Geophysical Fluid Dynamics Laboratory Review

June 30 - July 2, 2009

Effects of Land Use on Climate

Presented by

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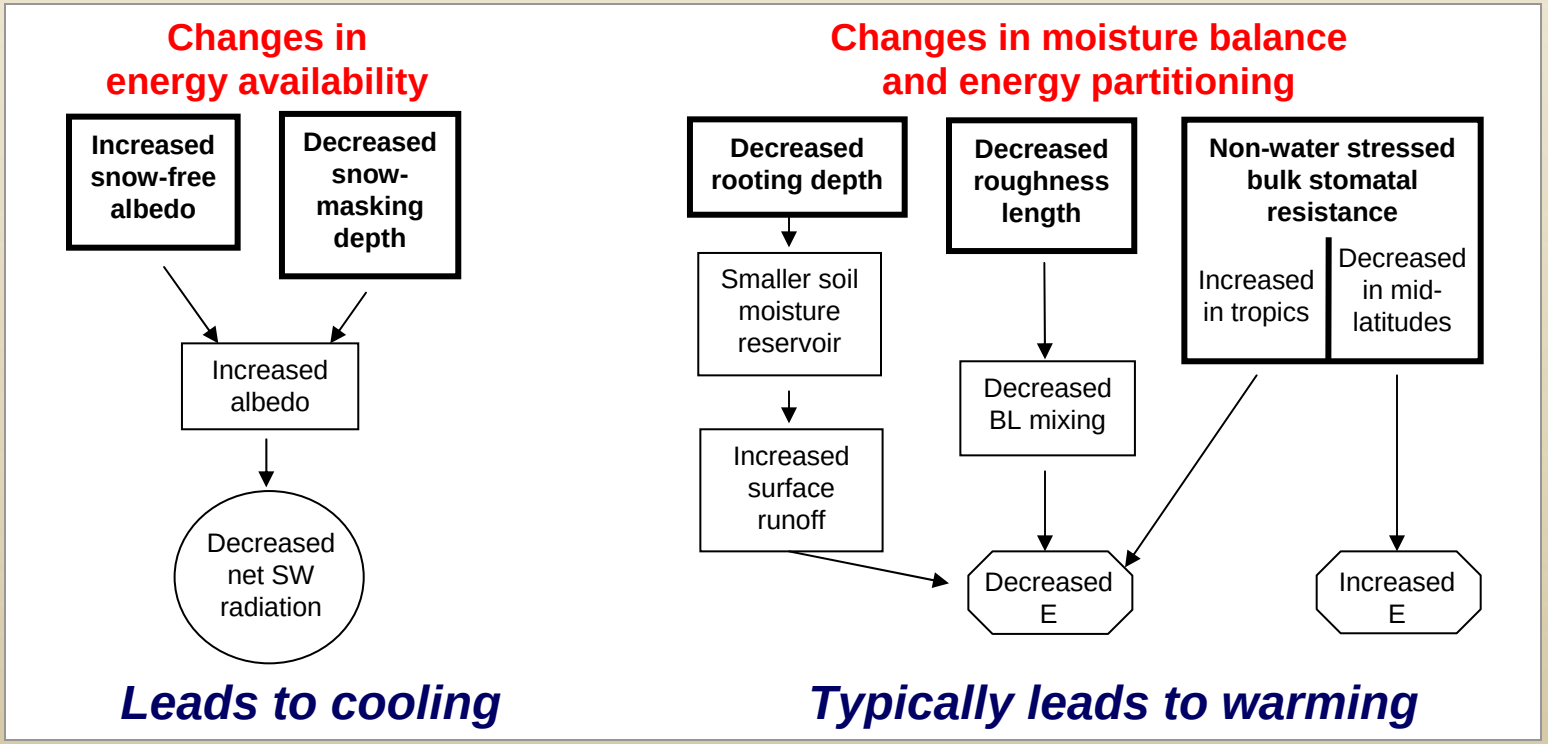
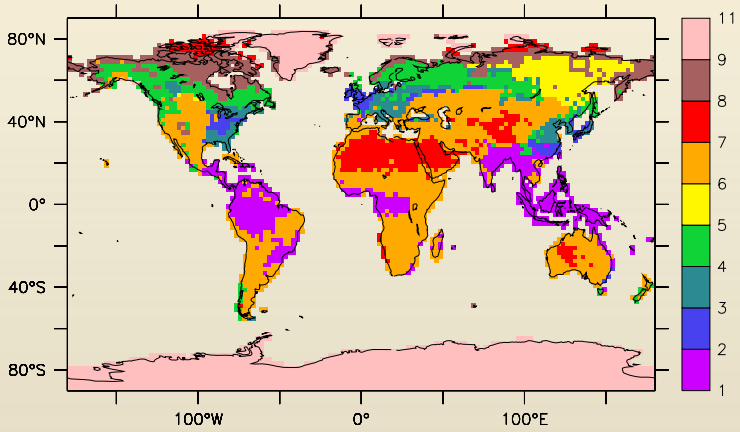
Why do models respond so differently to Land Cover Change (LCC)?

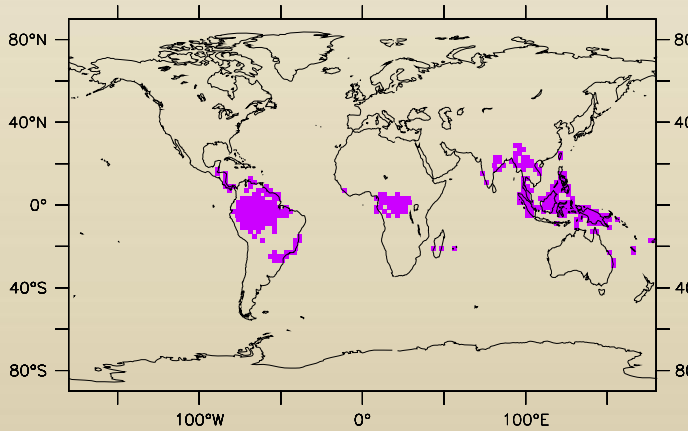
- Land use impacts the amount and partitioning of available energy at the earth's surface.
- Model response is dependent on weighting of various parameter changes.
- In our model (LM2), a change from forest to grassland leads to:



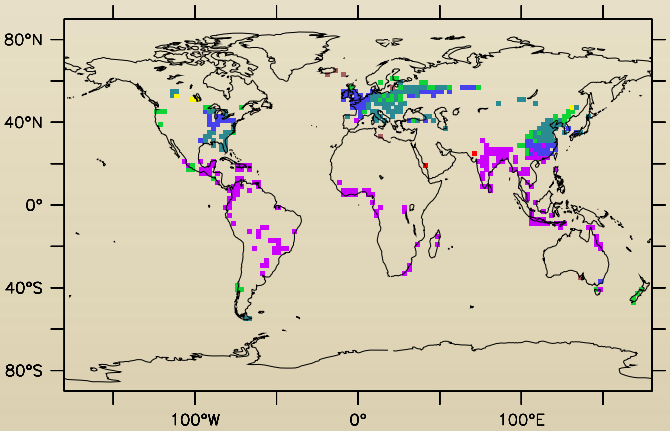
Land Cover Disturbances

Pre-anthropogenic land cover distribution





Tropical deforestation experiment

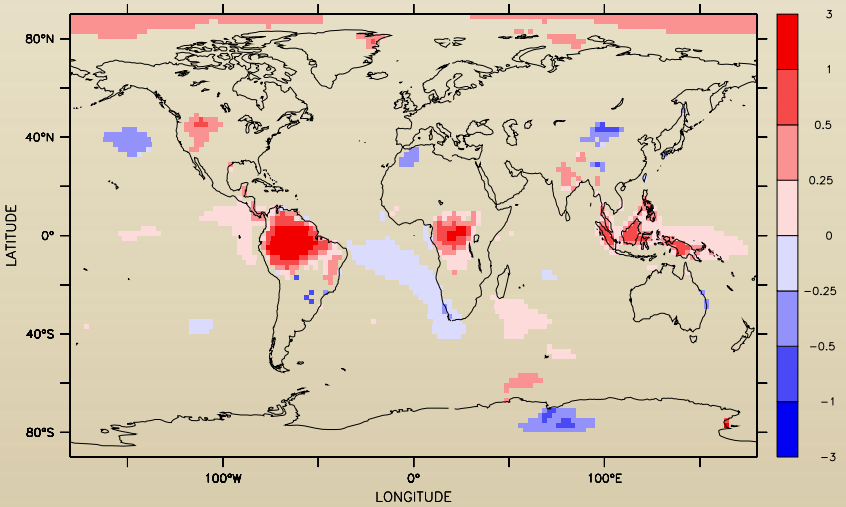


Historical land cover change experiment

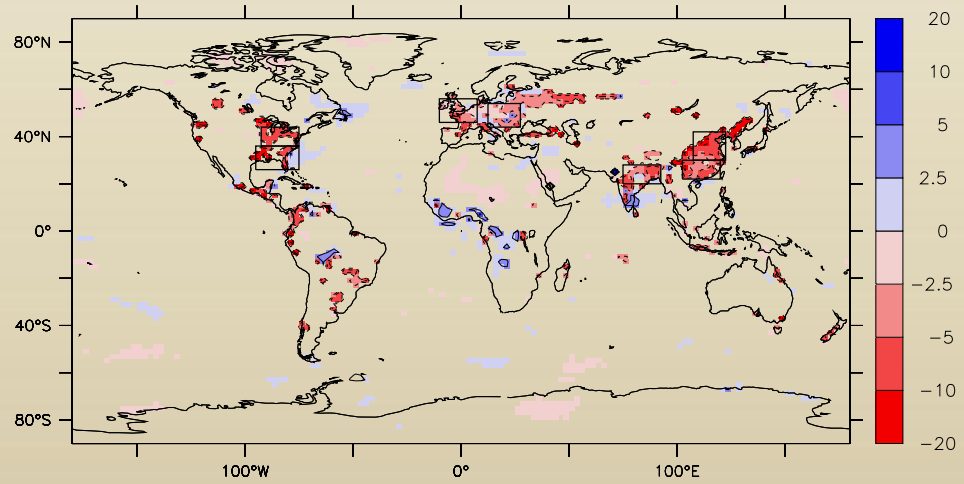
Experiments discussed in Findell et al. (2006, 2007, 2009)

Strong local response, weak remote response

- Local responses to both perturbations are generally significant
  - Less R_{net}, less evaporation, higher temperatures
  - Rainfall response not homogeneous
- Remote responses do not pass field significance tests
- Some globally and annually averaged fields do pass significance tests because of the strong local responses



Deforest – Control, Annual 2m air temperature

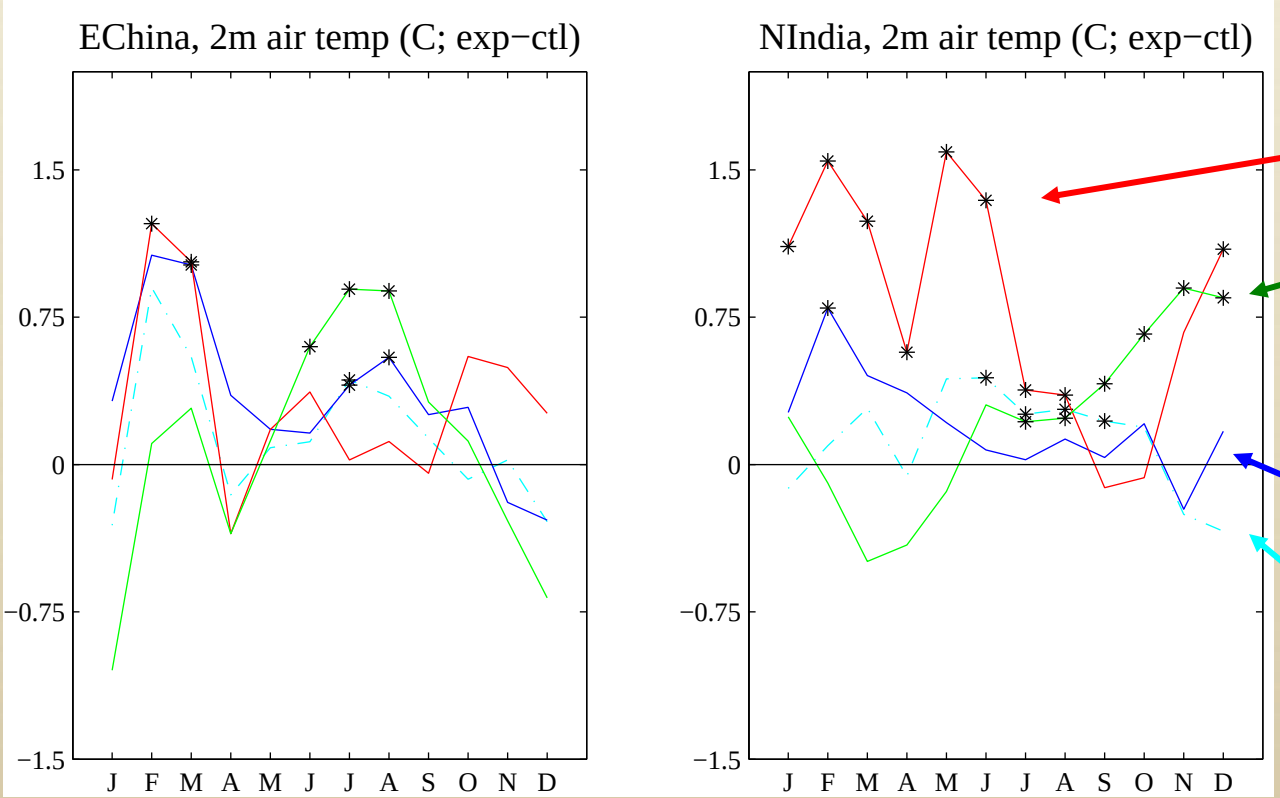


Change in annual net radiation (W/m^2), 1990-NatVeg

Strong local response

In many regions:

Local response to LCC on par with response to a warm Pacific, larger than response to a warm North Atlantic or a warm global Trend pattern



Conclusions

- LCC is important to include in climate-related experiments
- Regional impacts can be statistically significant and as large as other well-known forcing factors
- Impacts are especially important for water-balance considerations since fields like runoff, soil moisture, and evaporation can be so heavily affected
- Remote responses do not pass field significance tests
  - Argues against LCC-induced teleconnections, even for large perturbations like complete tropical deforestation
- Model limitations:
  - The experiments discussed here used LM2: only considered biophysical impacts of LCC.
  - Subsequent experiments will use LM3: improved biophysical representations, and eventually, the carbon cycle

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