EXAMINING THE CLIMATE ENGINEERING "SOLUTION"

Session Organizers

Sara Goldstein & Michaela Koke

Panelists (in order of presentations)

Sara Goldstein, Ben Kravitz & Chris Koski

Geology of mankind

Paul J. Crutzen

For the past three centuries, the effects of humans on the global environment have escalated. Because of these anthropogenic emissions of carbon dioxide, global climate may depart significantly from natural behaviour for many millennia to come. It seems appropriate to assign the term 'Anthropocene' to the present, in many ways human-dominated, geological epoch, supplementing the Holocene — the warm period of the past 10–12 millennia. The Anthropocene could be said to have started in the latter part of the eighteenth century, when analyses of air trapped in polar ice showed the beginning of growing global concentrations of carbon dioxide and methane. This date also happens to coincide with James Watt's design of the steam engine in 1784.

Mankind's growing influence on the environment was recognized as long ago as 1873, when the Italian geologist Antonio Stoppani spoke about a "new telluric force which in power and universality may be compared to the greater forces of earth,"

OUTLINE

1. Introduction to Geoengineering

2. Looking closer:

- Atmospheric Aerosol Injection
- Cloud Albedo Enhancement
- Engineered CO2 Capture & Biochar (DAC/BECCS)
- Ocean Fertilization

3. The Future & Politics of Geoengineering:

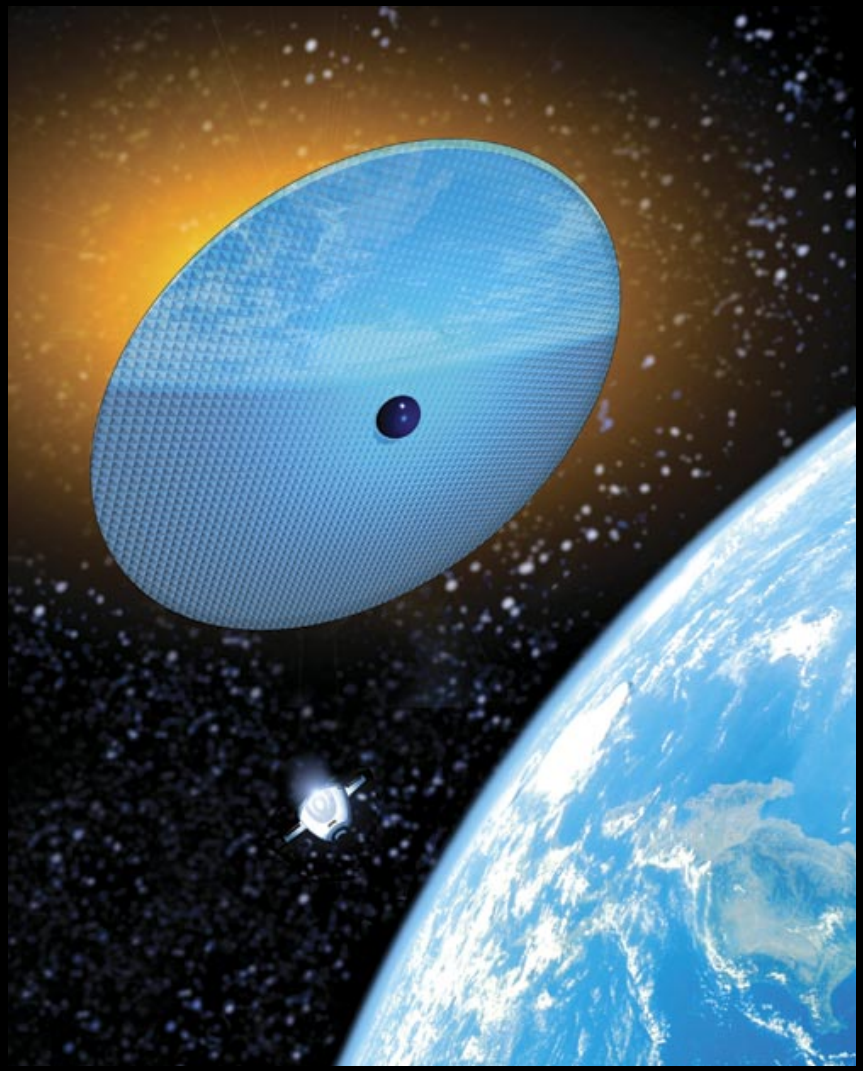
- Existing & Applicable Policies

WHAT IS *"GEO/CLIMATE ENGINEERING"*?

Solar Radiation Management (SRM)

Carbon Dioxide Removal (CDR)

SOLAR RADIATION MANAGEMENT



- Atmospheric aerosol injection
- Cloud albedo enhancement

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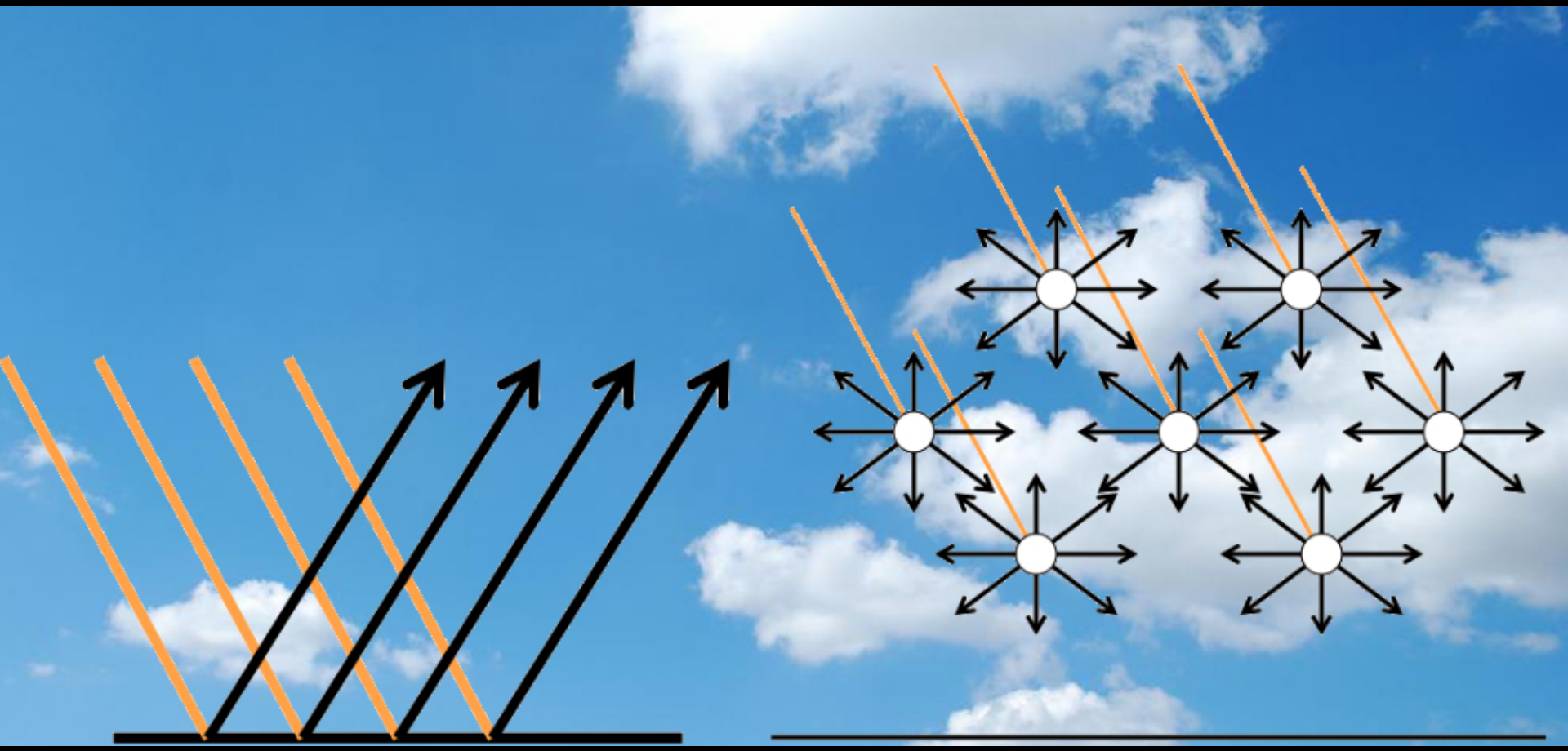
- Ocean bubbling
- Albedo enhancement via surfaces
- Space-based methods

CARBON DIOXIDE REMOVAL

- Direct Air Capture, Bioenergy with Carbon Capture and Storage & Biochar
- Ocean/Iron fertilization

- Reforestation
- No-till agriculture

LOOKING CLOSER: Aerosol Injection



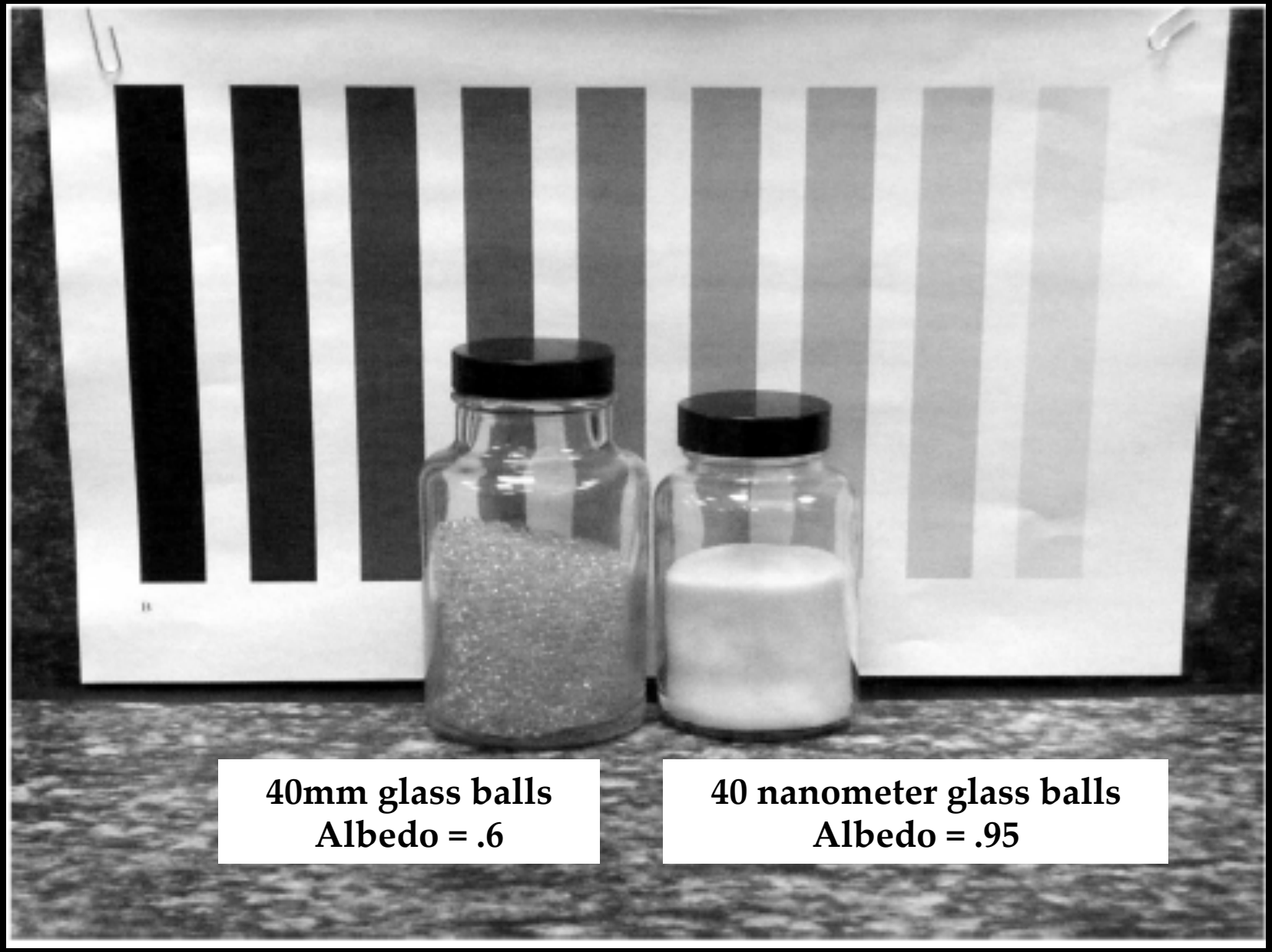
LOOKING CLOSER: Aerosol Injection

Potential Benefits

- Sulfate aerosol properties.
- Long stratospheric lifetime.
- Inexpensive comparatively.
- Lowering of temperatures → → →
- Increased light to canopy (productivity).

Potential Detriments

- Hydrologic cycle.
- Sulfuric acid deposition.
- Acid rain.
- O-zone hole formation.
- Whitening of sky.
- Astronomical observations.
- Solar impediment.


40mm glass balls
Albedo = .6
40 nanometer glass balls
Albedo = .95

LOOKING CLOSER: Cloud Albedo Enhancement

Potential Benefits

- Albedo increase
- Tropical cyclone intensity.
- Increased upwelling.
- Primary productivity.

Potential Detriments

- Reduction of sunlight.
- Increased outgassing of CO_2.
- More man made structures.
- Sea spray to land.

Unknown Changes

- Distribution of surface ocean species
- Stratification of water column
- El Nino/ La Nina

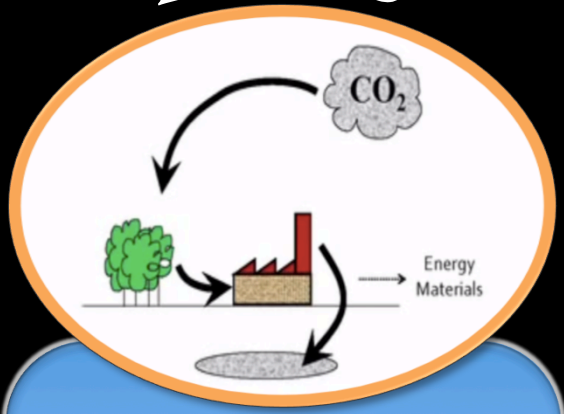
LOOKING CLOSER:

Direct Air Capture, Bioenergy w/ CO_2 Capture & Storage & Biochar

DAC

Chemical solvent removes CO_2 from ambient air, compresses & sequesters.

BECCS



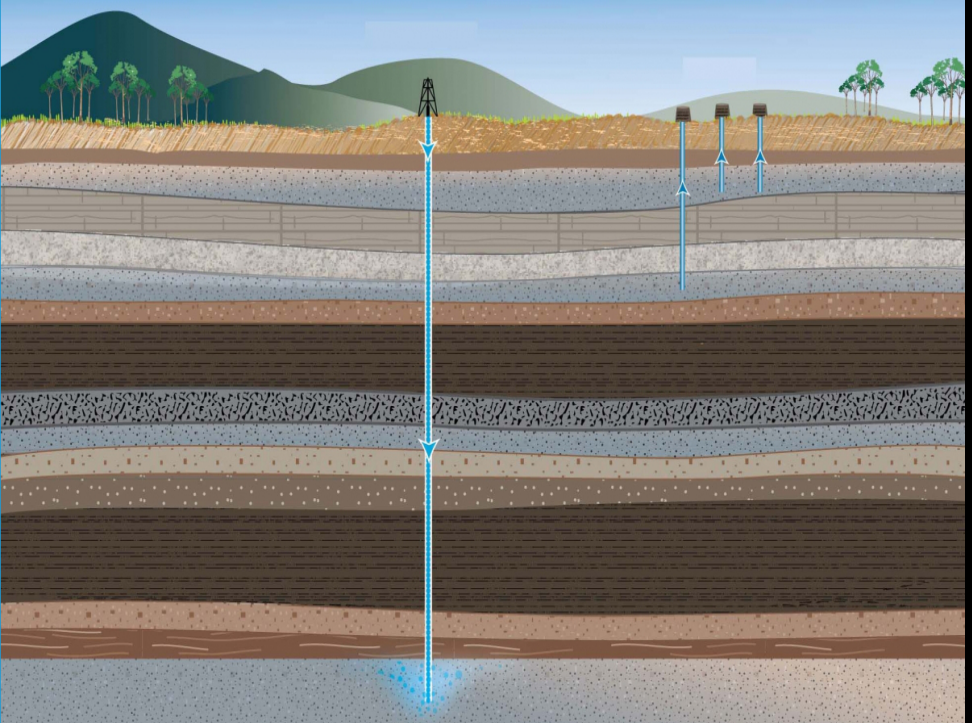
CO_2 capture + deep geologic storage w/ large-scale biofuel production.

BIOCHAR

Thermally-decomposed biomass in low O_2, added to soil to increase storage.

LOOKING CLOSER:

(DAC, BECCS & Biochar continued…)



Potential Benefits

- Cheap & feasible.
- Land & ocean impacts.
- Small unpopulated areas.
- DAC: 1 bill. tCO2/year.
- BECCS: byproducts
- Biochar + BECCS: up to 14 GtC/yr to CO_2 sink by 2100.

Potential Detriments

- Impacts on water use.
- DAC energy consumers.
- Large scale issues.

LOOKING CLOSER: Ocean/Iron Fertilization

NATURE | NEWS

Ocean-fertilization project off Canada sparks furore

Jeff Tollefson 23 October 2012

HSRC

Workers on a Haida Salmon Restoration Corporation boat release iron sulphate into the Pacific Ocean.

When a chartered fishing boat strewed 100 tonnes of iron sulphate into the ocean off western Canada last July, the goal was to supercharge the marine ecosystem. The iron was meant to fertilize plankton, boost salmon populations and sequester carbon. Whether the ocean responded as hoped is not clear, but the project has touched off an explosion on land, angering scientists, embarrassing a village of indigenous people and enraging opponents of geoengineering.

The New York Times

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A Rogue Climate Experiment Outrages Scientists

By HENRY FOUNTAIN

Published: October 18, 2012 | 288 Comments

A California businessman chartered a fishing boat in July, loaded it with 100 tons of iron dust and cruised through Pacific waters off western Canada, spewing his cargo into the sea in an ecological experiment that has outraged scientists and government officials.

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The entrepreneur, whose foray came to light only this week, even duped the National Oceanic and Atmospheric Administration in the United States into lending him ocean-monitoring buoys for the project.

Canada's environment ministry says it is investigating the experiment, which was carried out with no government or scientific oversight. A spokesman said the ministry had warned the venture in advance that its plan would violate international agreements.

Marine scientists and other experts have assailed the experiment as unscientific, irresponsible and probably in violation of those agreements, which are intended to prevent tampering with ocean ecosystems under the guise of trying to fight the effects of climate change.

LOOKING CLOSER:
Ocean/Iron Fertilization

Potential Benefits

- Primary productivity.
- CO2 uptake.
- Up to 30Tg/100yrs of CO_2.
- Biogeochemical cycling.

Potential Detriments

- Deep water pH
- Deep water O_2
- Ocean heat budget.
- Nutrient robbing
- Dead zones

THE FUTURE OF GEOENGINEERING:
Existing & Applicable Policies

- UN's Framework Convention on Climate Change.
- *London Protocol*.
- IPCC →

	Ocean fertilization, biological	Biochar	Direct capture
Feasibility	Y	Y	Y
Effectiveness	Y	Y	Y
Side effects	N	N	Y
Efficiency	N	N	Y
Social/legal acceptability	N (Y for legal)	Y	Y
Regulation	N	N	N
Monitoring & Verification	N	Y	Y
Ethics	N	N	N

- Law of the Sea
- National Ambient Air Quality Standards (NAAQS)
- UN's Treaty (1967):

Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies.

Write down or tweet questions #lcenvs, thank you!

Now: Ben Kravitz

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