

SAEMC Workshop 2008
South American Emissions, Megacities and Climate

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**Regional representativity of AERONET
observation sites in South America
determined by correlation studies with MODIS
AOD for data assimilation purposes**

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Objectives

- Assess skill of observations prior to assimilation
- Assessing differences in biomass burning and other influenced sites
 - > interannual variability, seasonality, AOD maxima
- Differences between TERRA and AQUA AOD
 - Differences due to overpass time
- Deriving radii of influence of AERONET site for data assimilation
 - Isotropic
 - Anisotropic



Contents

- Presentations of data sources
- Correlations MODIS / AERONET AOD
- Isotropic radii of influence
- Anisotropic areas of influence
- Aerosol assimilation with CCATT-BRAMS model

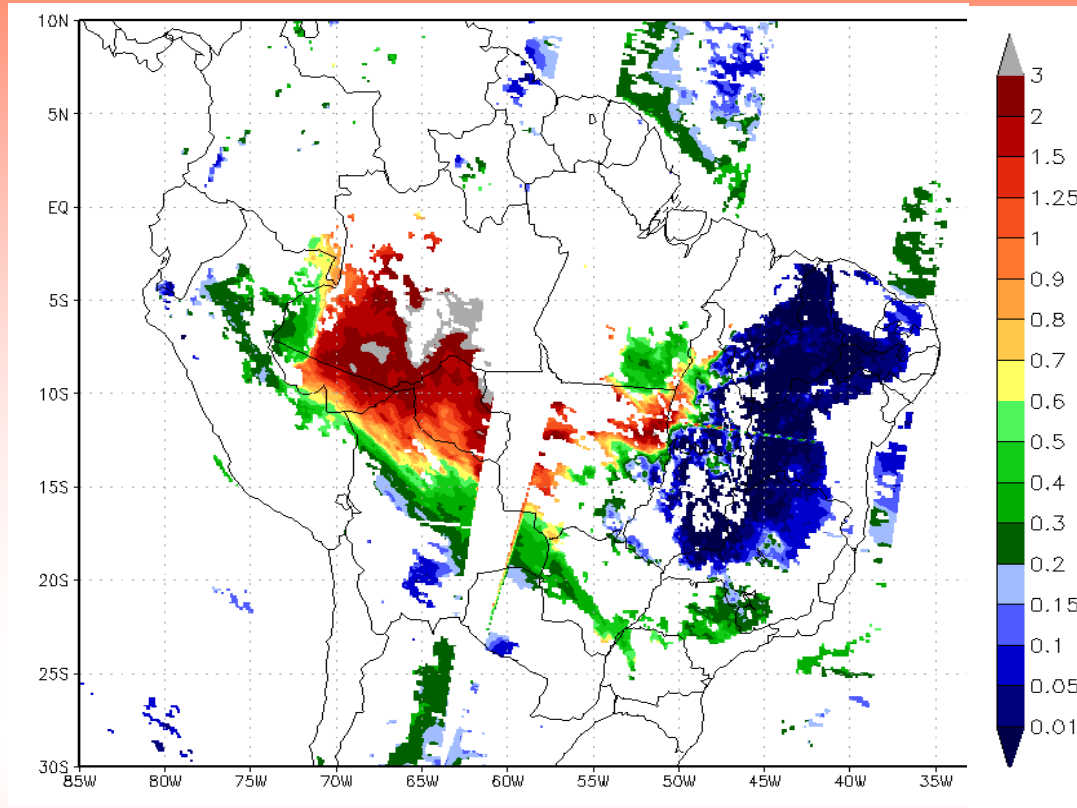


12 AERONET sites



Location of AERONET 12 sites in South America with AOD measurements during the period 2001-2007. Map source: Google Maps

Typical MODIS scene



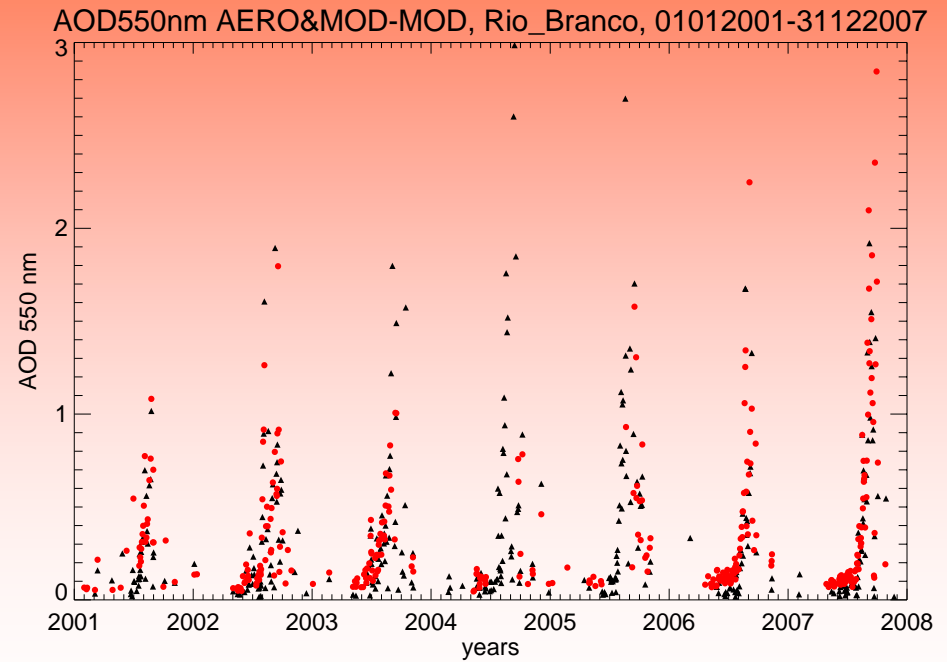
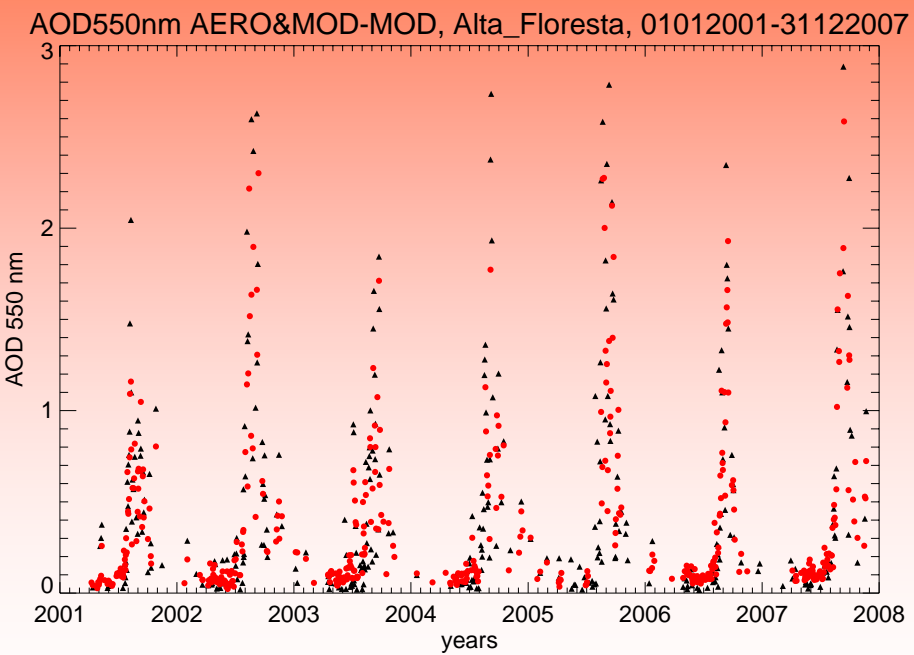
**MODIS/TERRA
AOD 550nm**

September 3, 2005

Aerosol Optical Depth (AOD) at 550 nm on 03/09/2005. Observation by MODIS/TERRA satellite

Time series of AERONET and MODIS

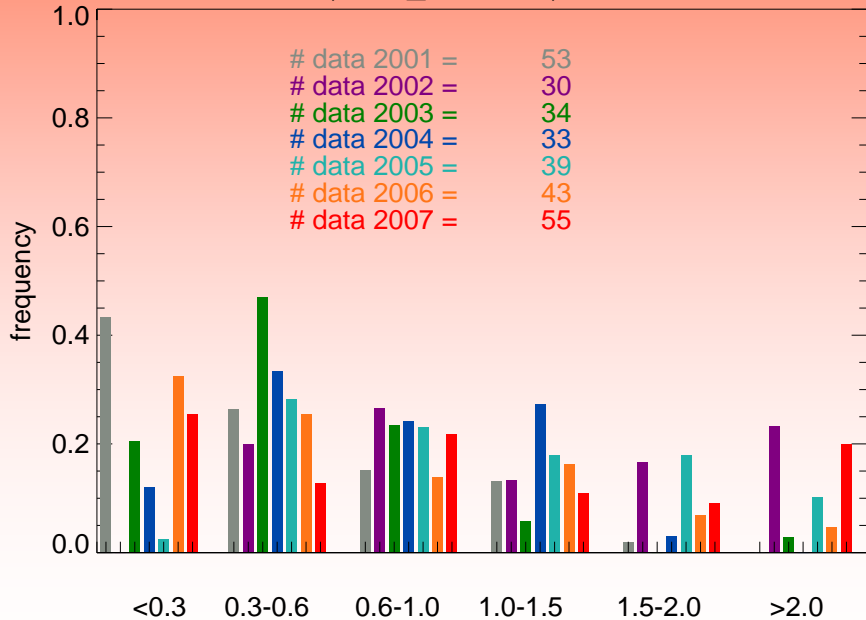
AOD from 2001 - 2007



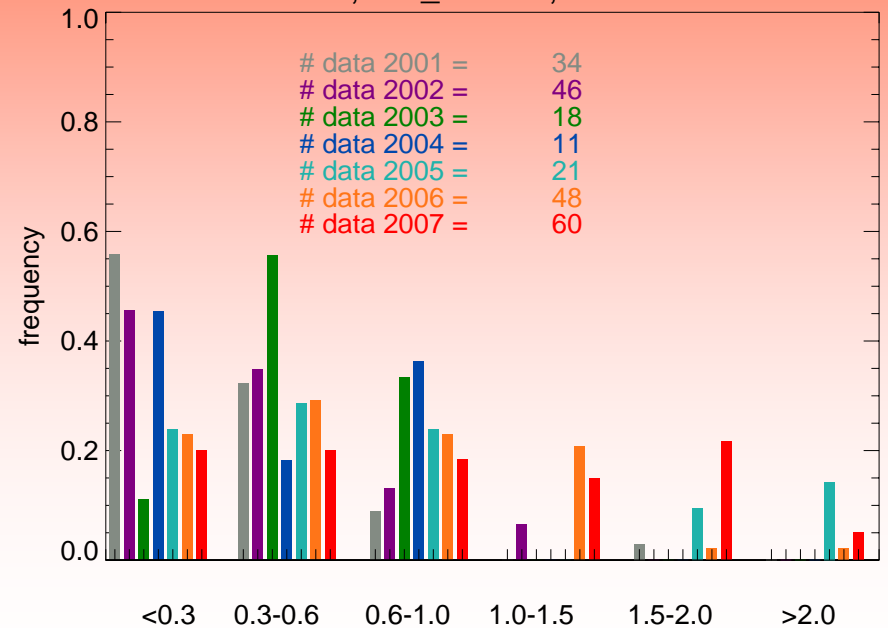
AOD-550nm time series of MODIS/TERRA (black) and AERONET (red) at biomass burning influenced sites: Alta Floresta (left) and Rio Branco (right). AERONET values are hourly means centered at TERRA overpass time

AERONET AOD histograms 2001-2007

Norm. AOD bins, Alta_Floresta, 01082001-31102007



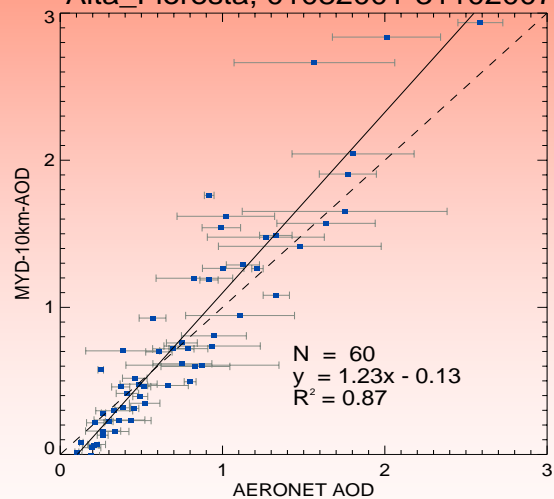
Norm. AOD bins, Rio_Branco, 01082001-31102007



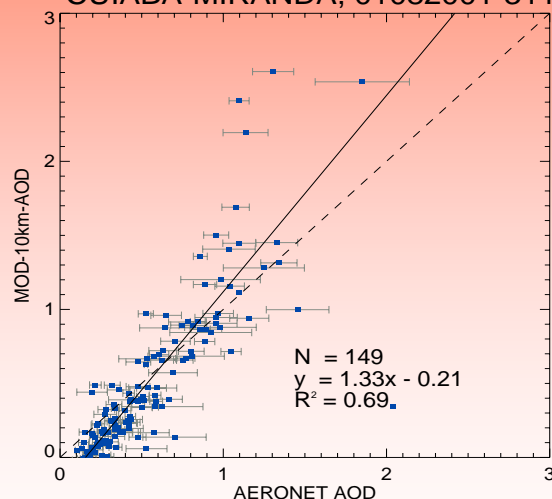
Normalized histograms of AERONET AOD bins for Alta Floresta and Rio Branco for years 2001 - 2007, at MODIS/TERRA overpass time

Isotropic representativity of AERONET sites

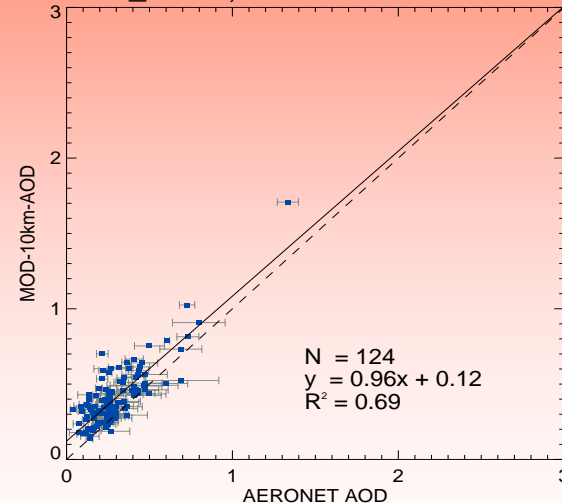
Alta_Floresta, 01082001-31102007



CUIABA-MIRANDA, 01082001-31102007

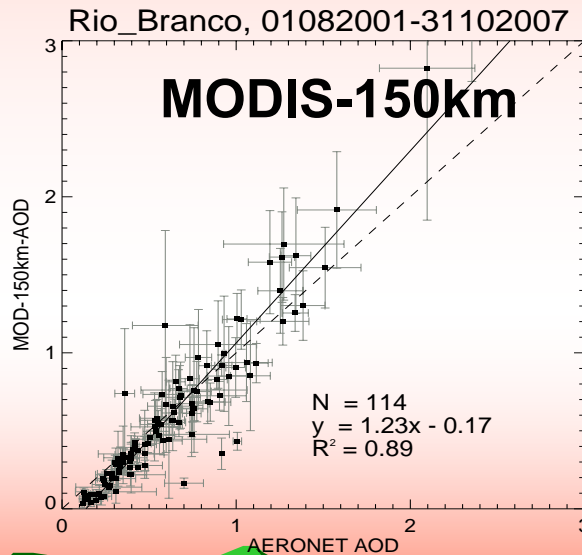
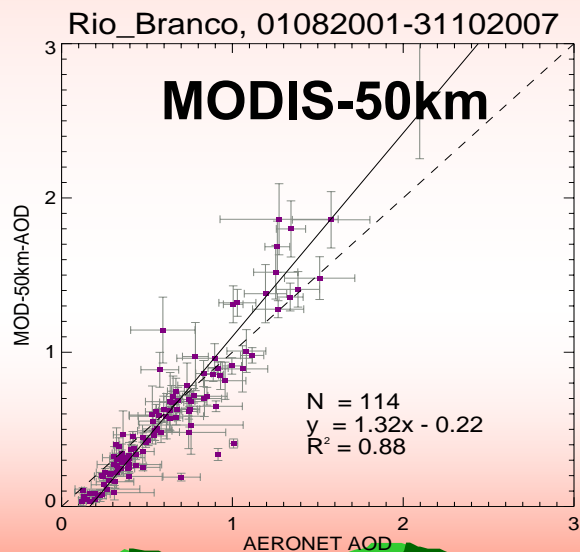
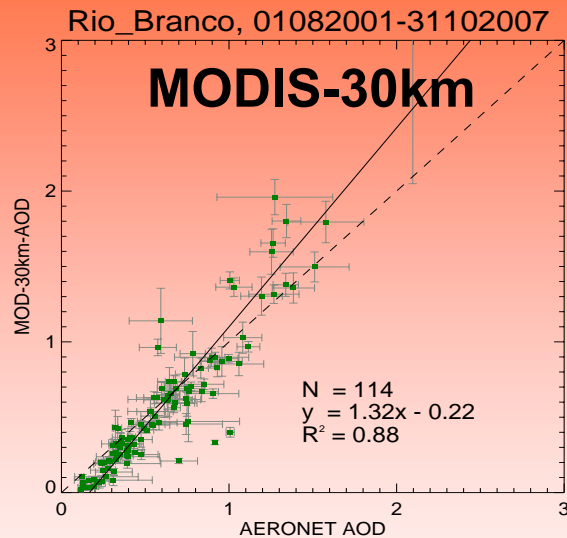
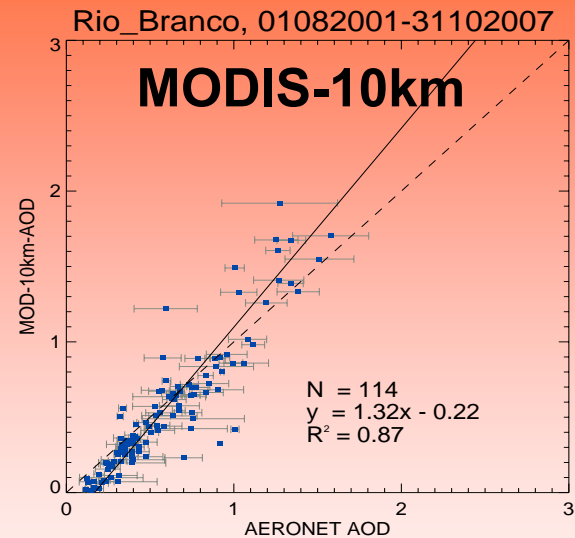


Sao_Paulo, 01082001-31102007



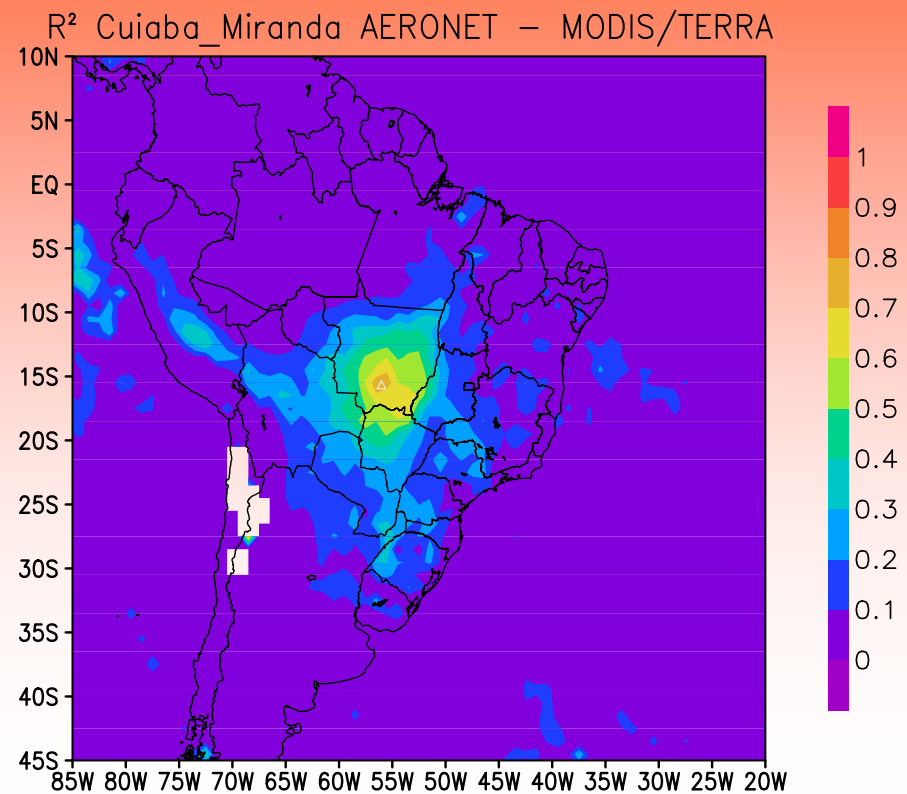
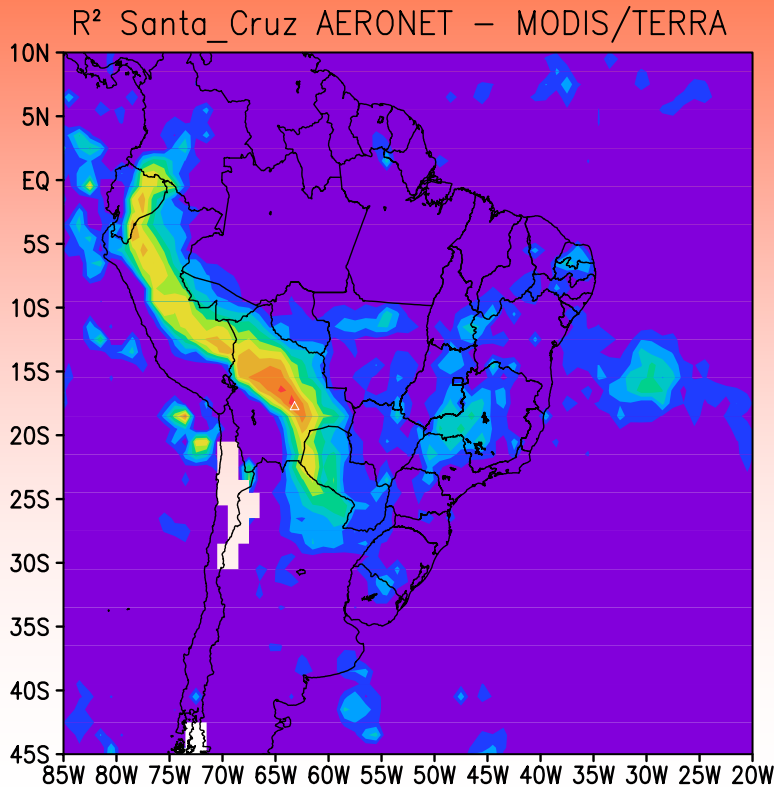
Correlations of MODIS/TERRA and AERONET AOD at 550 nm integrated from 2001-2007 at AERONET sites Alta Floresta, Cuiabá-Miranda, and São Paulo

Isotropic radii of influence



Correlations of MODIS /TERRA AERONET AOD at 550 nm integrated from 2003-2007 at Rio Branco for MODIS 10km, 30 km, 50 km, 150 km spatial average around each AERONET site

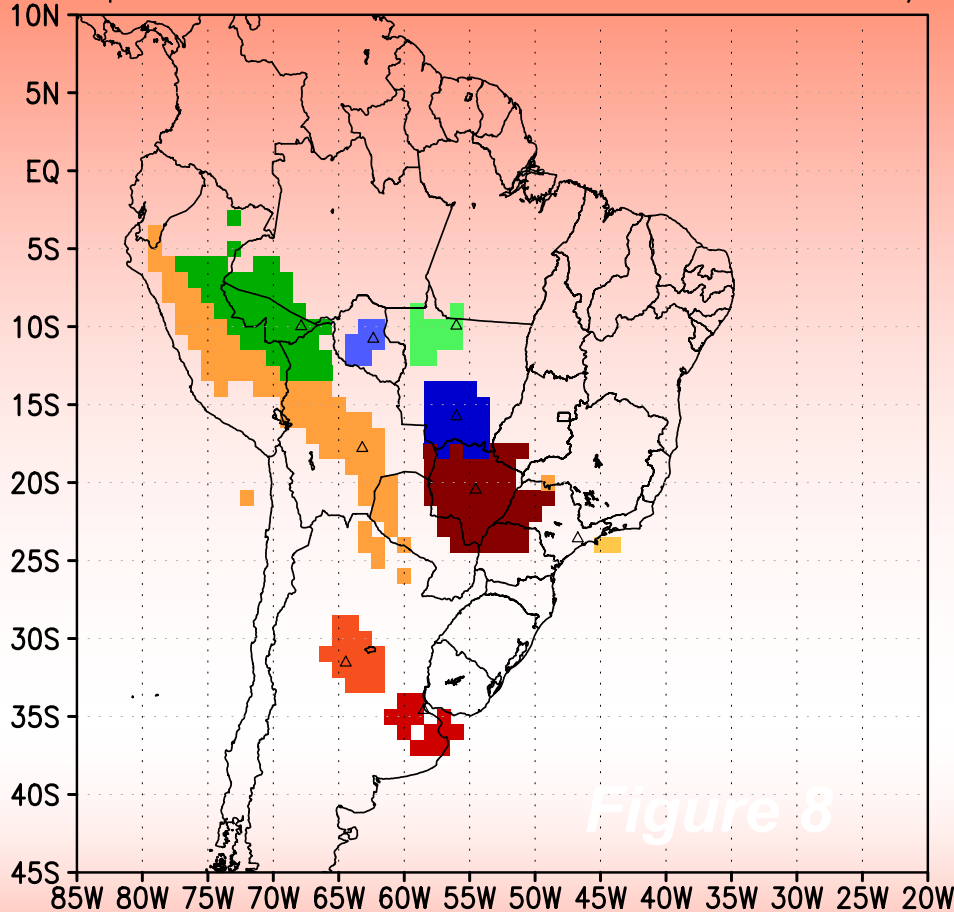
Anisotropic representativity of AERONET sites



Gridded correlations of Santa Cruz and Cuiabá-Miranda AERONET sites calculated by correlation studies of AERONET and MODIS/TERRA (MOVAS 1 x 1) AOD at 550 nm for the burning seasons (AUG-OCT) from 2001 - 2007

AERONET Areas of Influence in South America

Anisotropic radii of influence AERONET – MODIS/AQUA



Anisotropic areas of influence of AERONET sites in South America for data assimilation purposes, calculated by correlation studies of AERONET and MODIS (MOVAS 1° x 1°) TERRA AOD at 550 nm. Plotted AERONET sites: Abracos Hill (1), Cuiabá-Miranda (2), Rio Branco (3), Alta Floresta (4), Campo Grande Sonda (5), Ceilap-BA (6), Cordoba-CETT (7), Santa Cruz (8), and São Paulo (9)

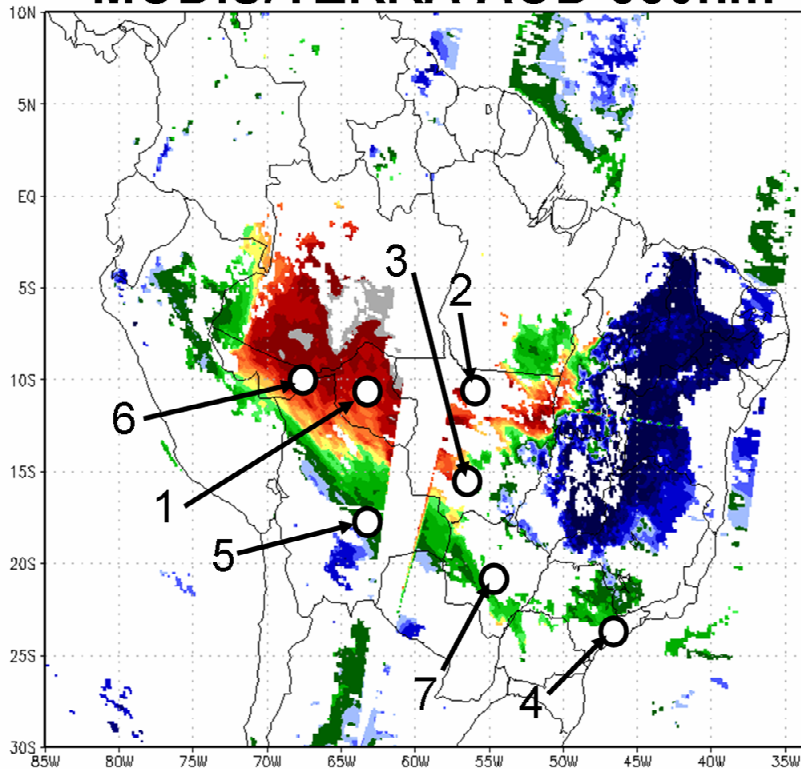
Conclusions

- biomass burning influenced sites show a distinct AOD signal during burning seasons, with maxima >3
- The correlation study, separately for TERRA and AQUA, revealed that AERONET and MODIS data correlate generally well ($R^2 > 0.7$), with a slope > 1
- MODIS yields systematic bias: $AOD_{MOD} < AOD_{AERO}$ for small values and $AOD_{MOD} > AOD_{AERO}$ for high values
- No inter-annual trend of correlation / slope
- Statistically, no large differences between MODIS/TERRA and MODIS/AQUA
- Isotropic approach: can infer gross representativeness errors
- Anisotropic approach:
 - strongly inhomogeneous and anisotropic areas of influence for AOD data for burning seasons 2001-2007
 - influence map may be directly used by AOD assimilation schemes, whose background error covariance matrix is prepared to deal with anisotropic areas of influence.
 - Influence map developed during the present study will now be used with the CCATT-BRAMS model

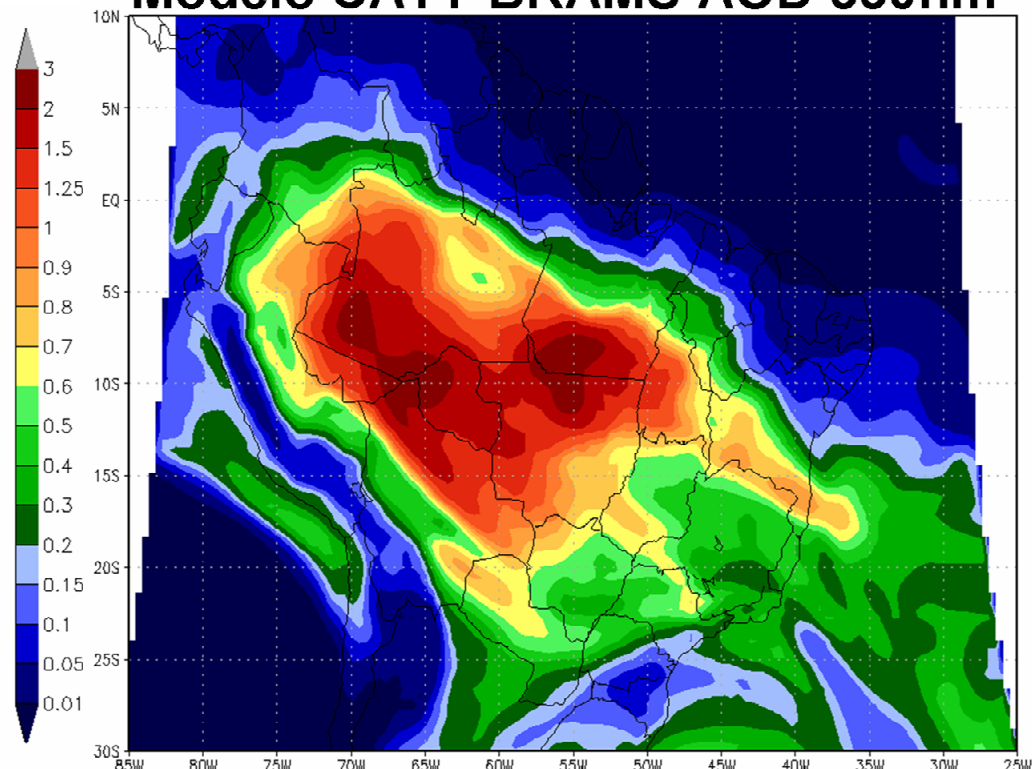
Observations and model

dia 3 de setembro de 2005

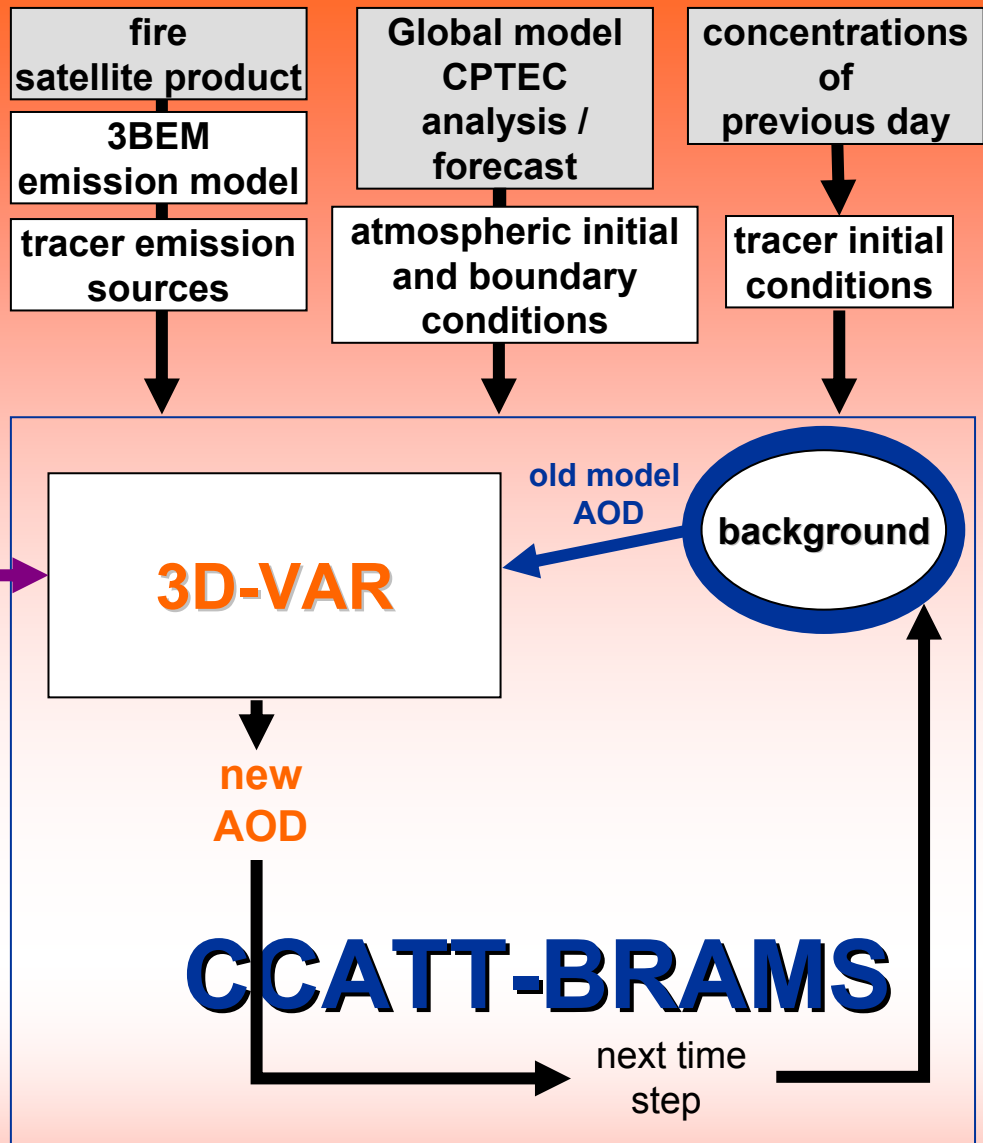
MODIS/TERRA AOD 550nm



Modelo CATT-BRAMS AOD 550nm



CCATT-BRAMS with 3D-VAR Assimilation System



MODIS/AQUA ~17 UTC 1 x day	MODIS/TERRA ~14 UTC 1 x day
AERONET hourly averages 4 x day?	

Ongoing work

- Adapt anisotropic area of influence calculation to CCATT-BRAMS dynamic aerosol model
(derive aerosol properties for RTC) → Nilton E. Rosário, Karla Longo
- Updating assimilation scheme to CCATT-BRAMS
- Adapting system to assimilation of AOD
- Train system
- Get operational for chemical weather forecast
- Assimilation of trace gases (possible for stable species such as CO, Ozone)

