Shortening of the Amazon's rainy season detected using satellite cloudiness observations

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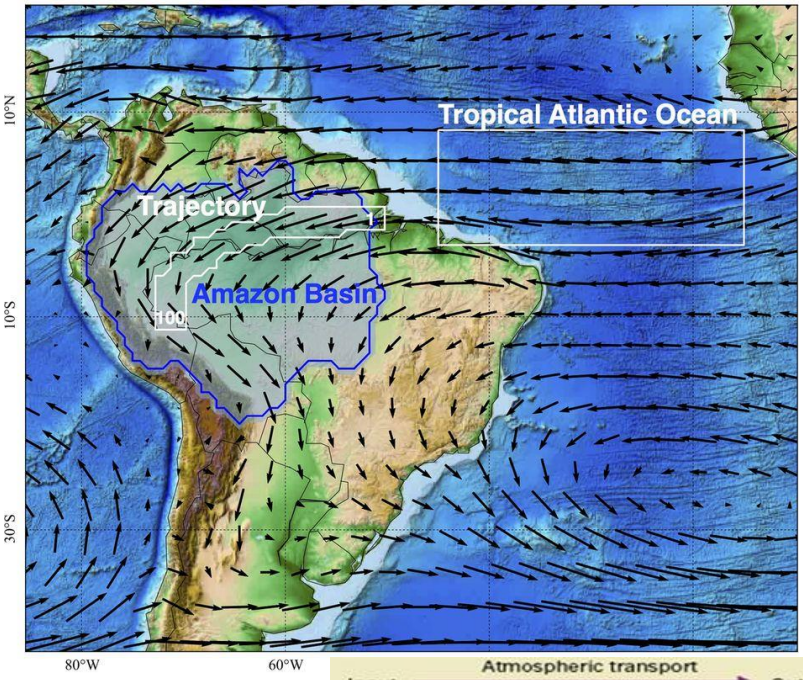
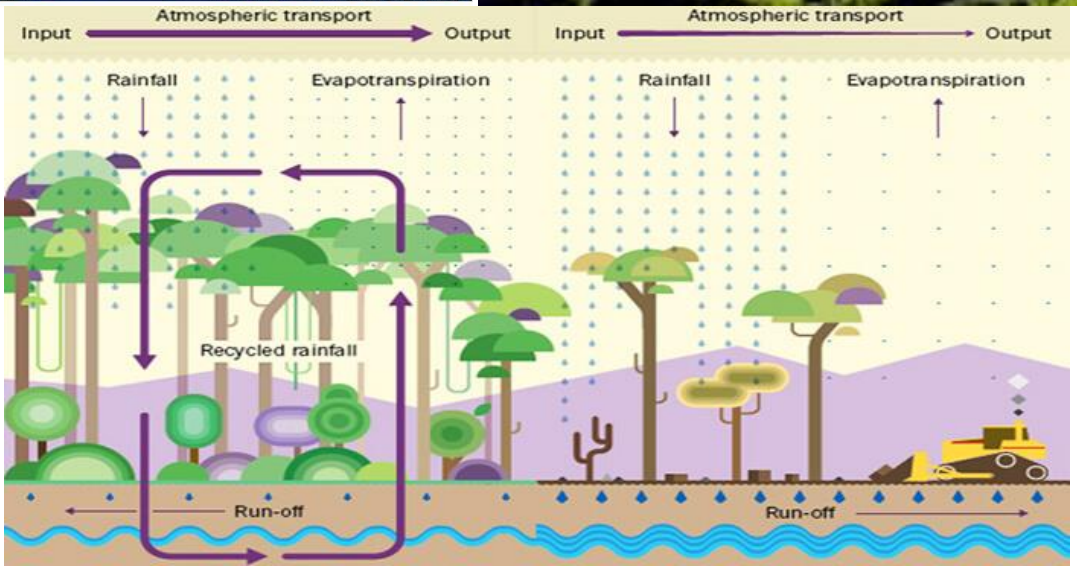
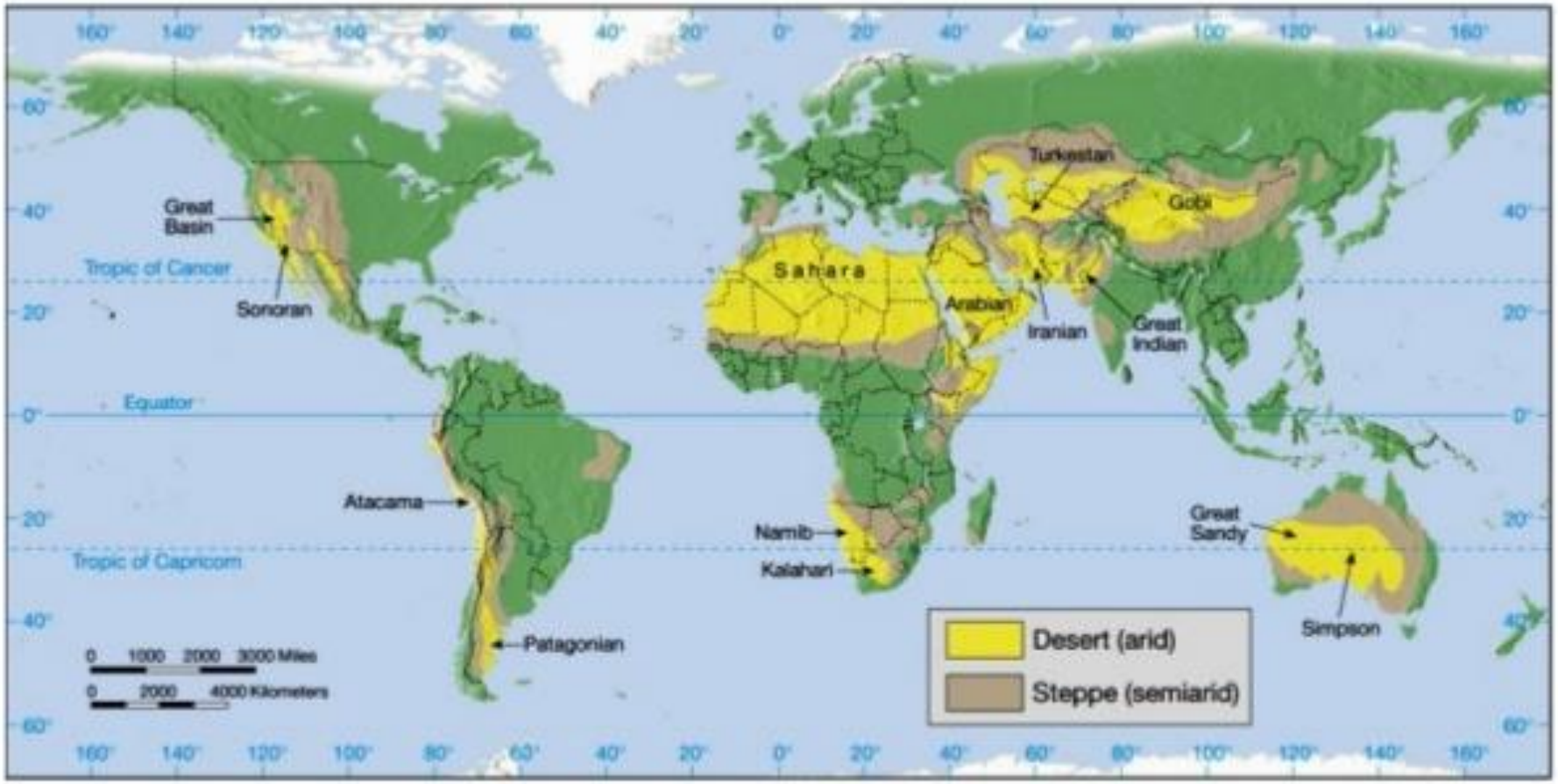
Why does the Amazon rainforest matter?



Boers et al., 2017



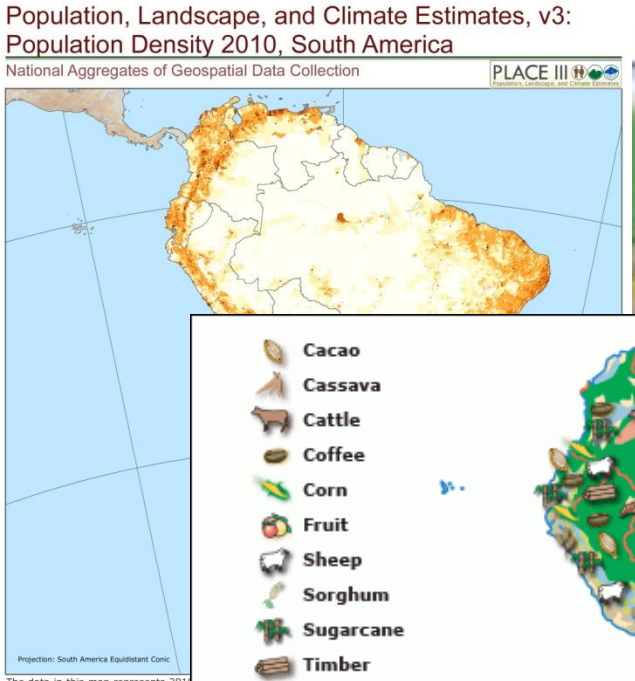
Largest deserts on Earth



Largest deserts on Earth

Population of the Southeast and South of Brazil: **108 million people.**

Largest deserts on Earth



Population of the Southeast and South of Brazil: **108 million people.**

South of Amazonia: agriculture and food security.

Largest deserts on Earth

What if Amazon's rainfall regime changes?

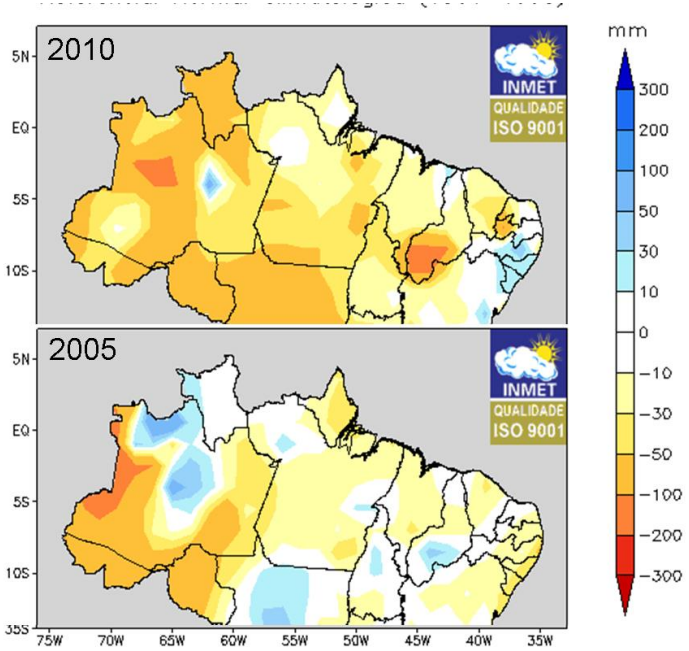
Population of the Southeast and South of Brazil: **108 million people.**

South of Amazonia: agriculture and food security.

Amazon rainforest hit by second 'once in a century drought' in five years

By DAVID DERBYSHIRE FOR MAILONLINE
UPDATED: 09:01 BST, 4 February 2011

Precipitation Anomaly –September



2010

2015

Goal:

Verify how Amazon's cloud life cycle and rainfall regime has changed over the years and explore the possible drivers and consequences of these changes.

Data:

International Satellite Cloud Climatology Project (ISCCP)

- 27 years of Cloud fraction retrievals from Geostationary Satellites (1983 – 2009)
- One measurement every 3 hours
- Grid cell: 2.5^{o} x 2.5^{o}

Other data sources

- ERA-Interim and ERA Interim/Land Reanalysis
- Climate indices time series

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- How are these variations linked to meteorological variables over the region?
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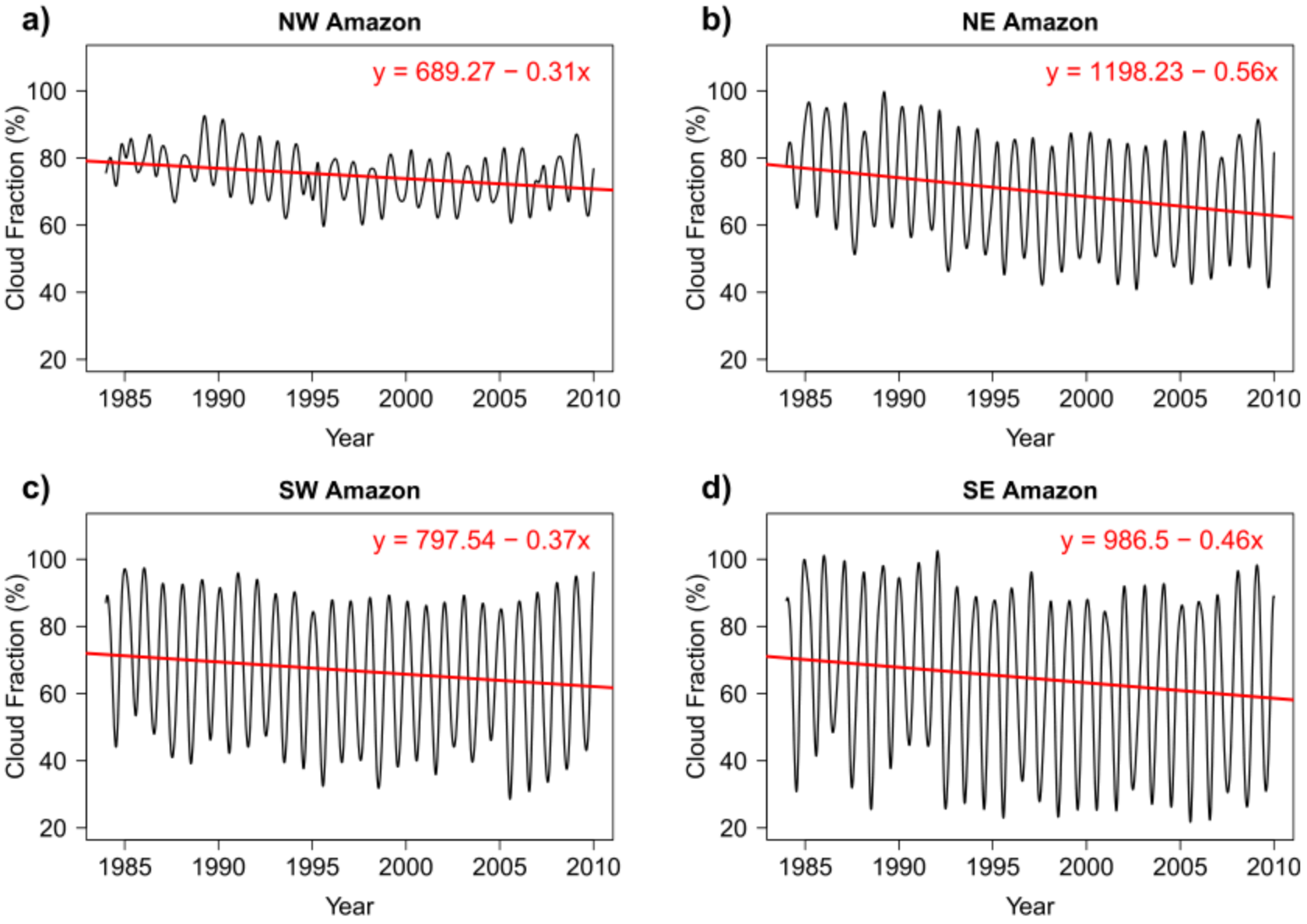
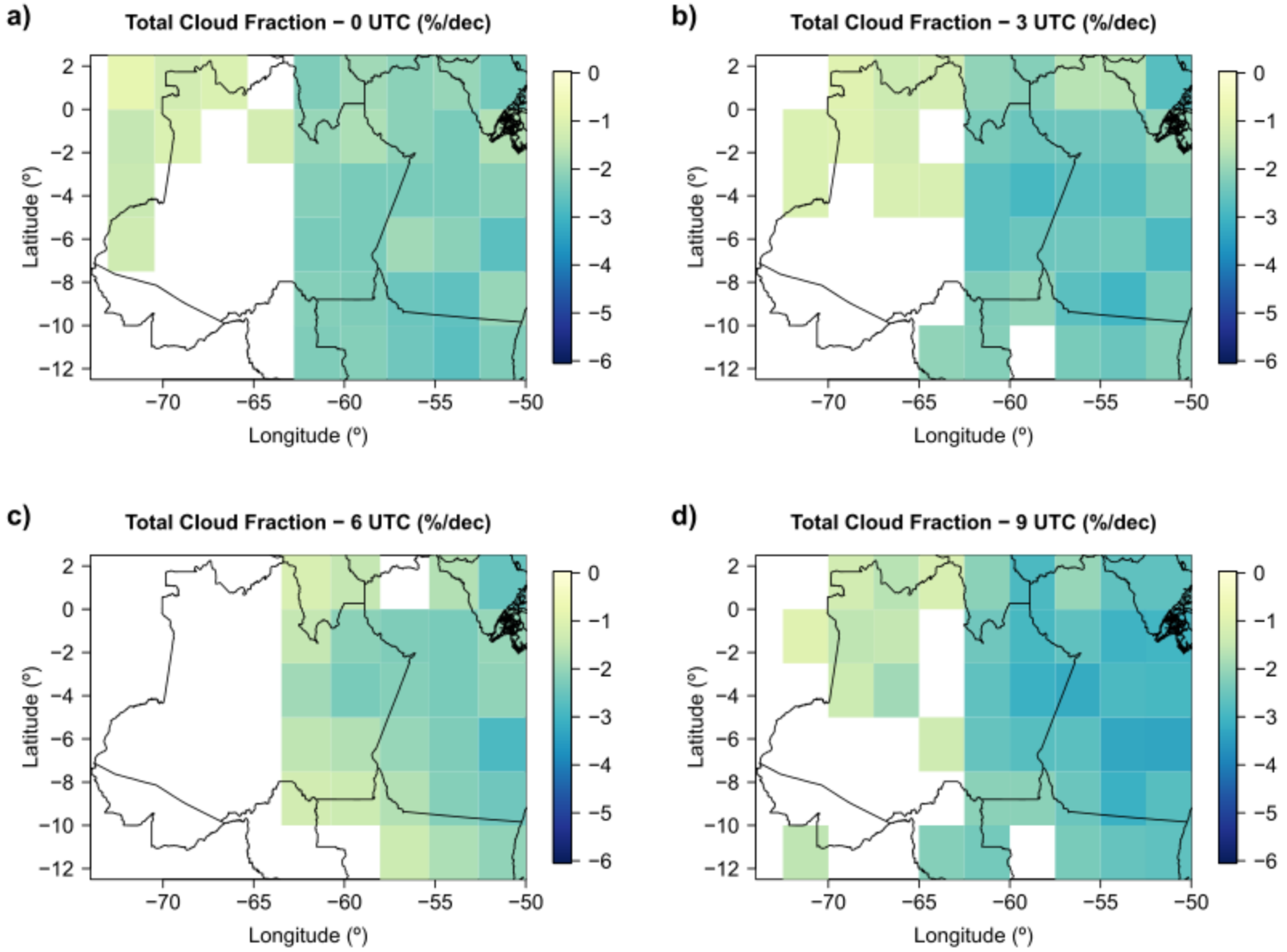
Time series of Total Cloud Fraction by region (1983 -2009)



Linear trends – Total CF (1983 – 2009)



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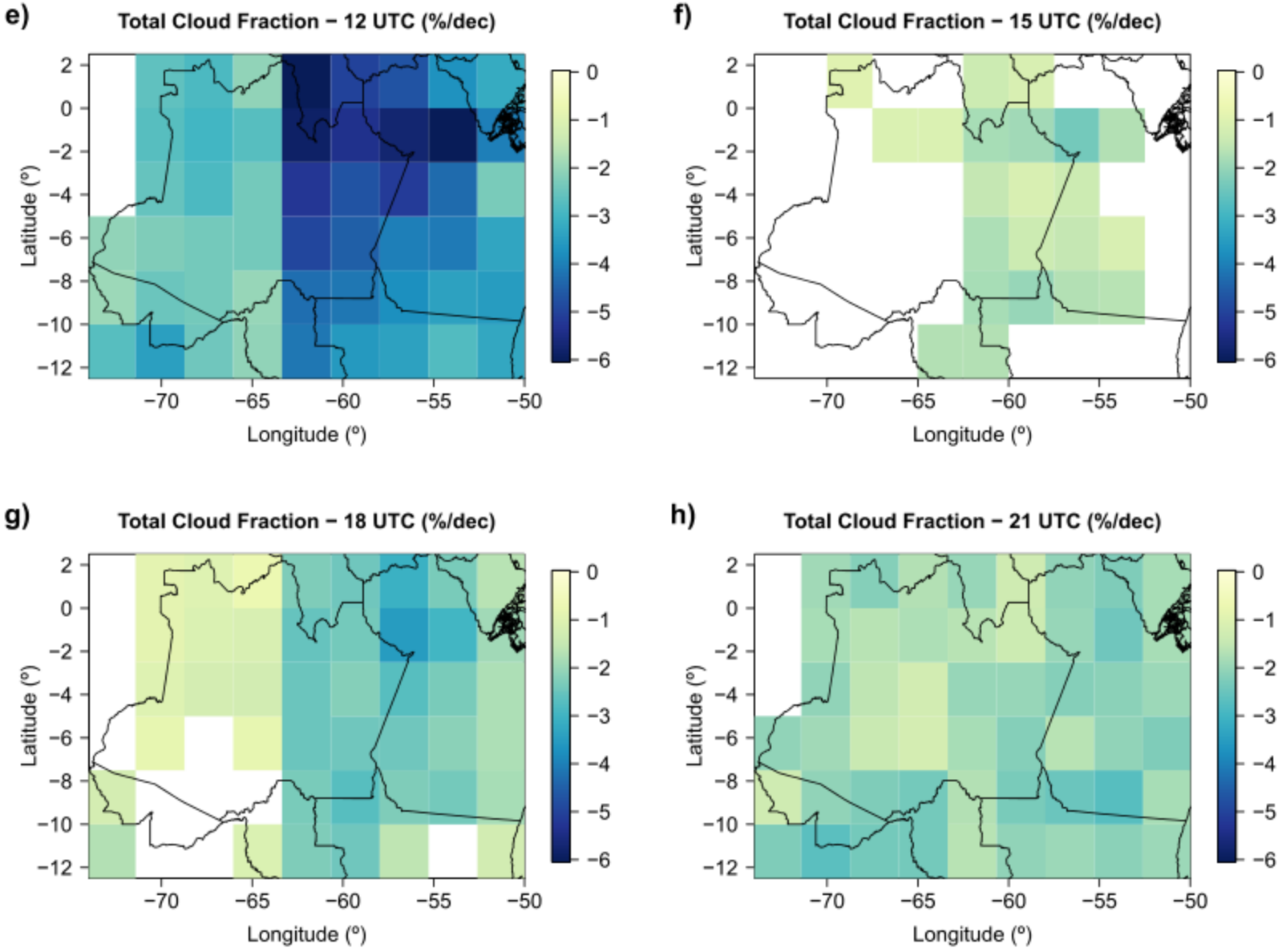

Cloud fraction reduction at all times, mainly due to high clouds reduction.

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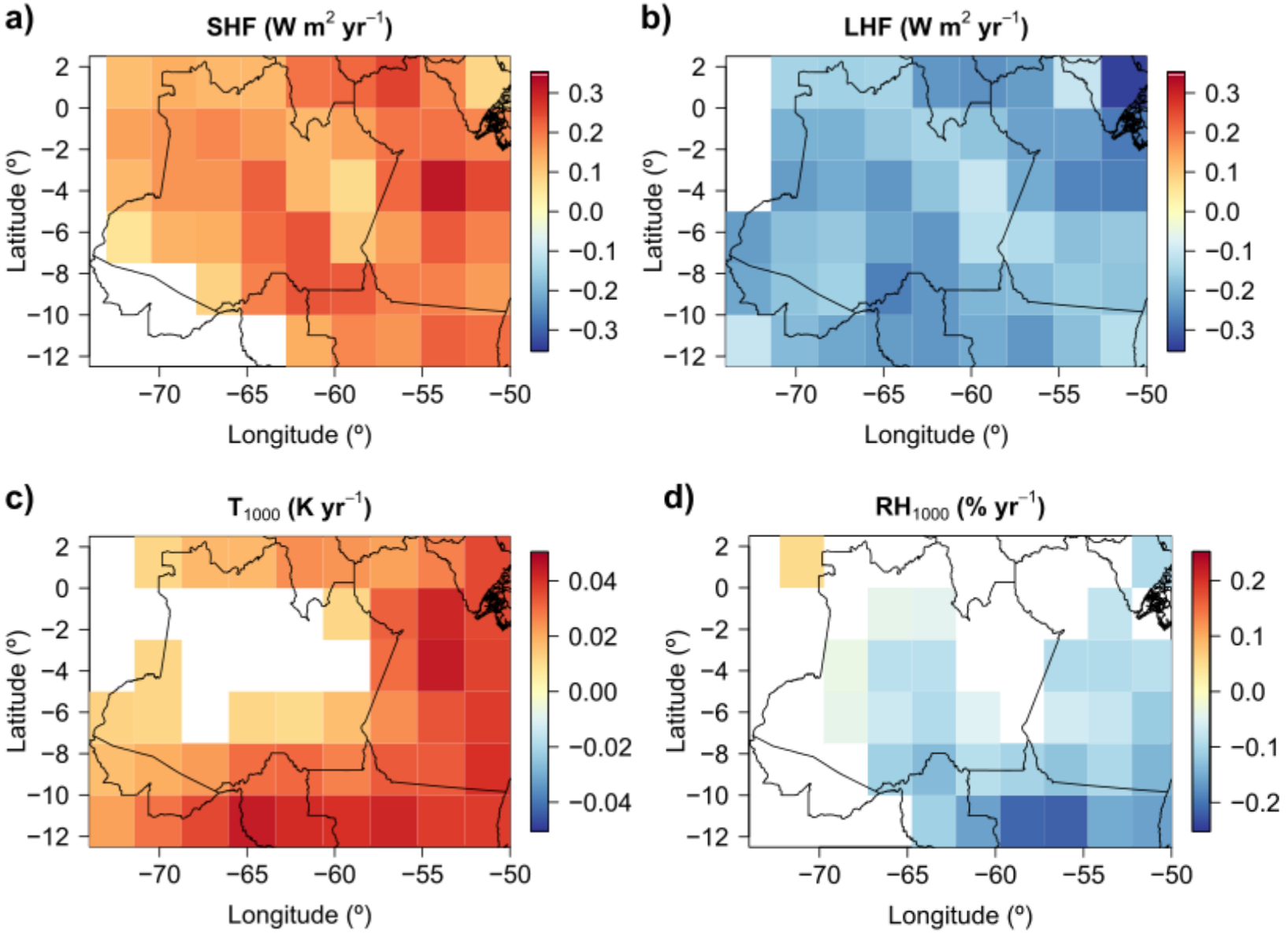
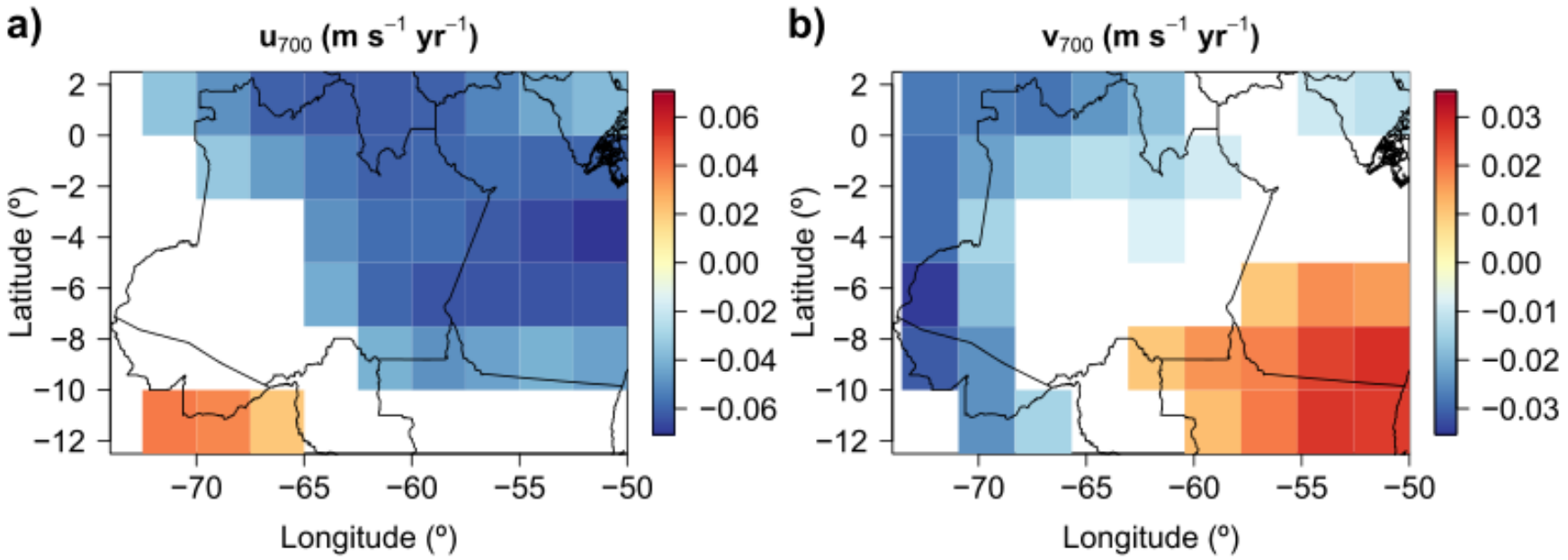


Consistent with decreased cloud fraction.

Linear trends (1983 – 2009)



- Intensification of easterly winds.
- Intensification of northerlies in the NW and weakening of northerlies in the SE.

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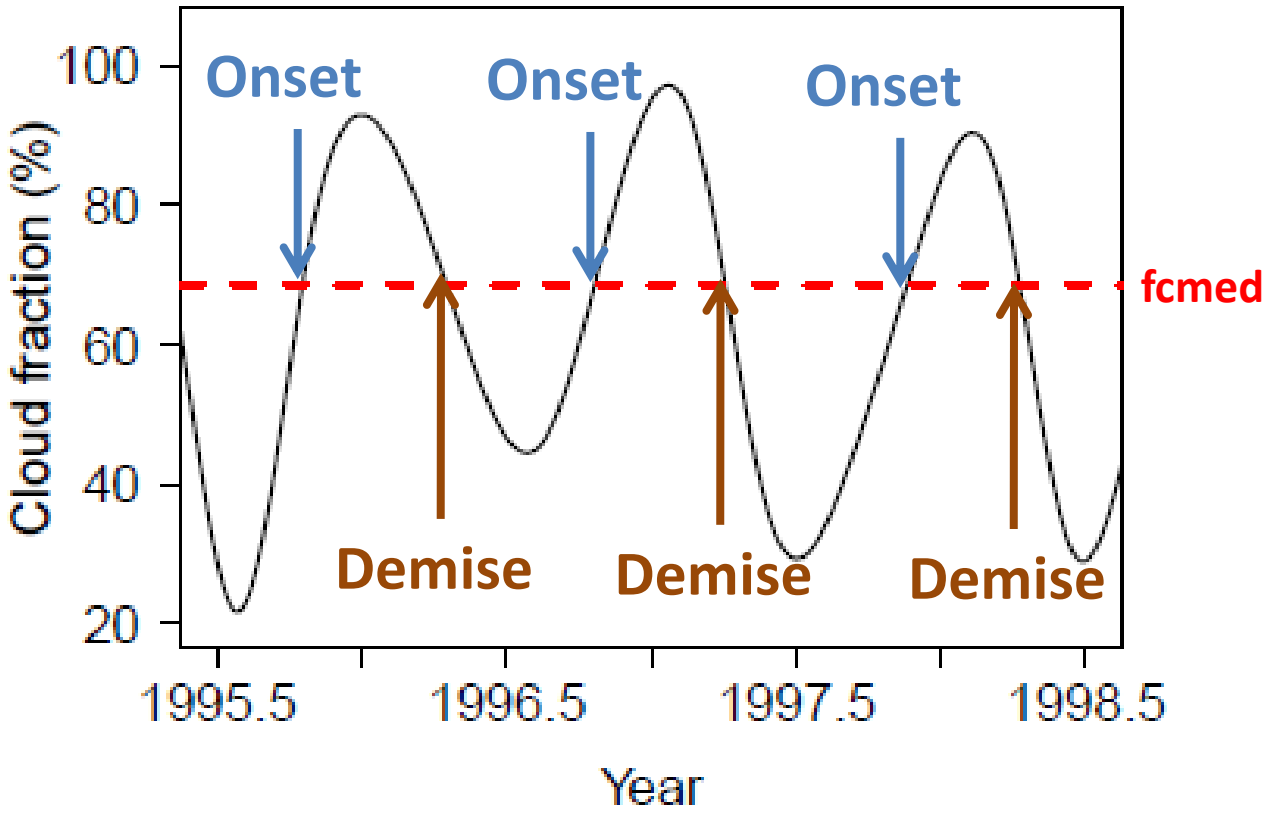
Methodology

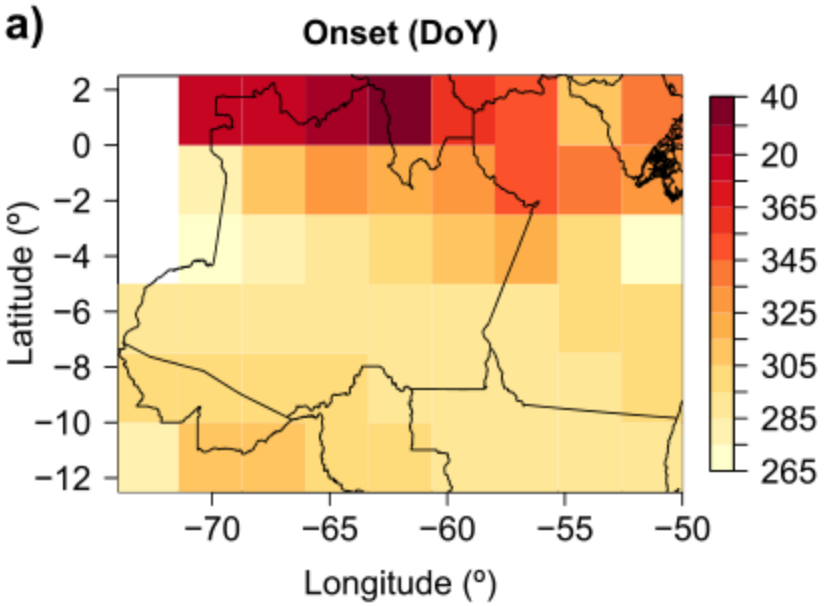
New method to estimate wet season onset, demise and length in Amazon.

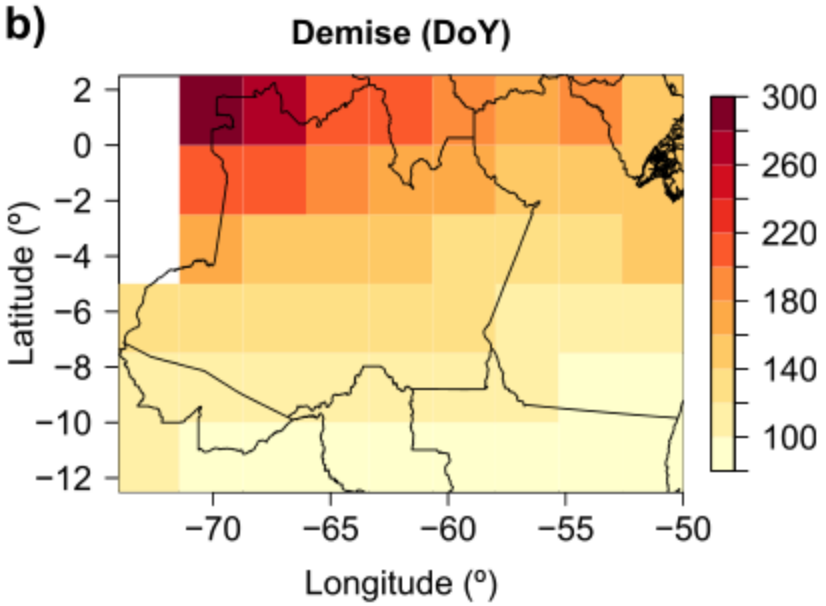
Example of smoothed cloud fraction

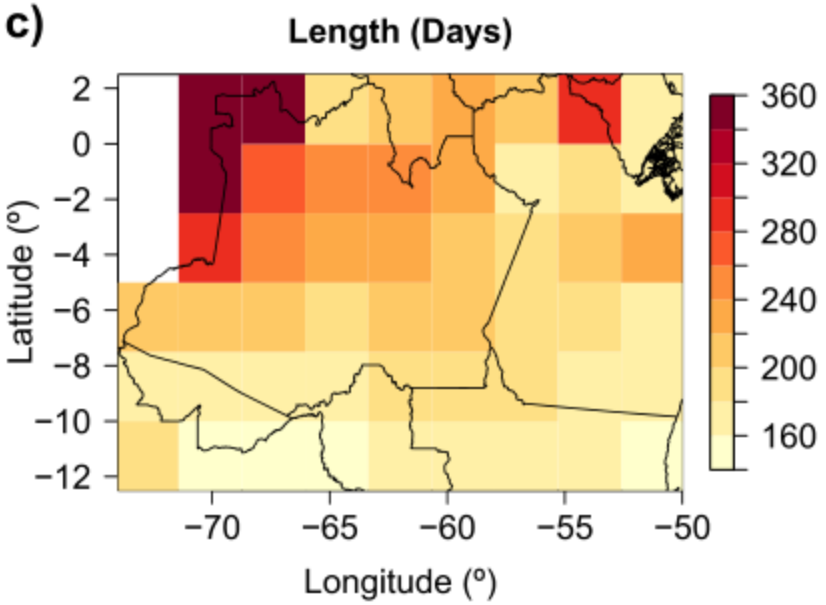
6.25°S, 56.25°W – 12 UTC (8 LT)



Average (1983 – 2009)



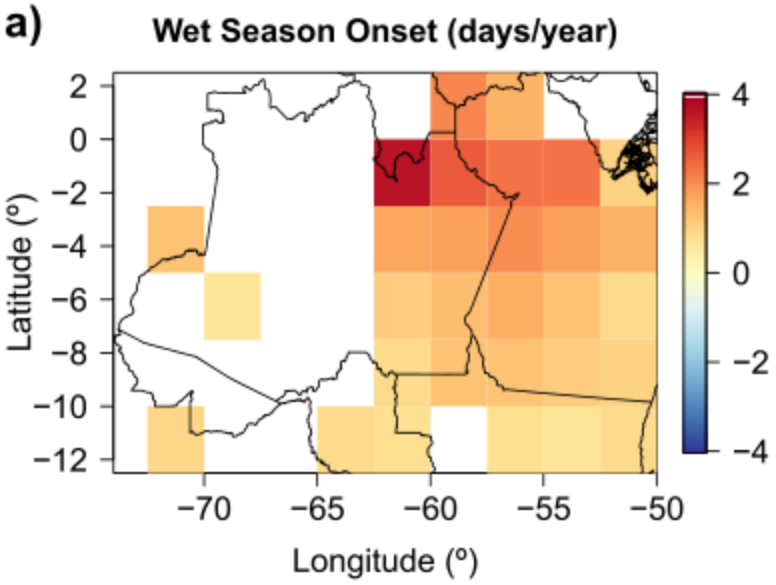


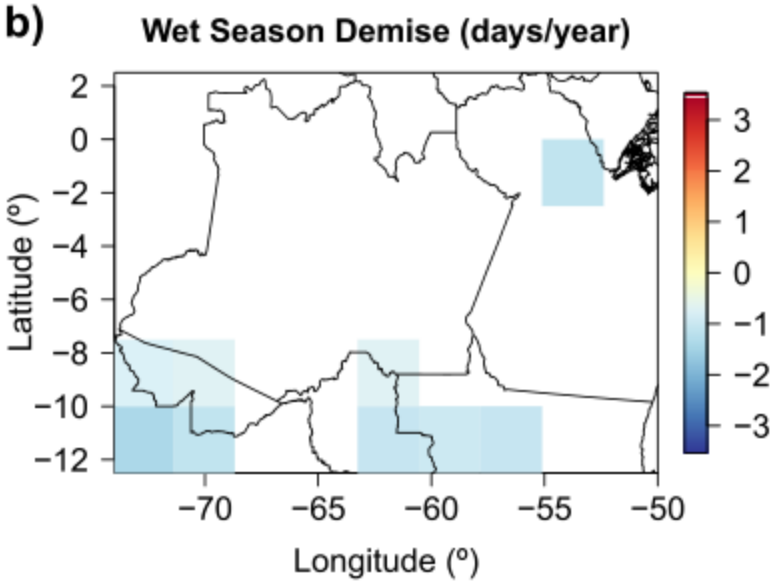


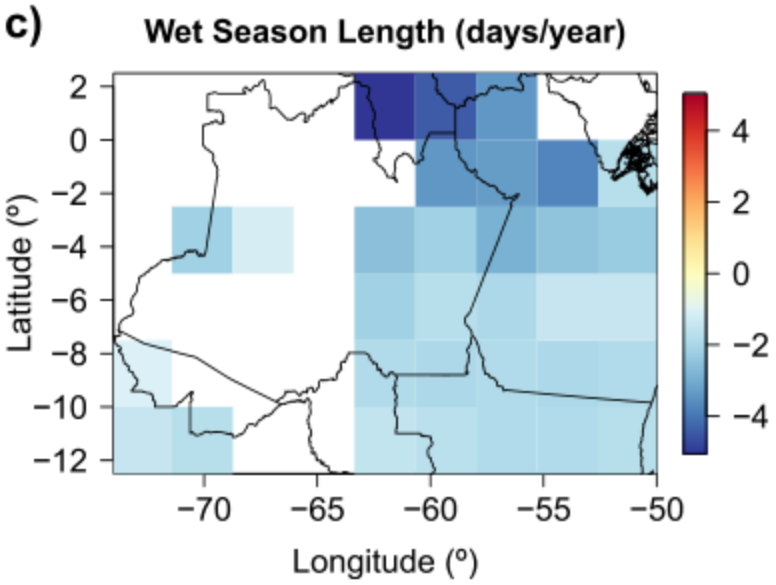
Consistent with previous approaches.

Advantage: Does not rely on rain gauges

Linear trends Onset, Demise and Length (1983 – 2009)







- Delayed onsets
- Earlier demises
- Shorter wet seasons

Large scale influence!!!

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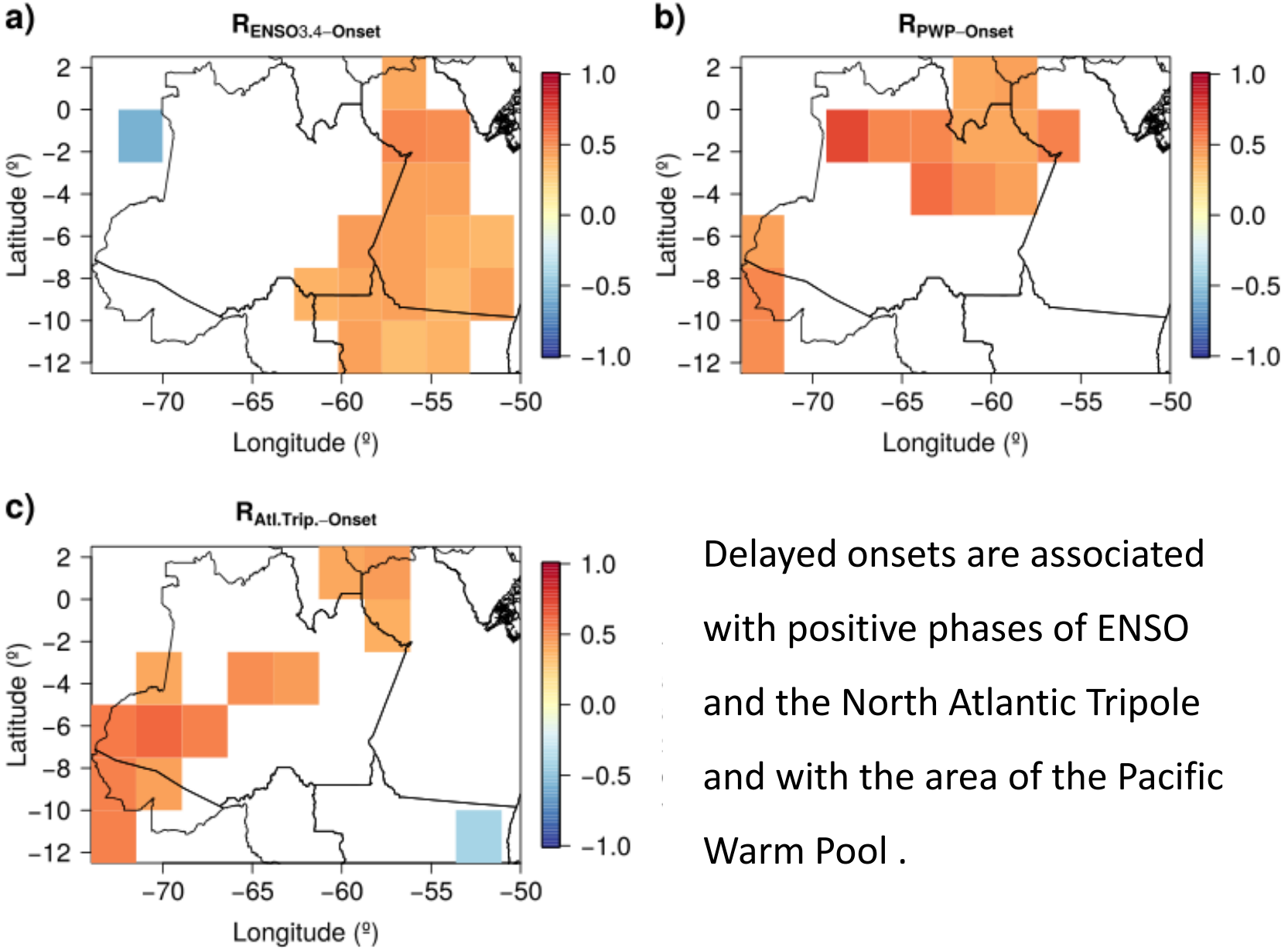
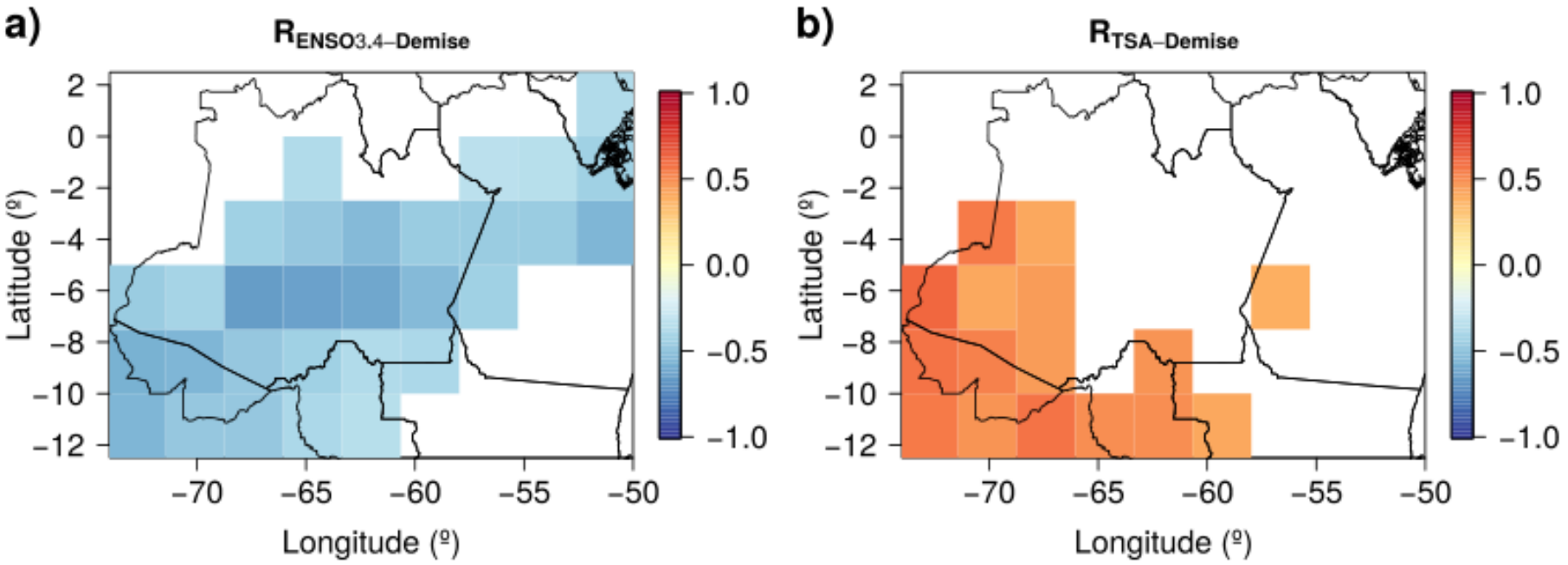
Correlation between detrended time series
Wet season onset



Delayed onsets are associated with positive phases of ENSO and the North Atlantic Tripole and with the area of the Pacific Warm Pool .

Correlation between detrended time series
Wet season demise

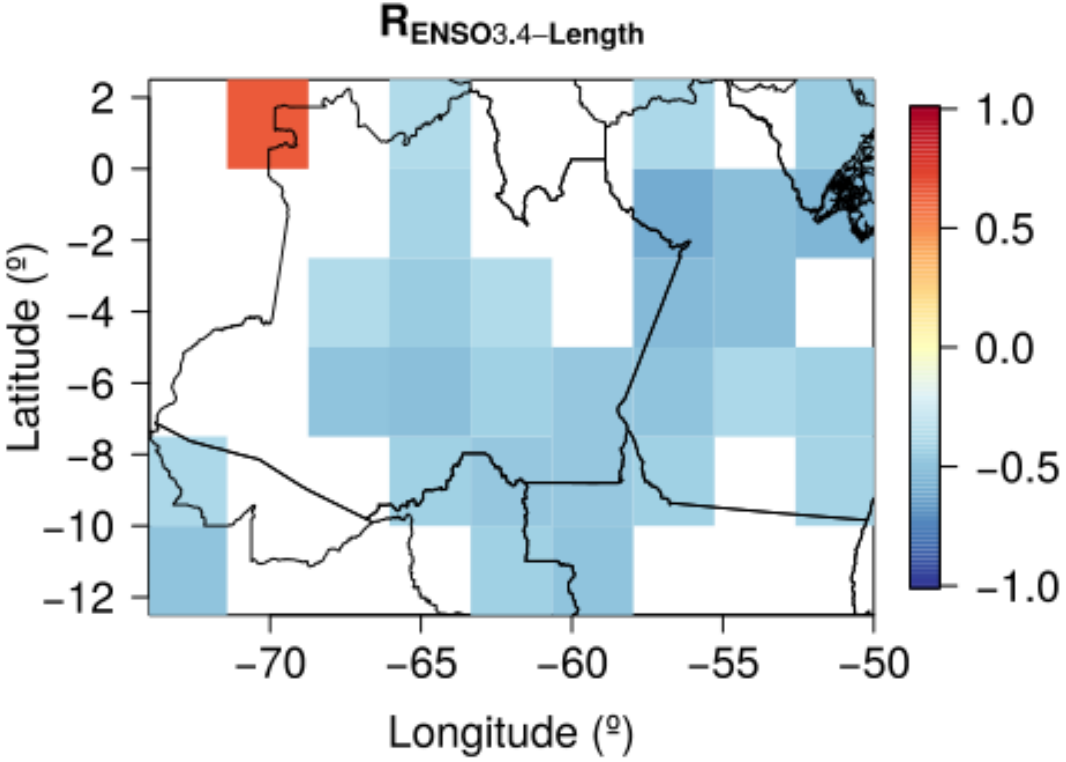


Links between:

- Earlier demises and El Niño.

- Delayed demises and positive anomalies of SST in the Tropical South Atlantic (TSA).

Correlation between detrended time series
Wet season length



Link between:

- Shorter wet seasons and El Niño.

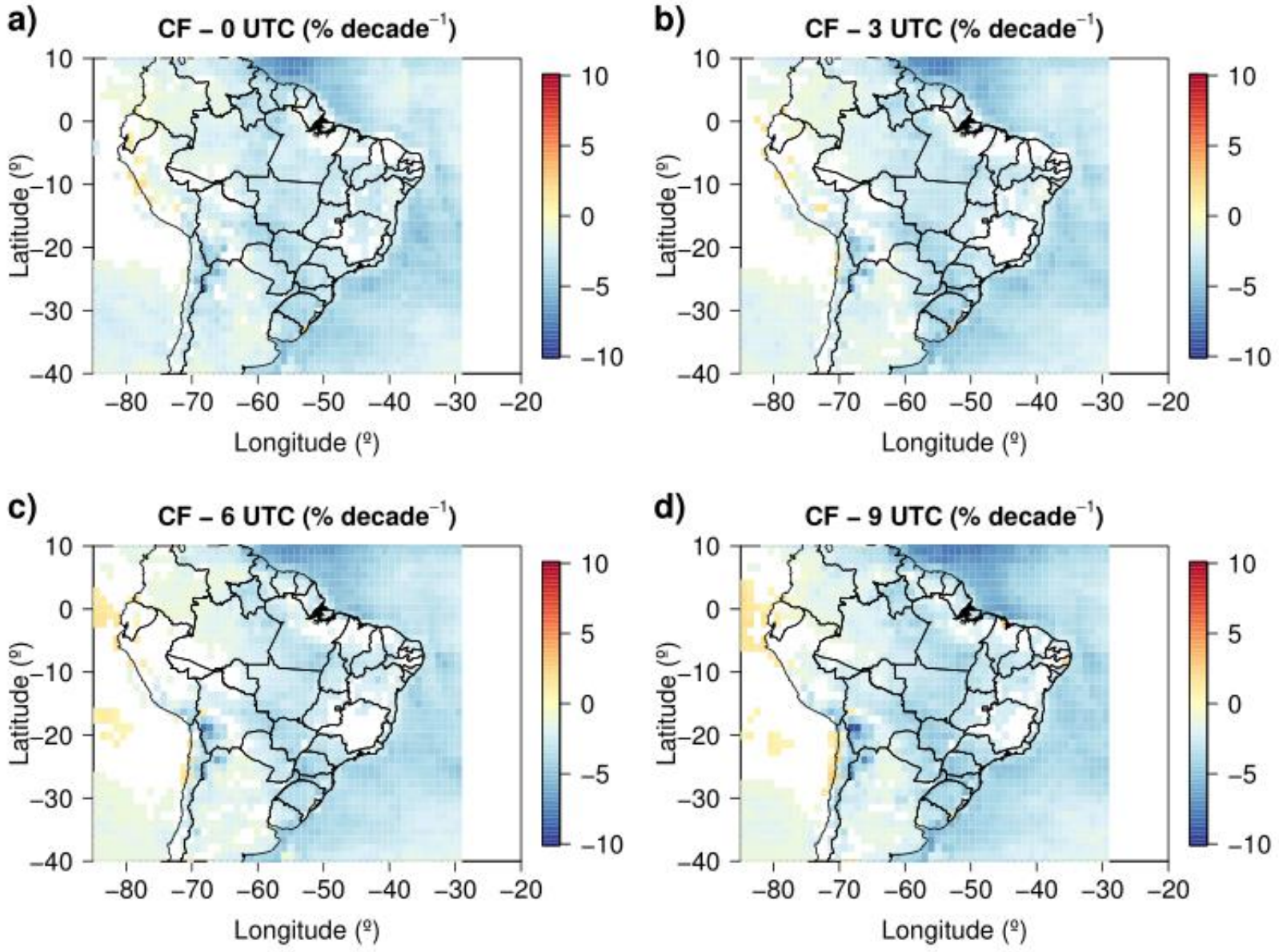
- **ENSO dominates interannual cycle of precipitation**
- **Modeling needed to understand long-term trends (AMO, PDO, etc.)**

Ongoing work:

Expanding to a larger area (Brazil)

- Longer time series of cloud fraction (1983 – 2015)
- Better spatial resolution - 1^{o} x 1^{o}

Linear trends of total cloud fraction (1983 – 2015)



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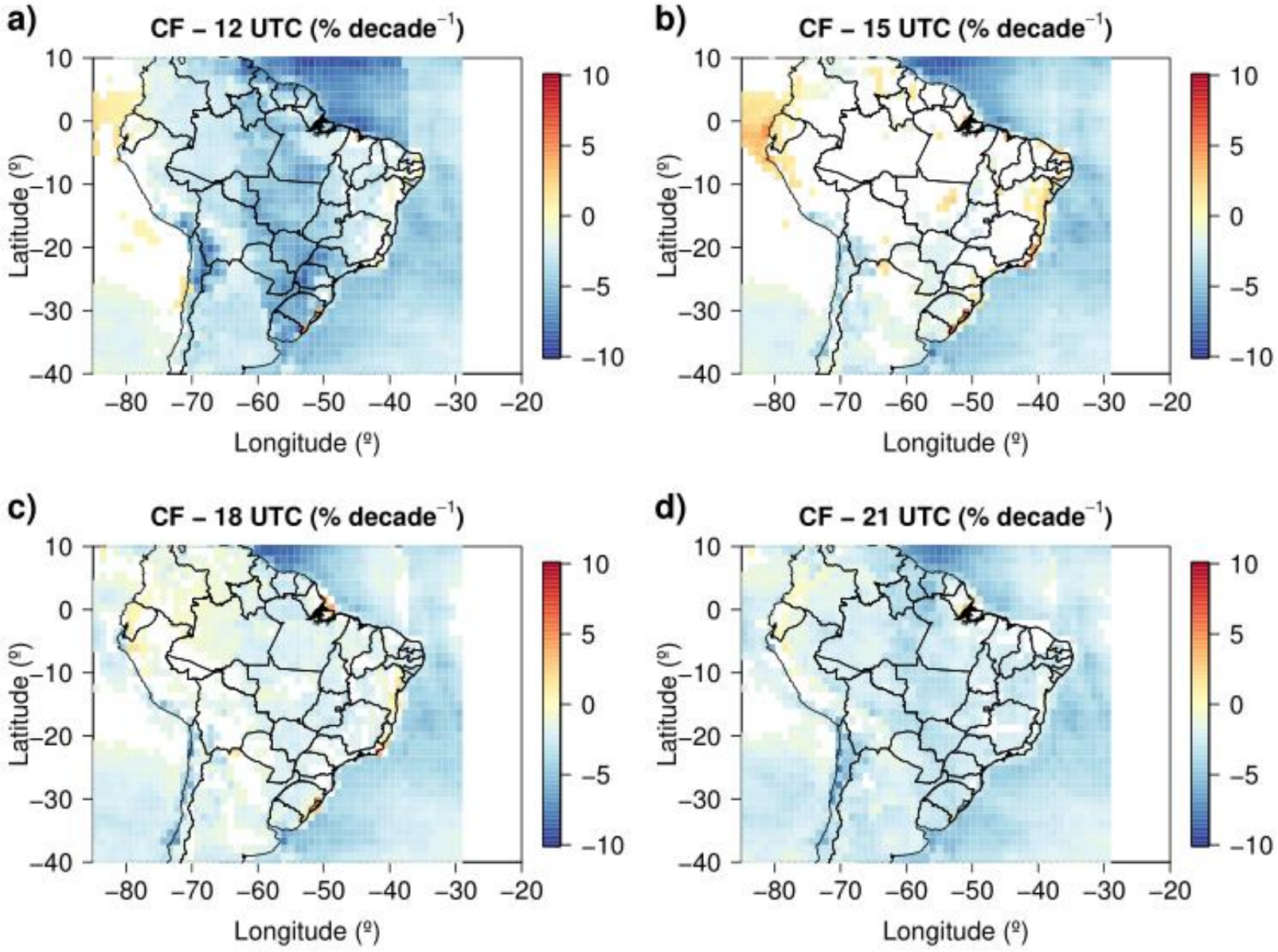
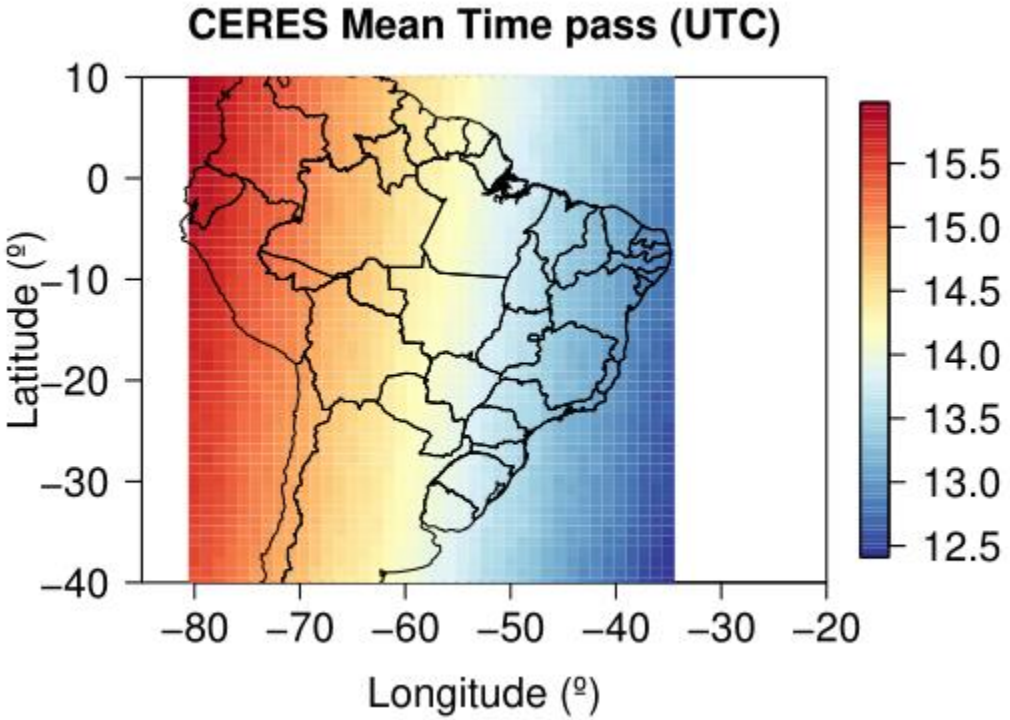
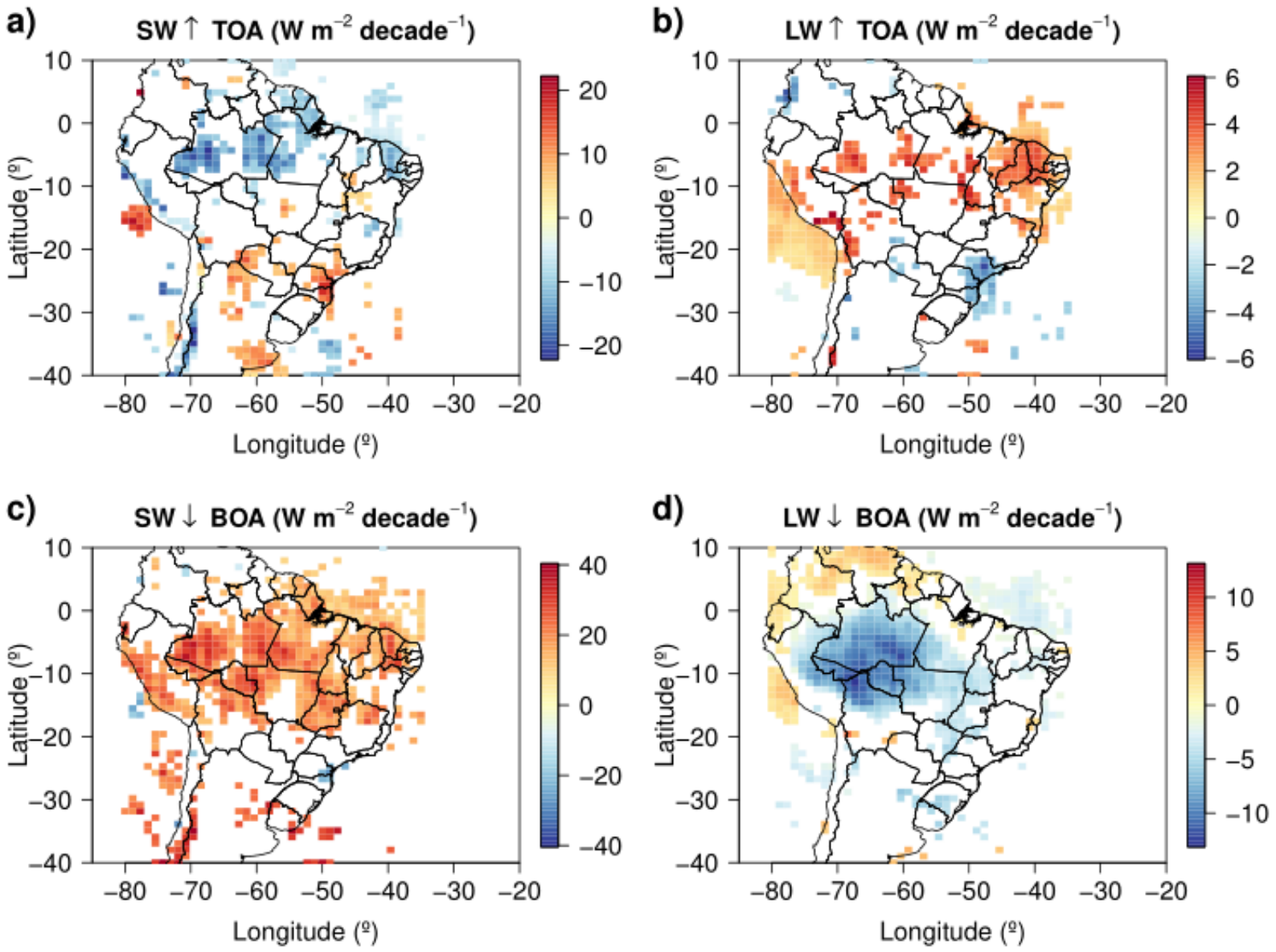


CERES sensor (2000 – 2016) aboard Terra (polar) satellite



Trends at mean time pass ± 15 minutes

Linear Trends of Irradiances by CERES (2000 – 2016)



Summary

- A new methodology to assess the rainy season onset and length in Amazon is proposed.
- The results show shorter wet seasons and earlier onsets, especially in Eastern Amazon likely linked to large-scale phenomena.
- This study provides strong evidence of the influence of ocean-atmospheric interactions on Amazon's rainfall regime.
- There is a consistent reduction of cloud fraction over the study area which significantly modifies Amazon's energy balance and thermodynamics.

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Thank you!!!

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Reduced wet season length detected by satellite retrievals of cloudiness over the Brazilian Amazonia: a new methodology (2018), Journal of Climate
Sena, E. T., Silva Dias, M. A. F. , Carvalho, L. M. V., Silva Dias, P. L.