

Global Warming: Who's Disagreeing with What?

Ross McKittrick
Professor of Economics
University of Guelph

Presented to Guelph Third Age Learning
September 28 2011

Outline

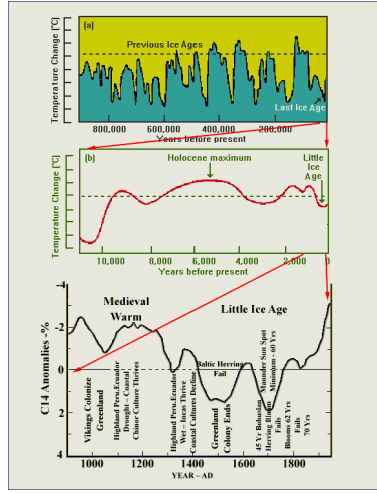
- What do people *agree* on?
 - Climate varies naturally on all time scales
 - CO₂ is a greenhouse gas
 - Atmospheric CO₂ levels are rising due to emissions
 - In principle this is likely to lead to some atmospheric warming
 - It is difficult to say what will change at the surface

- What do people disagree on?
 - My topics:
 - Natural variability
 - Measurement of surface warming
 - Testing climate models

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What do people agree on?

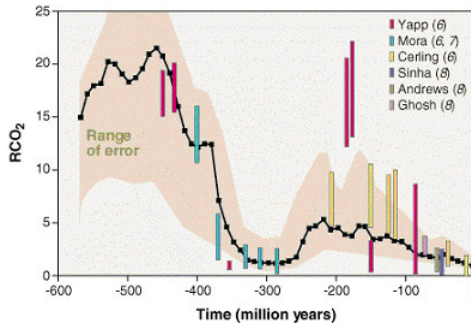
- The climate varies naturally on long and short time scales



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What do people agree on?

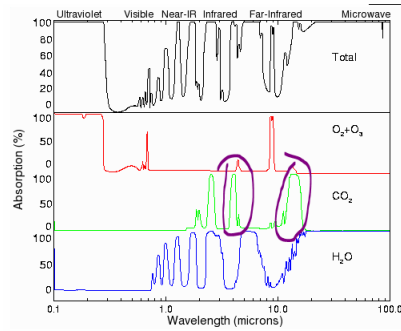
- CO₂ levels vary too



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What do people agree on?

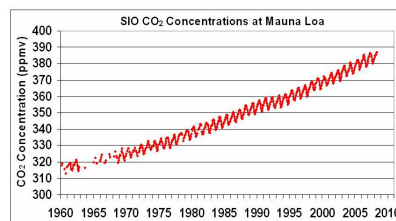
- CO₂ is a greenhouse gas
 - Absorbs narrow bands of infrared energy



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What do people agree on?

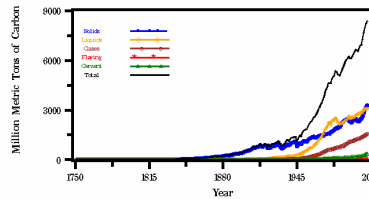
- CO₂ is a greenhouse gas
 - Absorbs narrow bands of infrared energy
- CO₂ concentration in the atmosphere is rising



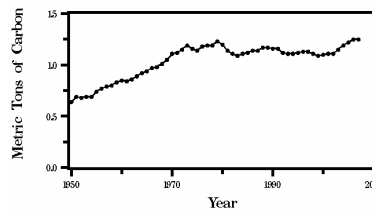
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What do people agree on?

- CO₂ is a greenhouse gas
 - Absorbs narrow bands of infrared energy
- CO₂ concentration in the atmosphere is rising
- This is attributable to fossil fuel use



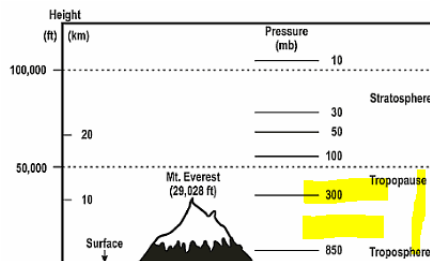
Global Per Capita Carbon Emission Estimates



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What do people agree on?

- Adding CO₂ to the air, *in principle*, would lead to warming in the troposphere
- When people refer to “basic physics” this is what they mean
- But it doesn't get you very far in predicting how much effect it has, or where
- Much depends on circulation patterns and feedbacks



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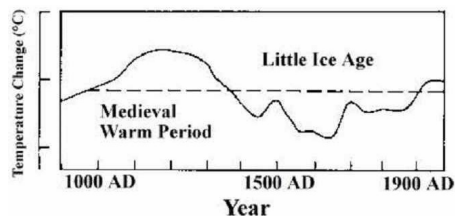
Where the agreement ends

- In principle, adding CO₂ to the air could warm the troposphere and affect weather at the surface
- Questions:
 - What are the feedback mechanisms?
 - How are effects distributed over the surface and in the oceans?
 - Is the overall effect big or small (compared to natural variability)?
 - Is it likely to be beneficial or harmful?
- These cannot be answered from first principles
- Yet the answers have big consequences for society

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Natural variability

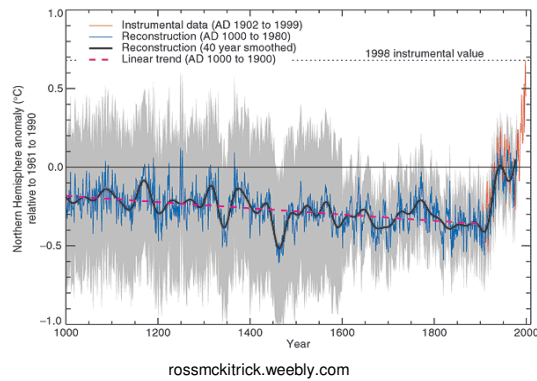
- 2 contrasting views of past millennium:
 - IPCC 1990



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Natural variability

- 2 contrasting views of past millennium:
 - IPCC 2001



Using paleo proxies

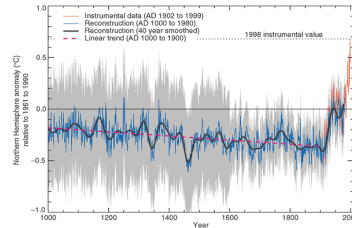
- Paleoclimate analysis: using tree rings and statistical models to reconstruct past temperatures



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The Hockey Stick

- 2 big claims to fame:
 - Large library of proxies
 - New statistical method
- Heavily promoted by IPCC in 2001 Report



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McIntyre & McKitrick work

- We showed
 - Hockey stick shape depended heavily on one small class of proxies (bristlecone pines) not suitable for temperature reconstructions
 - Statistical method contained erroneous steps that underestimated the uncertainty

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The saga

- Lots of media coverage, including WSJ front page article
- Congressional investigations
- Formation of NAS panel (North et al.) + Ad hoc investigation panel (Wegman et al.)
- House hearings in 2006



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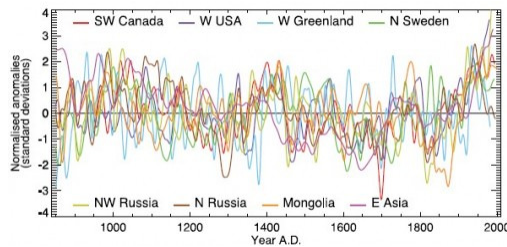
The outcome

- Nat'l Academy of Science panel:
 - Bristlecones should not be used (p. 50)
 - Hockey Stick unduly dependent on them (p. 107)
 - Uncertainties of the published reconstructions have been underestimated (p. 107)
- Wegman panel:
 - Data and methods cannot support conclusion that 1990s warmest in millennium

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Since then:

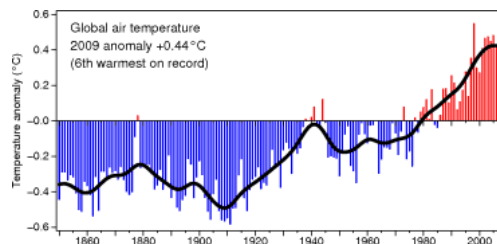
- IPCC “Spaghetti graph”
- Even without uncertainty bands, the lines are all over the place
- Is it warmer now than in medieval era? Unanswerable



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Measurement of surface temperature change

- 3 well-known “global temperature” series
 - CRU, GISS, NOAA



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Data sources

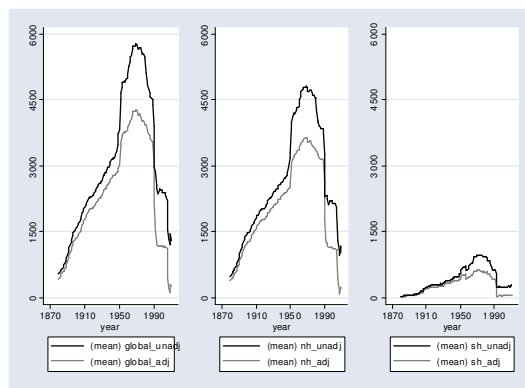
- Land: Global Historical Climatology Network (GHCN) – air temperature
- Oceans: ICOADS - Sea Surface Temperature

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GHCN

- Several concerns:

- Collapsing sample size

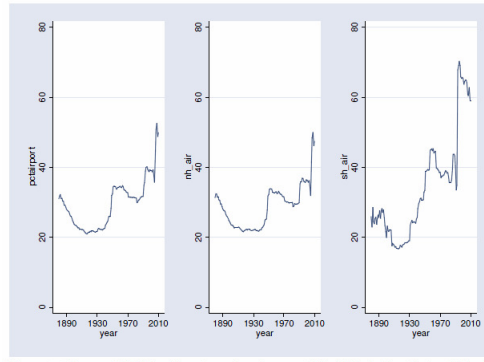


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GHCN

- Several concerns:

- Growing bias towards airports



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GHCN

- Several concerns

- Need for extensive adjustments to correct for urbanization etc.

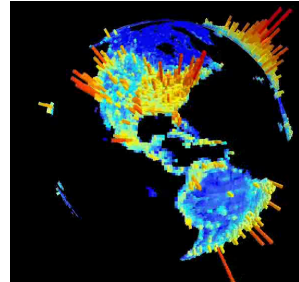


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McKittrick and Michaels 2004, 2007

- Tested if spatial pattern of temperature trends in CRU data over land are independent of spatial pattern of socioeconomic development
- The answer is no, they are strongly correlated (even after adjustments)

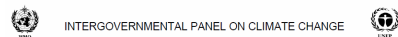
Can account for ~ 1/3 to 1/2 of post-1980 warming over land



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Intergovernmental Panel on Climate Change (IPCC)

- Acknowledges local urban heat island problem, but denies it affects large-scale data patterns



INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE

Climate Change 2007: The Physical Science Basis

Summary for Policymakers

Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change

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CRU Chief: Phil Jones

3

- Produces CRU data for IPCC
- Was lead author of IPCC Chapter assessing the quality of his own data

Observations: Surface and Atmospheric Climate Change

Coordinating Lead Authors:
Kevin E. Trenberth (USA), Philip D. Jones (UK)

Lead Authors:
Peter Ambenje (Kenya), Roxana Boparui (Romania), David Easterling (USA), Albert Klein Tank (Netherlands), David Parker (UK), Fatemeh Raftoyiannidis (Iran), James A. Renwick (New Zealand), Mette Rasmussen (Argentina), Brian Soden (USA), Panmao Zhai (China)

Contributing Authors:
R. Adler (USA), L. Alexander (UK, Australia, Iceland), H. Alexanderson (Sweden), R. Allan (UK), M. P. Dalbey (USA), M. Burston (Switzerland), D. Bromwich (USA), I. Camilloni (Argentina), C. Cassou (France), E.R. Cayán (USA), E.K.M. Chang (USA), J. Chouly (USA), A. Dai (USA), C. Deser (USA), N. Detting (Germany), J. Fasullo (USA), R. Fegh (USA), C. Folberd (UK), P. Forster (UK), M. Frei (USA), C. Frei (Switzerland), B. Glavac (USA), J. Giese (Germany), P. Gochis (USA, Russian Federation), S. Gulev (Russian Federation), J. Hurrell (USA), M. Ichi (Japan), S. Josey (UK), P. Kallberg (ECMWF), J. Kenney (UK), G. Klada (USA), R. Kipielew (USA), K. Kumar (USA), C.-X. Lam (China), J. Lanzante (USA), J. Lauenroth (USA), D. Lawton (USA), B. Legler (USA), G. Marshall (UK), C. Mears (USA), P. Mote (USA), H. Nakamura (Japan), N. Nicholls (Australia), J. Norris (USA), T. Oki (Japan), F.R. Robertson (USA), K. Rosenfeld (USA), E.H. Smerzi (USA), D. Shea (USA), J.M. Shepherd (USA), T.G. Shepherd (Canada), S. Shewman (USA), P. Stangor (Netherlands), I. Stremmel (Australia), A. Stouffer (ECMWF, UK), C. Thorncroft (USA, UK), P. Thorne (UK), S. Uppala (ECMWF), R. Vose (USA), B. Wang (USA), S. Warren (USA), R. Washington (UK, South Africa), M. Wheeler (Australia), B. Weicki (USA), T. Wong (USA), D. Wuezt (USA)

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2004-2006: studies critical of CRU products

- McKittrick and Michaels 2004
- De Laat and Maurellis 2004, 2006
- All pointed to warm bias in surface data due to socioeconomic development over land

Vol. 24, 119–123, 2004

CLIMATE RESEARCH	Published May 25
Climate Res.	

A test of corrections for extraneous signals in gridded surface temperature data*

Ross McKittrick^{1,2*}, Patrick J. Michaels²

¹Department of Economics, University of Guelph, Guelph, Ontario N1G 2W1, Canada
²Department of Environmental Sciences, University of Virginia, Clark Hall, 291 MC Center Rd, PO Box 40123, Charlottesville, VA 22904-4123, USA

ABSTRACT. Monthly surface temperature records from 1979 to 2000 were obtained from 218 individual stations in 83 countries and a linear trend coefficient determined for each site. This vector of trends was regressed on measures of local climate, as well as indicators of local economic activity (income, gross domestic product) GDP) growth rates, coal uses and data quality. The spatial pattern of trends is shown to be significantly correlated with non-climatic factors, including economic activity and sociopolitical characteristics of the region. The analysis is then repeated on the corresponding intergovernmental Panel on Climate Change (IPCC) gridded data, and very similar correlations appear, despite previous attempts to remove non-climatic effects. The socioeconomic effects in the data are shown to add up to a net warming bias, although more precise estimation of its magnitude will require further research.

KEY WORDS. Global warming, Temperature measurement, Data quality
*Article or publication not peer-reviewed without written consent of the publisher

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Preparation of IPCC 2007 Report

- 1st draft: no mention of our work
- 2nd draft: no mention of our work
- Peer review closed July 2006
 - Thereafter a paragraph inserted dismissing the issue in its entirety

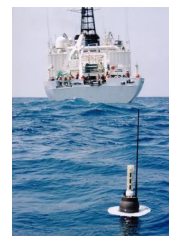
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Alternate measurement systems will help resolve some disputes

- Air: balloons and satellites



- Ocean: Argo floats



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Model evaluation

- Key prediction about spatial pattern:
 - Concentration of GHG warming in mid-troposphere over tropics
 - All models show this feature

Chapter 9 Understanding and Attributing Climate Change

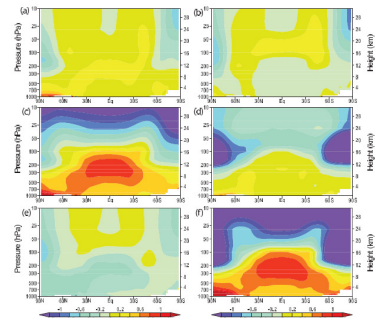
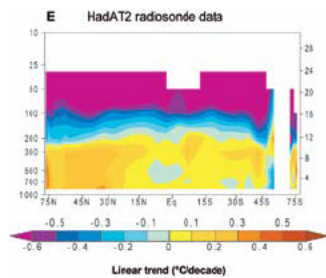


Figure 9.1. (a) and (b) show atmospheric temperature change from 1950 to 1979. (c) and (d) are vertical cross sections of radiative forcing, (e) radiative and greenhouse gas forcing, (f) greenhouse and atmospheric ozone change, (g) direct radiative aerosol forcing, and (h) the sum of all forcings. All are from 1000 hPa to 10 hPa (shown on left axis) and from 0 km to 20 km (shown on right). See Appendix 9.2 for additional information. Based on Scaife et al., 2005b.

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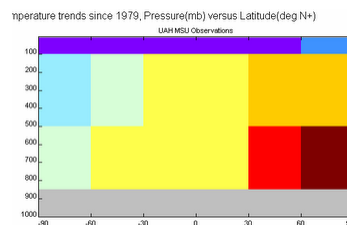
Problem: balloons and satellites don't show it

- Balloon record (CCSP p. 111)



- Satellite record

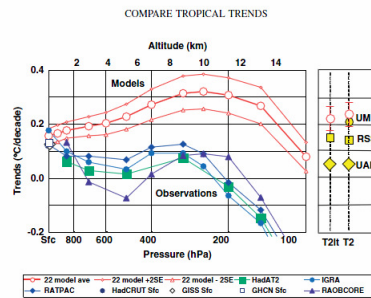
(<http://vortex.nsstc.uah.edu/data/msu>)



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Trend analyses

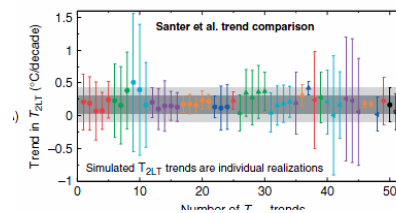
- Douglass et al. (2007): observations well below models



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Trend analyses

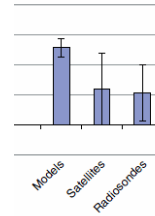
- Santer et al. (2008):
 - Model Confidence Intervals are wide enough to encompass observed trends



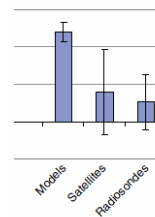
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McKittrick McIntyre & Herman (2010)

- Santer et al. only used data up to 1999
- Using data up to 2009 and proper econometric methods:
 - Models show 2-4x more warming than observations
 - Observed trends in LT not all significant
 - Observed trends in MT not significant
 - Model-data discrepancies significant



tropics, LT layer, 95% confidence interval



tropics, MT layer, 95% confidence interval

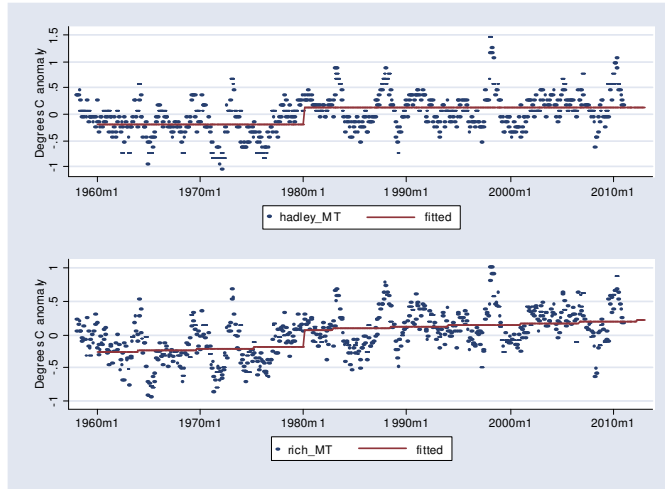
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McKittrick and Vogelsang (2011)

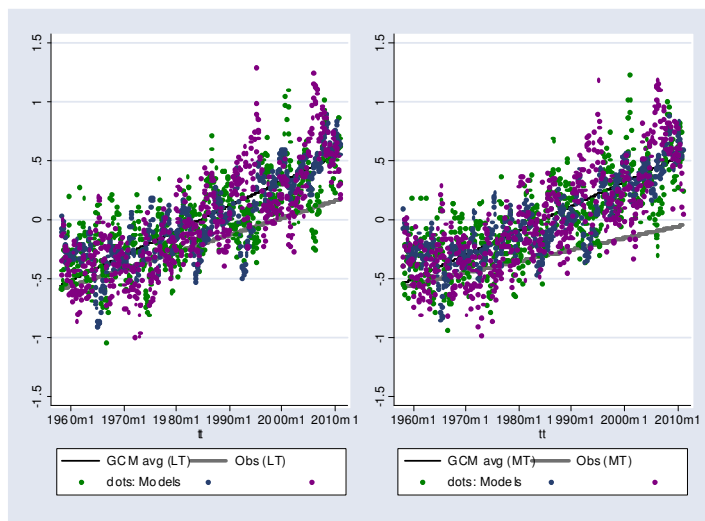
- Extended sample – 1958 to 2010 – using weather balloon records
- All warming in mid-troposphere accounted for by one step in 1977
- Obs-model discrepancy highly significant

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McKittrick and Vogelsang (2011)



McKittrick and Vogelsang (2011)



This one matters...

- EPA relied on Santer et al. paper in its endangerment finding
- Many other summary reports cite Santer conclusions
- CCSP report earlier called lack of tropical tropospheric warming “potentially serious inconsistency”

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Other points of disagreement

- Role of sun
 - Direct heating effect
 - Indirect effect on cloud formation via GCR's
- Role of oceans
 - Heat storage
 - Chaotic coupling and reorganization of major circulation systems

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Policy disagreements

- What is the best way to control CO₂ emissions?
 - Economists: price mechanism (emissions tax)
 - Industry lobbyists: Cap-and-trade, subsidies for wind&solar
 - Politicians circa 1997: International Treaties
 - Politicians circa 2006: National cap-and-trade
 - Politicians circa 2010: ???

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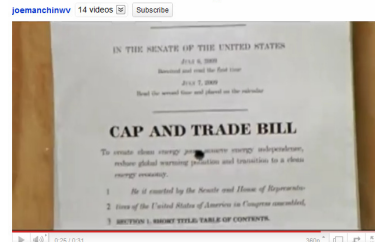
Policy disagreements

- US election: even the Dems ran against cap-and-trade & GHG controls

Dead Aim - Joe Manchin for West Virginia TV Ad



Dead Aim - Joe Manchin for West Virginia TV Ad



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A last word

- Judith Curry, Climatologist,
Chair of Earth and
Atmospheric Sciences,
Georgia Tech



The major problem with the IPCC reports and some research that was exposed during Climategate was unwarranted confidence, she says.

The question then naturally arises. What is Judith Curry sure about?

She pauses before giving an answer in three parts.

“Climate always changes,” she says.

“Carbon dioxide, all other things being equal, will contribute to a warmer planet.”

And lastly, “Whether in the coming century greenhouse gas will dominate natural variability remains to be seen.”

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Thank you

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