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# The 2019 biomass burning season in South America: climate diagnostics, fire monitoring and air quality forecasting

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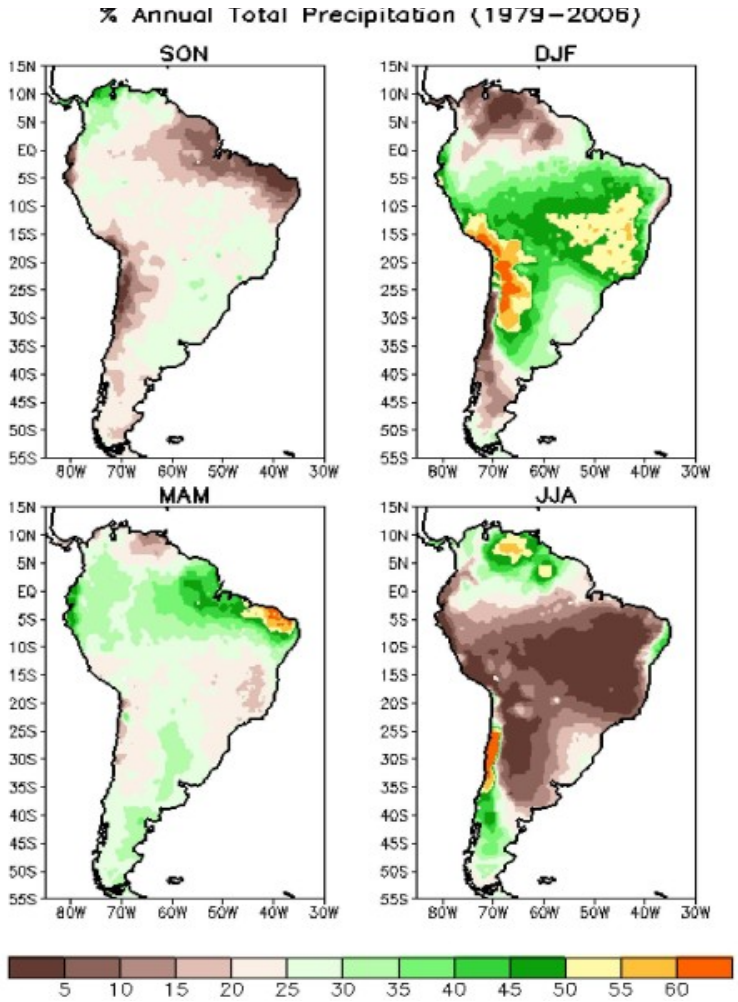
05 May 2020

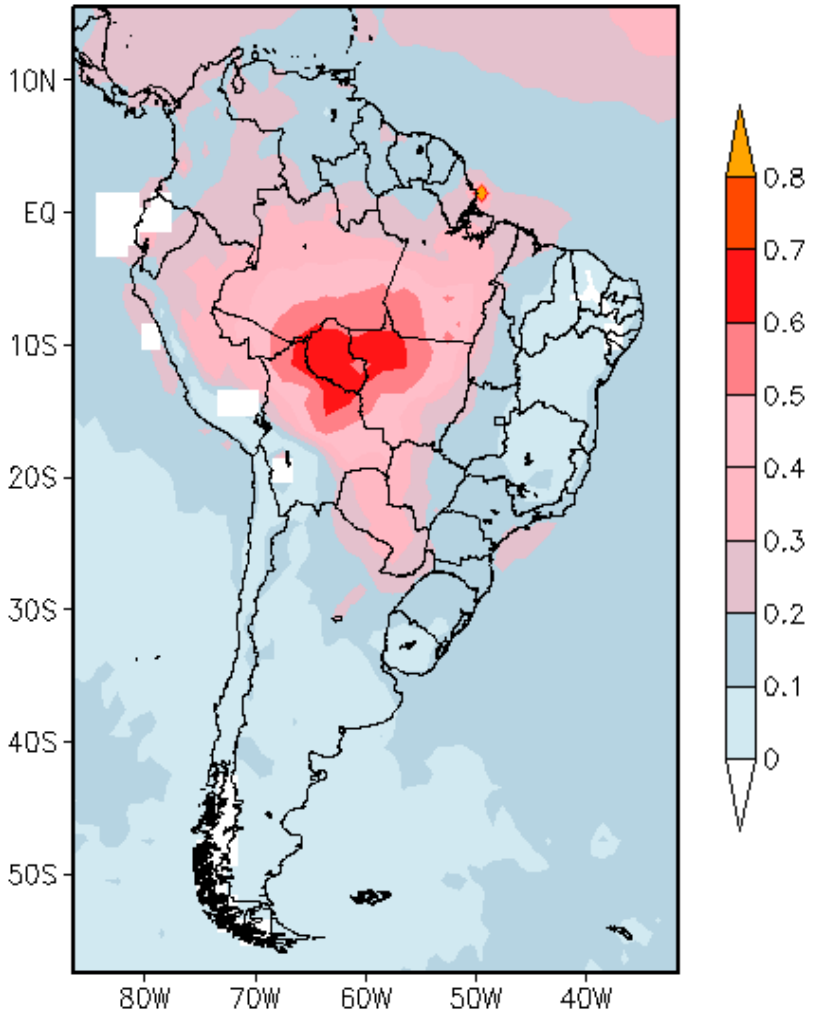
INPE
UNIDADE DE PESQUISA DO MCTIC

# The South American Monsoon System and Biomass Burning Season




Percentage of observed mean (1979-2006) annual precipitation for each season
Source: Silva and Kousky (2012)

AOD 550nm Climatology (2002-2019)

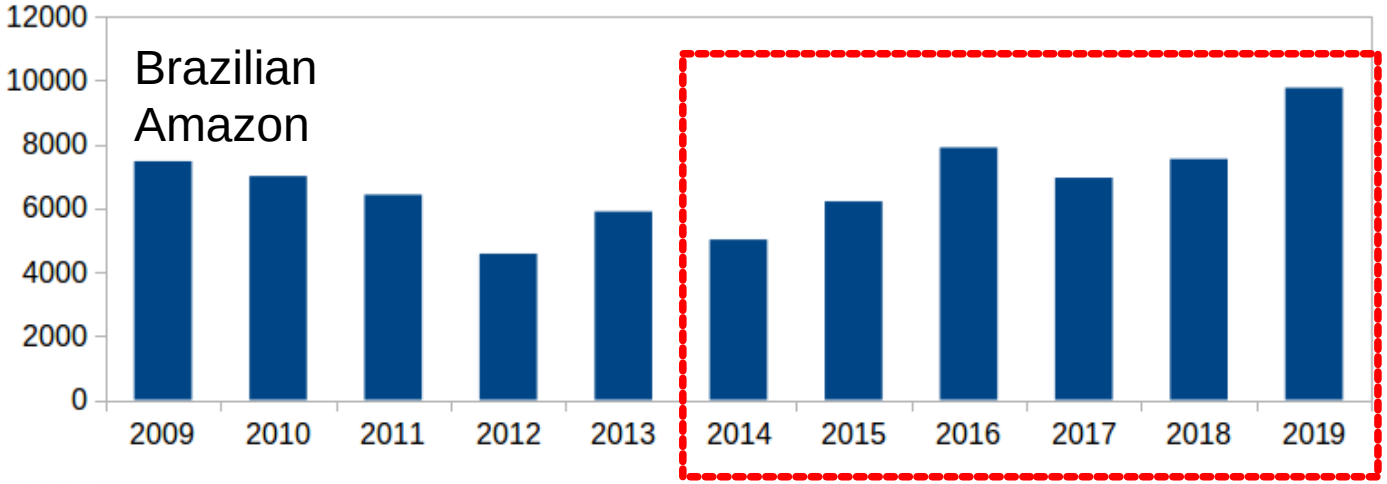



Data: NASA MODIS-AQUA MYD08_M3 v6.1

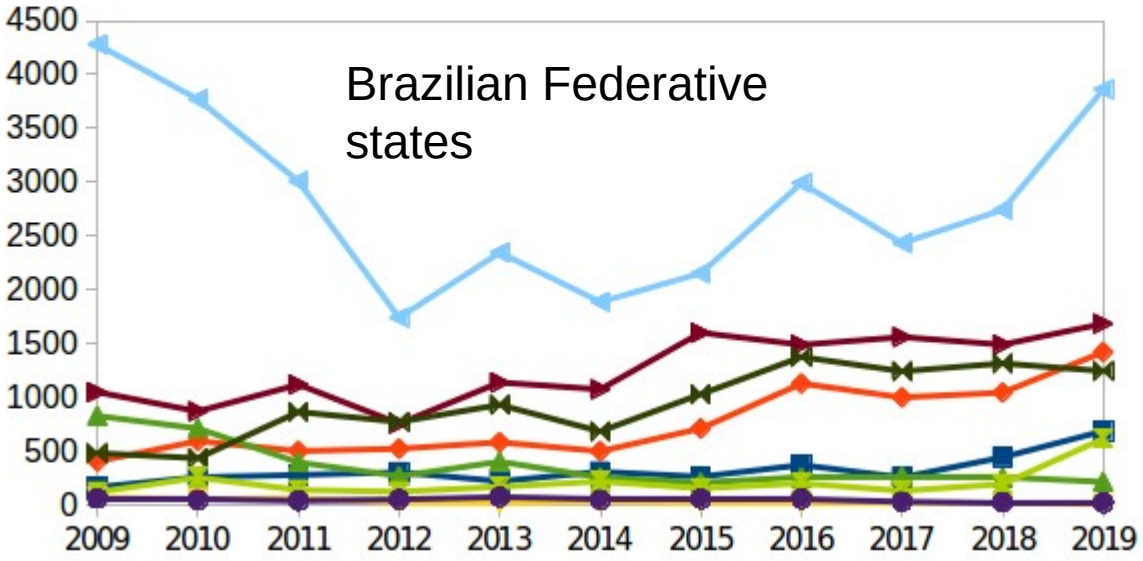
# Biomass Burning in South America: Climate and deforestation roles

## Deforestation rate (km$^2$)

Data available at: http://www.obt.inpe.br/OBT/assuntos/programas/amazonia/deter



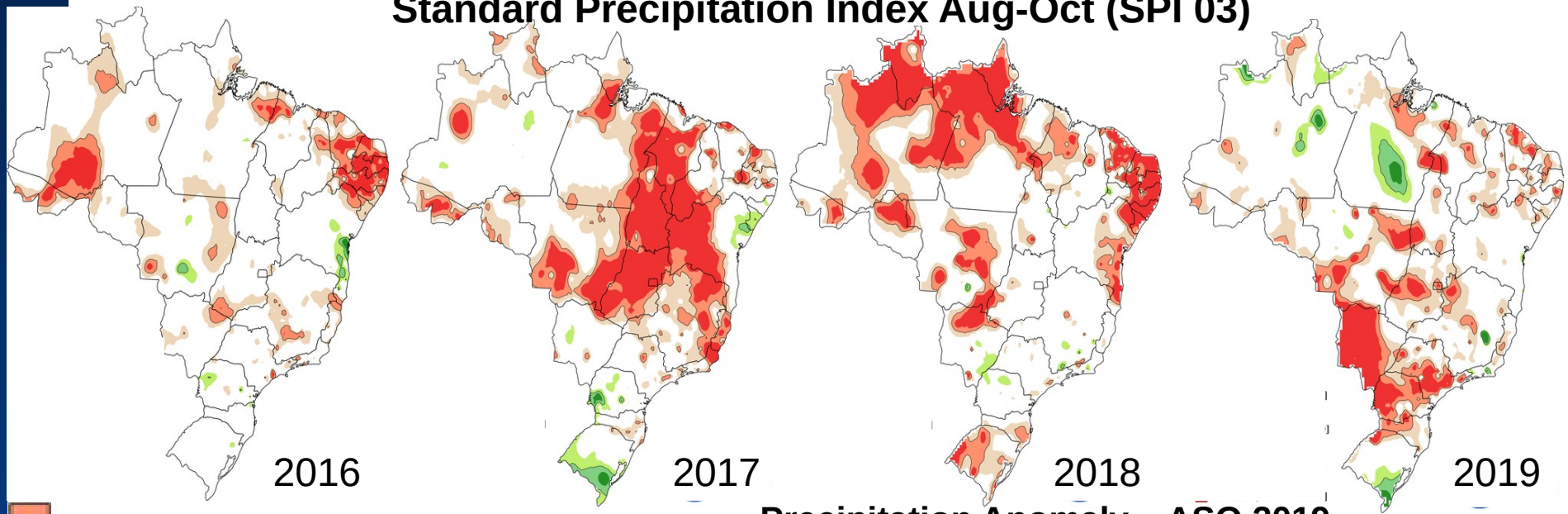

Deforestation continues to rise in the Brazilian Amazon




States with the highest deforestation rates

# Biomass Burning in South America: Climate and deforestation roles

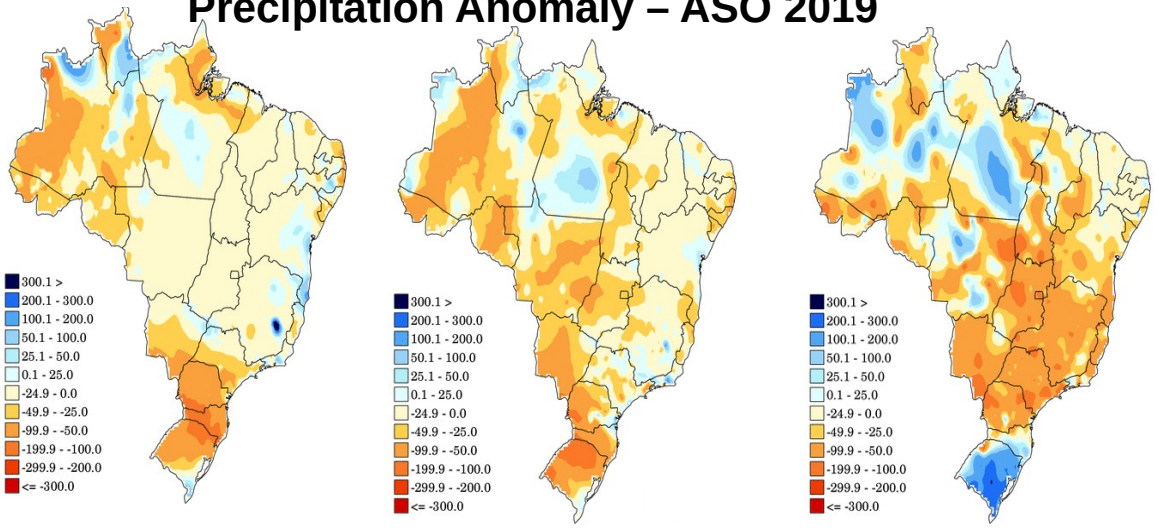
## Standard Precipitation Index Aug-Oct (SPI 03)




Severely dry [-1.5 – 1.99]

Extremely dry [-1.99 - below]

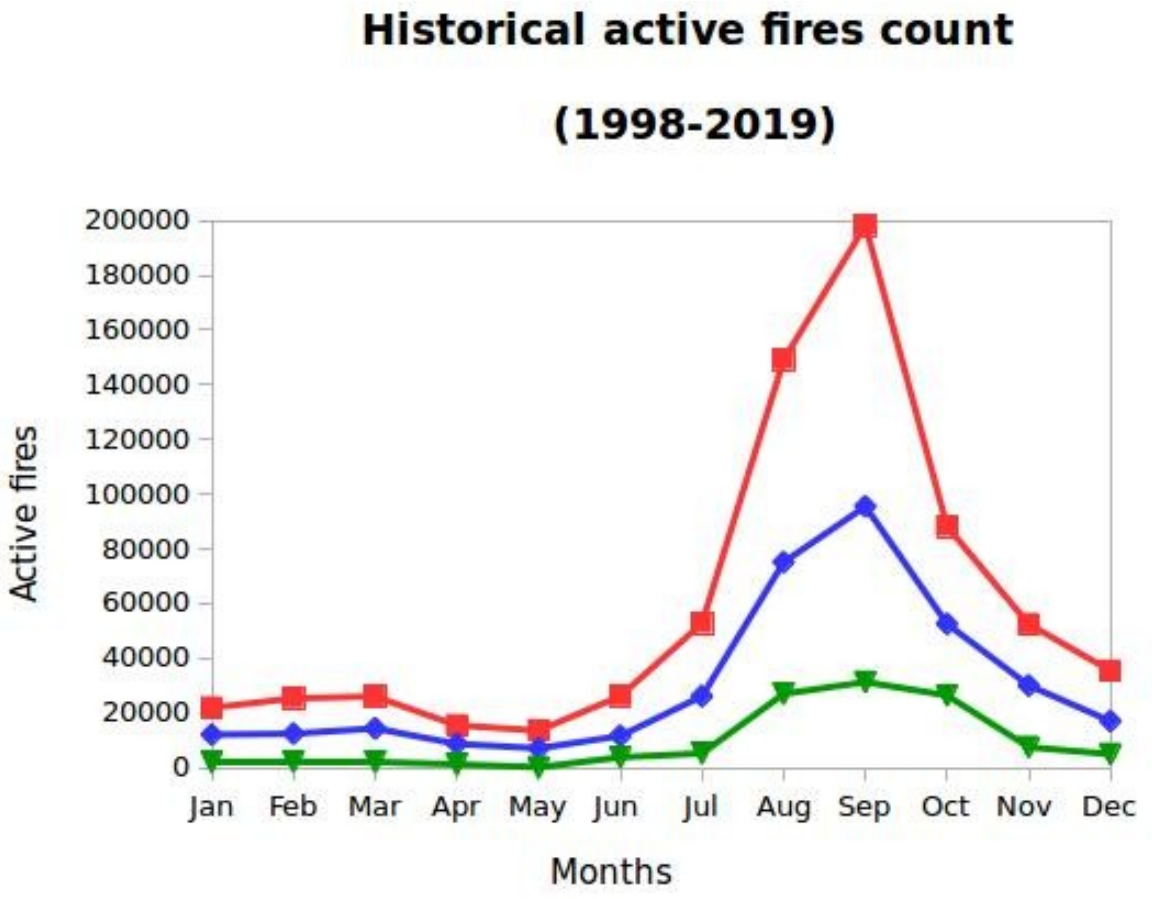
## Precipitation Anomaly – ASO 2019




SPI indicates normal conditions to most Brazilian Amazon in 2017 and 2019. Negative anomalies in Aug-Sep were compensated by positive anomalies in Oct in Legal Amazon

Data available at: http://clima.cptec.inpe.br/

# Active fires detected over South America and Brazil – AQUA satellite



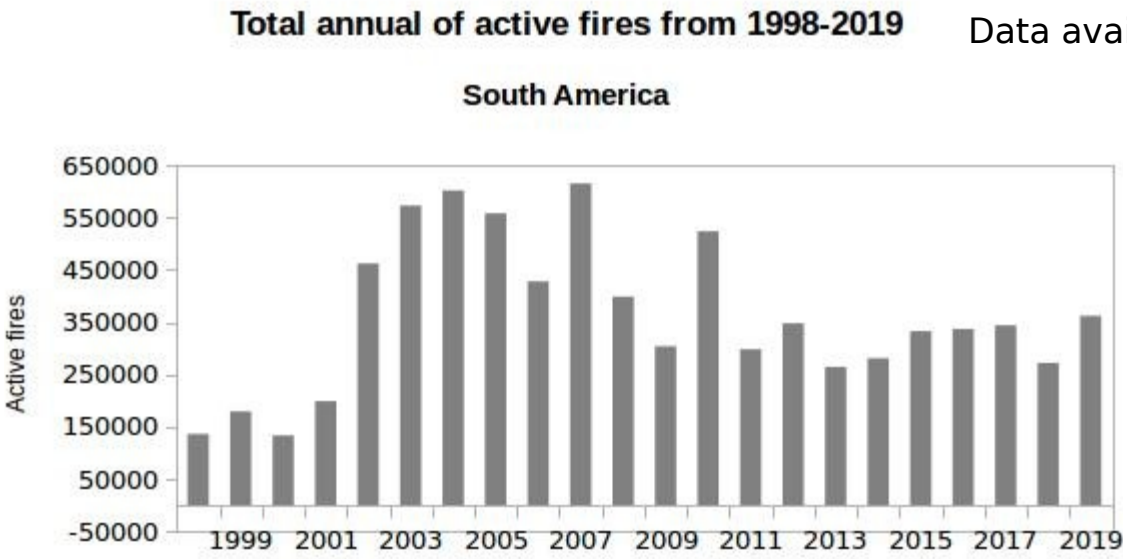

Maximum, mean and minimum number of active fires are highlighted in the historical database

Higher number of active fires in SA are observed between Aug-Oct, with the peak in **September**

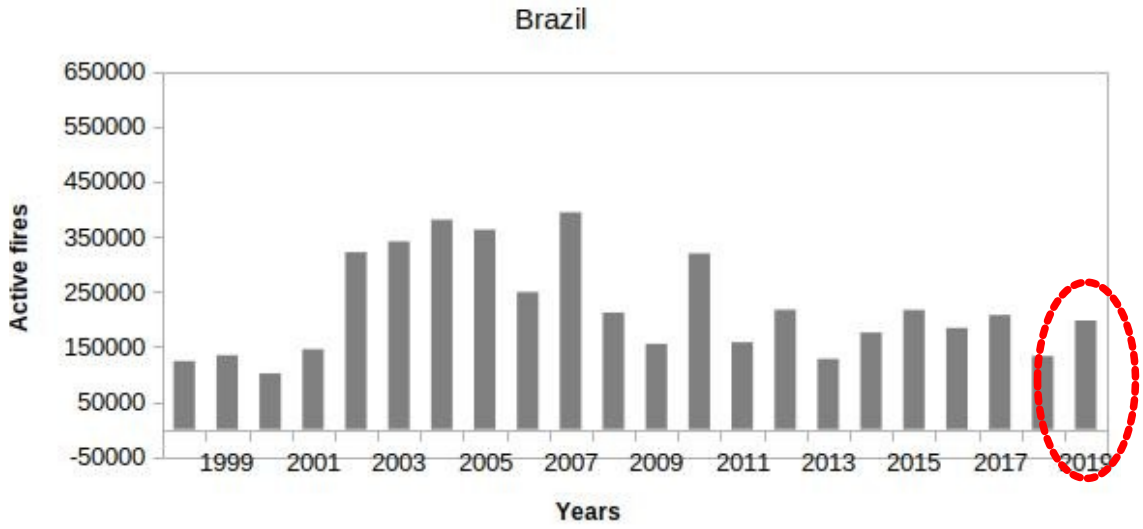
Data available at: http://queimadas.dgi.inpe.br

# Active fires detected over South America and Brazil – AQUA satellite

Data available at: http://queimadas.dgi.inpe.br

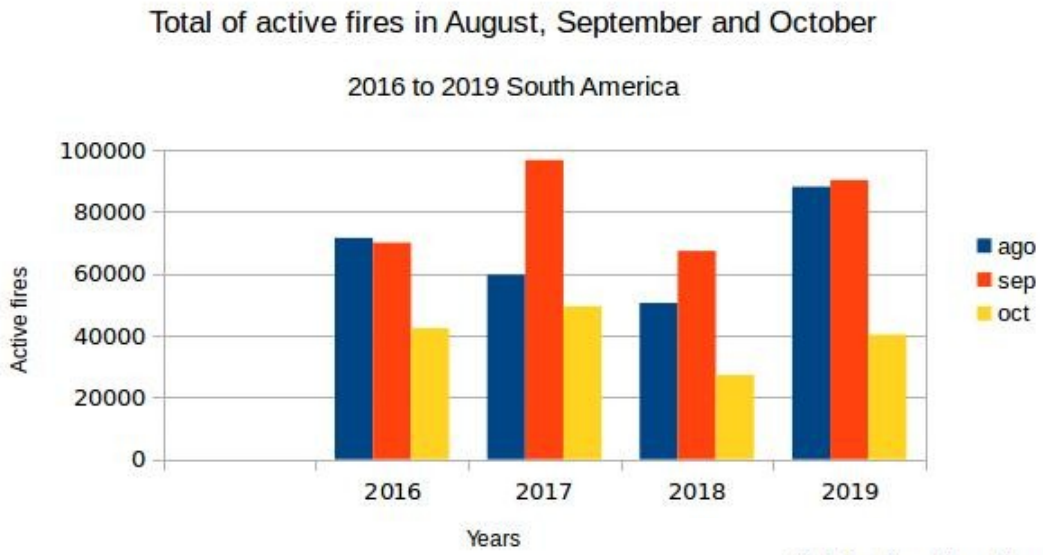


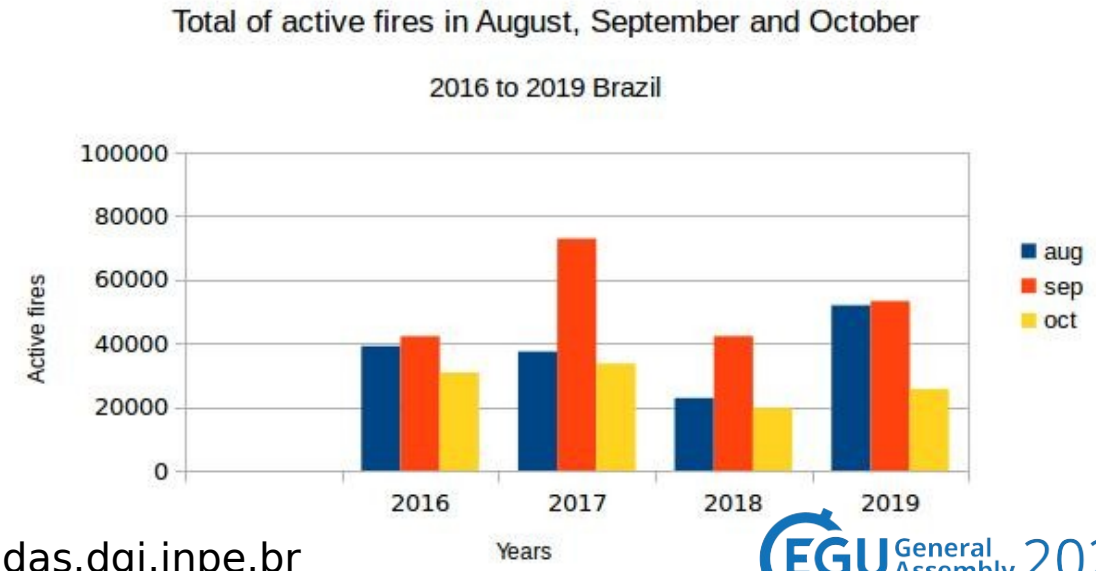

**Active fires tendency is decrease from 2005-2013 and increase from 2014-2019**




**Brazil responds for around 57% of SA active fires in 2019**

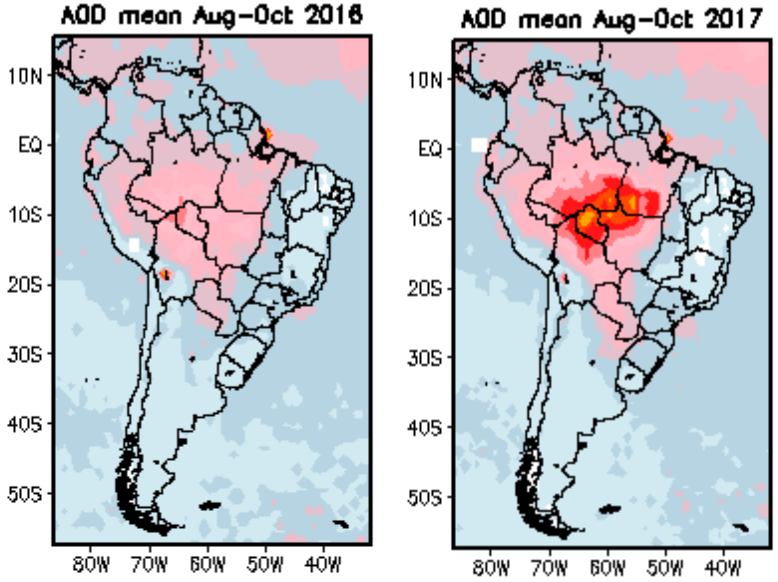
# Active fires detected over South America and Brazil – AQUA satellite



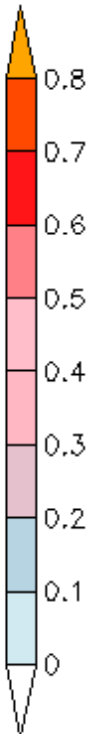



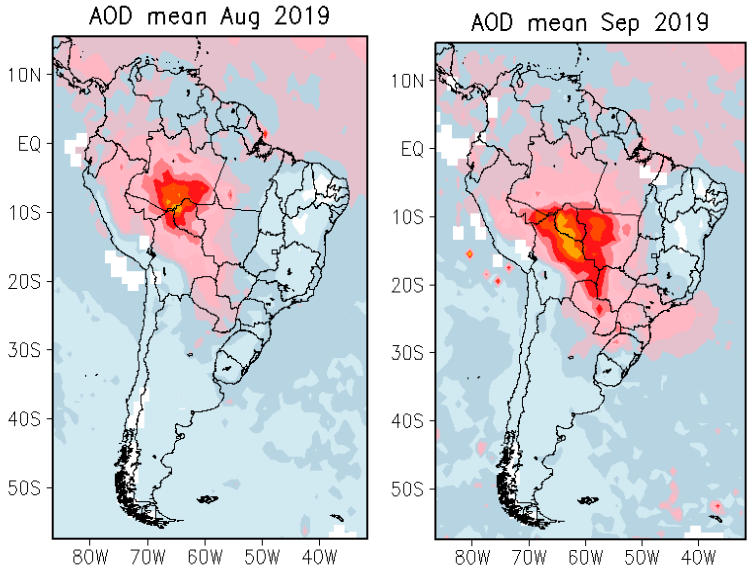

Data available at: http://queimadas.dgi.inpe.br

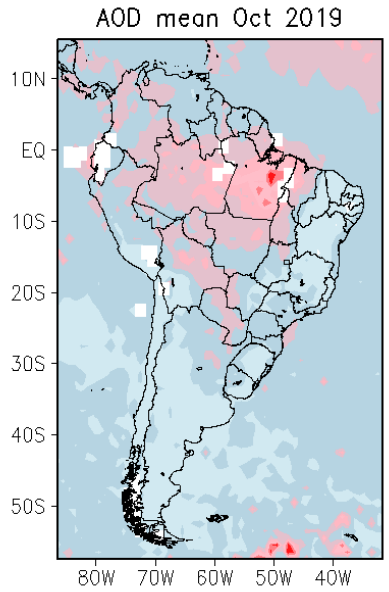
# How did ASO 2019 AOD vary if compared with previous years?




**MODIS/ NASA**




**As expected, aerosol loading was more intense during September**

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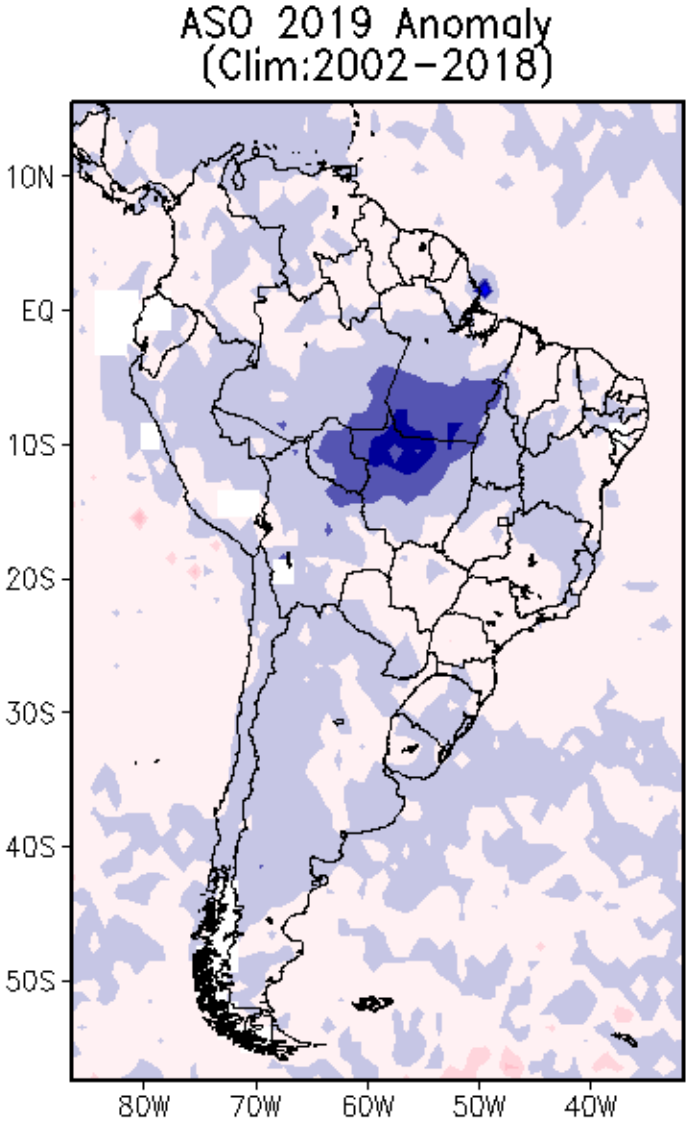
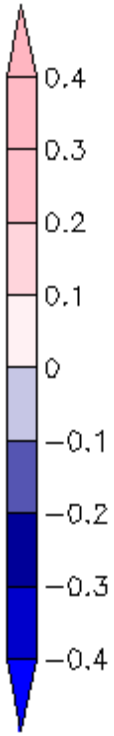
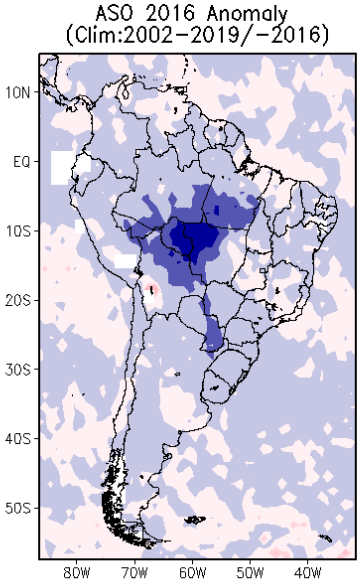
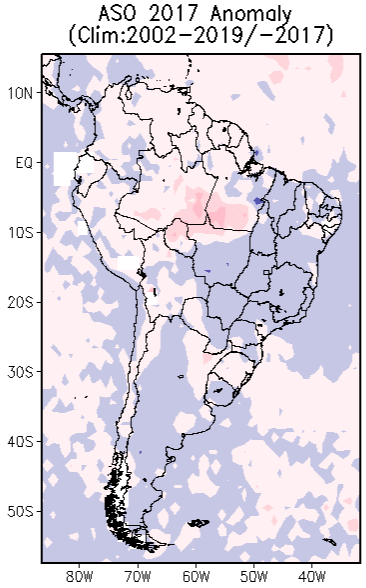
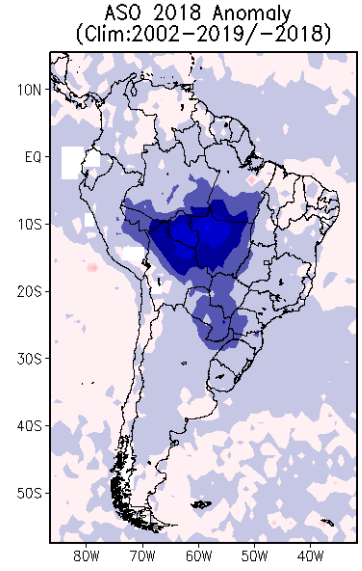
# How did ASO 2019 AOD vary if compared with previous years?



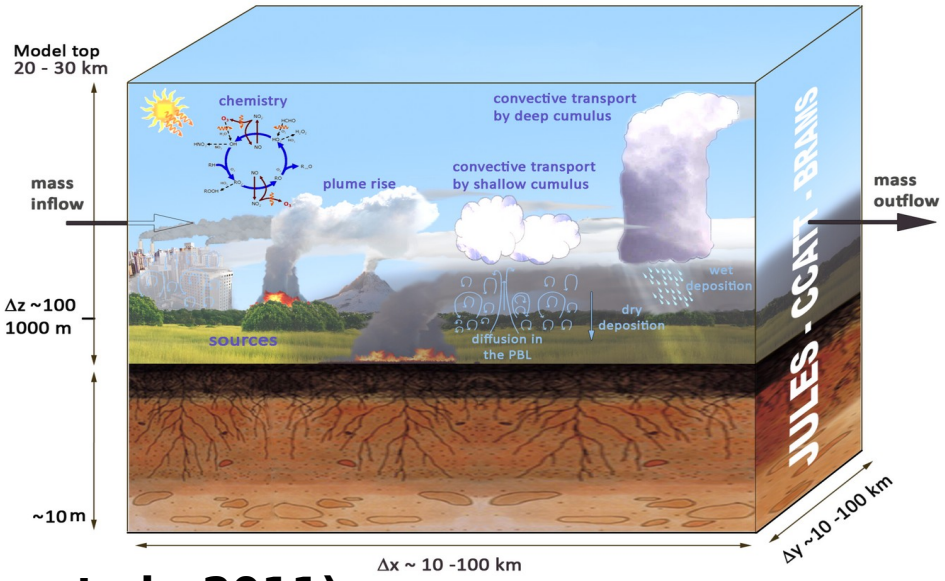




**2019 BBS was less active then 2017, but more active then 2016 & 2018**

# INPE Air Quality Forecasting System

Provides:
→ Weather + air quality FCT (CO, NOx, O3, PM2.5, AOD)
→ 24 h + 72h fct
→ 20 km
**In operation since 2003**
Freitas et al. (2017)




**Emissions: PREP-CHEM-SRC (Freitas et al., 2011)**

- Version 1.8 contais:
  - Streets invetory for MARJ (version 1.5)
  - FRP methodology (version 1.6)
  - New projections for WRF (version 1.7)
- Improvements of 3BEM methodology – review of emission factors
- Improvement of urban emissions for MASP

**Improvements in the model - under tests (~70% more efficient)**

Implementation of Runge-Kutta time integration scheme
Implementation of a new computational method on chemistry module (Rodrigues et al., 2019)

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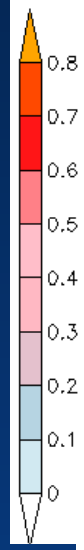
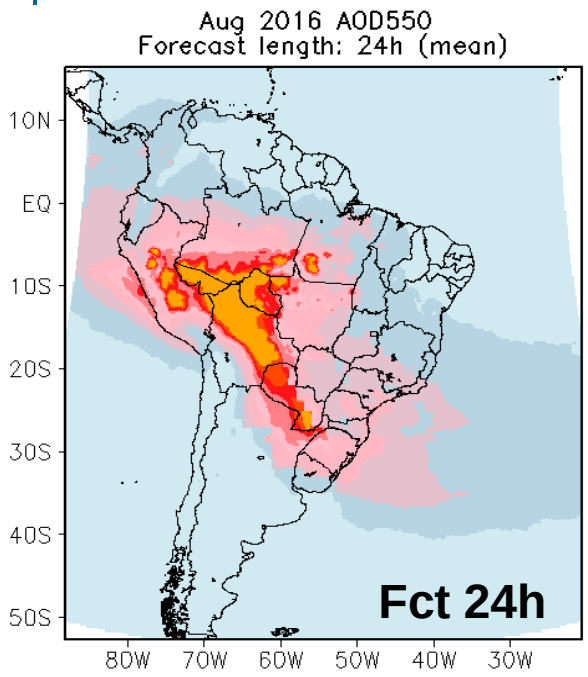
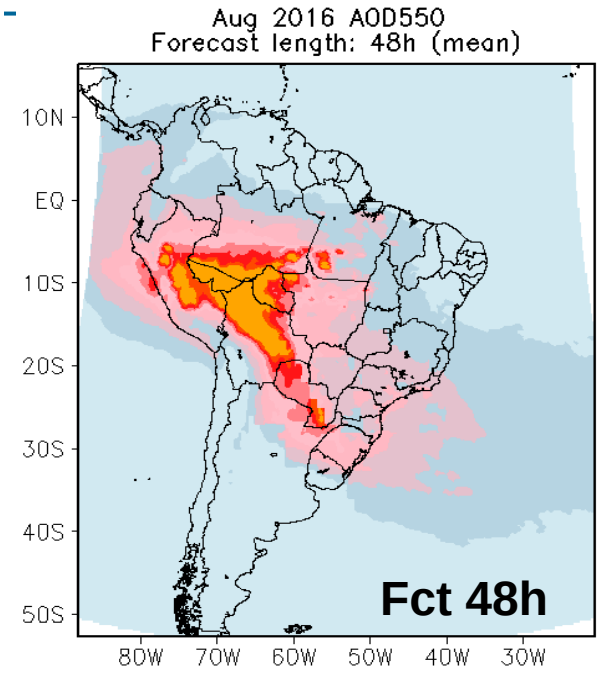
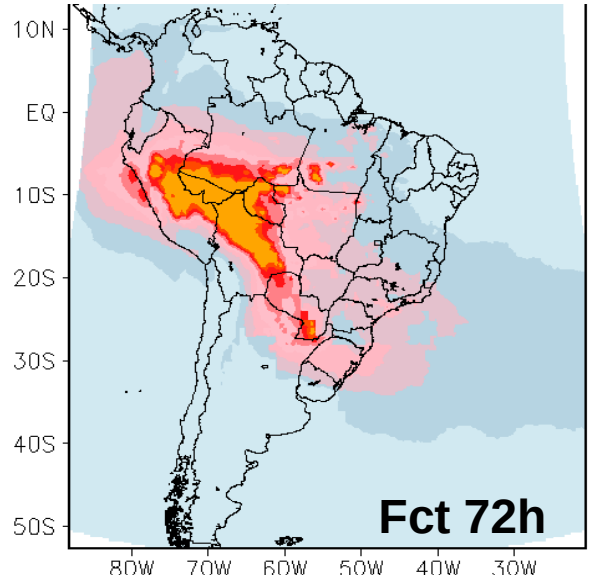
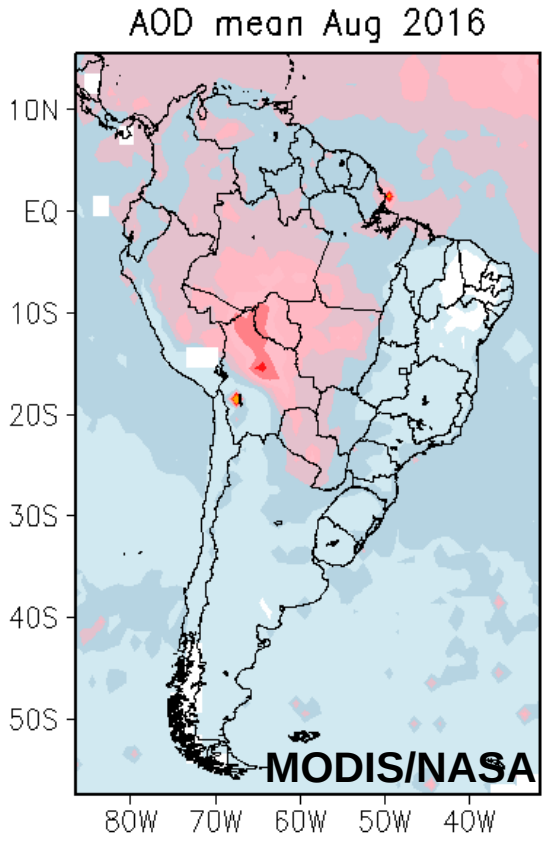
# AOD 550nm Forecast - 2016




**Location of the maximum mean AOD is well represented by the forecasts. The model overestimates AOD east of the Andes**

**Positive bias is slightly reduced with integration time**

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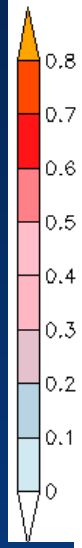
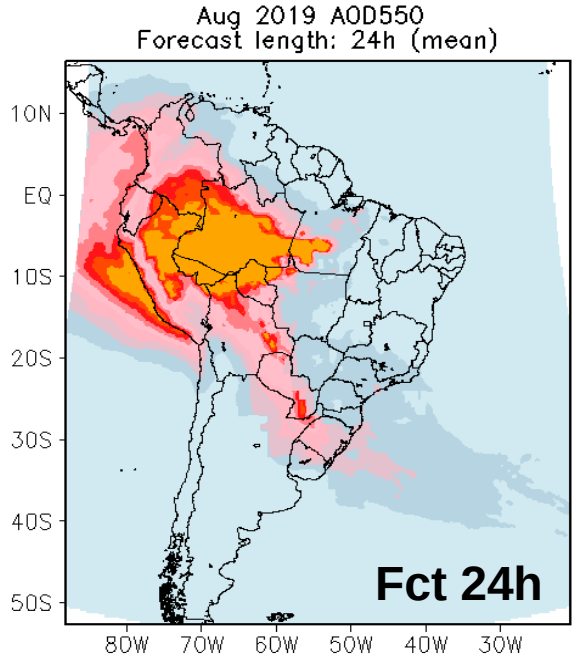
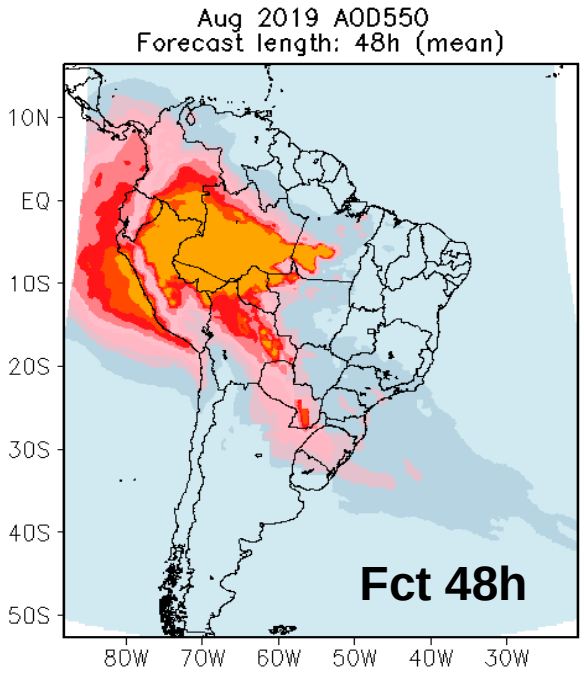
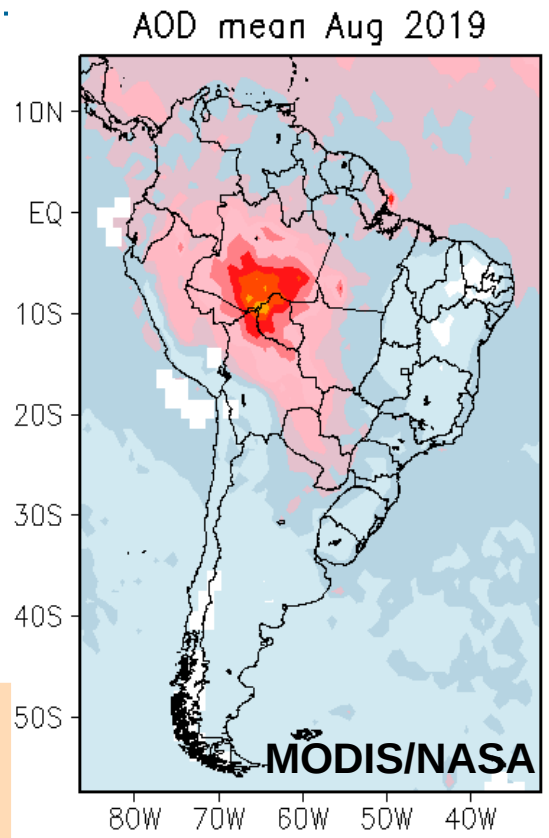
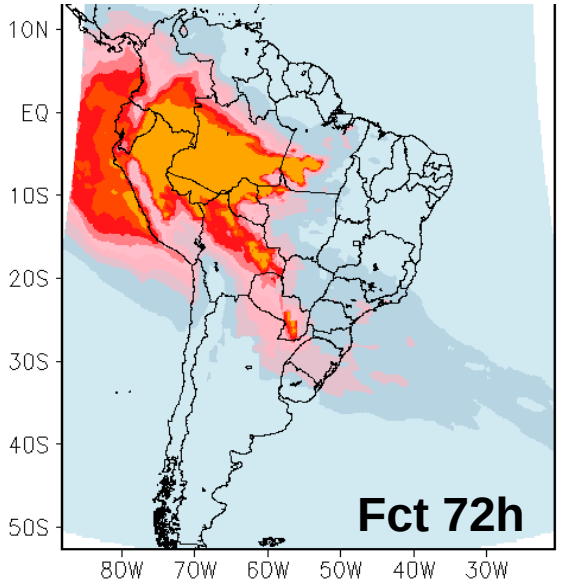
# AOD 550nm Forecast - 2019




**Location of the maximum mean AOD is well represented by the forecasts. The model overestimates AOD over Pacific Ocean, Amazon and east of the Andes**

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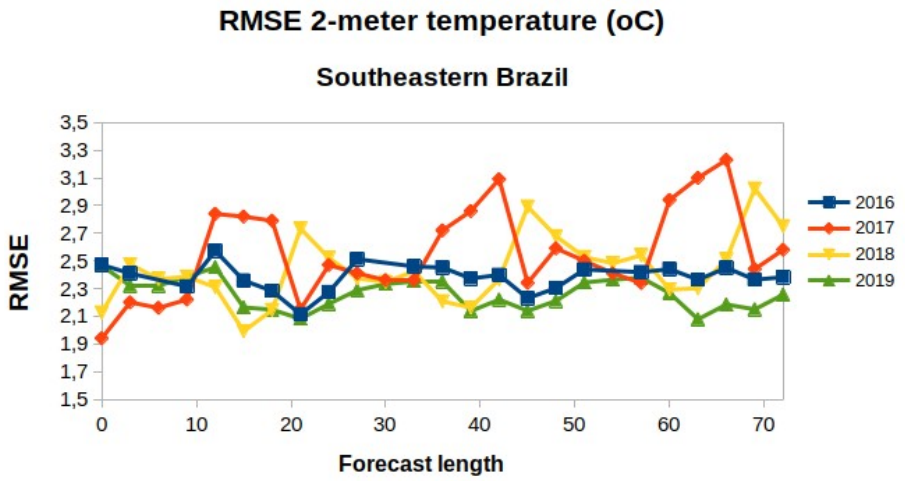
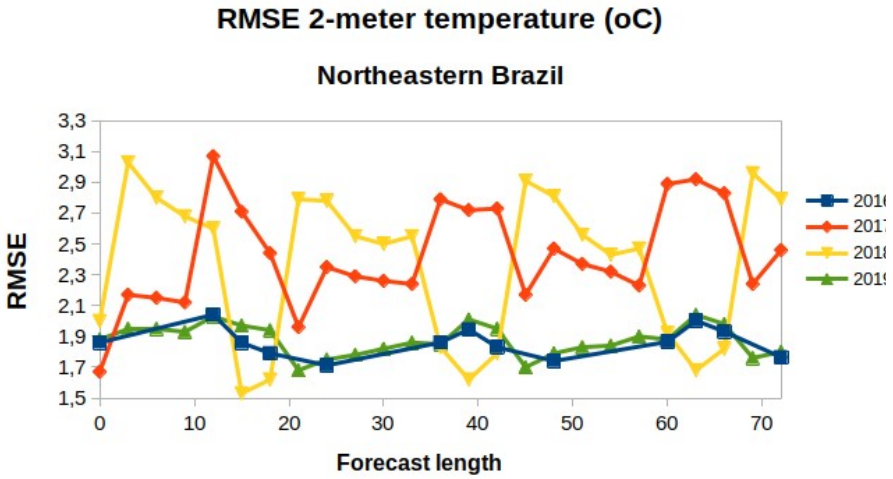
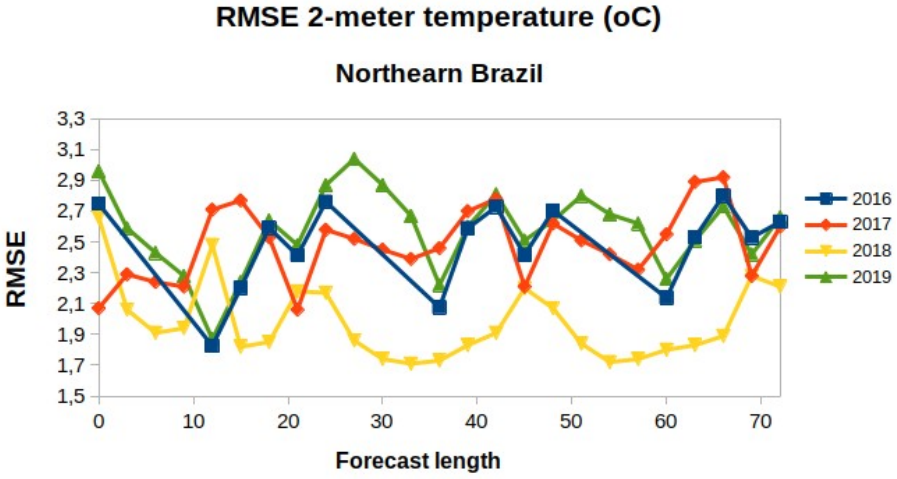
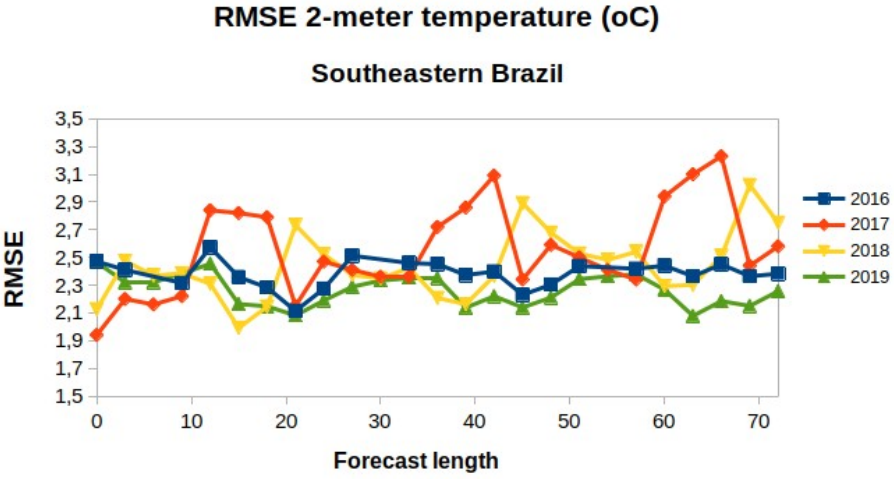
# 2-meter temperature skill




**Southeast Brazil station data are denser then Northern (NO) and Northeast (NE) regions. The model is consistent across analyzed years.**

# Final remarks

**SPI is a better indicator for precipitation departures compared with anomalies. Near normal climatic conditions during ASO 2019 indicate deforestation as the main driver for high aerosol load during 2019 BBS**

**2019 ASO AOD 550nm was bellow climatology, but in comparison with previous years indicates high aerosol load**

**AOD is overestimated over Amazon Basin, east of Andes and over Pacific Ocean by the AQFS. However, the model represents well the position of higher AOD 550nm**

**2-meter temperature presents a similar skill for analyzed years**

**Better skill in 2019 over Southeastern region is probably associated with a denser meteorological data station coverage**

**Ongoing: CO and PM2.5 assessment using Brazilian EPA; AOD assessment using AERONET datasets.**

# References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