Eta/Noah-MP model: Applications in South America

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Outline

- Eta/Noah-MP model history
- Deeper soil column
- Eta/Noah-MP simulations with high resolution in Amazonia
- Downscaling projections using Eta/Noah-MP in South America
- Downscaling projections with the tile approach
- Application of Noah-MP crop in northeastern Brazil

Eta/Noah-MP model history

- **2012-2015:** Implementation of coupling the Noah-MP LSM alpha version (Niu et al. 2011) to the Eta model (Eta/Noah-MP version)

- **2015:** Implementation of the tile approach to represent the subgrid effects (Pilotto et al. 2017)

- **2016-2018:**

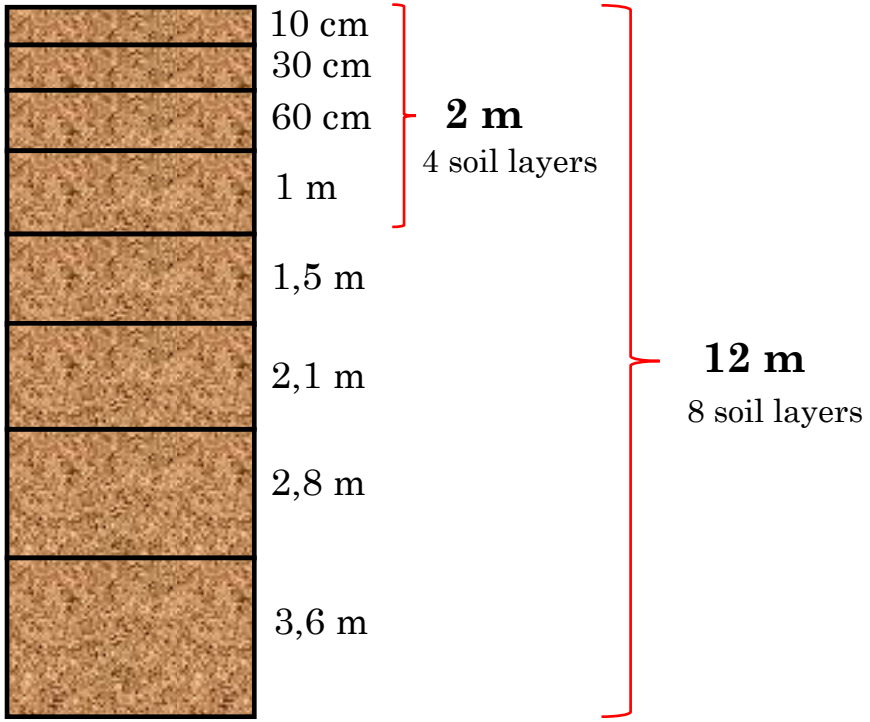
- Addition of 4 soil layer, reaching a soil column of 12 meters
- Annual update of the vegetation maps during the integration time

- **2018-2020:** Update of the versions from the Eta and Noah-MP (version used in WRF 3.9)

- **2020:** Improvements in the tile approach

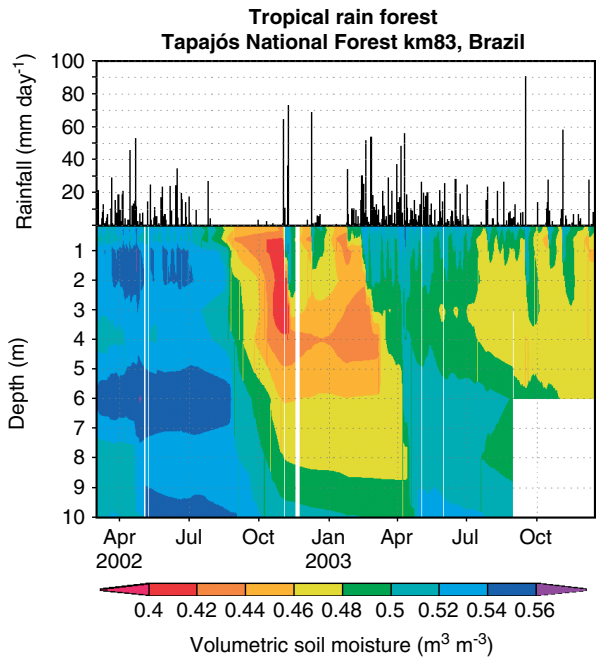
Deeper soil column

Soil column



Pilotto et al. 2023
(under revision)

Bruno et al. 2006



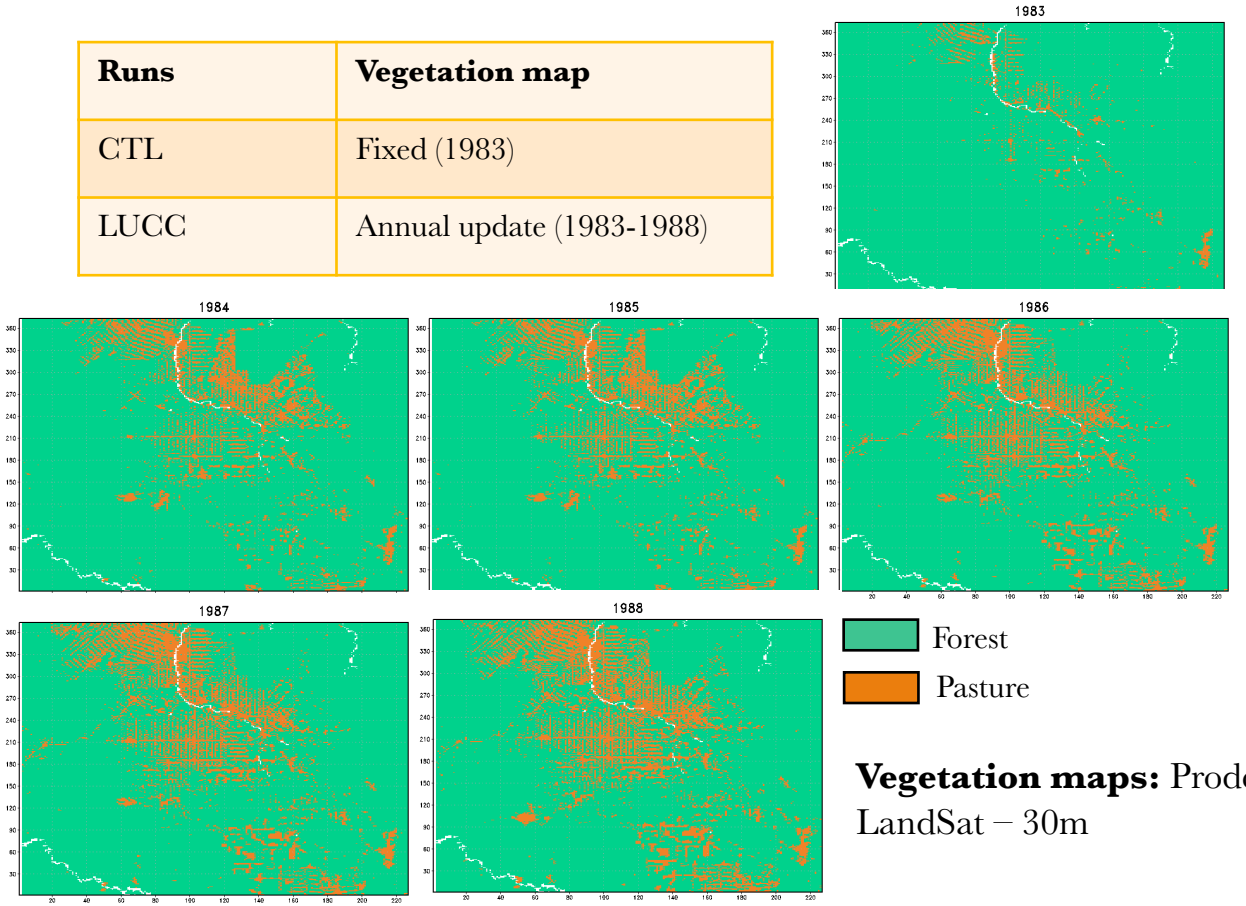
Impacts of the land use changes on local hydroclimate in southwestern Amazon

Eta/Noah-MP 1km

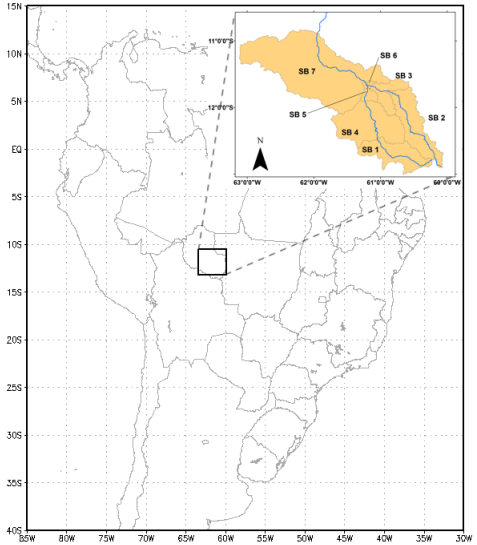
Period: 1984-1989

- The 1980s present the highest annual deforestation rates

Runs	Vegetation map
CTL	Fixed (1983)
LUCC	Annual update (1983-1988)



Domain: Jí-Paraná Basin

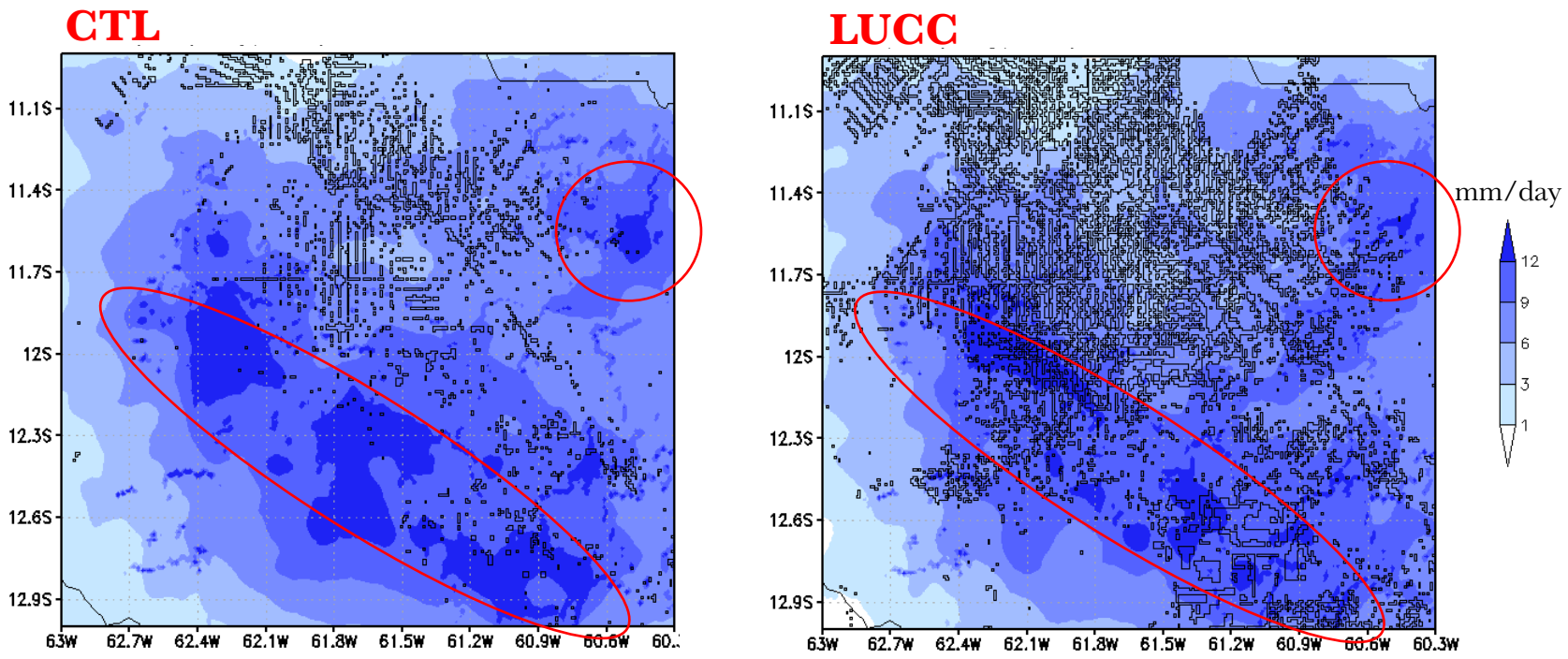


Vegetation maps: Prodes (Linhares, 2005) + LandSat – 30m

Pilotto et al. 2023 (under revision)

Impacts of the land use changes on local hydroclimate in southwestern Amazon

5 years-averaged precipitation (DJF)



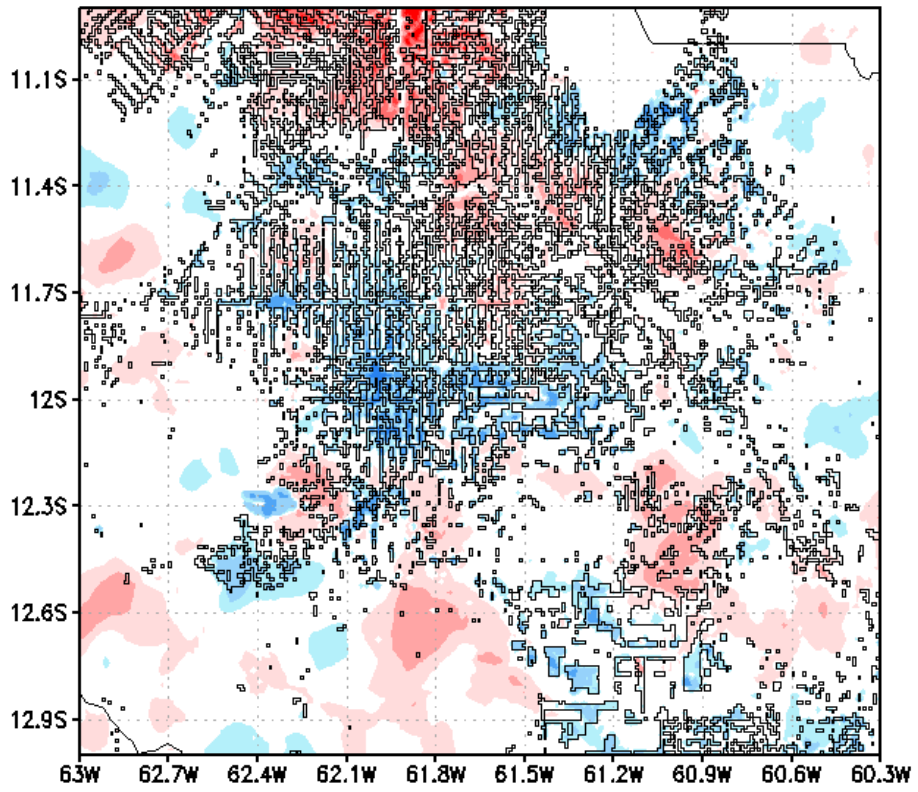
- Simulated higher rainfall volumes are reduced with expansion of pasture lands

Pilotto et al. 2023 (under revision)

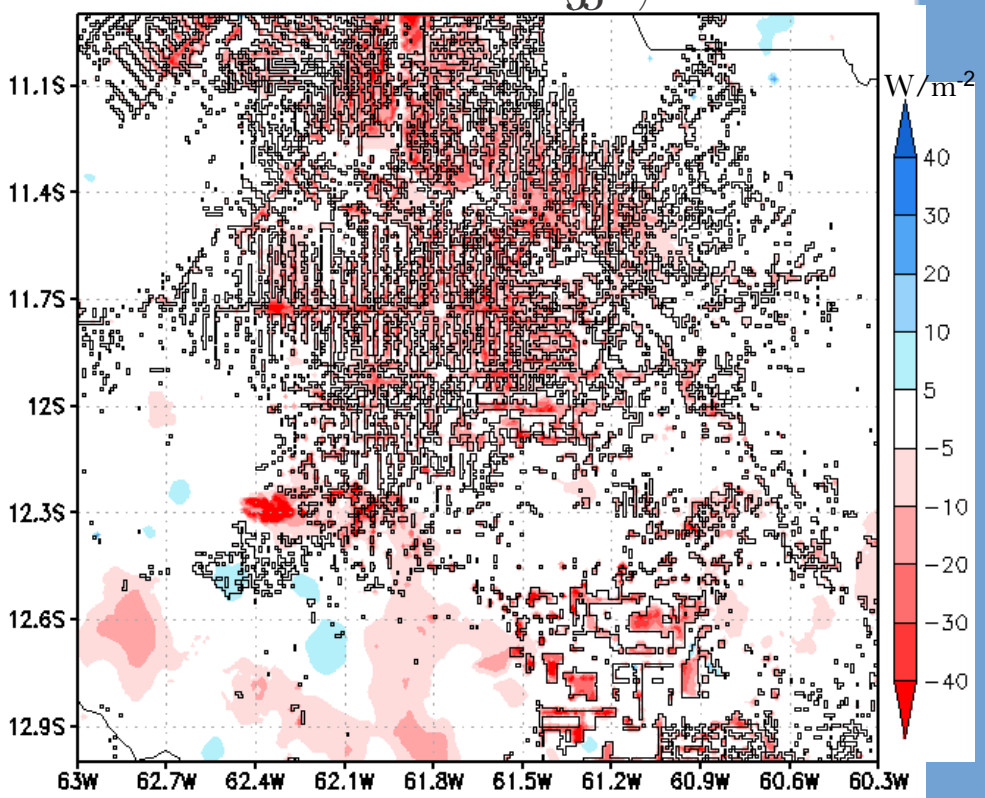
Impacts of the land use changes on local hydroclimate in southwestern Amazon

5 years-averaged latente heat flux

LUCC - CTL (DJF)



LUCC - CTL (JJA)



Black outlines: deforested areas from 1988

- Increase in evapotranspiration in some pasture lands during the rainy season (DJF)
- Reduction of evapotranspiration in deforested patches during the dry season (JJA)

Pilotto et al. 2023 (under revision)

Downscaling projections: impacts in future climate

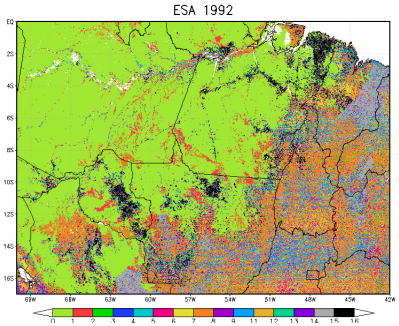
Eta/Noah-MP 20 km

1. CTL
BC:CanESM2
Period:1960-1990

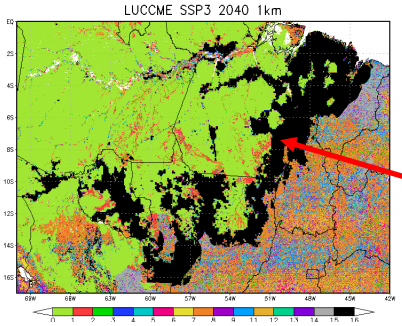
2. VegCTL
BC: CanESM2 RCP4.5
Period: 2006-2040

3. LUCC
BC: CanESM2 RCP4.5
Period: 2006-2040

CTL and VegCTL: veg map from ESA 1992



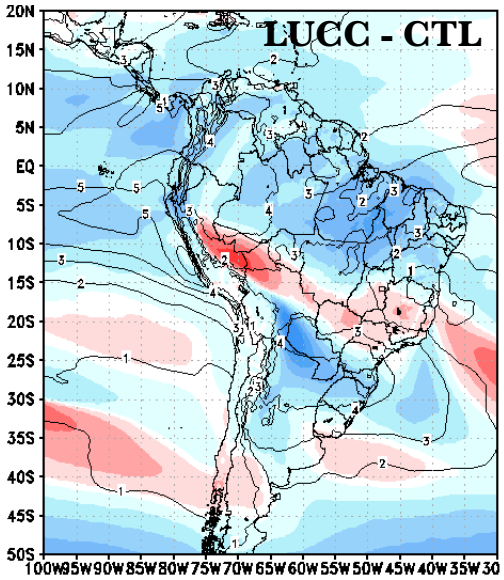
LUCC : SSP3 land use scenario (LuccME/DIIAV) for Amazonia (2010-40) + ESA 1992

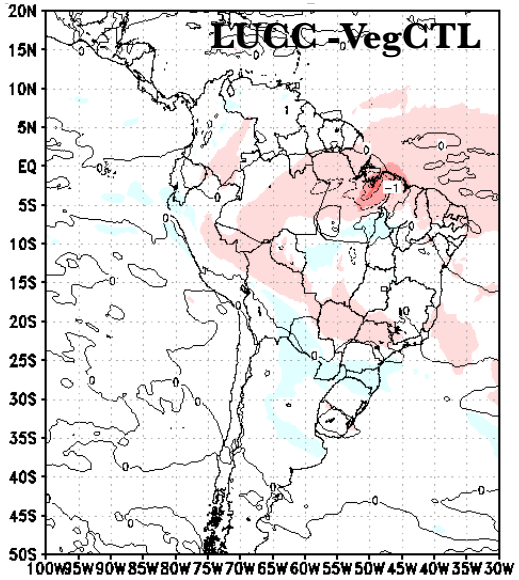


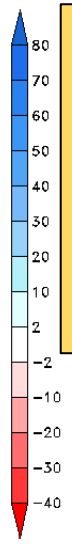
- planted pasture
- agriculture
- occupation mosaic

Vertically integrated water-vapor flux (kg/ms) - NDJFM

Effects of increased Amazonia deforestation and CO_2



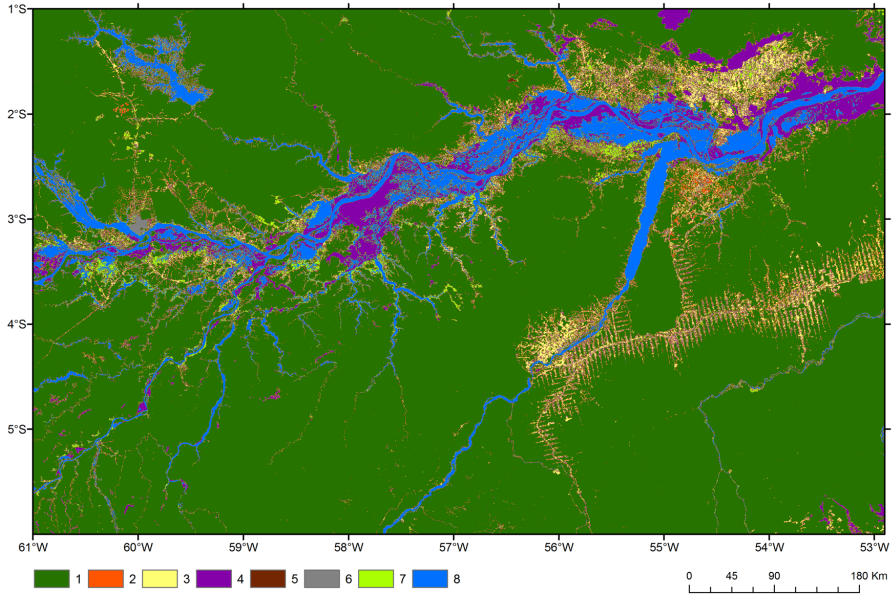


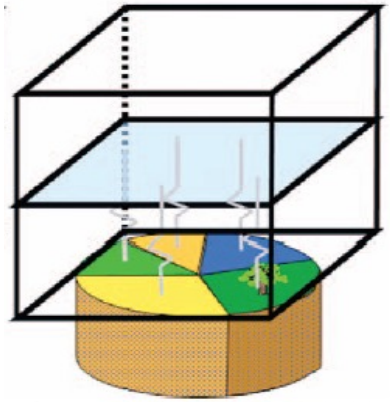


Effects of increased Amazonia deforestation on warmer climate

Tile Approach (Avissar and Pielke 1989)

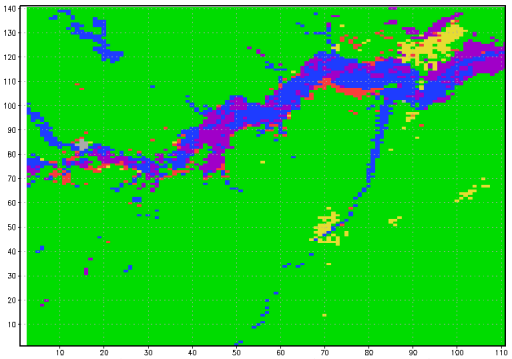
Map: TerraClass/INPE 30 meters



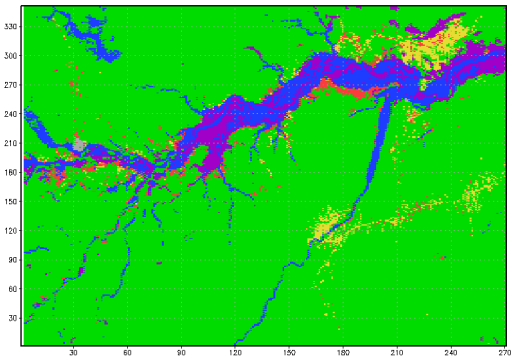


Source: Mengelkamp et al. 2006

$$LE_{total} = 0.4LE_{pasture} + 0.6LE_{forest}$$



Dominant vegetation at 5km

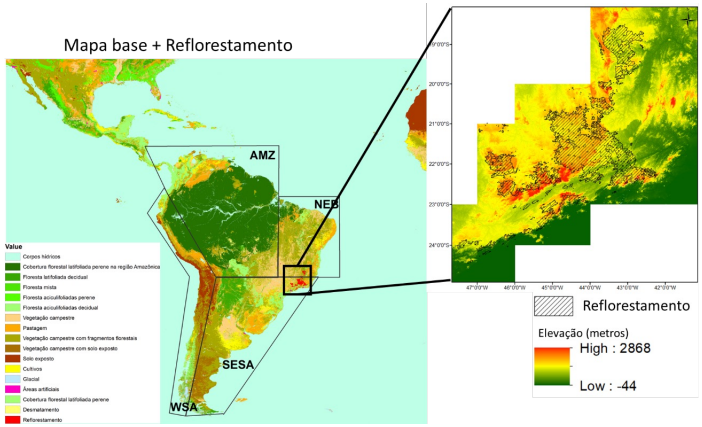


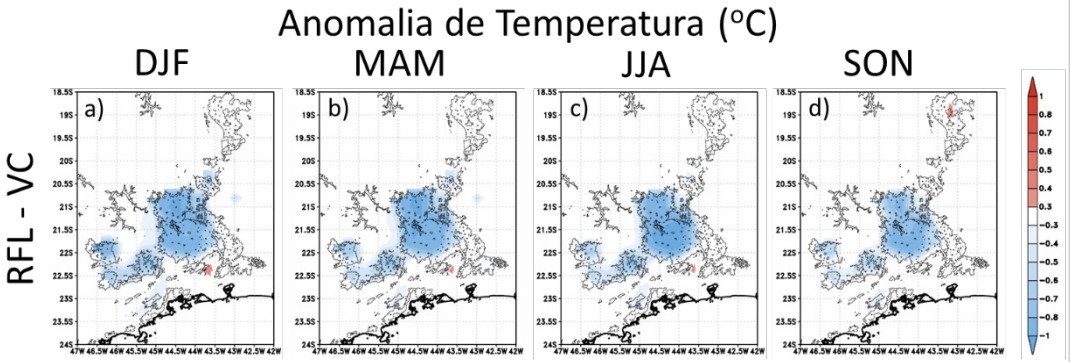
Dominant vegetation at 2km

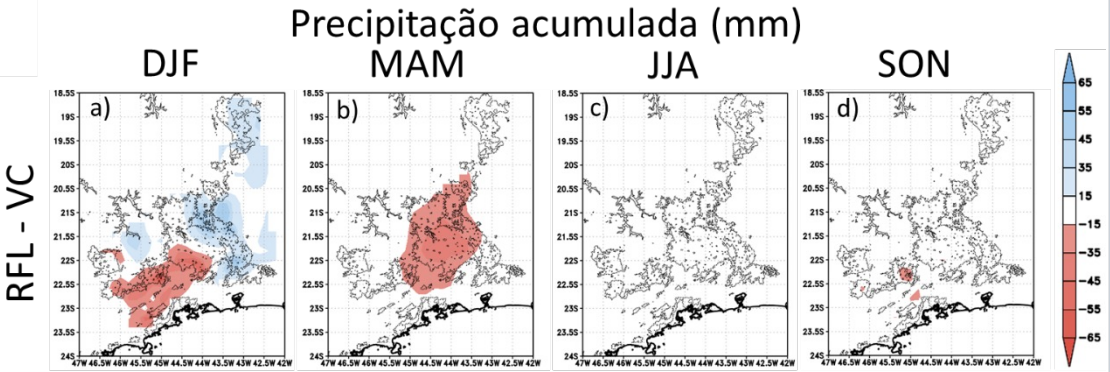
- Eta/Noah-MP (Pilotto et al. 2017)
- Improvements for climate changes version of Eta/Noah-MP model

Effects of reforestation in southeastern Brazil

Eta/Noah-MP 20 km with the tile approach
Period: 2070-2100
BC/IC: CanESM2 RCP8.5







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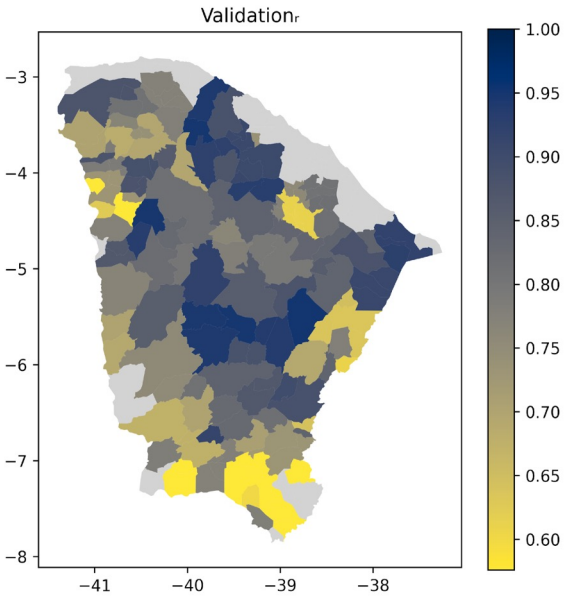
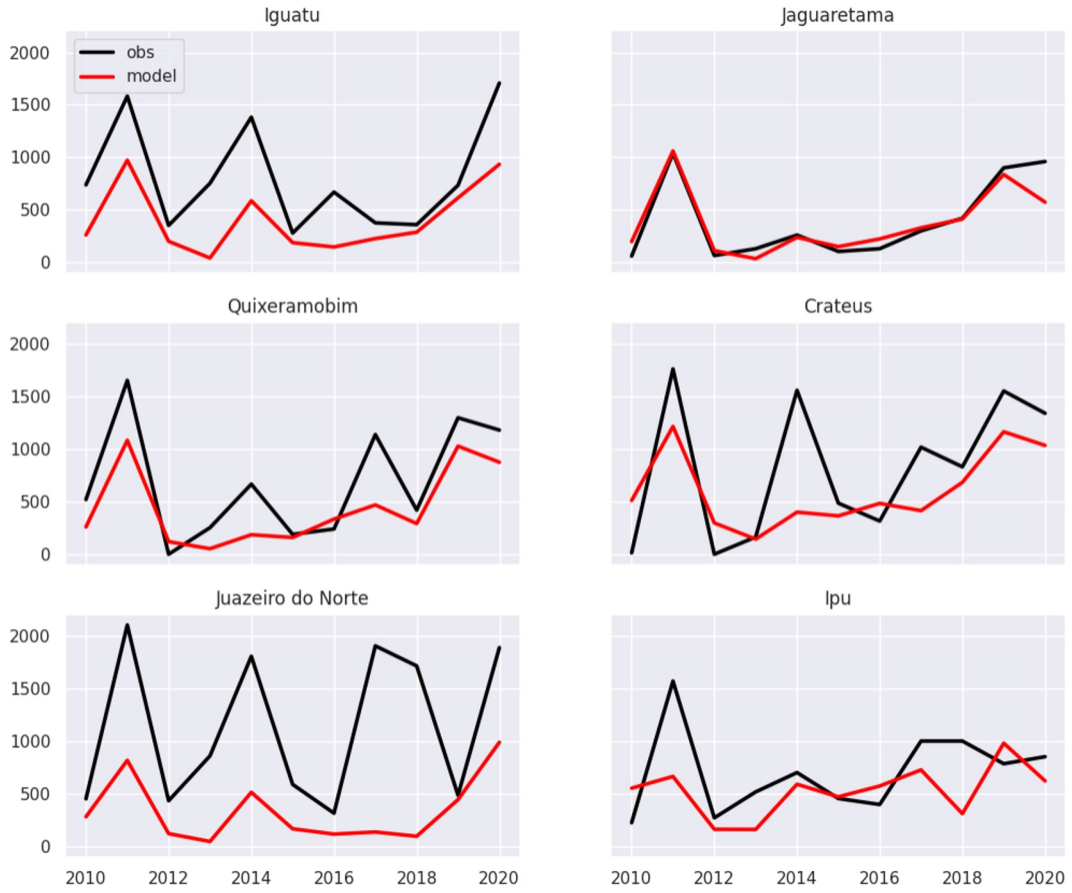
Corn yield prediction in Ceará State (northeastern Brazil) using Noah-MP Crop (Liu et al., 2016)



Correlation between simulated and observed crop yield in Ceará State



Observed and simulated crop yield in six municipalities of Ceará State

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Thank you!