Experimental approaches to resisting and redirecting high-latitude climate feedbacks

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unceded lands of the Lower Tanana Dene

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Here’s where climate change is headed, and we aren’t prepared!
Global consequences of climate warming

• More frequent extreme weather
  – Droughts in dry climates
  – Floods in wet climates
  – Hurricanes and storm surges on coasts

• Social disruption faced by today’s youth
  – Food insecurity
  – Mass migration
Stewardship

• Active shaping of pathways of social-ecological change to enhance ecosystem health and human well-being

• Key features
  – Active intervention to shape change
  – System of people as part of nature
  – Two goals: ecosystem health, human well-being
    • Not people or nature, but people with the rest of nature
If exogenous controls change substantially, social-ecological systems will inevitably change.
Some permafrost has massive ice and carbon
Sometimes this carbon is released quickly.
How might permafrost thaw influence atmospheric carbon?

• Expose more carbon to decomposition (+)
• Improve conditions for decomposition (+)
• Increase C flux to aquatic systems (+/-)
• Release N and P to enhance productivity (-)
• Increase drought and fire in some places (+)
• Foster vegetation change (-/+)
• Accelerate permafrost thaw (+?)
Reducing C loss from permafrost: Hypothetical solution options

• Reduce warming rate of global climate
  – Reduce human emissions
  – Increase stratospheric aerosols

• Increase albedo
  – High-latitude ecosystem change (eg, deforestation)

• Alter summer/winter heat flux
  – Alter surface insulation

• Alter ratio of respiration to photosynthesis
  – Alter plant/microbial functional groups
Formulate hypothesis
Debate for understanding
Model
Debate
Develop new models

Estimate areal extent and key drivers
Estimate properties through literature review
Estimate carbon stock
Select experimental sites
( Forest-tundra border; forest-steppe border )

Pleistocene Park (160 km² or 40,000 acres )
Establish experiment
  Fenced enclosures
  Import large herbivores
Preliminary observations
Scientific steps

- Formulate hypothesis and model system
- Estimate areal extent, properties, and drivers
- Select experimental sites
- Establish experiment
- Preliminary observations
- Measurements
- Evaluate: estimate impact, alternative explanations, indirect effects, and interactions
- Refine and repeat this scientific process
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