MINISTÉRIO DA CIÊNCIA E TECNOLOGIA
INSTITUTO NACIONAL DE PESQUISAS ESPACIAIS

Tipping points in climate modeling: Risk of Amazon die back and the ES

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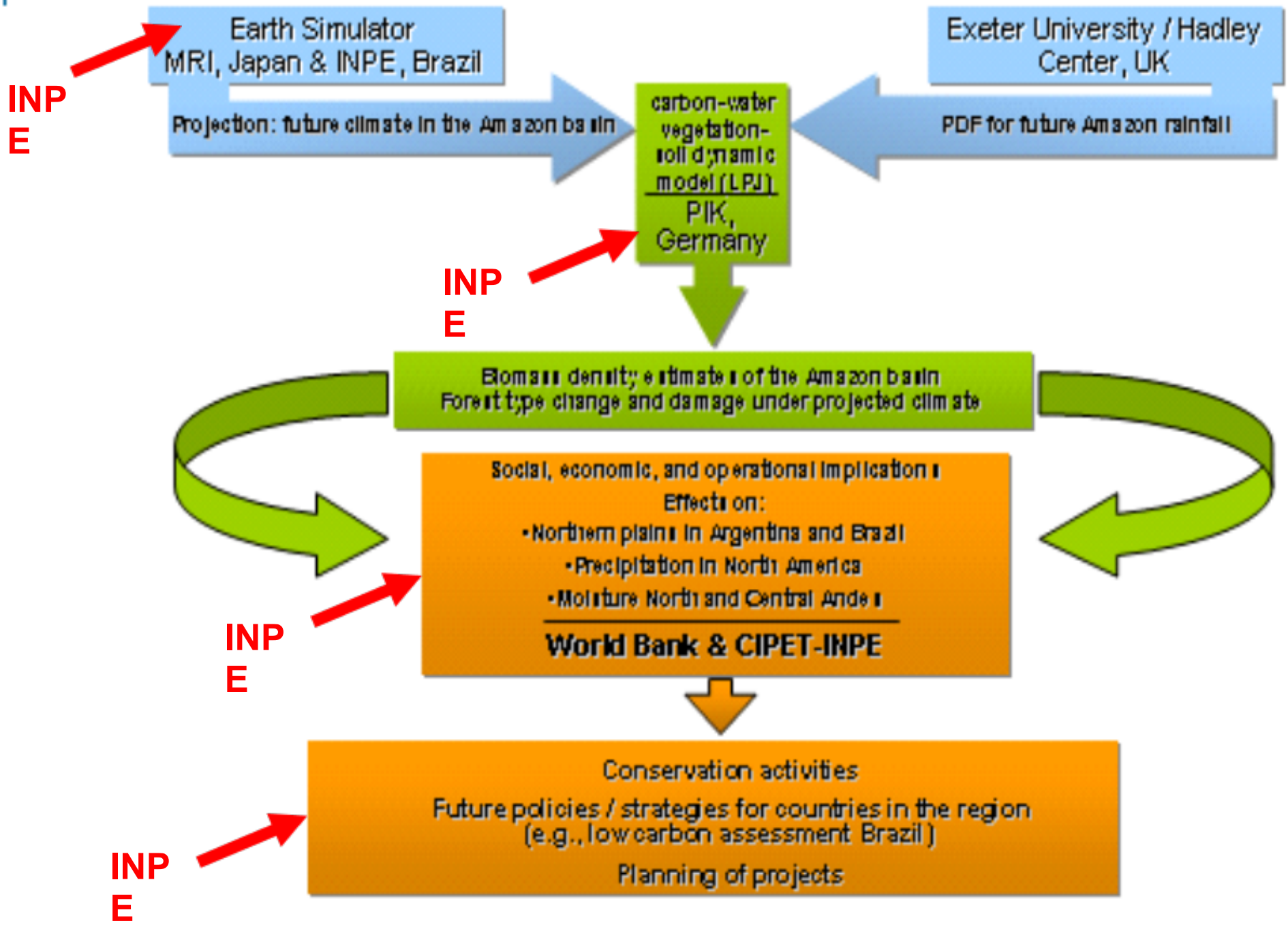
Schematic of proposed activities, responsibilities and information flows



Multiple Equilibria, Persistence & Climate

A shift in climate, due to natural or anthropogenic causes, can change the frequency and magnitude of disturbance. The change in relative system stability might make a vegetation change irreversible (e.g. Cox et al, 2001 and Oyama & Nobre 2004), but it might take a disturbance for the shift to occur. Leads to the concept of instability

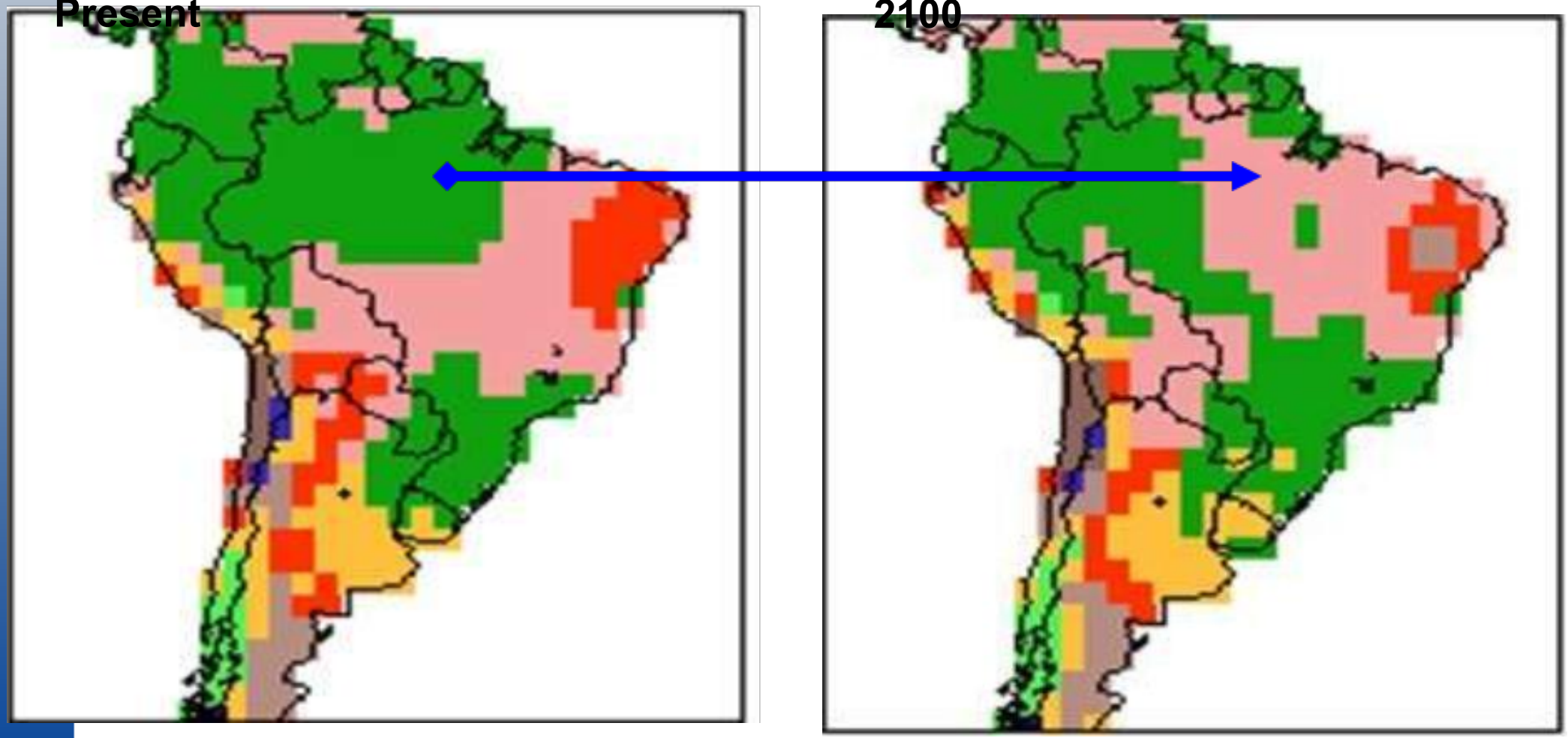
In a complex system, "tipping point" represents a level, and if as a consequence of an imposed forcing this level is overpassed, the

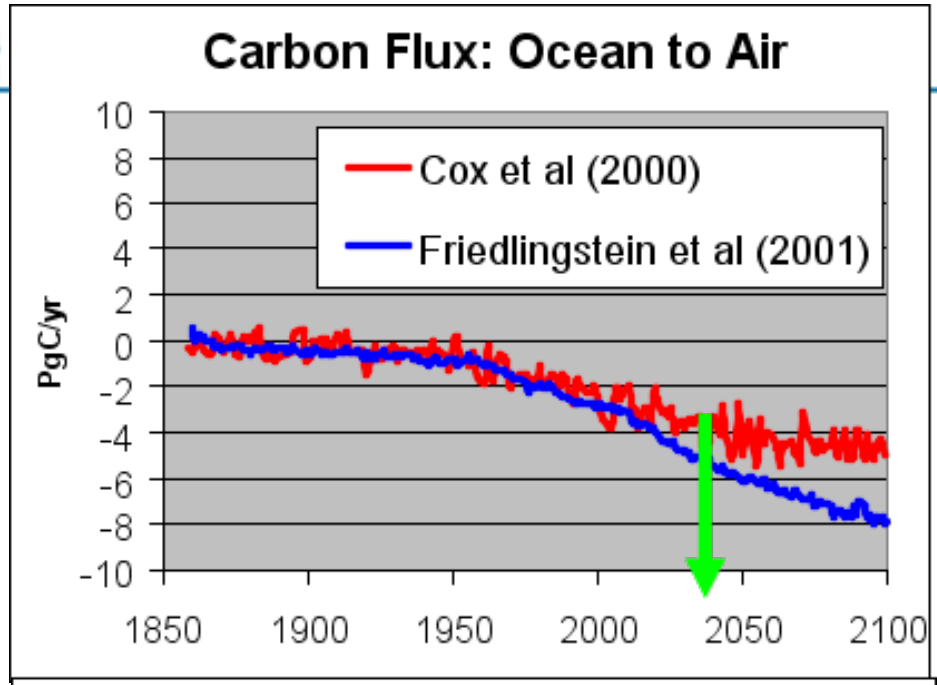
Question: Is there a “tipping point” in the increase of GHG concentration (natural and anthropogenic causes) and deforestation (anthropogenic causes) to induce abrupt changes to the new biome-climate stable equilibrium?

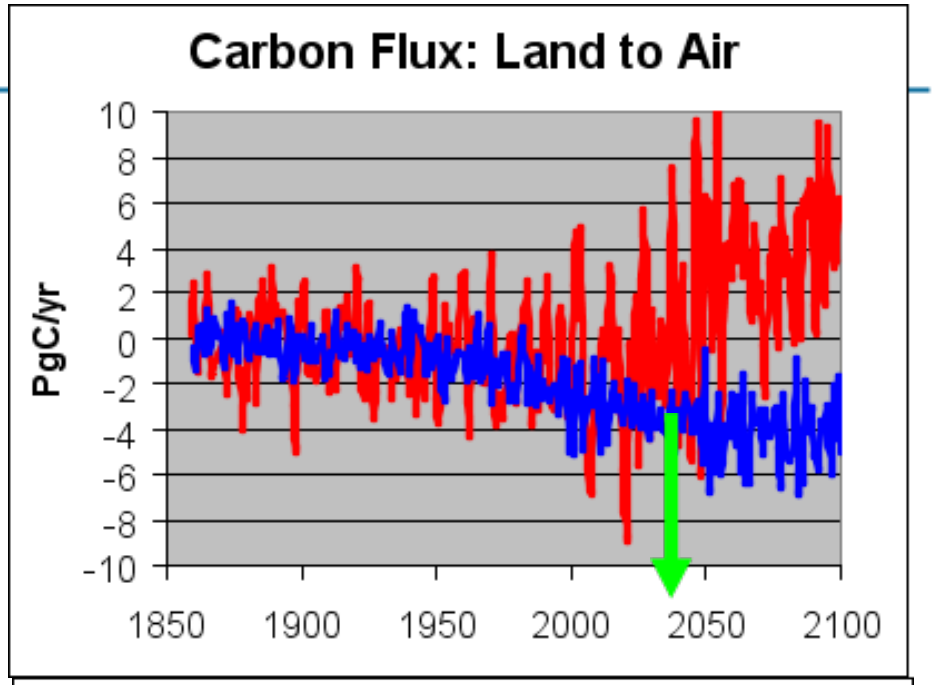
Potential vegetation model-INPE

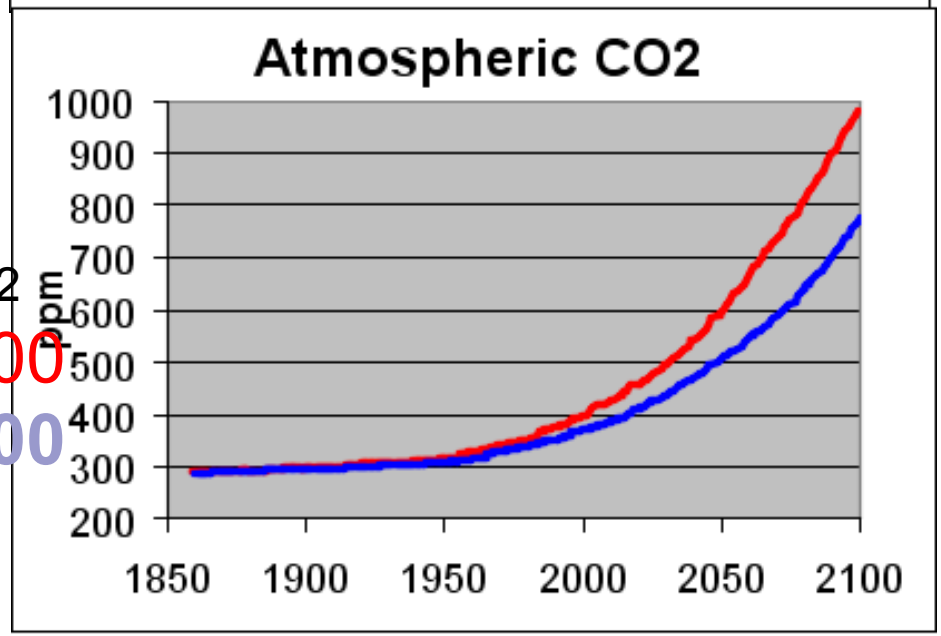
Natural Potential vegetation-Present

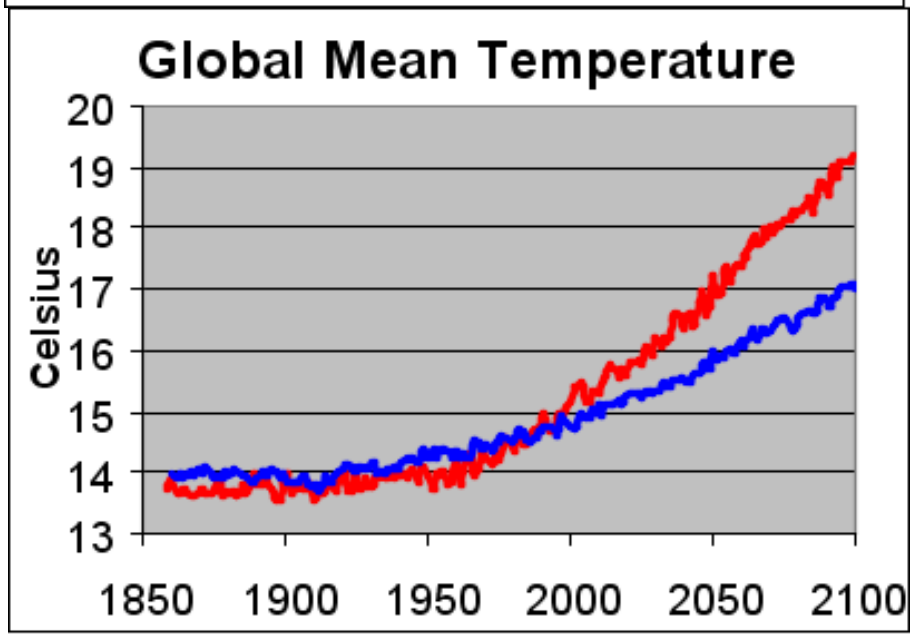
Natural Potential vegetation-2100





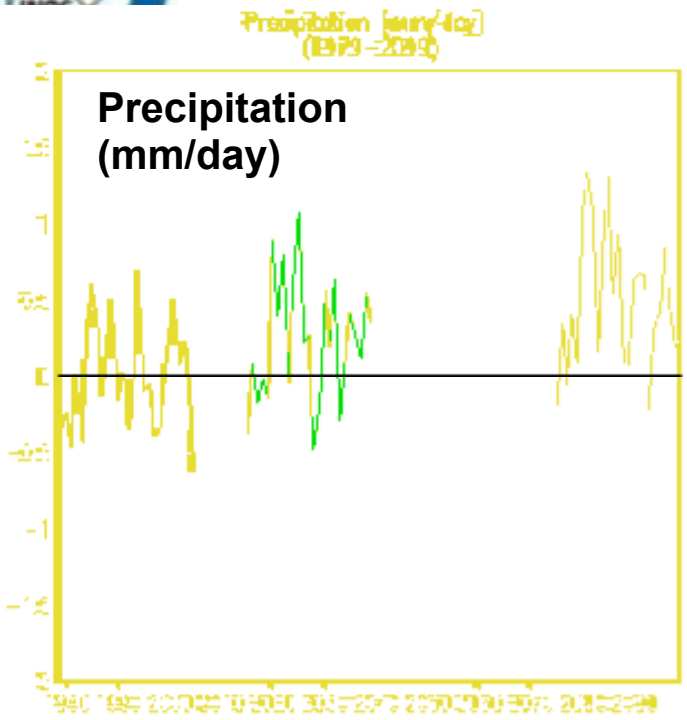


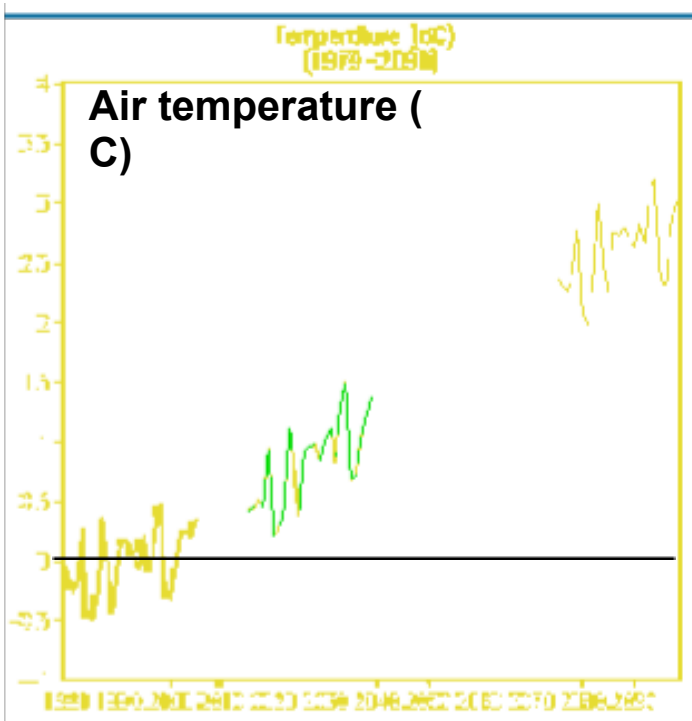


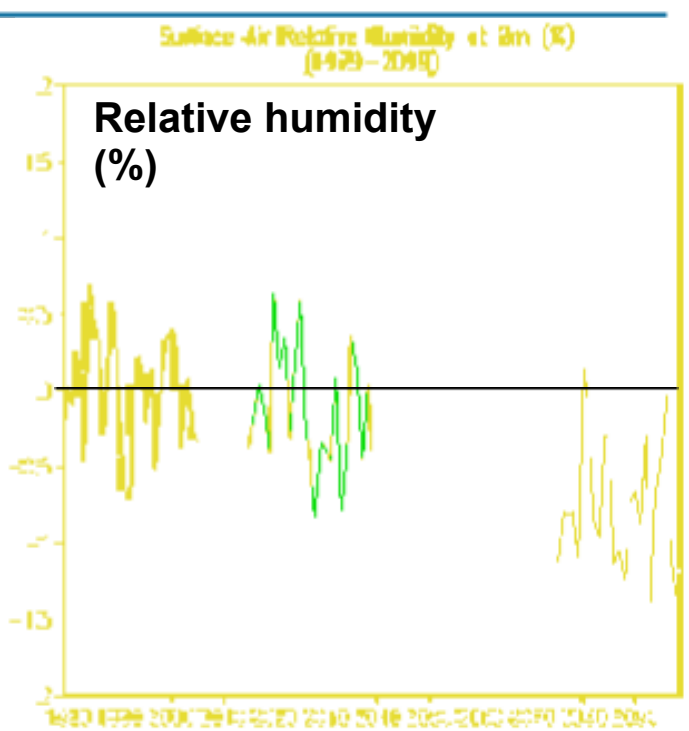


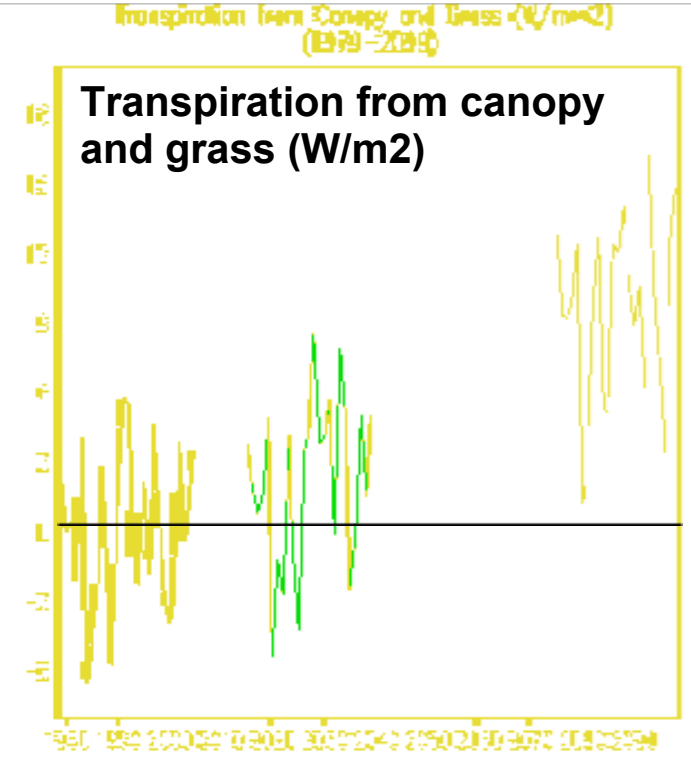
ΔCO_2
=> 700
=> 500

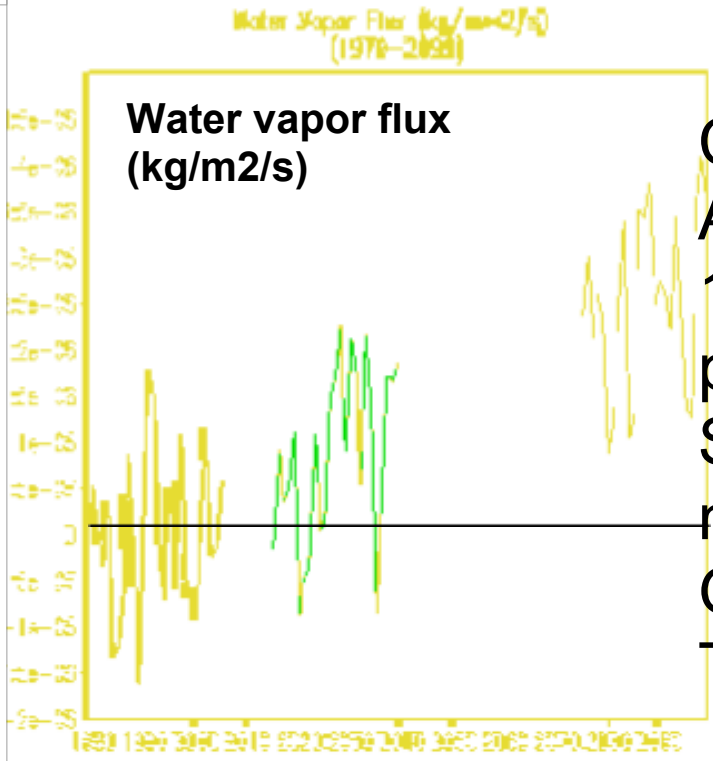
Coupled climate—vegetation models project dramatically different futures (CO_2, vegetation, T) using different ecosystem models from different models: HadCM3, IPSL.











Climate trends in Amazonia during 1979-2099 as projected by the Earth Simulator 60 km model. JAM-GSM0130. 60km = TL319L60

PRECIPITATION (%)

A1B-Near Future [(2015-2039)-(1979-2005)]

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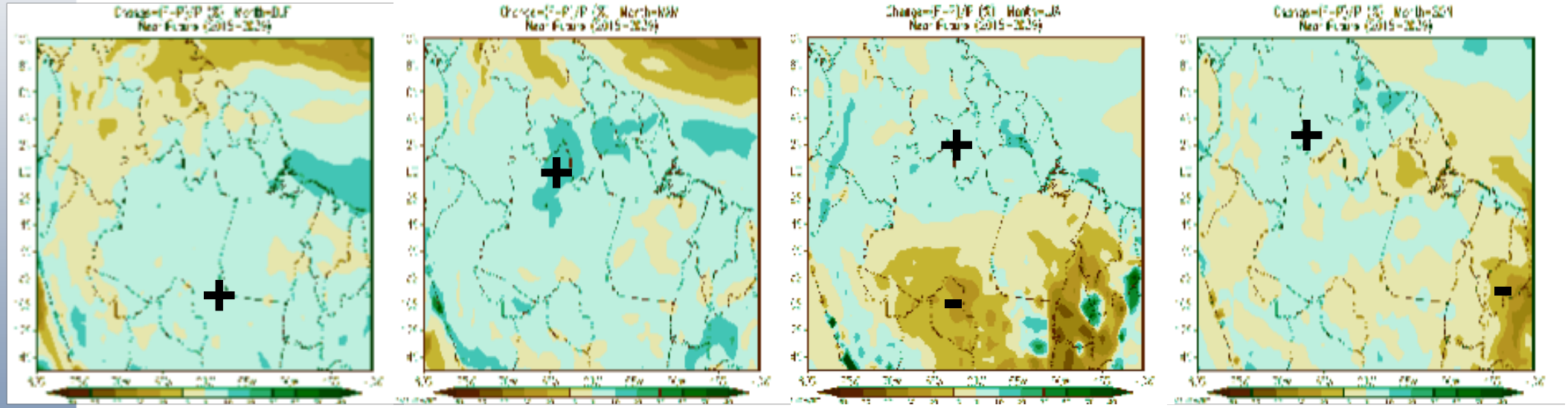
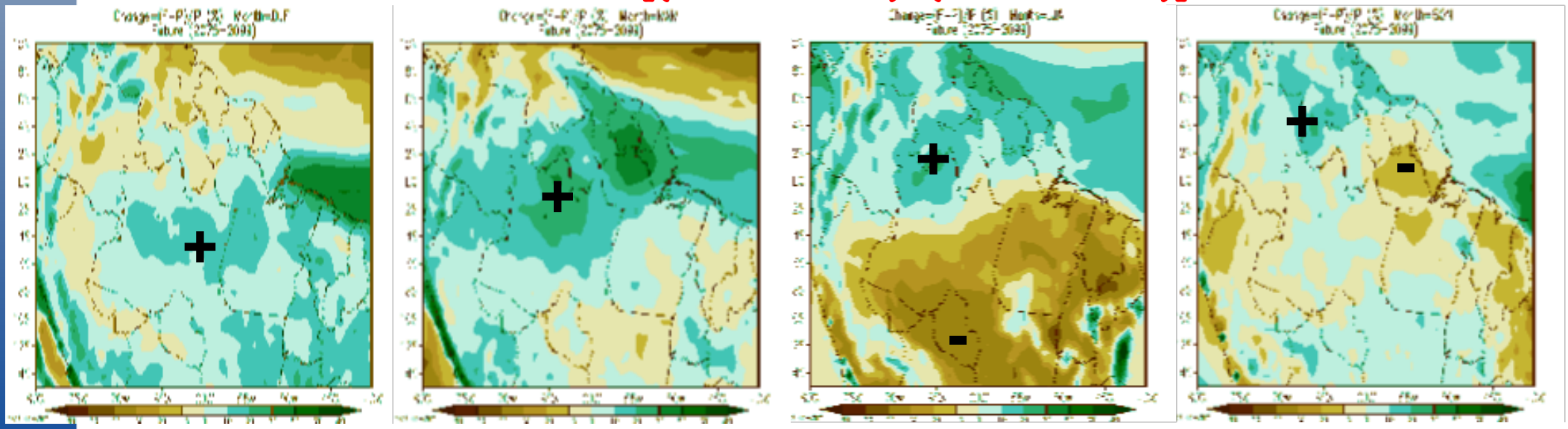


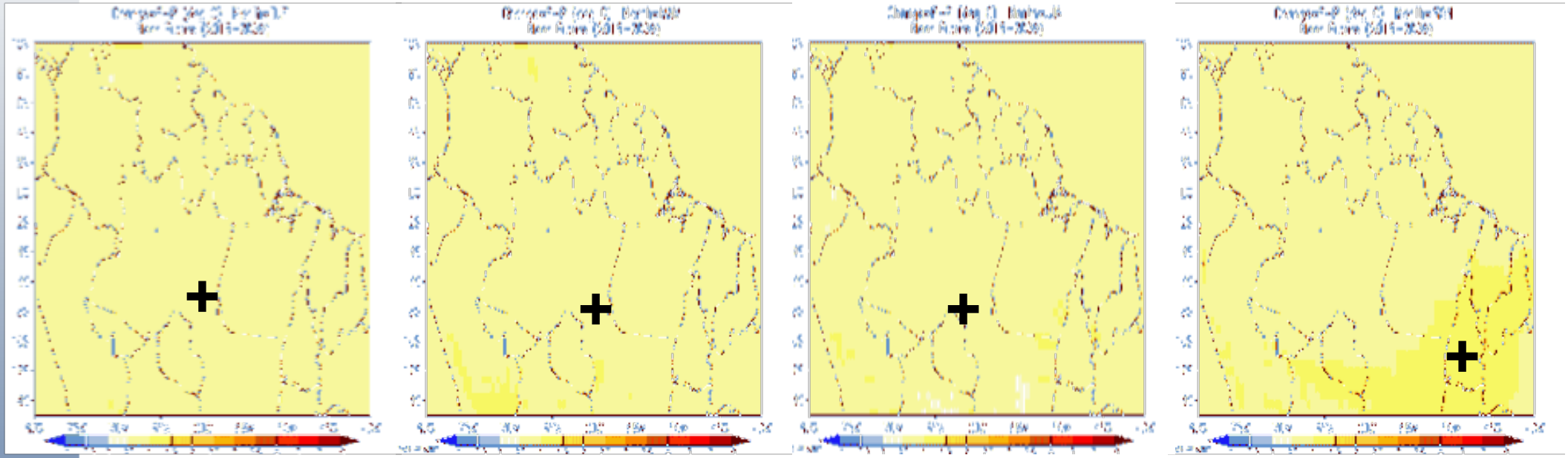
A1B-Future [(2075-2099)-(1979-2005)]



TEMPERATURE (oC)

A1B-Near Future [(2015-2039)-(1979-2005)]

DJF MAM JJA SON



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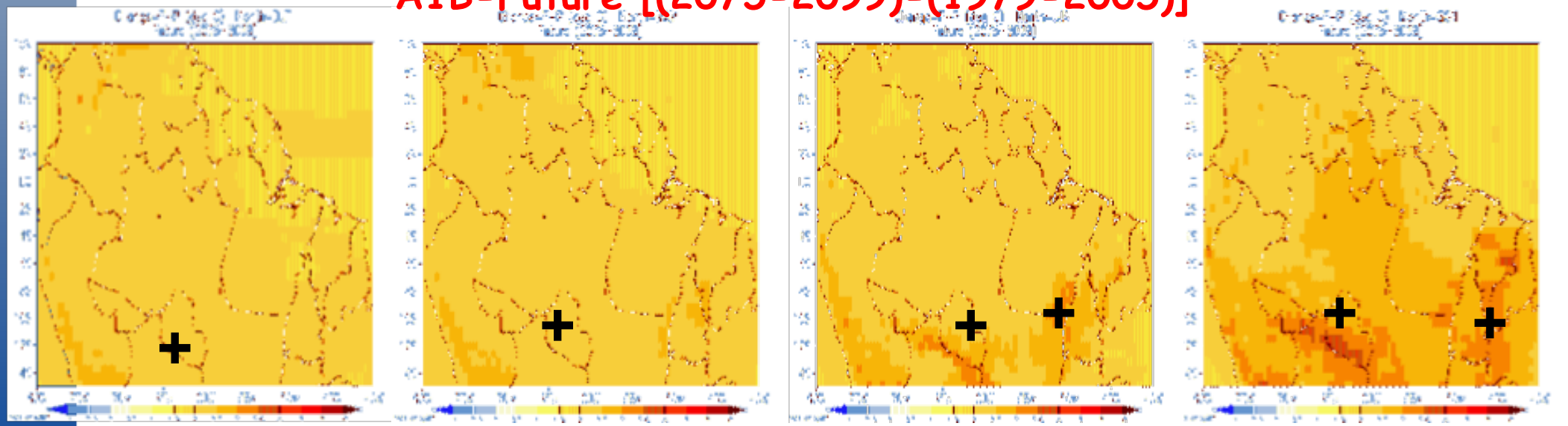
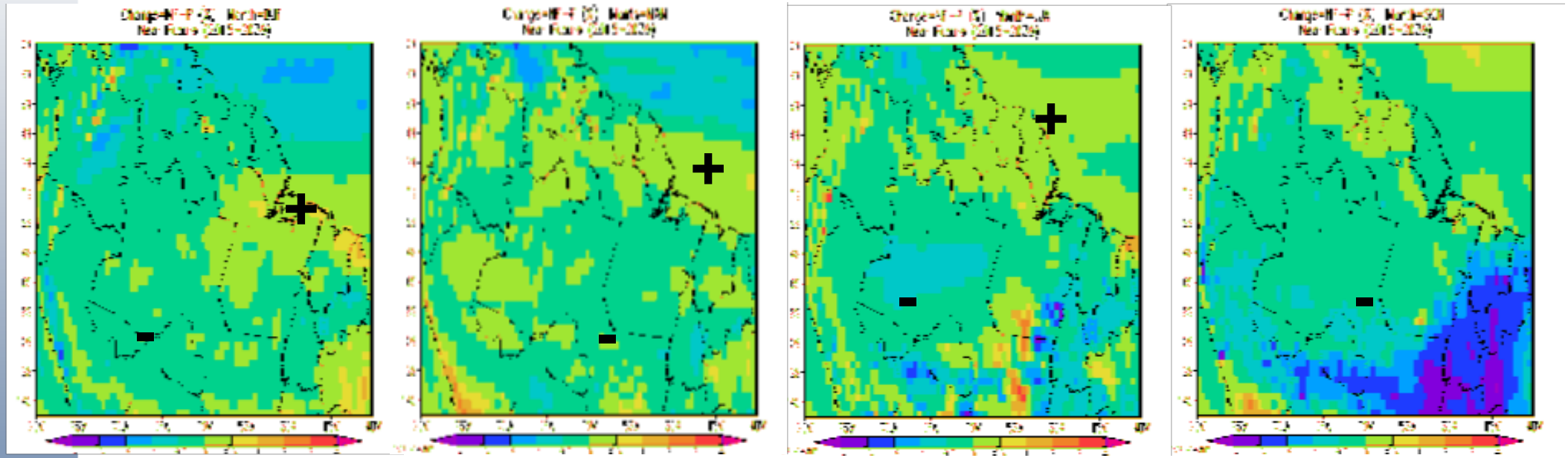


SURFACE AIR RELATIVE HUMIDITY AT 2m (%)

A1B-Near Future [(2015-2039)-(1979-2005)]

DJF MAM JJA SON



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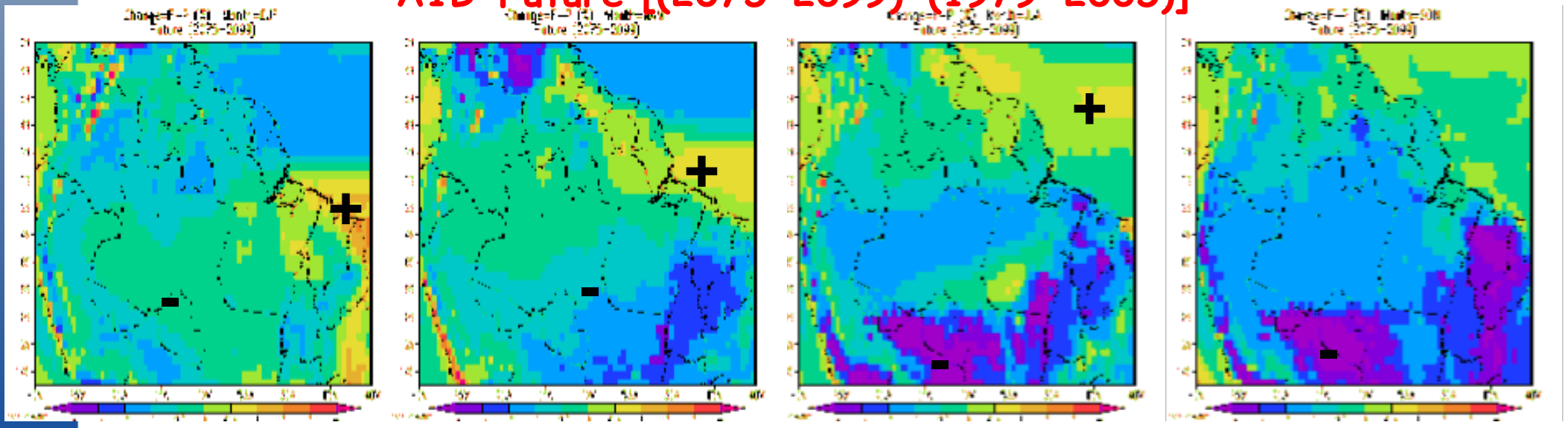

TRANSPIRATION FROM CANOPY AND GRASS (W/m**2)

A1B-Near Future [(2015-2039)-(1979-2005)]

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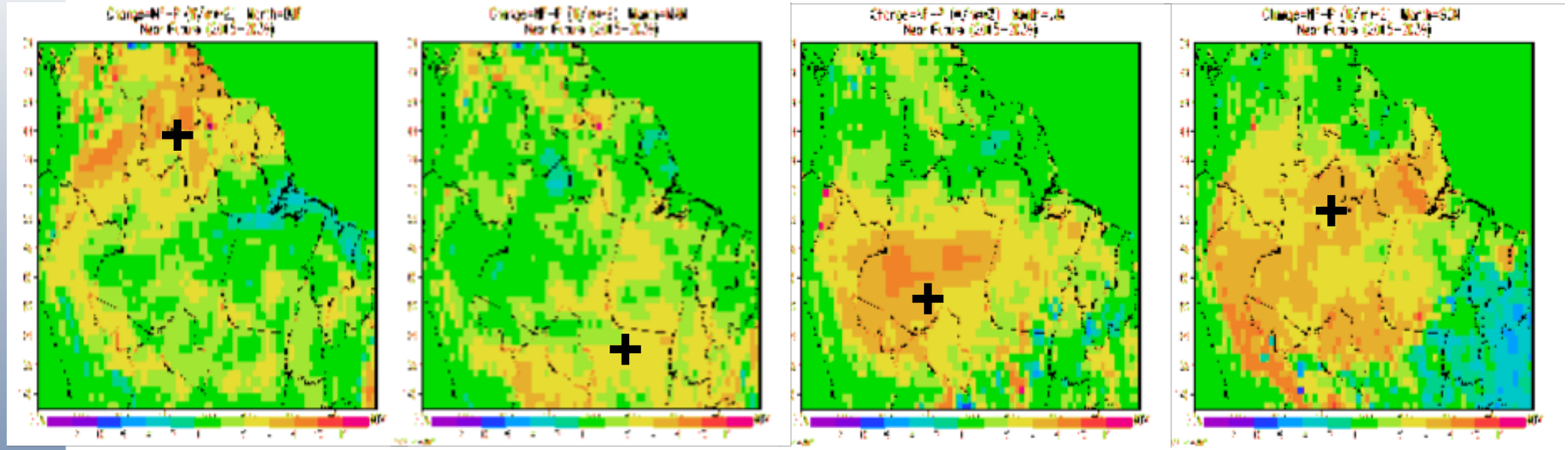

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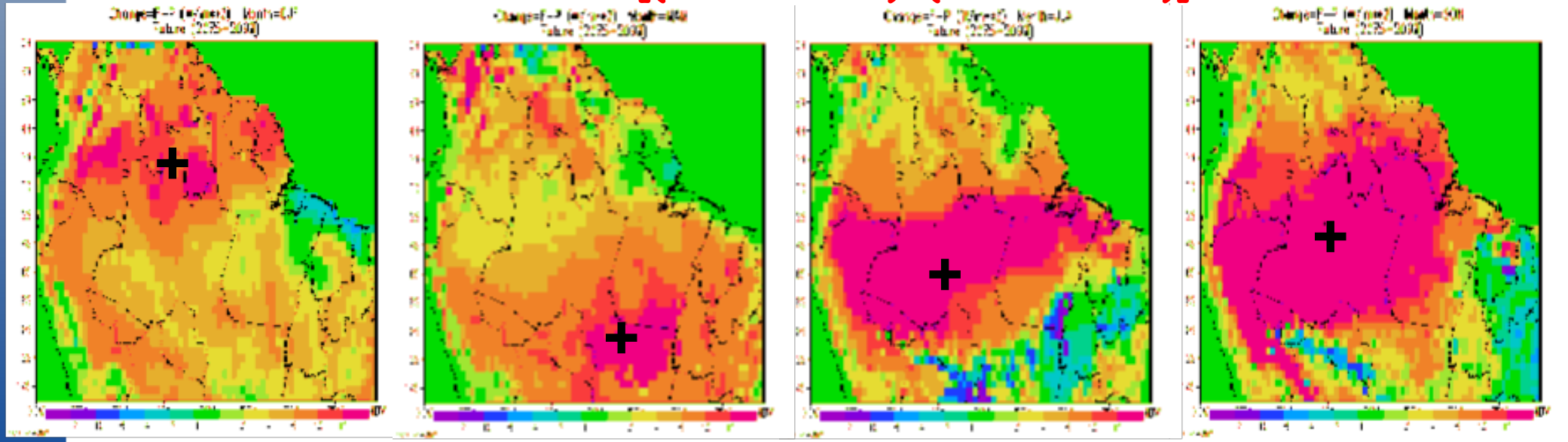

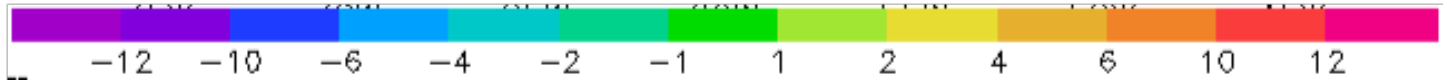

Initial results form the analyses of ES model projections

Hard to see in the ES simulations because of non availability of a continuous time series until 2100. Need more extreme scenarios

Using ES data: reductions in rainfall, increases in temperature and transpiration are stronger in south-central Amazonia, while similar changes are noticed over northwestern Amazonia in the HadCM3.

Next steps

Assess changes in natural vegetation in S. America using the CPTEC PVM and PIK LPJ vegetation models forced with future climate scenarios from the ES runs (20 km...)-A1B

Assess changes in forest cover in S. America using the CPTEC PVM and PIK LPJ vegetation models forced with future climate scenarios from the regional models run at CPTEC foecd ith the HadAm3 (50 km)-A2, B2, 2071-2100

Possible inclusion of anthropogenic land use change in the