# Risk Analysis and Climate Change

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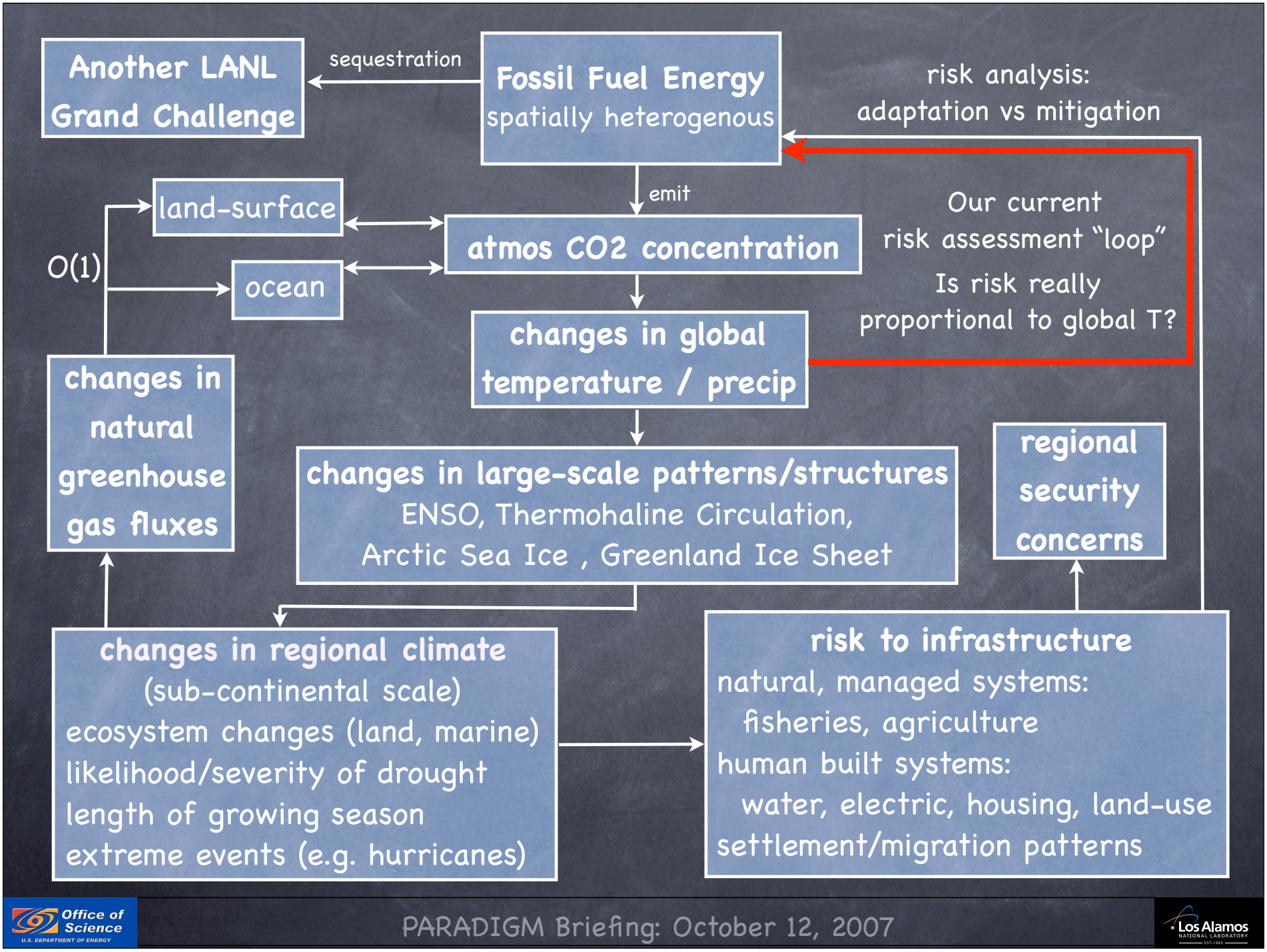
There is no doubt that robust risk-analysis tools will be invaluable in addressing the problem of climate change ....

but we really don't know how to "couple" climate systems models to socio-economic infrastructure models.


Another LANL Grand Challenge
sequestration
Fossil Fuel Energy
spatially heterogenous
risk analysis:
adaptation vs mitigation
emit
land-surface
ocean
O(1)
atmos CO2 concentration
Our current
risk assessment "loop"
Is risk really
proportional to global T?
changes in global
temperature / precip
changes in
natural
greenhouse
gas fluxes
changes in large-scale patterns/structures
ENSO, Thermohaline Circulation,
Arctic Sea Ice , Greenland Ice Sheet
regional
security
concerns
changes in regional climate
(sub-continental scale)
ecosystem changes (land, marine)
likelihood/severity of drought
length of growing season
extreme events (e.g. hurricanes)
risk to infrastructure
natural, managed systems:
fisheries, agriculture
human built systems:
water, electric, housing, land-use
settlement/migration patterns

# What does the previous slide tell us?

This certainly qualifies as a complex system

- the physical system feedbacks are the same order as forcing
- the physical system is enclosed in a social system
- discrete sources $\longrightarrow$ global forcing $\longrightarrow$ regional impacts/risks
- the source and risk are likely to be disjoint (in both x and t)

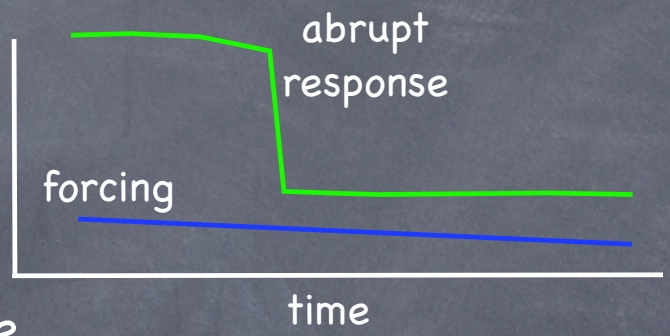
The focus was on the physical and spatial connectivity, but any risk analysis will have to include temporal connectivity (i.e. the time between cause and effect).

And this brings us to "abrupt" climate change .....

# What is Abrupt Climate Change?

A dynamical-systems based definition:

NRC: the effect occurs on a time scale shorter than the cause.




Overpeck: crossing of a threshold from one state to another on a time scale shorter than the lifetimes of the states

A risk-based definition:

Foreseeable, climate-related events which - if they materialize - will exceed our normal capacity for coping.

Corollary to a risk-based definition:

Abrupt climate change events are those we should worry about.

# Significant Challenges Exist at the Regional Scale ..... for example

1. predicting (in terms of probabilities distribution functions) regional change in precipitation is at the forefront of the physical sciences.

2. the change in precipitation is an O(1) driver for the process-based, surface water models, and by extension, the water infrastructure.

3. changes in precipitation and changes in the surface water budget are O(1) drivers for dynamic, land-surface ecology change.

4. and the reverse of 3. is also true.

How can we do risk-analysis
when the physical inputs are so uncertain?

How can we NOT do risk-analysis
when the socio-political-economic outputs are so uncertain?