Communicating Dangers and Opportunities in Global Warming

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I speak today for myself, not as a spokesman for NASA

There is a huge gap between what is understood about global warming and what is known about global warming – understood by the relevant scientific community, and known by those who need to know, the public and policy-makers.

The scientific knowledge that has emerged in the past several years is startling, and it has dramatic implications for the fate of life on this planet – if we fail to communicate it well enough to drive prompt actions.

Actions needed to meet the climate threat make sense for other reasons. Indeed, other benefits – for human health, for energy independence, for national security, for our long-term economic well-being – make the case for action all the more compelling.

Yet it is not happening. Why? I will come to that, after summarizing remarkable, but sobering, advances in our understanding of climate change.

1. Emergent Science

A. Climate Sensitivity: "Slow Feedbacks Happening Fast"

(Chart 2: The "Little" Climate Whip-Saw)

First, climate sensitivity. The long-standing "**Charney**" problem has been solved. If continents are fixed as at present, ice sheets are fixed, vegetation distributions are fixed – global climate sensitivity for doubled CO_2 is about 3°C. This Charney sensitivity includes fast feedback processes – water vapor, sea ice, clouds. Models have inherent uncertainties, but comprehensive empirical data for the last ice age implies a sensitivity of about three degrees.

The size of ice sheets for the past 400,000 years is known from sea level data, and greenhouse gas amounts are known for the same period. Taking these as boundary conditions, or forcings, shows that the same Charney fast feedback sensitivity fits the entire period. However , the ice sheets and greenhouse gases are feedbacks on these time scales, driven by small forcings due to slow changes in the Earth's orbit. In response to these small forcings the Earth is whip-sawed through dramatic climate changes. Positive feedbacks reign supreme.

Yet these climate changes, however staggering they seem to humans, with 400 foot changes of sea level, and New York, Minneapolis and Seattle under ice sheets thicker than our tallest sky-scraper, are just the "little whip saw". Consider the changes that have occurred on longer time scales, for example, global warming events such as that at the Paleocene-Eocene boundary, driven at least in part by methane hydrate release.

Go back further to the greatest whip-saw of all, "snowball Earth" events in the Proterozoic, and the most recent one, which ushered in the Cambrian period. The Earth froze all the way to the equator, and after greenhouse gases accumulated and some melting began, the planet was whipsawed to hellish hothouse conditions.

We live on a planet whose climate is dominated by positive feedbacks, which are capable of taking us to dramatically different conditions. The problem that we face now is that many feedbacks that came into play slowly in the past, driven by slowly changing forcings, will come into play rapidly now, at the pace of our human-made forcings, tempered a few decades by the oceans thermal response time.

B. Climate Range: "The Garden of Eden"

(Chart 3: Warm Pool Temperature for Past Million Years)

Civilization developed during the past several thousand years in the tranquil Holocene, temperature hardly changing, shorelines practically fixed. Our infrastructure has been built for that planet. Some previous interglacials were warmer than the Holocene, but, with the warming

of the past few decades, we are now within about 1°C of the warmest interglacial. If we follow business-as-usual greenhouse gas emissions, the warming this century due to just the fast feedback processes will approach 3°C. But surely additional feedbacks would start to come into play, with dark evergreen forests moving poleward, tundra melting and possibly releasing methane hydrates, ice sheets beginning to shrink. It would be a **different planet**, with no sea ice in the Arctic, with many species of life driven to extinction, with ice sheet disintegration and rising sea level out of our control, more intense hot dry conditions in spreading subtropical areas such as the western U.S., the Mediterranean, Middle East and parts of Africa. The semi-arid part of the United States, stretching from West Texas through Oklahoma, Kansas, Nebraska and the Dakotas is likely to have more extensive droughts and be less suited for agriculture. As isotherms move poleward, so too will pests and diseases normally associated with low latitudes.

C. Climate Inertia: What's "In the Pipeline?"

(Chart 4: Fossil Fuel Reservoirs)

There is about one-half °C global warming "in-the-pipeline", because of the ocean's thermal inertia, due to gases already in the air. And because of energy infrastructure, such as power plants, enough gases for another half degree will be added even if we decide now to replace business-as-usual with an alternative scenario, in which we begin to phase down emissions of uncaptured CO_2 in a gradual, economically-sound way.

In practice, what that means is that we will have to phase out use of coal except at power plants where it can be captured and sequestered. And we must stretch the supplies of readily available gas and oil, so that alternative energy sources can be developed without squeezing fuels out of shale and tar, unless the same criteria are applied as for coal.

D. Carbon and Water Cycles: "Nature's Bi-Cycle"

(Chart 5: Science and Implications)

It did not have to turn out that positive feedbacks dominate. But what has become clear recently is that the Earth's bi-cycle, the water and carbon cycles, together make a very sensitive climate system. We must keep this bi-cycle under control. So far the system has continued to take up about 40% of fossil fuel CO_2 emissions, but, if we follow business-as-usual, the ocean will become less effective in absorbing CO_2, the terrestrial biosphere is likely to be less effective and could even become a source of CO_2, and methane hydrates could become a significant source.

One scientific fact deserves emphasis. CO_2 that we put in the air does not decay exponentially. The CO_2 taken up by the ocean exerts a back pressure on the atmosphere, so that at least a quarter of the fossil fuel CO_2 stays in the air **"forever"**, more than 500 years.

2. Personal Experience

A. Iowa Talk: "Role of the White House"

What causes the gap between scientific understanding of global warming and public knowledge of it? There was a prior global problem (***Chart 6: Ozone Story***), ozone depletion, in which scientists did a good job of informing the public. What is different now?

The organizers asked me to describe my experiences in trying to communicate global warming science. (I provide my personal opinion, under protection of the First Amendment.)

I have been dismayed for decades by political intrusion into communication of government scientists with the public. Testimony to congress in a sensitive area such as global warming is reviewed by the party in power, which feels that it has the right to torque scientific

testimony to fit the reigning politics. Offices of Public Affairs, intended to expedite information to the public, have become controllers of information.

These are not new problems, but in thirty-some years in the government I have never seen anything approaching the degree to which the present administration attempts to control the flow of information from scientists to the public. I refer to Public Affairs at NASA Headquarters and other agencies, where political appointees preside, not NASA Centers. The professional Public Affairs people at the Centers are the heroes in this story.

It seems that science is filtered or adjusted so as to fit preferred policies. One of my staff members submitted a story based on his paper that found the ocean was less effective at removing human-made CO_2 than had previously been estimated. The story was left on the cutting room floor. Another staff member had to attend a "practice" press conference. When asked if there was anything that could be done to stem accelerating loss of sea ice, his response "we could reduce emissions of greenhouse gases", was greeted with a stern shout "that's unacceptable!" The message was clear to all.

Most distressing, I know that press releases relating to global warming science have routinely gone from NASA Headquarters to the White House for review, approval or disapproval, and editing. When I publicly noted this practice ("Iowa talk", www.columbia.edu/~jeh1/dai_complete.pdf) the professional writer at Goddard Public Affairs who had informed me was promptly visited by the NASA Assistant Administrator for Public Affairs, who dressed him down in front of his boss, admonishing him to "mind his own business".

Such reprimands and orders are delivered orally. If NASA Headquarters Public Affairs is queried by media about such abuses they respond "**that's hearsay!**", a legal term that frightens the media. There is an easy way to get at the truth. Put the then NASA Associate Administrator for Earth Science under oath. He knows who in the White House reviews press releases.

B. AGU Talk: "Subversion of Public Affairs"

The unbridled arrogance of Public Affairs political appointees reached a new height after my "Keeling" talk at last year's AGU meeting and our release of data on record 2005 global temperature. Public Affairs was furious about the media attention. Their consternation, expressed during Headquarters-Greenbelt-New York telecons, was described by a participant as a "shit-storm". Their anger was sparked by a call from the White House complaining about news stories based on our temperature analysis. In multiple calls, Public Affairs defined new constraints on me, including requirement that any media interviews be approved beforehand and that Headquarters have the "right of first refusal" on all interviews, that I provide my calendar of all talks and meetings, and that I get prior approval for every posting on the GISS web site.

These orders were delivered orally, of course, as was a threat of "**dire consequences**" if I did not comply. However, a new young political appointee at Public Affairs, who said "my job is to make the President look good", was not well-schooled in the rules and he left a paper trail, including a description of the process by which Public Affairs barred me from speaking to NPR, offering the Associate Administrator instead. These indiscretions, I believe, were the real reason behind his departure, rather than the fact that his resume failed to show that he was one course short of the university degree that he claimed. But he was not acting on his own. He was a bit player. His paper trail showed that the problem starts at the top of Public Affairs, the decision to bar me from speaking with NPR being made "on the ninth floor" of Headquarters.

My initial reaction to the constraints was "what else is new". I would find a way around them. But this time they had a pit bull enforcing them. When I was forced to take our routine

posting of annual temperature analysis off the GISS web site, I got worried and decided to write down the constraints and let the media know. It took a few weeks – I should have gone immediately to Andy Revkin – he had both the courage to go with a limited paper trail and enough clout with the Times to get the story on page one.

(Chart 7: Global Warming Story)

To NASA's credit, the Administrator promptly issued an unequivocal statement in support of scientific openness. It may be a giant leap for NASA, I hope, but it is an imperceptible baby step in communication of the global warming story. Problems here, I believe, run all the way from us scientists, to failure of U.S. political leadership. And special interests warrant special attention.

C. Tenets of a Democracy: "An Informed Public"

(Chart 8: Unitary Executives)

Our democracy is based on the premise that citizens are informed, honestly informed. If our Founding Fathers came back for a visit, like the Native American pictured in a canoe on a polluted river, our present situation would put a tear in their eyes. How has our democracy allowed government science agencies, when the topic is politically sensitive, to become offices of propaganda?

How does this relate to the trend toward a unitary executive, the grasping of more and more power by the executive branch? In this article in World Watch ("Iowa talk", www.columbia.edu/~jeh1/worldwatch_nov2006.pdf), I discuss the fact that in some cases the executive branch has taken control of the purse strings, a power given to Congress by our Constitution. But that is another story.

3. Role of Scientists

A. Painting a Picture: "A Different Planet"

A few words about the role of scientists in the global warming discussion ***(Chart 9: Threat to the Planet)***.

As scientists, I believe that we have ethical responsibilities, just as medical doctors have to their patients. It is not o.k. to allow Public Affairs to stop us from making the connection between greenhouse gases and ice melt. We cannot expect the public to connect scientific dots. It is appropriate that we point out evidence for dangerous climate change when we detect it.

We will not all agree on the details, as evidenced by pronouncements about sea level rise. It is obvious from the IPCC draft report that the fundamental difference between the paleoclimate case, in which the time constant for response of the climate system is set by the slow growth of feedback processes, and the present situation, in which the time constant is set by the incredibly rapid growth of the human-made climate forcing, has not yet penetrated the thick skull of Iceblock Geezer (www.giss.nasa.gov/research/briefs/hansen_12/) (sorry to be so blunt and impolite).

But even if we accepted the conclusion, which I do not, that business-as-usual would not cause sea level change this century measured in meters, it does not alter the assessment of "danger". A large fraction of the human-made CO_2 emissions stay in the air "forever", so even Geezer's ice sheets would produce calamity before the "seventh generation".

B. Science & Religion: "Preserving Creation"

(Chart 10: Fossil Fuel Emissions: Pie & Bar Charts)

A few words about science and religion, about preserving creation".

Does it matter whether Creation was 6000 years ago or six billion years? And whether we take the entire Bible literally, or more broadly as a source of enlightened guidance, or even if we simply have humanistic values and love for fellow creatures in our world, as Ed Wilson describes in his book "Creation"? We can all agree on the need for stewardship, the need to protect Creation. We should be humble as scientists. We certainly do not have all the answers, but we can help with limited information about how things work in the world that we live in. Decisions that the public makes do not need to be science-based, but they should be science-informed.

It is appropriate, I think, to point out the moral and legal burdens that our present course will place upon our children and grandchildren. China's CO_2 emissions will soon pass those of the U.S. But the climate effect is not caused by current emissions, it is caused by integrated emissions. The responsibility of the United States is 3 and one-half times that of any other country, and it will remain the largest for many decades to come. Our responsibility is still greater, because we have blocked the attainment of international accords designed to address climate change.

C. Personal Opinion: "Connecting the Dots"

(Chart 11: Inferences (Opinions))

Finally, a comment about "connecting the dots". I believe that scientists should attempt to connect the dots, and give their opinions, appropriately labeled. Otherwise the public hears only from the special interests, who speak loudly, and falsely, in my opinion. They claim that dealing with climate change will harm the economy, when what they really mean is that it will harm their own bottom line, a fate that they could avoid by becoming energy companies instead of fossil fuel companies.

In my opinion, it will be necessary to put a price on carbon emissions in order to drive innovation and spur renewable energies and alternative energies. It is also necessary for the U.S. to take a leadership role.

(Chart 12: Fossil Fuel Facts & Opinions)

An important point is that the actions needed to avert large climate change have enormous benefits to society. It is not a gloom-and-doom story at all. A slowly increasing price on carbon, with rebates as appropriate, would not harm the little guy nor the nation. Indeed, it could reduce transfer of money to places where it can be used for harm. Energy independence is a good thing, and so is reduction of balance of payment deficits, so is cleaner air, so are good high-pay high-tech jobs. We need a government that pays attention to what is good for the people, not what is good for special interests. Of course, that is just my opinion. Thank you.

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Jim Hansen

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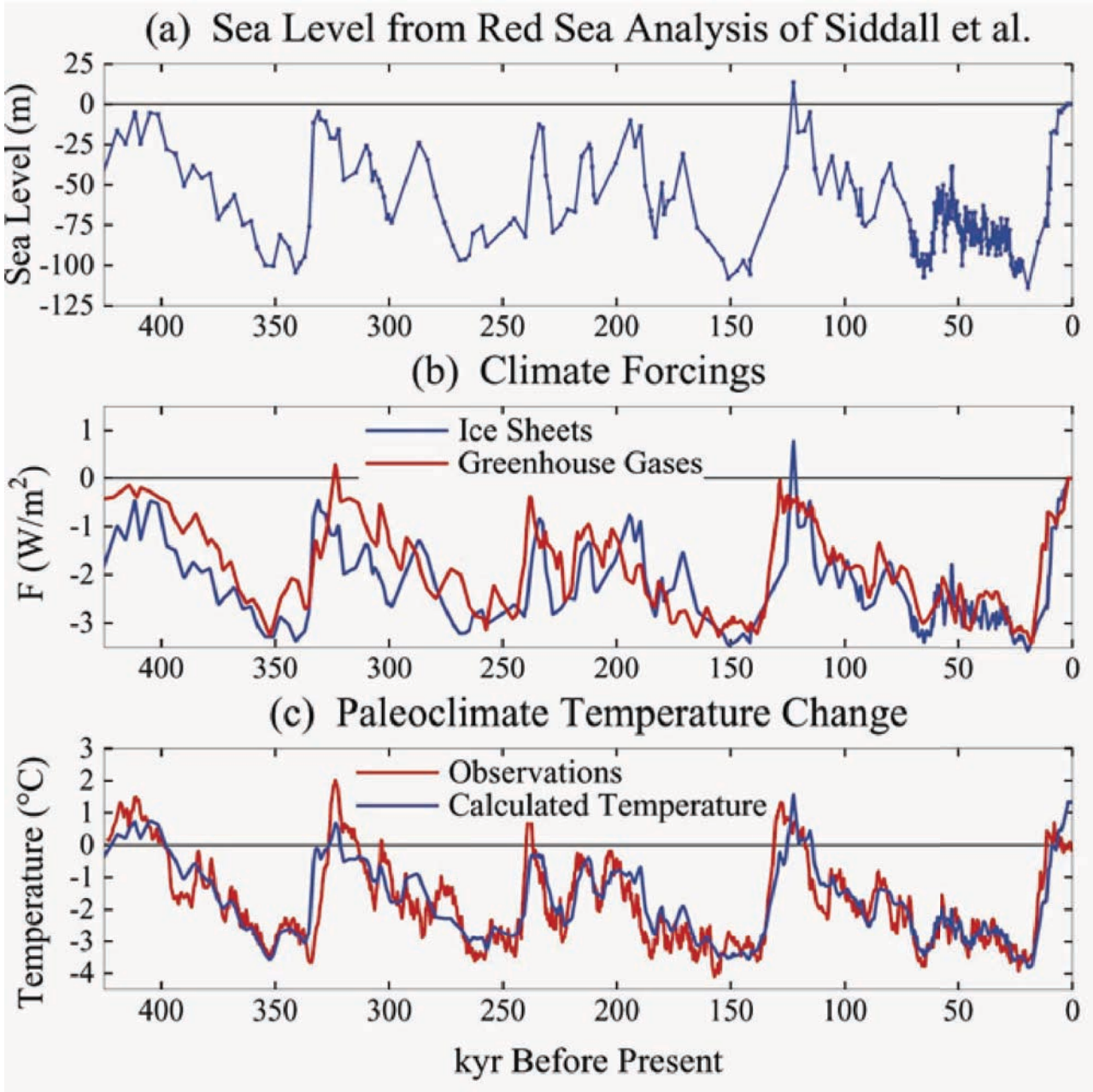
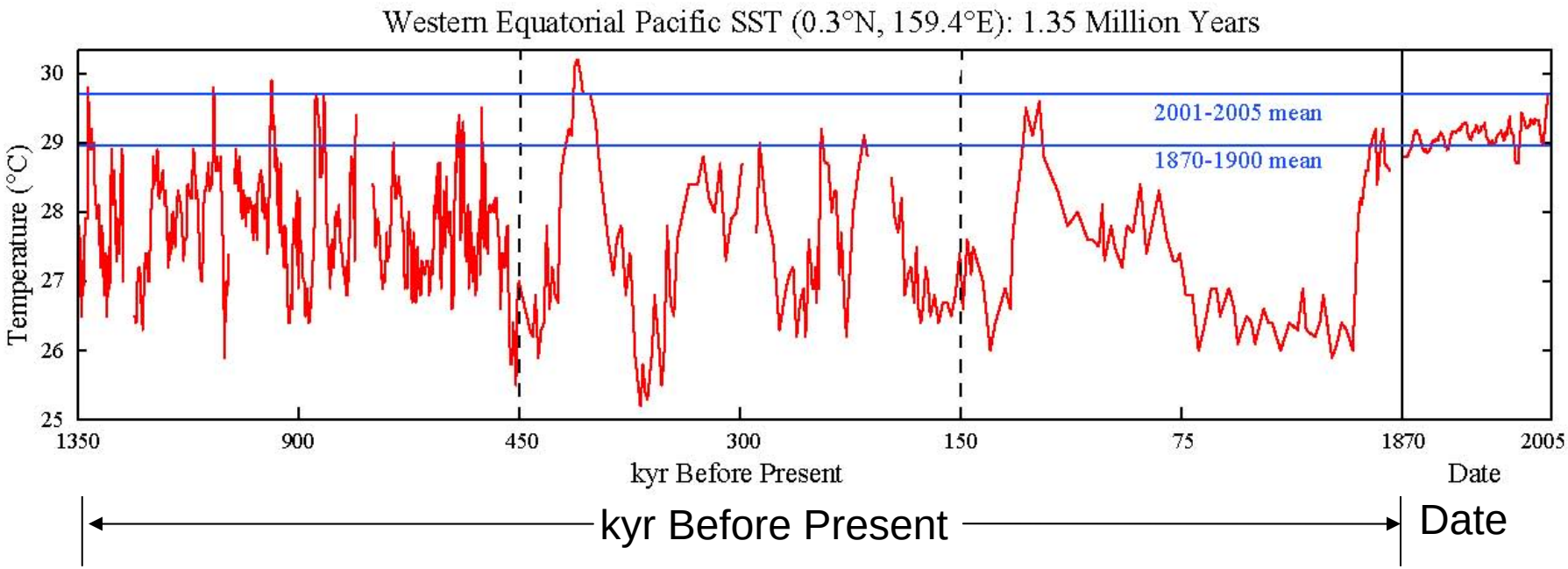
American Geophysical Union

San Francisco, CA

Available

www.columbia.edu/~jeh1/agu_communicating.pdf
www.columbia.edu/~jeh1/agu_communicating.ppt

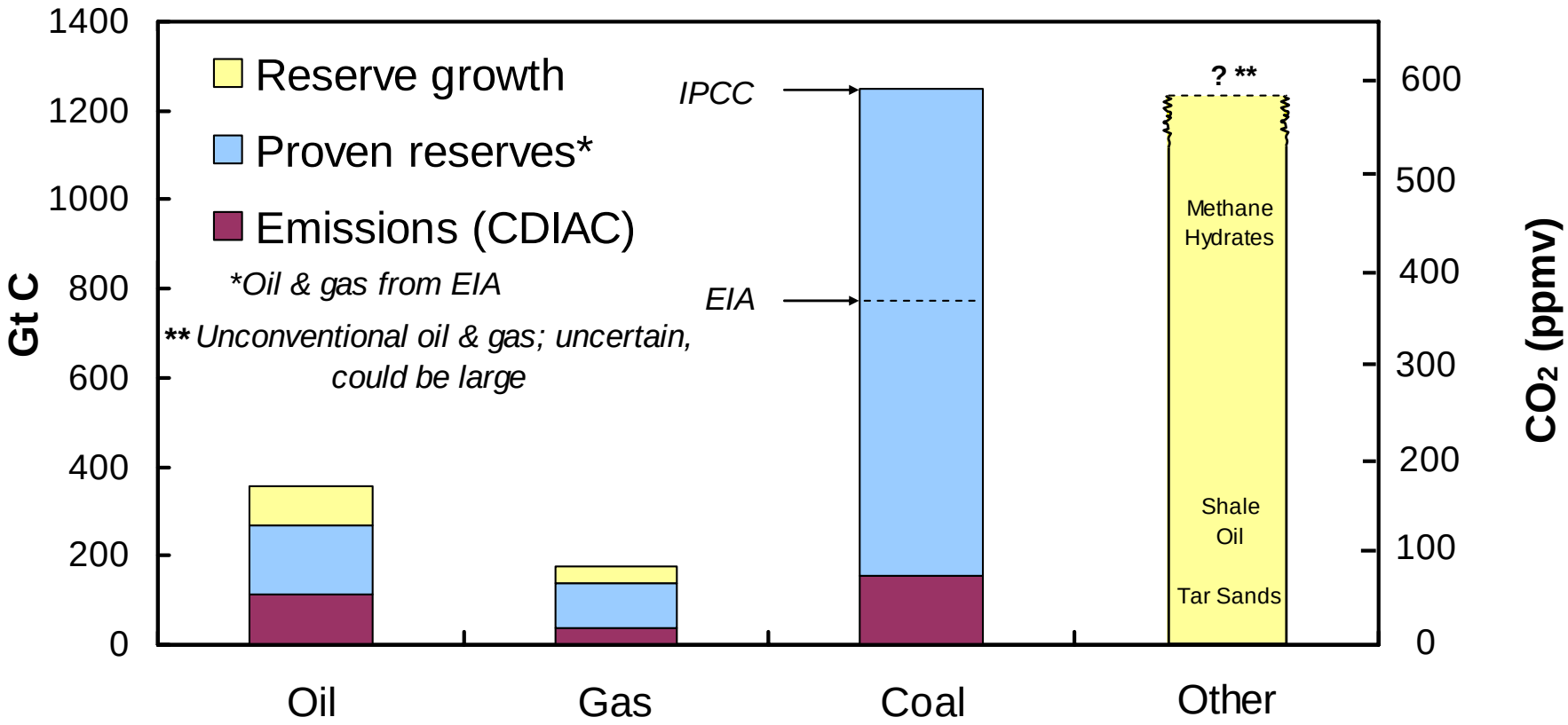

(a) Sea Level from Red Sea Analysis of Siddall et al.
Sea Level (m)
25
0
-25
-50
-75
-100
-125
400
350
300
250
200
150
100
50
0
(b) Climate Forcings
F (W/m^2)
Ice Sheets
Greenhouse Gases
1
0
-1
-2
-3
(c) Paleoclimate Temperature Change
Temperature (°C)
Observations
Calculated Temperature
3
2
1
0
-1
-2
-3
-4
kyr Before Present



SST in Pacific Warm Pool (ODP site 806B, 0°N, 160°E) in past millennium. Time scale expanded in recent periods. Data after 1880 is 5-year mean.

Source: Medina-Elizalde and Lea, ScienceExpress, 13 October 2005;data for 1880-1981 based on Rayner et al., *JGR*, **108**, 2003, after 1981 on Reynolds and Smith, *J. Climate*, **7**, 1994.

Fossil Fuel Reservoirs and 1750–2004 Emissions



Science & Implications

1. Warming >1°C Risks 'Different Planet'

- Maximum CO_2 ~450 ppm
- Somewhat greater if non-CO_2 ↓

2. Gas + Oil Use Most of 450 ppm Limit

- Coal/unconventional must sequester CO_2
- Gas + Oil supplies must be stretched

3. Quarter of CO_2 Stays in Air "Forever"

- Eventual Vehicles must be Zero-CO_2
  (renewable, hydrogen from nuclear or solar, etc.)
- Eventual Power Plants must be Zero-CO_2

Ozone Success Story

↑ 1. **Scientists**: Clear warning

↔ 2. **Special Interests**: Denied story for years, but developed ozone-friendly technology

↑ 3. **Media**: Transmitted the message well

↑↑ 4. **Public**: quick response; spray cans replaced; concern of public was clear to lawmakers

↑ 5. **Government**: U.S./Europe leadership; allow delay & technical assistance for developing countries

Result: No additional CFC-producing infrastructure built

Global Warming Story

↓ 1. **Scientists**: Fail to clearly distinguish climate change & BAU = A Different Planet

↓↓ 2. **Special Interests**: Disinformation campaigns, emphasis on short-term profits

↓ 3. **Media**: False "balance", & leap to hopelessness

↓ 4. **Public**: understandably confused, uninterested

↓ 5. **Government**: Aids and abets special interests; fails to lead – no Winston Churchill today

Result: CO_2 emissions continue to increase at BAU rate

WORLD·WATCH

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Swift Boating, Stealth Budgeting, & Unitary Executives

by James Hansen

Illustrations by William Bramhall

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Robert Skidelsky: America & Empire

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Sanford Schwartz: The Best of Ingres

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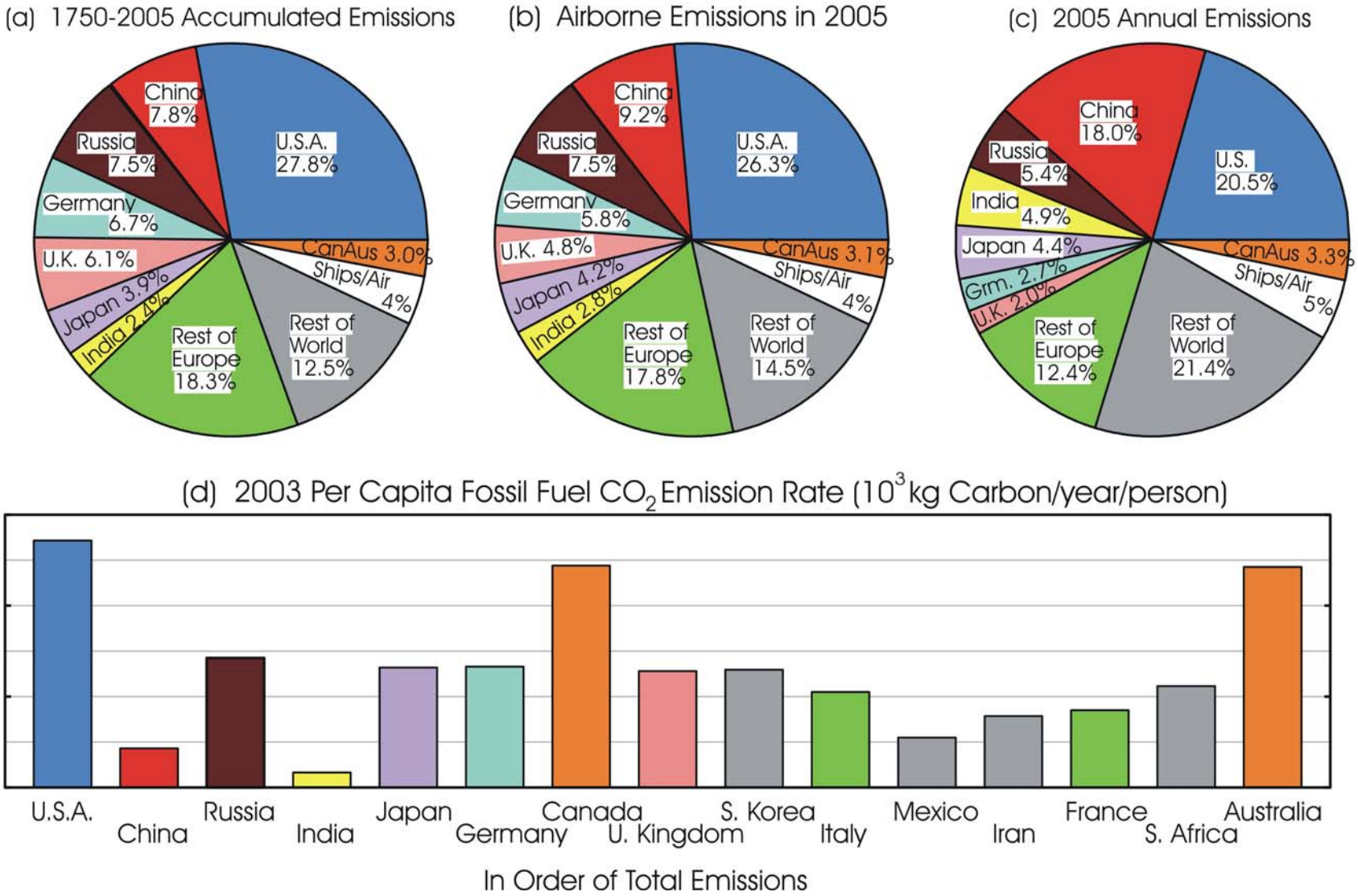
Responsibility, Irresponsibility and Fairness



Inferences (Opinions)

1. **Building/Vehicle Efficiencies Critical**
   - Needed to Stretch Oil/Gas Supplies
   - Needed for Future Non-Carbon Energy

2. **Both Incentives and Standards Needed**
   - Rising Price on Carbon Drives Innovation
   - Efficiency Standards Proven Effective

3. **United States Leadership Essential**
   - Large Emissions, Tech & Political Leader
   - Developing Countries cannot be expected to act until the U.S. Takes First Step

Fossil Fuel Facts & Opinions

1. **Value Fossil Fuels >> Mining Cost**
   - $$$$ Pocketed by Middle East & Russia
   - Those $$$$ Fund Many Things

2. **Steadily Rising Carbon Tax**
   - Can Be Revenue Neutral
   - Nonpartisan Tsar Adjusts Rate (a la Fed. Res.)
   - Spurs Technology Devel. & Efficiency
   - Energy Need per GDP Decreases

3. **Results**
   - Energy Independence & National Security
   - $$$$ to U.S. Treasury, not Middle East/Russia
   - Improves U.S. International Competitiveness
   - Good High-Tech High-Pay Jobs in the U.S.