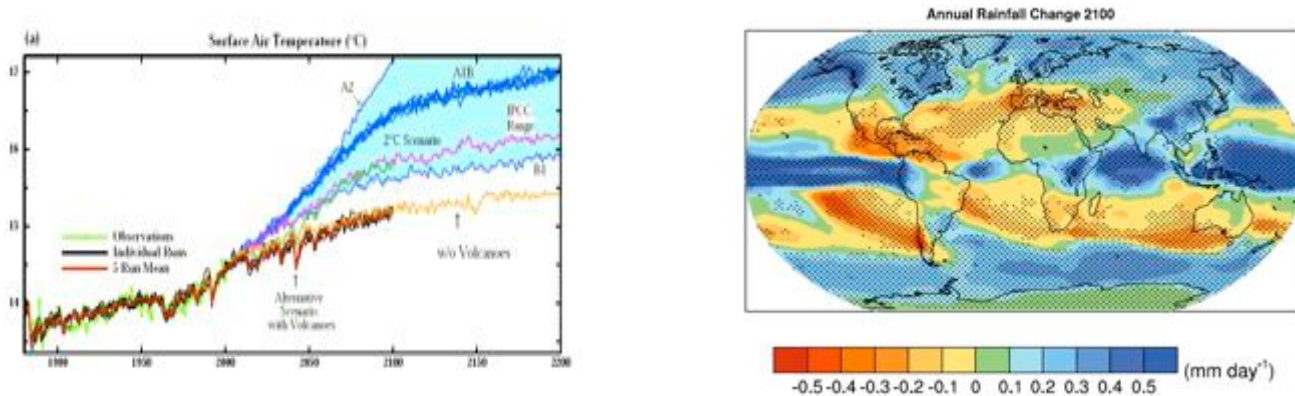


# Climate Model Results: Perceptions and Confusions



Gavin Schmidt

NASA Goddard Institute for Space Studies and  
Center for Climate Systems Research, Columbia University

# Model Confusions...

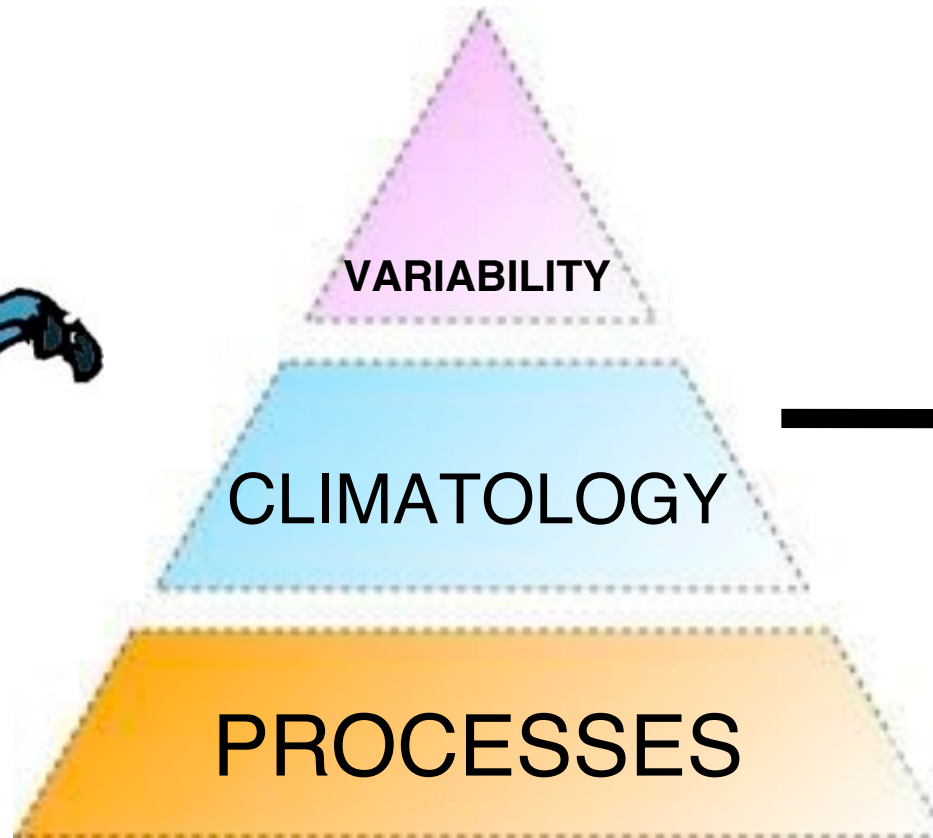


- What exactly is a climate model?
- What do scenarios represent?
- Why do they have any credibility?
- How can a model be wrong and still be useful?
- What can you rely on?

# The Climate Pyramid



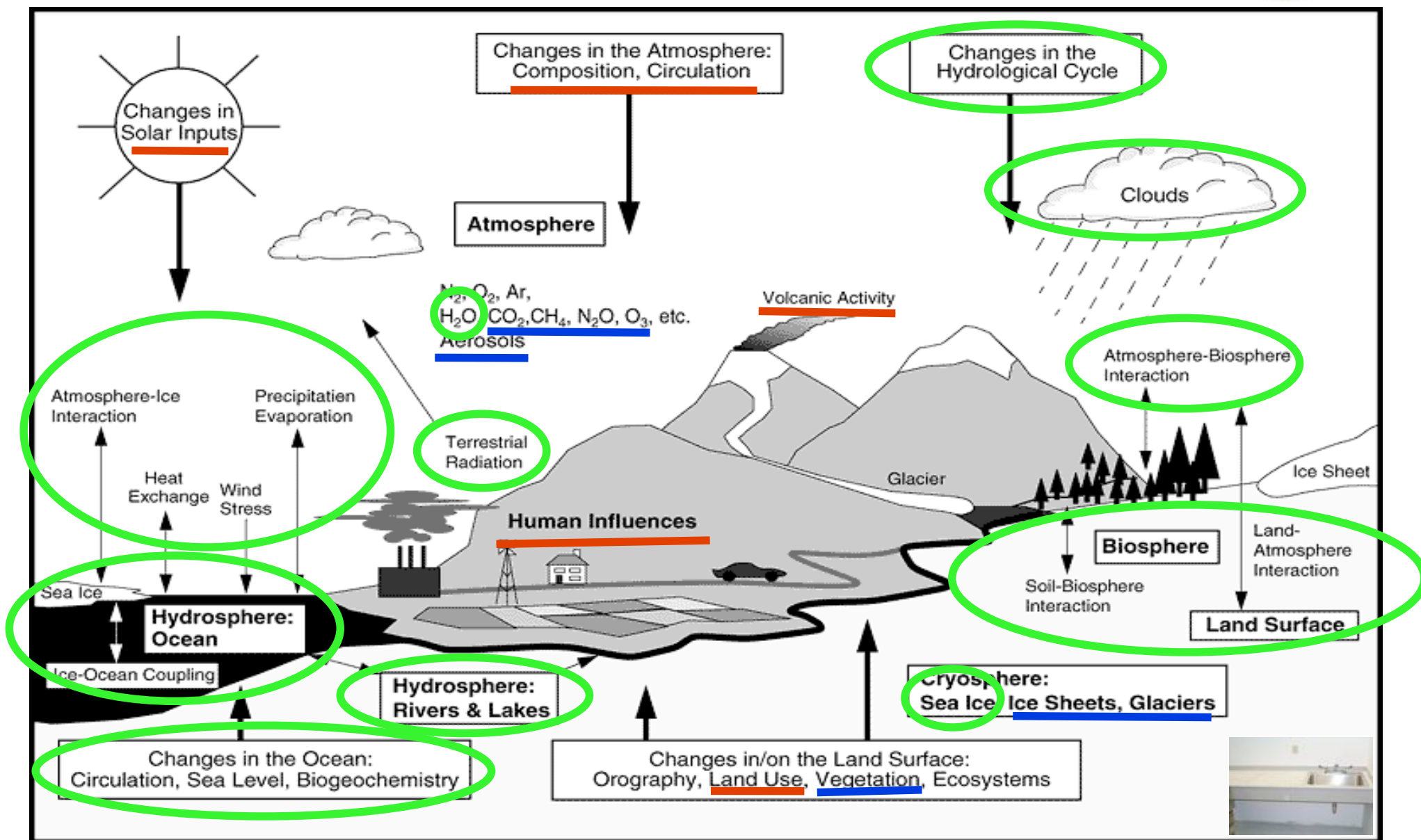
FORCINGS



RESPONSE



# Climate processes



— Forcings

— Forcings or Feedbacks

— Calculated

# Predictions, projections and forecasts



**Predictions:** Estimated outcomes under highly specific conditions – not restricted to the future!

**Projections:** Predictions conditional on a future scenario (forced component)

**Forecasts:** Predictions dependent on scenario and initial conditions

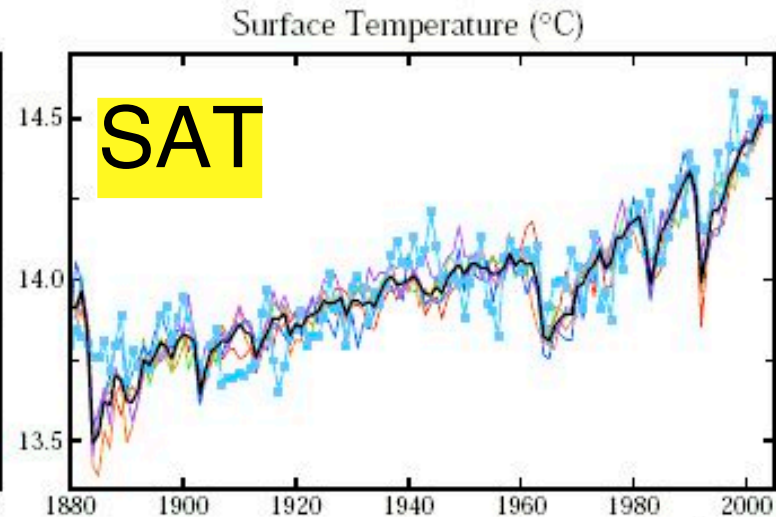
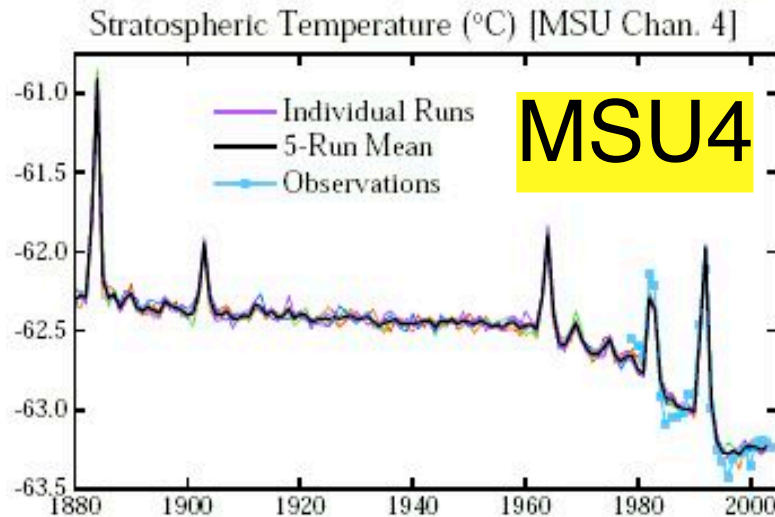




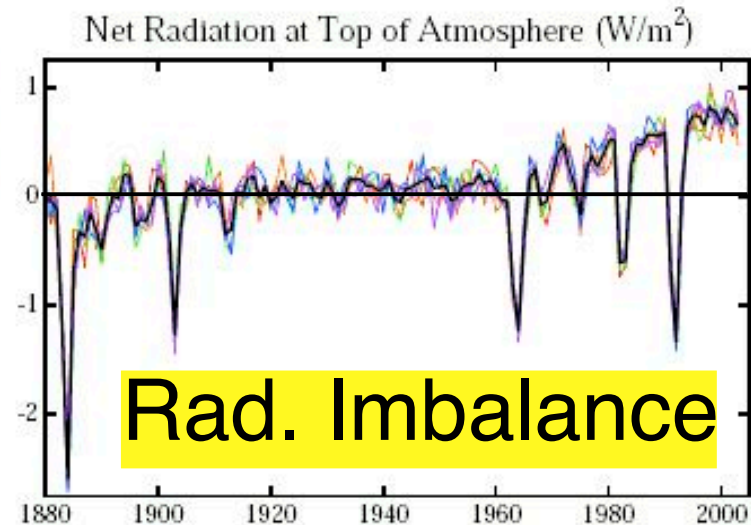
# 20<sup>th</sup> Century climate hindcast



Coupled Atmosphere-Ocean Model



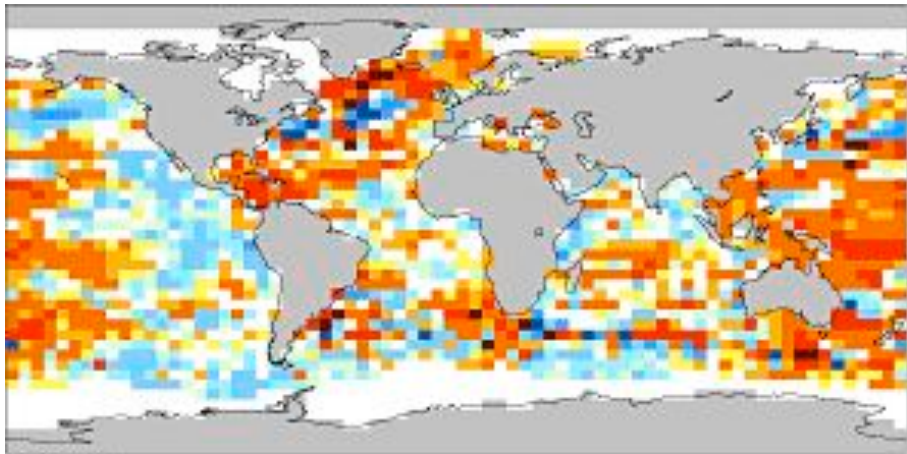
Matches to observed data imply consequences that can be looked for in the real world...



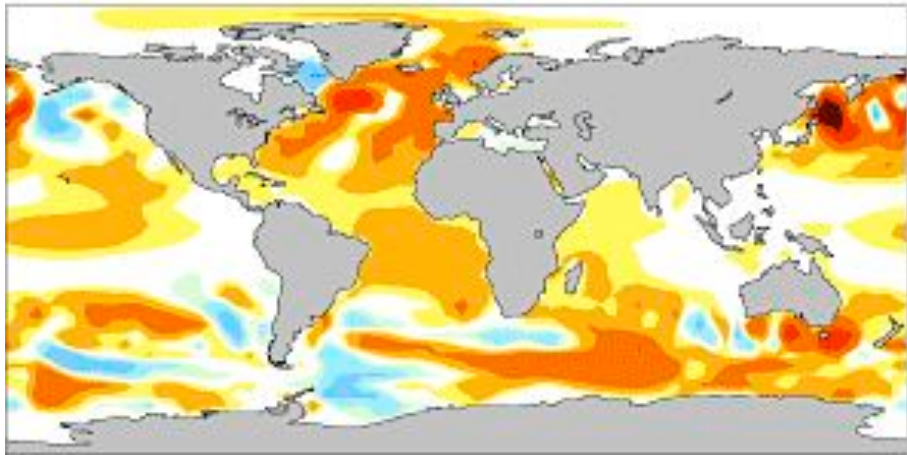
# Ocean heat content change



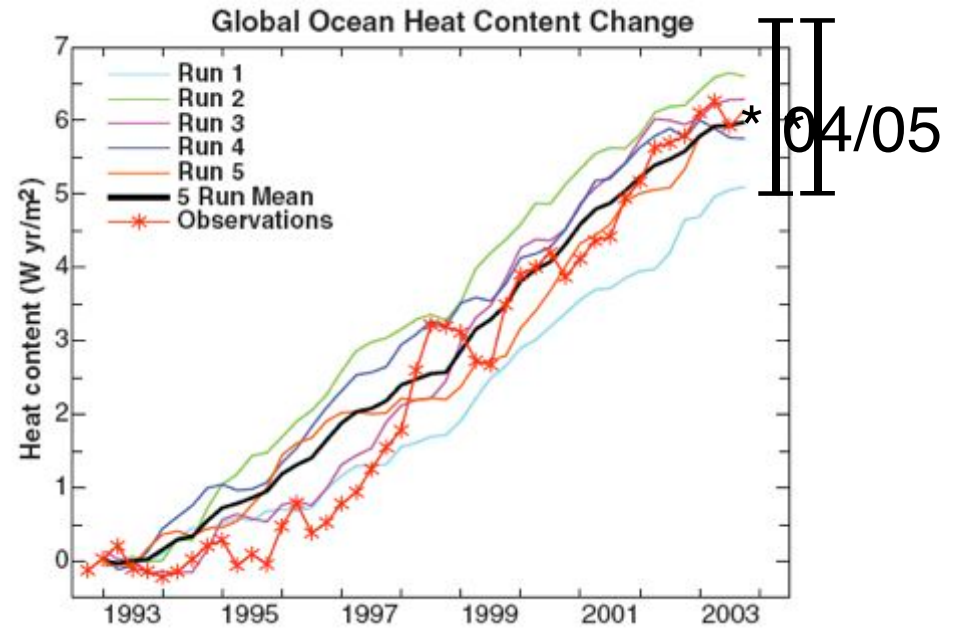
Observations:  
1993-2003  $\sim 0.6$  W/m<sup>2</sup>



Observations



Modeled



Model

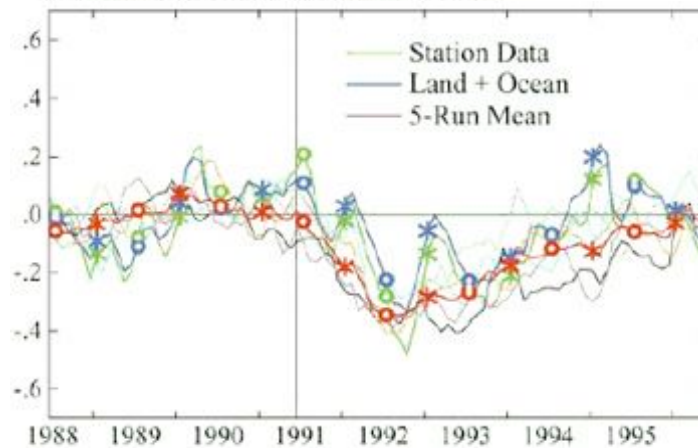
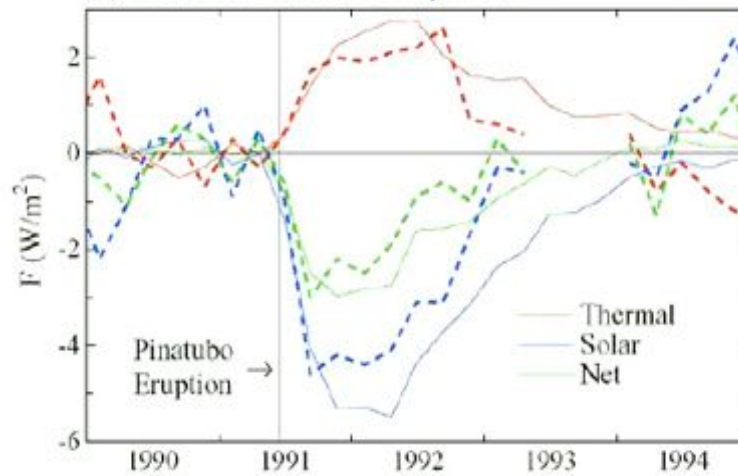
Hansen et al, 2005



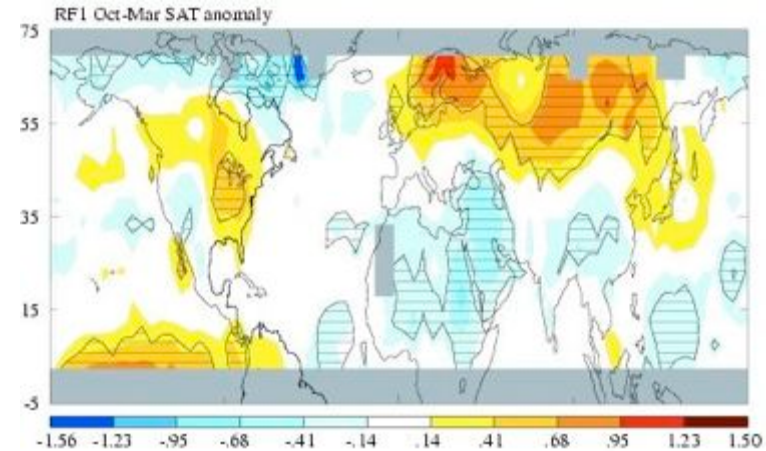
# Volcanic forcing and response



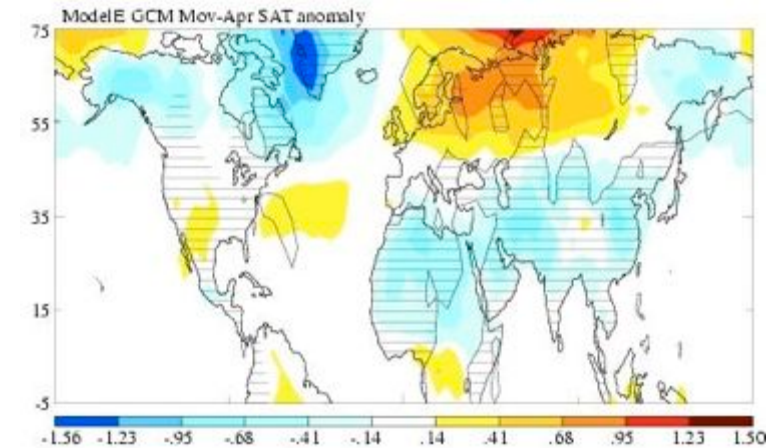
Radiation Balance Anomalies (60°N - 60°S)  
(a) Mean of 5 Runs, 72 Day Mean



Mt. Pinatubo 1991



Obs



Model

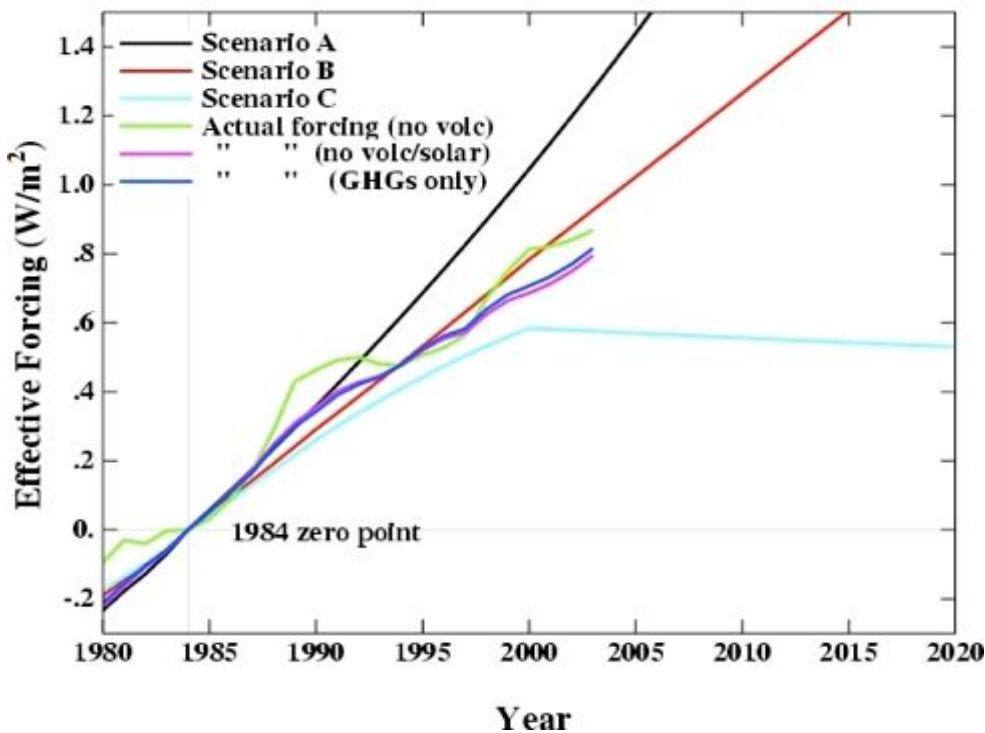
“Winter warming”

# Past projections: Hansen 1988

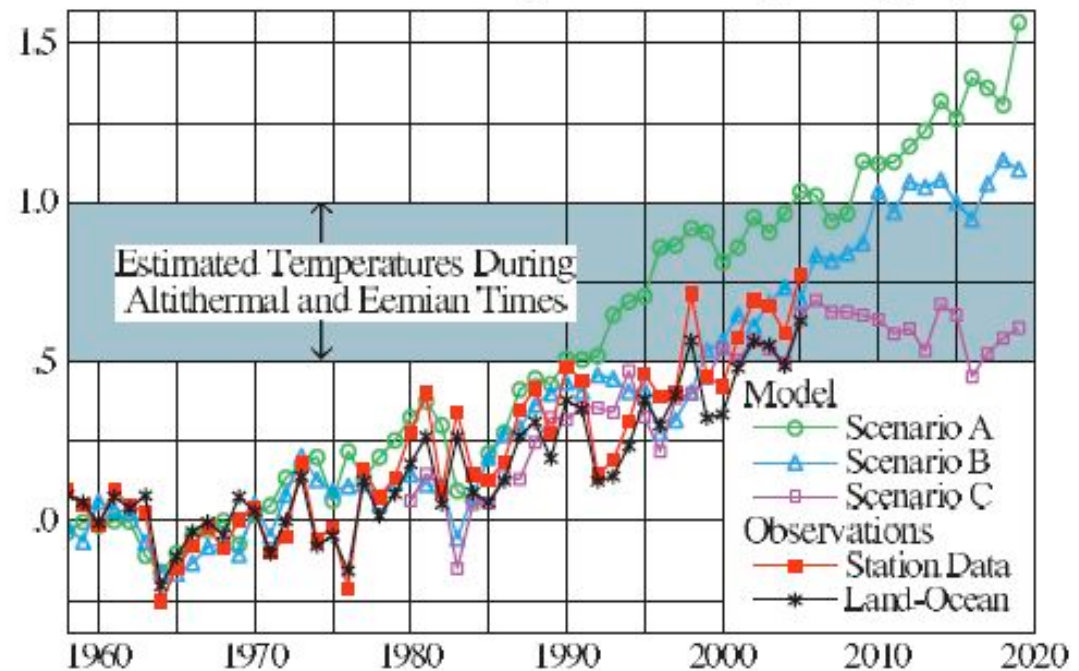


3 Scenarios: A - exponential growth,  
 B - business as usual 'most plausible'  
 C - no further GHG growth after 2000

Scenarios from Hansen et al 1989



Annual Mean Global Temperature Change:  $\Delta T_s$  ( $^{\circ}\text{C}$ )



SAT Trends 1984-2005:

OBS:  $0.23 \pm 0.04 / 0.20 \pm 0.03$  (different indices)  
 Scen. B:  $0.23 \pm 0.06$

# Getting your modelling ducks in a row



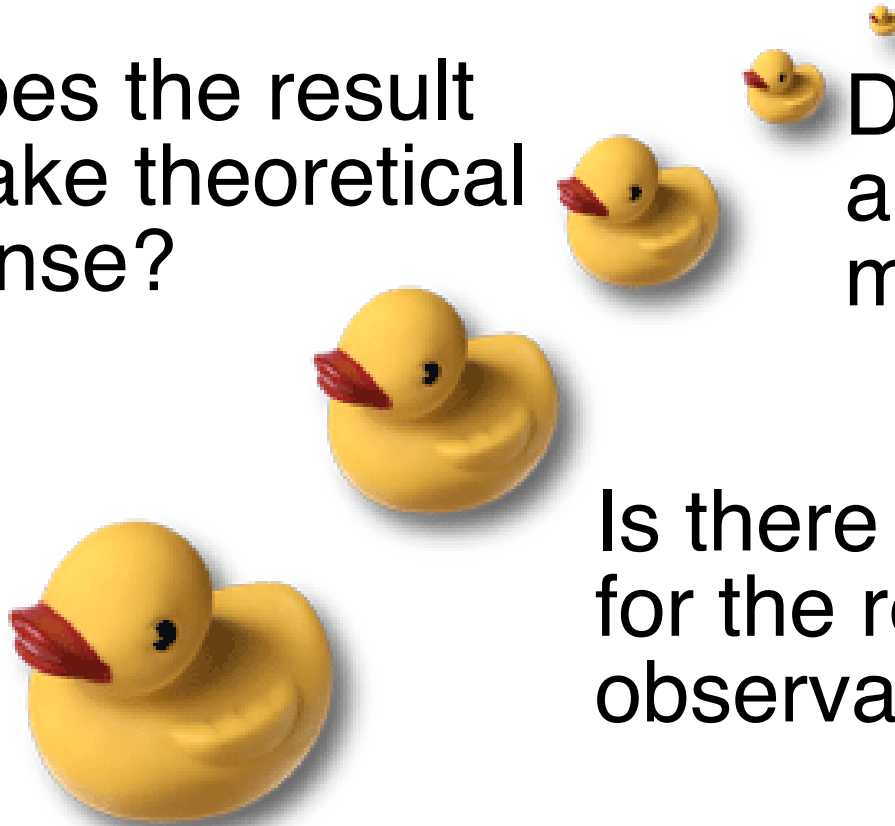
Does the result  
make theoretical  
sense?

Does the result  
appear in multiple  
models?

Is there some support  
for the result in the  
observations?

Do the predicted  
and observed  
magnitudes match?

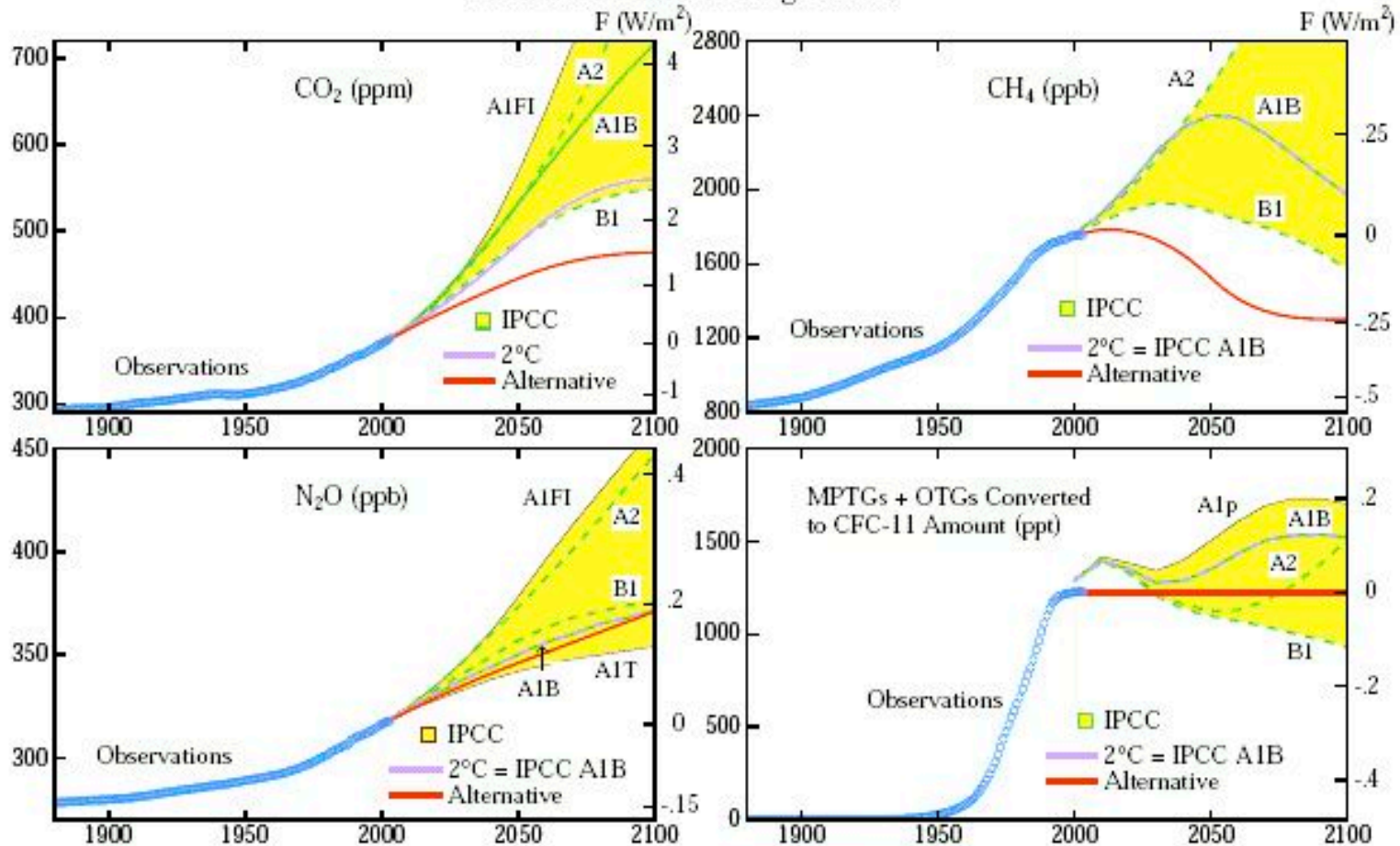
Then it might be robust...



# Future scenarios...

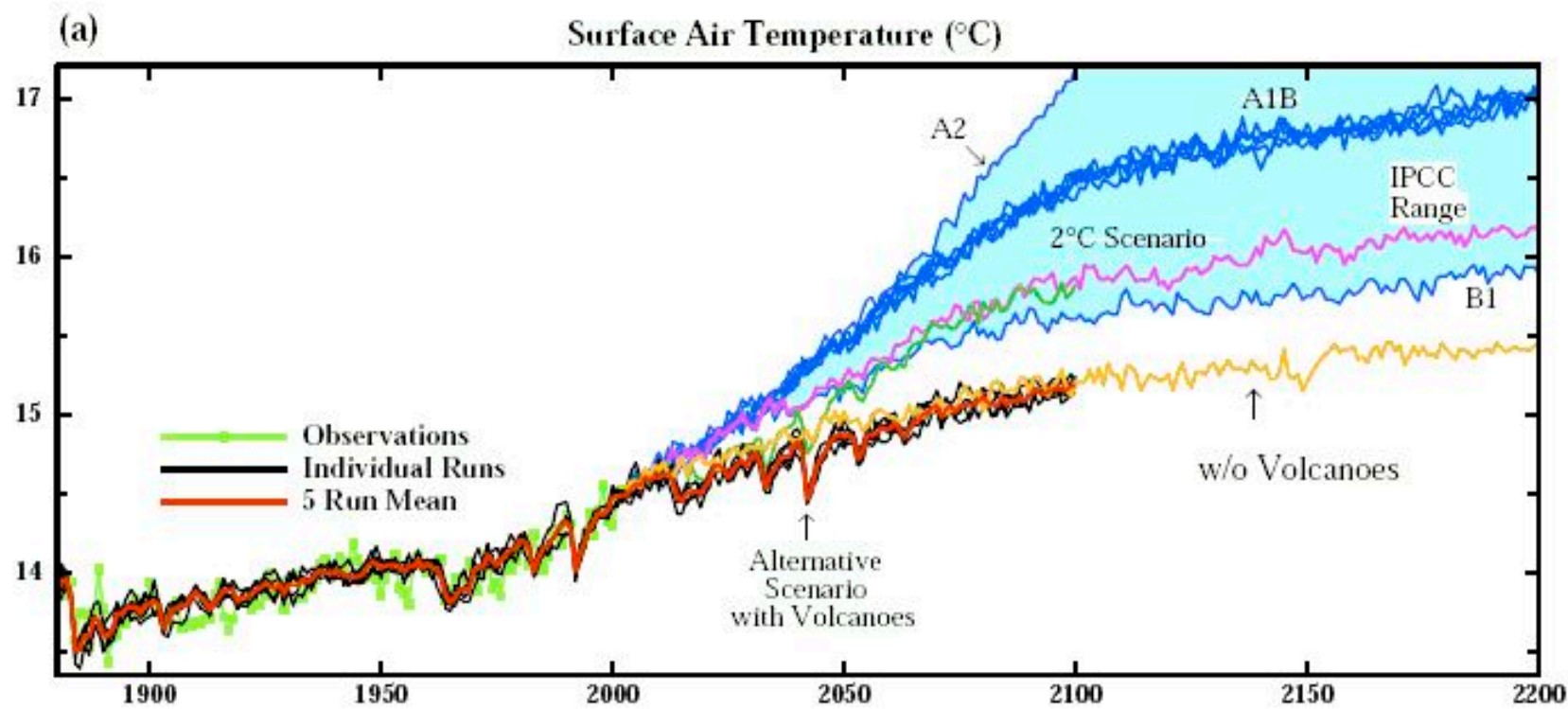


Greenhouse Gas Mixing Ratios





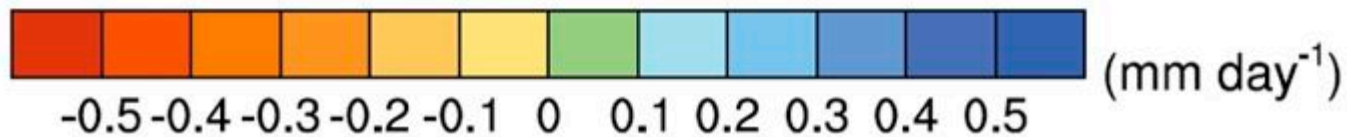
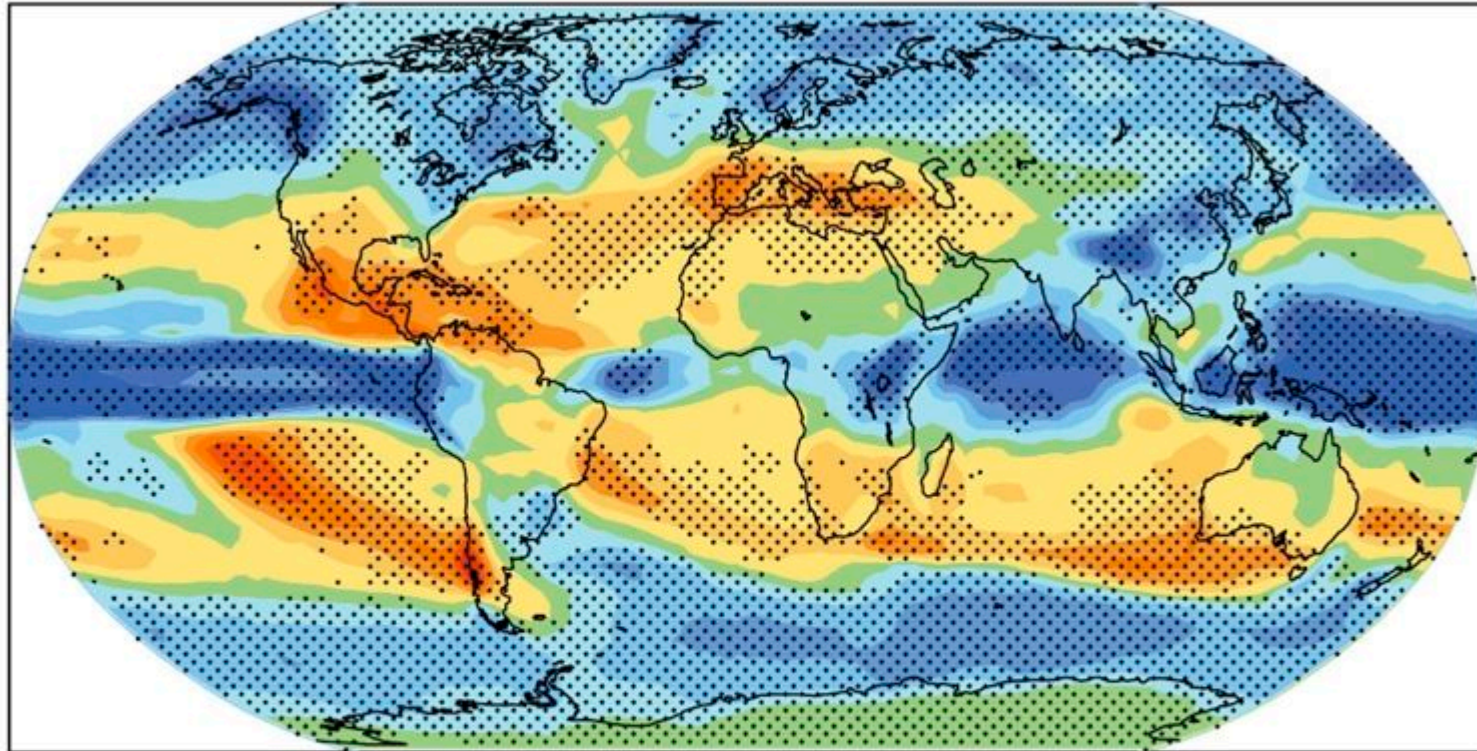
# Future temperatures?



# How do you define robustness?



Annual Rainfall Change 2100



# Future Sea Level Rise?



## Science

### Simulating Arctic Climate Warmth and Icefield Retreat in the Last Interglacion

Bette L. Otto-Bliesner,<sup>1\*</sup> Shawn J. Marshall,<sup>2</sup> Jonathan T. Overpeck,<sup>3</sup> Gifford H. Miller,<sup>4</sup> Aixue Hu,<sup>1</sup>  
CAPE Last Interglacial Project members

### Paleoclimatic Evidence for Future Ice-Sheet Instability and Rapid Sea-Level Rise

Jonathan T. Overpeck,<sup>1\*</sup> Bette L. Otto-Bliesner,<sup>2</sup> Gifford H. Miller,<sup>3</sup> Daniel R. Muhs,<sup>4</sup> Richard B. Alley,<sup>5</sup>  
Jeffrey T. Kiehl<sup>2</sup>

## Arctic, Antarctic Melting May Raise Sea Levels **Faster** than Expected

March 23, 2006

BOULDER—Ice sheets across both the Arctic and Antarctic could melt more quickly than expected this century, according to two studies that blend computer modeling with paleoclimate records. The studies, led by scientists at the National Center for Atmospheric Research (NCAR) and the University of Arizona, show that Arctic summers by 2100 may be as warm as they were nearly 130,000 years ago, when sea levels **eventually** rose up to 20 feet (6 meters) higher than today.





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From **The Times**

March 24, 2006

## London 'under water by 2100' as Antarctica crumbles into the sea

DOZENS of the world's cities, including London and New York, could be flooded by the end of the century, according to research which suggests that global warming will increase sea levels more rapidly than was previously thought.



# Communicating better?

- 'loading dock' model - “put the science out there and let the public take what they want” - clearly insufficient
- But, public is hungry for more context/possibility to see for themselves
- “Tacit” information plays a big role in how science really works
- This needs to be written about and the necessary context given....



# There is much work to do...

