipitation Events for the United States



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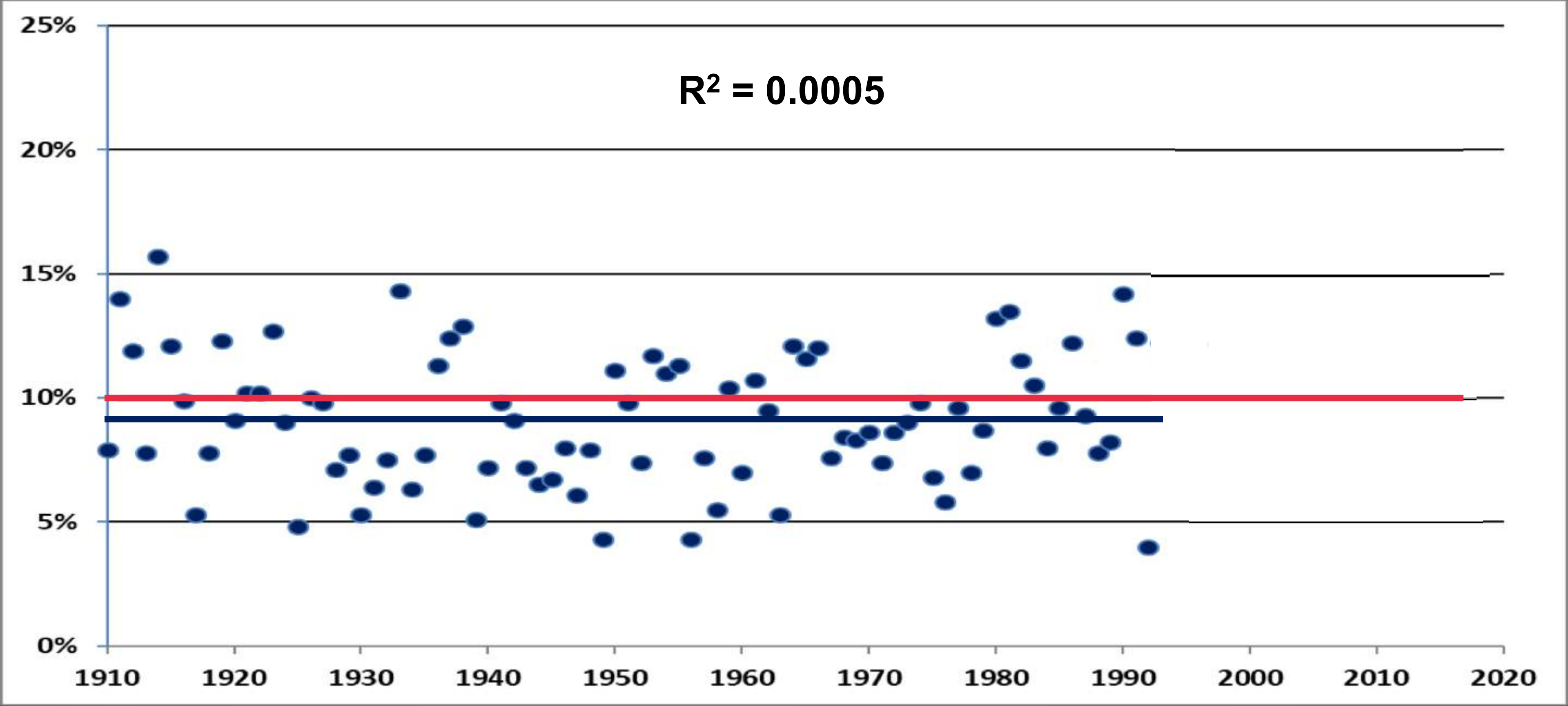
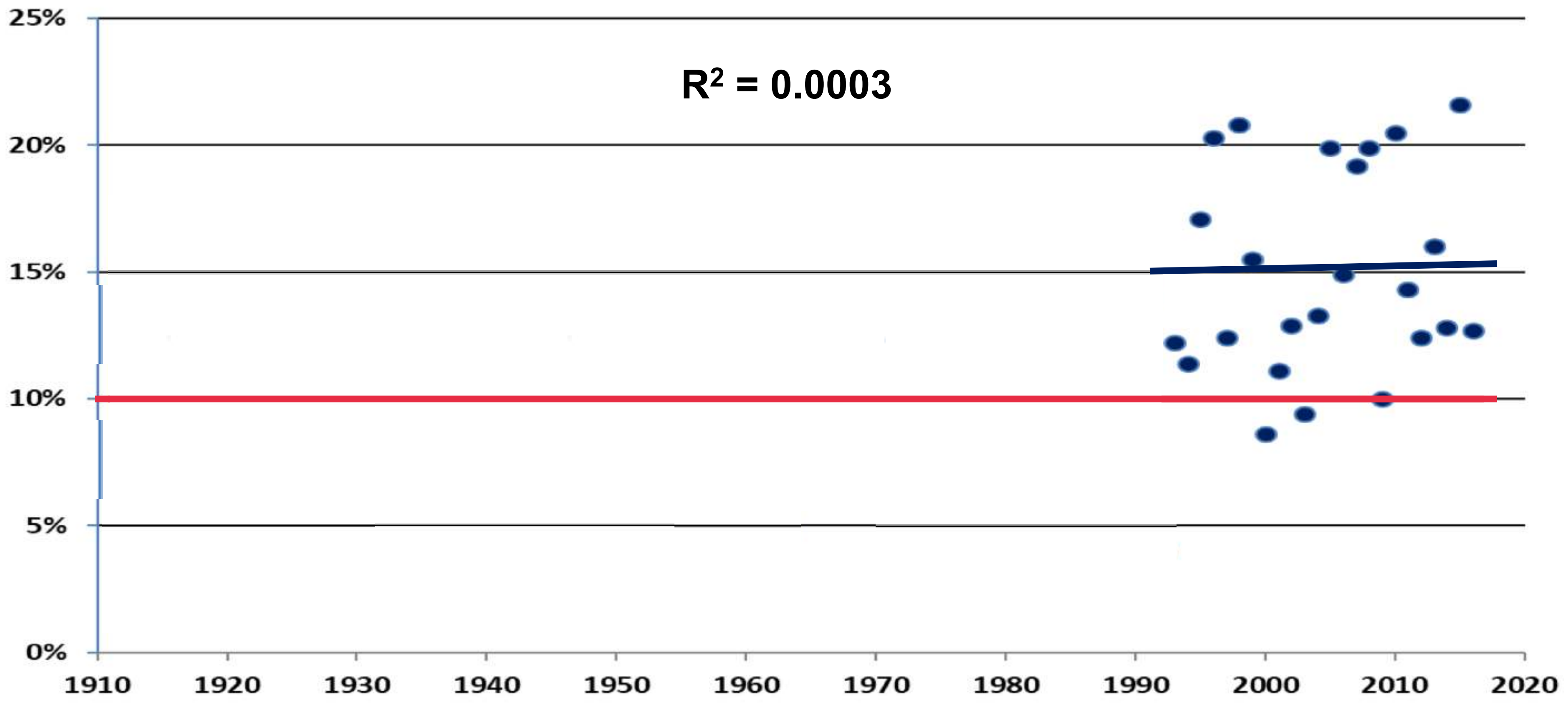


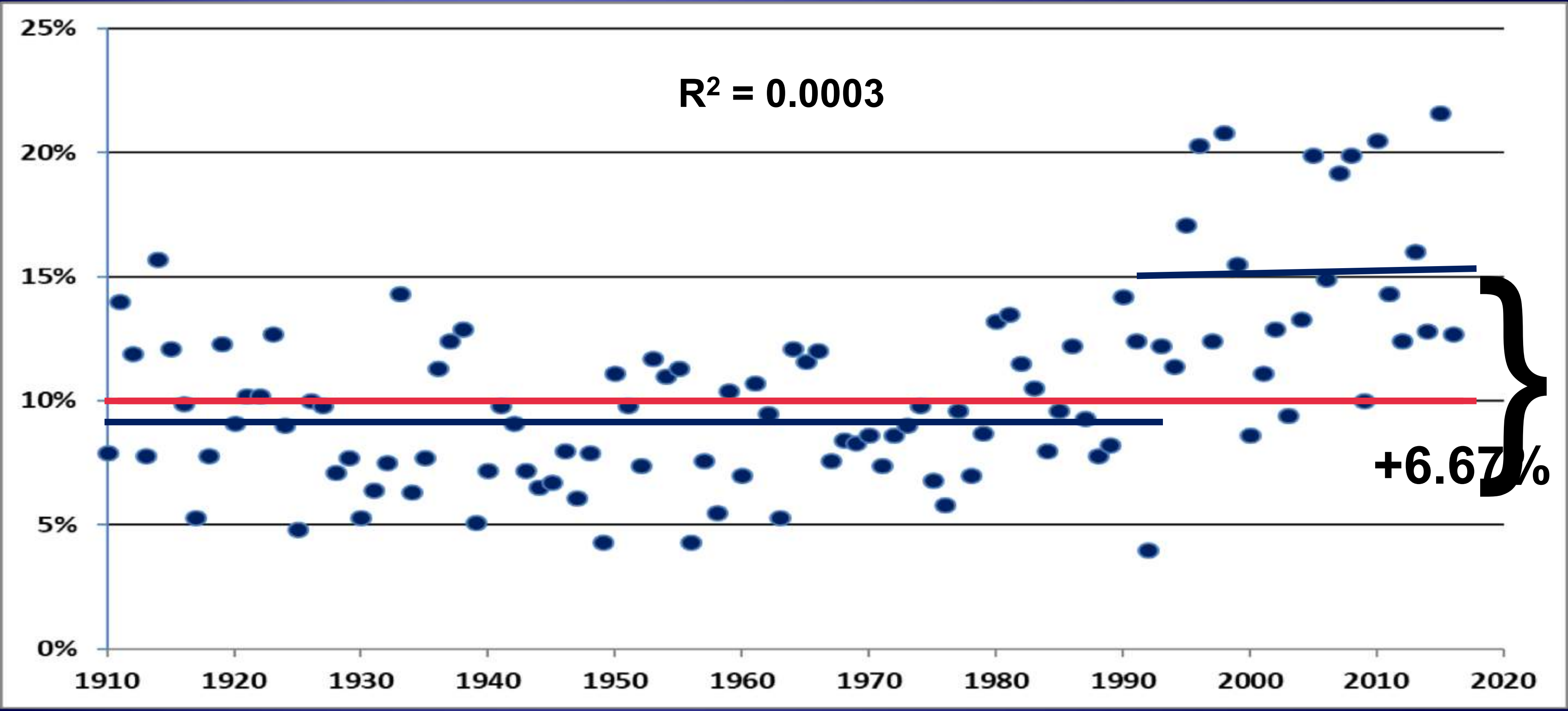
Data: 1910 to 1992

Extreme 1-Day Precipitation Events for the United States



Data: 1995 to 2016

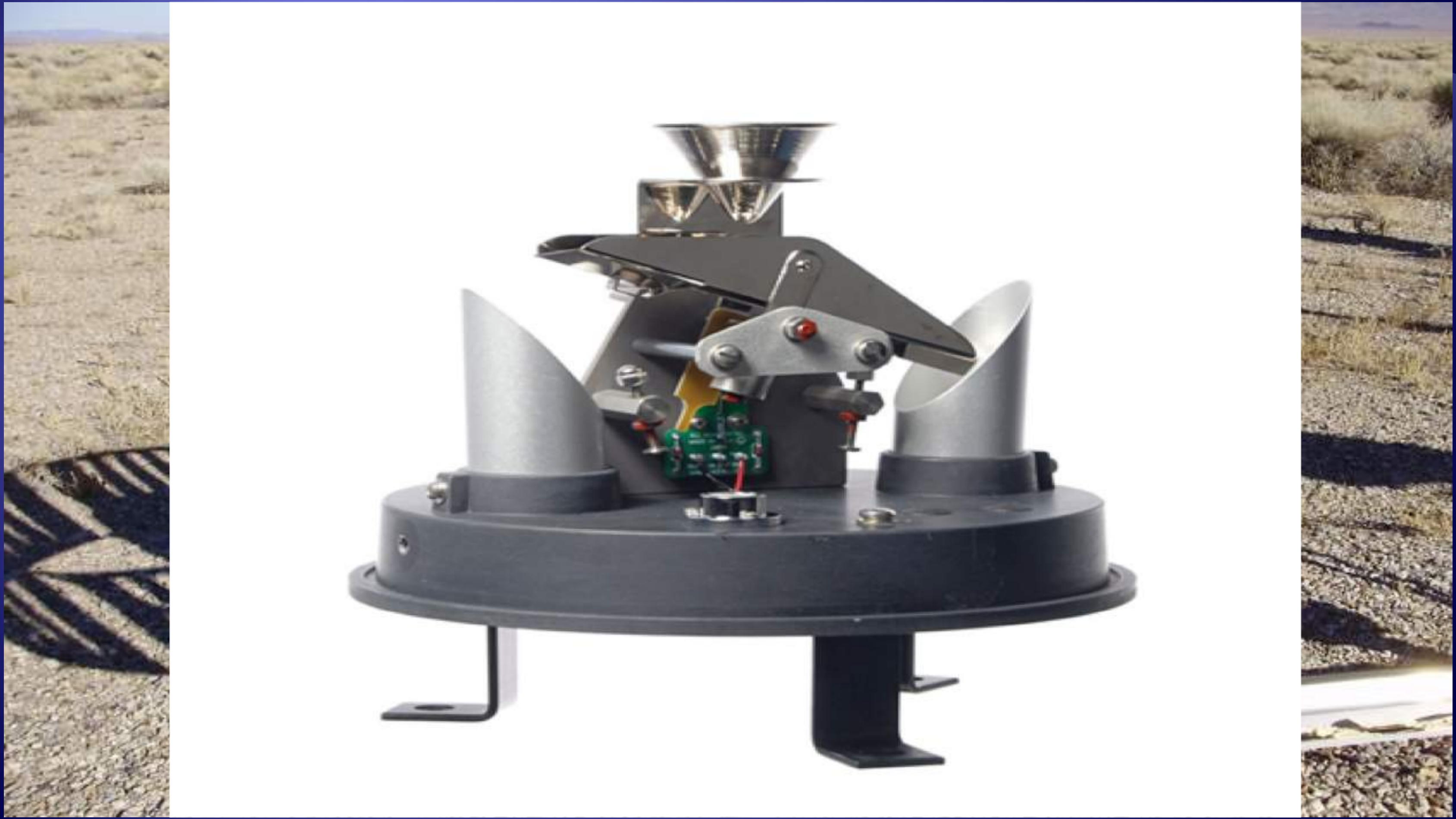
Extreme 1-Day Precipitation Events for the United States



Data: 1910 to 1992; 1995 to 2016

Through 1992: Manual NWS 8" Raingage

Since 1995: The ASOS Raingages



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