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The Transport of Dust from the Sahara Desert to the Central Amazon Determined with in situ Measurements in the ATTO/ZF2 Towers and Remote Sensing

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Introduction

The Sahara, besides being the largest desert in the world, is the largest global source of dust to the atmosphere, contributing to changes in the climate and atmospheric chemistry at both regional and global scales.

The Amazon annually receives this dust through transatlantic transport, which acts on the long term as a valuable fertilizer in the forest, providing essential nutrients to the forest.

From a data series of 10 years, it will be possible to determine the elemental concentration of dust aerosol from the Sahara desert, transported from the North of Africa by the trade winds and to investigate the different compositions from continuous and long term measurements in three sites in the Central Amazon.

Methodology

An analysis of the time series of measurements performed by the Nephelometer, Aethalometer and MAAP is aimed to quantify the BC and dust concentrations. The AOD measurements of CIMEL solar photometers from the AERONET network are also being used.

Aerosol filters are used to collect dust carried by trade winds during wet seasons, trace element measurements are used on AFG filters. AOD measurements on the Giovanni platform are used to characterize the large-scale aerosol distribution. The transport is modeled from the HYSPLIT air mass trajectories.

Site	Location Lat. (ºS)	Long. (ºW)
ATTO	2.1466º	59.0050º
ZF2	2.5946	60.2093º
EMBRAPA	2.8905º	59.9697º

Tab. 1: Location of sites in Central Amazon.

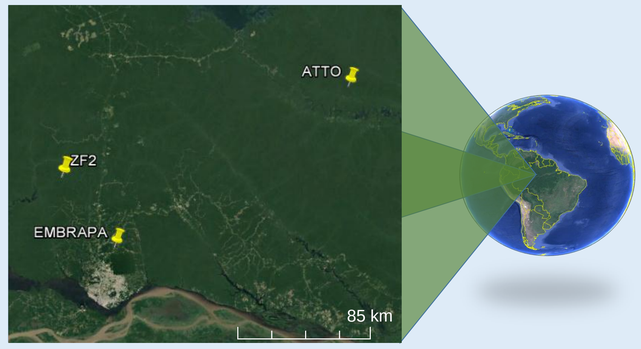

Fig. 1: Sampling sites on Central Amazon.

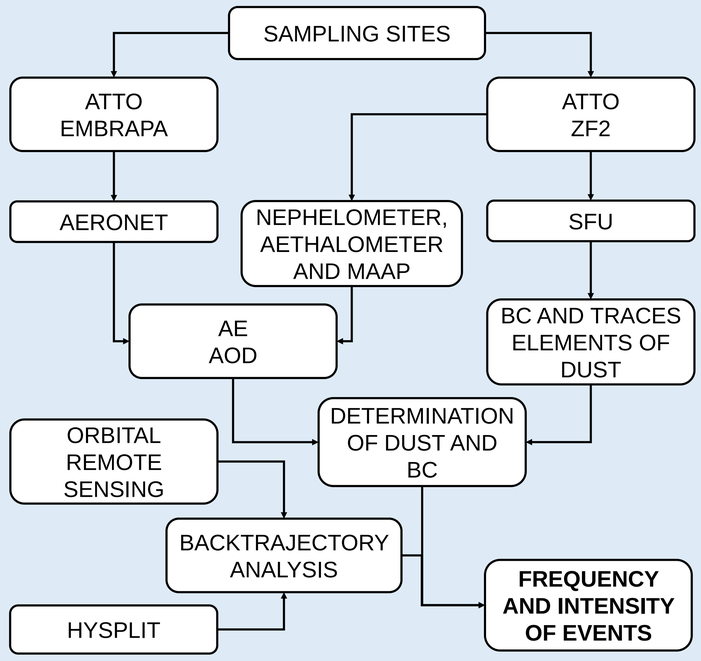

Fig. 2: Method workflow and applied analysis.

Preliminary Results

From the analysis of the data obtained by the AERONET Solar photometers at the EMBRAPA site, it was possible to obtain the values of the Absorption Angstrom Exponent and the Simple Scattering Albedo, which indicate the presence of dust and BC present in the atmospheric column during the wet season in Central Amazonia. From these values, several other analyzes can be performed.

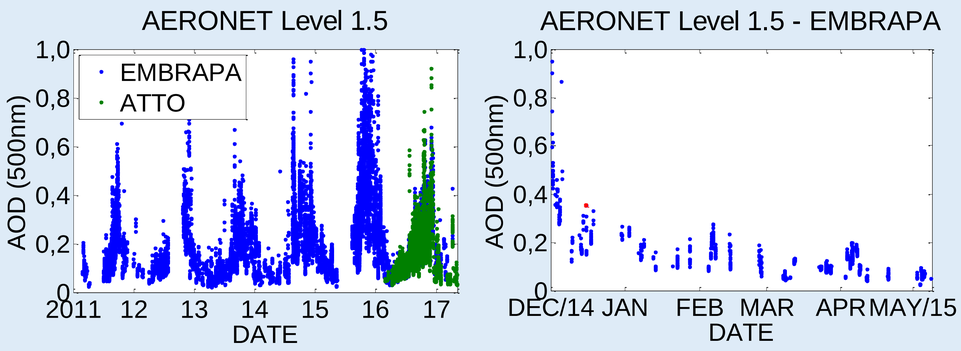

Fig. 3: AOD 500 nm for the period 2011-2017 at EMBRAPA and 2016-2017 at ATTO (left), and for the period between Dec/2014 and May/2015 at EMBRAPA (right).

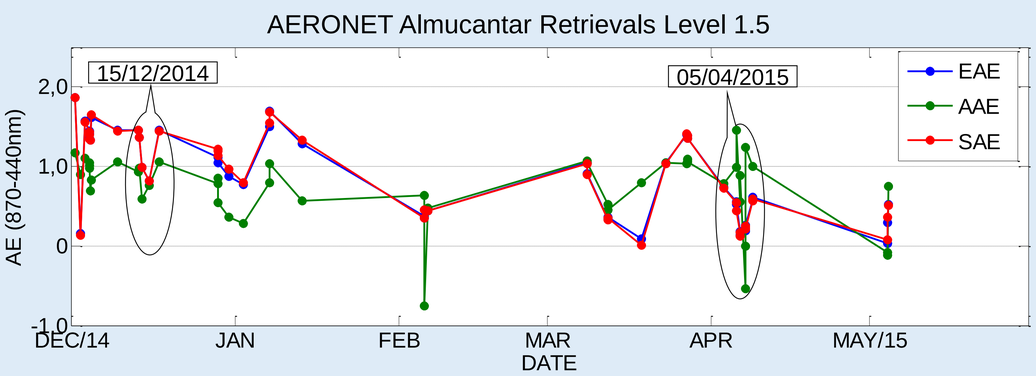

Fig. 4: AE in each component (Extinction, Absorption and Scattering) for the events where the highest occurrences of BC (15/12/14)* and Dust (05/04/15)* measured by the AFG.

* The dates highlighted in the graph correspond to the midtime referent to the sampling period of the AFGs: occurrence of BC 13-17/12/2014 and Dust 03-08/04/2015.

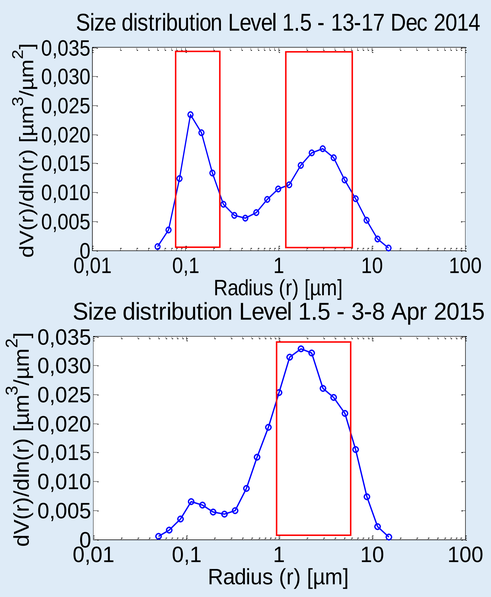

Fig. 5: Distribution of the particle sizes obtained by the AERONET inversion products present during the BC (15/12/14) and Dust (04/05/15) periods, for the periods identified by the AFG.

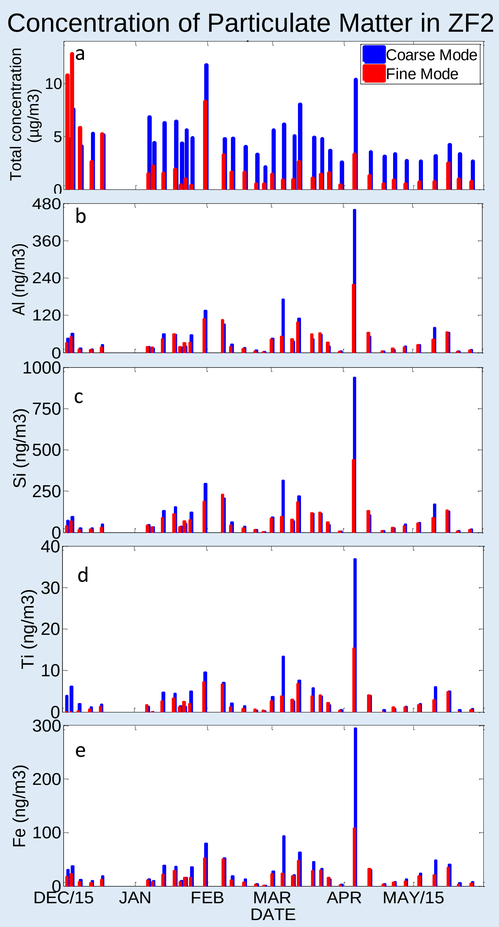

Fig. 6: Time series of particulate matter obtained in ZF2 by AFG between Dec/2014 (a) and May/2015. Values obtained from the EDXRF analyzes for Al (b), Si (c), Ti (d) and Fe (e).

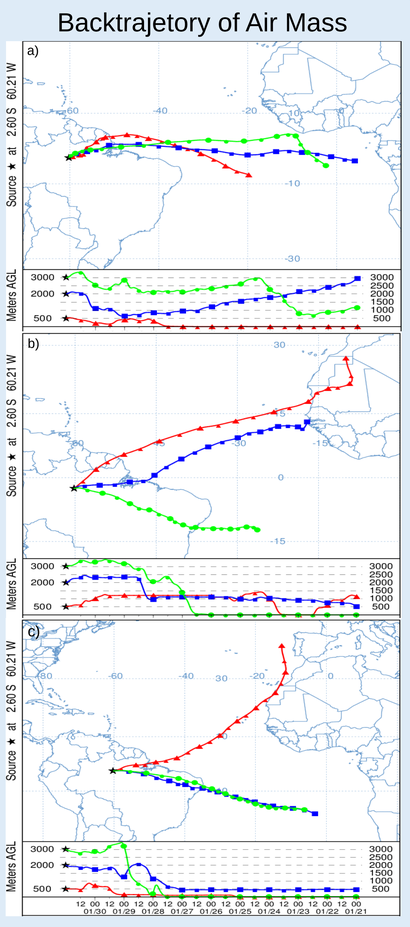

Fig. 7: Backtrajectories of air masses of 10 days from HYSPLIT, arriving in the zf2 on days: a) 15/12/2014, b) 05/04/2015 e c) 31/01/2015.

Final Considerations

The measurements of the sun photometer show that the AOD presents a strong seasonal variation, with values close to 0.20 in the wet season, and with a maximum value of 0,35 observed on 15/12/2014, being associated to the presence of BC mainly due to the biomass burning aerosols. Analyzes of the AAE with a value of 1,45 on 05/04/2015 show a strong presence of dust, which is confirmed by the trace element AFG analyzes.

These results were obtained from measurements of a single wet season (Dec/2014 - May/2015). We plan to extend this analysis for at least 10 years in order to obtain good statistics in the events of Sahara Dust transport to Amazonia.