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

Major Volcanic Eruptions in Low Latitudes

Theory
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.

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
The unintended consequence of model tuning has been to make the models wrong!
With the increasing diversity in the applications of climate models, the number of potential targets for tuning increases. There are a variety of goals for specific problems, and different models may be optimized to perform better on a particular metric, related to specific goals, expertise or cultural identity of a given modeling center.

One can imagine changing a parameter which is known to affect the sensitivity, keeping both this parameter and the ECS [equilibrium climate sensitivity] in the anticipated acceptable range... 

**THIS IS NOT SCIENCE!**
Change in the Relative Humidity Threshold for Low Clouds

Brunetti and Vérard In Press

85.0% → Only 0.6%! → 84.4%
What is the true climate sensitivity for a doubling of carbon dioxide?
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.**

Bulletin of the American Meteorological Society (March 2017)

THE ART AND SCIENCE OF CLIMATE MODEL TUNING

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.

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 factor with a definable effect on plant growth and development.

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) and 93 °F (34 °C).
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)

24-month Running Averages

Entire Globe

Northern Hemisphere Only

Integrated over ALL Tropical Cyclone producing basins

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

Dr. Ryan N. Maue
Updated through September 30, 2017
Annual Number of Severe (F3-F5) Tornadoes in the United States
Annual United States Tornado Deaths
Percentage of the United States with a greater than normal proportion of precipitation derived from extreme 1-day precipitation events (equivalent to the highest tenth percentile).
Extreme 1-Day Precipitation Events for the United States

Data: 1910 to 2016
Extreme 1-Day Precipitation Events for the United States

\[ R^2 = 0.0005 \]

Data: 1910 to 1992
Extreme 1-Day Precipitation Events for the United States

Data: 1995 to 2016

$R^2 = 0.0003$
Extreme 1-Day Precipitation Events for the United States

$R^2 = 0.0003$

Through 1992: Manual NWS 8” Raingage
Since 1995: The ASOS Raingages
Where the Science Debate Stands Now

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