

Influence of Climate-induced Vegetation Shifts on Future Land Use and Associated Land Carbon Fluxes

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Climate-induced Land-cover Changes

Succession



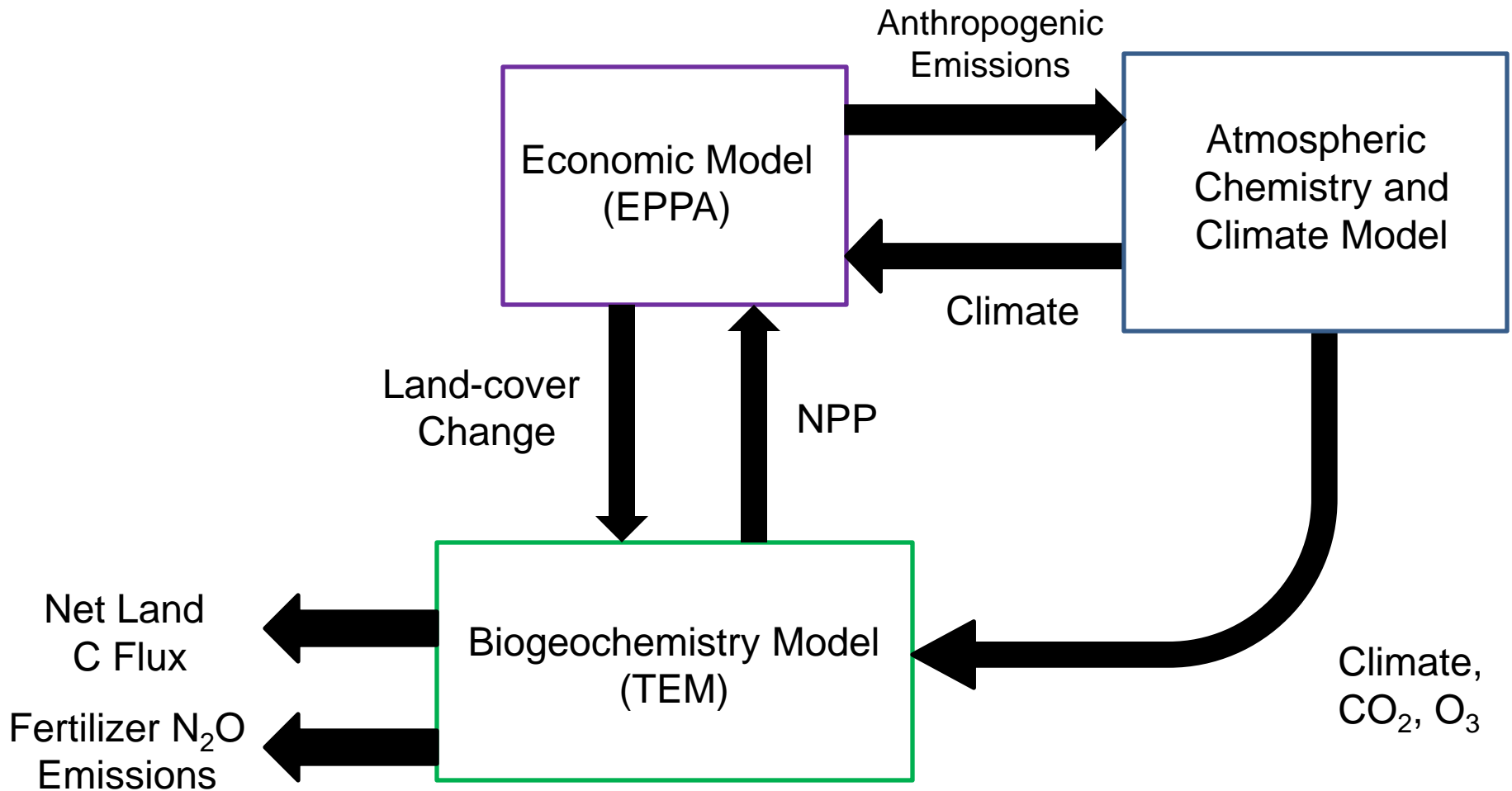
Disturbance

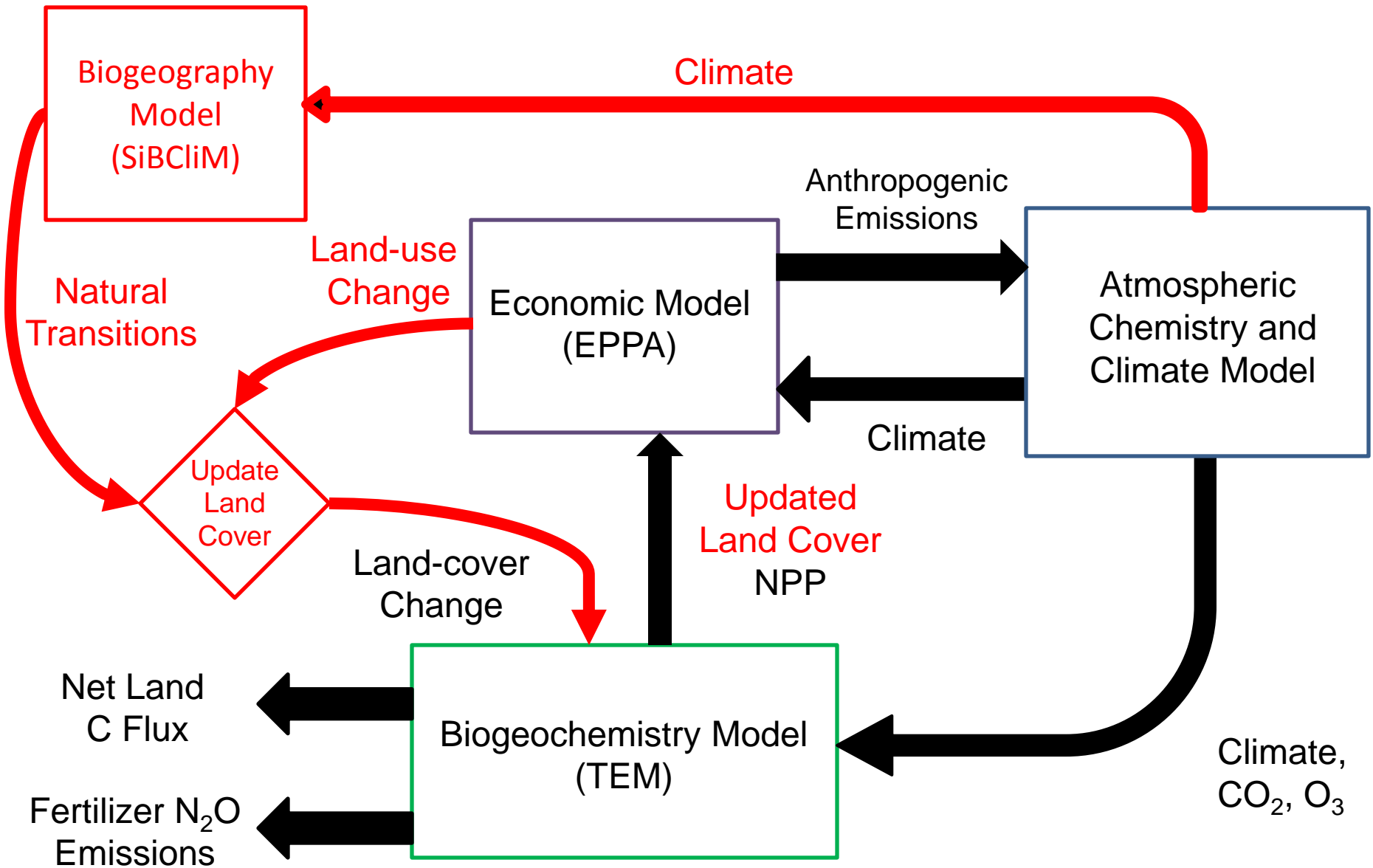


New Land-use Opportunities?

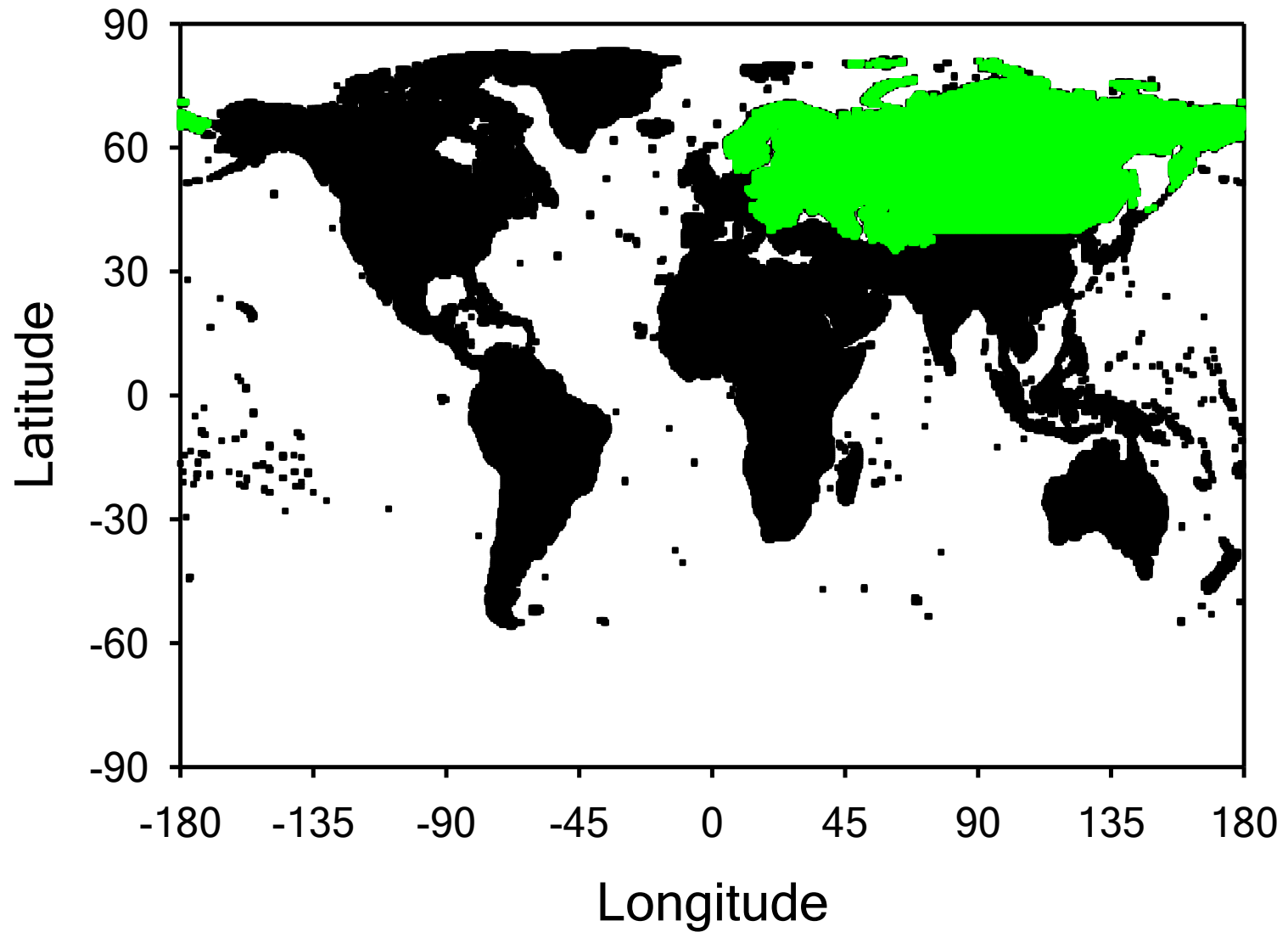


General Approach





Northern Eurasia

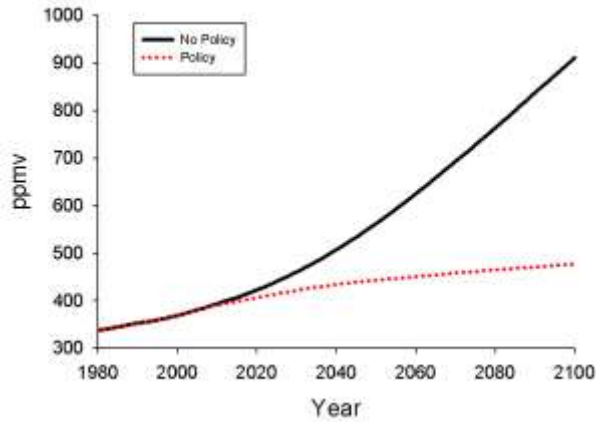


Fire & Vegetation Shifts

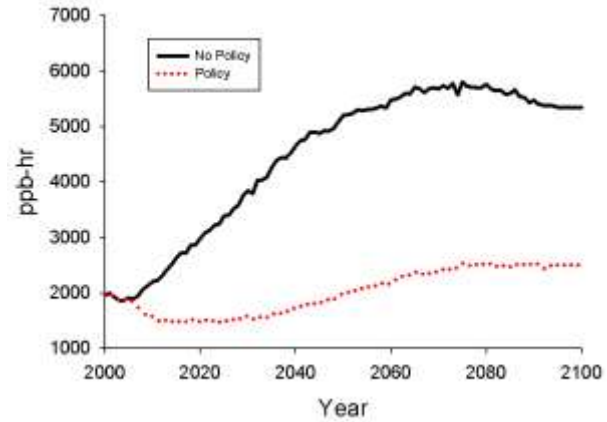
New Vegetation Type	Old Vegetation Type										
	Tundra	Needle-leaf Evergreen Forest-Tundra	Needle-leaf Deciduous Forest-Tundra	Needle-leaf Evergreen Taiga	Needle-leaf Deciduous Taiga	Boreal Birch Subtaiga/Temperate Broadleaf	Temperate Mixed Forest	Forest-Steppe Boreal	Forest-Steppe Temperate	Steppe Boreal, Temperate	Semi-Desert/Desert
Tundra	No Change	Fire	Fire	Fire	Fire	Fire	Fire	Fire	Fire	Fire	Succession
Needle-leaf Evergreen Forest-Tundra	Succession	No Change	Succession	Fire	Fire	Fire	Fire	Succession	Succession	Succession	Succession
Needle-leaf Deciduous Forest-Tundra	Succession	Fire	No Change	Fire	Fire	Fire	Fire	Succession	Succession	Succession	Succession
Needle-leaf Evergreen Taiga	Succession	Succession	Succession	No Change	Succession	Succession	Succession	Succession	Succession	Succession	Succession
Needle-leaf Deciduous Taiga	Succession	Fire	Succession	Fire	No Change	Fire	Fire	Succession	Succession	Succession	Succession
Boreal Birch Subtaiga/Temperate Broadleaf	Succession	Fire	Fire	Fire	Fire	No Change	Fire	Succession	Succession	Succession	Succession
Temperate Mixed Forest	Succession	Succession	Succession	Fire	Fire	Succession	No Change	Succession	Succession	Succession	Succession
Forest-Steppe Boreal	Fire	Fire	Fire	Fire	Fire	Fire	Fire	No Change	Succession	Succession	Succession
Forest-Steppe Temperate	Fire	Fire	Fire	Fire	Fire	Fire	Fire	Succession	No Change	Succession	Succession
Steppe Boreal, Temperate	Fire	Fire	Fire	Fire	Fire	Fire	Fire	Fire	Fire	No Change	Succession
Semi-Desert/Desert	Fire	Fire	Fire	Fire	Fire	Fire	Fire	Fire	Fire	Fire	No Change

Fire assumed to be associated with 62 vegetation transitions!

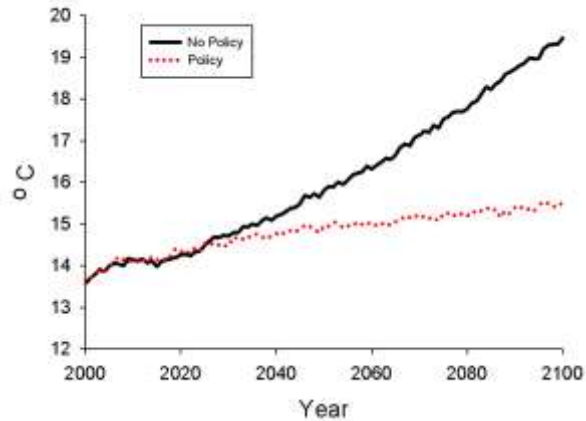
a) Atmospheric CO₂ concentrations



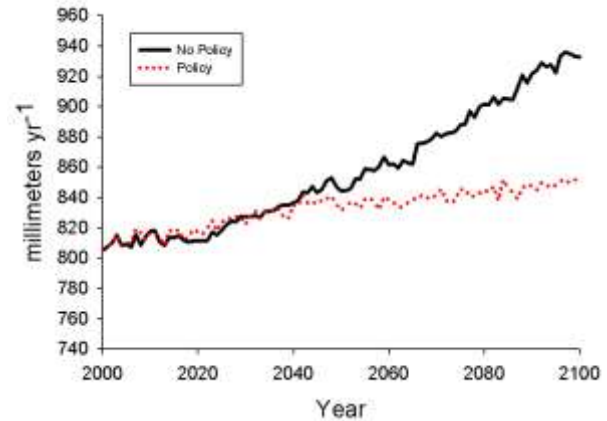
b) AOT40 ozone index



c) Global mean air temperature



d) Global mean precipitation



Shifts of Natural Vegetation in Northern Eurasia (2000-2100)

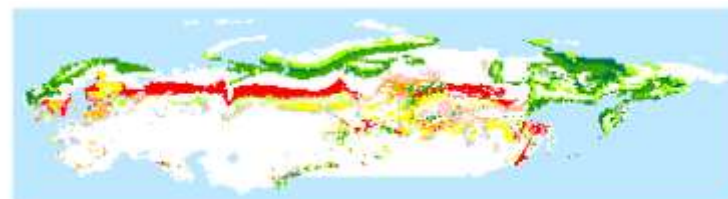
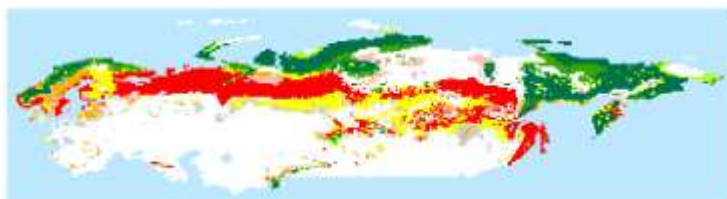
No Policy

Policy

Tundra



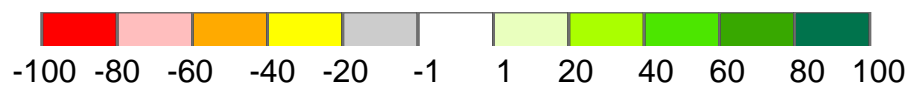
Boreal Forests



Grasslands

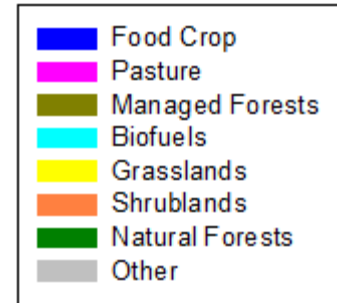
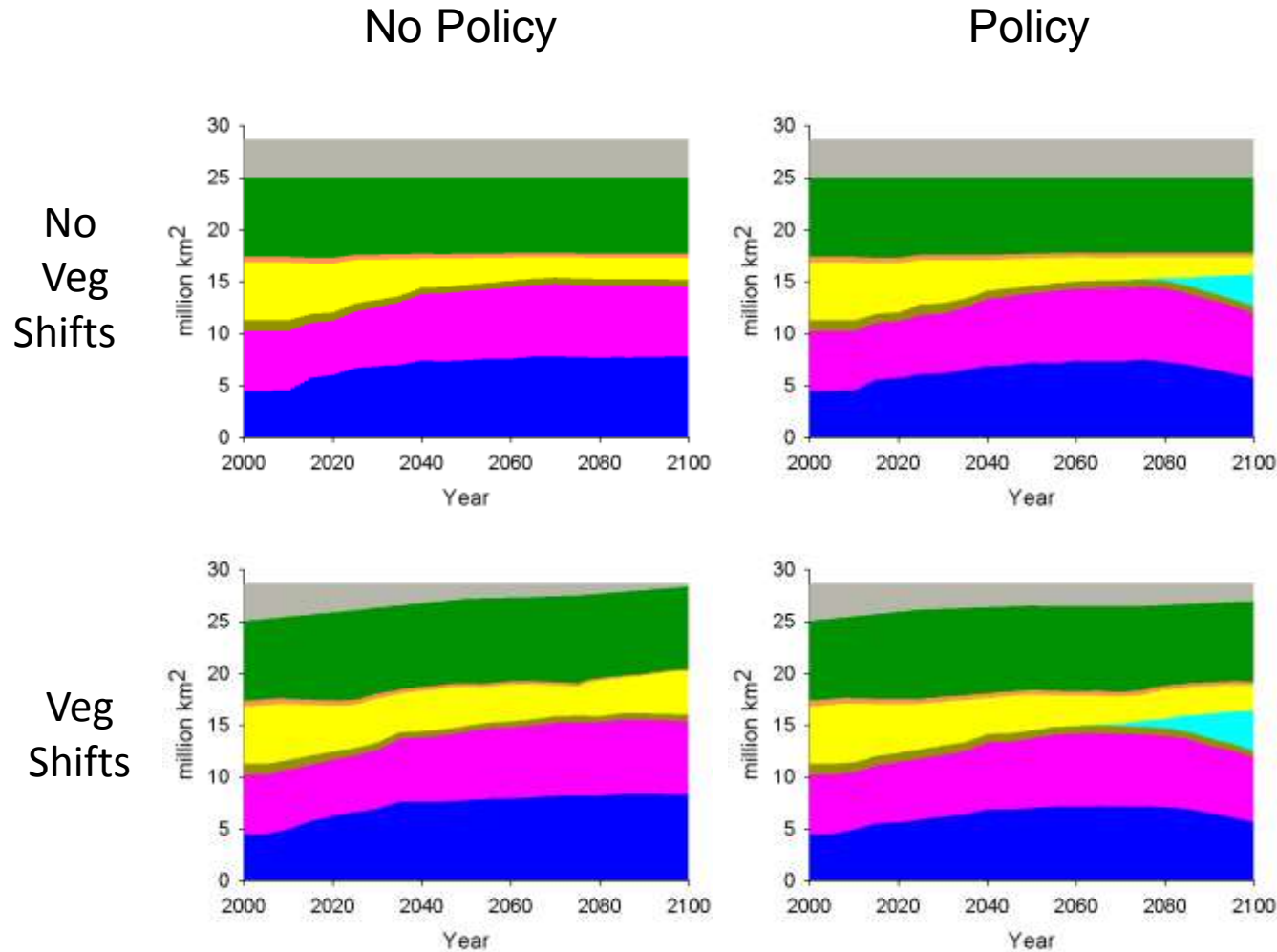


Temperate Forests

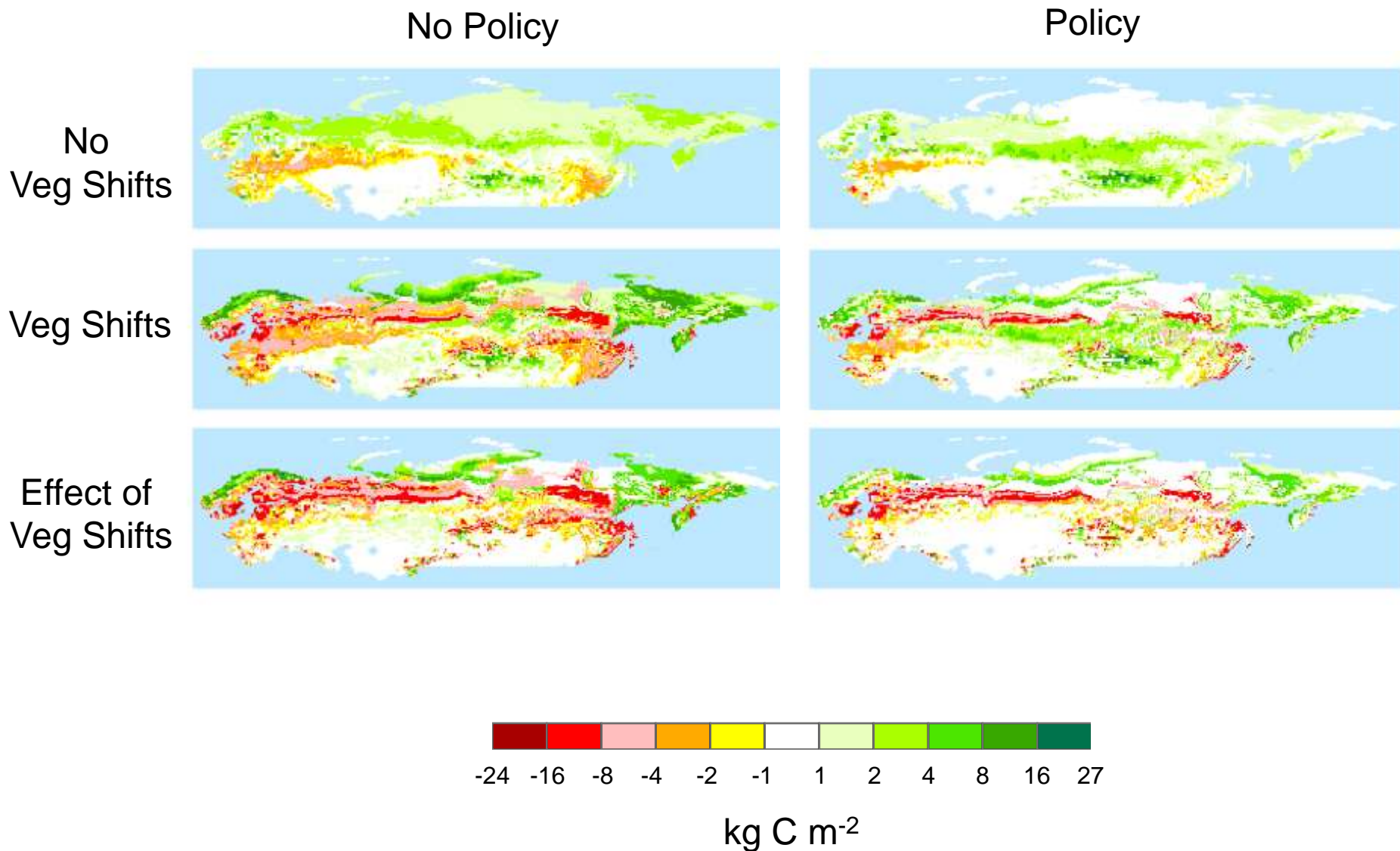


Percent

Land-cover and Land-use Change in Northern Eurasia 2000-2100



Distribution of Land Carbon Gain/Loss in Northern Eurasia 2000-2100

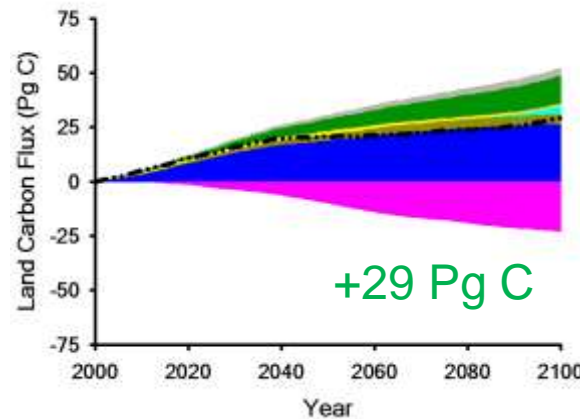
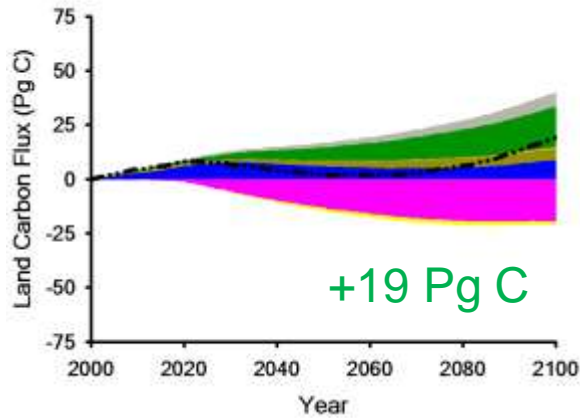


Net Land Carbon Flux - Northern Eurasia

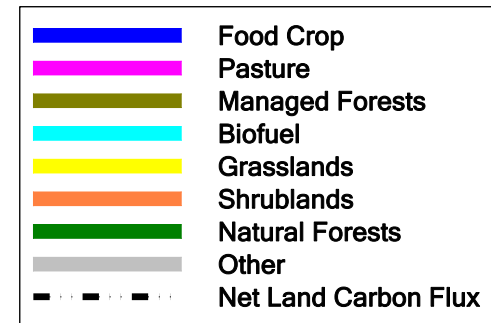
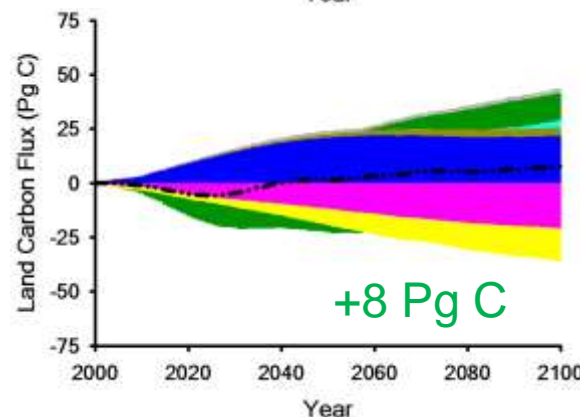
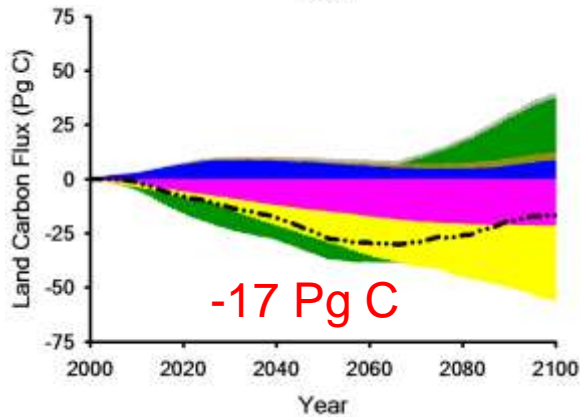
No Policy

Policy

No Veg Shifts



Veg Shifts

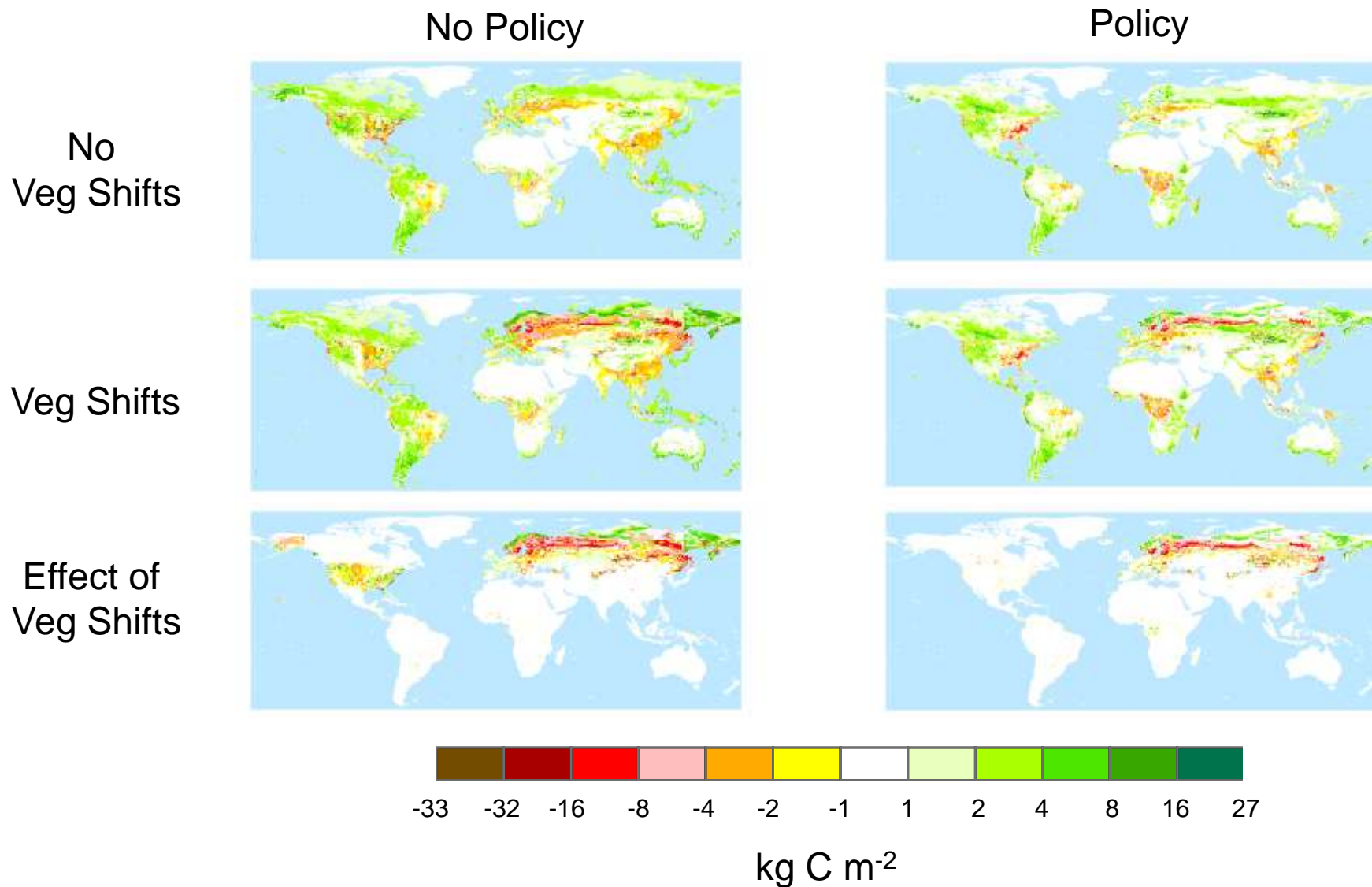


Positive – C sequestered

Negative – C lost

Distribution of Land Carbon Gain/Loss across Globe

2000-2100



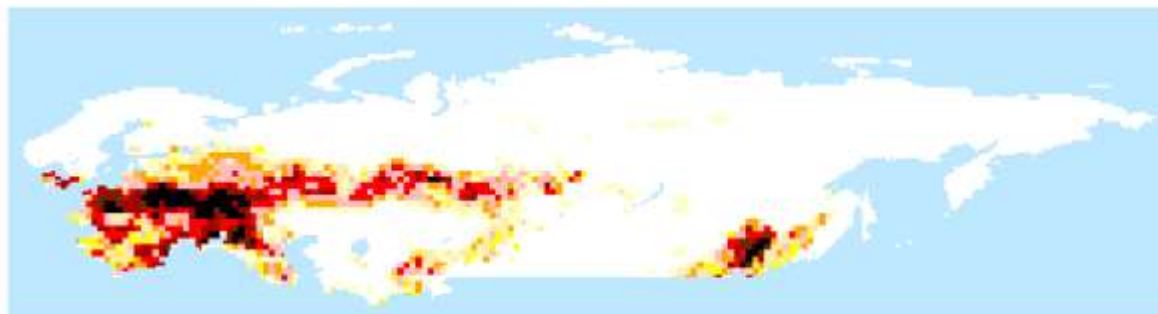
Conclusions

- **Climate-induced vegetation shifts in Northern Eurasia**
 - Decreases area of tundra and boreal forests
 - Increases area of temperate forests and grasslands
- **Impacts of vegetation shifts on managed lands**
 - Allows ~6% expansion of food crops and pastures with No Policy
 - Allows ~25% expansion of biofuels with Policy
- **Impacts of vegetation shifts on terrestrial carbon fluxes**
 - Enhances carbon emissions from some areas and enhances carbon sequestration in other areas
 - Overall, decreases the terrestrial carbon sink by 72% or creates a carbon source in Northern Eurasia over the 21st century
 - Overall, decreases the global terrestrial carbon sink by 27-41%
 - Effect of wildfires on carbon budgets from vegetation shifts in Northern Eurasia cannot be ignored

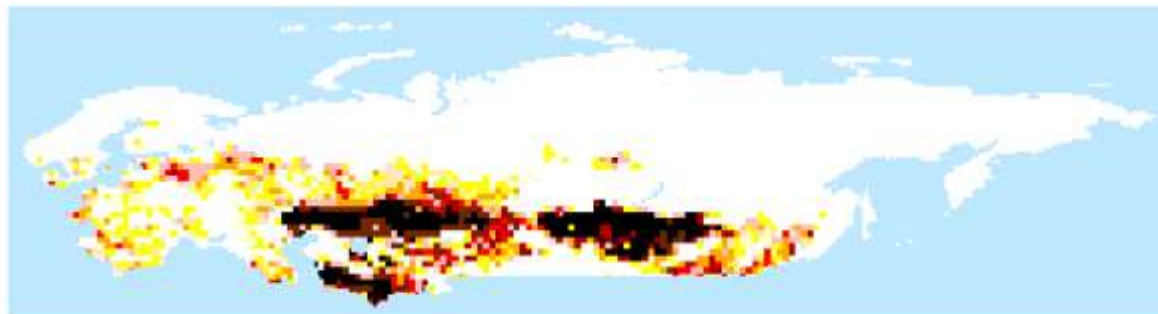
Thank-you!

Distribution of Land use in Northern Eurasia during year 2000

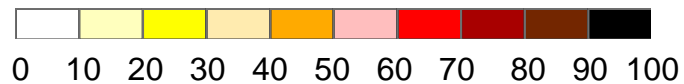
Food Crops



Pasture



Managed Forests



Percent

Difference in Land Use due to Veg Shifts in Northern Eurasia 2000-2100

