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

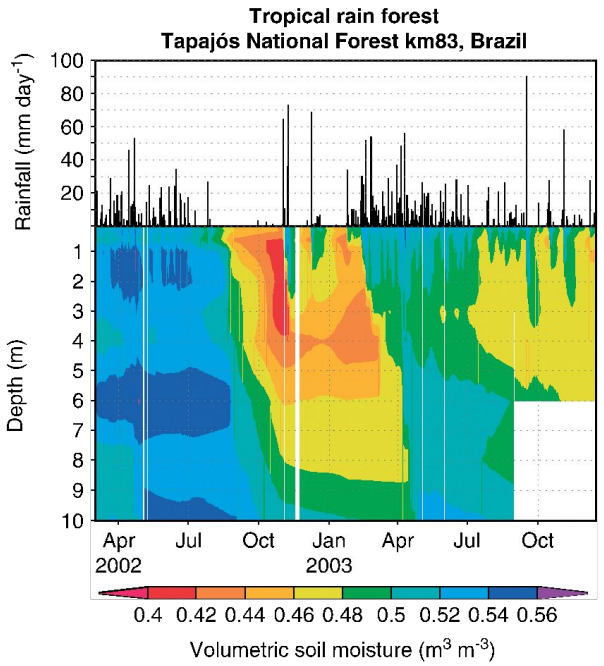
10 cm
30 cm
60 cm
1 m
1,5 m
2,1 m
2,8 m
3,6 m

2 m
4 soil layers

12 m
8 soil layers

Pilotto et al. 2023 (under revision)

Bruno et al. 2006



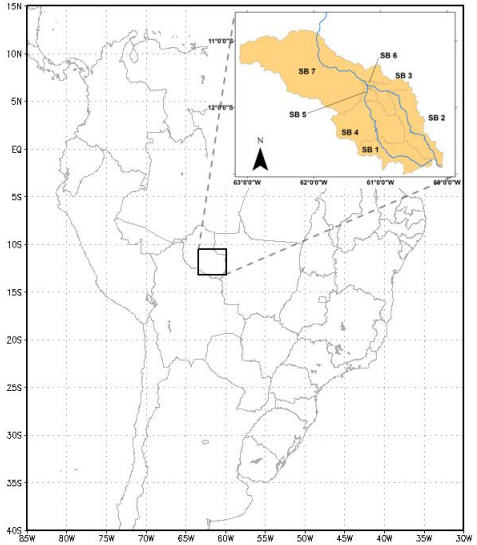
Impacts of the land use changes on local hydroclimate in southwestern Amazon

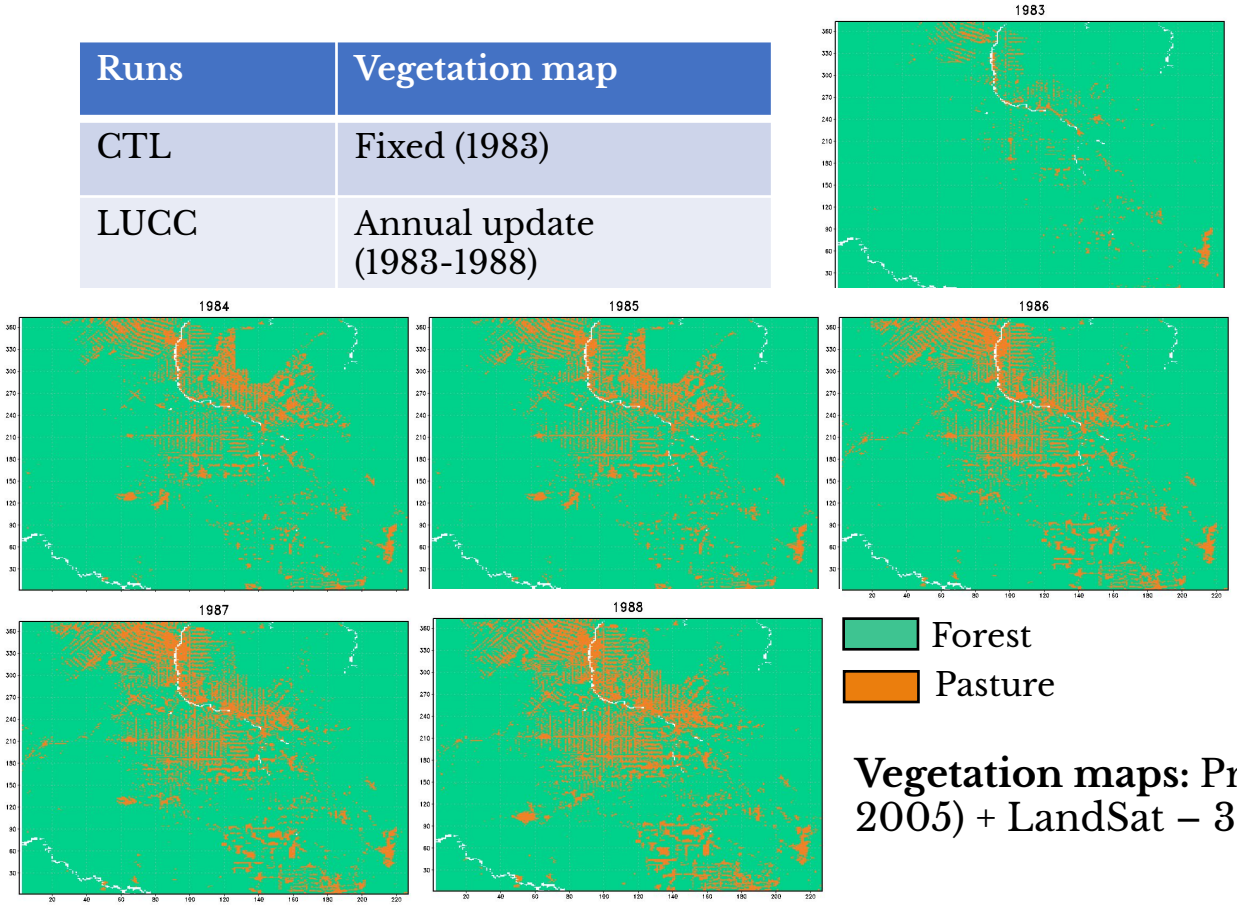
Eta/Noah-MP 1km

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





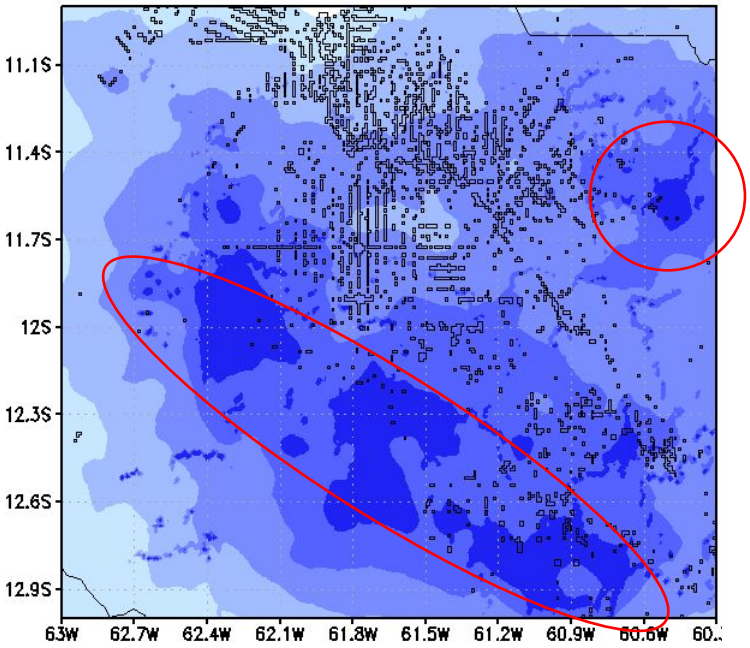
Vegetation maps: Prodes (Linhares, 2005) + LandSat – 30m

Pilotto et al. 2023 (under revision)

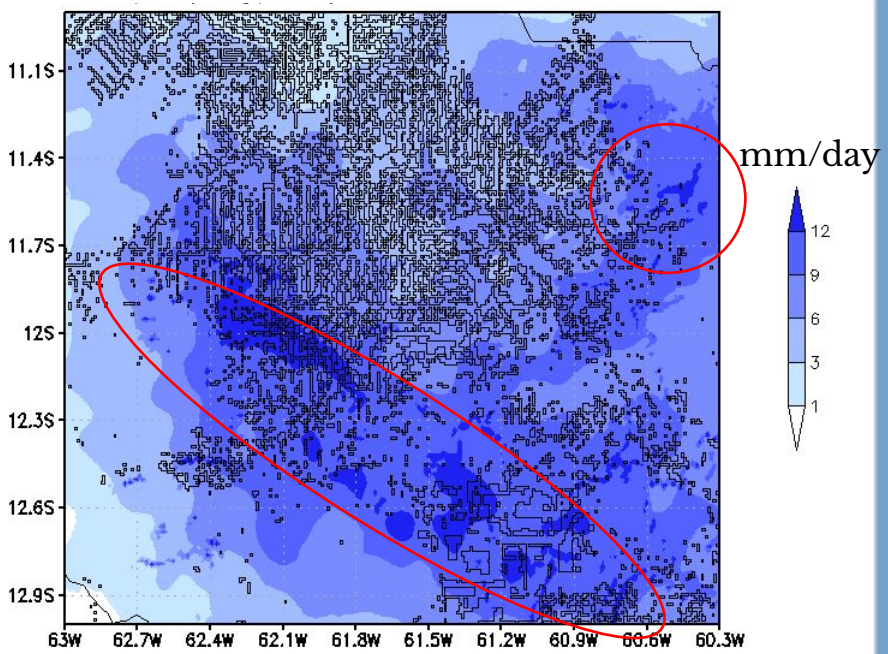
Impacts of the land use changes on local hydroclimate in southwestern Amazon

5 years-averaged precipitation (DJF)

CTL



LUCC



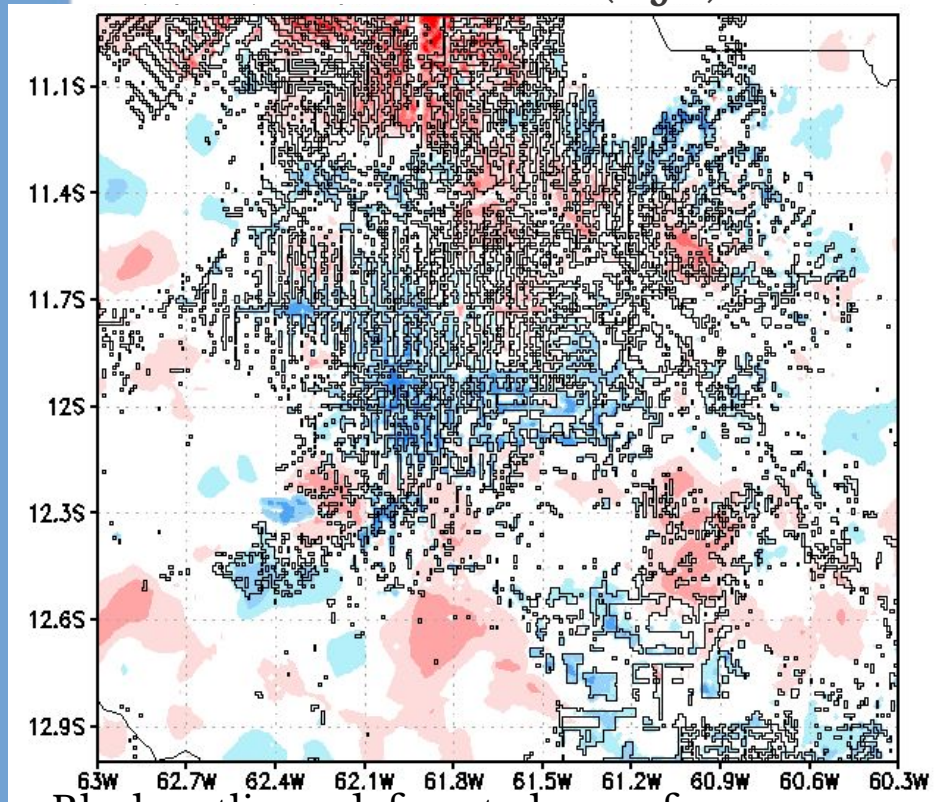
- Simulated higher rainfall volumes are reduced with expansion of pasture lands

Pilotto et al. 2023 (under revision)

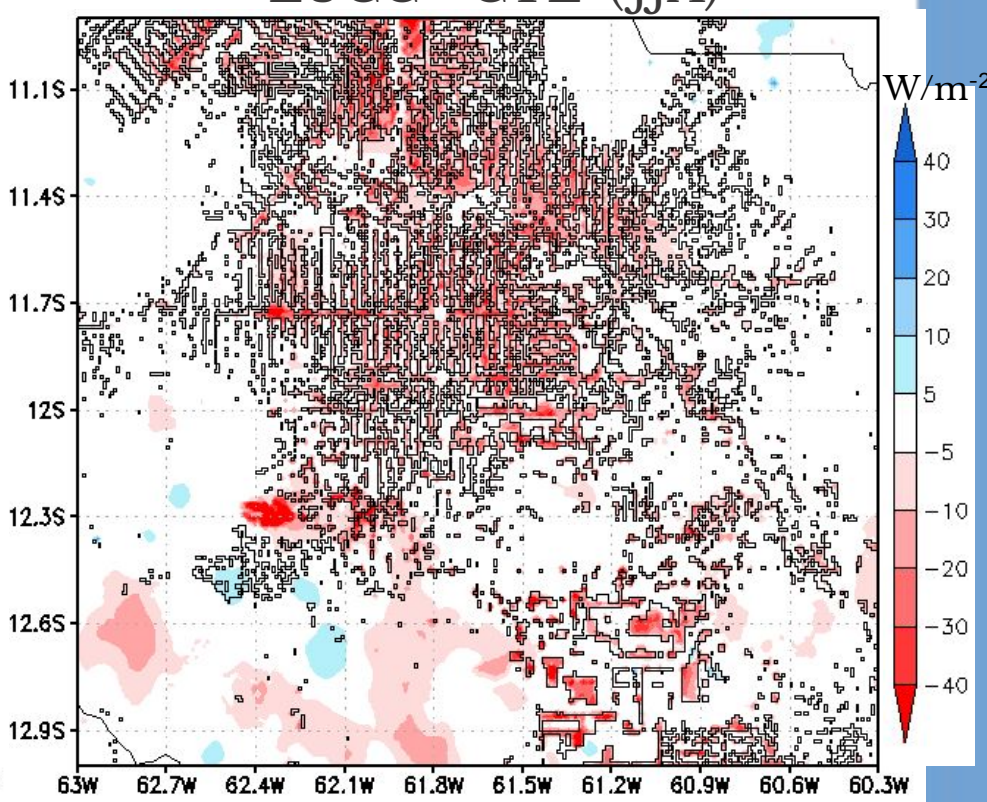
Impacts of the land use changes on local hydroclimate in southwestern Amazon

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 d A)

Pilotto et al. 2023 (under revision)

Downscaling projections: impacts in future climate

FAPESP
FUNDAÇÃO DE AMPARO À PESQUISA DO ESTADO DE SÃO PAULO

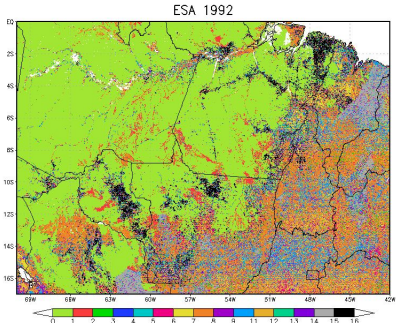
Eta/Noah-MP 20 km

1. CTL
BC:CanESM2
Period:1960-1990

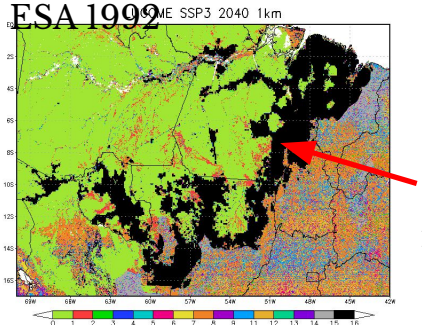
2. VegCTL
BC: CanESM2 RCP4.5
Period: 2006-2040

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

CTL and VegCTL: veg map from ESA 1992



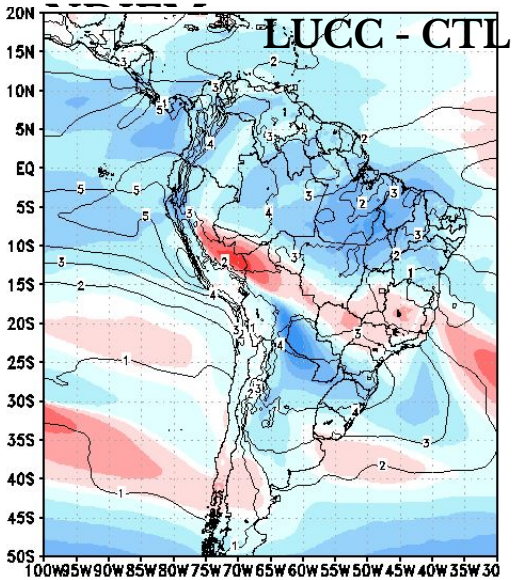
LUCC : SSP 8 land-use scenario (LuccME/DIIAV) for Amazonia (2010-40) + ESA 1992

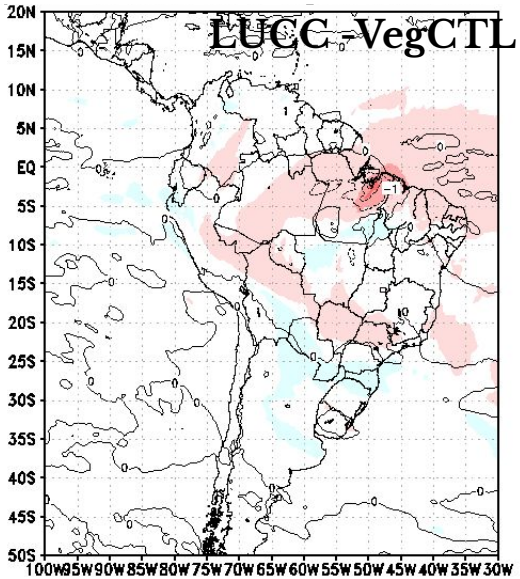


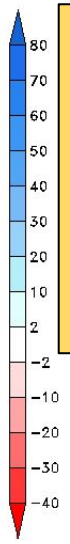
- planted pasture
- agriculture
- occupation mosaic

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

Effects of increased Amazonia deforestation and CO_2



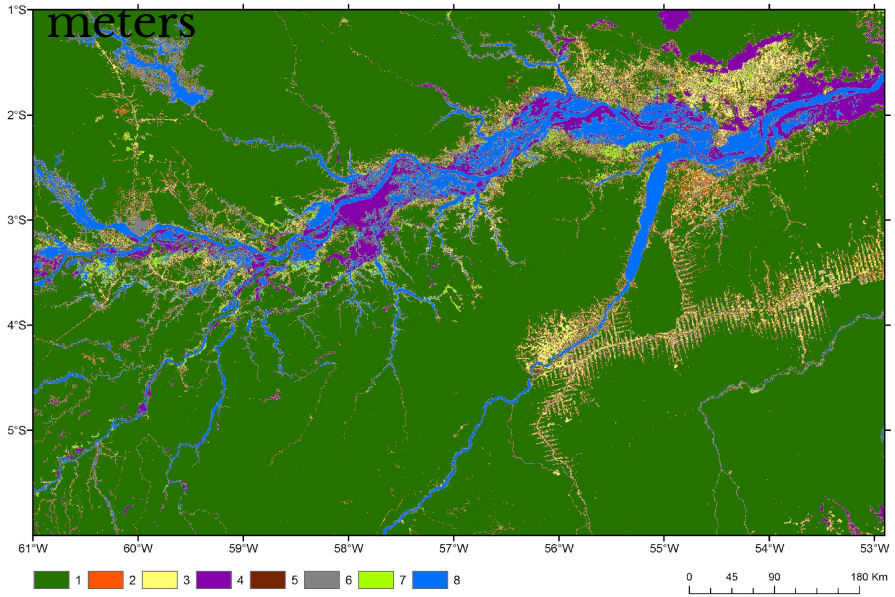


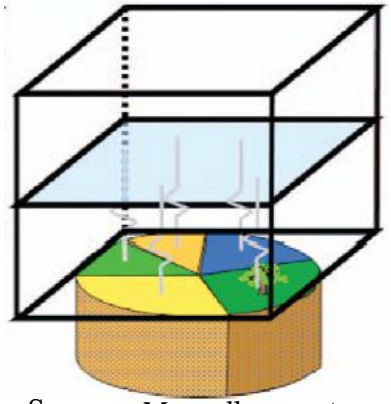


Effects of increased Amazonia deforestation on warmer climate

Tile Approach (Avissar and Pielke 1989)

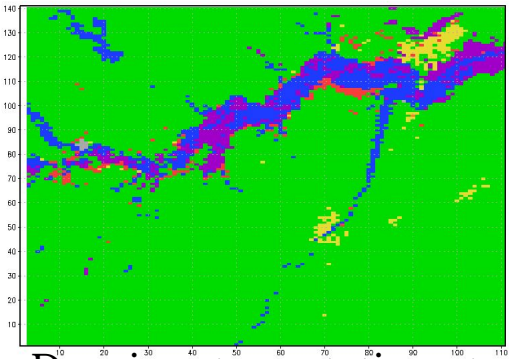
Map: TerraClass/INPE 30 meters



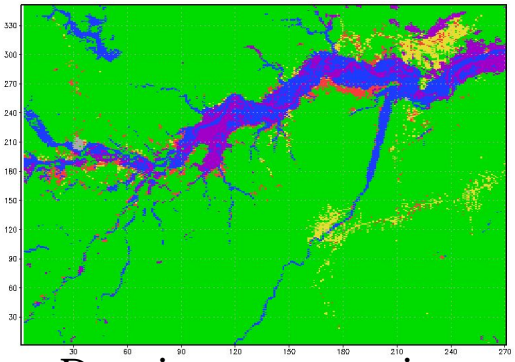


Source: Mengelkamp et al. 2006

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



Dominant vegetation at 5km

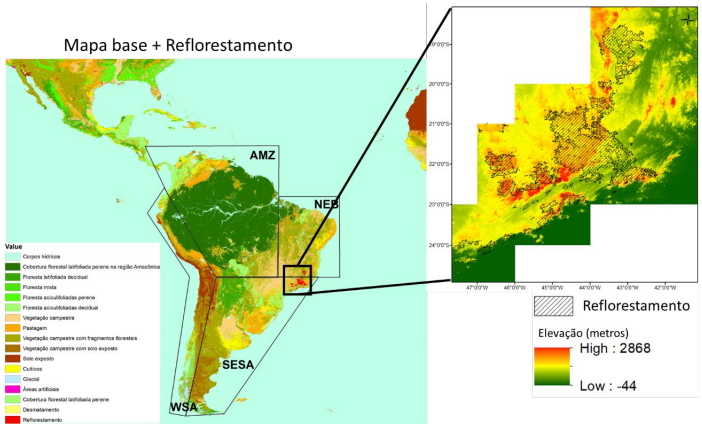


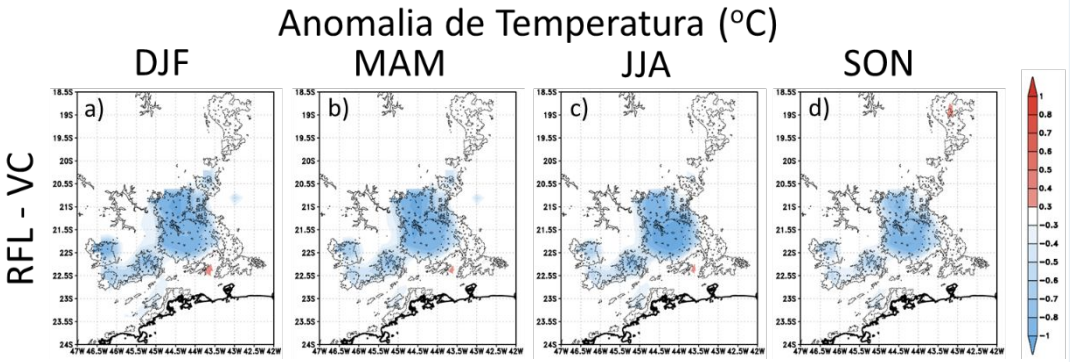
Dominant vegetation at 2km

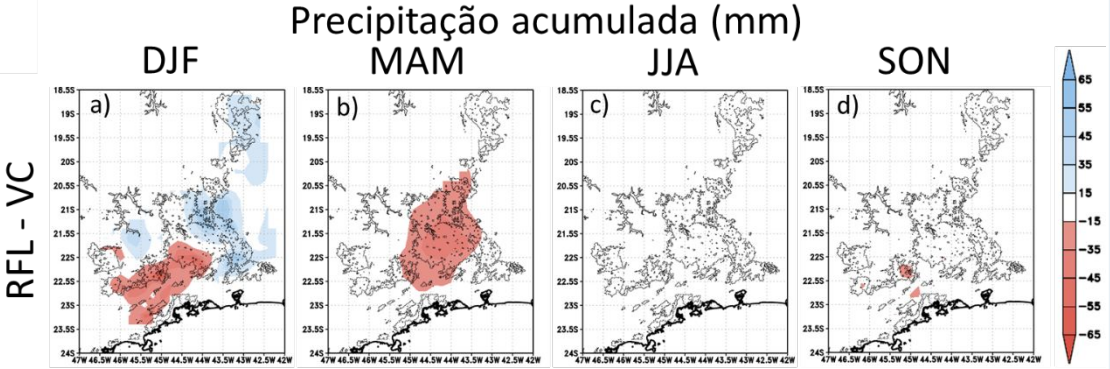
- Eta/Noah-MP (Pilotto et al. 2017)
- Improvements for climate changes version of Eta/Noah-MP model

Effects of reforestation in southeaster Brazil

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

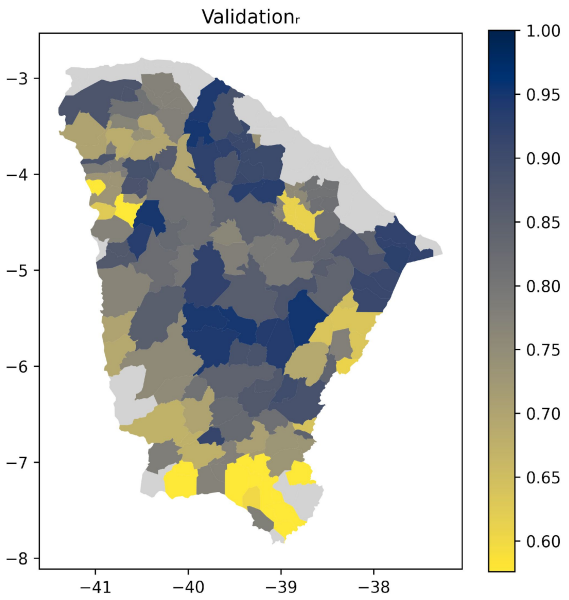




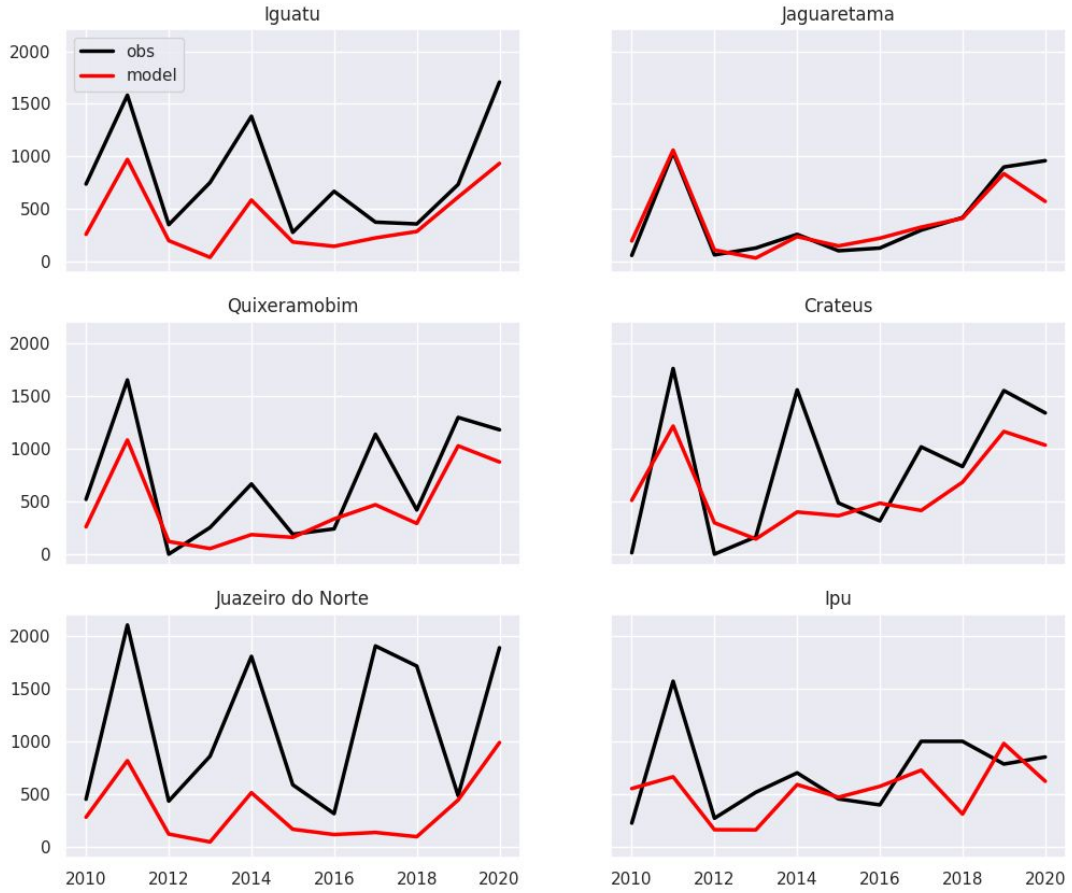


Lucas Garofolo's Dissertation

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!