Influence of the Manaus plume on aerosol size distribution and CCN during GoAmazon2014/5 – preliminary results

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Pacific Northwest NATIONAL LABORATORY

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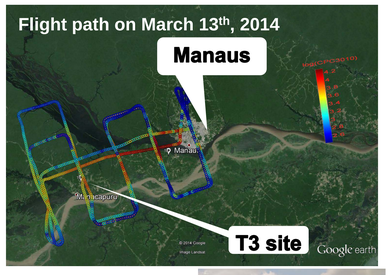
Introduction & Motivation

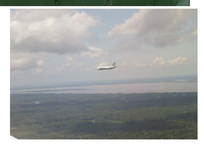
- Aerosol indirect effects, which describe the influences of aerosol on climate through modifying cloud properties, remain the most uncertain components in forcing of climate change over the industrial period.
- The Amazon is one of the few continental regions where atmospheric aerosol particles and their effects on climate are not dominated by anthropogenic sources. This field study took advantage of the city of Manaus in the setting of the surrounding "green ocean" as a natural laboratory for understanding the effects of present and future anthropogenic pollution on the aerosol life cycle in the tropics.
- In this study, we examine the influences of the Manaus plume on aerosol size distribution and the CCN activities as compared to natural conditions.

Aircraft sampling pattern and Periods



IOP1 (wet season)
•02/01/2014 -- 03/31/2014

IOP2 (dry season)
•08/15/2014 -- 10/15/2014



G-1 photo taken from HALO

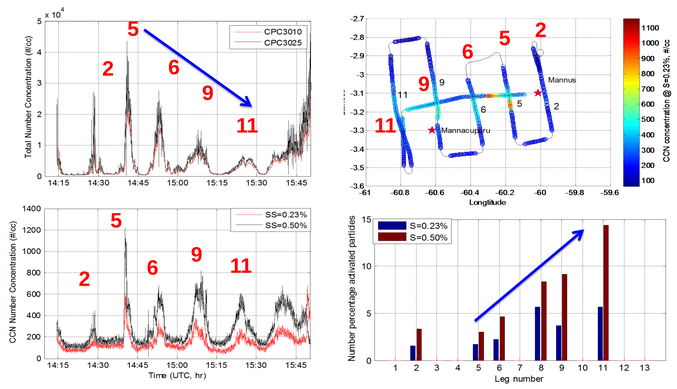
ARM Aerial Facility - Gulfstream-1(G-1) were deployed in both phases to obtain measures of cloud, trace gas, and aerosol properties

Aerosol measurements used here

Instruments	Measurements
Condensation Particle Counter (3010 and 3025, TSI)	Aerosol total number concentration (> 3 nm)
Fast Integrated Mobility Spectrometer (FIMS, BNL)	Aerosol size distribution (15-500 nm)
Ultra High Sensitivity Aerosol Spectrometer- Airborne (UHSAS-A, DMT)	Aerosol size distribution (60 – 1000 nm)
Passive Cavity Aerosol Spectrometer Probe (PCASP, DMT)	Aerosol size distribution (100 – 3000 nm)
High Resolution Time of Flight Aerosol Mass Spectrometer (HR-ToF-AMS, Aerodyne)	PM1 aerosol chemical composition (non-refractory)
Cloud Condensation Nuclei Counter (CCN-200, DMT)	Total CCN concentration at 2 supersaturations

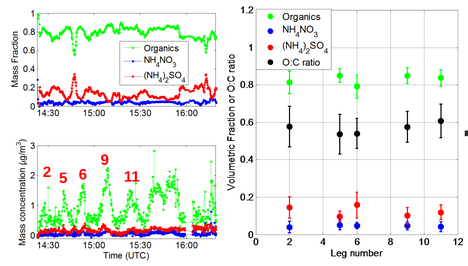
Results from wet season

➢CCN activity increase along the plume



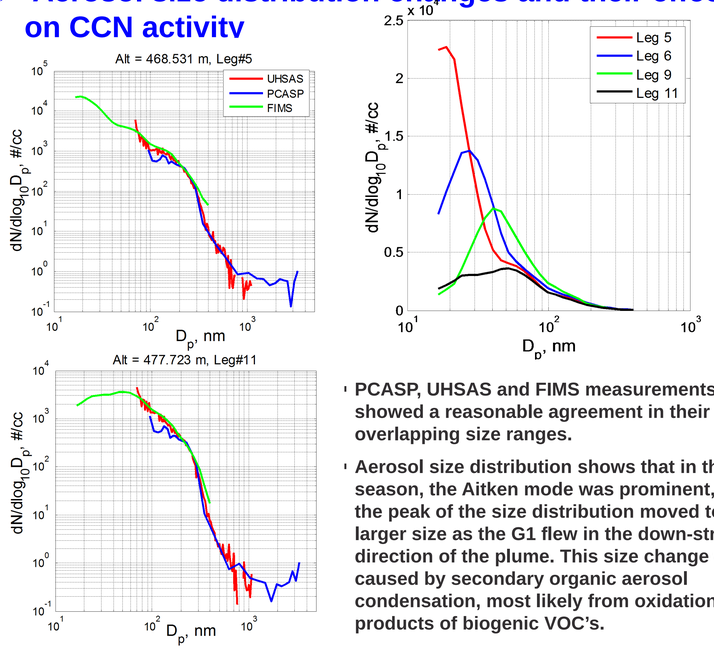
- **The flight legs are defined when G1 flew at a constant altitude.**
- **From flight leg 2-11, G1 flow to the down wind of Manaus plume. The plume concentration peaks decrease due to plume spreading and the CCN activity increases due to atmospheric processing**

➢ Aerosol chemical composition of Manaus plume in wet season (03/13/2014)



- **Aerosol chemical composition is dominated by organic compounds, most likely constituted by mass from gas to particle conversion of biogenic oxidation products, yielding SOA.**
- **In Manaus plume, the ambient aerosols seemed highly oxidized (O:C ~ 0.6). There is no significant change in volume fractions of main aerosol compounds along the plume.**

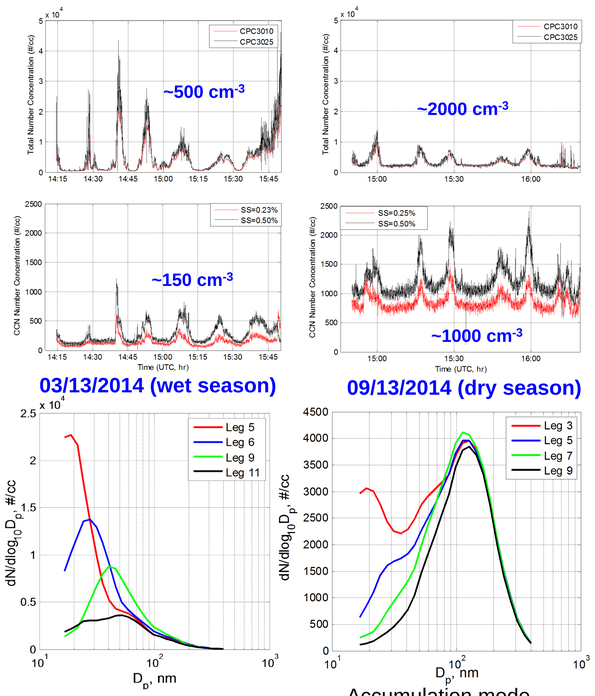
➢ Aerosol size distribution changes and their effects on CCN activitv



- **PCASP, UHSAS and FIMS measurements showed a reasonable agreement in their overlapping size ranges.**
- **Aerosol size distribution shows that in the wet season, the Aitken mode was prominent, and the peak of the size distribution moved to larger size as the G1 flew in the down-stream direction of the plume. This size change was caused by secondary organic aerosol condensation, most likely from oxidation products of biogenic VOC's.**

Seasonal Comparison

➢CPC/CCN concentrations in wet/dry seasons



- **The background aerosol total concentration in dry season is a factor of 4 of the aerosol total concentration in wet season.**
- **The background ambient aerosols in dry season are more CCN active than the aerosols in wet season.**
- **The aerosol size distributions of Manaus plume are averaged at each flight leg.**
- **We observed a clear particle growth along the plume in wet season and the growth is hidden in dry season by the dominated accumulation mode aerosols likely from biomass burning.**

Conclusions and Future plans

- Aerosol number concentration downstream of Manaus in wet season is higher than in dry season. However, CCN number concentration in dry season is higher than that in wet season.
- The CCN activation fraction increases along the plume.
- At same altitude, aerosol size effect is the dominant effect on the CCN activation properties along the plume. At the same location, aerosol chemical composition effect also plays a role to change the CCN activation properties vertically.

Future plans

- Size/chemical composition effect on CCN activation properties in Manaus plume.
- Sensitivity study on the organic hygroscopicity assumption.
- Comparison between the wet and dry seasons.
- Coupling with modeling work to constrain aerosol parameterization

Acknowledgements

ASR Atmospheric System Research
ARM CLIMATE RESEARCH FACILITY
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