Long Term Absorption Properties of Aerosols in Amazonia Using AERONET and in situ Measurements

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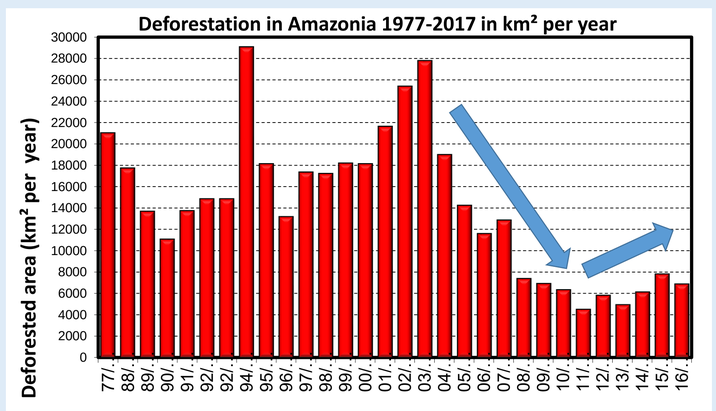
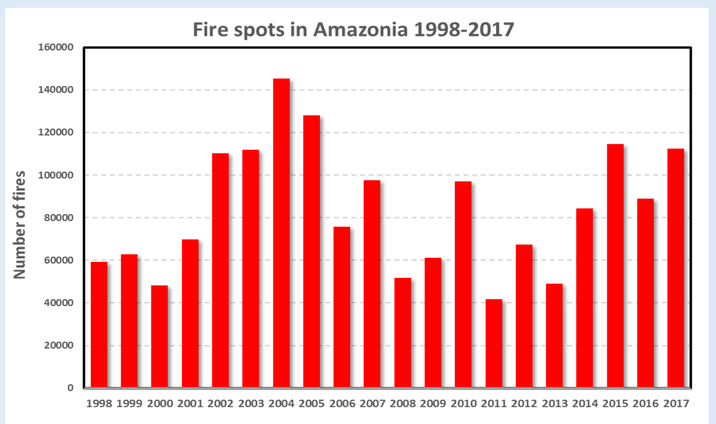
Agriculture expansion and climate change and variability are critical ingredients on Amazonian deforestation.

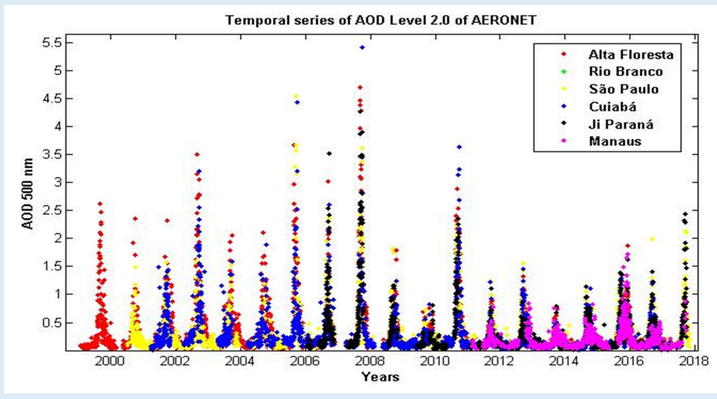
Interactions between land use change and climate change are major drivers for changes in Amazonia.





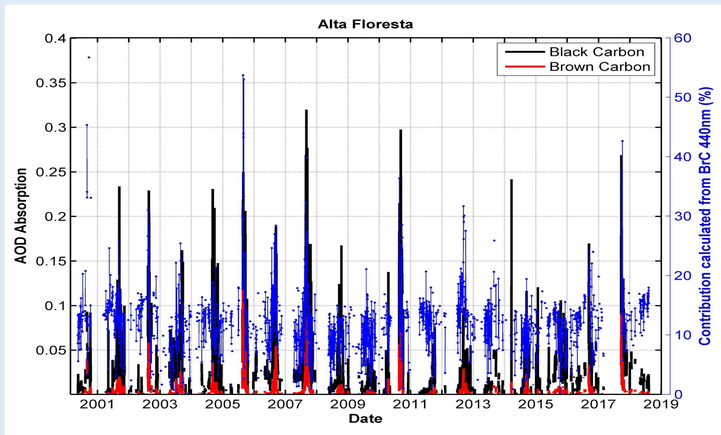
Optical properties of aerosols in Amazonia have been measured over the last 18 years at 7 AERONET sites using CIMEL sun photometers.

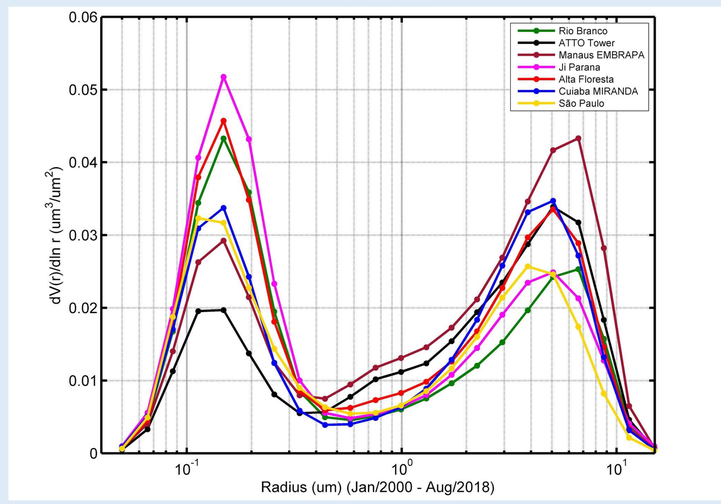
Time series of aerosol optical depth (AOD) measurements at 500nm wavelength and level 2.0 using AERONET algorithm



Strong seasonality between dry and wet seasons is observed. Also, strong association with deforestation and fire counts is observed. Dry years such as 2005 and 2010 shows enhanced aerosols from biomass burning.

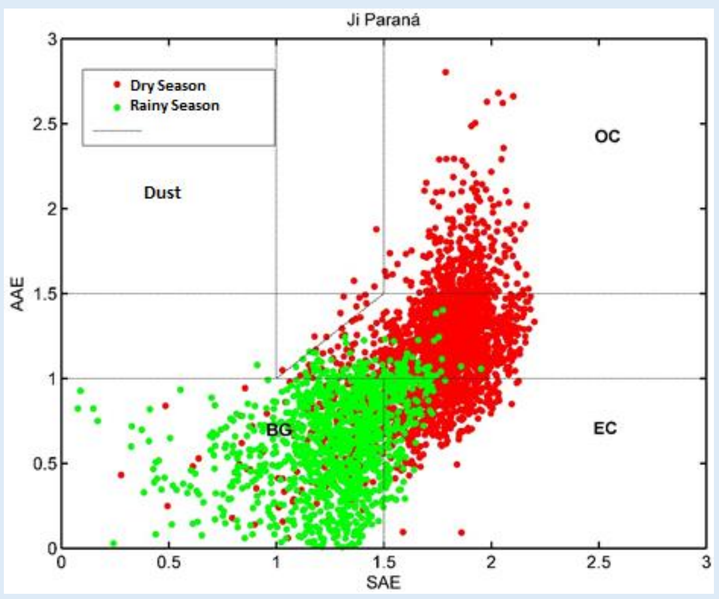
The absorption AOD can be partitioned between Black Carbon and Brown Carbon (BrC) using the procedure from Wang et al., 2016. BrC accounts for 15% of absorption in the dry season.





Average for volume size distribution values for all analyzed sites shows a consistent size distribution in both fine and coarse mode. Dry season aerosols shows an average radius of 120-150 nm in the fine mode. Wet season aerosols shows a consistent coarse mode fraction with average radius of about 5-7 micrometers from biogenic aerosols

Classification of aerosol types using the Ångström matrix that compares the scattering Ångström Exponent (SAE) with the absorption Ångström Exponent (AAE). OC stands for Organic Carbon. EC for Elemental Carbon, BG for biogenic aerosols and Dust is soil dust.



It is possible to observe a clear separation between dry and wet season aerosols in terms of different components in the Ångström matrix. Wet season sees the dominance of biogenic aerosols, while dry season is dominated by biomass burning with strong participation of OC and EC. We observe that no Dust episode was observed using this technique.

Conclusions

Long term (18 years) AOD measurements were done in Central Amazonia (Manaus ZF2, Manaus EMBRAPA and ATTO tower), as well as in sites more impacted by biomass burning emissions (Rio Branco, Porto Velho, Ji Paraná, and Alta Floresta).
Results shows important geographical and seasonal variability in terms of aerosol impacts. It was observed 5 main aerosol components: natural biogenic primary aerosol particles, biogenic secondary organic aerosols, biomass burning, long range transport from Africa and eventual urban component. The Ångström matrix helps in separating these different components.
It was possible to observe BrC in addition to BC and it accounts for a significant 15% of aerosol absorption.

Reference: Wang, Xuan, Colette L. Heald, Arthur J. Sedlacek, Suzane S. de Sá, Scot T. Martin, M. Lizabeth Alexander, Thomas B. Watson, Allison C. Aiken, Stephen R. Springston, and Paulo Artaxo. Deriving Brown Carbon from Multi-Wavelength Absorption Measurements: Method and Application to AERONET and Surface Observations. Atmos. Chem. Phys., 16, 12733-12752, 2016, doi:10.5194/acp-16-12733-2016.