Carbon cycle and vegetation dynamics during interglacials within MPI-ESM

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summary

Results out of two transient paleo model experiments[1,2] based on the MPI Earth System Model (MPI-ESM) are presented showing the vegetation and carbon response to orbital forcing within the Holocene (6K→0K) and the Eemian (125K→124K).

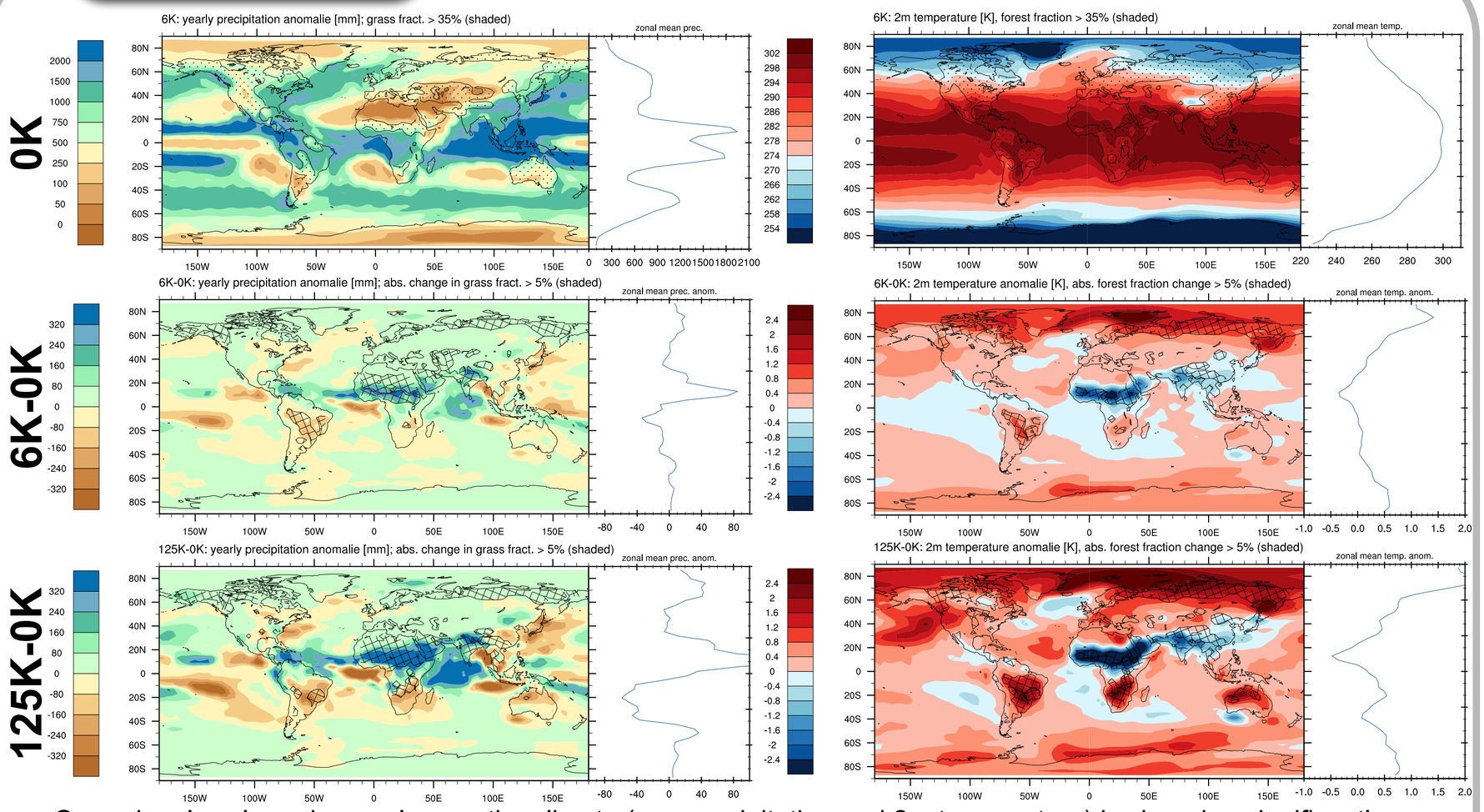
Conclusions:

- The model results show reasonable patterns for temperature and precipitation changes (compared to present day climate).
- Notably is for example the shift of the boreal tree line and the greening of West Africa during both interglacials.
- The signals derived from the Eemian snap-shot simulation feature more pronounced changes but the patterns are similar to the Mid-Holocene results.

(1) Fischer and Jungclaus, Climate of the Past, Volume 6, Issue 2, 2010, pp.155-168

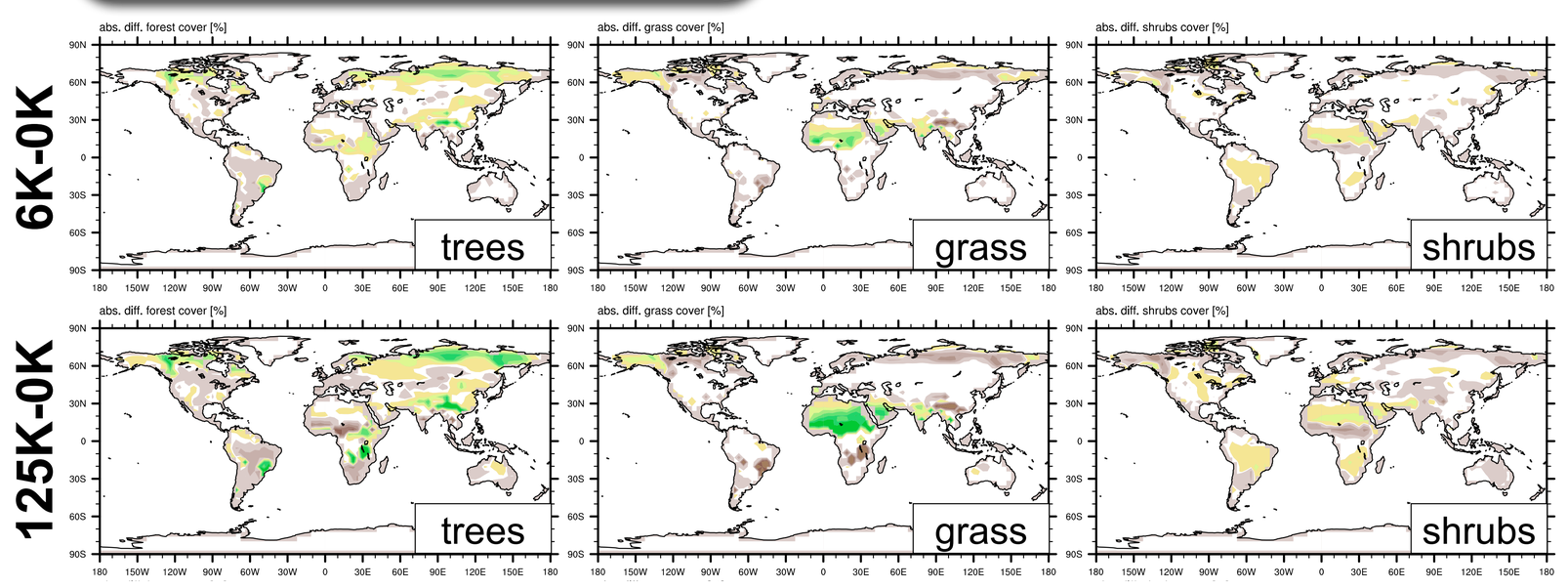
(2) Fischer and Jungclaus, Clim. Past Discuss., 7, 463–483, 2011

climate



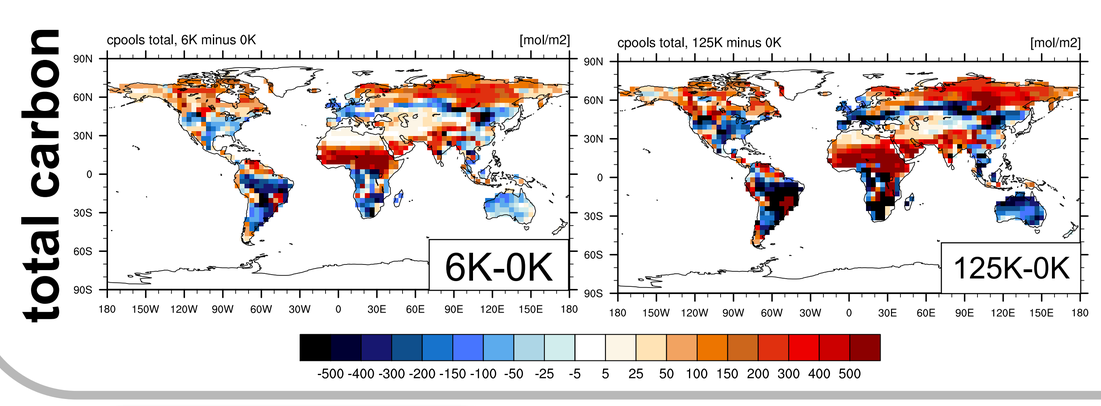
On regional scale and annual mean the climate (e.g. precipitation and 2m temperature) is changing significantly and these trends are much more pronounced on a seasonal basis (not shown). On the global, annual mean scale, these changes are small.

vegetation & carbon



[GT]	Soil	Biomass	Total
0K	1966	517	**2483**
6K	2034	532	**2566**
125K	2010	547	**2557**
6K-0K	68	15	**83**
125K-0K	44	30	**74**

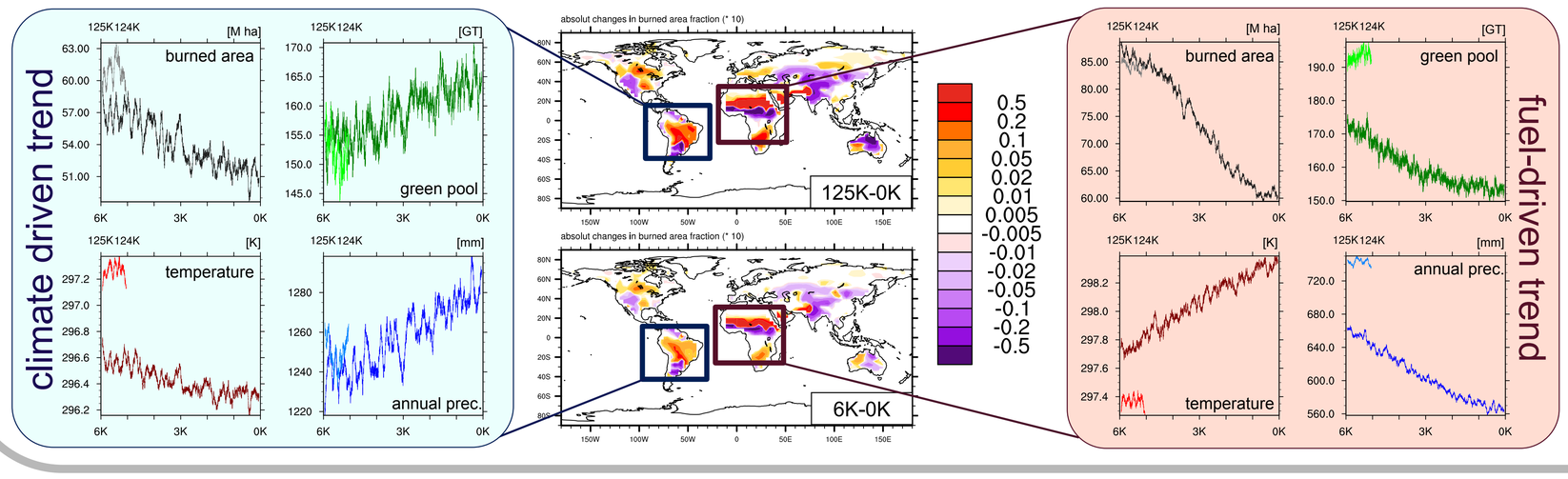
All simulations are based on 280 ppm atmospheric CO_2 (observed: app. 265 ppm for 6K and app. 300 ppm for 125K).



Simulated shifts in vegetation covers resample values from reconstructions. The combination of changes in precipitation and temperature due to the Milanković forcing lead to shifts in the boreal tree line and a higher grass fraction in tropical West Africa.

Compared to present day, the carbon storage on land during the interglacials is higher, mainly in North Africa and the boreal regions. Less carbon storage is simulated for the Amazon and Australia. Interestingly, the values for the Eemian are lower than for the Mid-Holocene, although both simulations have the same atmospheric CO_2 forcing of 280 ppm.

fire



The burned area [M ha] is calculated as a function of moisture and available fuel.

Within the Holocene the trend in South America (left) is driven by precipitation [mm] and by fuel load (green carbon [GT]) in Africa (right).

Remarkably, in these two regions the driving mechanism to control burned area is the same for both interglacials.

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