Evidence-based Decision Making in a Belief-based World

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Decision Making: Evidence- or Belief-based?

1) Physical Processes
2) Atmospheric Chemistry
3) Evidence for Human-Caused Climate Change
4) Disinformation and Denial
5) Ethical/Political Challenges
The Greenhouse Effect

Solar radiation: 343 Watts per m²

Some of the solar radiation is reflected by the atmosphere and the Earth's surface.

Outgoing solar radiation: 103 Watts per m²

Some of the infrared radiation passes through the atmosphere and out into space.

Outgoing infrared radiations: 240 Watts per m²

Solar radiation passes through the atmosphere:
Incoming solar radiation: 200 Watts per m²

About half the solar radiation is absorbed by the Earth's surface:
Absorption solar radiation: 168 Watts per m²

Some of the infrared radiation is absorbed and re-emitted by the greenhouse gas molecules.

Radiation is converted to heat energy, causing the emission of longwave (infrared) radiation back to the atmosphere.
Physics

Albedo

Sea Ice reflects 30 to 45% of solar radiation

Water reflects 3 to 10% of solar radiation

Snow reflects 40 to 95% of solar radiation
Satellite data show

- Arctic sea ice extent on Sept. 17, 2014 was 5.02M km² (1.94M miles²).
- This was the 6th lowest ice cover in the satellite record.
- It was 1.24 million km² (479,000 miles²) less than the 1981-2010 median extent for September (magenta line).
- This is ~2 x Michigan land area.
- September 2012 ice cover, the record lowest, was 3.61M km² (1.39M miles²).

This is >4.5 x Michigan area
The rate of decline in Arctic sea ice extent is 13.3% per decade. The last 10 minima are the 10 lowest in the satellite record.
Chemistry: Atmospheric CO$_2$

Atmospheric CO$_2$ at Mauna Loa Observatory

Scripps Institution of Oceanography
NOAA Earth System Research Laboratory

June 1958: 317 ppm

April 2014: 401 ppm
Atmospheric CO$_2$:
- 825 (399 ppm) (±3 to ±5 per year)

Global Carbon Cycle:

- Vegetation: 610 (Billion metric tons)
- Soils: 1580 (Billion metric tons)
- Ocean: 39000 (Billion metric tons)

Net Flux:
- +10.4 per year

Fluxes:
- Fossil fuels: 9.5
- Land-use: 0.9
- Photosynthesis
- Plant respiration
- Soil respiration

2 at >30°N
Chemistry: Atmospheric CO$_2$

A 450 Thousand Year Record in the Vostok Ice Core

Thousands of Years Ago

From Petit et al. 1999 (Nature 399, 429-436)
2014 was the warmest year on global land & ocean surfaces since records began in 1880.

The annually-averaged temperature for 2014 was 0.69°C (1.24°F) above the 20th century average of 13.9°C (57.0°F).

2014 is the 38th consecutive year (since 1977) the global temperature was above average.
Has Earth stopped warming?

This is a deceptive argument that only works with 1998 (the last Super El Nino year) as the starting point.
Climate Change is Here: The Midwest

Temperature
- Climate is warming (esp. in winter)
- Extreme heat events are increasing (frequency & length)
- Growing season are several weeks longer

Precipitation
- Winter, spring increasing
- Summer, fall decreasing
- Drier soils, more droughts
- More extreme events

Health, Economy & Environment
- Heat-related mortality and morbidity will increase
- “Warm climate” diseases are increasing, e.g. lyme disease, West Nile virus
- Risks to crops are increasing
- Water management (urban and rural) is more expensive
- Key invasive species and plant pathogens are being facilitated by warming temperatures and longer frost-free seasons.
... over the past decade, have funded a campaign against wind farms.

Photograph: Alex Garcia/Getty Images.
Donors Trust: a 501(c)(3) “charitable organization”
gave $118M to ~100 climate denial groups from 2002 - 2010

In Science, hypothesis are tested, rejected, re-tested... until evidence informs understanding. Theories and predictive models result.

Rigorous testing and measurements have established understanding of the fact that fossil fuel emissions are heating up our planet.

Measurements show increasing frequencies of extreme weather events that pose serious risks.

Our challenge is to overcome the denial and distortion of climate science and understanding of climate change impacts by groups who manipulate public opinion and influence legislative processes to prevent adapting to and minimizing human-caused climate change.