

Future carbon budget over Northern Eurasia: land use change vs. climate change

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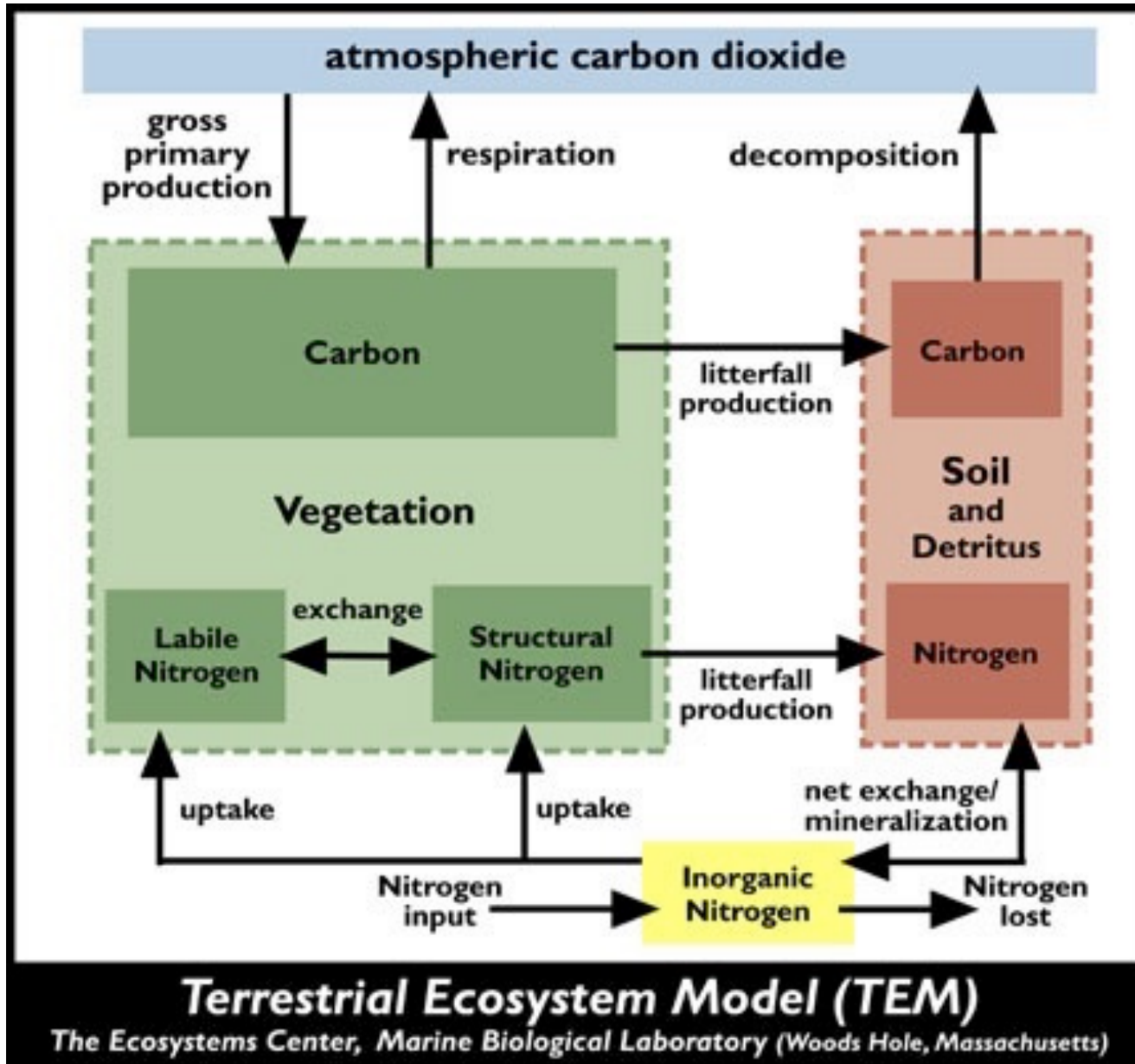


<http://globalchange.mit.edu/>

Background

- Northern Eurasia is a major player of the global carbon budget
- Climate change and human influence have and will continue to have a large impact on the region
- What will be the largest drivers of future changes in the Northern Eurasia carbon cycle?
 - Changes in ecosystem productivity
 - Land use land cover change
 - Natural vegetation migration
 - Forest fires
 - Permafrost thaw
 - Others...

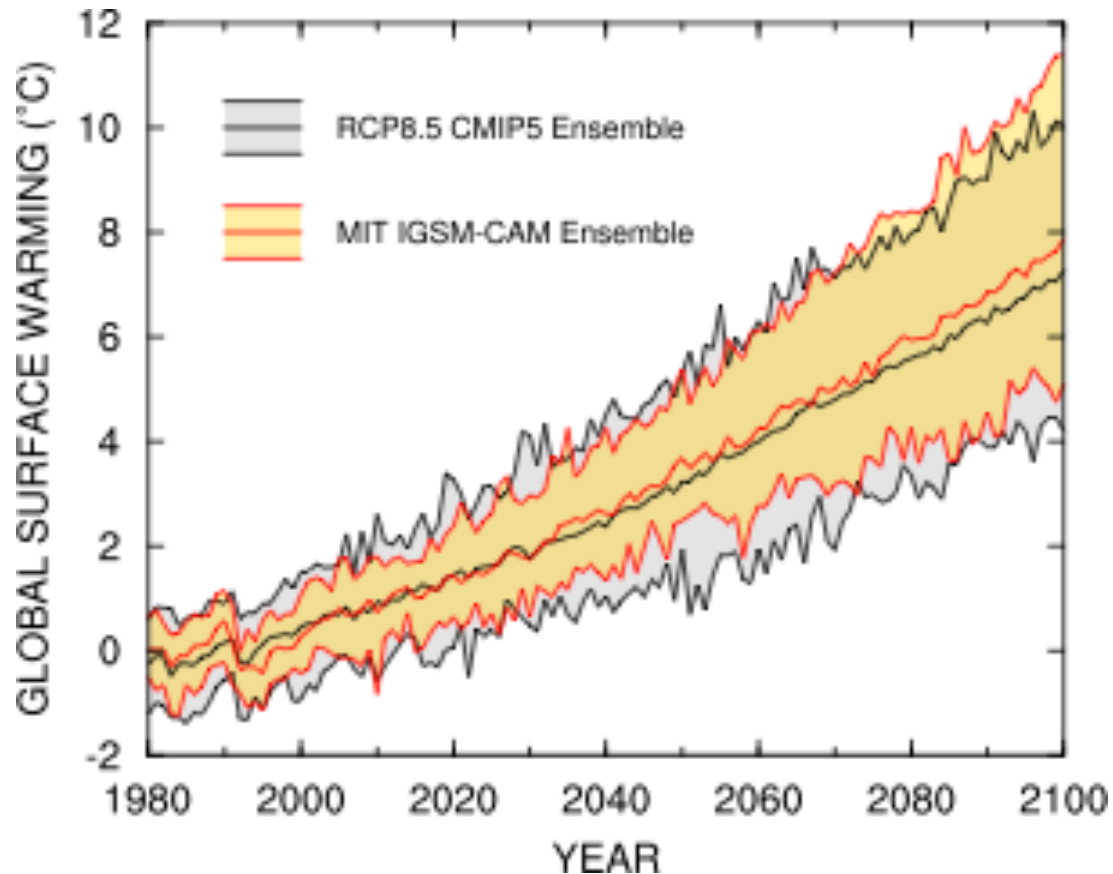
Modeling setup



Modeling setup

30 climate simulations with the MIT IGSM-CAM

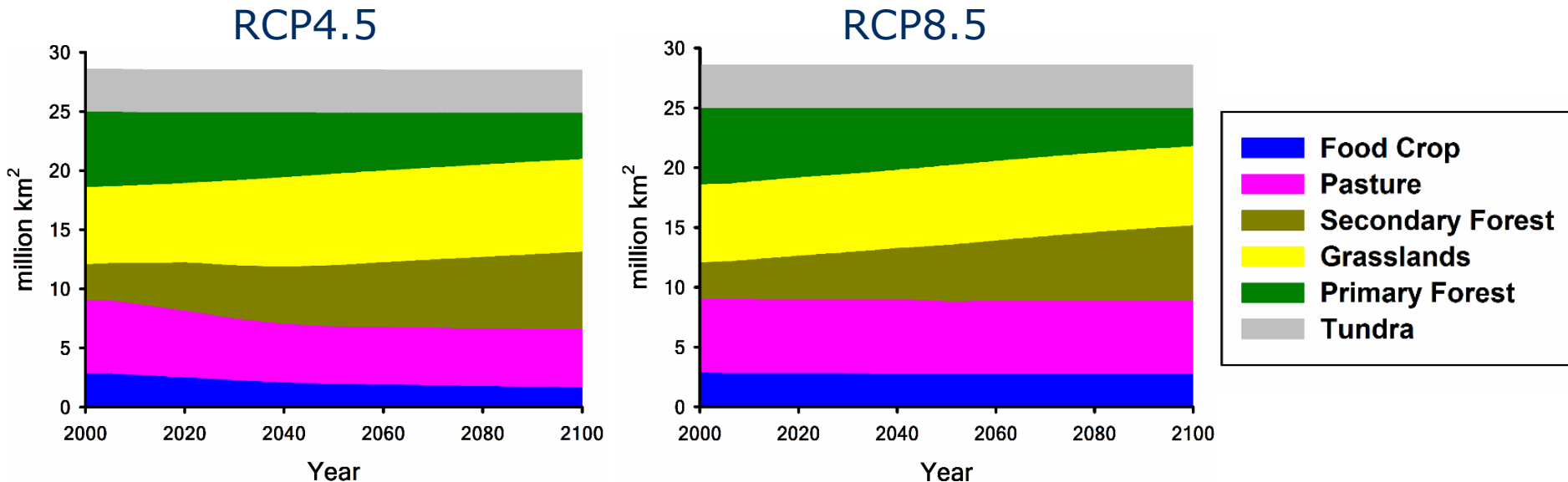
- 2 emissions scenarios (similar to RCP8.5 and RCP4.5)
- 3 values of climate sensitivities (2.0, 2.5 and 4.5°C)
- 5 initial conditions to represent a range of natural variability



Modeling setup

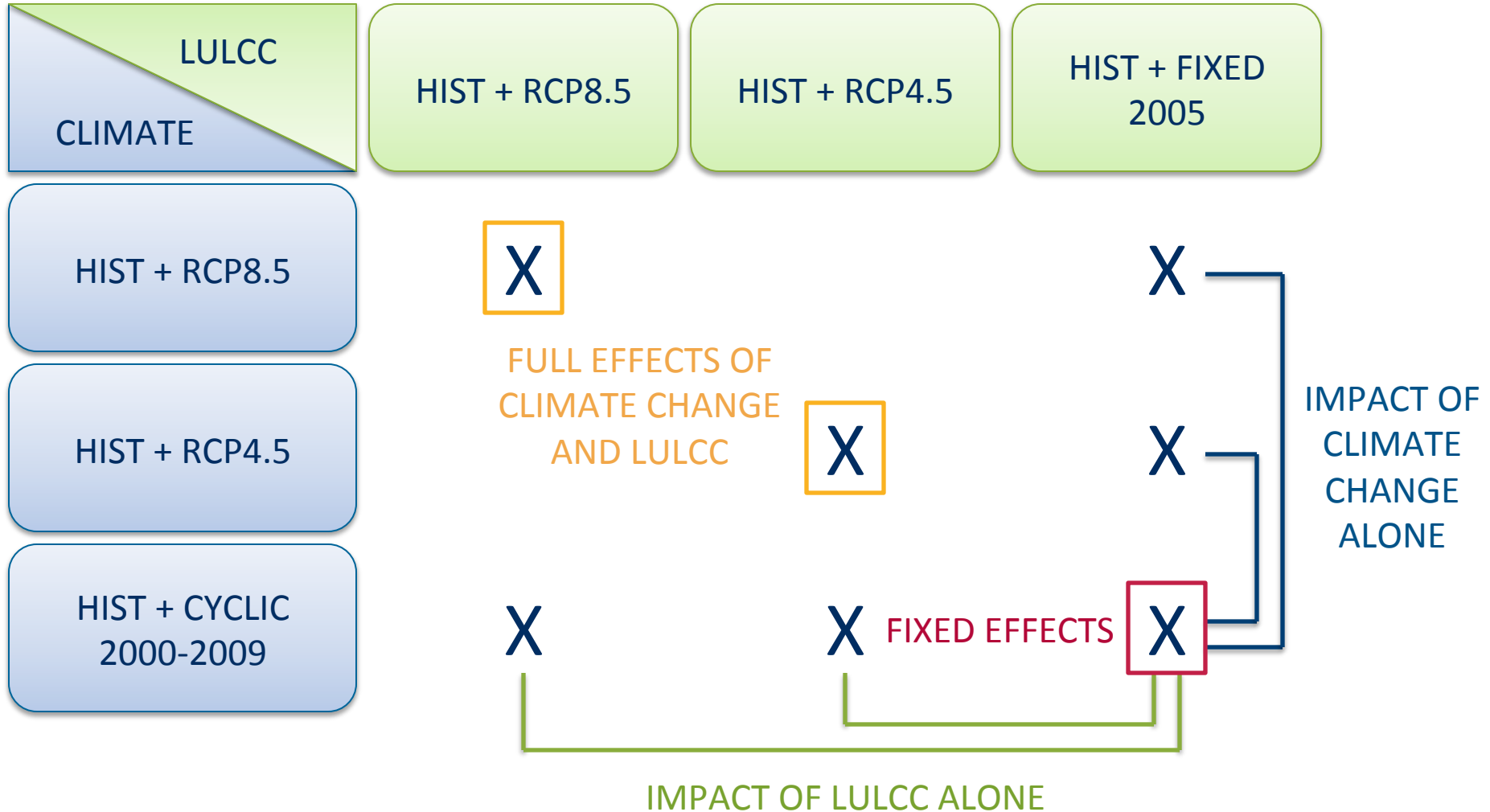
2 Land Use/Land Cover Change scenarios:

- Based on land use transitions: cropland, pasture, primary land and secondary (recovering) land
- Historical transitions from 1500 to 2005 (Hurtt et al., 2005)
- After 2005:
 - RCP8.5 (MESSAGE model) & RCP4.5 (GCAM model)
- No natural vegetation migration



Matrix of simulations

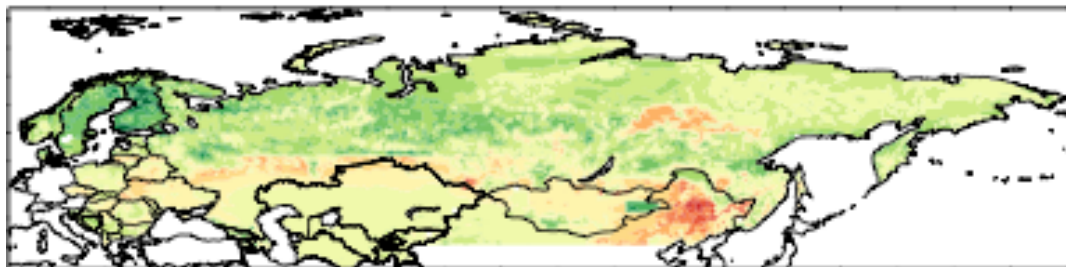
SIMULATIONS FROM 1500 to 2100



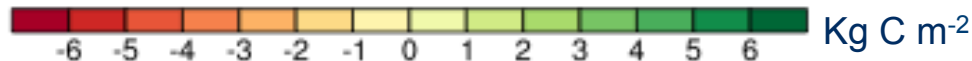
Attribution of future carbon fluxes

FULL SIMULATION

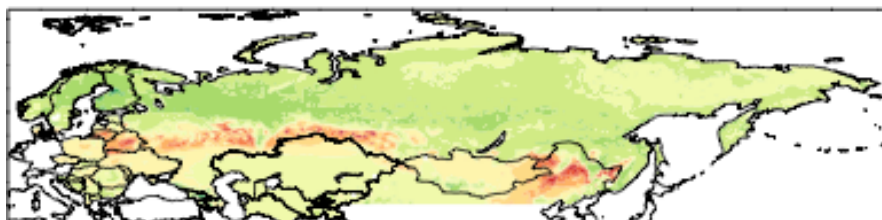
CUMULATIVE
NET CARBON
EXCHANGE
2001 to 2100



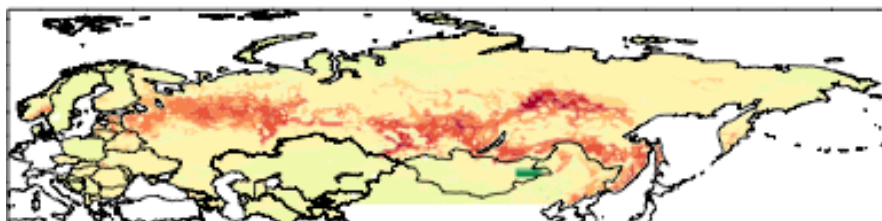
RCP8.5



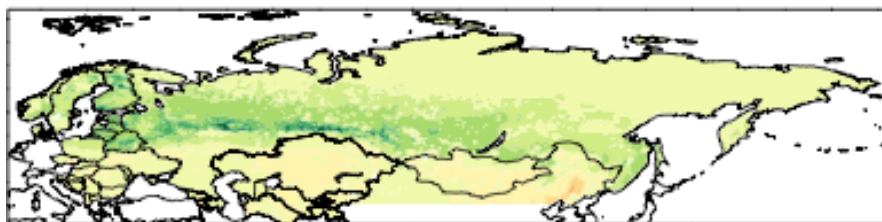
CLIMATE CHANGE ALONE



LULCC ALONE

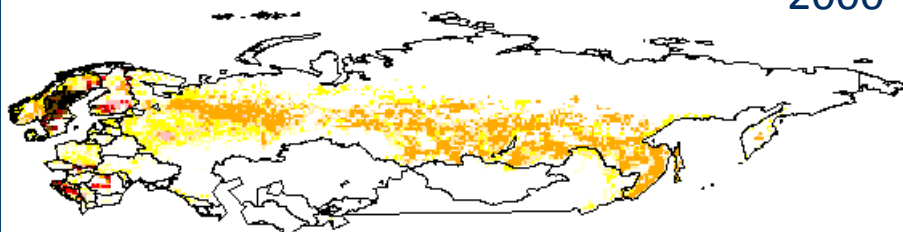


FIXED EFFECTS

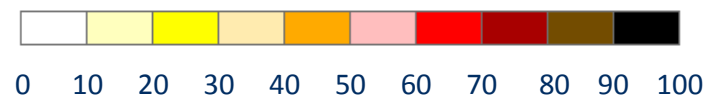
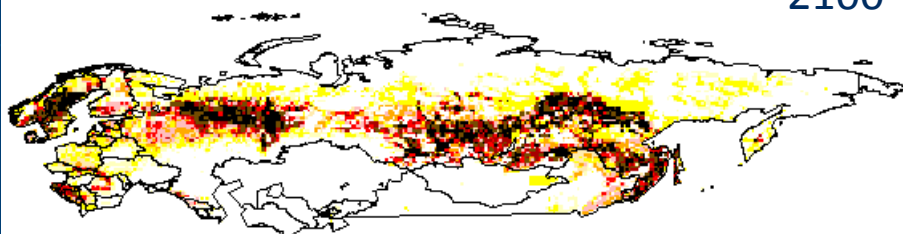


SECONDARY FORESTS

2000



2100

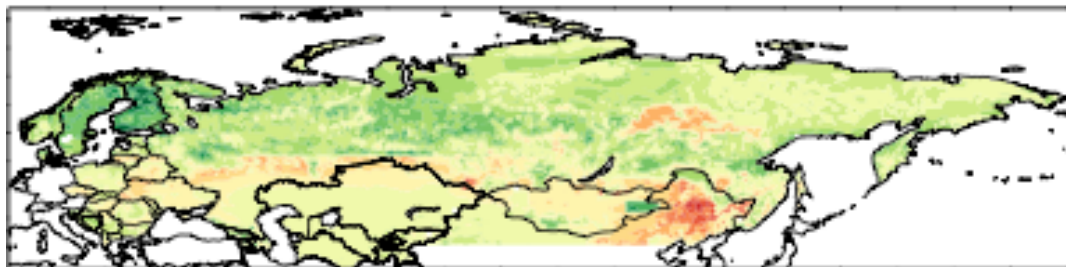


Percent Cover

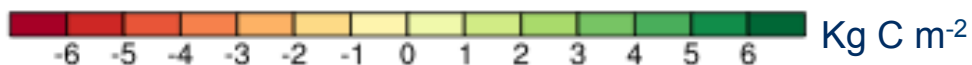
Attribution of future carbon fluxes

CUMULATIVE
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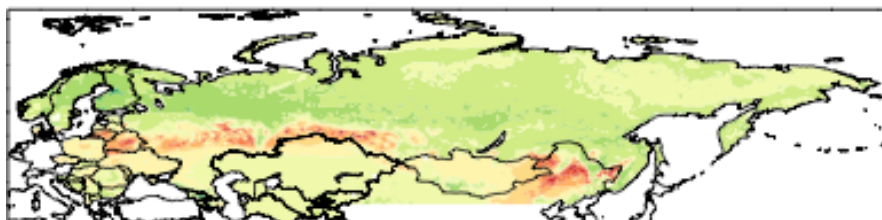
FULL SIMULATION



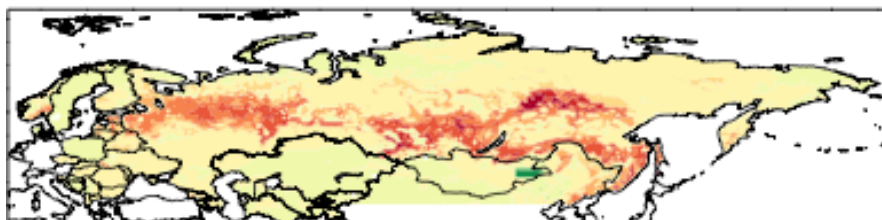
RCP8.5



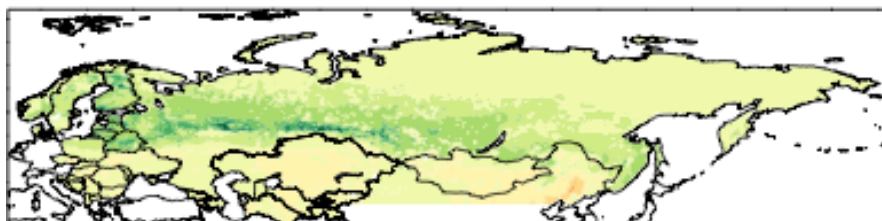
CLIMATE CHANGE ALONE



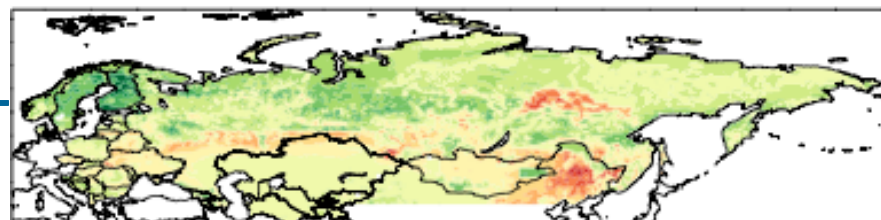
LULCC ALONE



FIXED EFFECTS



LINEAR COMBINATION



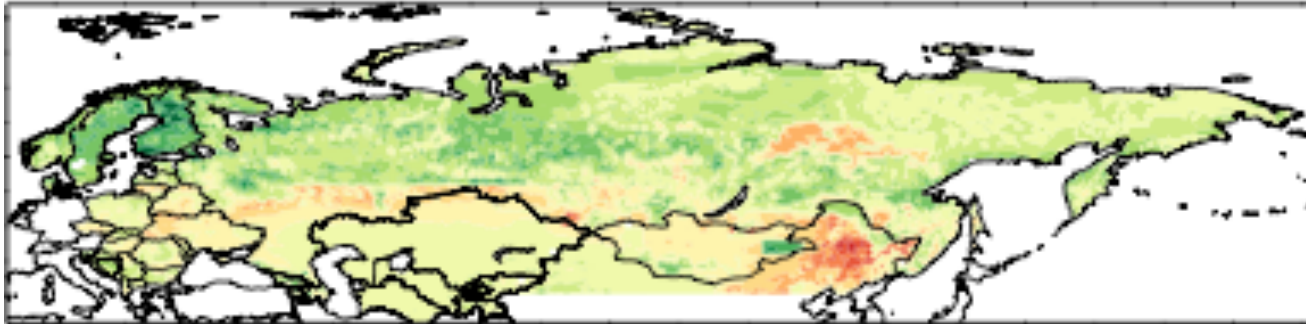
RESIDUAL



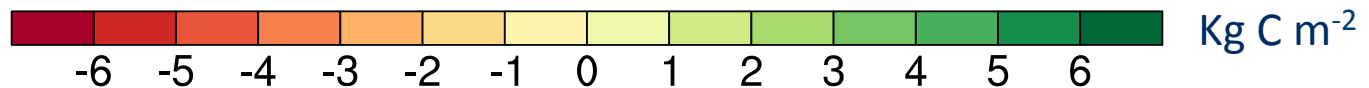
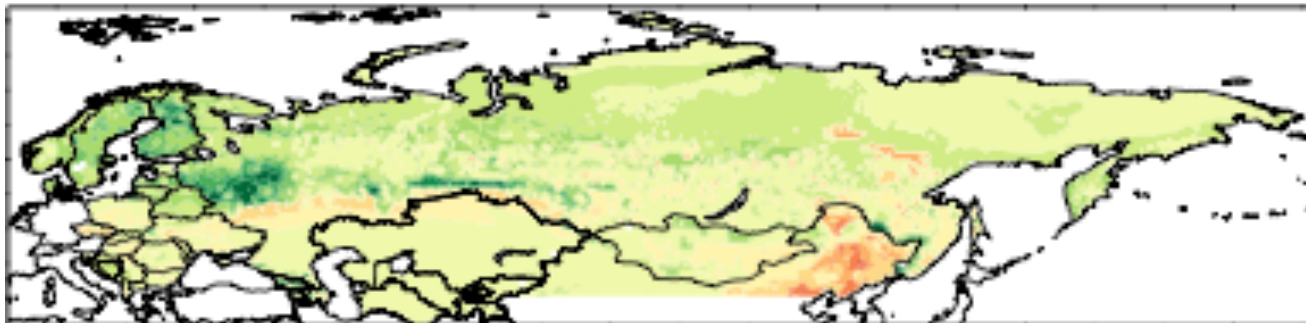
Full simulation

CUMULATIVE NET CARBON EXCHANGE (2001 to 2100)

RCP8.5



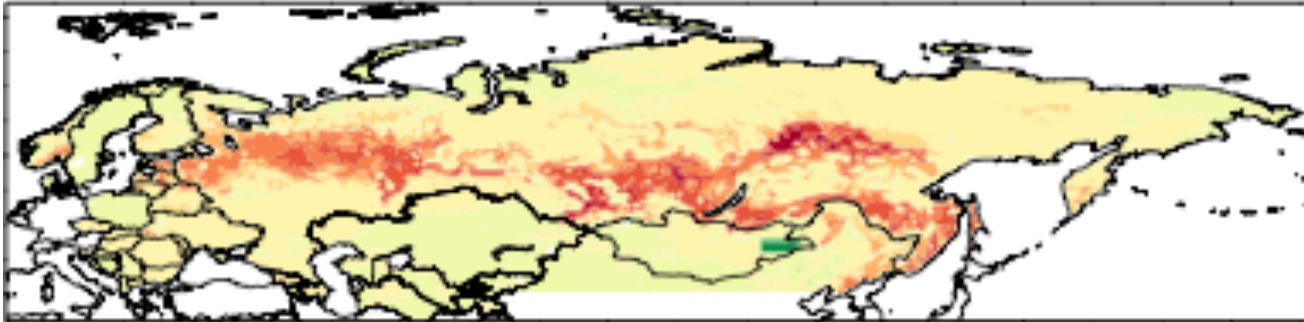
RCP4.5



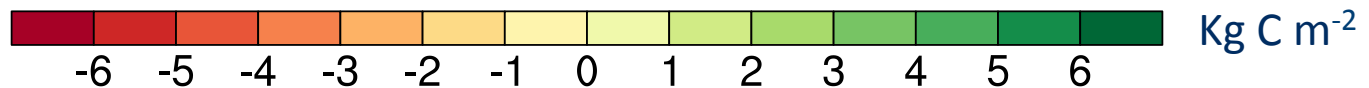
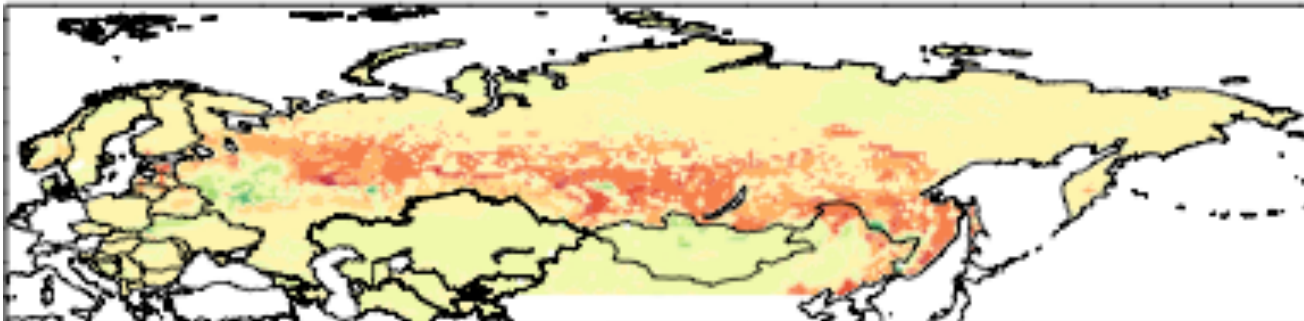
Land use land cover change

CUMULATIVE NET CARBON EXCHANGE (2001 to 2100)

RCP8.5



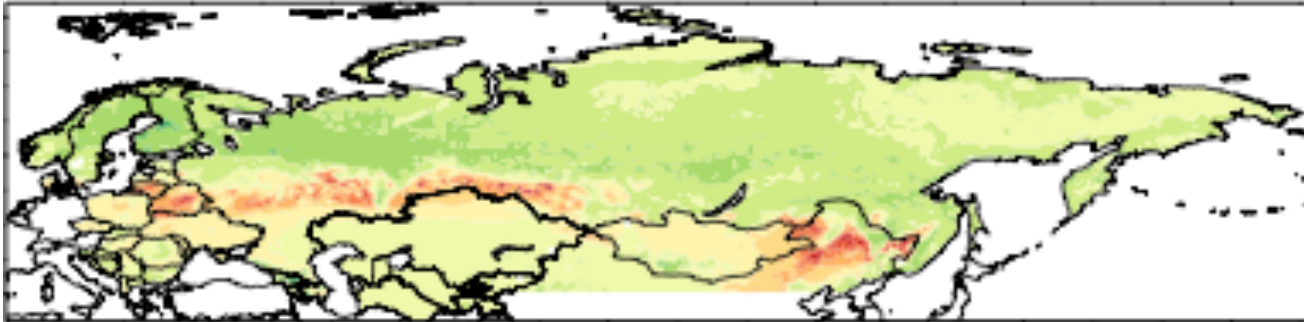
RCP4.5



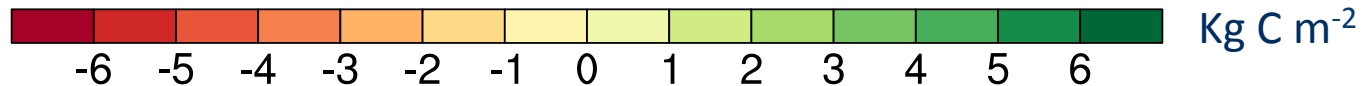
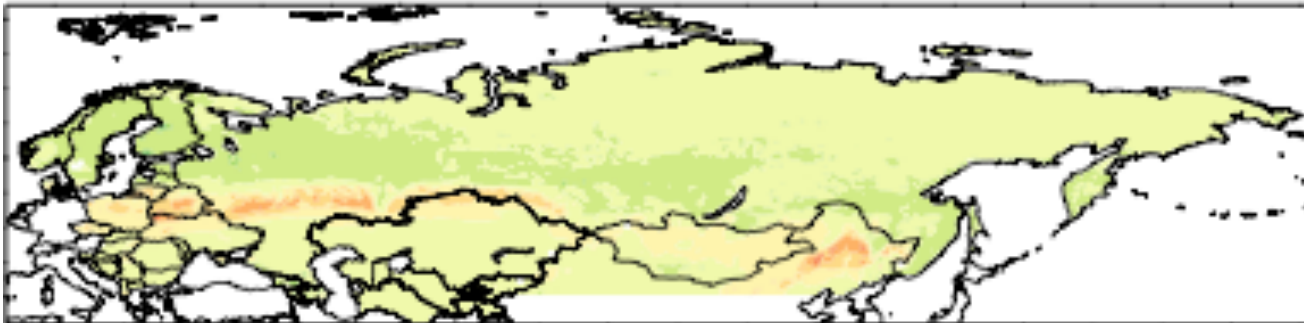
Climate change

CUMULATIVE NET CARBON EXCHANGE (2001 to 2100)

RCP8.5



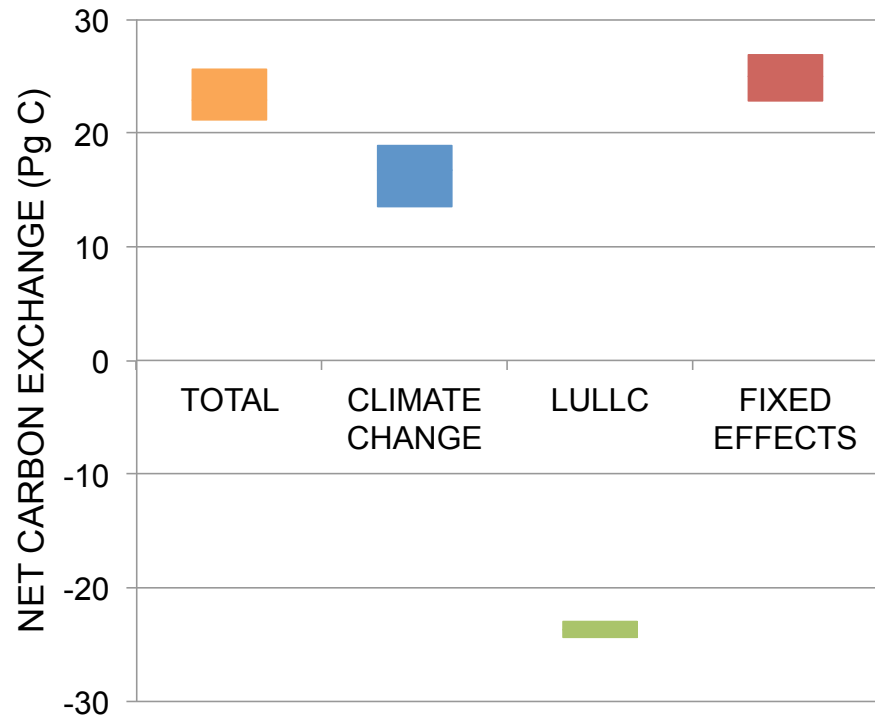
RCP4.5



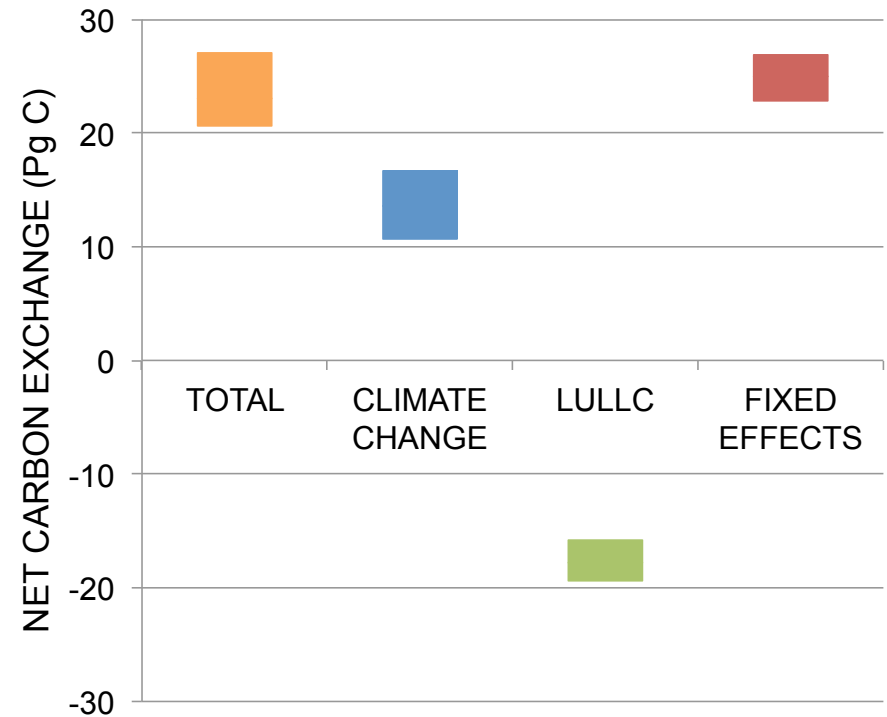
Summary

CUMULATIVE NET CARBON EXCHANGE (2001 to 2100)

RCP8.5



RCP4.5



Conclusions

Attribution of future carbon cycle over Northern Eurasia:

- Impact of land use land cover change
- Impact of climate change
- Fixed effects

Climate change is associated with a release of carbon at the southern edge of the boreal forest, and an uptake northward

-> net sink of carbon

Land use land cover change is associated with a release of carbon from secondary forests

-> net source of carbon

Fixed effects (no climate change, no land use change) are associated with uptake from secondary forests

These estimates highlight the large and opposite contributions from climate change and land use change

-> need to better understand the linkages between climate change and land use change

Acknowledgments

This work is funded by the NASA Land-Cover / Land-Use Change Program and by the US Department of Energy, Office of Biological and Environmental Research.

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THANK YOU
ANY QUESTIONS?