LPJ model of future biome shifts in the Amazon

Visualization of results

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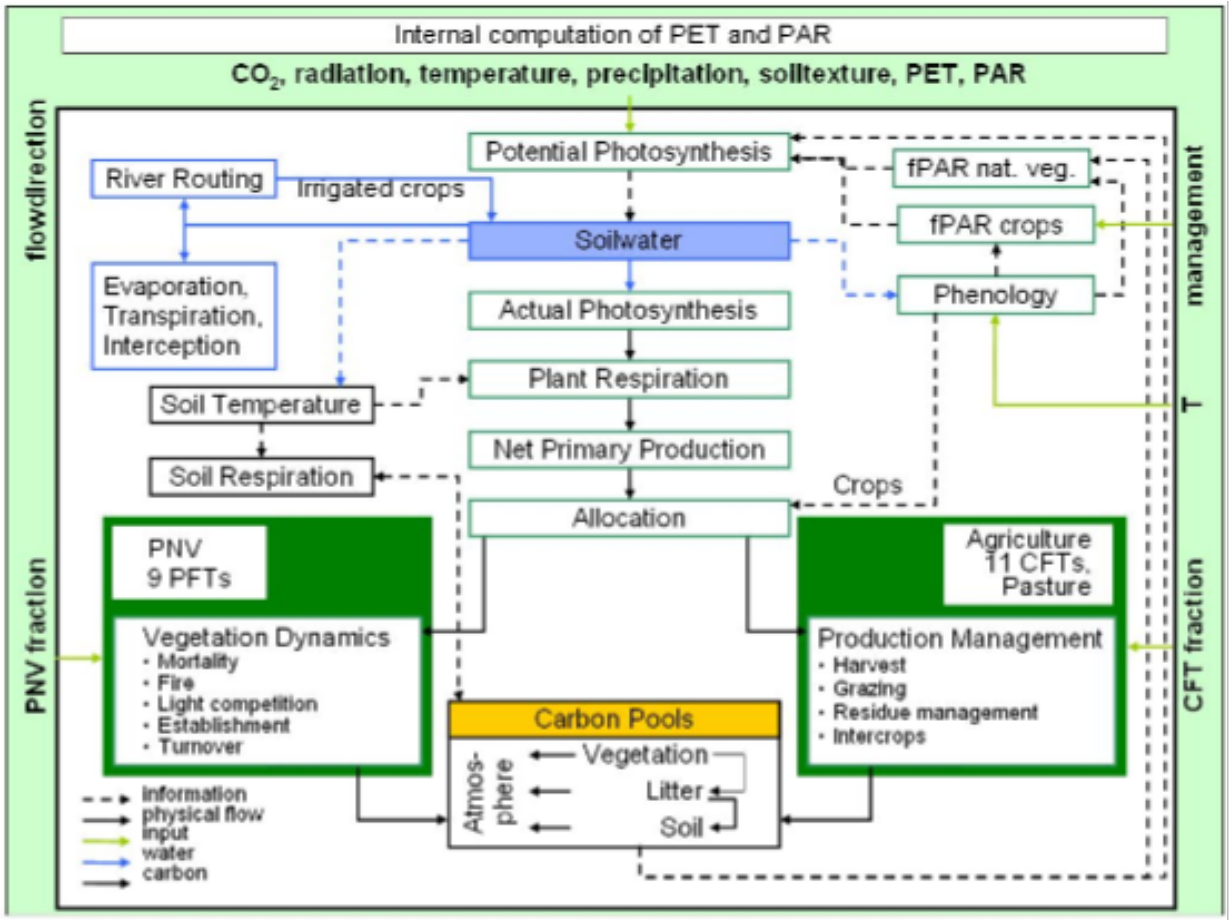
Dynamic Global Vegetation models (LPJ)



Sitch et al. 2003, GCB
Gerten et al. 2004, J. Hydrol.
Schaphoff et al. 2006, Clim. Ch.
Bondeau et al. 2007, GCB

- One of the world's leading vegetation models
- Process-based (simulates processes such as photosynthesis, respiration)
- Follows the carbon and water pools of the simulated vegetation
- Predicts vegetation composition dynamically

- Input: Climate variables

Tasks in the analysis of potential Amazon forest die-back

1. LPJ-Simulations for Amazonia using
   - high-resolution Earth Simulator data
   - IPCC AR4 climate scenarios (18 models, 3 emission scenarios)
   - regional climate scenarios from INPE

1. Improve key process components of LPJ for Amazonia

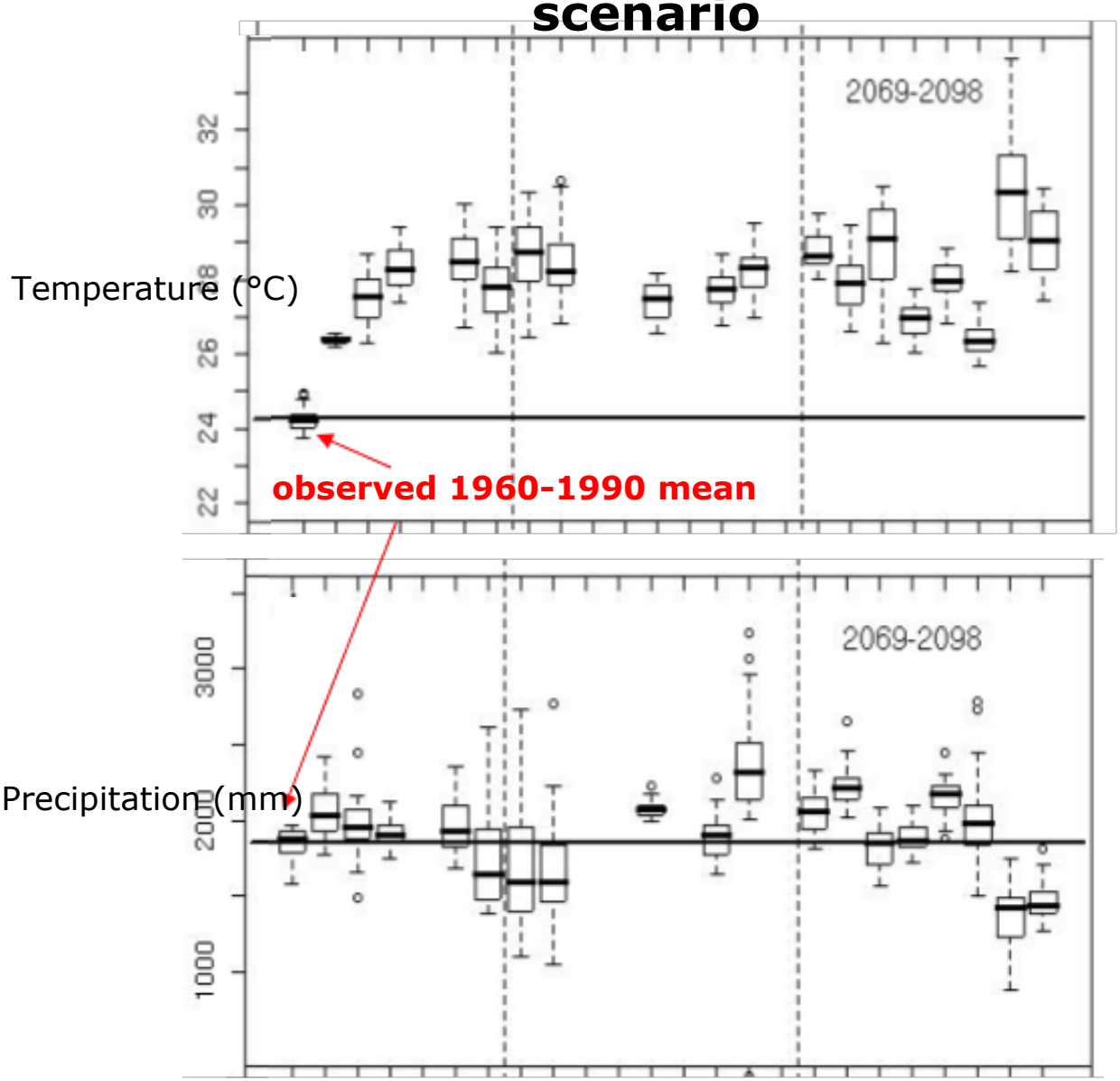
- Combine results across climate projections, vegetation model simulations and process uncertainties into a risk analysis.

- Current uncertainty implies: die-back is not certain, but also cannot be ruled out.

- Next-phase science needs to reduce uncertainty (= define risk better, as a function of temperature increase/precipitation decrease, under elevated CO_2)

Variability in temperature and precipitation projections

18 AR4 Models, SRES A2 emission scenario

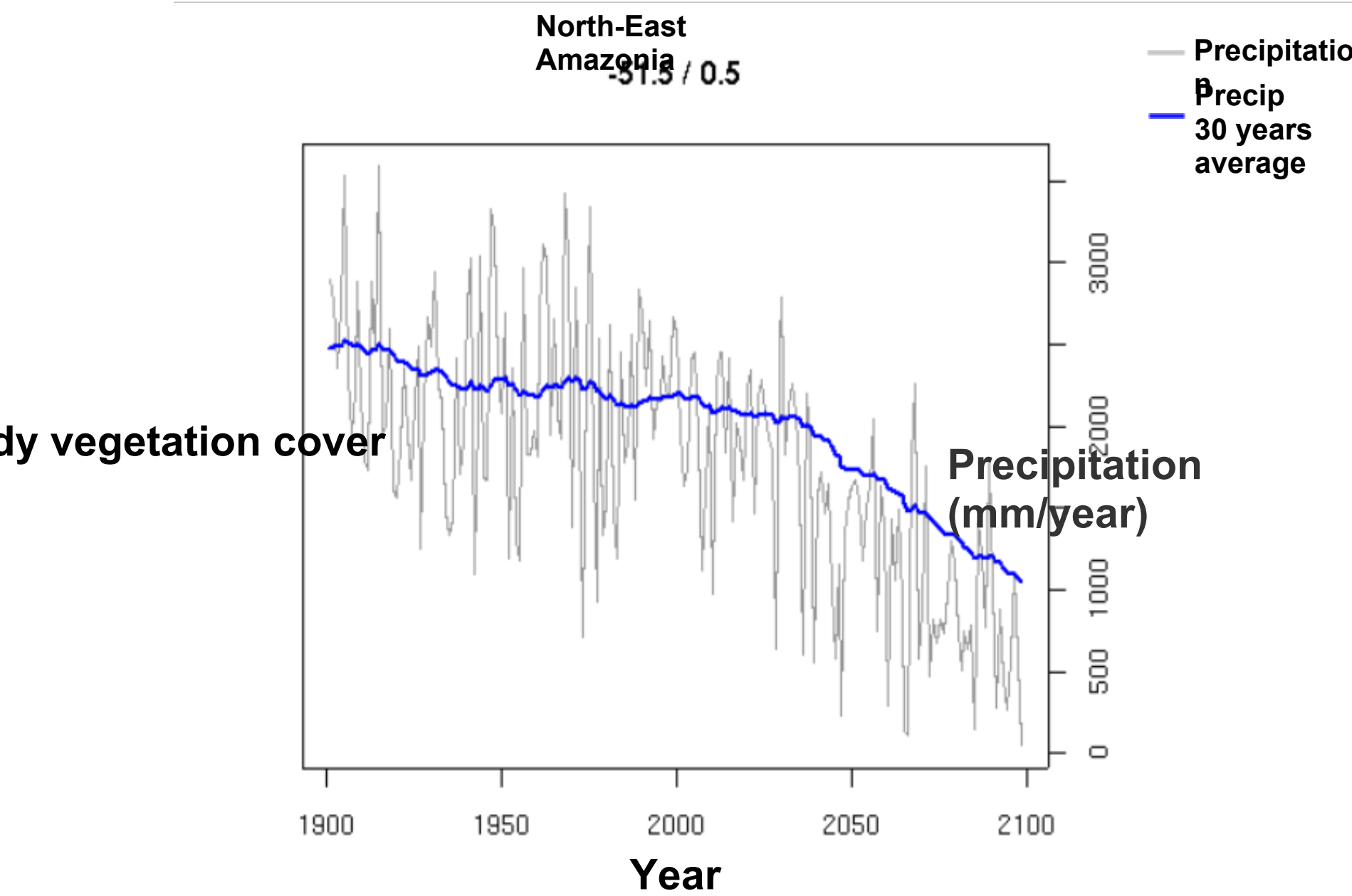


Temperature change

Precipitation change

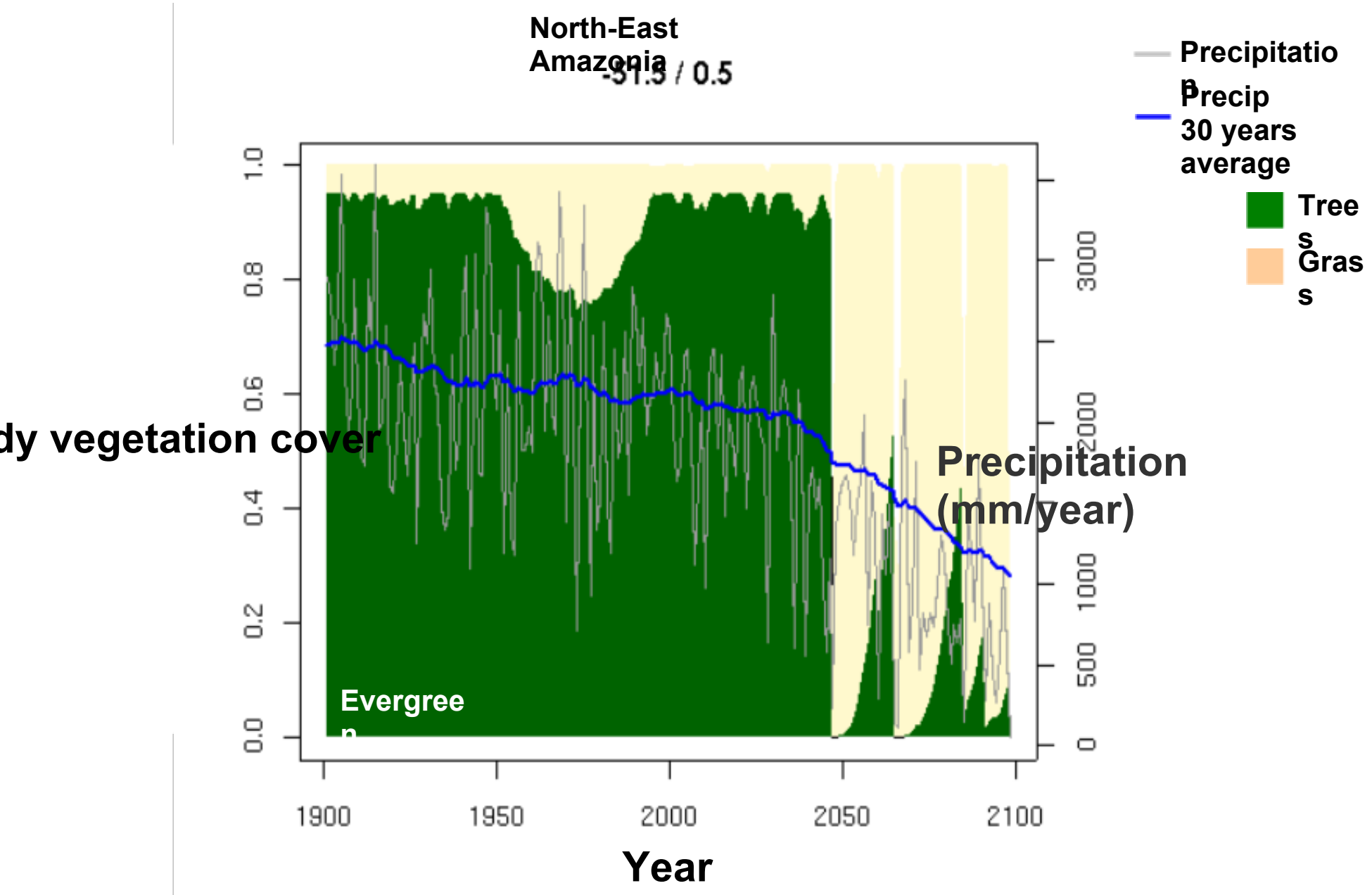
Source: B. Poulter

Collapse of forest cover below rainfall threshold



Hadley SRES A2

Collapse of forest cover below rainfall threshold



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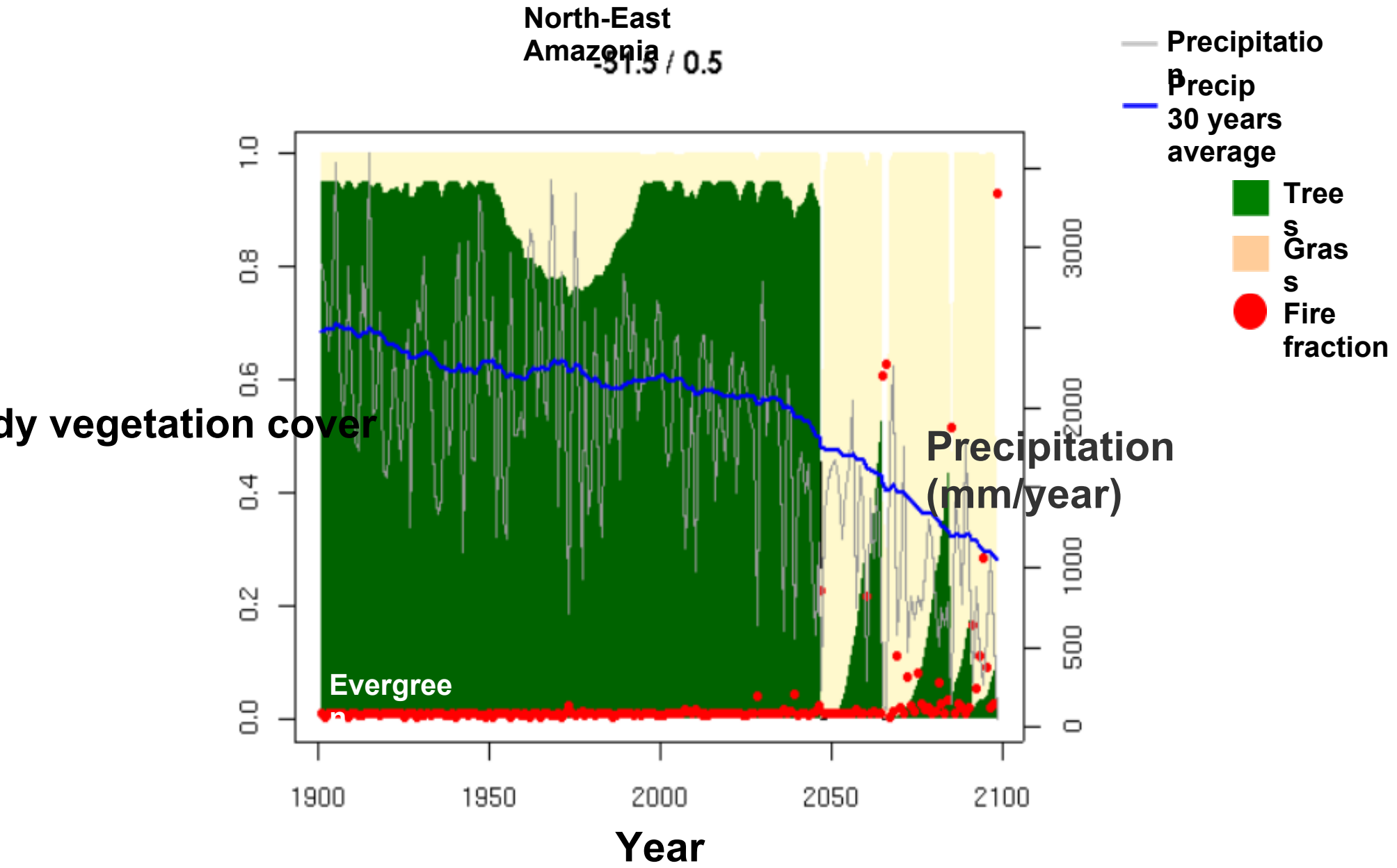
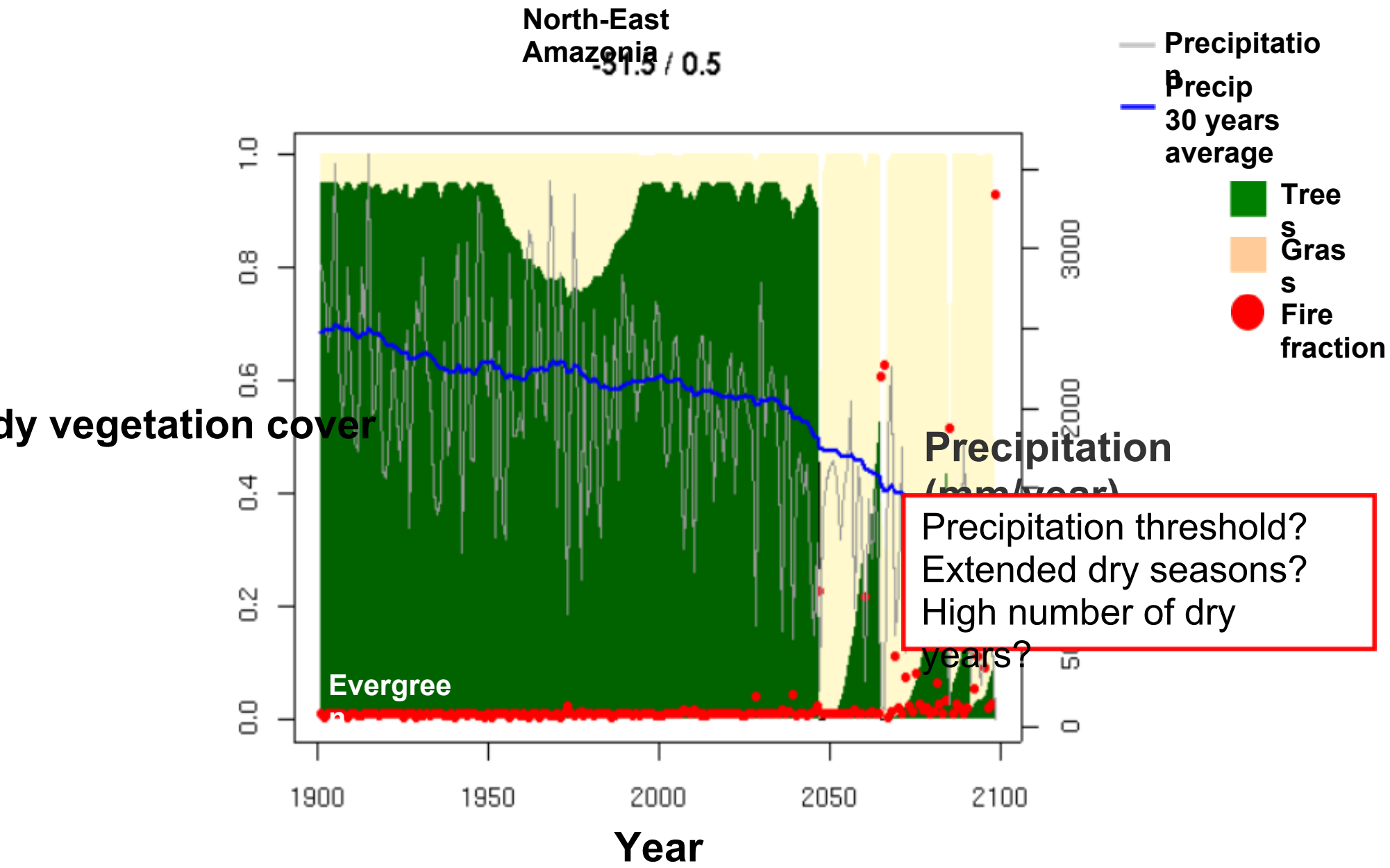


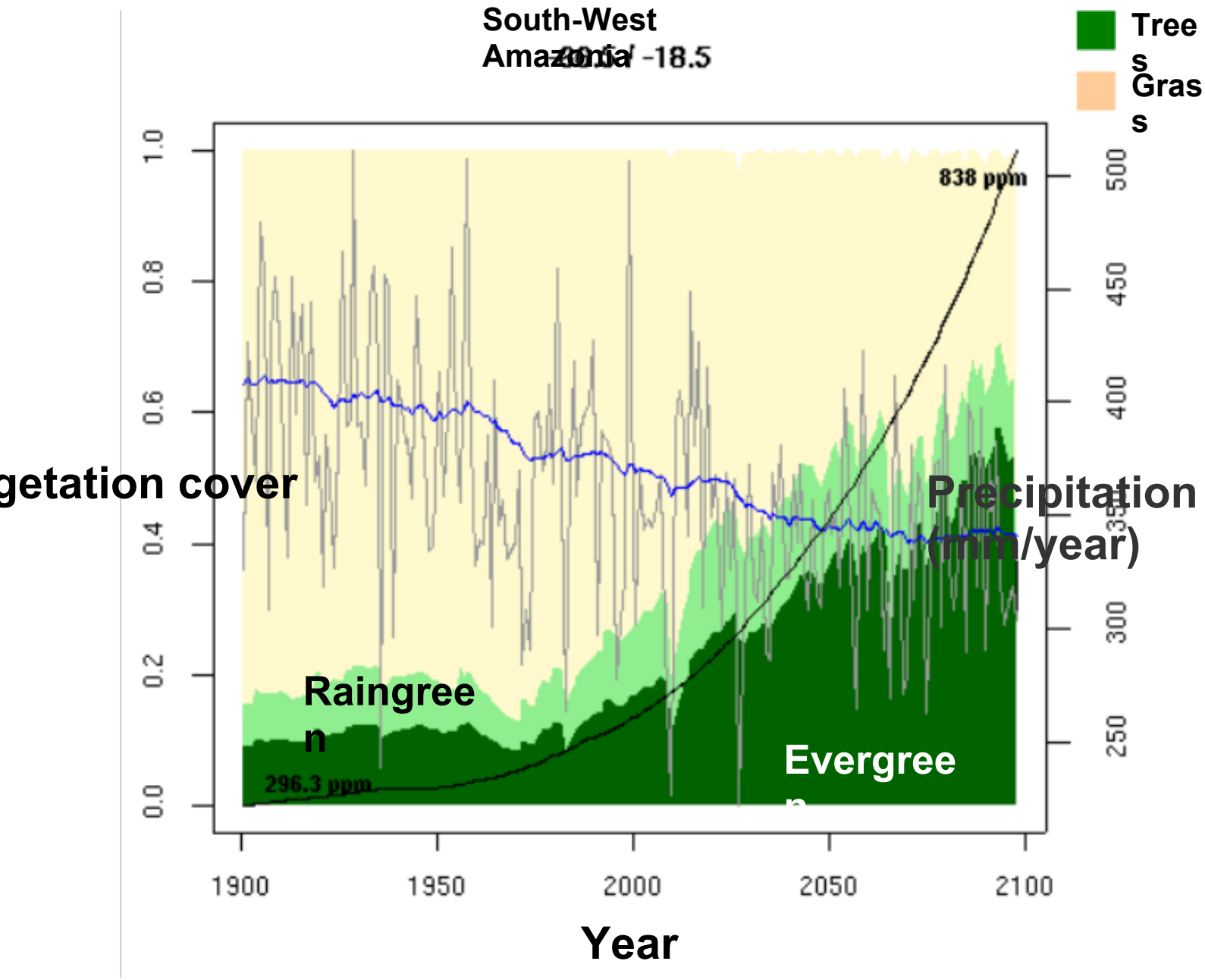
Hadley SRES A2

Collapse of forest cover below rainfall threshold

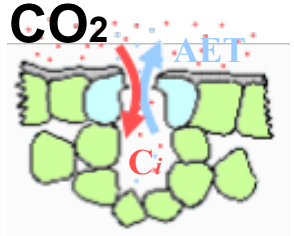


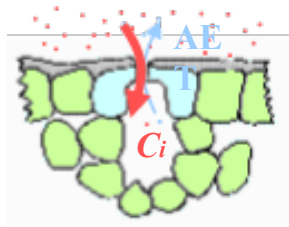
Hadley SRES A2

Increased woody cover in water-limited regions (CO_2 effect)

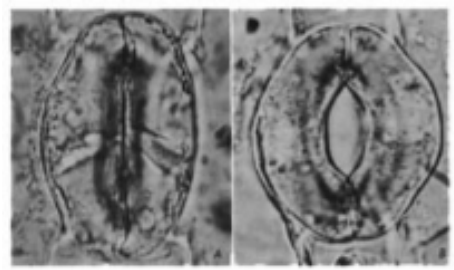


low CO_2



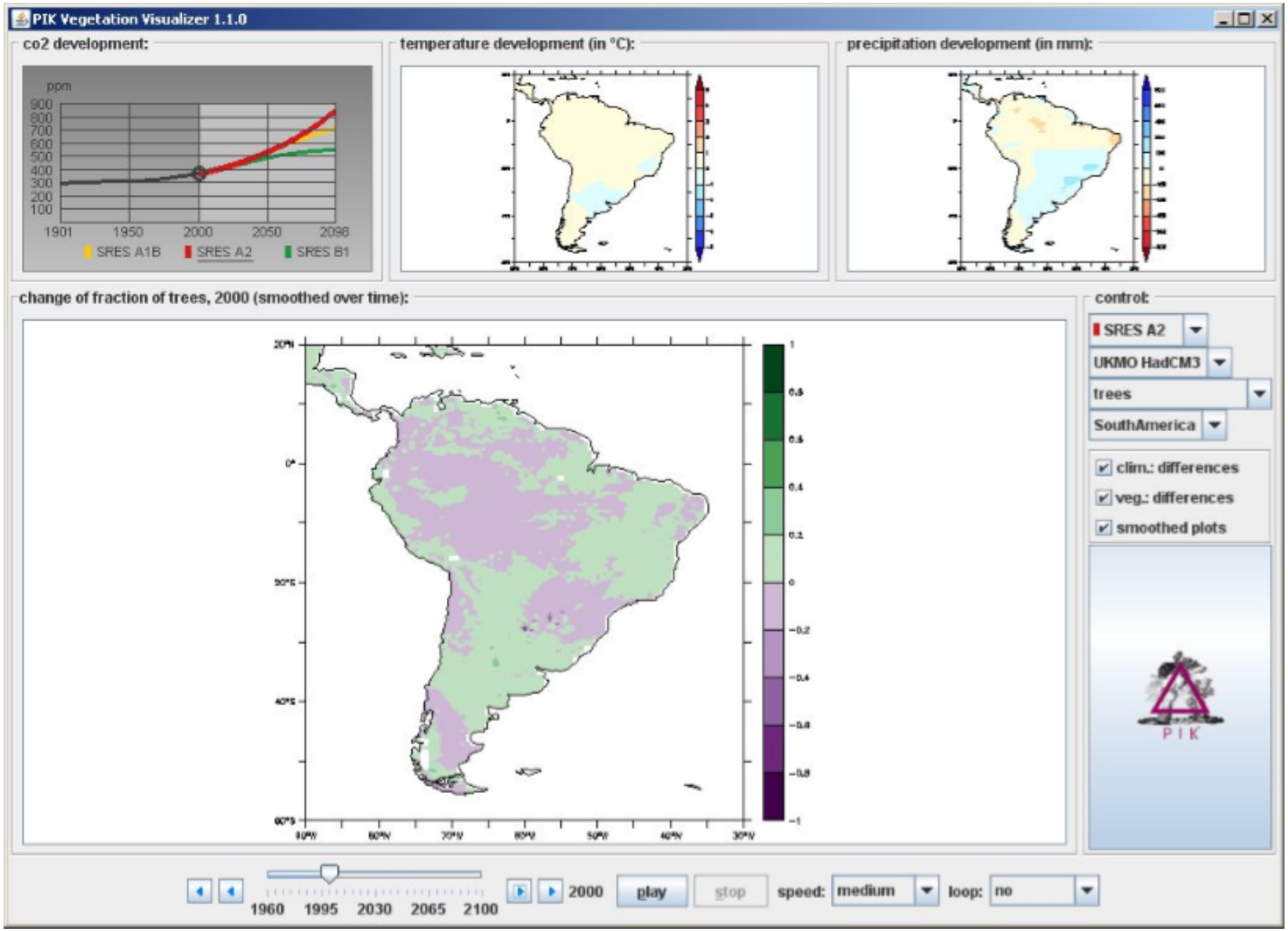


high CO_2



Hadley SRESA2

Changes in forest cover 1900-2100



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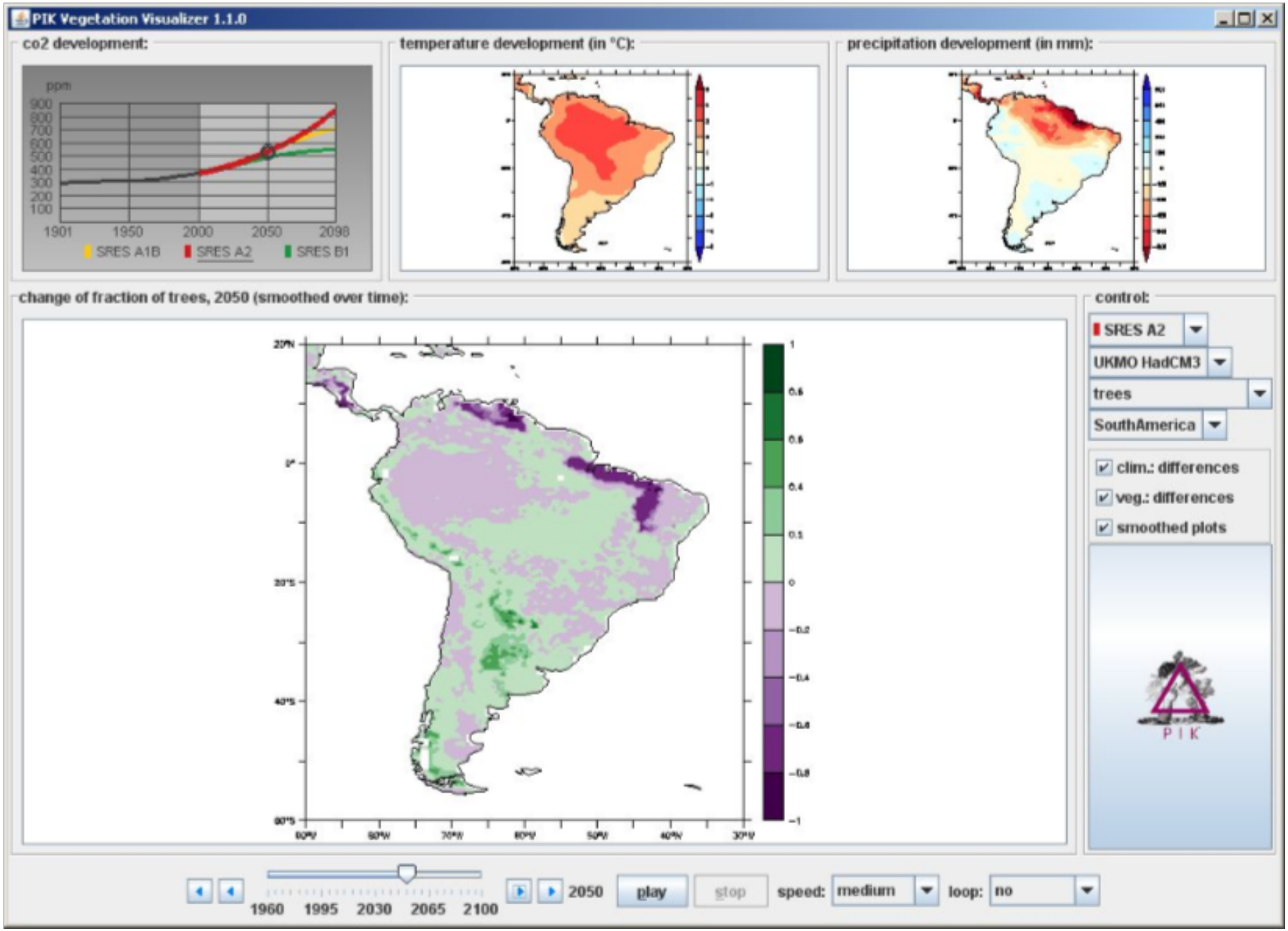

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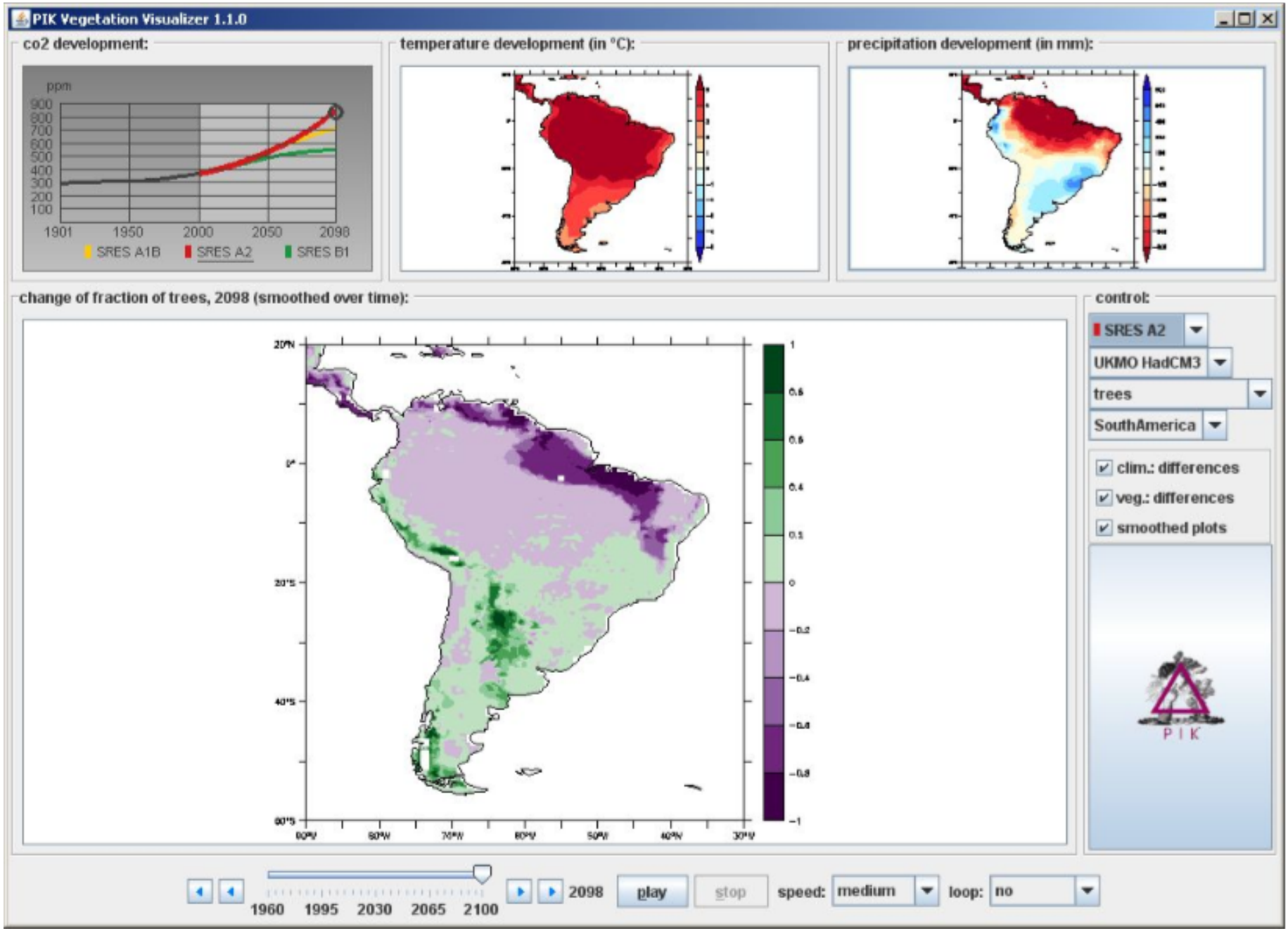
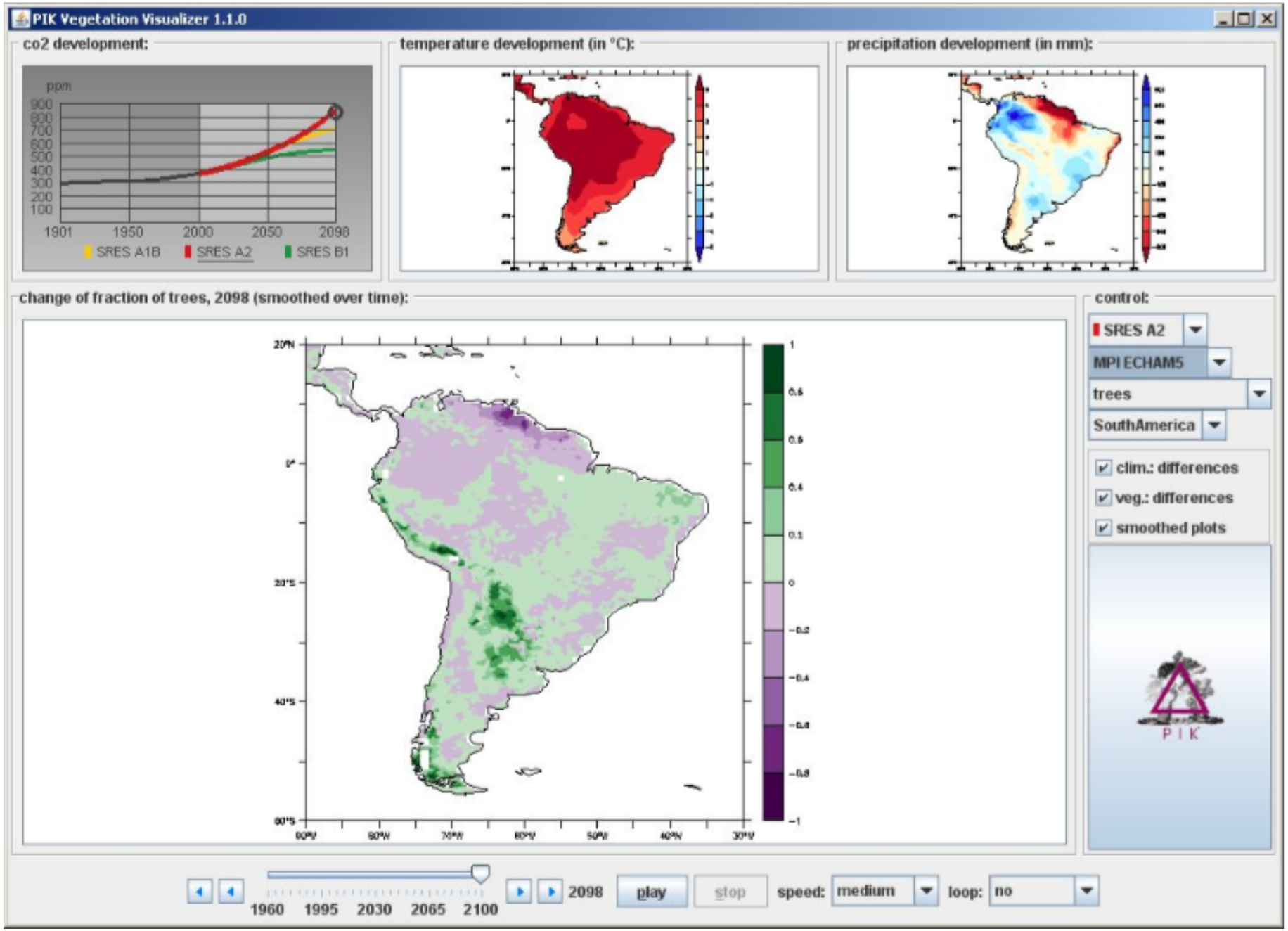


Changes in forest cover 1900-2100



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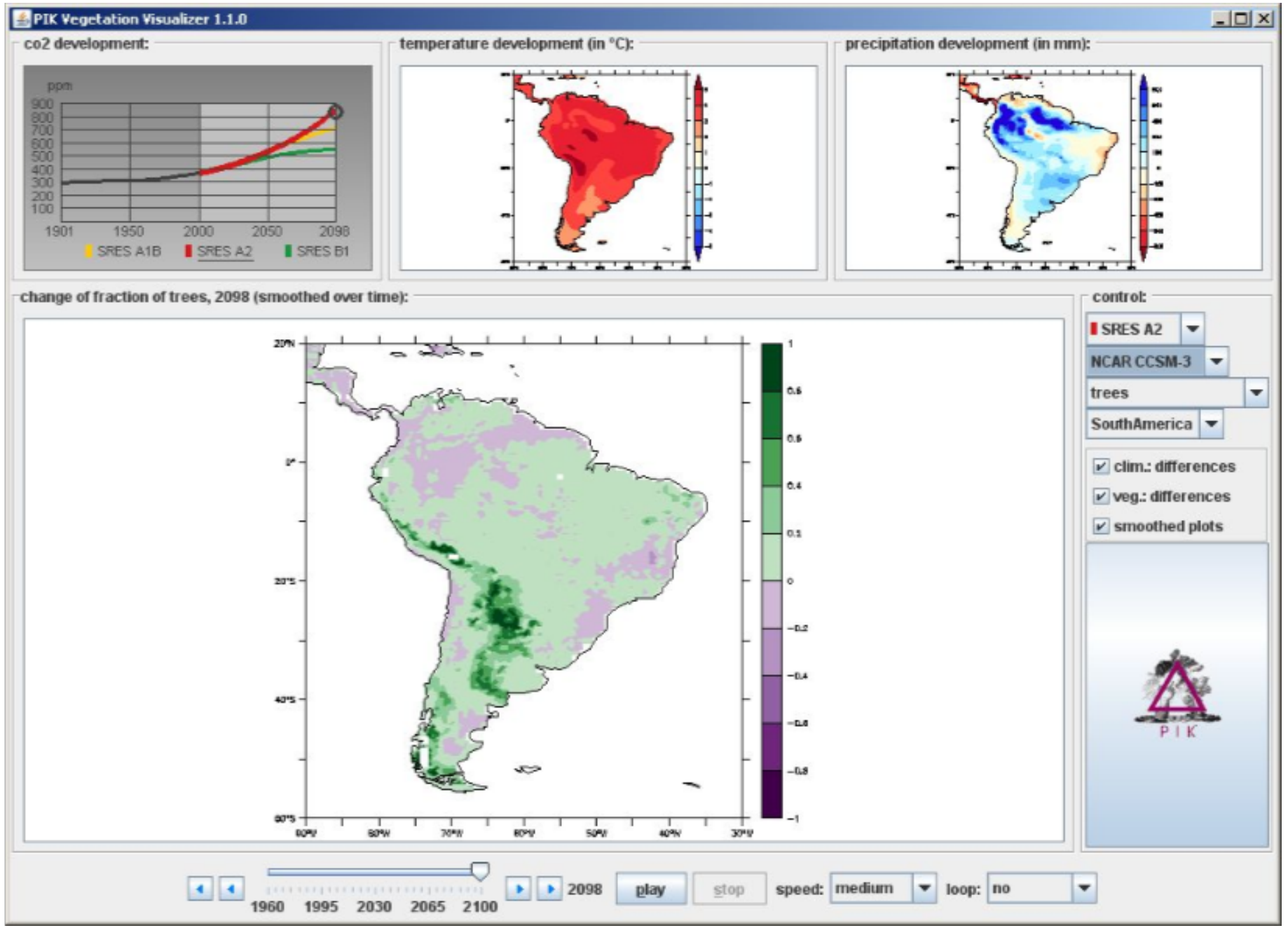
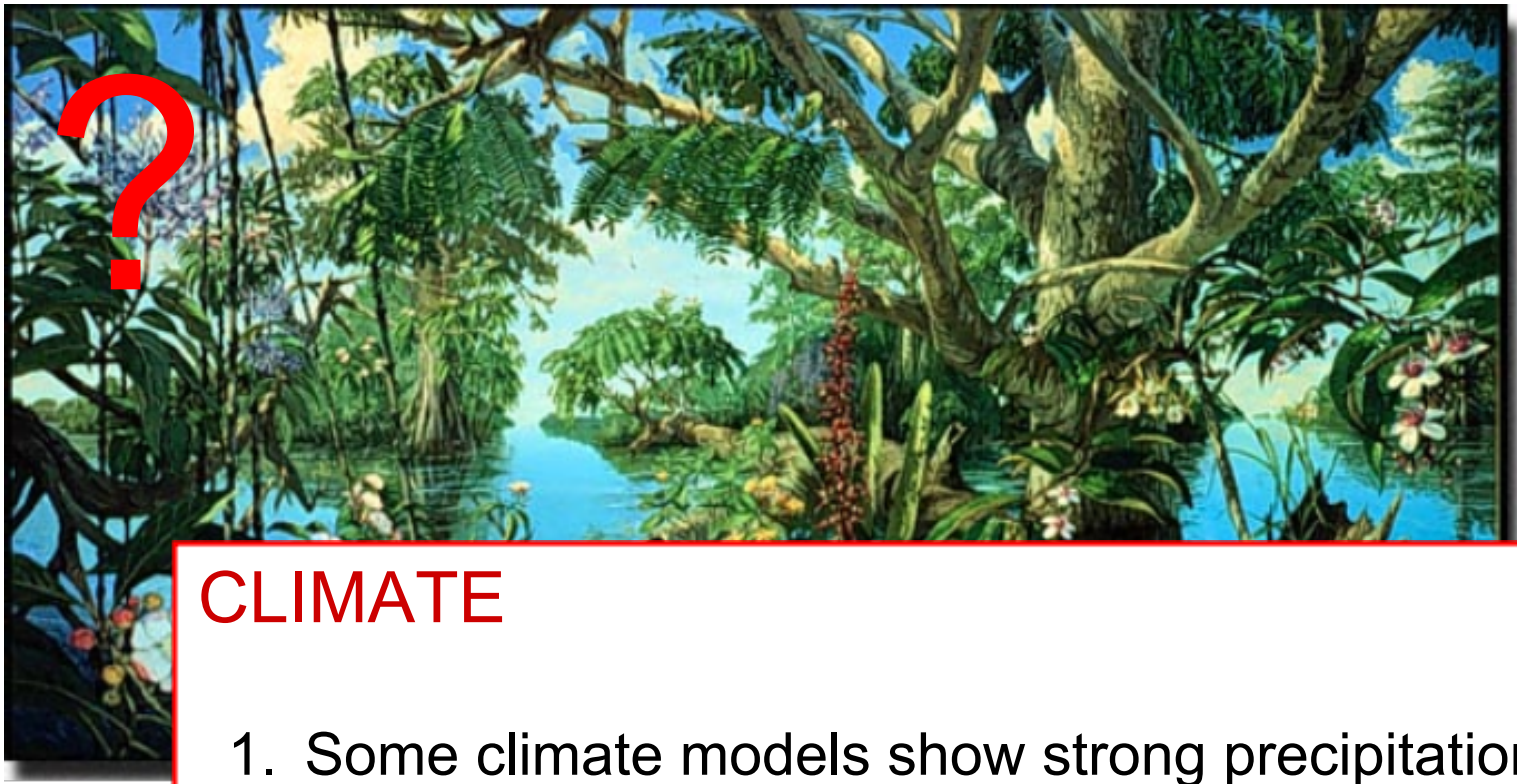


10 statements about Amazonian forest die-back

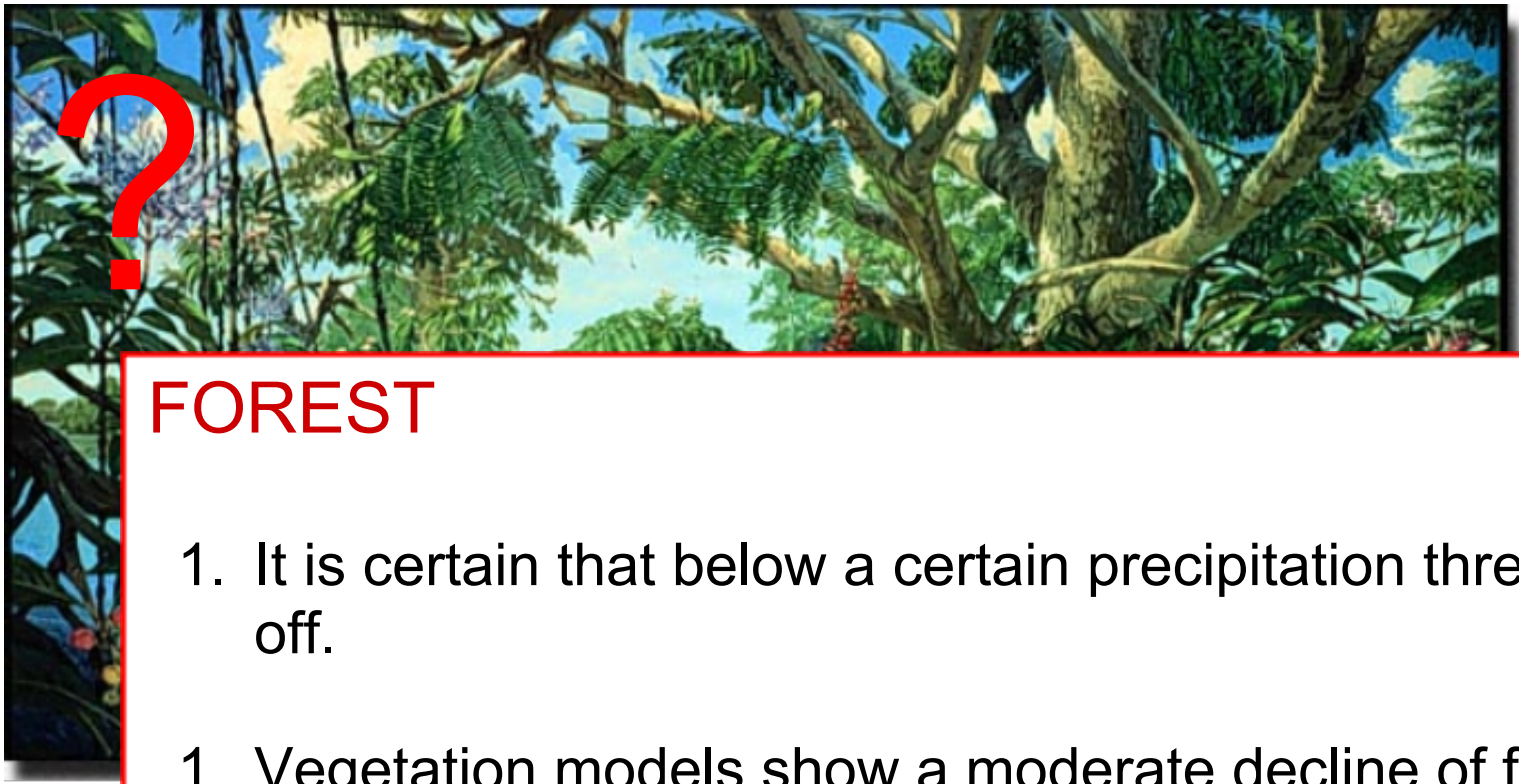


CLIMATE

1. Some climate models show strong precipitation decline (at least regionally) by 2100, but most don‘t.

1. The models which show precipitation decline might have it right – we currently don‘t know, the trigger are complex circulation shifts in atmosphere and oceans. So the potential has to be taken seriously.

10 statements about Amazonian forest die-back



FOREST

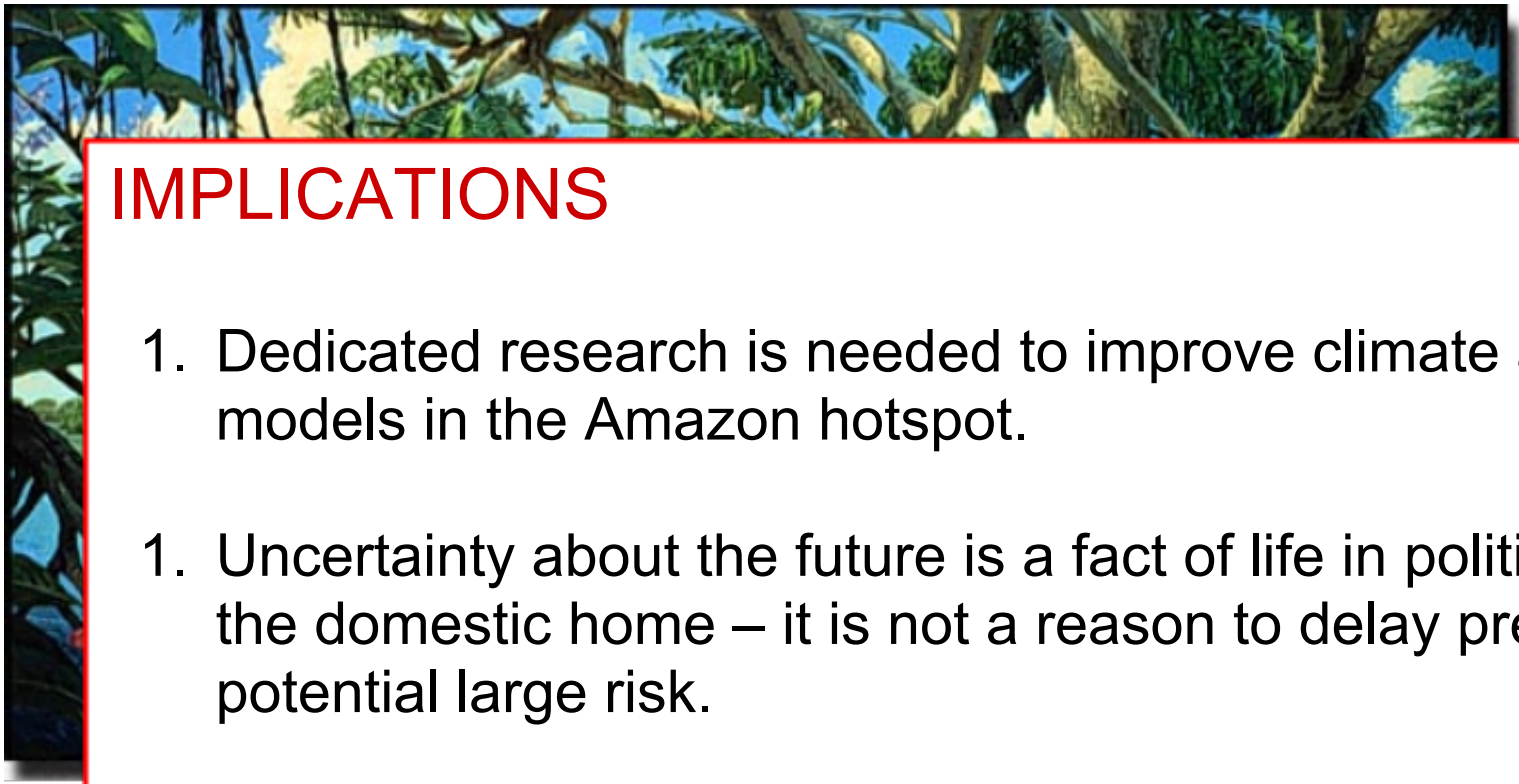
1. It is certain that below a certain precipitation threshold, forest dies off.

1. Vegetation models show a moderate decline of forest cover, but uncertainty is high.

1. The (regional) decline is triggered by dry spells, and the de-forested state may later self-stabilize (fire and/or precipitation feedbacks).

1. Should a die-back occur, the consequences would be severe. Critical-risk-avoidance demands to take the potential seriously.

10 statements about Amazonian forest die-back



IMPLICATIONS

1. Dedicated research is needed to improve climate and vegetation models in the Amazon hotspot.

1. Uncertainty about the future is a fact of life in politics, economics and the domestic home – it is not a reason to delay preparation for a potential large risk.

1. Land use change is a 2nd serious threat to the Amazonian forest. The forest might not be saved if climate change is stopped, and it might not be saved if deforestation is stopped.

1. This requires to develop models like LPJ into a next phase of realism concerning land use, climate change impacts and ecophysiological process representations.

Thank you for your attention!

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Visualization
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