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Morning concurrent track 2: Creation and correction of myths about global warming

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Global Warming
misconceptions and myths:
Barriers and Opportunities for communicating climate change science to a non-scientific audience

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Mayan ruins at Tikal, Guatemala. Photo by Lachniet
Abstract

Opinions on an anthropogenic influence in global warming abound. Within the non-scientific public, the strength of one’s opinion commonly seems to be in inverse proportion to their knowledge of climate science. One reason for this disconnect between reality and opinion is the persistence of many climate change myths in popular knowledge of global warming. These myths are regularly propagated in popular media and internet blogs, some of which appear to be driven more by ideology than a quest for truth about Nature. In the past, the desire to provide balance in media coverage of global warming at the expense of scientific accuracy has handed the soapbox to many with minority viewpoints that are not supported by all of the available scientific evidence. However, many of these myths contain an element of reality but have been misunderstood (at best) by the general public and misappropriated (at worst) by interest groups on all sides of the ideological spectrum. This presentation will outline some of the common myths on global warming and how they can be used as opportunities in a teaching environment to enhance students’ understanding of global warming and climate science.
Context

- A persistence of climate change myths in popular knowledge of global warming.
- Propagated in popular media and internet blogs, some of which appear driven by ideology
- Media providing 'balance' in media coverage at the expense of accuracy
Introduction

• Several persistent misunderstandings and myths pervade the public’s understanding of Global Warming
  • Most have
    - elements of truth...
    - elements of misunderstanding...
    - missed one or more important steps in the scientific method
    - and sometimes show evidence of political influence...

• Represent both
  - Barriers: what is heard first is often what is remembered most, even if it is wrong
  - Opportunities: to show elements of truth and correct misinterpretations
Top Global Warming Myths

1. Climate has always varied in the past so the current changes are natural
2. Global warming is caused by changes in the sun's irradiance (output)
3. Scientists predicted a global cooling in the 1970s, now they say it's a warming! Scientists are unreliable.
4. Some locations on Earth show a recent cooling trend, therefore Global Warming is disproved
5. The globe has been cooling since 1998, therefore increasing GHGs can't have caused global warming
6. Glacier retreat from Little Ice Age limits (ca. 1850 A.D.) began before increases in GHG concentrations. Therefore, the current warming is a natural variation.
7. The greenhouse effect of increasing CO₂, CH₄, and other long-lived GHGs doesn't cause warming
8. Water is the Earth's dominant GHG, is not released by humans, so Global Warming is a non-issue
9. Vineyards on Britain during the Medieval Warm Period are proof that climate has been as warm as today due to natural climate variations
10. Galactic cosmic rays are responsible for Global Warming
11. Global warming is "unstoppable" so we should just adapt rather than mitigate
12. Increased hurricanes and other extreme events are proof of global warming (even our President made this statement)
13. CO₂ is pulled out of the atmosphere and stored in soils, so there's no need to worry about GW and the GH effect
14. The "theory" of Anthropogenic Global Warming (AGW) is propagated by left-wing liberals for moralistic and/or monetary gain
15. The Earth is too big for human's to have an appreciable effect
16. Future projections are flawed because the computer models are incomplete. "They are just models" and climate is too complicated to be modelled.
17. The "Global" averaged temperatures are biased by the Urban Heat Island Effect and are therefore unreliable.
18. During the Ice Ages, temperature changed increased first, and CO₂ followed after. Therefore, increasing CO₂ does not cause temperature rise.
19. Antarctica is cooling, therefore anthropogenic global warming is not happening
20. They are just "hypotheses" and "theories" of scientists
21. Most scientists even don't agree that Global Warming is caused by humans
22. The amount of CO₂ already in the ocean and atmosphere is so huge that anthropogenic inputs are negligible.
23. The Ozone hole causes Global Warming
24. Global temperature and greenhouse gas emissions are not perfectly correlated, therefore they can't be causing global warming
25. Etc., etc., etc.!
Top 4 Global Warming Myths

1. Scientists predicted global cooling in the 1970s, now they say it’s a warming! Scientists are unreliable

2. Global warming is caused by changes in the sun’s irradiance (output)

3. Length of sun’s solar cycle forces climate

4. Global warming stopped in 1998
Example 1: Predictions of Global Cooling

- The claim:
  - In the 1970s, after several decades of cooling, “scientists” predicted an imminent return to an Ice Age.
  - Now, these same scientists are predicting global warming!
  - If they were so wrong then, they could be wrong now.
  - Scientific “consensus” doesn’t exist, as witnessed by this 180° change of opinion.
  - Climate scientists don’t know what they are talking about!
Example 1: Predictions of Global Cooling

• The facts:
  - Idea was originated and propagated by the popular media, not "scientists"
  - Improper attribution
• "Scientists" at the time largely disagreed with the media’s story
• The media got their facts wrong
Global Cooling?

- Cooling superimposed upon a warming trend
- Later temperature increases
- 1940s – 50s were anomalously warm for “weather” reasons
Truth and Fallacy
( Opportunity and Barrier )

• Truth (opportunity for learning)
  - Absent a human role, changes in earth’s orbital configuration will lead to a glacial climate
  - Timescale: 1000s to 10,000s of years
  - Aerosols (soot, etc.) also contribute to a cooling when pollution is high, e.g. in 1960s-70s

• Fallacy (barrier to understanding)
  - Decades of cooling are not related to Ice Age cooling due to Earth’s orbit
  - Mix of “weather” with “climate”
• We are “due” for another Ice Age

• In 10,000 to 30,000 years

• Only if we discount the human role in changing GHGs
• “Yes, but there was a scientific consensus that global cooling was happening!”

• Reality: No, there wasn’t

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**Fig. 1.** The number of papers classified as predicting, implying, or providing supporting evidence for future global cooling, warming, and neutral categories as defined in the text and listed in Table 1. During the period from 1965 through 1979, our literature survey found 7 cooling, 20 neutral, and 44 warming papers.

Blame it on the sun!

• Claim:
• 1) Changes in the sun's irradiance (output) are enough to explain the modern warming trend
• 2) Changes in the Solar Cycle Length can explain warming
Changes in solar irradiance?

- Natural variations in the Sun’s energy output
  - 0.08% changes
- Related to sunspots on an ~11 yr cycle
- No overall trend since 1980
Changes in solar irradiance?

![Graph showing changes in solar irradiance over years from 1980 to 2005.](Image)
Sun?

- Link between filtered Solar Cycle Length and Temperature?
- (note scale)
- Based on incorrect data

Fig. 1. (a) Solar cycle lengths (blue plus signs) and terrestrial temperatures (red asterisks) as presented by Friis-Christensen and Lassen [1991]. All points on the solar curve up to the point marked zero represent 1,2,2,2,1-filtered values; the points marked 1 and 2 represent values that are only partially filtered, and the points marked 3 and 4 represent values that are not filtered at all. (b) An update as presented by Lassen and Friis-Christensen [2000]. The upward bend of points 3 and 4, corresponding to the recent global warming, is the result of some trivial arithmetic error. (c) The correct update.
• Corrected data
• No correlation to temperatures, especially after 1985
• But the myth persists
Truth and Fallacy
(Opportunity and Barrier)

• Truth/opportunity
  - Solar irradiance variation does have a role in climate change
  - Example is cooling during the Little Ice Age (ca. 1700-1850 A.D.) during the Maunder Minimum of solar irradiance

• Fallacy/barrier
  - Improper use of statistics
  - Lack of a demonstrated mechanism
  - for small variations in the sun to cause large variations in climate
Radiocarbon from tree rings

- Proxy for variations in sun’s output
- 420 yr cycle
- 11 and 22 yr cycles
Global Warming stopped in 1998

• Claim: The Earth has cooled since 1998, whereas greenhouse gas concentrations have continued to rise. Therefore, GHGs aren’t responsible for the temperature rise

• Reality:
  - Peak warmth in 1998 was related to a very strong El Niño event
  - And 2005 and 2007 were warmer than 1998 (in GISSTEMP time series)
Global warming stopped in 1998?

- Simply wrong!

- Short-term anomalies (1-2 yr) are not climate, they are weather

- El Niño results in a warmer Earth, via redistribution of oceanic heat

Truth and Fallacy
(Opportunity and Barrier)

- **Truth/opportunity**
  - Short-term climate variability is expected with climate
  - Particulary with El Niño events

- **Fallacy/barrier**
  - Misunderstanding of the differences between “weather” and “climate”
  - Easily rectified
Classes of misunderstanding

- **Scientific (Lack of intellectual focus)**
  - “**Complexity of Nature**” conundrum:
    - Lack of a scientific background
    - Smart people without training miss the bigger picture

- The “**Plausibility**” conundrum:
  - Presentation of limited facts leads to a plausible conclusion, although omission of important data would show that conclusion to be false
Classes of misunderstanding

• **Scientific (Lack of intellectual focus)**
  - The “Correlation” conundrum
    - assuming correlation implies causation without a plausible mechanism

- **Confusion of “Weather” and “Climate”**
  - Coldest winter in decades in my home state proves that Global Warming isn’t happening

- **Confusion of “Regional” with “Global”**
  - Some locations are cooling, therefore GW is disproved
Classes of misunderstanding

- **Political/Ideological (selective focus)**
  - Deliberate and/or ignorant “cherry picking” of facts to suit a political ideology
  - Mixing of value judgements with scientific data: e.g. “deleterious”, “benign”, or “beneficial” effects from increasing GHGs
  - **Example**: $CO_2$ increase has a beneficial effect on plant growth (fossil-fuel industry), therefore we shouldn’t worry about GW
Balance vs. accuracy in the media

Legitimate media has commonly attempted to show “balance” in reporting:
- Soapbox given to many with opinions not backed up by data and publications
- Reporters need a “hook” for their story

Recommendation: “Accuracy trumps Balance”
A contrarian parable

- Picture Contrarian Charlie (CC) talking to Galileo as he is walking up the Tower of Pisa with his wooden and lead balls:

- Galileo: I predict that when dropped at the same time, the balls will hit the ground after an equal amount of time.

- CC: But have you seen this paper on the wind?

- Galileo: I'm assuming that the winds are a negligible effect.

- CC: But what about the uncertainties in time-keeping apparatus - Here's a paper about clocks drifting.

- Galileo: Obviously I am only talking about time differences that are detectable with current technology.
A contrarian parable

• *CC*: here’s another paper about variations in the gravity field across the planet, and here’s one about the impact of operator error in ball dropping stations, and here’s another on cosmic ray impacts on small round objects in the air.

• Galileo: None of those things are relevant.

• *CC*: Well, all I’m saying is that we’ll have to wait and see.

• Galileo: Hmmm…. (drops balls and they both land at the same time)… See, I was right.

• *CC*: Here’s a paper on the non-reproducibility of ball dropping experiments.

• Galileo: Sigh…..

From the www.realclimate.org Climate Change website
• And sometimes enough is never enough....

• Thank you.
Optional Slides
Is there a scientific consensus?

“Do you think human activity is a significant contributing factor in changing mean global temperatures?”

“It seems that the debate on the authenticity of global warming and the role played by human activity is largely nonexistent among those who understand the nuances and scientific basis of long-term climate processes” Doran and Zimmerman, 2009, EOS, v. 90, p. 22.
GHG Radiative Forcing

More GHGs = Higher Temperatures
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- Some locations on Earth show a recent cooling trend, therefore Global Warming is disproved
- The globe has been cooling since 1898, therefore increasing GHGs can’t have caused global warming
- Glacier retreat from Little Ice Age limits (ca. 1850 A.D.) began before increases in GHG concentrations. Therefore, the current warming is a natural variation.
- The greenhouse effect of increasing CO2, CH4, and other long-lived GHGs doesn’t cause warming
- Water is the Earth’s dominant GHG, is not released by humans, so Global Warming is a non-issue
- Galactic cosmic rays are responsible for Global Warming
- Global warming is “unstopable” so we should just adapt rather than mitigate
- Increased hurricanes and other extreme events are proof of global warming (even our President made this statement)
- CO2 is pulled out of the atmosphere and stored in soils, so there’s no need to worry about GW and the GH effect
- The “theory” of Anthropogenic Global Warming (AGW) is propagated by left-wing liberals for moralistic and/or monetary gain
- The Earth is too big for human’s to have an appreciable effect
- Future projections are flawed because the computer models are incomplete. “They are just models” and climate is too complicated to be modelled.
  - This ignores the fact the models have been very successful at modeling climate changes and give good results.
- The “Global” averaged temperatures are biased by the Urban Heat Island Effect and are therefore unreliable.
- During the Ice Ages, temperature changed increased first, and CO2 followed after. Therefore, increasing CO2 does not cause temperature rise.
- Antarctica is cooling, therefore anthropogenic global warming is not happening
  - First statement is likely false (2009 paper in Science), second statement is a non-sequiter, because the comparison of natural GHG variations is not valid to anthropogenic GHG variations. Further, the initial lag of some 300-700 years of CO2 only relates to a portion of the longer-term (~1000-2000 yr) temperature rise.
- They are just “hypotheses” and “theories” of scientists
  - Confusion of the scientific terms to mean a “hunch”, whereas the literature on GW is so well-constrained.
- Most scientists even don’t agree that Global Warming is caused by humans
  - >95% of CLIMATE scientists agree that Global Warming has an anthropogenic origin.
  - Would you hire a foot doctor to perform open-heart surgery on you? Having a Ph.D. is not in itself sufficient to understand climate science. In fact, I have talked with many Ph.D.s who claim to not believe in a human role in Global Warming, yet queries as to their knowledge reveals huge gaps in understanding of even the basics of climate science.
- The amount of CO2 already in the ocean and atmosphere is so huge that anthropogenic inputs are negligible.
  - This idea suggests that the absolute amounts, not the change in concentrations, is more important for understanding climate. It’s a strange idea, because it tacitly agrees that CO2 causes warming. An analogy is useful: Because a Billionaire is so rich, making an additional million dollars per year is inconsequential. I would tend to disagree!
- The Ozone hole causes Global Warming
  - Nope.
- df