Field Experiments: The Genisis of SAI Governance

Resources for the Future Conference

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Object of early SAI Governance: Field experiments

- Not deployment!
  - Anti-climactic, but likely
- Most governance literature leaps ahead to deployment
  - Rendering much of it inapt
- Field experiments will come first
  - By decades
- They are a different context
  - Producing different outcomes

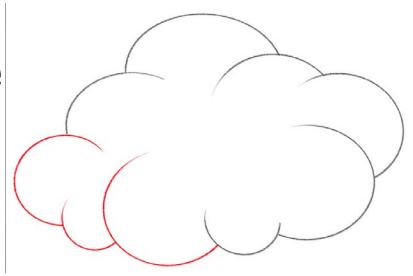
- I seek to clarify why field experiments should be the initial focus
- And what this pathway may imply for the nature of governance

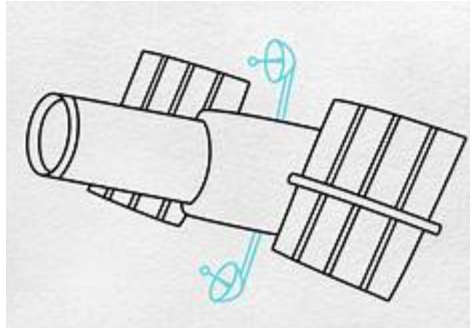
Field experiments are coming -- soon

- Mitigation is unlikely to achieve Paris targets
- SAI is too promising to leave unexplored
- Serious exploration will soon require field experiments
- Threshold question: mature particle size distribution
  - Radiative efficacy is poorly understood
  - Models are crudely parameterized and substantially divergent
- Field experiments are required to improve parameterizations
  - Perhaps by the end of this decade

Plausible field experiment description

- Planeload-scale plumes
  - Likely with a sulfate precursor: SO2 or H2S
  - A “tankerized” bizjet should suffice
  - Payload too small to create physical effects anywhere
- Track plume around globe for weeks
  - Oxidation/particle formation
  - Balloons, HALE aircraft, satellites
- Interrogate plume in far-field
  - Bizjets, NASA high-altitude aircraft, satellites





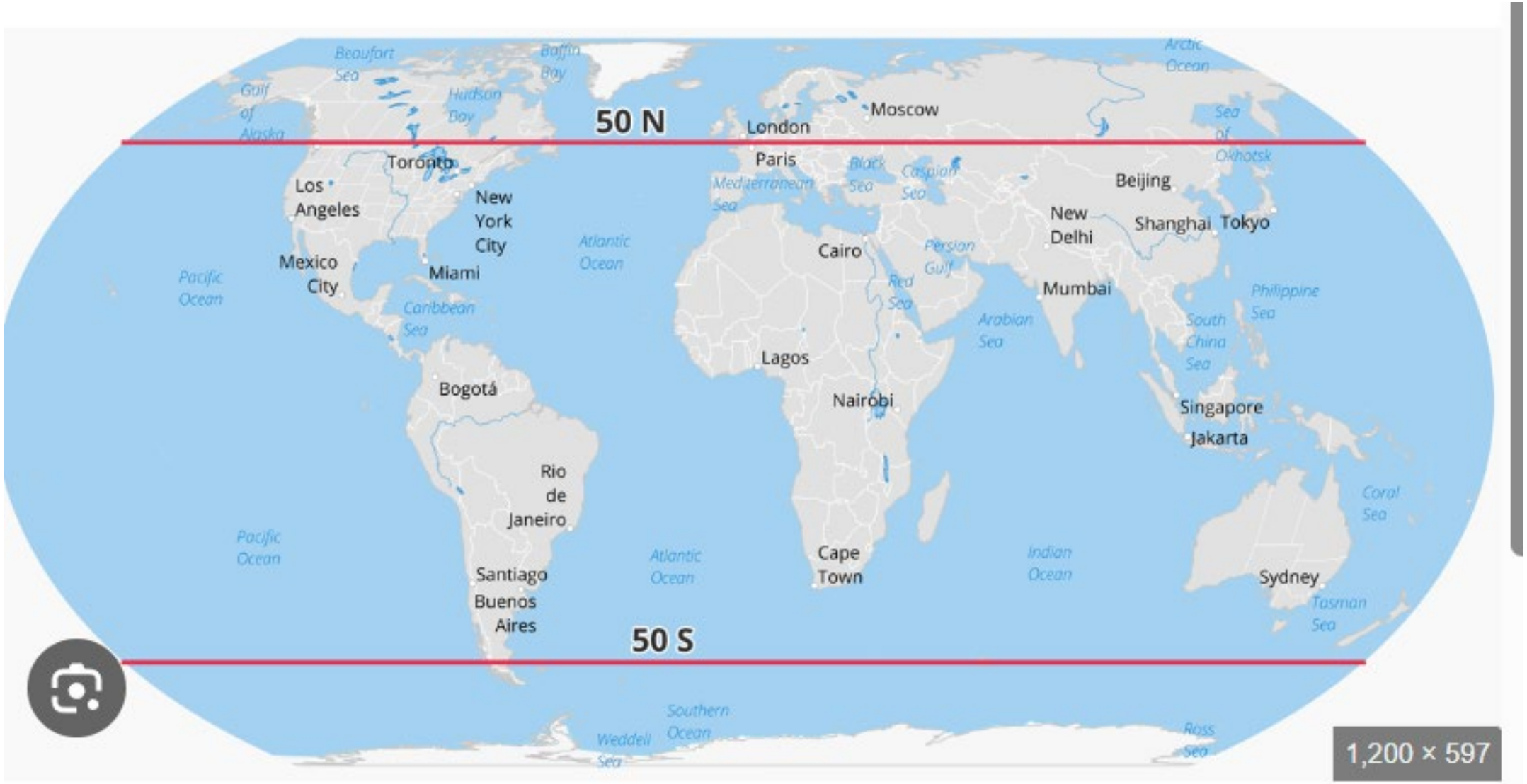
- Multiple pulses w different substances, locations, techniques
  - How we deploy will steer particle size and efficacy
- Span of years

Initial deployment likely in sub-polar regions

- Objective would be to slow warming where it is most severe
  - Suppress polar amplification
  - Preserve ice/permafrost/AMOC
  - Lower tropopause at higher latitudes reduces technical difficulty
- Initial field experiments should be in same regions
  - Recreate local atmospheric conditions
- Mid-latitudes at mid-altitudes
  - ~50°N/S latitude
  - 13 – 16 km altitude
  - Within capabilities of high-end bizjets

- Field experiments could occur in just one hemisphere
  - Unlike deployment, which should be in BOTH hemispheres

Either hemisphere would suffice



Pathway diverges from many of our priors

- Not “Big Green Button”
  - Doesn’t commit humanity to this interventon
- Confounds “All affected principle”
  - None are affected physically
- No “blurry line” between research and deployment
- Would not risk “Termination Shock”
- Not exclusive to hegemons
  - No advanced technology required
  - Middle powers could do this
- Nor a clear challenge to hegemons
  - Not obvious that superpowers would veto
- Unclear this would invoke Arctic Council/Antarctic Treaty
  - Neither Great Barrier Reef nor SCoPEx did

But consistent with other priors

- Would accentuate “slippery slope” hypothesis
- Trigger “moral hazard” concerns
- May intrude too much on nature
- Place undue faith in “technofixes”
- Violate some faith traditions including those of northern indigenous peoples
- Would carry obligations of transparency/engagement/consultation
- Could be dominated by superpowers
- Likely to remain domain of states rather than non-state actors

Interests of uninvolved states/parties

- Transparency
  - Public engagement and independent assessments (Oxford)
  - Consultation with diverse publics
- Participation
  - Many mid/low latitude states may want to to join coalition
- Prohibition
  - Many external parties will demand a moratorium or stringent conditions
- Limitation on escalation
  - Agreed ceilings on deployment mass/frequency beyond de minimis scale

Interests of acting states/parties

- Autonomy & non-interference
  - States possess right to fly over own territory & high seas
- Technical cooperation on plume tracking & interrogation
  - Over multiple states and high seas
  - Strongly implies multilateral effort
- Information sharing among acting parties
  - Particularly regarding evaluation of far-field observations
- Joint funding

Lack of physical impact shifts debate

- Deployment impacts on uninvolved parties would yield strong claims on governance authority
  - “You can’t do that to me without my permission” – very reasonable
  - Unilateral deployment would likely provoke muscular response
- But experiments with de minimis impacts yield weak claims
  - “You can’t do that because it is inconsistent with my beliefs”?
  - Less compelling call to action
- May transgress ethical or moral boundaries
  - But those are lesser harms
- Unilateral deployment could risk armed conflict
  - Field experiments a vastly lesser provocation

Knowledge creation has intrinsic legitimacy

- Vulnerable states and parties will want to know if they can rely on this technology
  - The explicit purpose behind the UK's ARIA program
- The philanthropic community is funding multiple lines of research
- Even skeptical states wish to understand solar geo to know how to detect or regulate it
- Preserving/enforcing ignorance is hard to justify
  - Weakest feature of NUA arguments

Field experiments will require state sponsors

- Operational bases will require consent of host countries
  - Flight activity is a heavily regulated sector
  - Can’t be done without state oversight
- Extensive engagement and public consultation would be required
  - This is how legitimacy is achieved
- Nonetheless, field experiments would be controversial
  - May be challenged legally
  - But more likely to be resolved in political arena
- Hosting states would need to have arrived at a decision to proceed
  - No obvious candidates yet





A hypothetical minilateral field experiment

- If Chile+NZ announced trials, how would the world respond?
- Not clear why great powers would forbid it
  - Unlikely to provoke a military response
  - More likely to demand transparency and participation
  - Many smaller powers may follow suit
- Chile+NZ would have reasons to consent
  - In return for funding/technical support
- What may emerge is an alliance of cooperating states
  - Combination of constraints and assistance
  - Both negative and positive governance
- Experiments may expand in scale and geography
  - Coordinating alliance might endure

Where does that take us?

- If solar geo is to progress, field experiments will be required
- Field experiments likely to invoke international governance
  - But not necessarily prohibitions by great powers
- Field experiments would require state sponsors
  - But experiments with state sponsors would be hard to deter
- Best domain for field experiments may be far south
  - Technically harder, but politically simpler
- Multilateral field experiments may call forth a planning forum
  - Likely a novel body centered on acting states
  - Potentially with wide membership
- The genesis of SAI governance (perhaps)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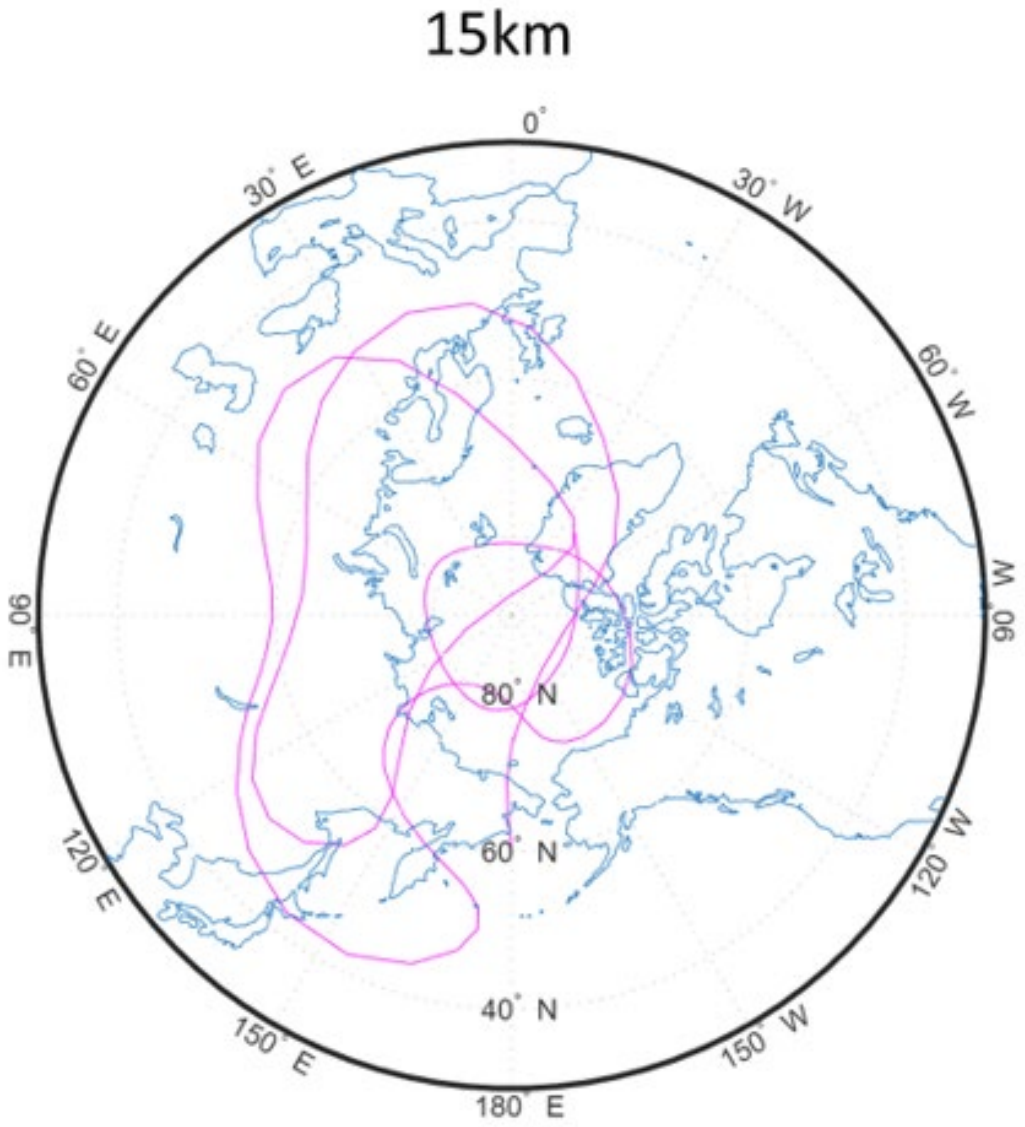
Plume tracking will be hard



Lessons from outdoor experiments

- SPICE
- Great Barrier Reef
- SCoPEx
- Make Sunsets
- Alameda
- SATAN