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Afforestation Scenarios

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August 6, 2014

Aspen, Colorado

- ▶ How do IAMs achieve afforestation?
- ▶ How did we do in CMIP5?
- ▶ What can we expect from IAMs in CMIP6?
- ▶ How can we improve on CMIP5?



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How do IAMs achieve afforestation?

Two means of afforestation

- ▶ Cropland or pastureland abandonment
 - If cropland or pasture is abandoned on potentially forested land, then forest will naturally regrow.

- ▶ Explicit effort to increase forest cover
 - Usually achieved through either an economic or a command & control policy.
 - Either implicitly or explicitly includes management (e.g., planting, watering, fertilizing, etc.)



“Planting trees for climate”



Frequent Flyer?

Plant a tree for all the carbon you emit flying miles above the ground.

- ▶ 1 Tonne of carbon is generated every 16 hours spent in flight



Save the Planet



Plant a tree!



- ▶ There are policies that aim to increase forest cover today (e.g., REDD+).
- ▶ There are case studies at a small scale that incentivize land use change through monetary instruments.
- ▶ However, realism of global economic policies to change land cover is debatable.
 - Requires (1) identification of land owners, (2) transfer of potentially large sums of money, (3) measuring, monitoring, reporting, verification
 - May only be consistent with an SSP1 world
- ▶ Additionally, we aren't sure how well these trees will grow, or what their total effect on climate is.

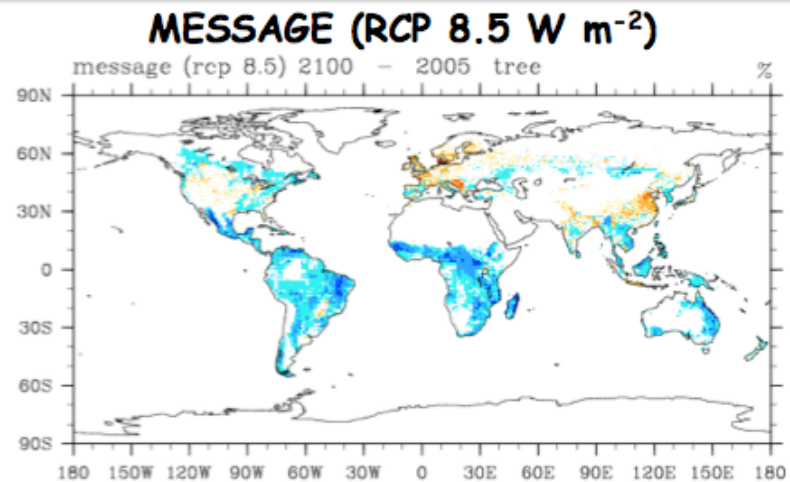
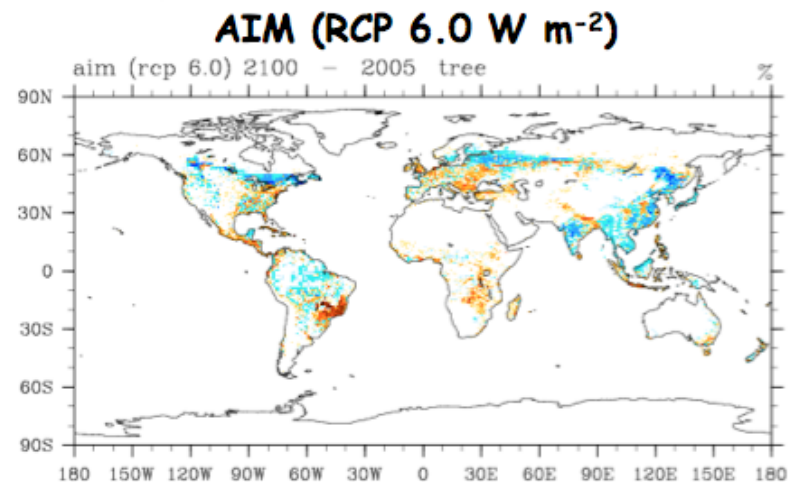
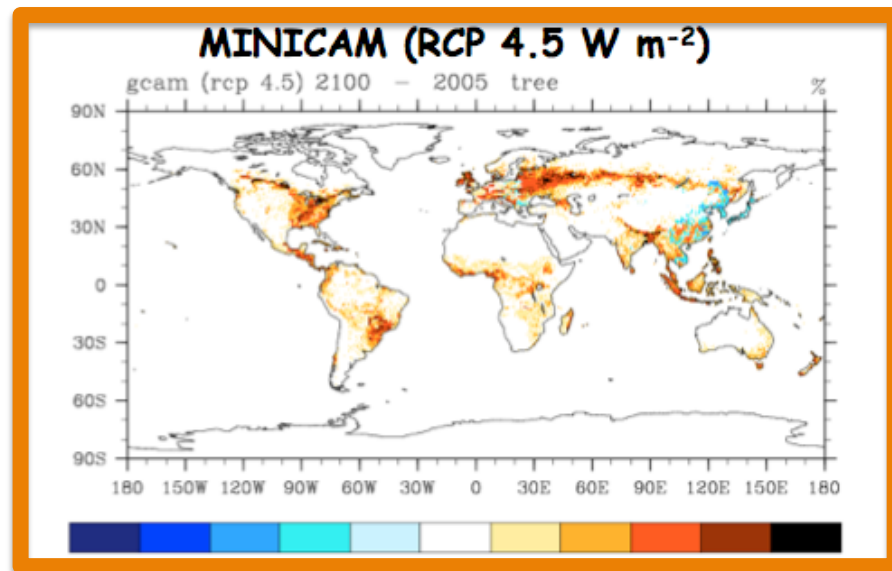
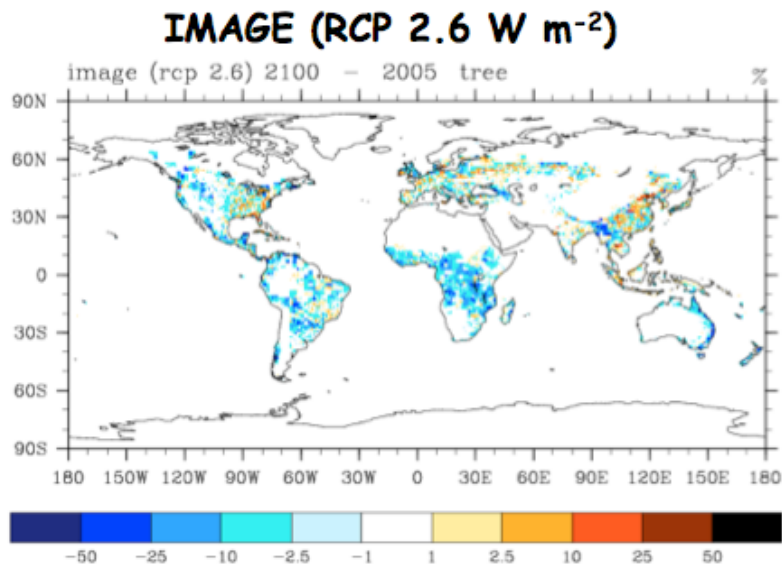


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How did we do in CMIP5?

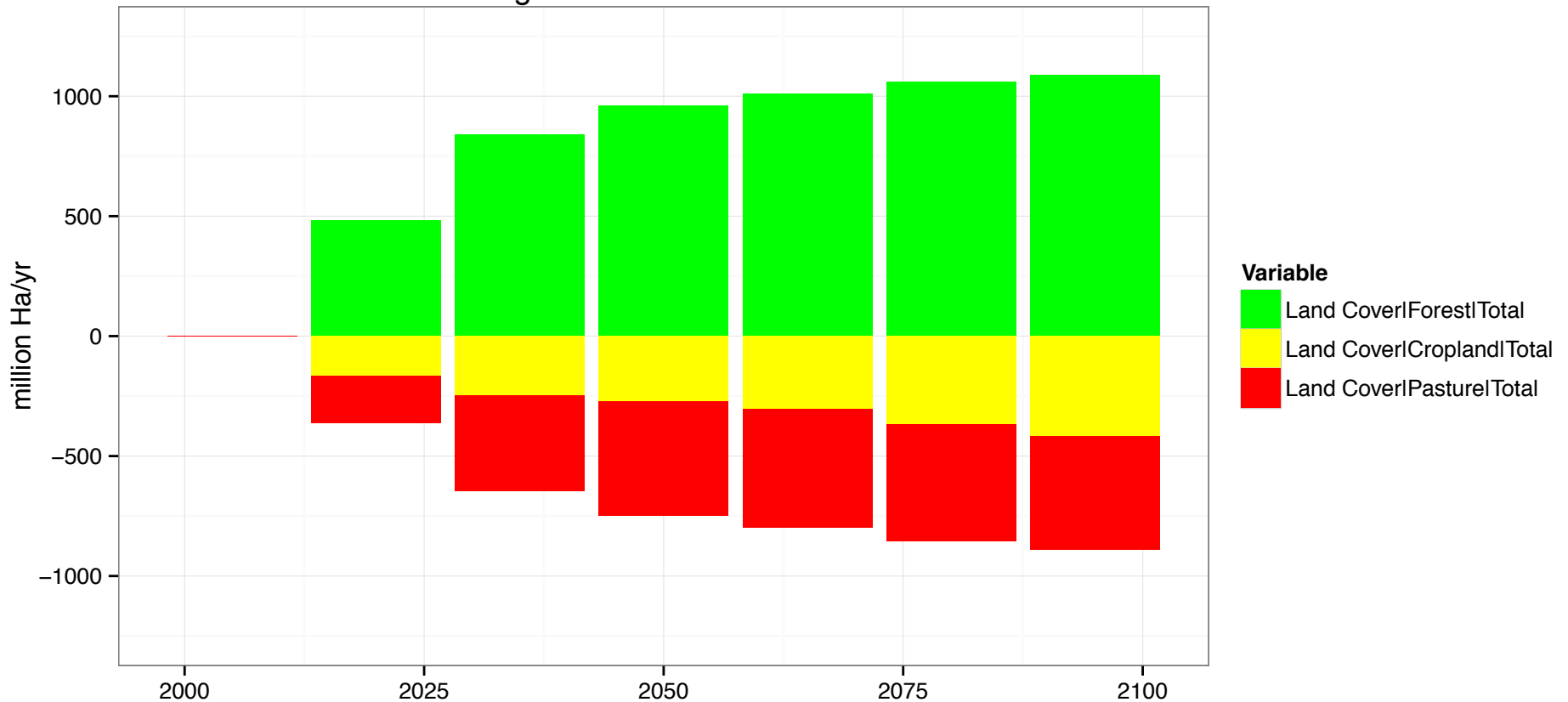
Land Cover Change in the RCPs



Lawrence, P. J., J. J. Feddema, G. B. Bonan, G. A. Meehl, B. C. O'Neill, S. Levis, D. M. Lawrence, K. W. Oleson, E. Kluzek, K. Lindsay, and P. E. Thornton (2011), Simulating the Biogeochemical and Biogeophysical Impacts of Transient Land Cover Change and Wood Harvest in the Community Climate System Model (CCSM4) from 1850 to 2100, *Journal of Climate*.

Land Cover Change in the RCP4.5

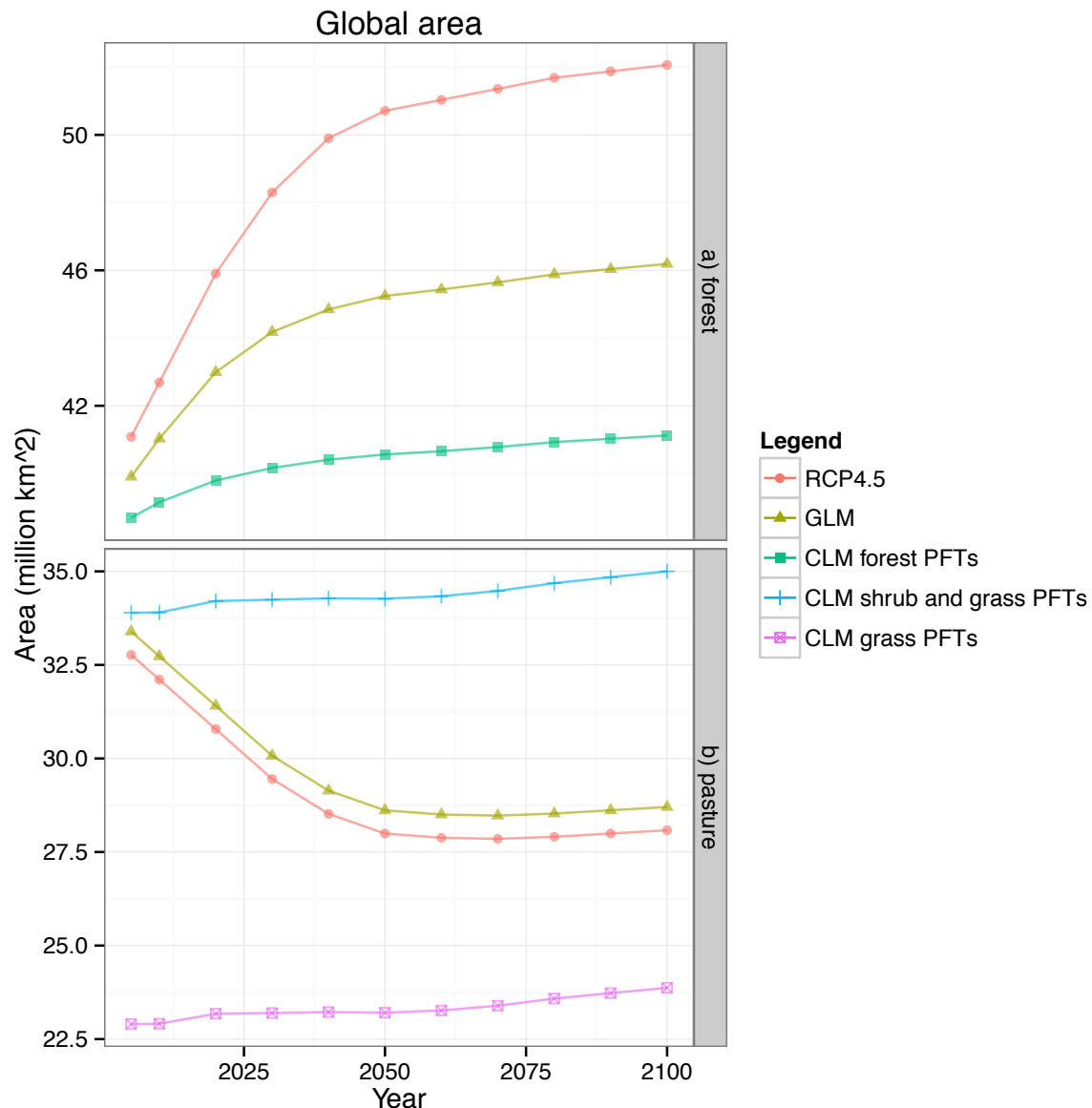
Change in land cover from 2005



Note: this is IAM output, pre-harmonization

Implementation in the RCPs

- ▶ Original RCP4.5 had an increase in forest area of 11 million km² between 2005 and 2100.
- ▶ Only 22% of that increase was captured in CLM.



Source: Di Vittorio et al. (in review). From land use to land cover: Restoring the afforestation signal in a coupled integrated assessment - earth system model and the implications for CMIP5 RCP simulations. *Biogeosciences*.



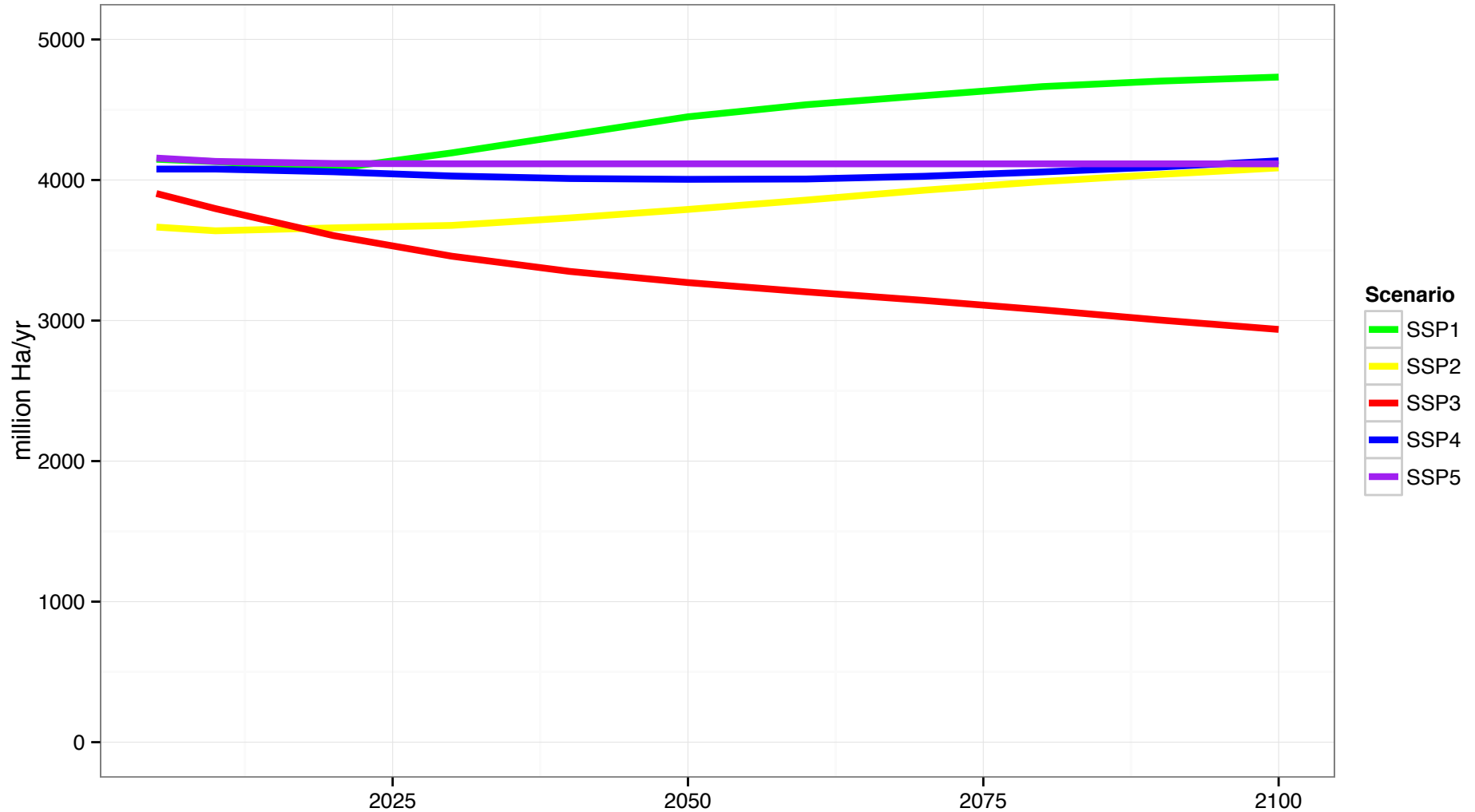
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What can we expect from IAMs in CMIP6?

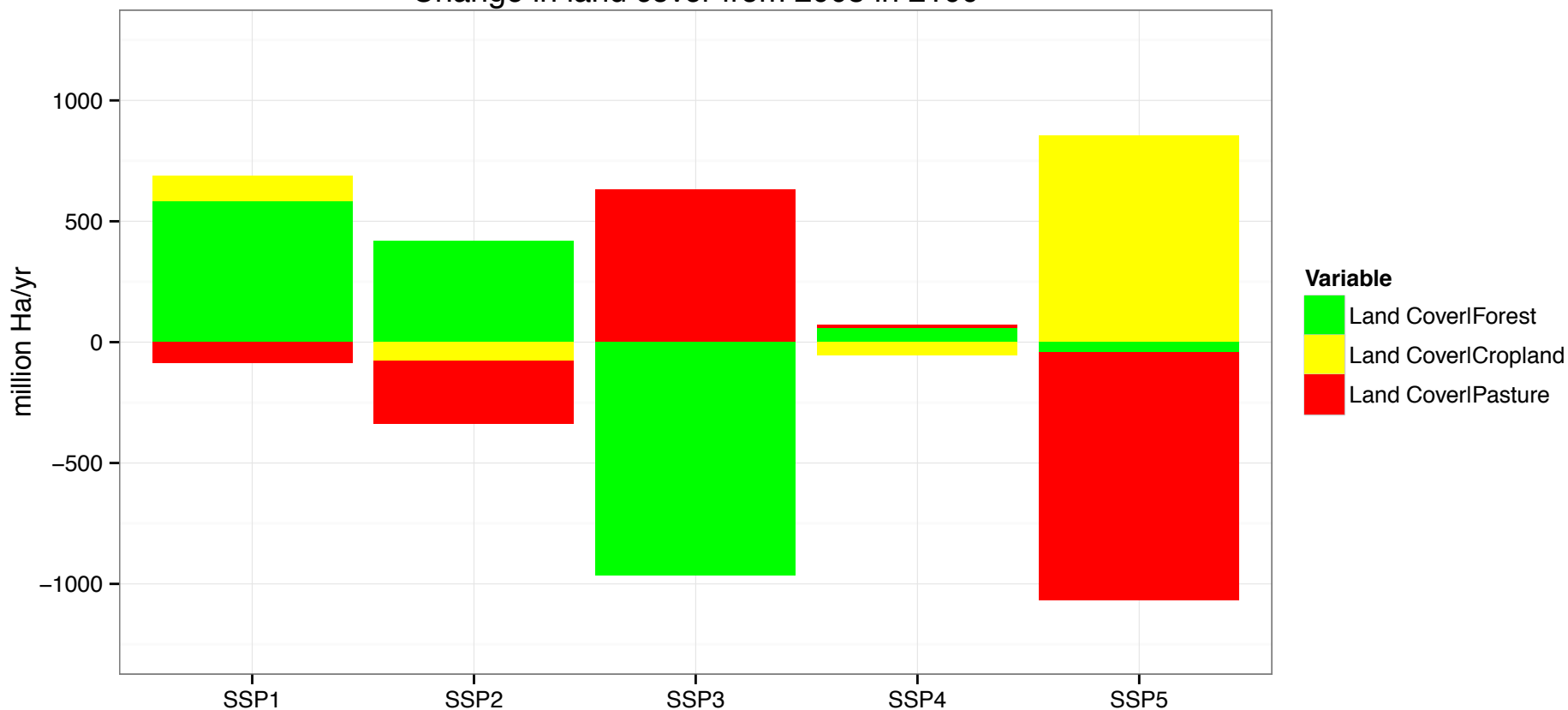
Forest Cover in the SSP-RCP4.5 Scenarios

Global Forest Cover



Land Cover Change in the SSP-RCP4.5 Scenarios

Change in land cover from 2005 in 2100





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How can we improve on CMIP5?

How can we improve on CMIP5?

- ▶ Systematic survey of how CMIP5 models implemented the land use and how their land use/land cover compares to the original IAM realizations.
- ▶ Provide more information:
 - Land use & land cover
 - Wood harvest quantity and area
- ▶ Increase interactions between ESM modelers and IAM modelers.



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DISCUSSION