平成22年度（第19回）ブループラネット賞
受賞者記念講演会

2010 Blue Planet Prize
Commemorative Lectures

ジェームス・ハンセン博士　講演スライド集
「人起源の気候変動：道徳的、政治的、法的課題」

ロバート・ワトソン博士　講演スライド集
「オゾン層破壊、気候変動及び生物多様性の損失：
　　食糧、水、人間の安全保障に関する意味合い」

Dr. James Hansen
Slides for the Lecture
“Human – Made Climate Change: A Moral, Political and Legal Issue”

Dr. Robert Watson
Slides for the Lecture
“Ozone Depletion, Climate Change and Loss of Biodiversity:
Implications for Food, Water and Human Security”

af 公益財団法人 旭硝子財団
THE ASAHI GLASS FOUNDATION

ジェームス・ハンセン博士

講演スライド集

「人起源の気候変動：道徳的、政治的、法的課題」

Dr.James Hansen

Slides for the Lecture

“Human-Made Climate Change:A Moral,Political and Legal Issue”

Human-Made Climate Change:

A Moral, Political and Legal Issue*

James Hansen

27 October 2010

Blue Planet Lecture

Tokyo, Japan

*Statements relating to policy are personal opinion

slide 1

Global Warming Status

1. **Knowledge Gap Between**
   - What is Understood (scientists)
   - What is Known (public)
2. **Planetary Emergency**
   - Climate Inertia → Warming in Pipeline
   - Tipping Points → Could Lose Control
3. **Bad News & Good News**
   - Safe Level of CO_2 < 350 ppm
   - Multiple Benefits of Solution

slide 2

Climate Tipping Points

1. **Ice Sheet Disintegration**
   - Ocean Warming → Ice Shelves Melt → Ice Streams Surge → Disintegration
2. **Species Extermination**
   - Shifting Climate Zones, Multiple Stresses, Species Interdependencies
3. **Methane Hydrate 'frozen methane'**
   - In Tundra & On Continental Shelves
   - Depends On Ocean & Ice Sheets

slide 3

First grandchild, Sophie – at age almost two years

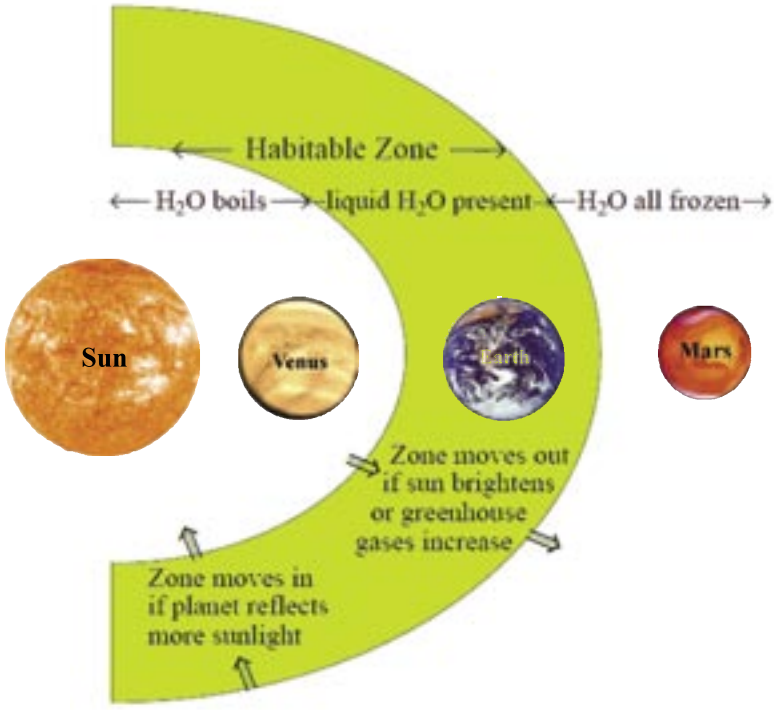
slide 4

GOLDILOCKS PLANETS

Temperature	-50°C	+15°C	+450°C
Greenhouse Effect	a few degrees	~30°C	~470°C

Venus is closer to sun than Earth is, but cloud-covered Venus absorbs only 25% of incident sunlight, while Earth absorbs 70%. Venus is warmer because it has a thick carbon dioxide atmosphere causing a greenhouse effect of several hundred degrees.

slide 5



When the solar system formed, the sun was 30% dimmer than today and Venus had an ocean. As the sun brightened, a runaway greenhouse effect caused the Venus ocean to boil away.

At times when Earth was younger, the sun brighter, and atmospheric CO_2 less, Earth froze over ("snowball Earth").

Earth is in the sweet spot today.

slide 6

Basis of Understanding

1. Earth's Paleoclimate History

2. On-Going Global Observations

3. Climate Models/Theory

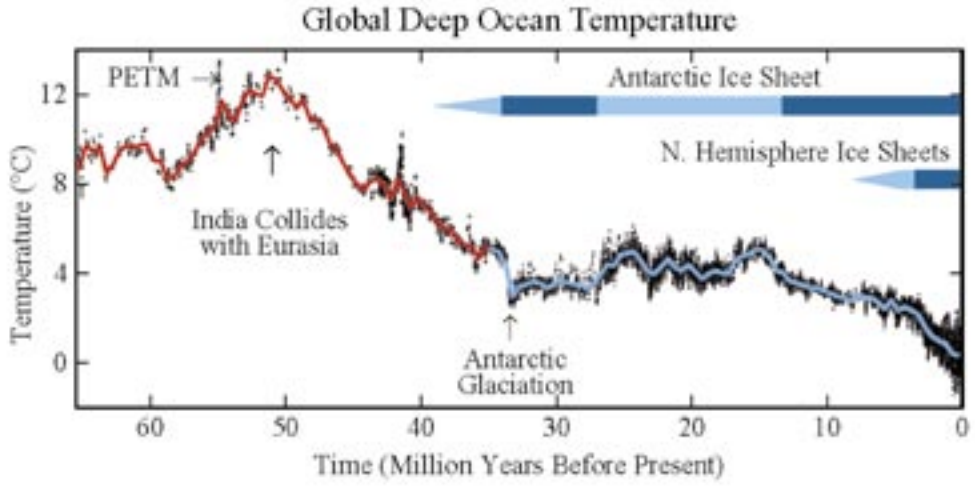
slide 7

Why be concerned about human-made climate change?

There have been huge climate changes during Earth's history!

It is arrogant to think that humans can control climate or that we know enough to say that today's climate is the best one for the planet.

slide 8



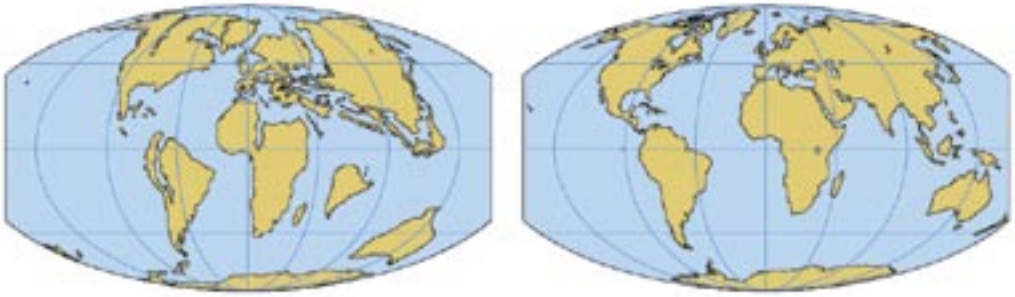
50 million years ago (50 MYA) Earth was ice-free.

Atmospheric CO_2 amount was of the order of 1000 ppm 50 MYA.

Atmospheric CO_2 imbalance due to plate tectonics ~ 10^{-4} ppm per year.

slide 9

Cenozoic Era



End of Cretaceous (65 My BP) Present Day

Global Climate Forcings

External (solar irradiance): +1 W/m^2

Surface (continent locations): ~1 W/m^2

Atmosphere (CO_2 changes): > 10 W/m^2

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Summary: Cenozoic Era

1. Dominant Forcing: Natural ΔCO_2

- Rate ~100 ppm/My (0.0001 ppm/year)
- Human-made rate today: ~2 ppm/year

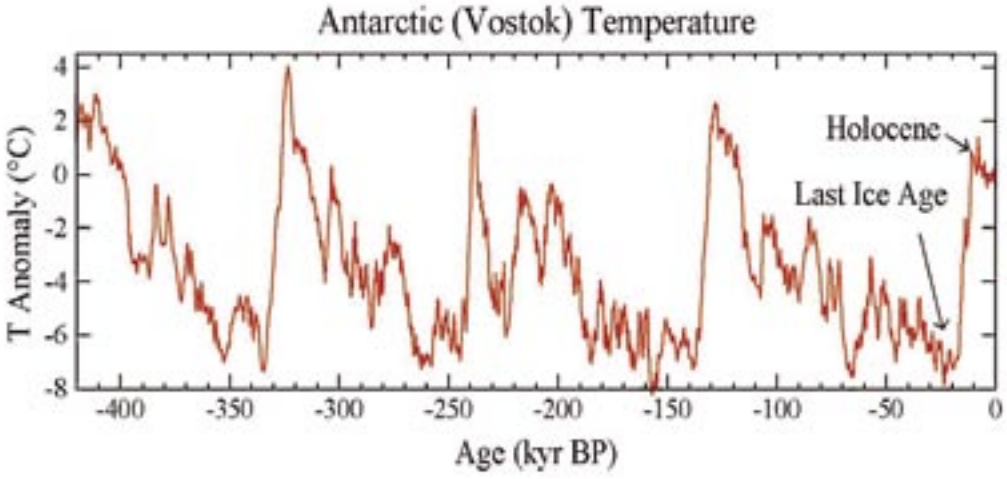
Humans Overwhelm Slow Geologic Changes

2. Climate Sensitivity High

- Antarctic ice forms if CO_2 < ~450 ppm
- Ice sheet formation reversible

Humans Could Produce "A Different Planet"

slide 11



Earth's history provides important information on global warming.

Recorded human history occurs within the Holocene warm period.

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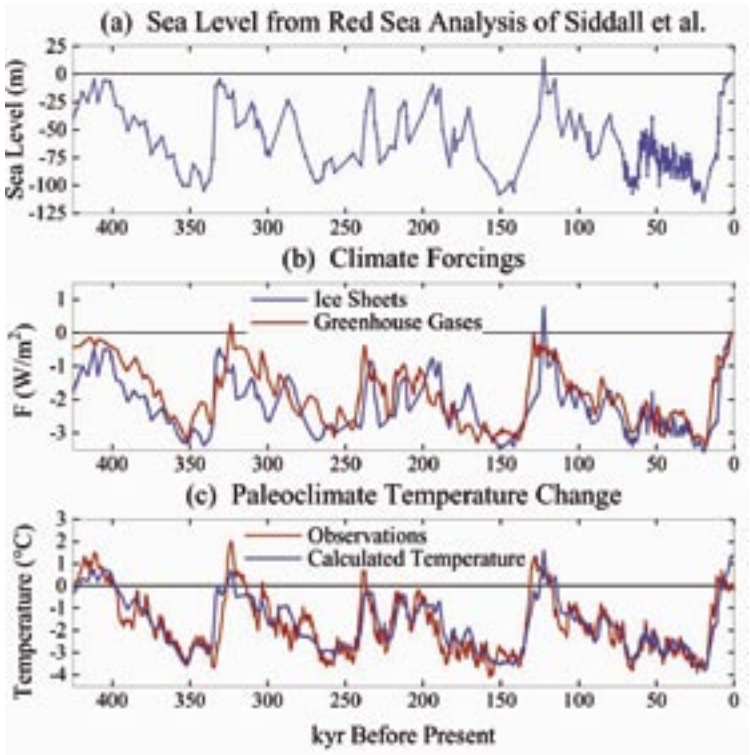

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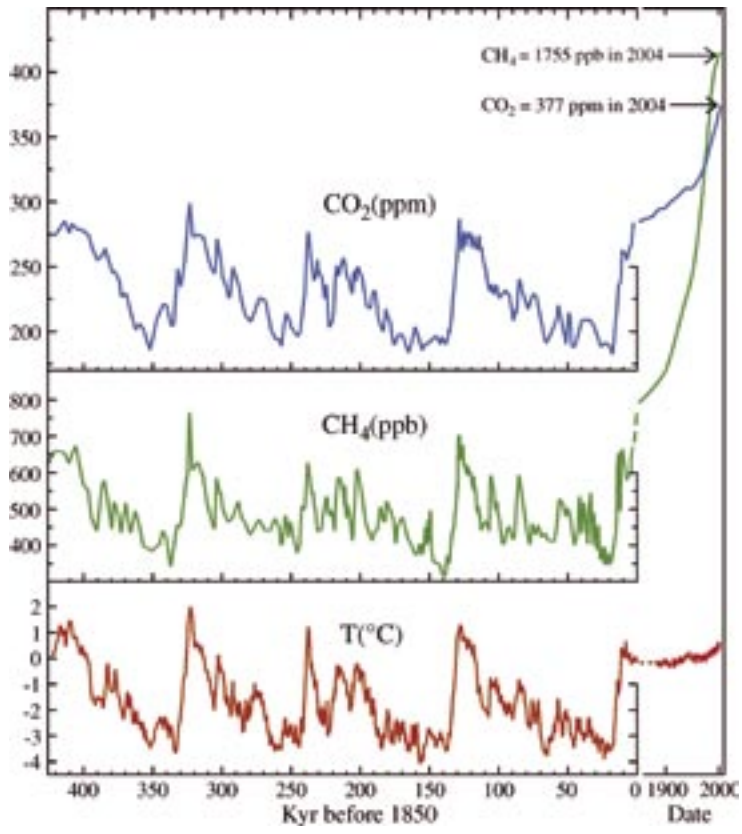
CO_2,CH_4 and estimated global temperature (Antarctic ΔT/2 in ice core era) 0 = 1880-1899 mean.

Source: Hansen, *Clim. Change*, **68**, 269, 2005.



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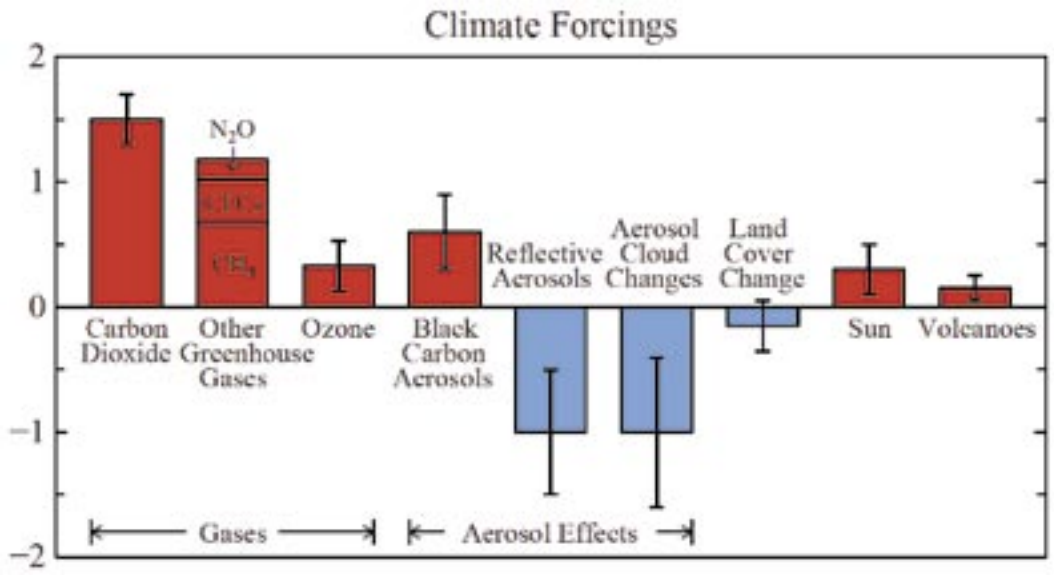


Change of climate forcings in W/m^2 between 1750 and 2000.

[from Hansen *et al. "Efficacy of Climate Forcings" J. Geophys. Res.* (2005)]

slide 15

Sophie explains 2 Watts of forcing to brother Connor

Sophie Explains GH Warming:

"It's 2 W/m^2 Forcing."

Connor only counts 1 Watt

slide 16

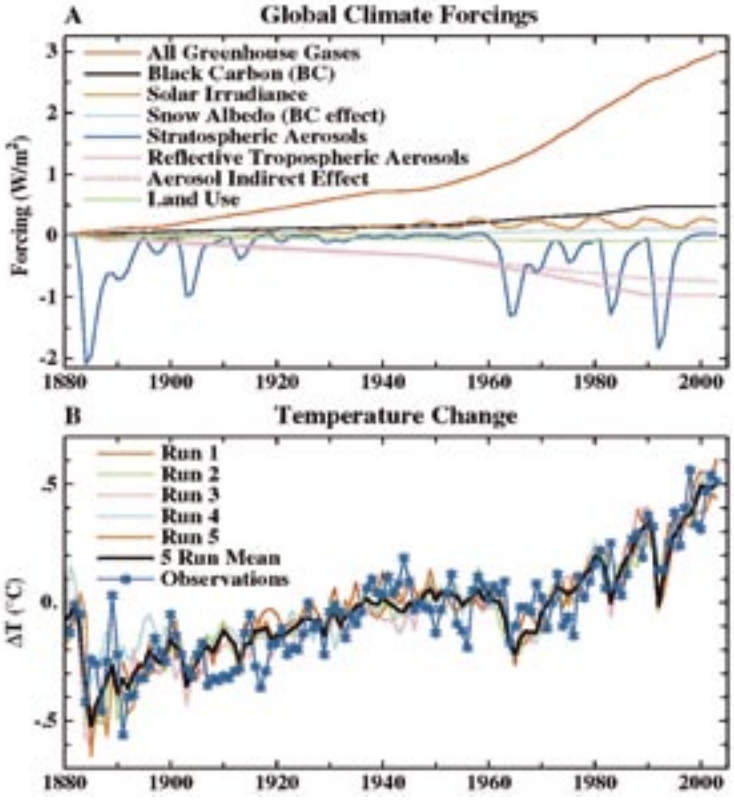
Sophie and Connor at ages 9 and 4.

slide 17

(A) Forcings used to drive climate simulations.

(B) Simulated and observed surface temperature change.

Source: Earth's energy imbalance: Confirmation and implications. *Science* **308**, 1431, 2005.



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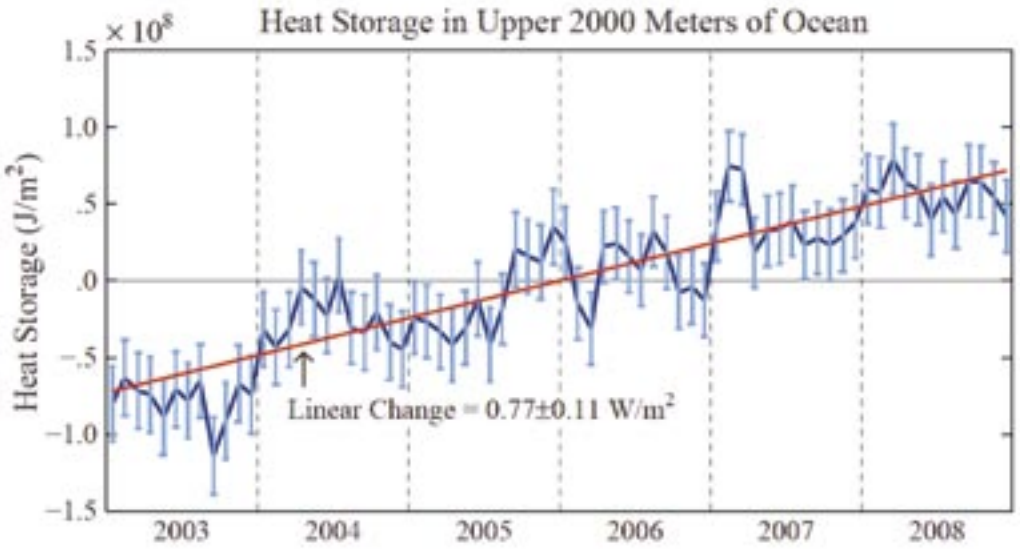

Heat storage in upper 2000 meters of ocean during 2003-2008 based on ARGO data.

Knowledge of Earth's energy imbalance is improving rapidly as ARGO data lengthens.

Data must be averaged over a decade because of El Nino/La Nina and solar variability.

Energy imbalance is smoking gun for human-made increasing greenhouse effect.

Data source: von Schuckmann *et al. J. Geophys. Res.* **114**, C09007, 2009, doi:10.1029/2008JC005237.

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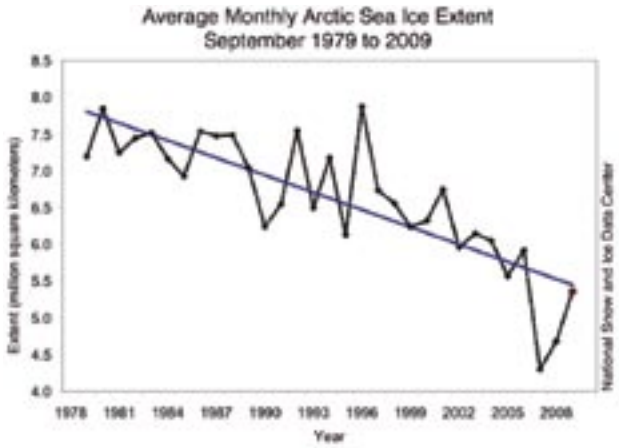
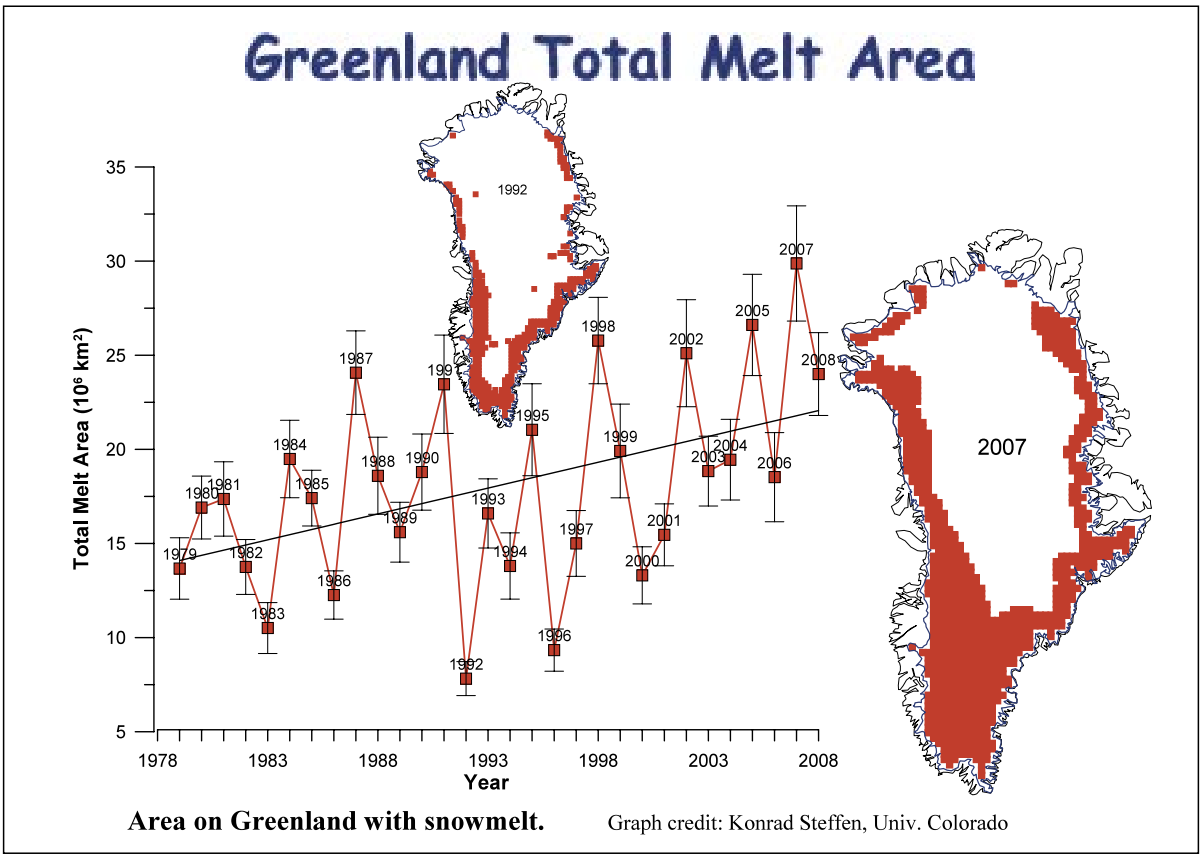
Arctic sea ice area at warm season minimum.



September sea ice extent based on satellite microwave observations.

Data source: National Snow and Ice Data Center

slide 20



Area on Greenland with snowmelt. Graph credit: Konrad Steffen, Univ. Colorado

slide 21

Surface Melt on Greenland

Melt descending into a moulin, a vertical shaft carrying water to ice sheet base.

Source: Roger Braithwaite, University of Manchester (UK)

slide 22

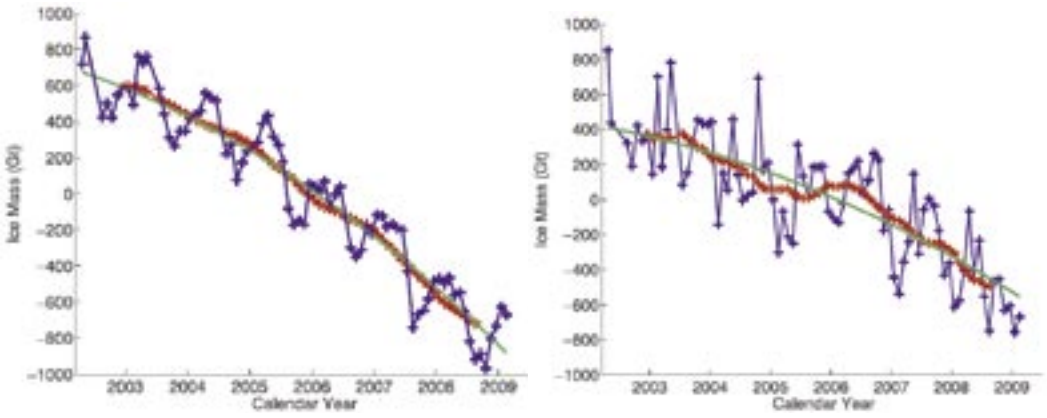
Jakobshavn Ice Stream in Greenland

Discharge from major Greenland ice streams is accelerating markedly.

Source: Prof. Konrad Steffen, Univ. of Colorado

slide 23

Gravity Satellite Ice Sheet Mass Measurements



Greenland Ice Sheet **Antarctic Ice Sheet**

Source: Velicogna, I. *Geophys. Res. Lett.*, **36**, L19503, doi:10.1029/2009GL040222, 2009.

slide 24

Pier on Lake Mead

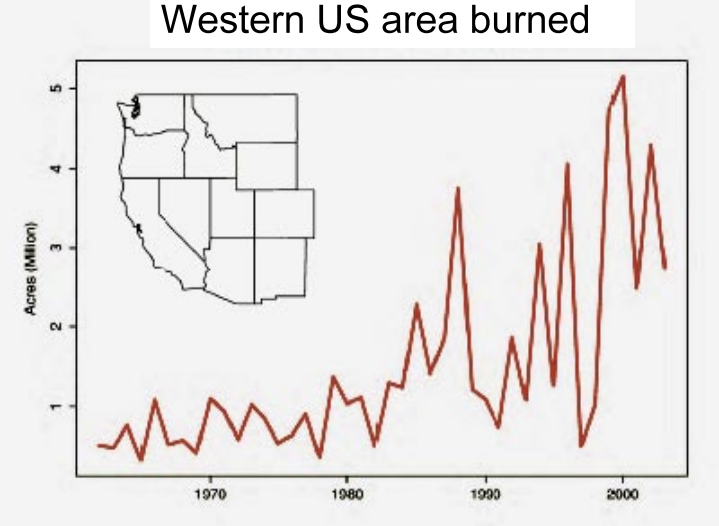
Subtropics are expected to expand with global warming.

Observations show, on average, 4 degrees of latitude expansion.

slide 25

Fires Are Increasing World-Wide

Wildfires in Western US have increased 4-fold in 30 years.



Source: Westerling et al. 2006

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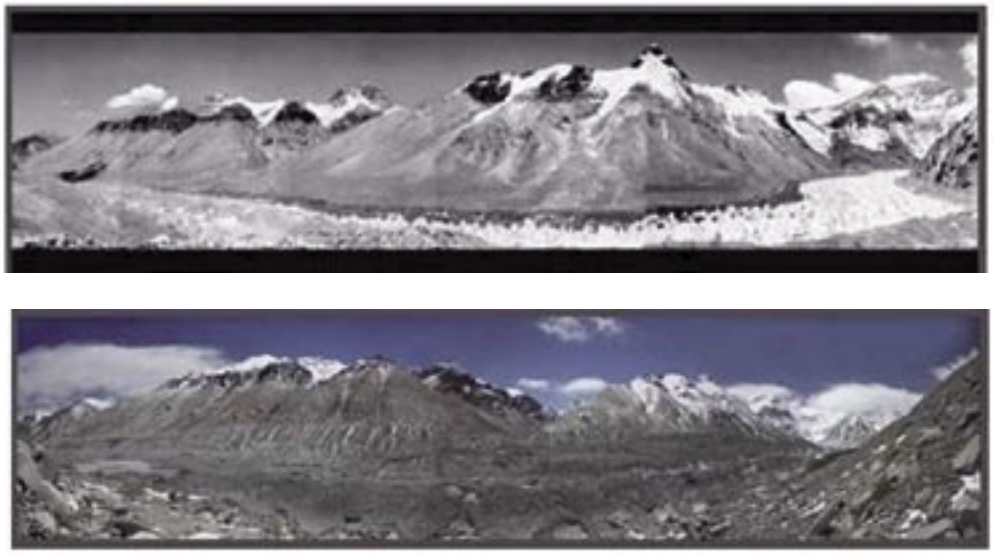
Himalayan (Rongbuk) Glacier



Rongbuk, the largest glacier on Mount Everest's northern slopes, in 1968 (top) and 2007.

Glaciers are receding rapidly world-wide, including the Rockies, Andes, Alps, Himalayas.

Glaciers provide freshwater to rivers throughout the dry season and reduce spring flooding.

slide 27

Stresses on Coral Reefs

Coral Reef off Fiji

(Photo credit: Kevin Roland)

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Assessment of Target CO_2

Phenomenon	Target CO_2 (ppm)
1. Arctic Sea Ice	300-350
2. Ice Sheets/Sea Level	300-350
3. Shifting Climatic Zones	300-350
4. Alpine Water Supplies	300-350
5. Avoid Ocean Acidification	300-350

→ **Initial Target CO_2 = 350* ppm**

*assumes CH_4, O_3, Black Soot decrease

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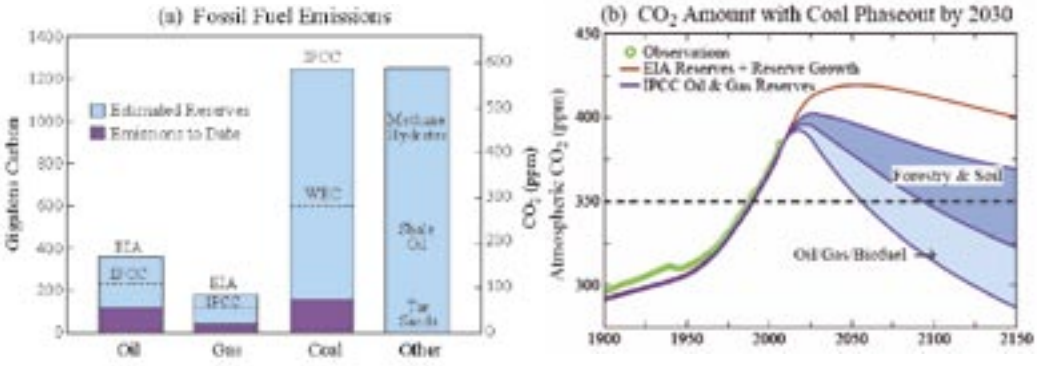
Target CO_2:

< 350 ppm

To preserve creation, the planet on which civilization developed

slide 30

Fossil Fuel Reservoirs & CO_2 Scenarios



Scenarios assume no "Other" = Tar Sands, Oil Shale, Methane Hydrates

Coal phase-out by 2030 → peak CO_2 ~400-425 ppm, depending on oil/gas.

Faster return below 350 ppm requires additional actions

Source: Hansen *et al.*, Target atmospheric CO_2: where should humanity aim? *Open Atmos. Sci. J.*, **2**, 217-231, 2008.

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<350 ppm is Possible, But…

Essential Requirements

1. Quick Coal Phase-Out Necessary
All coal emissions halted in 20 years

2. No Unconventional Fossil Fuels
Tar sands, Oil shale, Methane hydrates

3. Don't Pursue Last Drops of Oil
Polar regions, Deep ocean, Pristine land

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What's Really Happening

1. **Tar Sands Agreement with Canada**
   Pipeline planned to transport oil
2. **New Coal-fired Power Plants**
   Rationalized by 'Clean Coal' mirage
3. **Mountaintop Removal Continues**
   Diminishes wind potential of mountains
4. **Oil & Gas Extraction Expands**
   Arctic, offshore, public lands

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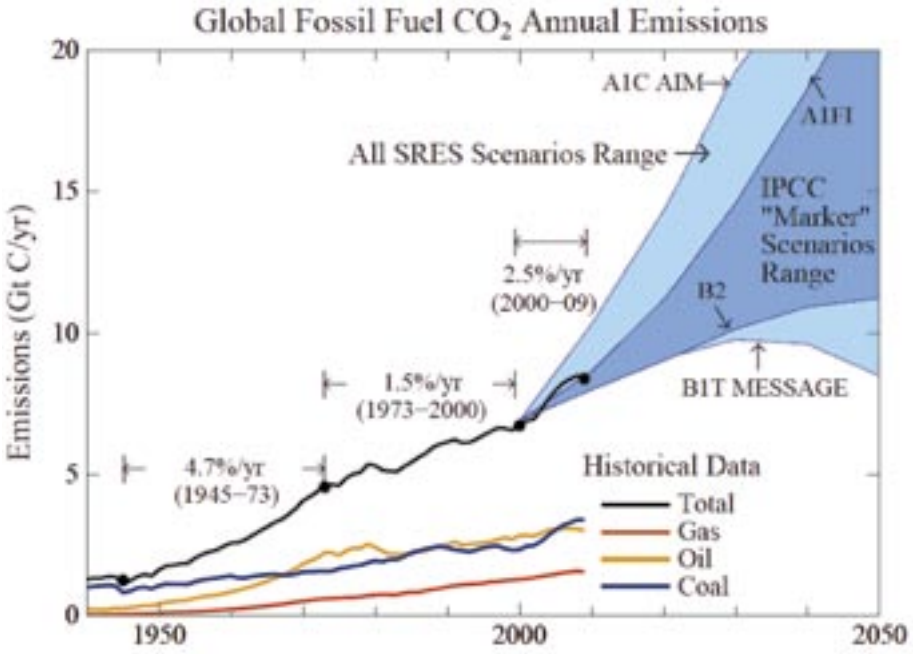
Global Action Status

1. **Huge Gap: Rhetoric & Reality**
   - Rhetoric: Planet in Peril
   - Policies: Small Perturbation to BAU
2. **Greenwash/Disinformation Winning**
   - Appeasement of Fossil Interests
   - Still Waiting for a Winston Churchill
3. **Kyoto & Copenhagen Failures**
   - Kyoto → accelerating emissions
   - Copenhagen → still "cap-&-trade"

slide 34



Global fossil fuel carbon dioxide emissions accelerated after Kyoto Protocol.

Date sources: Marland et al. (U.S. Dept. Energy, Oak Ridge and extended with BP Statistical Review of World Energy.)

slide 35

Problem & Solution

1. Fossil Fuels are Cheapest Energy

- Subsidized & Do Not Pay Costs
- Solution: Rising Price on Carbon

2. Regulations also Required

- Efficiency of Vehicles, Buildings,e.g.
- Carbon Price Provides Enforcement

3. Technology Development Needed

- Driven by Certainty of Carbon Price
- Government Role Limited

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Fee & Green Check (Dividend)

1. **Fee Applied at First Sale/Port of Entry**
   - Covers all Oil, Gas, Coal → No Leakage
2. **Fee Specified: No Speculation, No Volatility**
   - No Wall Street Millionaires at Public Expense
3. **Other Merits**
   - Only Potentially Global Approach
   - Simple, Honest, Can be Implemented Quickly
   - Market Chooses Technology Winners
   - Most Efficient & Largest Carbon Reductions

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Cap-and-Trade Flaws

1. **Designed for Banks & Fossil Interests**
   - Impossible to exclude big money
2. **Price Volatility**
   - Discourages clean energy investments
3. **Ineffectual**
   - Real carbon reductions small
4. **Cannot be made global**
   - China/India will not (& should not) accept caps

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Fee & Green Check Addresses

1. **Economy: Stimulates It**
   - Puts Money in Public's Hands– A Lot!
2. **Energy: Fossil Fuel Addiction**
   - Stimulates Innovation – Fastest Route to Clean Energy Future
3. **Climate**
   - Only Internationally Viable Approach - - Zero Chance of China/India Accepting a Cap
   - Would Result in Most Coal & Unconventional Fossil Fuels, and some Oil, left in the Ground

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Lauren Emma (age 2½ days) and Jake (age 2½ years)

slide 40

Lauren Emma (age 2½ days) and Jake (age 2½ years)

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Intergenerational Justice

Jefferson to Madison: …self-evident that "Earth belongs in usufruct to the living"*

Native People: obligation to 7th generation

Most Religions: duty to preserve creation

Governments (with fossil interests): we set emissions at whatever level we choose

Public: when will it become involved?

*Legal right to use something belonging to another

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Notes of Optimism

1. **China**

   Enormous investments in carbon-free energy (solar, wind, nuclear power)

2. **Legal Approach**

   Judicial branch less influenced by fossil fuel money (than executive and legislative branchs)

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Atmospheric Trust Litigation*

1. **Atmosphere is a public trust asset**

   Governments have fiduciary obligation to manage asset – it is not political discretion

2. **Courts can enforce via injunction**

   Require carbon accounting, with schedule specified by science

3. **Force governments at all levels**

* Wood, M., Atmospheric Trust Litigation, in *Adjudicating Climate Change: Sub-National, National, and Supra-National Approaches* (William C.G. Burns & Hari M. Osofsky, eds.) (2009, Cambridge University Press

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Web Site

www.columbia.edu/~jeh1

includes

Target Atmospheric CO_2: Where Should Humanity Aim?

Global Warming Twenty Years Later: Tipping Points Near

In Defence of Kingsnorth Six

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