WEDNESDAY AUGUST 15
LECTURE 6:30PM
Followed by a wine & cheese reception
Given Institute Auditorium [100 E. Francis St]

ASPEN GLOBAL CHANGE INSTITUTE

The Surprising Importance of FORESTS IN GLOBAL WARMING

Will migration of Russian forests promote warming?

Speaker: Dr. Hank Shugart, Jr.
Director of the Center for Regional Environmental Studies at the University of Virginia

A WALTER ORR ROBERTS MEMORIAL LECTURE PRESENTED BY
THE ASPEN GLOBAL CHANGE INSTITUTE

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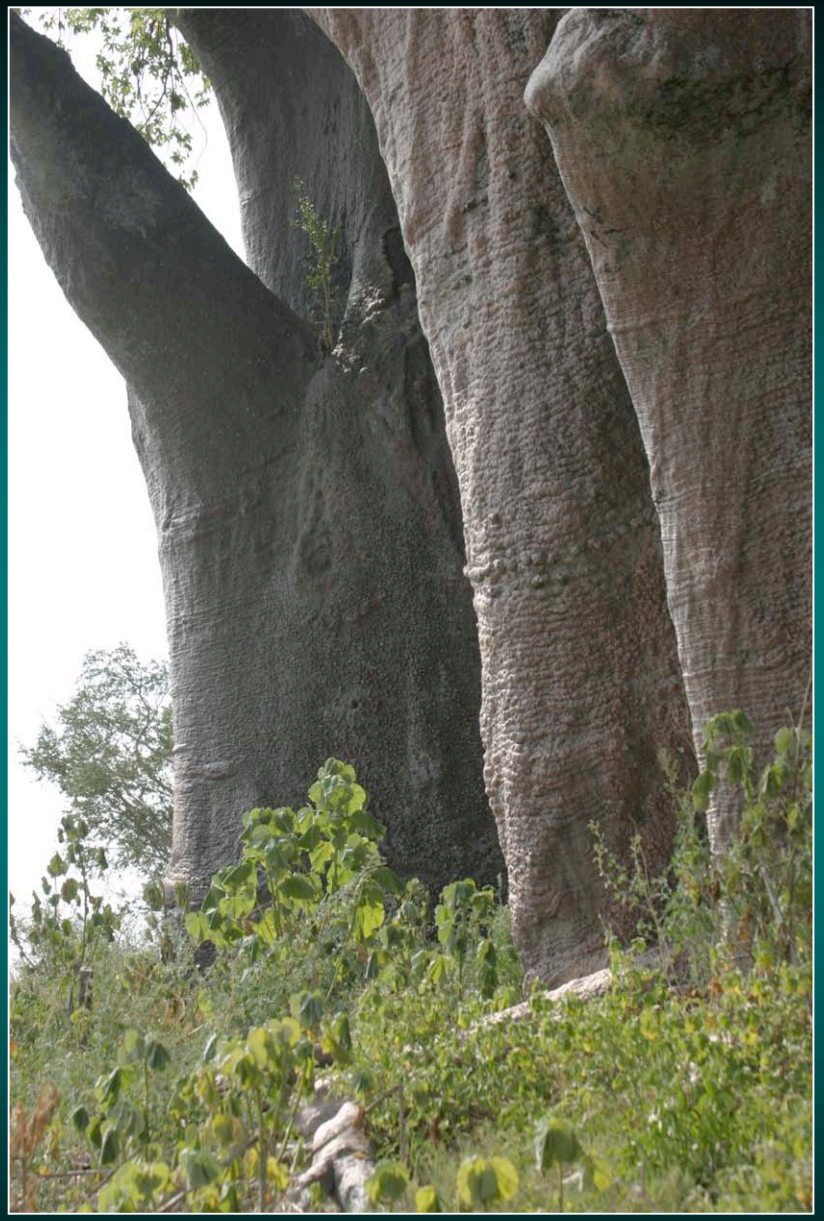
The Surprising Importance of Forests in Global Warming



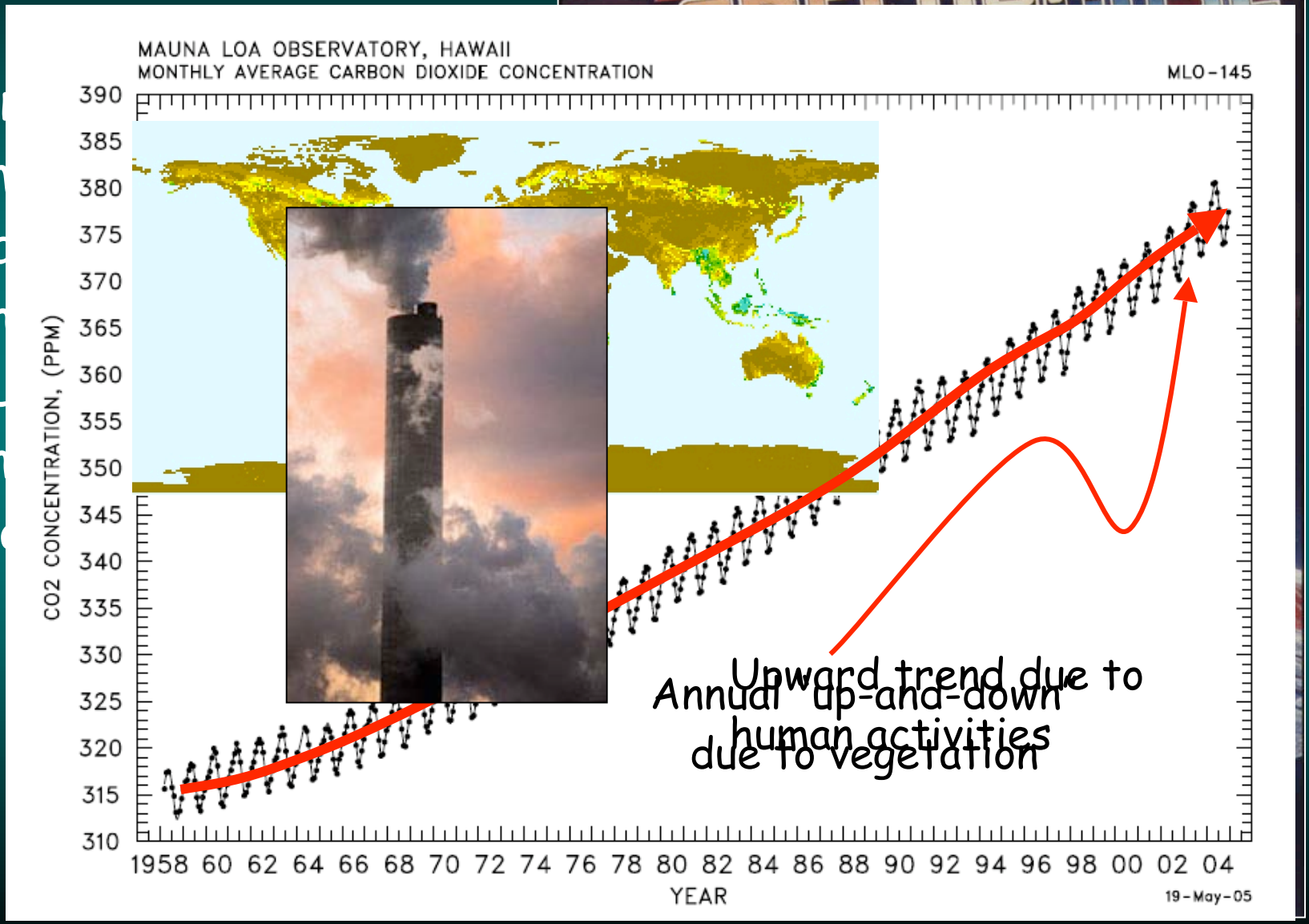
Baobab Grove in N'Xia Pan, Botswana

What is "surprising"?

Surprises often involve positive feedback.

… but first let's discuss the some of forests' role on our planet.

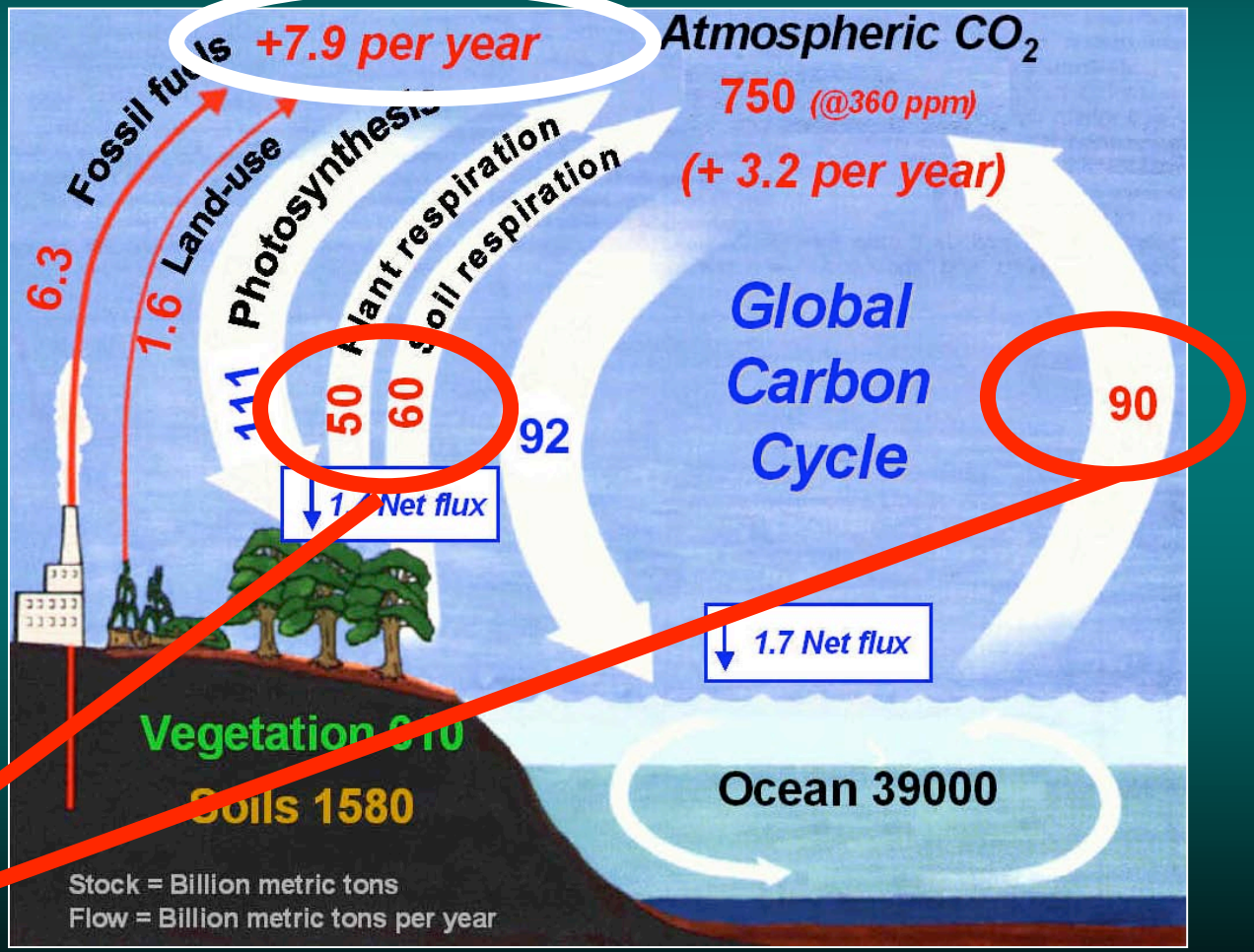
The obligatory diagram of CO_2 change in the atmosphere



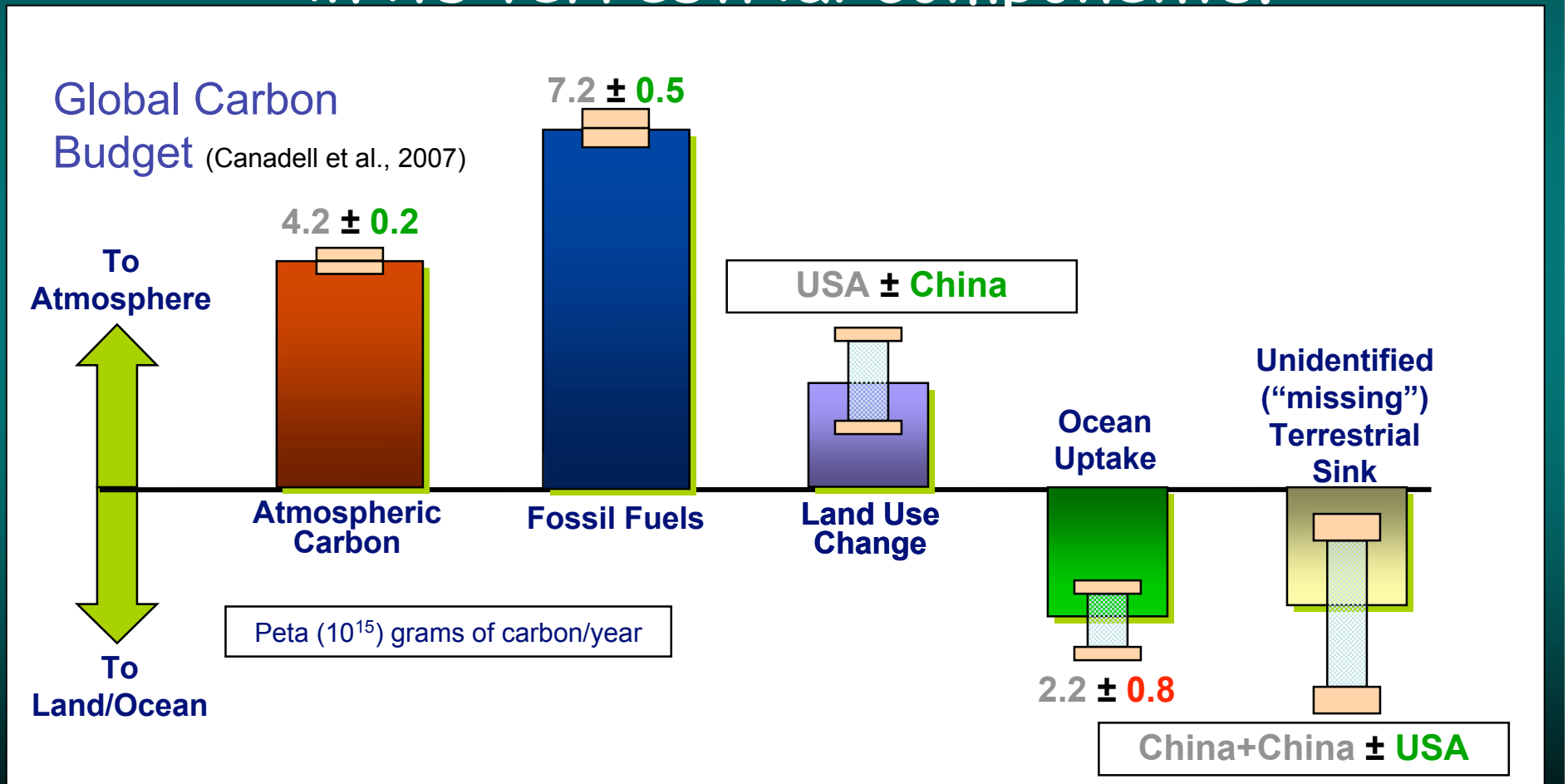
This has inspired a need to better understand the global carbon budget and the contribution of different countries to the increase in carbon dioxide.

Human contributions of carbon into the atmosphere are about 4% of the "natural" contributions"

Sum = 200



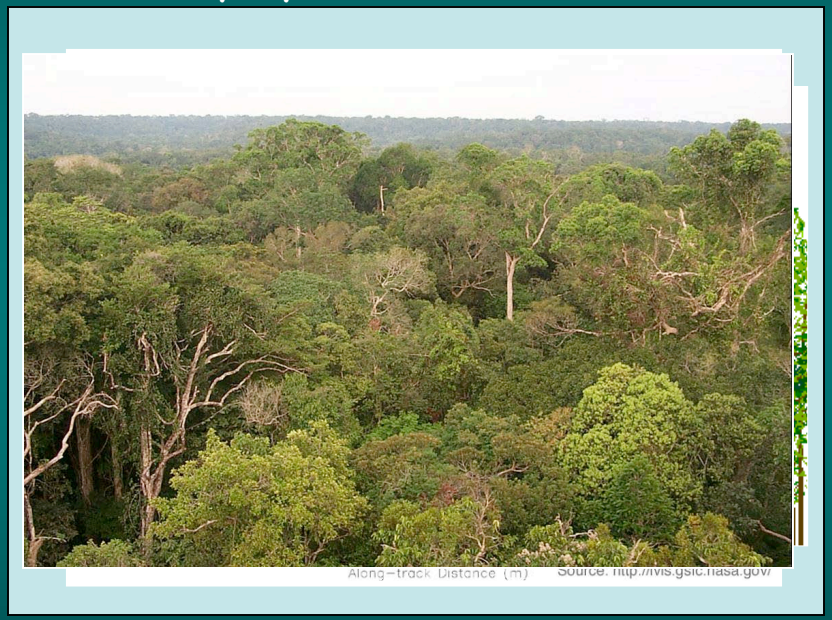
Largest remaining uncertainties about the Earth's carbon budget are in its terrestrial components.



A Primer on the Dynamics of Forest Ecosystems

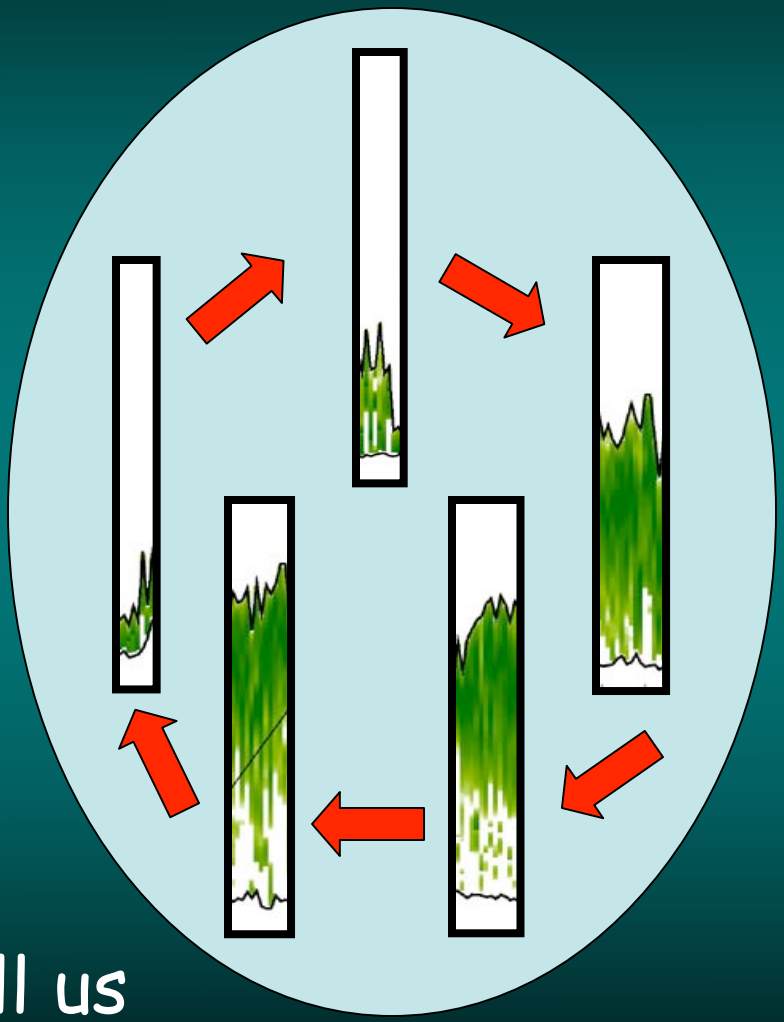
Tropical Rain Forest Canopy in the Brazilian Amazon

In a mature forest, one expects the canopy to be a mosaic of spatial elements about the size of a large tree crown. These elements go through a cyclical recovery cycle.

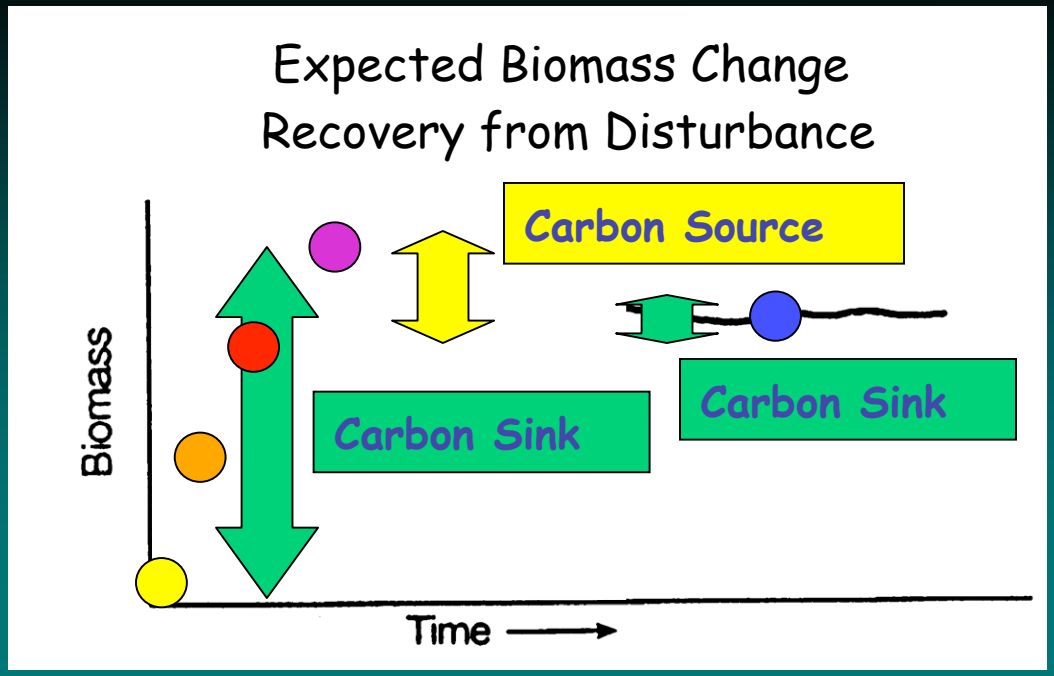


Lidar Image of Mature Tropical Rain Forest

Forest Gap-Dynamics Cycle



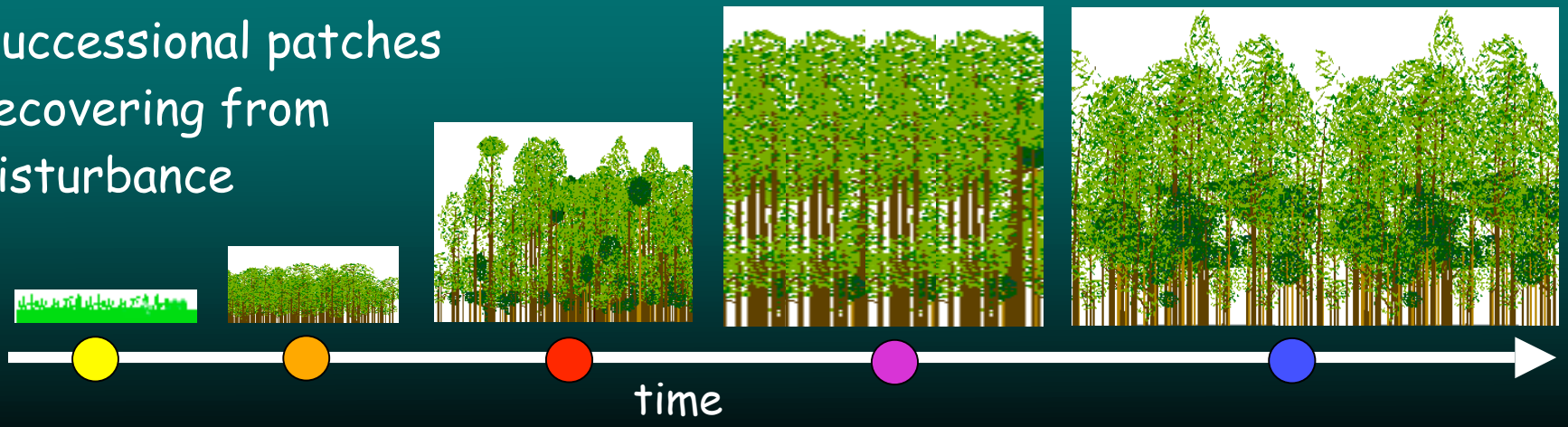
What do gap dynamics tell us about forest biomass dynamics?



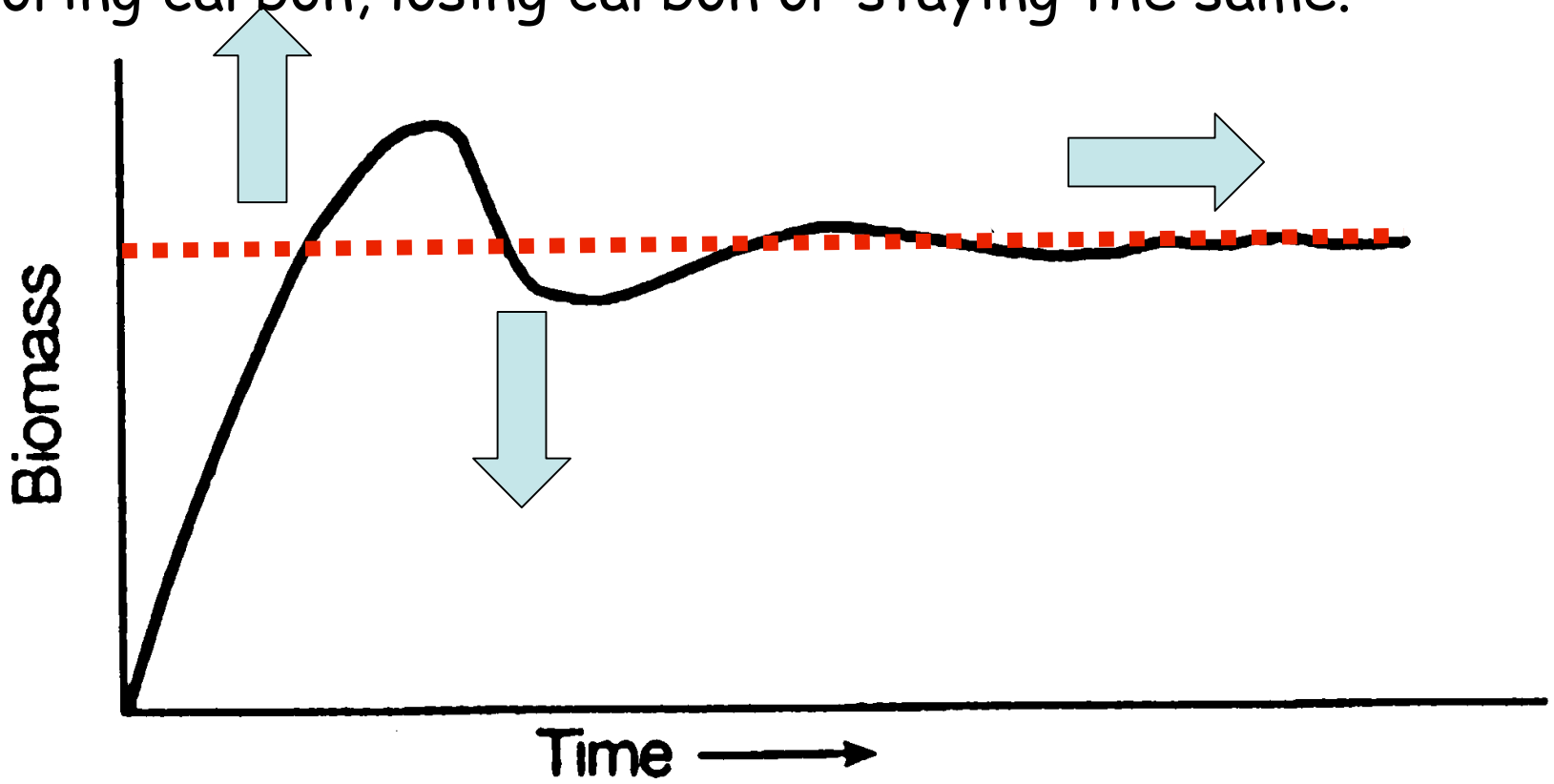
Carbon disturbance recovery dynamics are non-linear as the all-aged successional patches become desynchronized to produce the mixed-aged mature-forest mosaic.

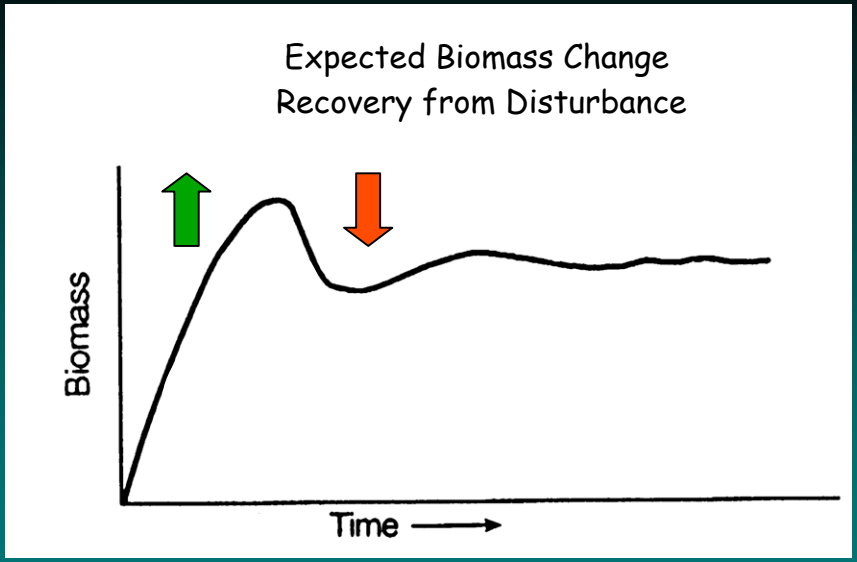
Successional patches recovering from disturbance

Mature forest is a mosaic.



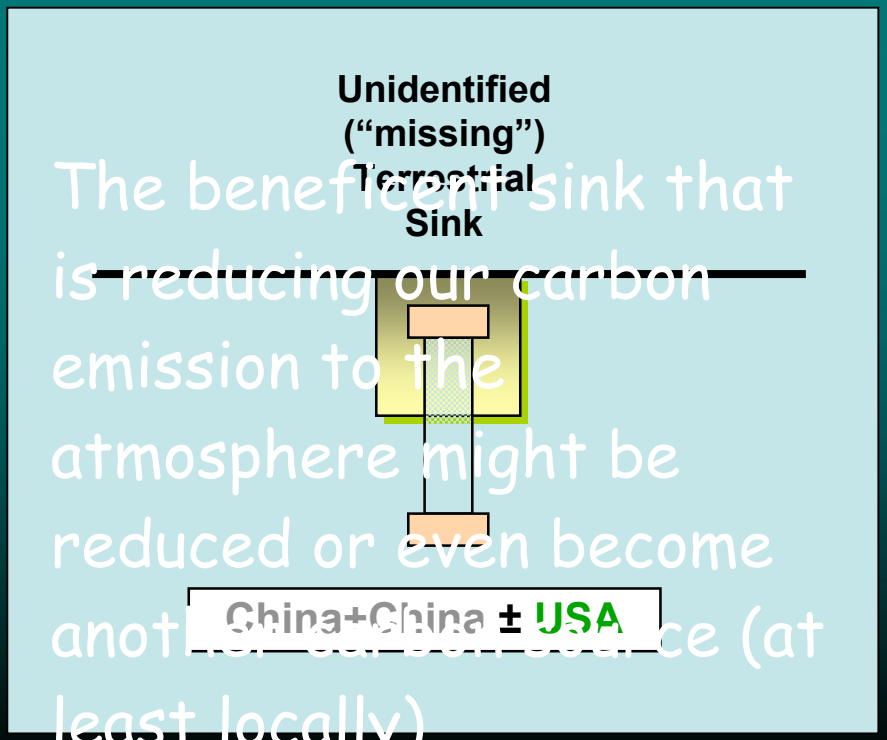
Depending on antecedent history, a forest with the biomass level associated with a mature forest, could be storing carbon, losing carbon or staying the same.





In terms of the carbon budget, recovering forests act as a sink for forests when they are young.

As these forests get older, they could become a source of carbon.



The beneficent sink that is reducing our carbon emission to the atmosphere might be reduced or even become another [illegible] source (at least locally).

Could you somehow make this a bit less abstract?

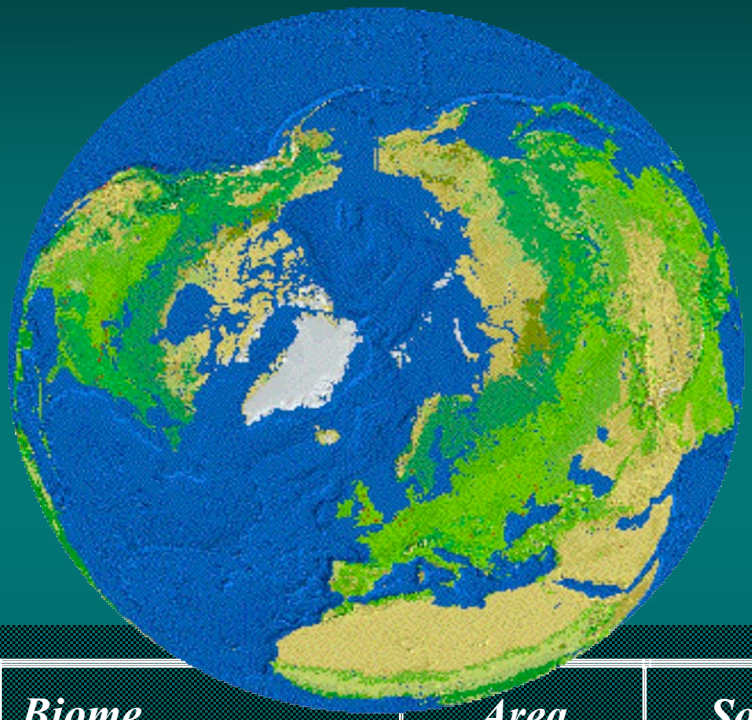
One of the places this "missing carbon" could be going is to the vast forests of Russia — the world's largest ~~forests~~ and that could stop happening. This stoppage would not be good.

Surprising Importance of Russian Forests in Global Warming

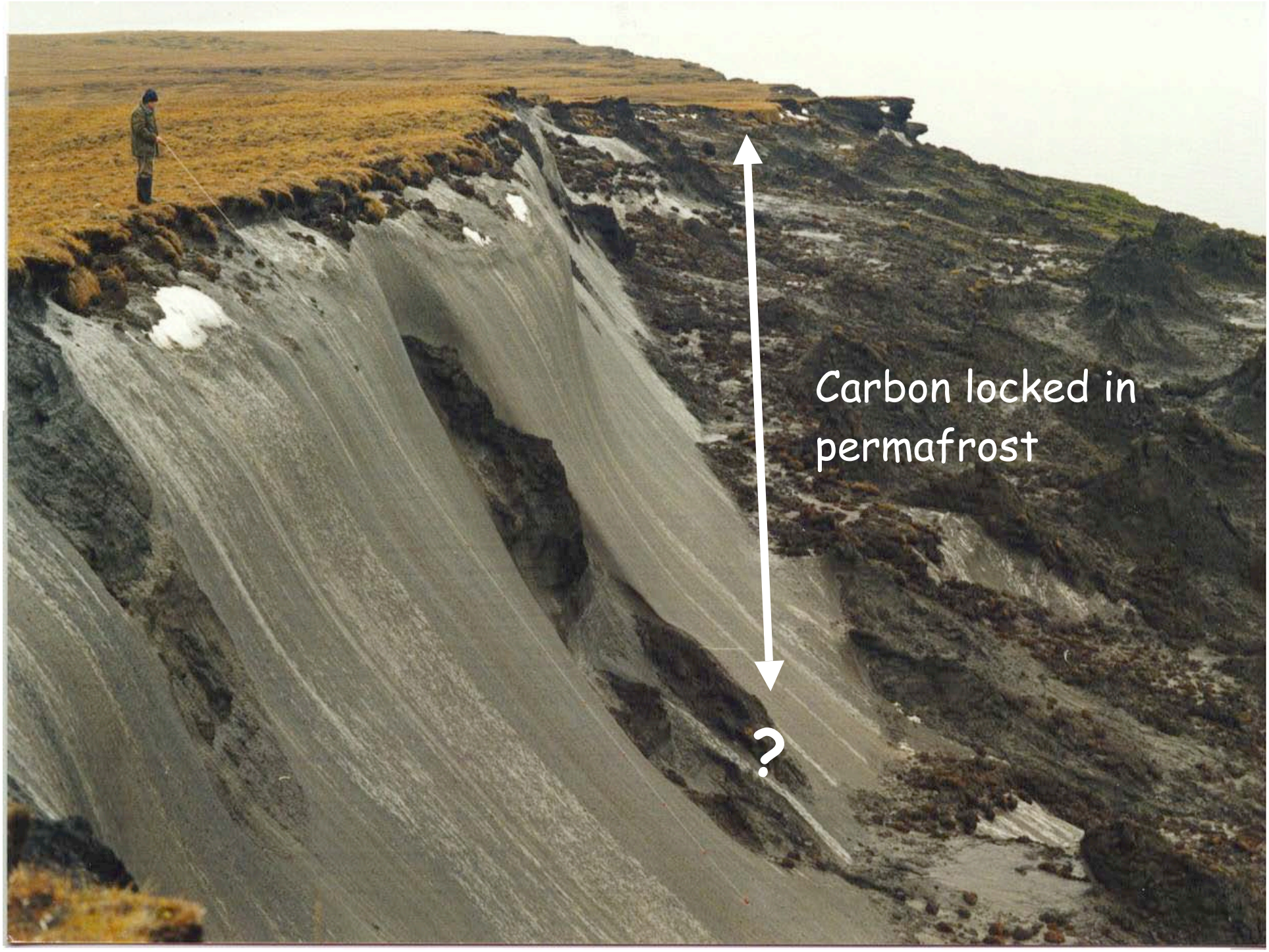
Or, if You Don't Know Russian Forests, …
… You Can't Know Global Climate Change

On a carbon storage basis, the first-order assessment of the global role of the Eurasian region would be as a major player in the global carbon budget.

The Boreal Region

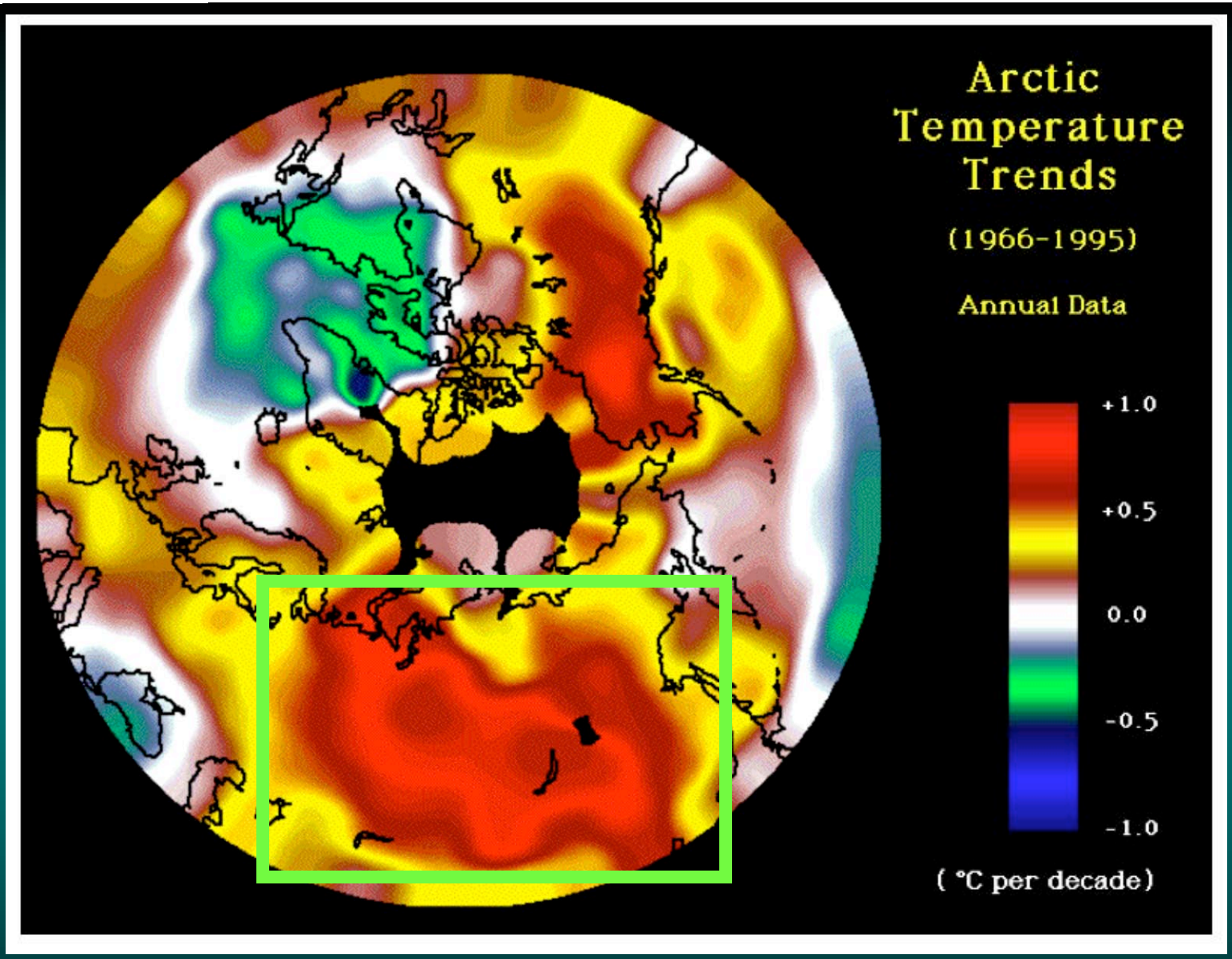


Biome	*Area* (10^6 *ha*)	*Soil Carbon* (*Pg*)	*Plant Biomass Carbon* (*Pg*)	*Total Carbon* (*Pg*)
Boreal Forest	**1509**	**624**	**51**	**675**
Tropical Forest	1756	216	159	375
Temperate Forest	1040	100	21	121


Carbon locked in
permafrost
?

Certainly, the Kyoto Protocol is written to greatly enc articipation.


Please allow me to
motivate this lecture
with a few ground
observations from
Northern Siberia.
At the Russian Tree Line



Observed Warming Trend From: Serreze, MC, et al. 2000. Observational Evidence of Recent Change in the Northern High-latitude Environment. Climatic Change 46:159-207.

1962

1997

Tree Line Shifts

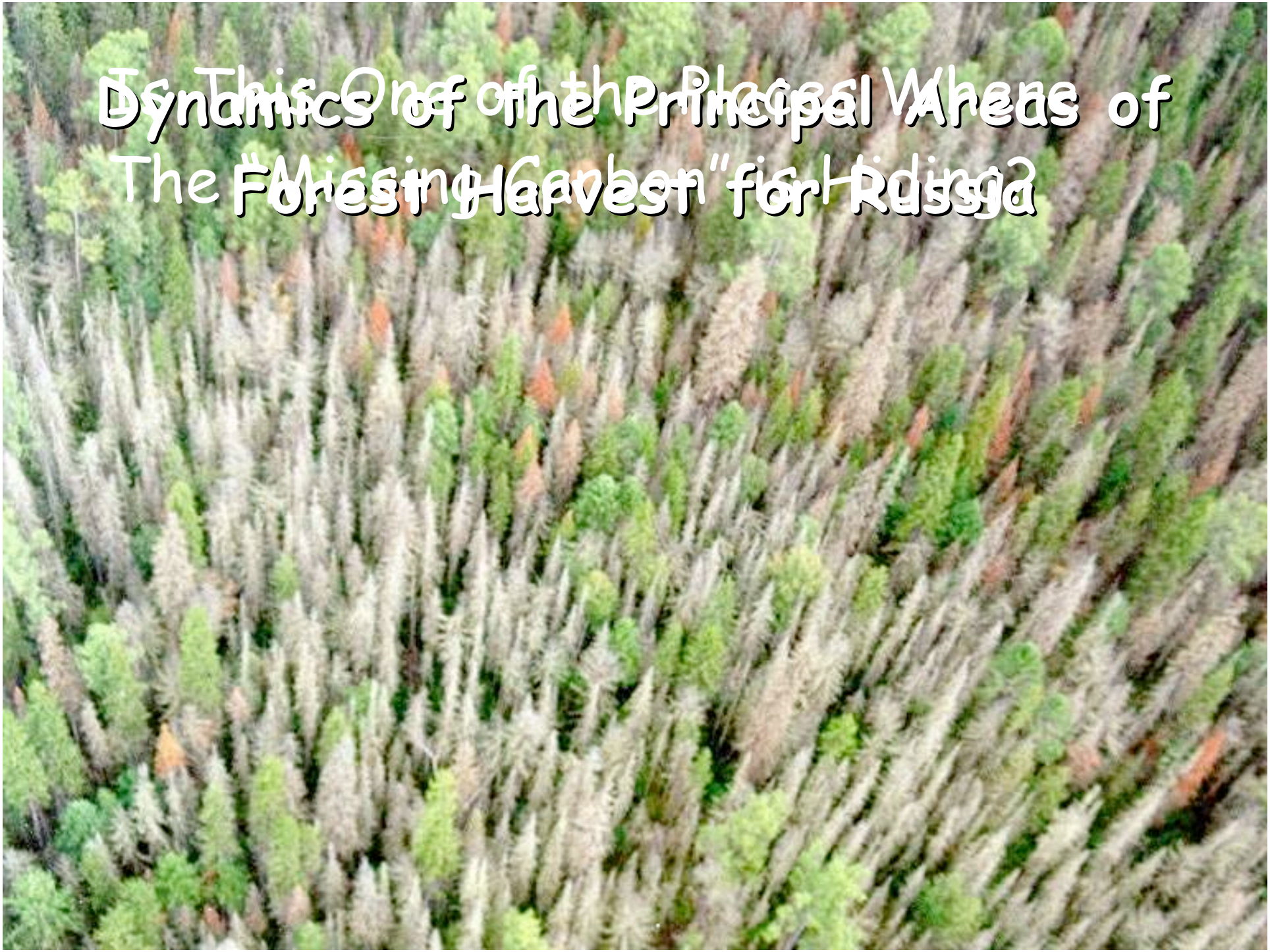
In the Tundra:
Slope Failures and Landslips

These observed changes are consistent with predictions from general circulation models or "climate models"

What are the consequences of such changes and are there significant feedbacks to the atmosphere from responses of terrestrial ecosystems?

Collapse of Buildings due to Permafrost Thawing

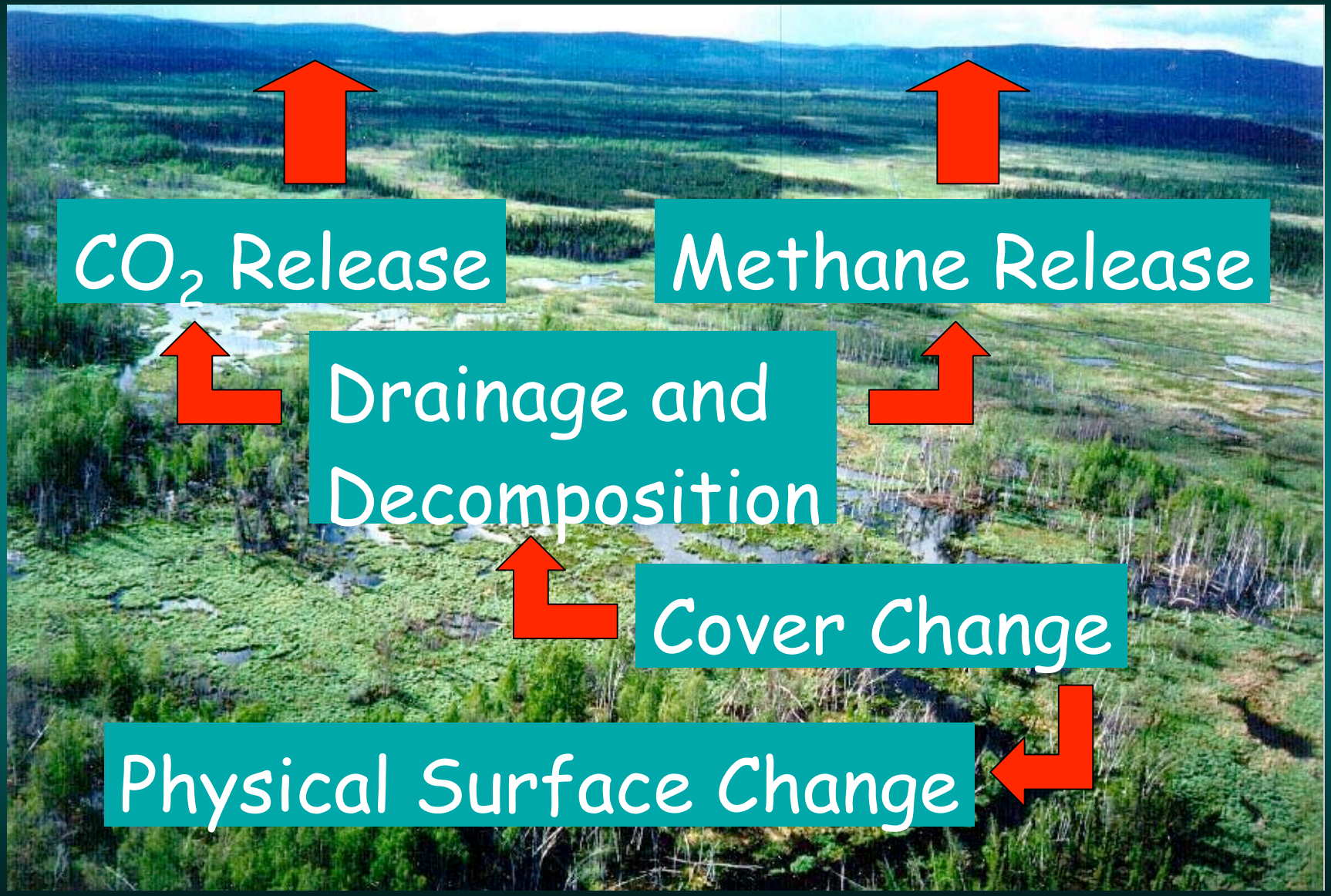
Basically, the environmental changes taking place in Russia have all the sweeping drama of a Russian novel


Dynamics of the Principal Areas of
Forest Harvest for Russia

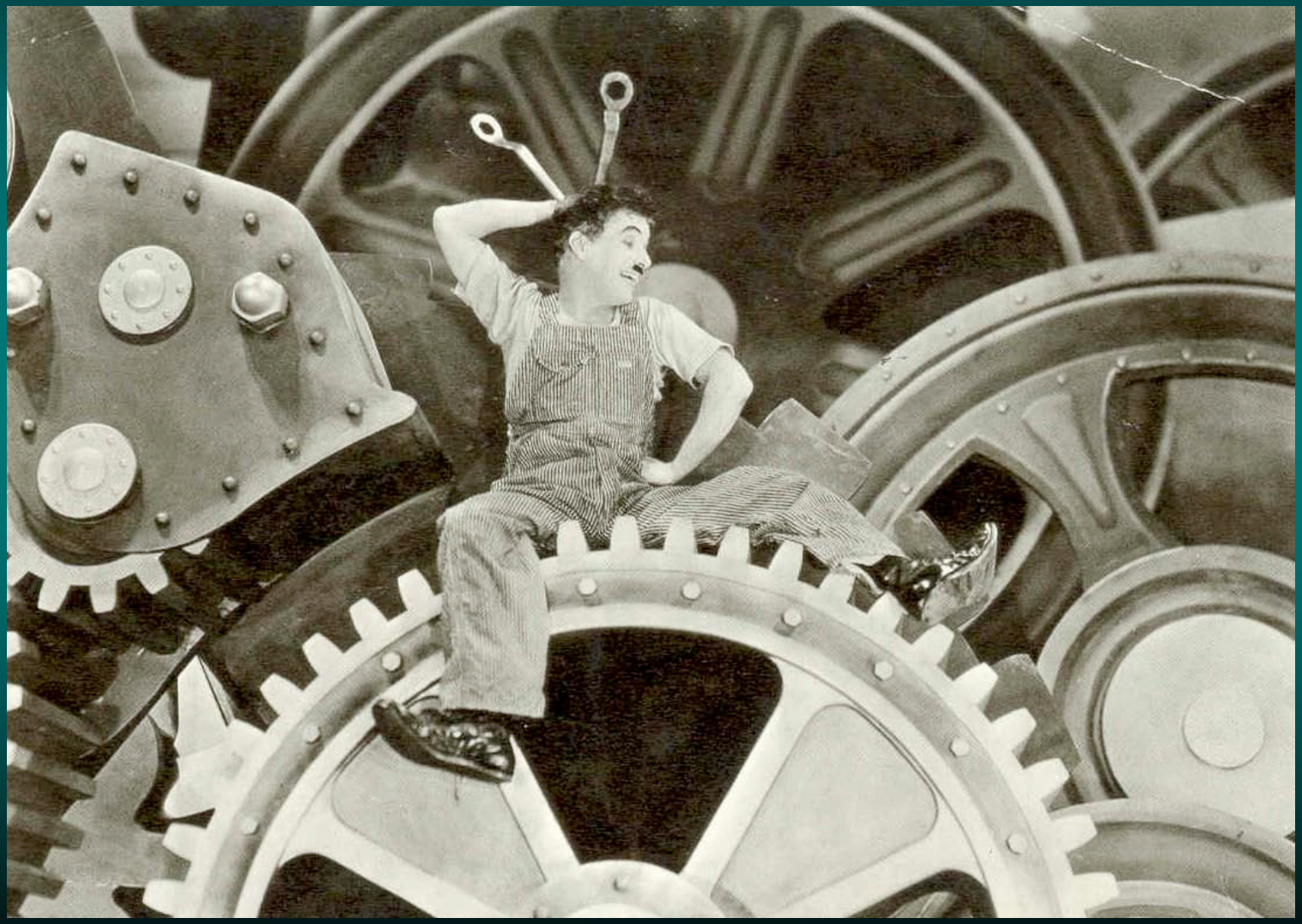
Vladimir, old buddy, I surely do appreciate yore help handlin' those doggone pesky environmentalists!

I hate to tell the Americanski Bush that I'm signing the Kyoto Protocol.

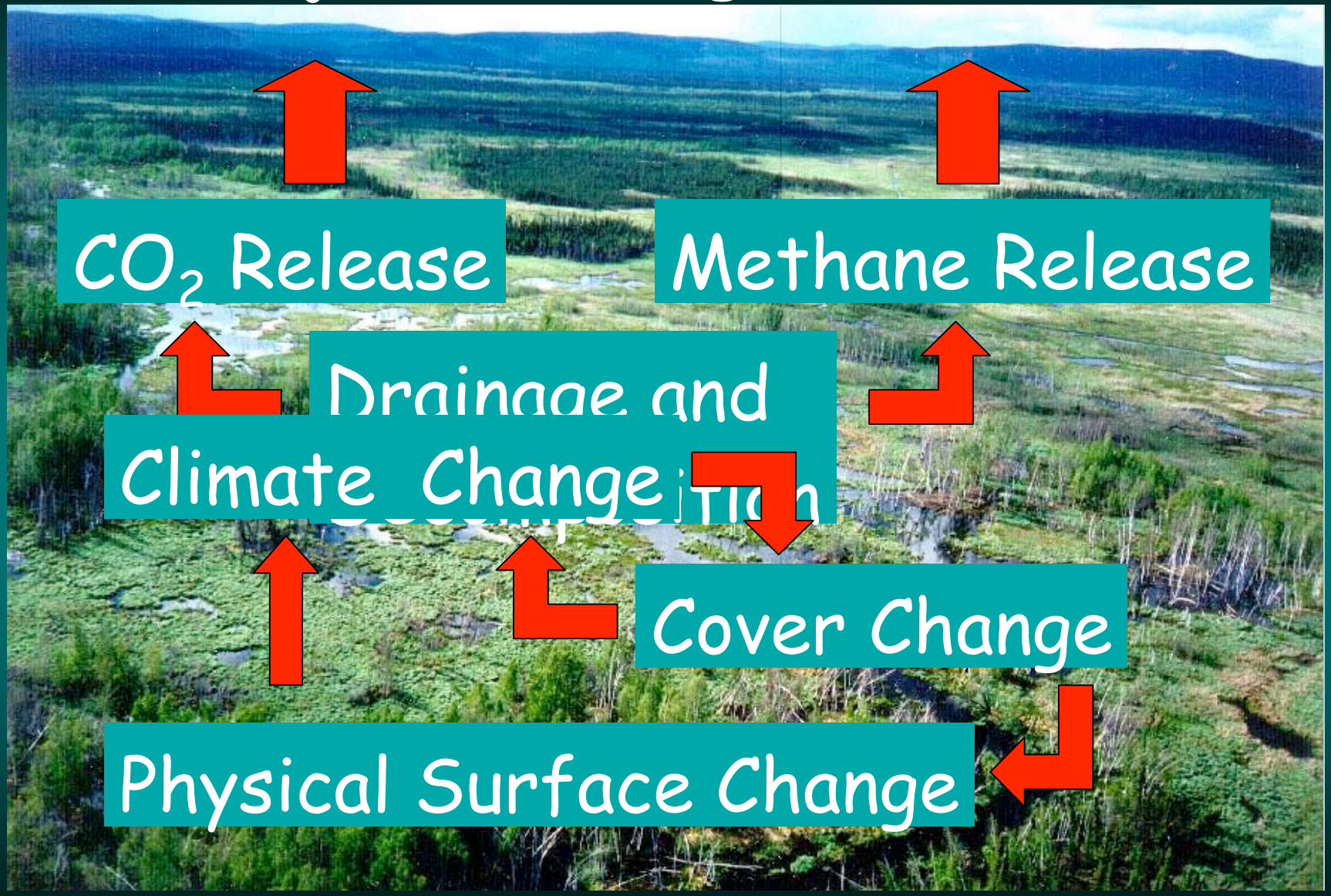
Implications of Change:



Where do we go next?

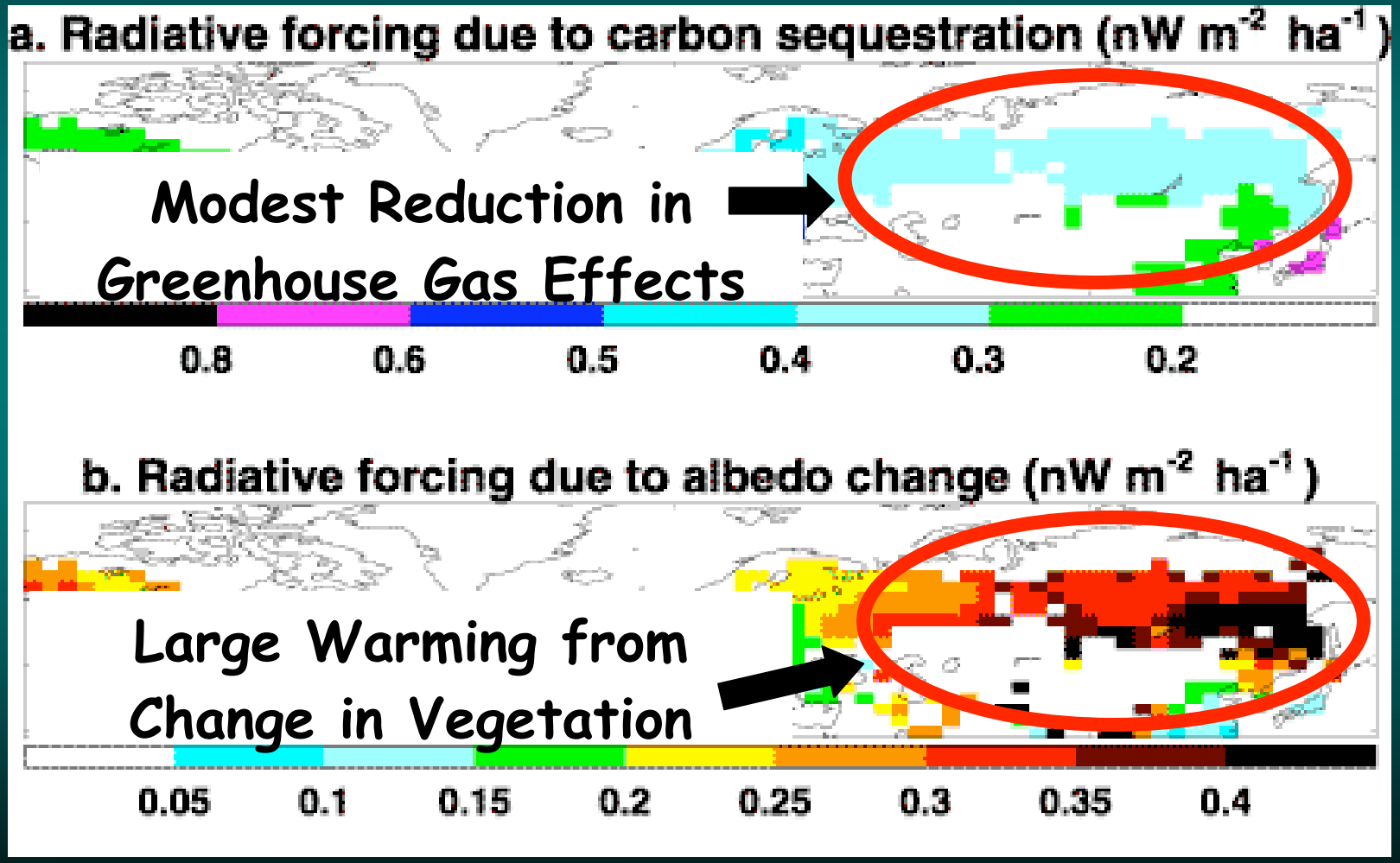


Consider just one "cog in the machine":



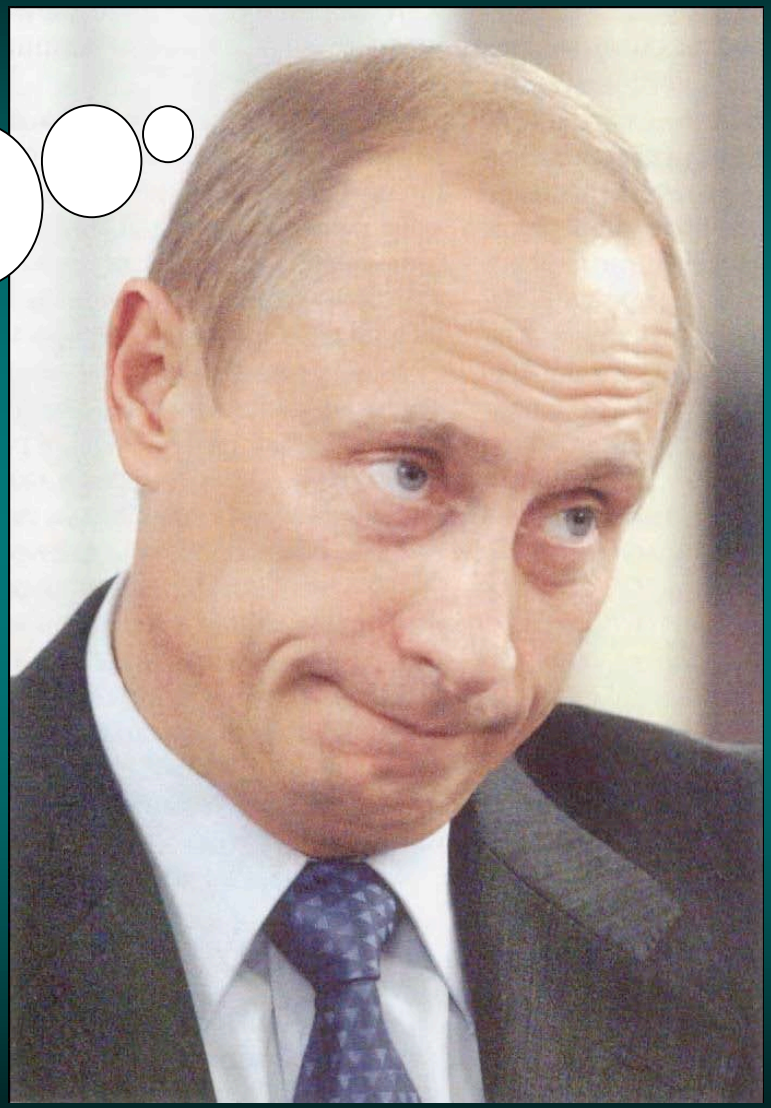
The Effects of Growing More Trees

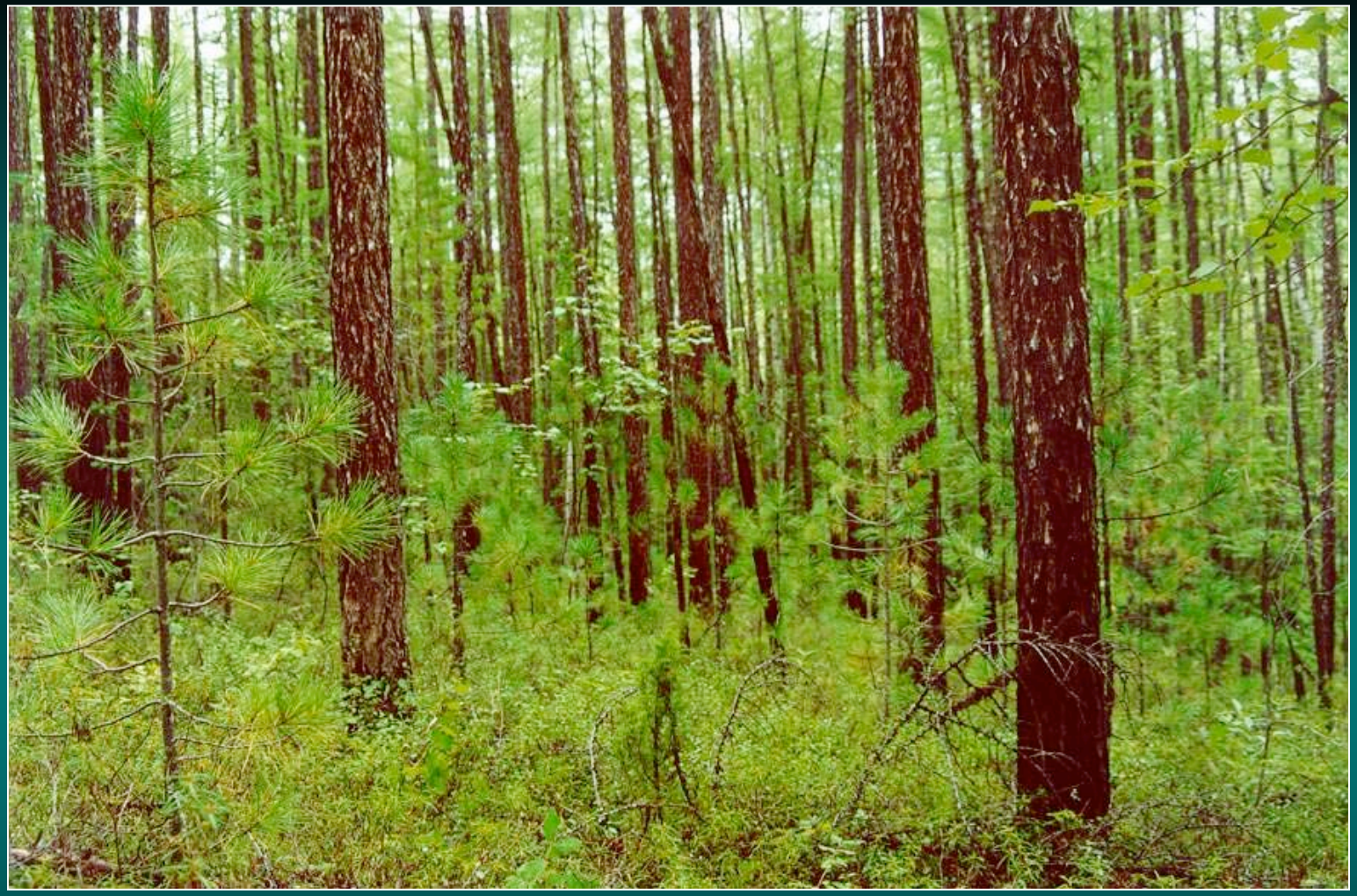
"… in large parts of the temperate and boreal forest areas, the decrease in surface albedo by forestation is as important as carbon sequestration in its forcing of climate. As a result, forest carbon sinks in these regions could exert a much smaller cooling influence than expected, or even exert an overall warming influence."



From: Richard A. Betts. 2000. Offset of the potential carbon sink from boreal forestation by decreases in surface albedo. Nature 408:187-190.

Growing trees in Siberia works for the Kyoto Protocol but it warms the Earth … Life was so much easier when all I had to do was run the KGB!





Replacing Larch with Evergreen Conifers has an effect analogous to

Siberian pine regeneration under a larch canopy

growing trees.

Predicting Cover and Composition Change for the Boreal Forest

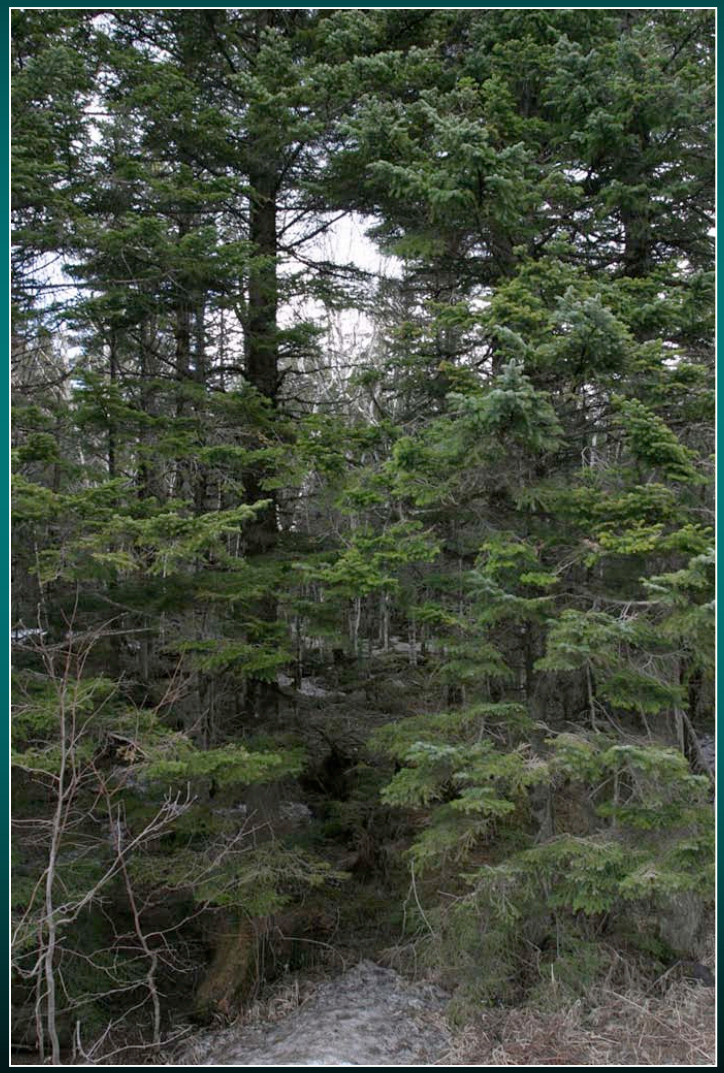
FAREAST: A Boreal Forest Simulator

Growth:

- Available Light
- Soil Moisture
- Site Quality
- Growing-Degree Days
- Depth of Thaw
- Diameter
- Age
- Height

Mortality:

- Stress
- Fire
- Insects
- Age

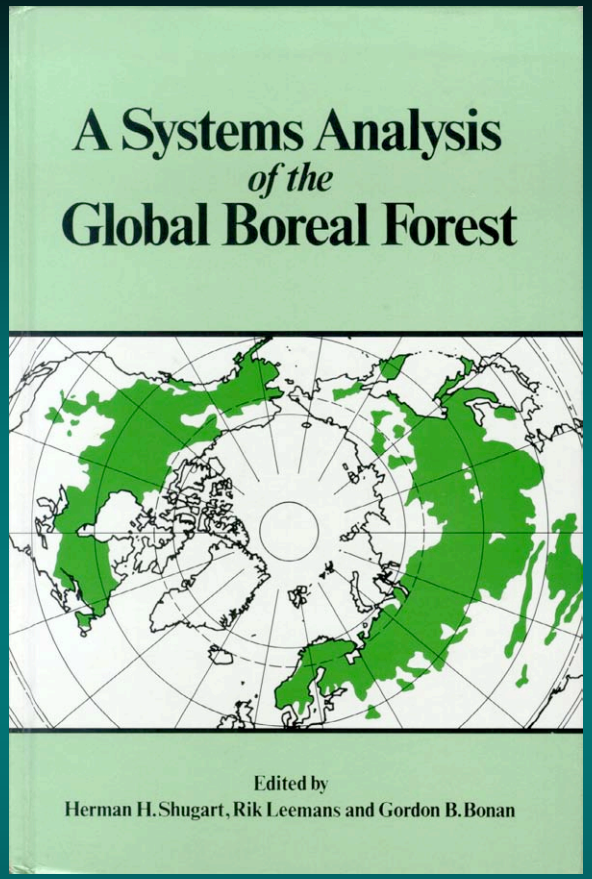


Regeneration:

- Available Light
- Soil Moisture
- Site Quality
- Depth of Thaw
- Seed Bed
- Seed Availability
- Sprouting
- Layering

Data Needs:

Process information on the silvicultural features of the boreal tree species, allometric equations, light extinction coefficients, and other biological, biophysical and physical aspects of stand dynamics.

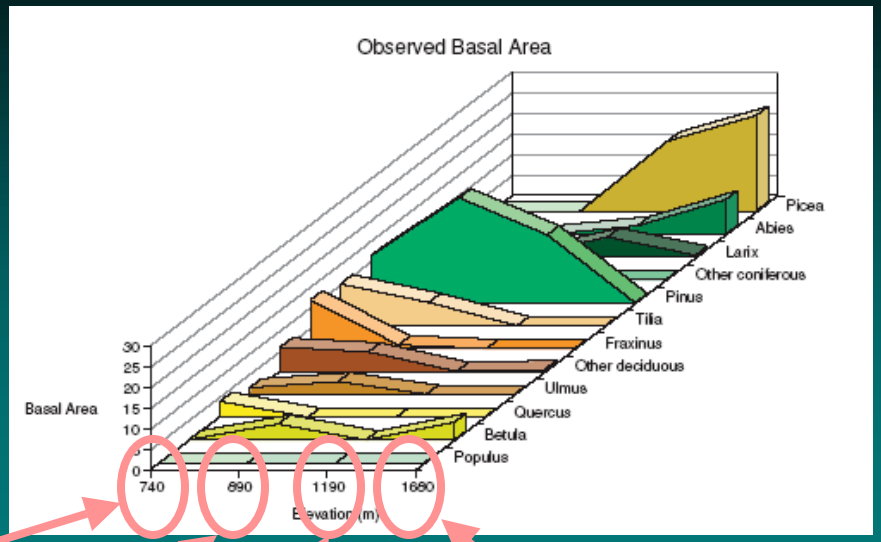


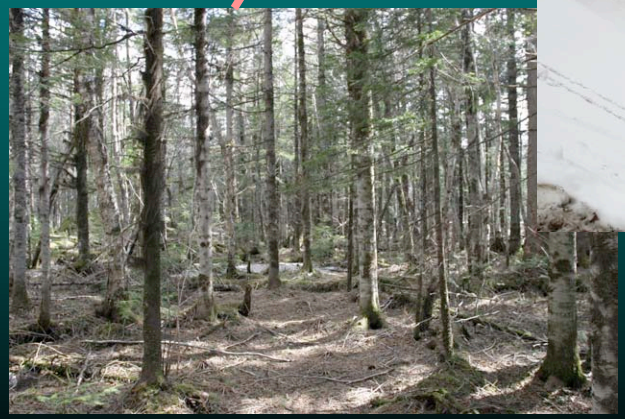
Much of this has been derived from earlier synthesis activities but there remains a need for a characterization of the fundamental processes, particularly thermal fluxes and ice-related processes.

Tests of the FAREAST Model on Mountain Gradients

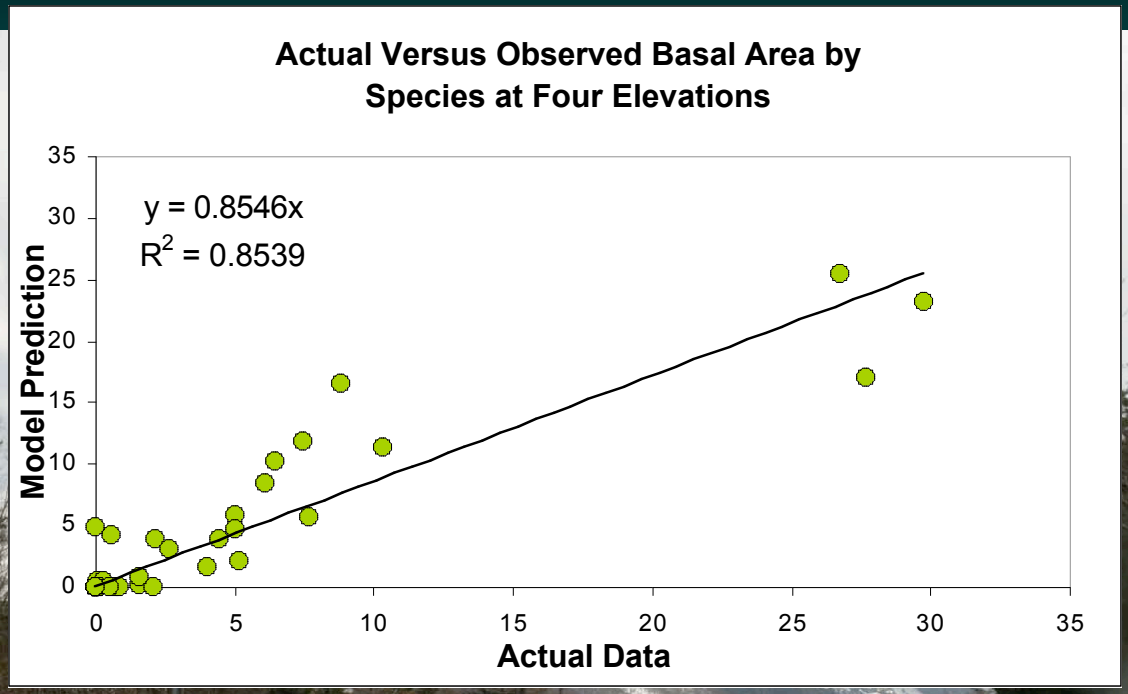
Changbai Shan (Always White Mountain) on the Chinese-Korean Border

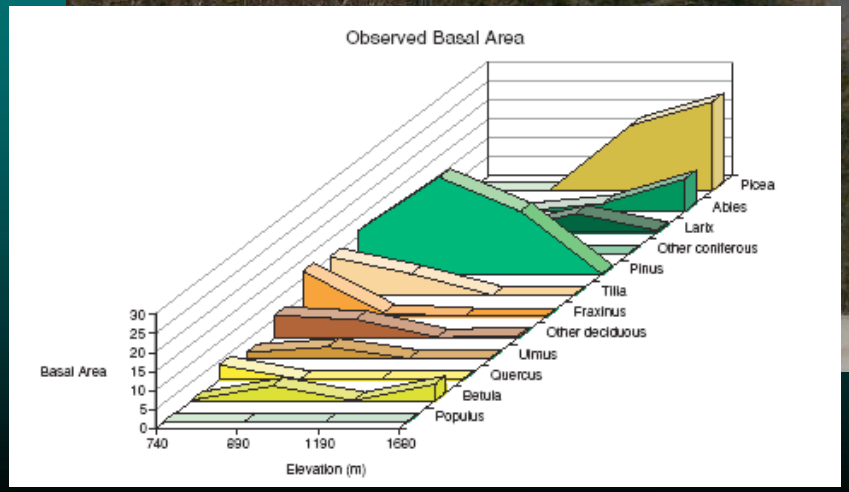
Chang Bai Shan Vegetation Gradient

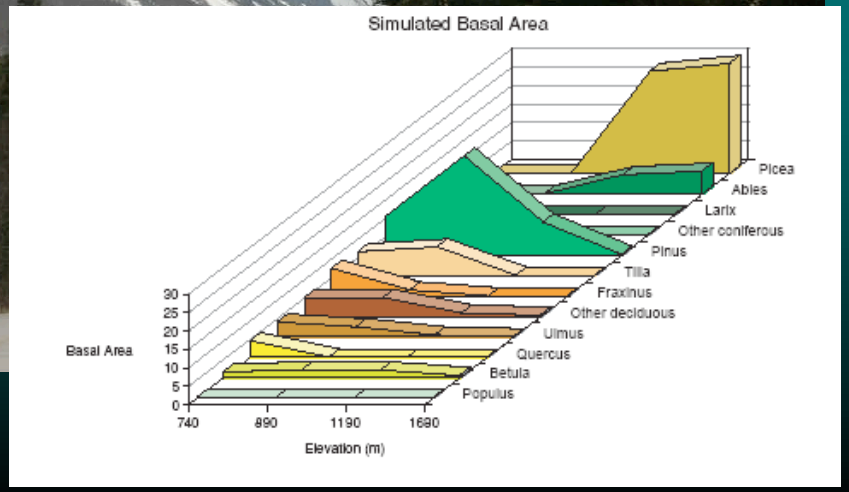




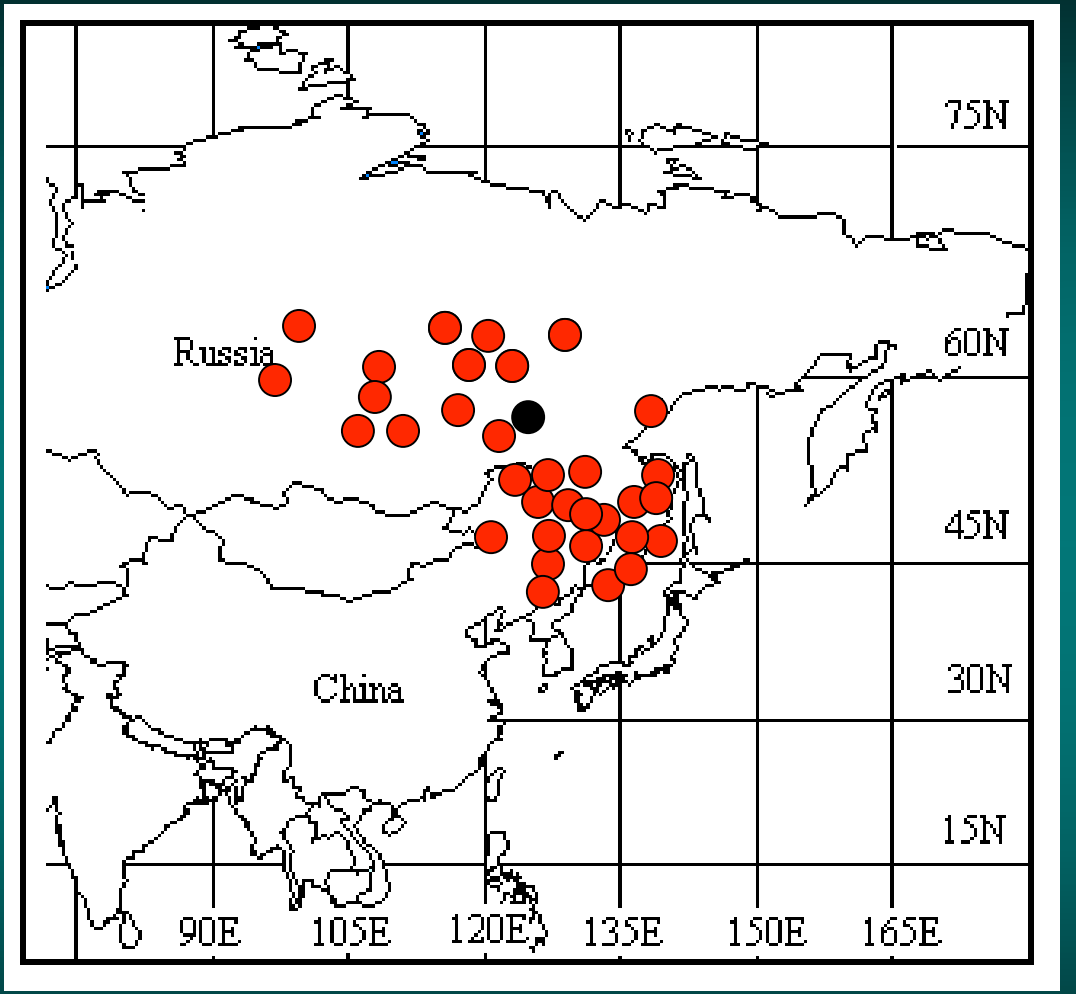
Tests of the FAREAST Model on Mountain Gradients







Test sites in China and Russia



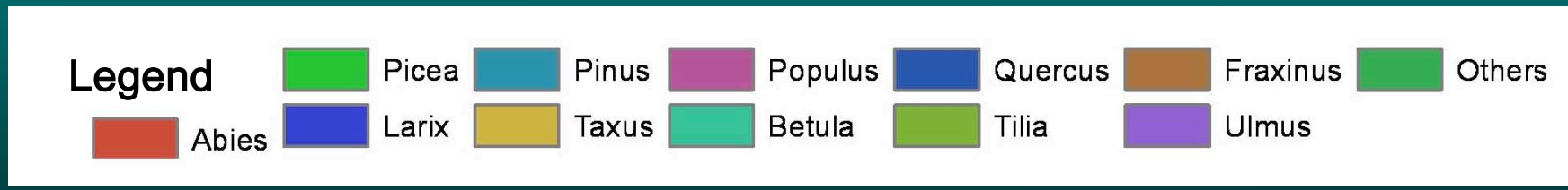
85% Correct (Validation Mode)

95% Correct (Verification Mode)

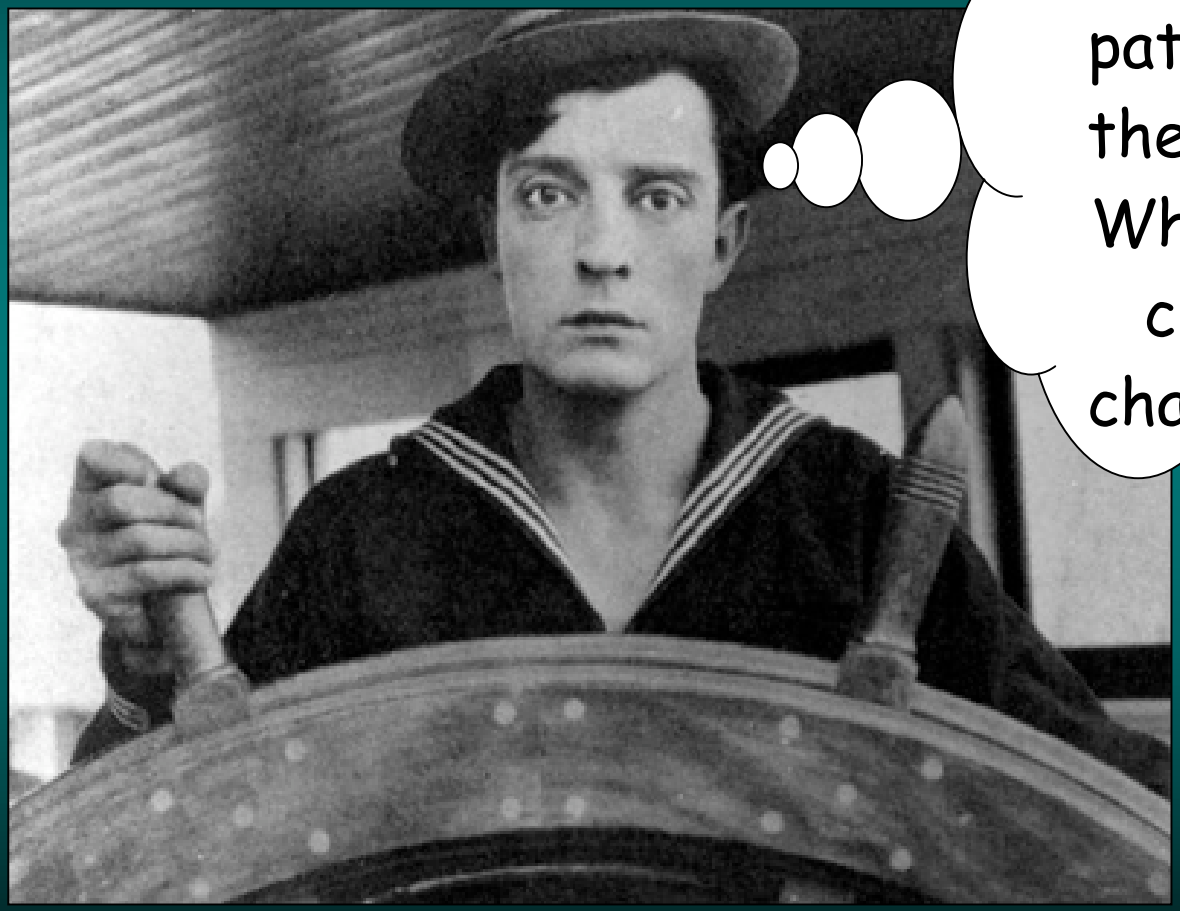
Running the FAREAST model (200 simulated plots for 700 years starting with an open plot) for 234 weather stations across the former Soviet Union.

Size of circles indicates the biomass of mature forests.

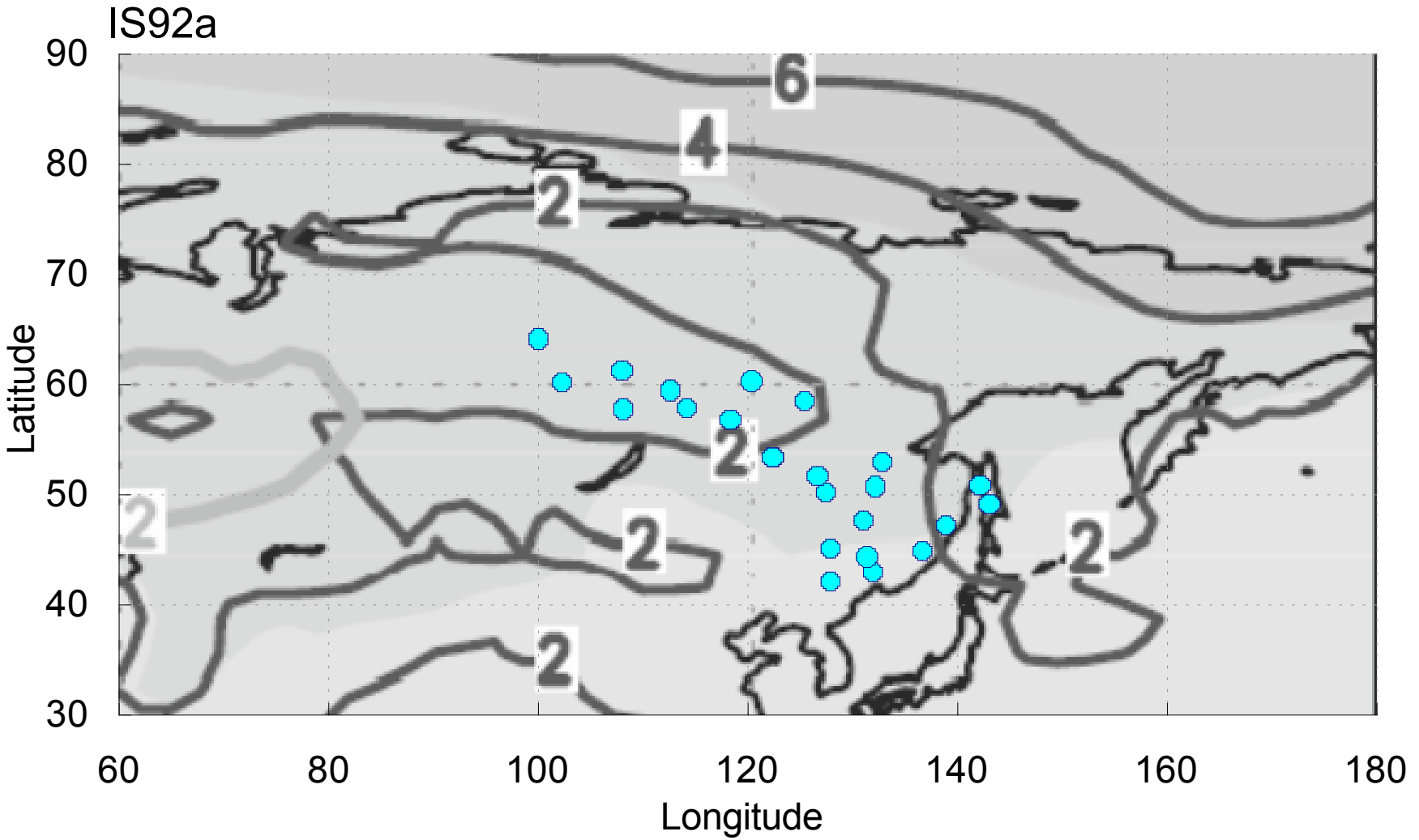
Running the FAREAST model (200 simulated plots for 700 years starting with an open plot) for 234 weather stations across the former Soviet Union.



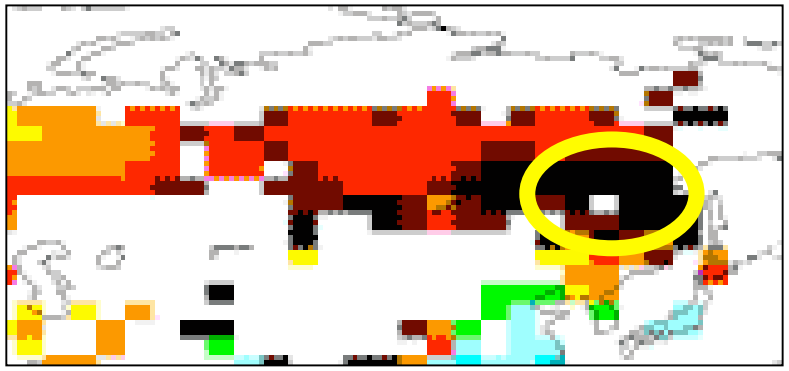
Size of pie slices indicates species presence by weight in mature forests at each point.



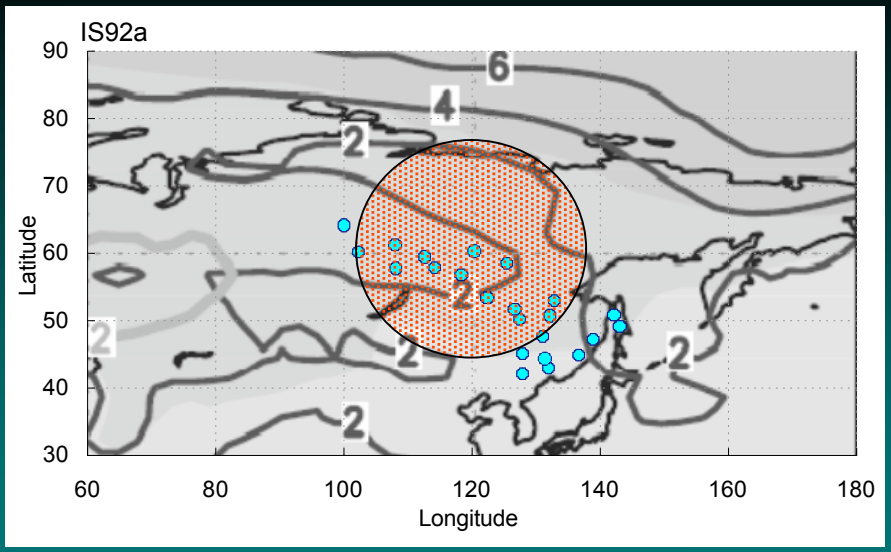
So we can simulate the patterns in the forest. What does climate change do?

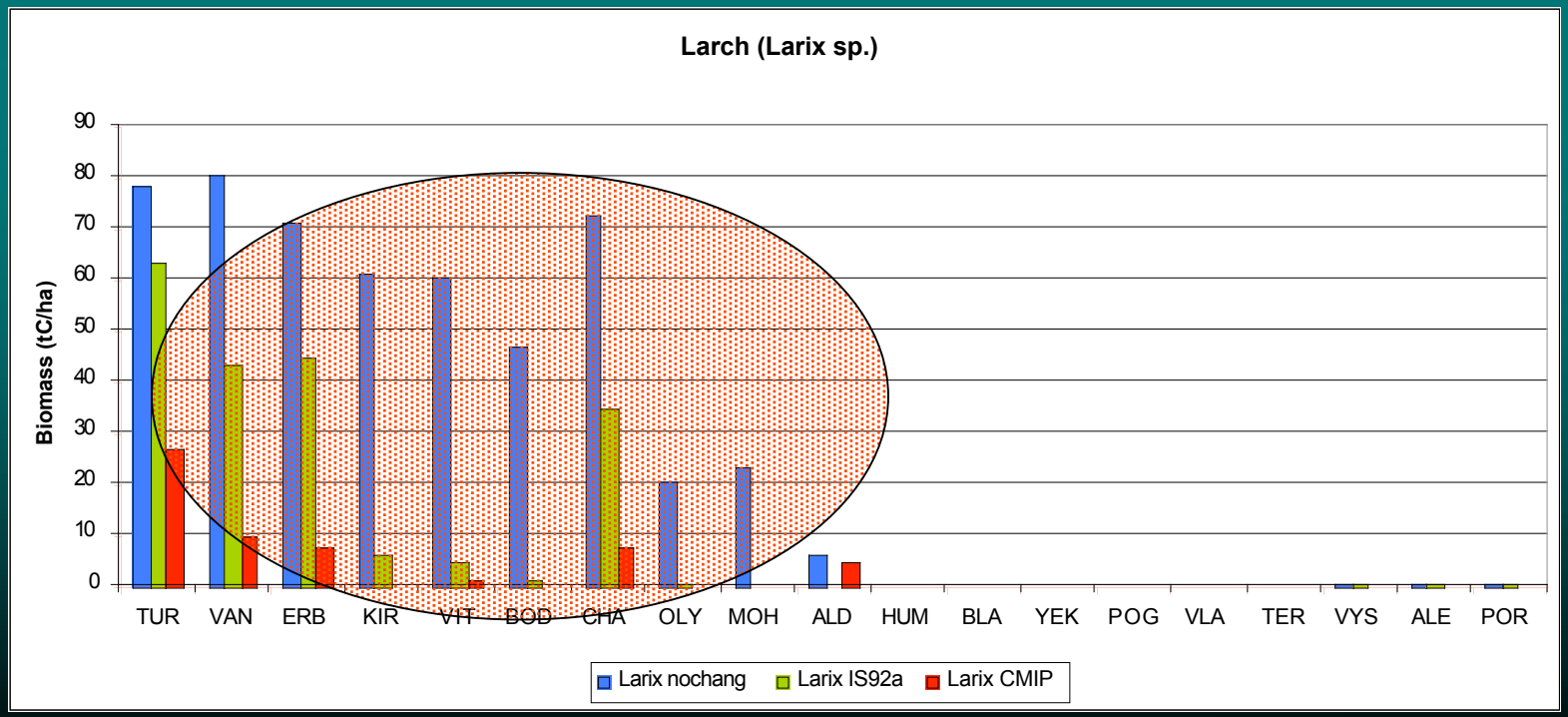


Multi-model-ensemble annual-mean change of the temperature (Gray shading), its range (Unit:°Ê mean change divided by the multi-model standard deviation for the IPCC-DDC scenario IS92a (GS: greenhouse gases and Sulphate aerosols) for the year 2021 to 2050 relative the period 1961 to 1990.

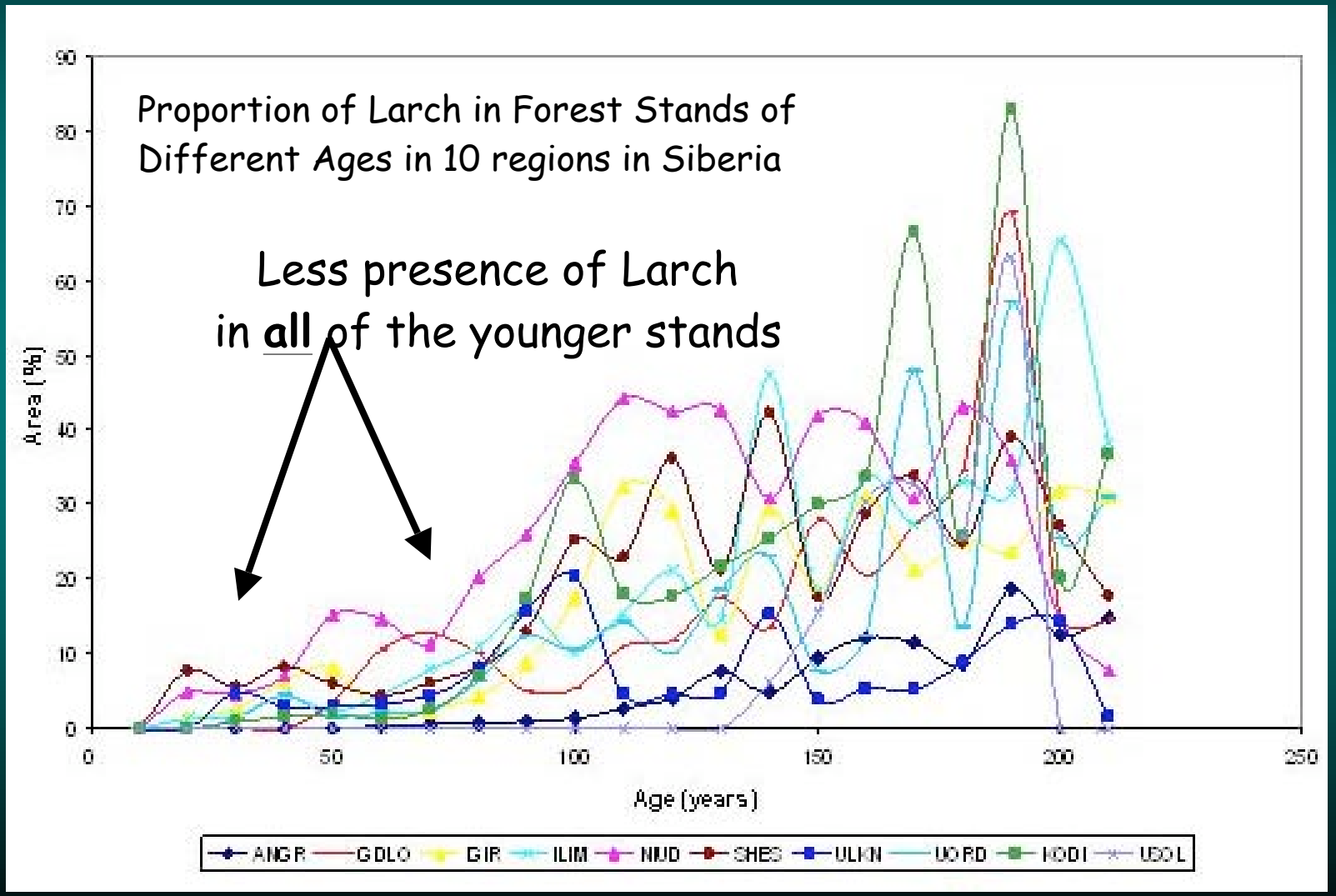


Zone of Larger Warming from Growing Trees





Relating Model Results to Russian Data

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Cover Change
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gether.
Climate Cha

Understand Regionally

Think Globally; Act Locally.

Global wisdom may have its origins in regional knowledge.


THE END