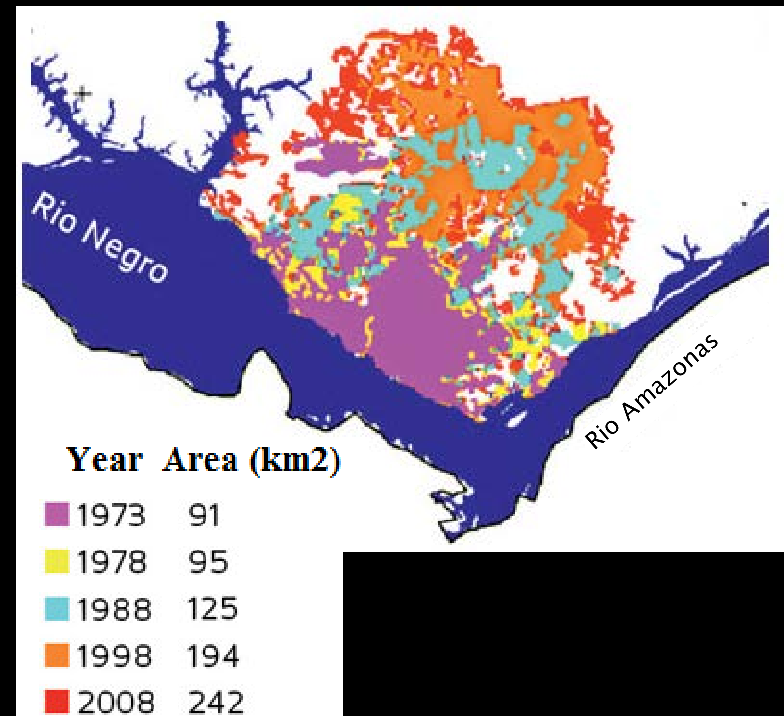
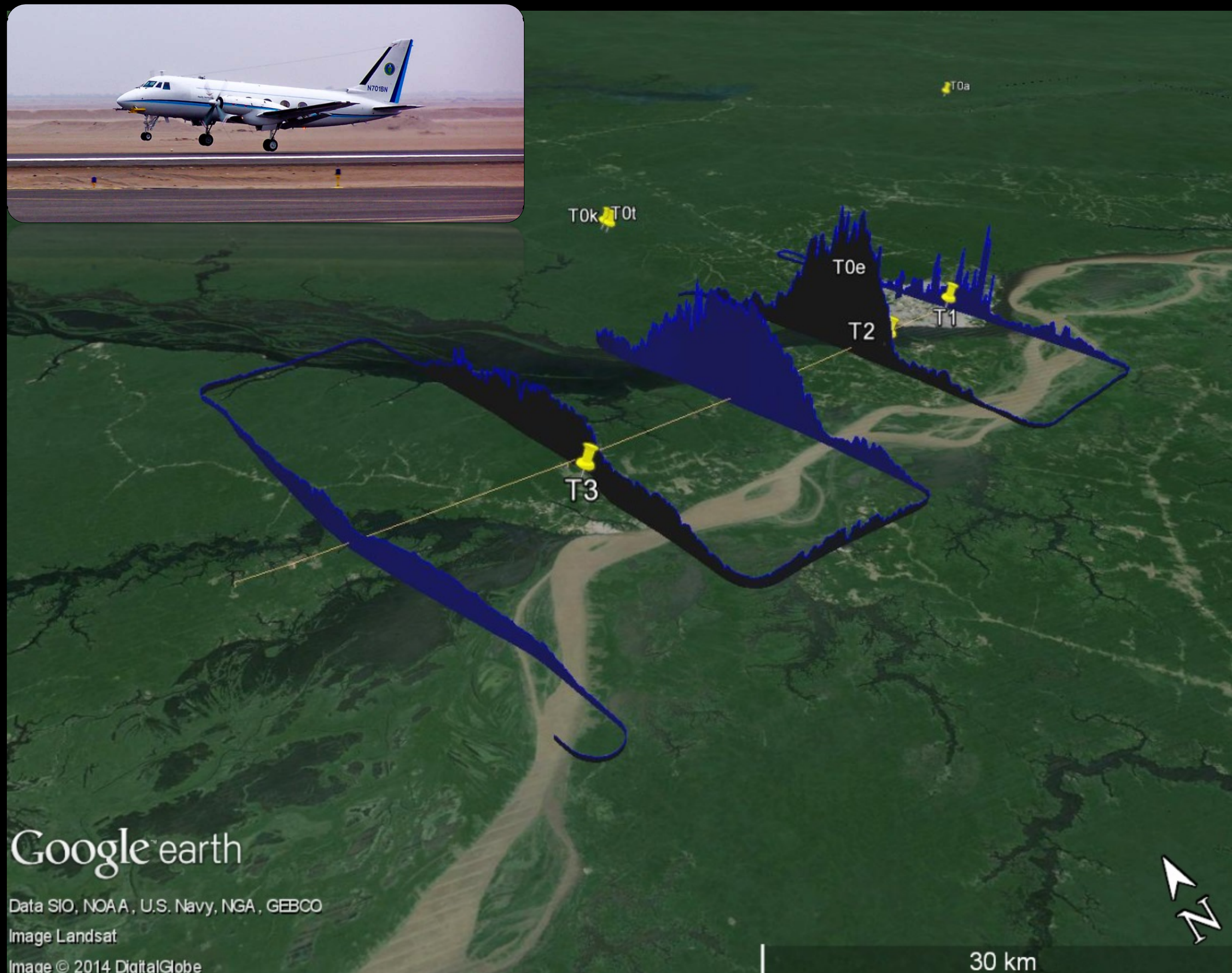
GoAmazon2014/5: 1 Jan 2014 to 31 Dec 2015

IOP1: wet season 2014 (1 Feb – 31 Mar), IOP2: dry season 2014 (15 Aug – 15 Oct)



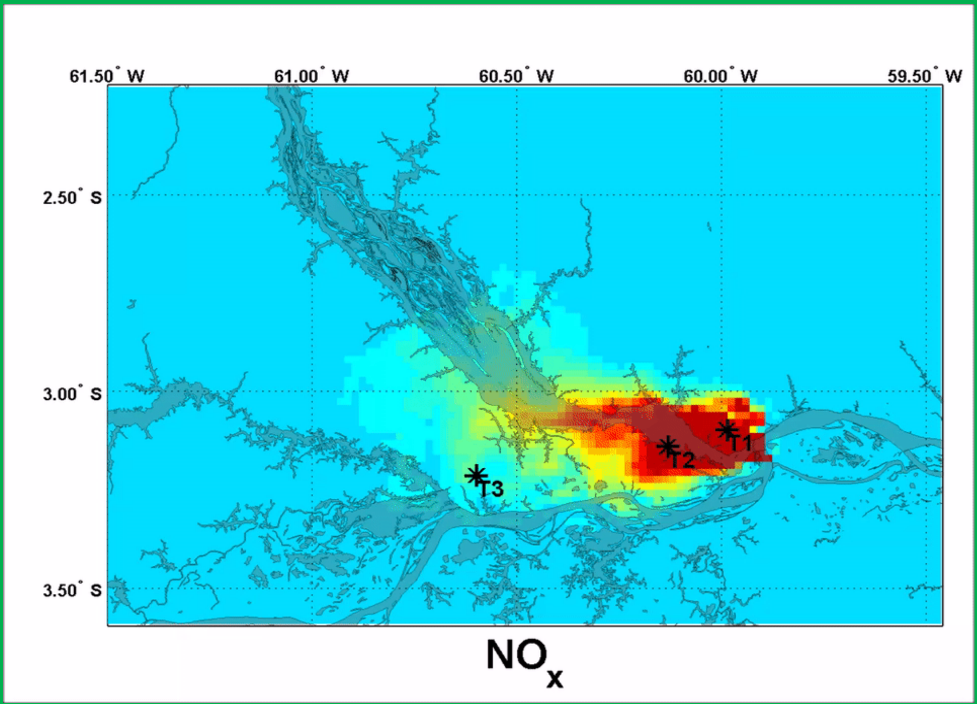
Transverse Transects of Urban Plume

500 m
11 AM local
13 March 2014



Rain
CDNC
CCN
CN

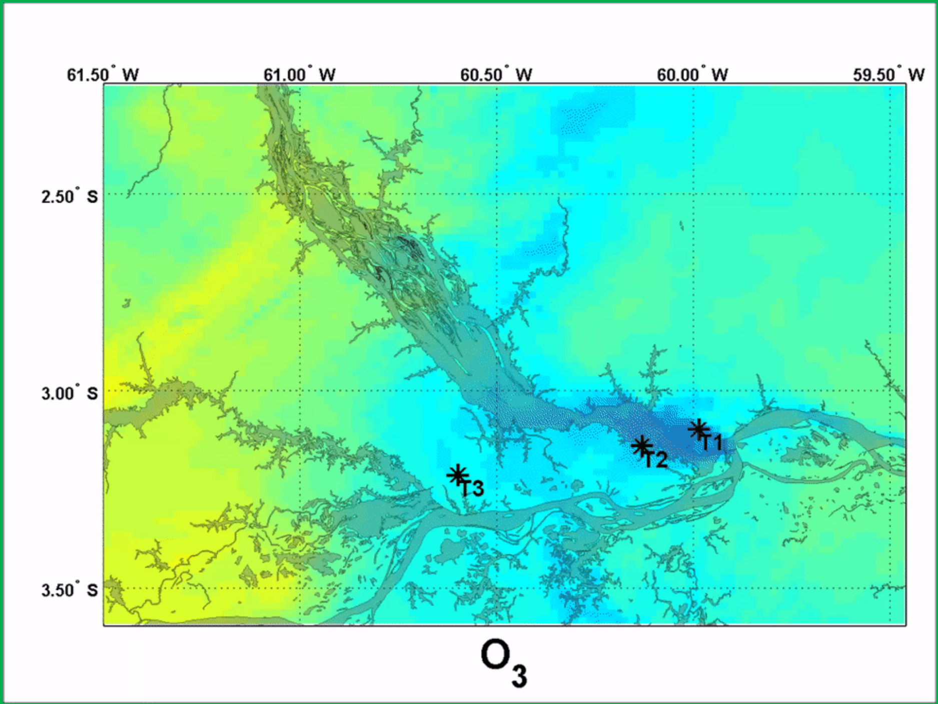
UEA ATMOSPHERIC MODELING GROUP



WRF-CHEM
(MOZART-4, MEGAN, CFSv2)

Feb 1, 2014, 06:00 – 20:00 Local Time, at 500 m

Two nested domains with 10 km and 2 km resolution



Implemented to WRF-CHEM emissions database:

- Vehicle inventory and emissions of Manaus for 2014;

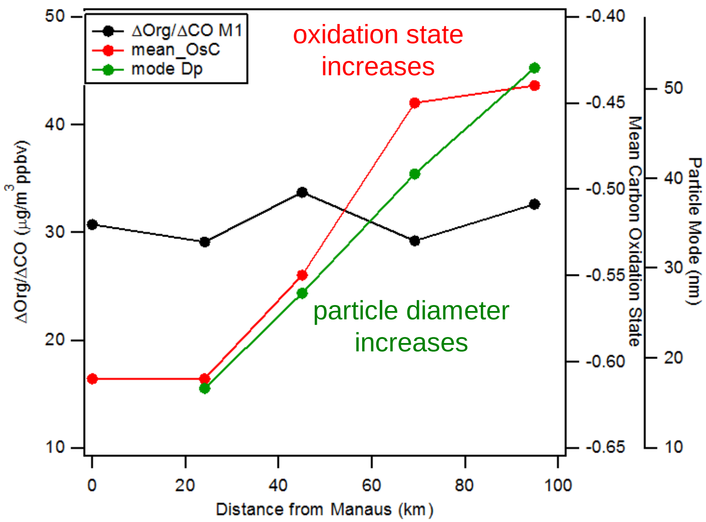
- Energy matrix and power plant emissions of Manaus for 2014.

Prepared by Adan Medeiros, Rodrigo Souza, and Scot Martin.

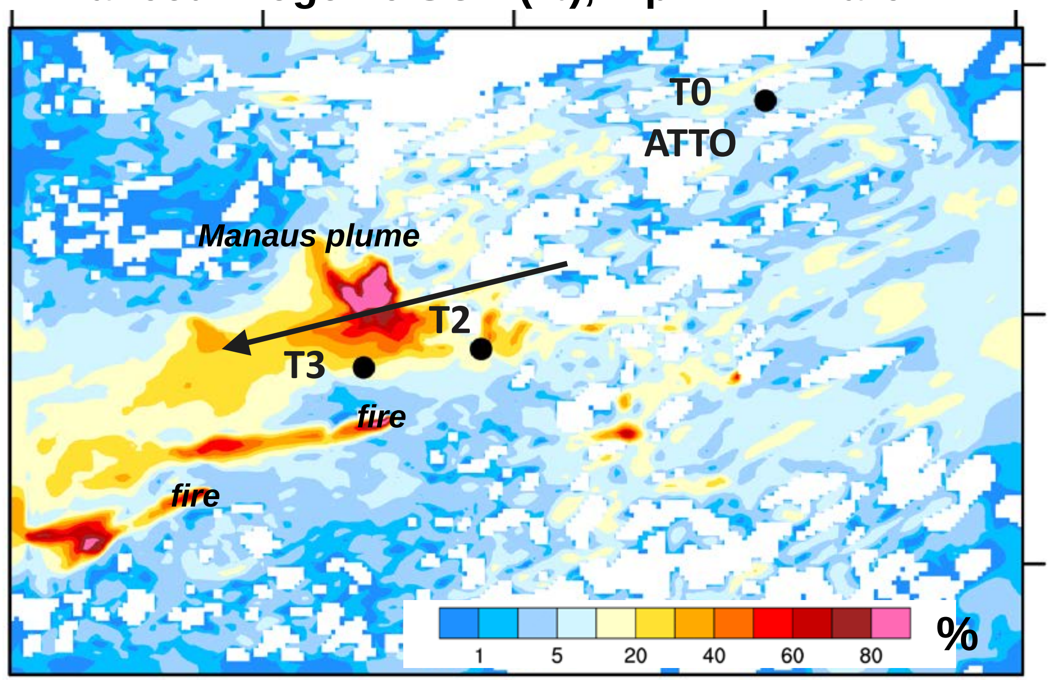
Modeling SOA Production

Manish Shrivastava, John Shilling et al.

Objective: Investigating new anthropogenic-biogenic interaction pathways on the formation of secondary organic aerosols using the WRF-Chem model



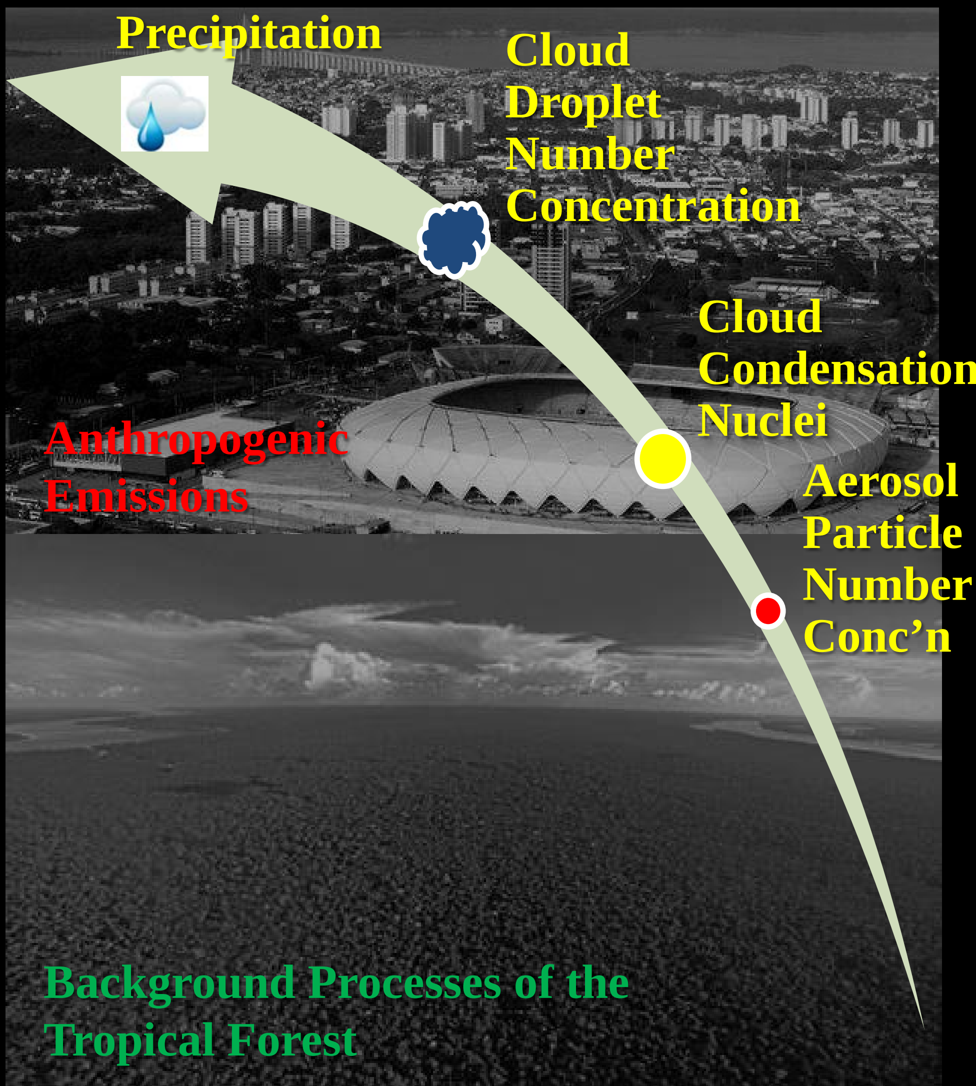
Enhanced Biogenic SOA (%), 2 p.m. LT March 17

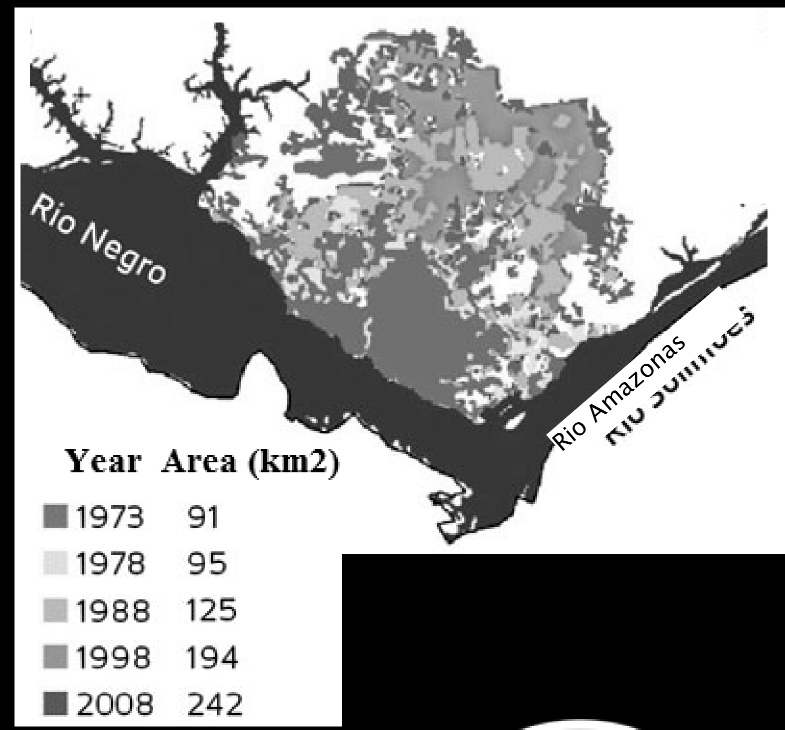


Results

- G-1 data shows particle size and oxidation state increase with aging, indicating SOA formation downwind of Manaus
- Finding **enhancements in biogenic SOA, up to 80%**, due to anthropogenic and fire emissions that increase oxidants within the background Amazon, thus increasing SOA
- Including a more detailed treatment of biogenic SOA chemistry (e.g., IEPOX), and effects of NO_x regimes on SOA; evaluating model predictions based on field measurements

Amazon Basin has strong coupling between terrestrial ecosystem and the hydrologic cycle: The linkages among carbon cycle, aerosol life cycle, and cloud life cycle need to be understood and quantified.





GOAMAZON 2014–2015

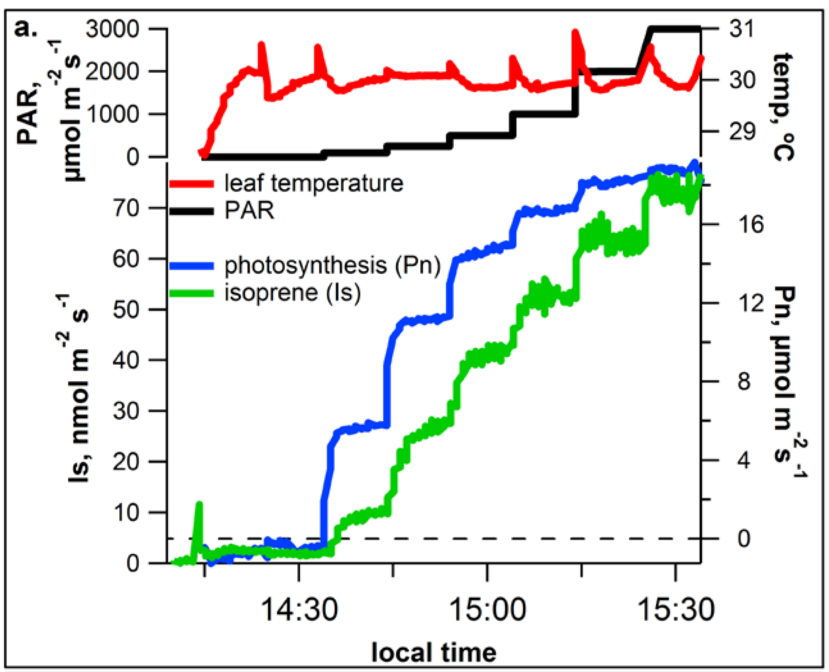
Plant physiological functions in the tropics

Objective: Leaf response curves of photosynthesis with isoprene in Amazonia.

Results:

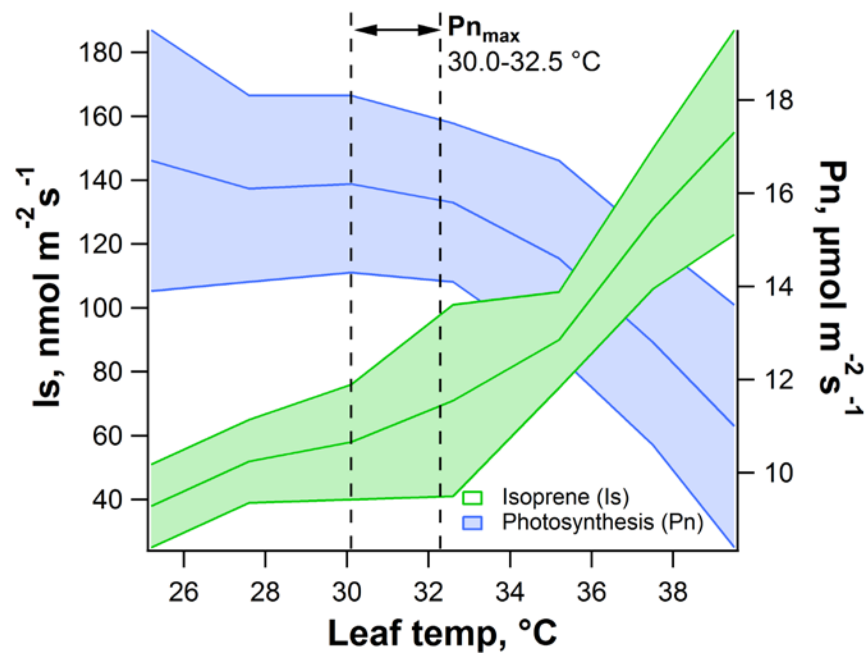
- Supports function of isoprene through excess photosynthetic energy consumption
- a protective role of isoprene for photosynthesis during high temperature extremes regularly experienced in secondary rainforest ecosystems.

Light (PAR)



As light increases, non-linear increase in isoprene emissions and photosynthesis.

Leaf Temperature



Photosynthesis and isoprene emissions uncouple at high leaf temperature

Jardine, K. J., Jardine, A. B., et al., Atmos. Chem. Phys. Discuss., 2016, GoAmazon2014/5 Special Issue.

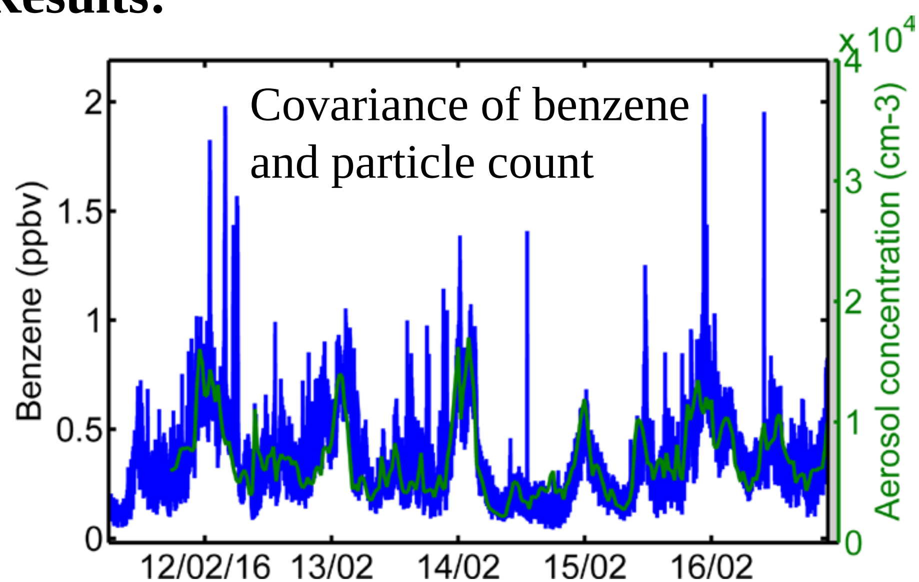
Characterization of Urban Environment (T1u)

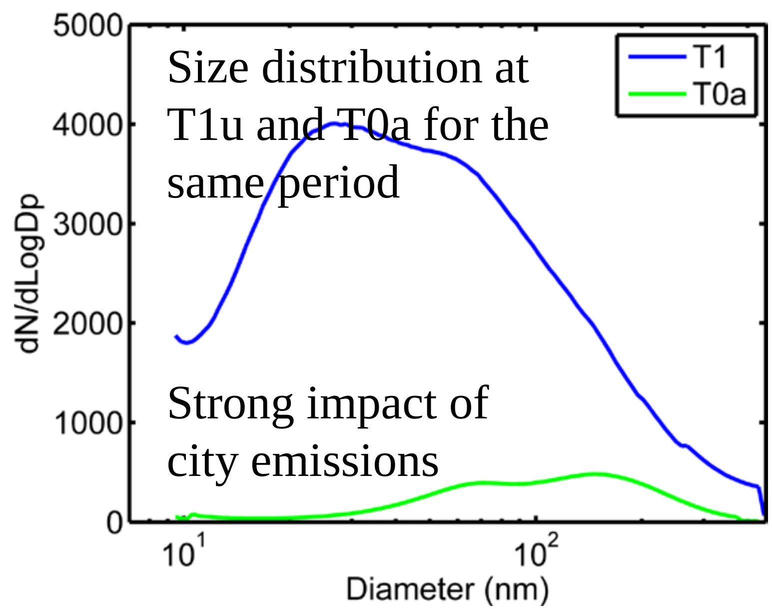
Objective:

Characterize pollution source region

Brito, Artaxo, Barbosa, Souza, et al., in prep, GoAmazon2014/5 Special Issue

Results:

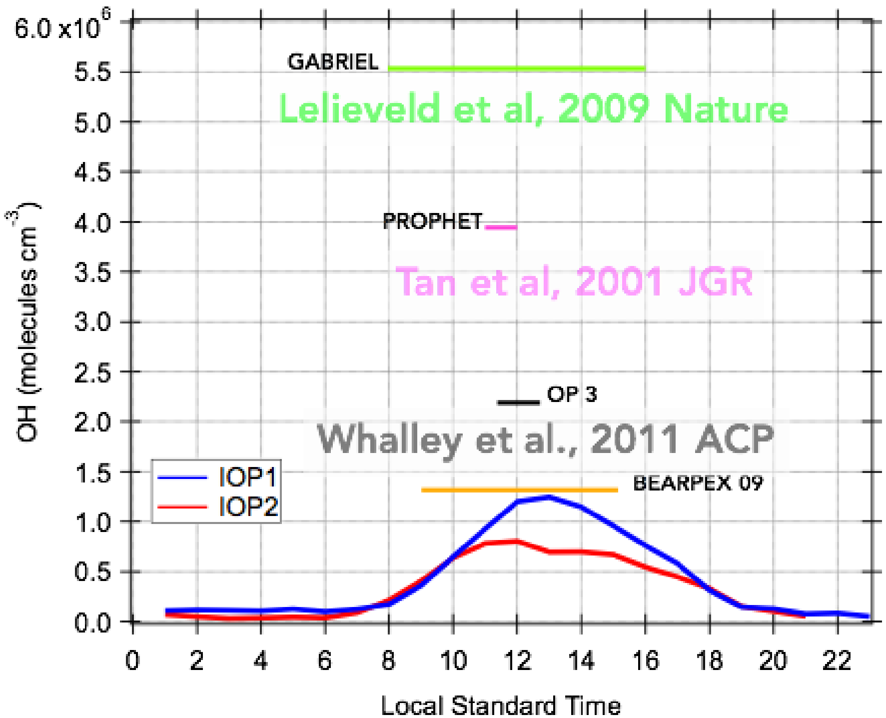


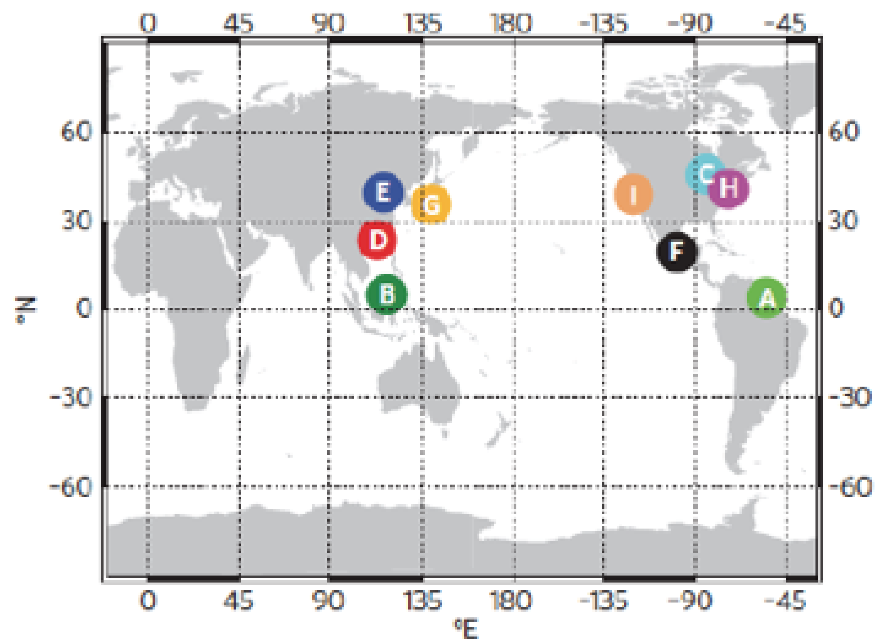


Hydroxyl Radical Concentrations

Objective: Measure OH radical concentrations in light of literature possibly suggesting sustained high concentrations over tropical forest because of radical recycling

Result: GoAmazon2014/5 measurement show concentrations are normal, instead of elevated, during wet and dry seasons (IOP1 and IOP2).



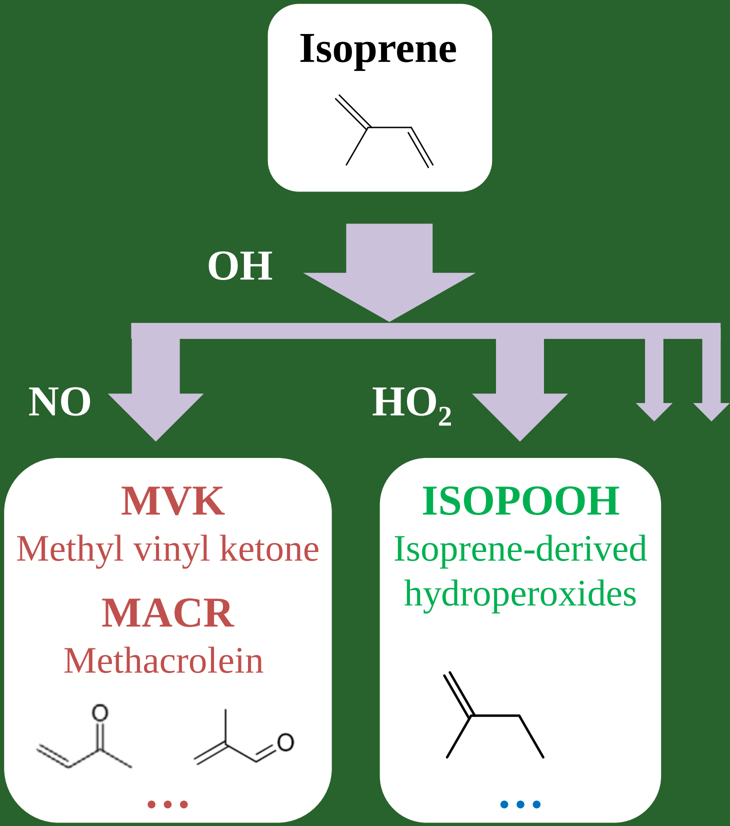


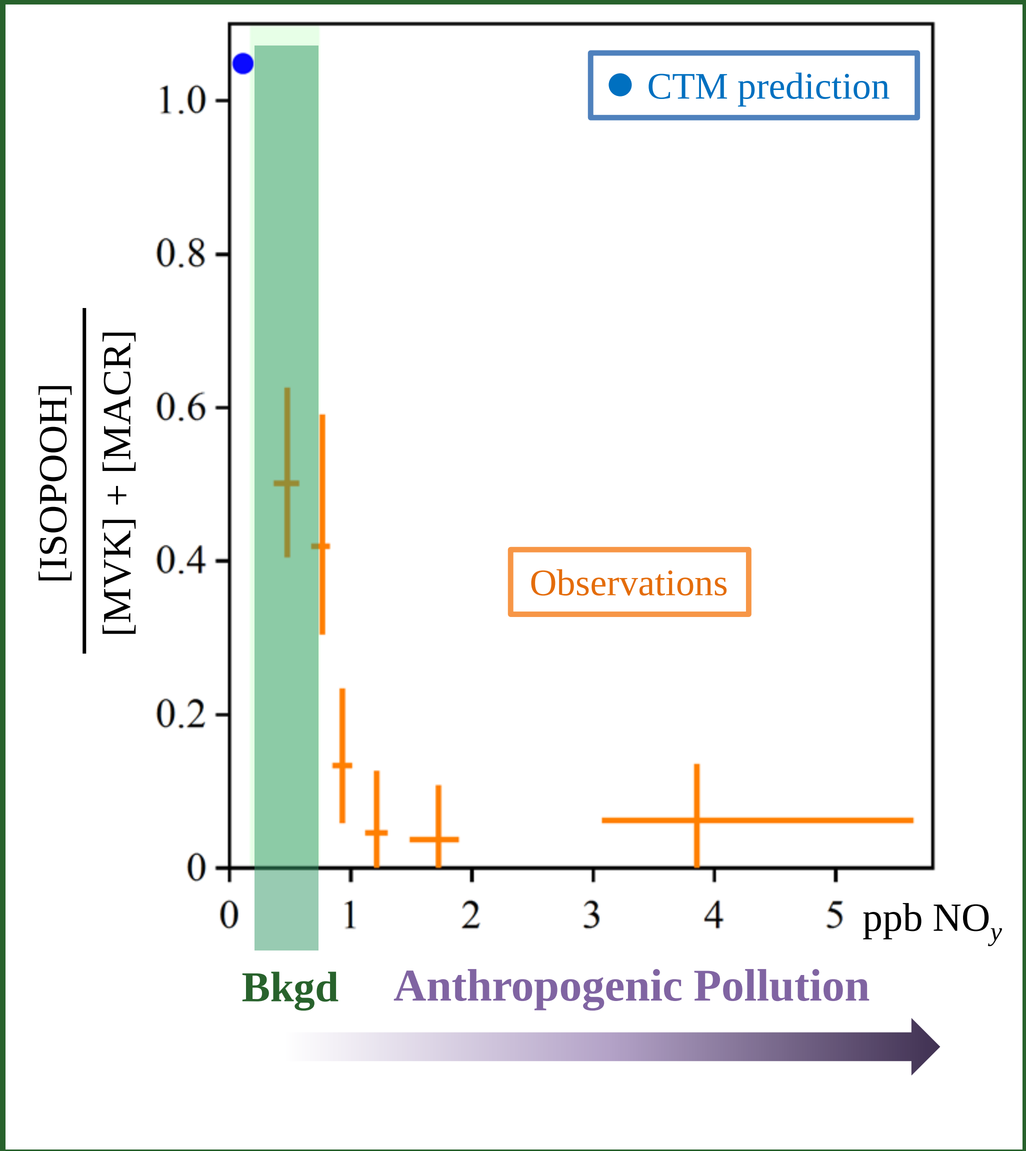
UCI University of California, Irvine

Forthcoming manuscript of Saewung Kim et al.

Isoprene Chemistry over the Amazon Rain Forest

***Liu, Martin, et al.*, PNAS, in press**





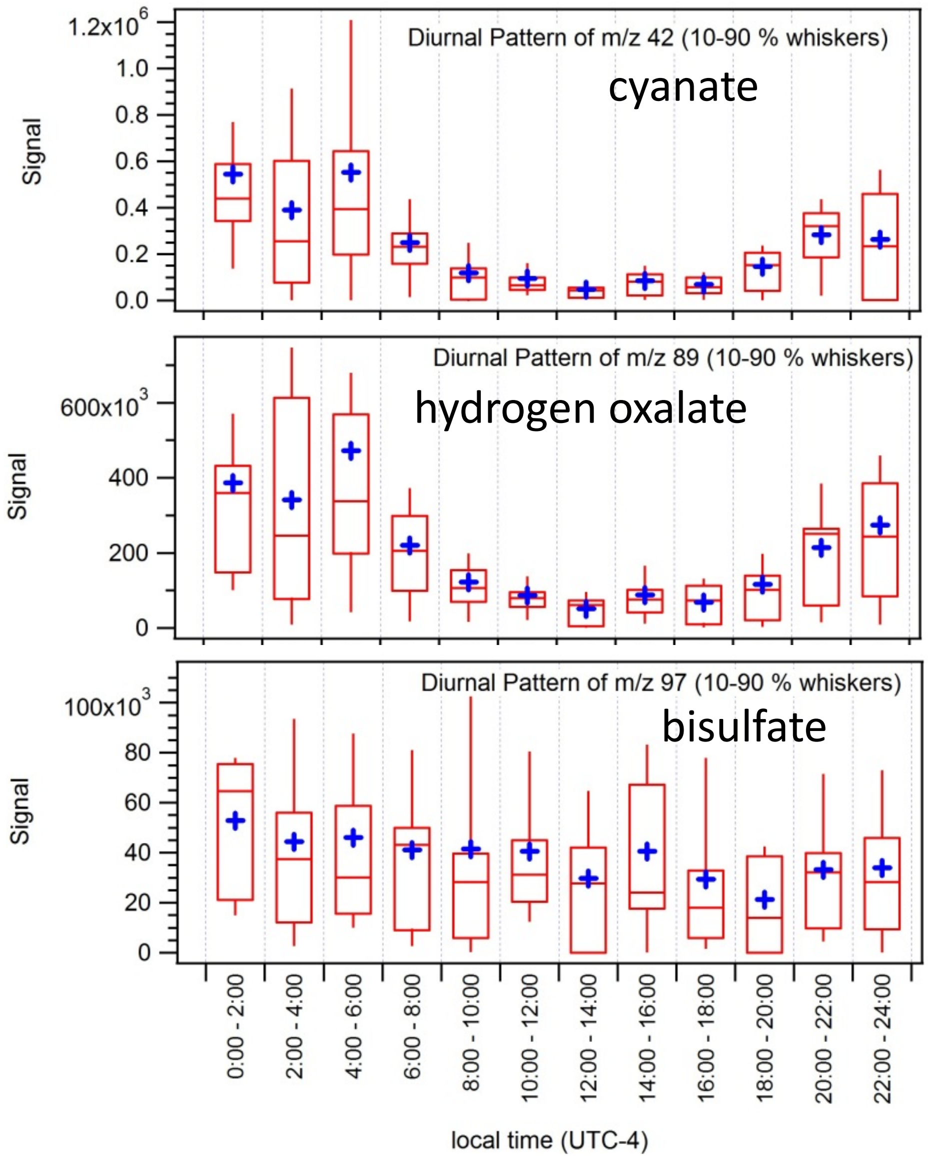
- Observational constraints of anthropogenic influence.
- Underestimate of the NO pathway for background conditions.

What are the sources of ultrafine aerosol particles in the Amazon?

Objective:
Through measurements of composition of particles smaller than 100 nm, infer the processes that control the source of particles in the Amazon

Results:

- Peaks in most detected compounds in ultrafine aerosol particles occur in early morning under stagnant wind conditions.
- Ultrafine aerosol particles are primarily composed of oxidized and nitrogen-containing organics, the latter includes cyanate, which is often associated with biomass burning.
- Oxalate and methyl furan suggest biogenic precursors also play important role.

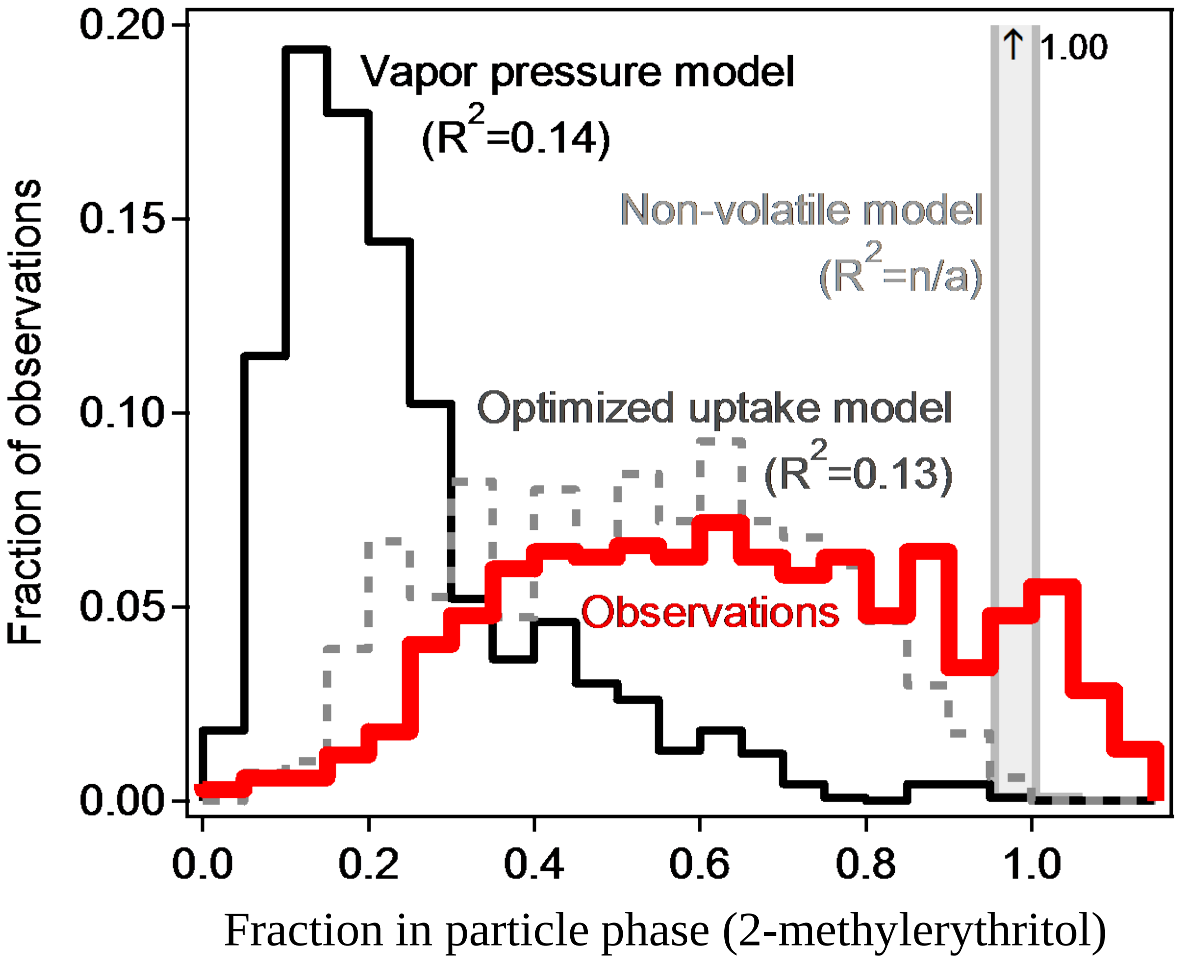


UCI University of California, Irvine

Smith et al., in preparation for GoAmazon2014/5 special issue

New view on gas & particle phase partitioning

SV-TAG



Objective:
Determine fractional partitioning of species between gas and particle phases

Results:
- Greater particle-phase contribution than models can explain
- Not a particle-phase only tracer as traditionally reported

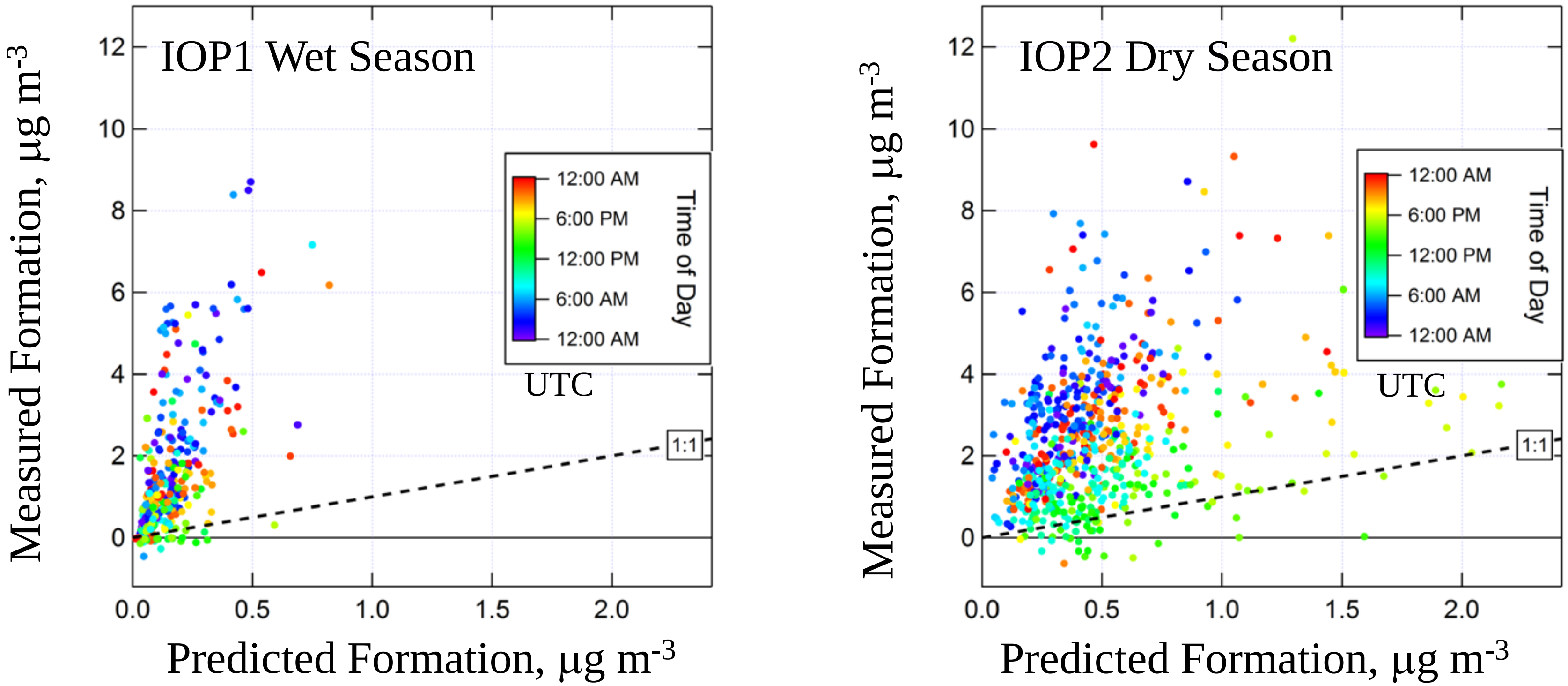
Berkeley UNIVERSITY OF CALIFORNIA

Isaacman-VanWertz, Yee, Goldstein, et al., in review

More Secondary Aerosol Potential than Expected

Objective:

Test through in situ data sets the potential for secondary aerosol production and compare to state of understanding with respect to known species and their reactive yields



Results:

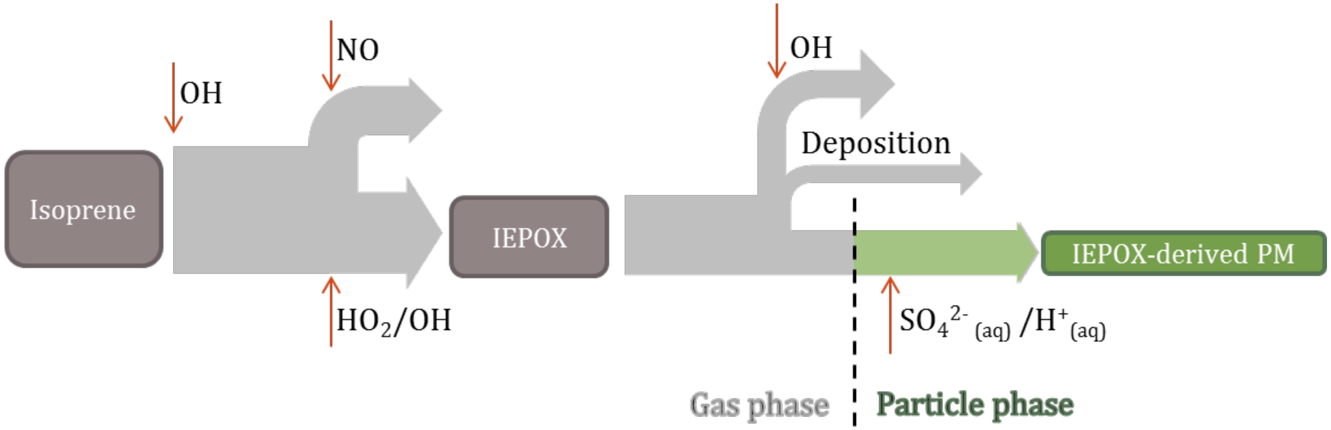
- Secondary aerosol produced from oxidation by OH of ambient air
- Production much greater than predicted from modeled yields of measured ambient precursors
- Suggests that production is dominated by unmeasured species

Palm, Jimenez, et al., in prep. for GoAmazon2014/5 Special Issue

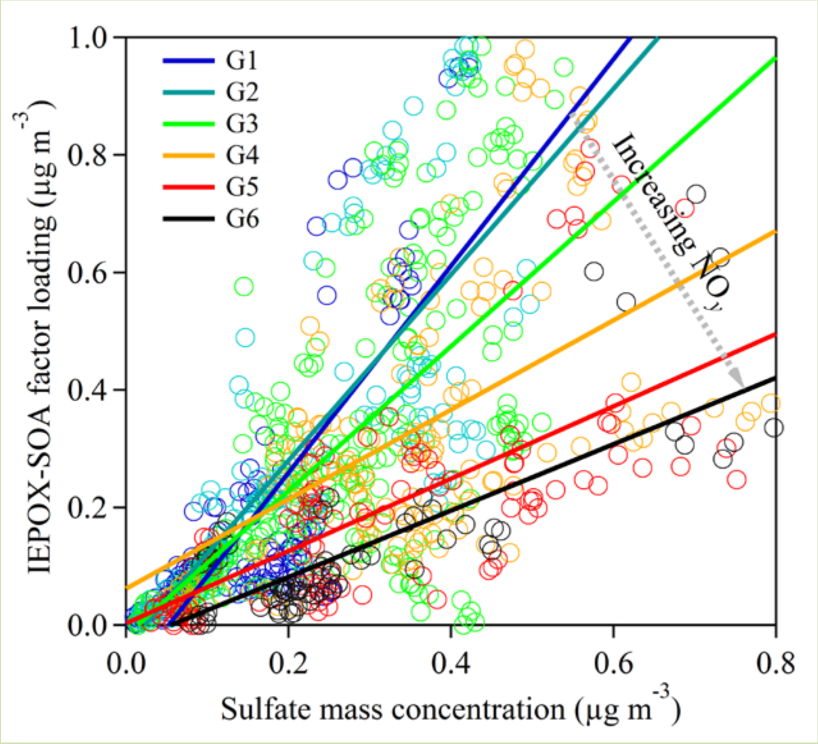
University of Colorado Boulder

GOAMAZON 2014-2015

Influence of anthropogenic emissions on isoprene-derived particulate matter in central Amazonia



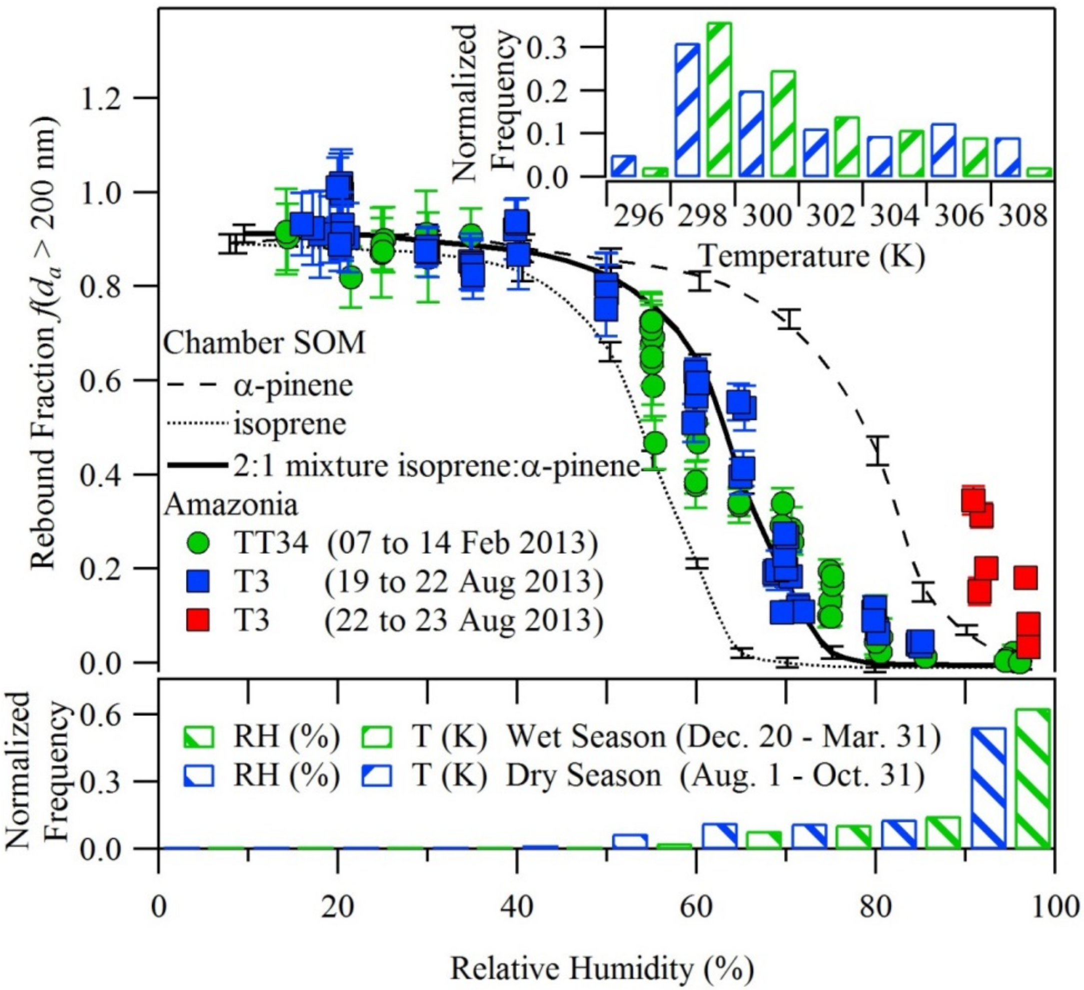
- Observational constraints of sulfate as a first order predictor and NO as a modulator of IEPOX-derived PM.
  - NO_y serves as indicator of integrated exposure of airmass to NO chemistry.
  - IEPOX-SOA factor obtained from PMF analysis of AMS data is a proxy for IEPOX-derived PM.
- Lower loadings of IEPOX-SOA factor observed for polluted compared to background conditions



S. de Sá, L. Alexander, S. Martin et al., in prep.

Submicron Particles are Liquid

Objective: Investigate ambient particle physical state over a tropical forest as a function of relative humidity using particle rebound.



Results:

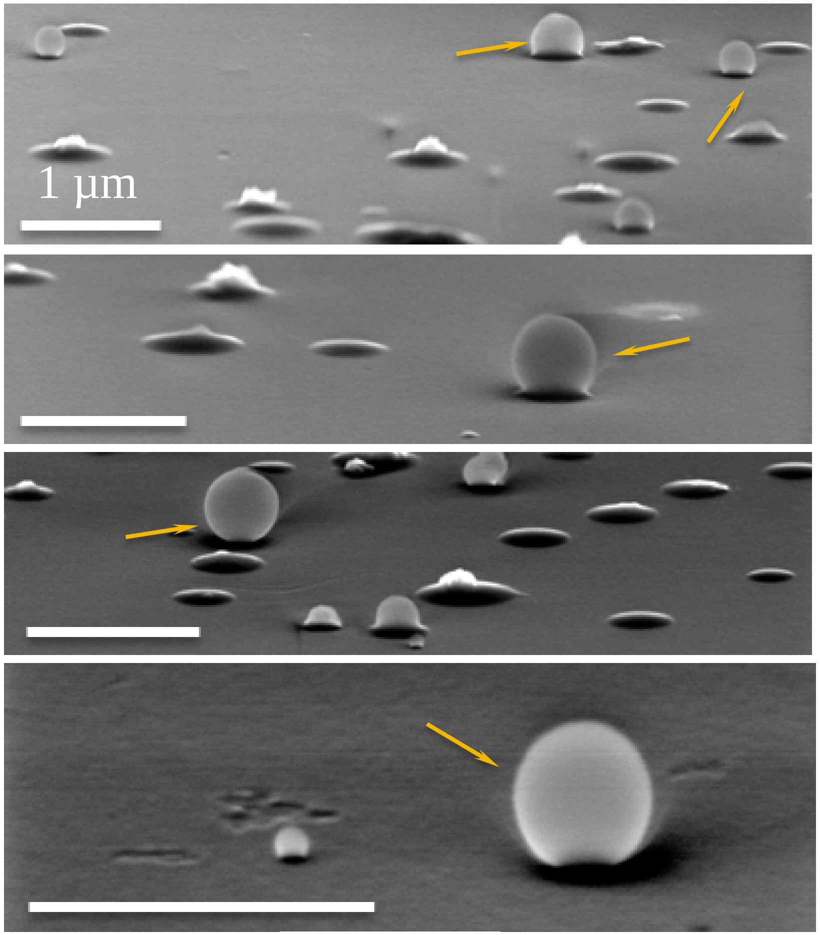
Liquid particulate matter (sub-micron) dominates over the Amazon tropical forest.

⇒ Isoprene-dominated emissions

⇒ High RH (~70 - 100 %)

Bateman, Martin, et al., Nature Geoscience 9, 34–37 (2016) doi:10.1038/ngeo2599.

Glassy Rebound Particles at T3 but not T0z



Observation

⇒ Glassy spherical particles common at T3

⇒ Not observed at T0z

Interpretation

⇒ Particles are associated with human activities

⇒ Similar observations at SGP just published: **Laskin, Gilles, et al.,** Nature Geoscience, (2016) in press, doi:10.1038/ngeo2705. Evidence that particles at SGP are from raindrop impaction on open soils.

⇒ Working hypothesis: similar origins in and around Manaus.

- ⇒ For this hypothesis, these particles are not directly from pollution plume of Manaus but rather are from agricultural fields between Manaus and T3.
- ⇒ The implication could be that deforestation changes composition of atmospheric aerosol.

BERKELEY LAB

EMSL

Pacific Northwest NATIONAL LABORATORY

GOAMAZON 2014–2015

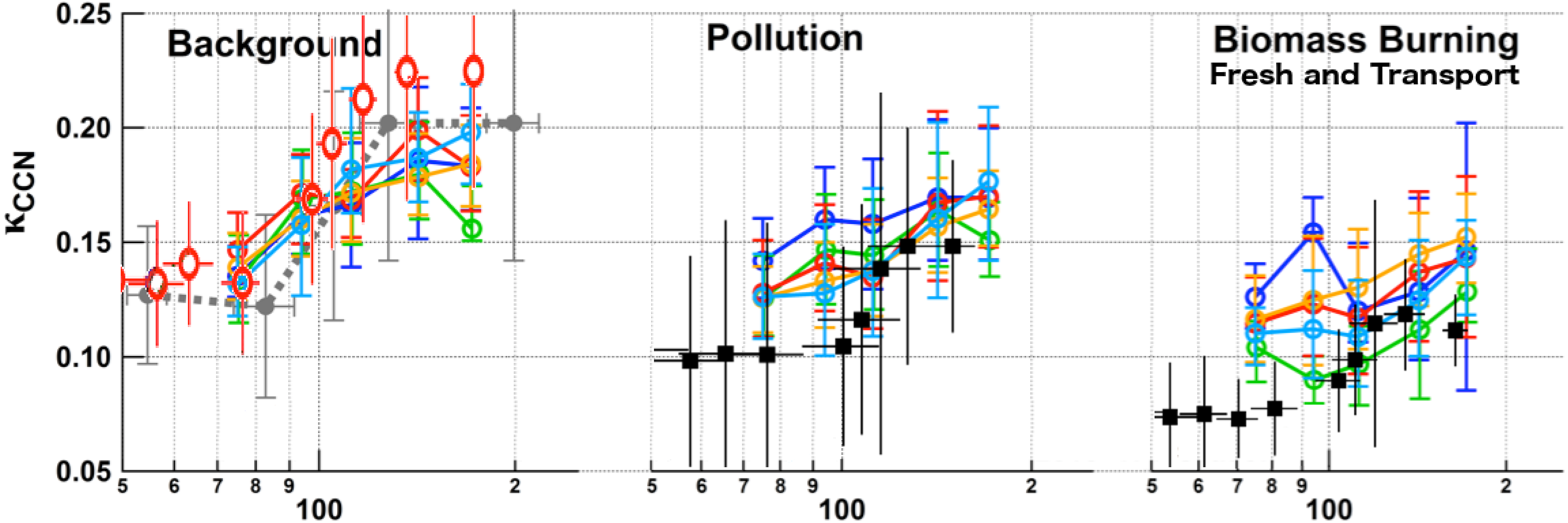
Cloud Condensation Nuclei (CCN) Activity

Objective:

Investigate the effects of anthropogenic pollution on the CCN activity of particulate matter over a tropical rainforest

Results:

- Dominated by low-hygroscopicity organic species
- Manaus plume affects the Aitken mode, with greater oxidation further downwind (T2 compared to T3)



T0: Pöhlker et al., T2: Barbosa et al., T3: Thalman et al., in prep, GoAmazon2014/5 Special Issue

GOAMAZON 2014–2015

BROOKHAVEN NATIONAL LABORATORY

MAX-PLANCK-INSTITUT FÜR CHEMIE

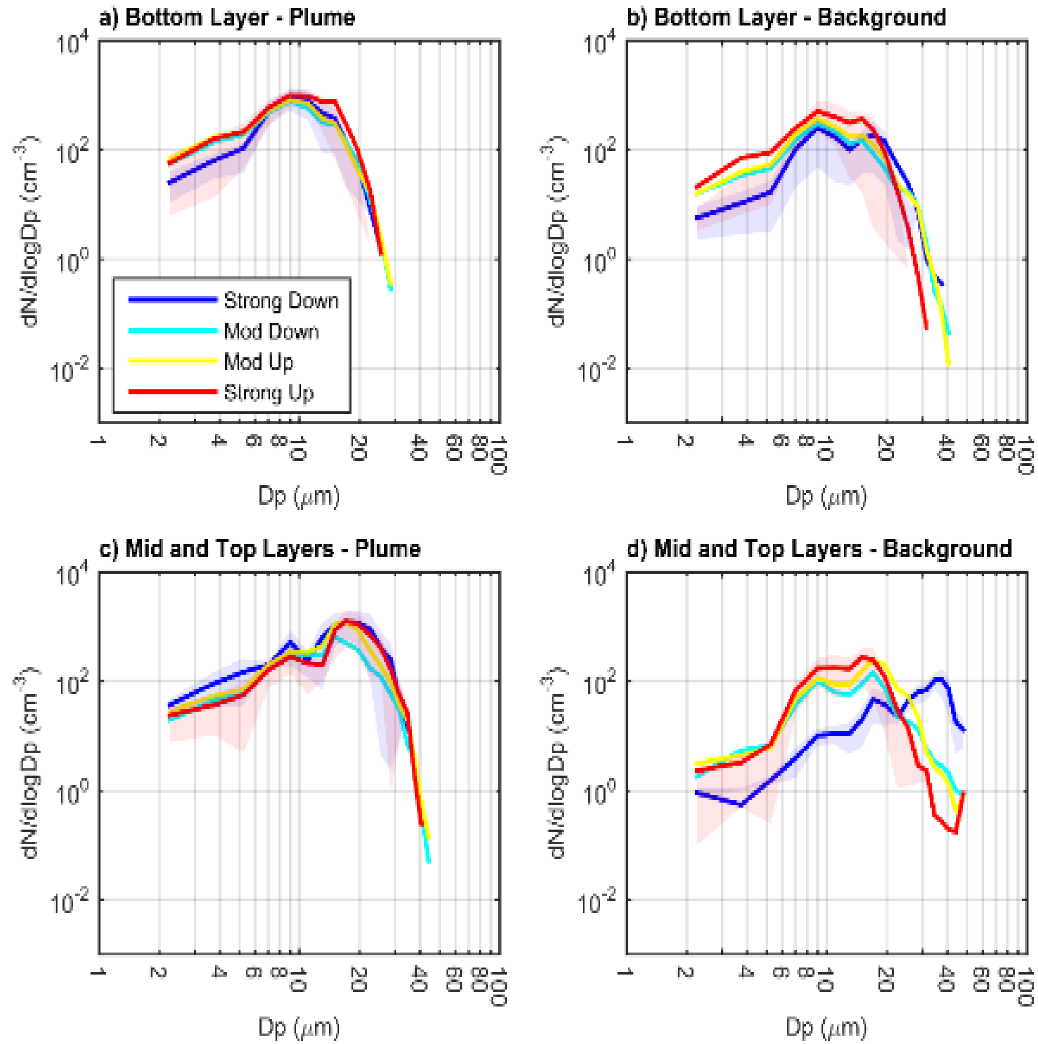
Effect of urban pollution on Amazonas cloud properties

Objective

Understand the Manaus Plume in the cloud microphysics. First time cloud-aerosol-precipitation is studied during the Amazonas wet season

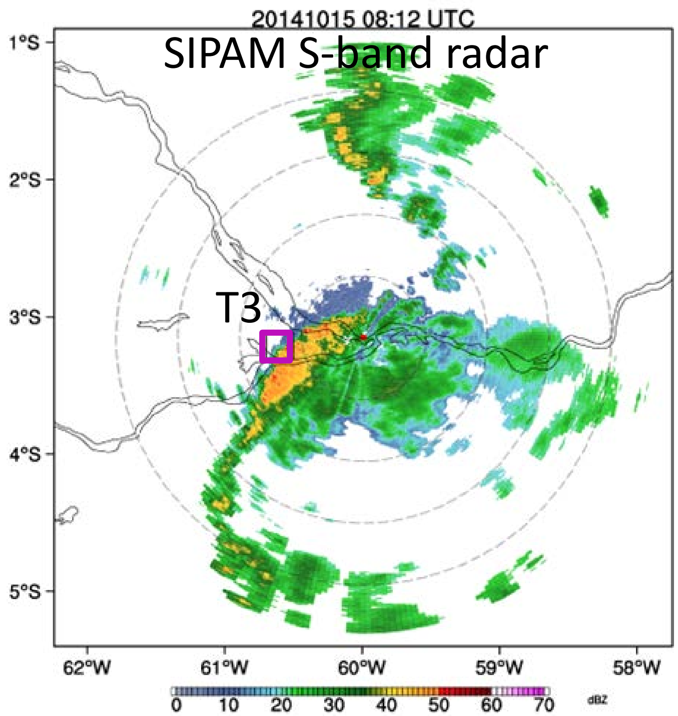
Results

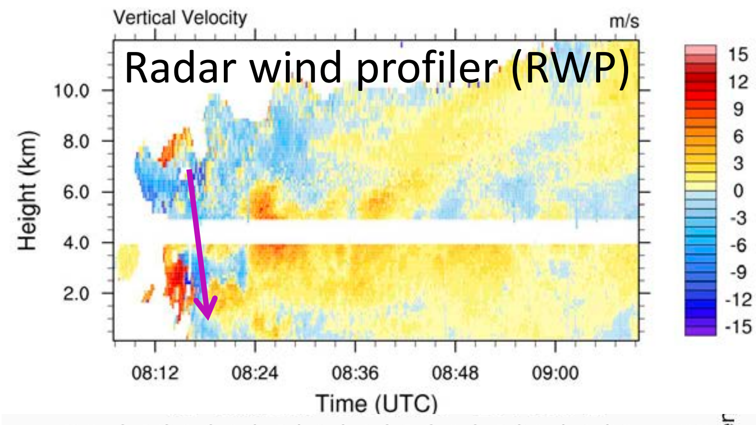
Plume decrease cloud droplet size and increase cloud droplet concentration.



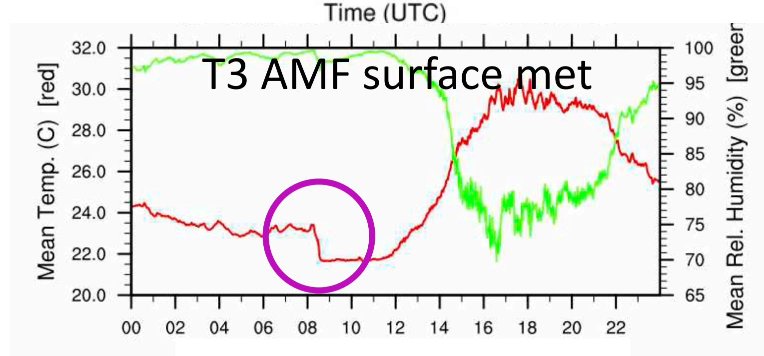
Micael A. Cecchini, Luiz A.T. Machado et al., ACPD, GoAmazon2014/5 Special Issue

Vertical motions, cold pools and ozone transport in Amazonian convection

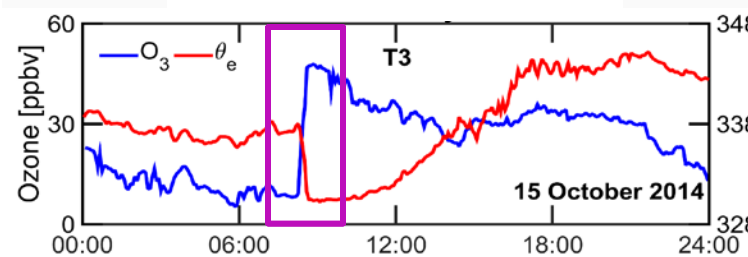




↑ -w



↓ T



↓ Θ_e

↑ O_3

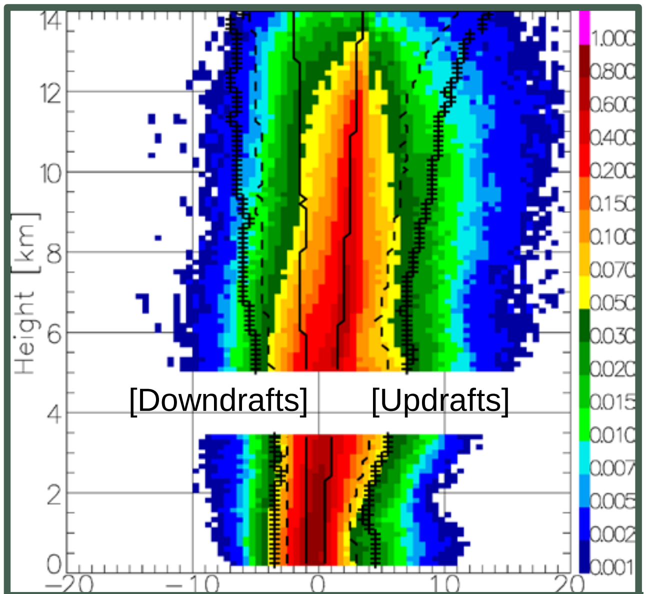
T3 observations documented over 100 events of strong downdrafts and the resulting cold pools and ozone transport in deep convection during GoAmazon2014/5

Slide contributed by Courtney Schumacher

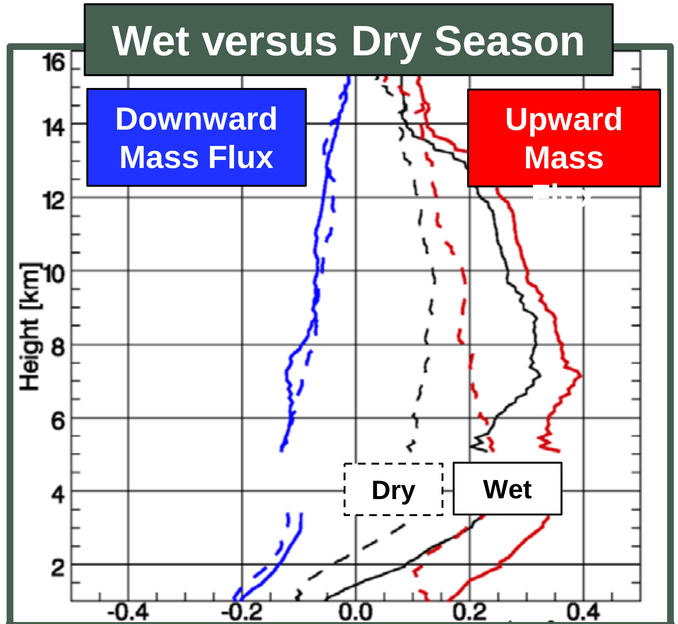
GoAmazon2014/5 Deep Convective Vertical Velocity and Mass Flux

Objective: Characterizing domain-aggregated and averaged vertical velocity, convective area fraction, and mass flux profiles to inform GCM deep convective parameterizations.

Results: GoAmazon2014/5 data sets have provided new insights into deep convection, including the role of environmental forcing controls on areal coverage, confirming more intense convection found within the dry season, and substantial increases in updraft mass flux during the wet season.



Vertical Velocity CFAD [m s^{-1}]



Mass Flux [kg $s^{-1}m^{-2}$]

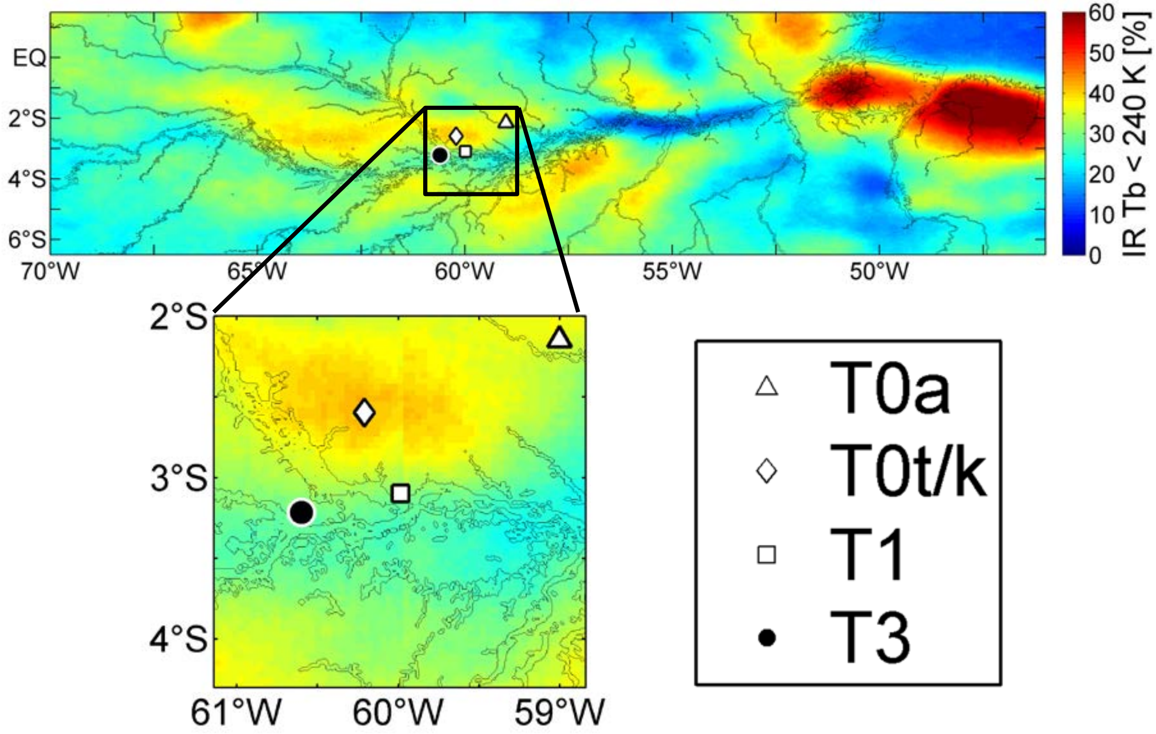
S. Giangrande, M. Jensen, et al.

Propagation and Diurnal Variability of Convection

Casey Burleyson, Zhe Feng, Samson Hagos, and Jerome Fast (PNNL)
Luiz Machado (INPE) and Scot Martin (Harvard)

- Used 15-years of satellite data to examine the spatial variability of convection around the GoAmazon2014/5 sites.

Frequency of Convection [1700-1800 LT, Mar-Apr-May]



Findings

- Previous day's "sea breeze front" arrives in phase with diurnal cycle of convection near Manaus.
- T0e, T0t/k, and T1 see up to 10% more frequent afternoon convection compared to T3 due to their position east of the river.

Burleyson, C. D., Z. Feng, S. M. Hagos, J. Fast, L. A. T. Machado, and S. T. Martin, 2016: Spatial variability of the background diurnal cycle of deep convection around the GoAmazon2014/5 field campaign sites. *In Revision for J. Appl. Meteor. Climatol. – April 2016.*

Data Sets

http://www.arm.gov/campaigns/amf2014goamazon

Campaign : Observations and Modeling of the Green Ocean Amazon (GOAMAZON)

2014.01.01 - 2015.11.30

Website : http://www.arm.gov/sites/amf/mao/

Lead Scientist : Scot Martin

For data sets, see below.

Abstract

The hydrologic cycle of the Amazon Basin is one of the primary heat engines of the Southern Hemisphere. Any accurate climate model must succeed in a good description of the Basin, both in its natural state and in states perturbed by regional and global human activities. At the present time, however, tropical deep convection in a natural state is poorly understood and modeled, with insufficient observational data sets for model constraint. Furthermore, future climate scenarios resulting from human activities globally show the possible drying and the eventual possible conversion of rain forest to savanna in response to global climate change. Based on our current state of knowledge, the governing conditions of this catastrophic change are not defined. Human activities locally, including the economic development activities that are growing the population and the industry within the Basin, also have the potential to shift regional climate, most immediately by an increment in aerosol number and mass concentrations, and the shift is across the range of values to which cloud properties are most sensitive. The ARM Climate Research Facility in the Amazon Basin seeks to understand aerosol and cloud life cycles, particularly the susceptibility to cloud aerosol precipitation interactions, within the Amazon Basin.

The ARM Mobile Facility will be located downwind of the city of Manaus, Brazil (3 6' 47" S, 60 1' 31" W) near Manacapuru from January 2014 to November 2015. The site is situated so that it experiences the extremes of (i) a pristine atmosphere when the Manaus pollution plume meanders and (ii) heavy pollution and the interactions of that pollution with the natural environment when the plume regularly intersects the site. The central Amazon where this site is located is only weakly influenced by biomass burning emissions in the dry season. The city of Manaus uses high-sulfur oil as its primary source of electricity; the city is also an industrial zone of 3 million people and has high emissions of soot. Particle number and mass concentrations are 10 to 100 times greater in the pollution plume compared to the times when pristine conditions prevail. The deployment will enable the study of how aerosol and cloud life cycles, including cloud-aerosol-precipitation interactions, are influenced by pollutant outflow from a tropical megacity.

Additional Information

» GoAmazon2014/5 results appear in an interjournal Special Issue of Atmospheric Chemistry Physics (ACP), Atmospheric Measurement Techniques (AMT), Geoscientific Information (GI), and

Campaign Links

» GOAMAZON Website
» ARM Manacapuru Deployment Page

ARM Data Discovery

Browse Data

Related Campaigns

Observations and Modeling of the Green Ocean Amazon - Hi-Vol Filter Sampling
2015.03.13, de Mello Dias Machado, AMF

Observations and Modeling of the Green Ocean Amazon: LIDAR Comparison
2014.10.05, Barbosa, AMF

Observations and Modeling of the Green Ocean Amazon: Oxidation Flow Reactor 2
2014.08.15, Palm, AMF

Observations and Modeling of the Green Ocean Amazon: Parsivel2
2014.05.12, Schumacher, AMF

Observations and Modeling of the Green Ocean Amazon: Scaling Amazon Carbon Water Couplings (SACWaC)
2014.05.01, Dubey, AMF

Journal metrics

IF 5.053

IF 5-year 5.656

SNIP 1.574

Special issue

Special issues

Special issues

Special issue

Observations and Modeling of the Green Ocean Amazon (GoAmazon2014/5) (ACP/AMT/GI/GMD inter-journal SI)

Editor(s): J. Allan, T. Petäjä, T. Karl, M.A. Silva Dias, and T. Garrett

Special issue jointly organized between Atmospheric Chemistry and Physics, Atmospheric Measurement Techniques, Geoscientific Instrumentation, Methods and Data Systems, and Geoscientific Model Development

More information

Download citations of all papers: Bibtex EndNote Reference Manager

23 Mar 2016
Seasonality of isoprenoid emissions from a primary rainforest in central Amazonia
Eliane G. Alves, Kolby Jardine, Julio Tota, Angela Jardine, Ana Maria Yãnez-Serrano, Thomas Karl, Julia Tavares, Bruce Nelson, Dasa Gu, Trissevgeni Stavrakou, Scot Martin, Paulo Artaxo, Antonio Manzi, and Alex Guenther
Atmos. Chem. Phys., 16, 3903-3925, doi:10.5194/acp-16-3903-2016, 2016
Summary

23 Oct 2015
Characterization of a real-time tracer for isoprene epoxydiols-derived secondary organic aerosol (IEPOX-SOA) from aerosol mass spectrometer measurements
W. W. Hu, P. Campuzano-Jost, B. B. Palm, D. A. Day, A. M. Ortega, P. L. Hayes, J. E. Krechmer, Q. Chen, M. Kuwata, Y. J. Liu, S. S. de Sá, K. McKinney, S. T. Martin, M. Hu, S. H. Budisulistiorini, M. Riva, J. D. Surratt, J. M. St. Clair, G. Isaacman-Van Wertz, L. D. Yee, A. H. Goldstein, S. Carbone, J. Brito, P. Artaxo, J. A. de Gouw, A. Koss, A. Wisthaler, T. Mikoviny, T. Karl, L. Kaser, W. Jud, A. Hansel, K. S. Docherty, M. L. Alexander, N. H. Robinson, H. Coe, J. D. Allan, M. R. Canagaratna, F. Paulot, and J. L. Jimenez
Atmos. Chem. Phys., 15, 11807-11833, doi:10.5194/acp-15-11807-2015, 2015

19 Apr 2016
Introduction: Observations and Modeling of the Green Ocean Amazon (GoAmazon2014/5)
S. T. Martin, P. Artaxo, L. A. T. Machado, A. O. Manzi, R. A. F. Souza, C. Schumacher, J. Wang, M. O. Andreae, H. M. J. Barbosa, J. Fan, G. Fisch, A. H. Goldstein, A. Guenther, J. L. Jimenez, U. Pöschl, M. A. Silva Dias, J. N. Smith, and M. Wendisch
Atmos. Chem. Phys., 16, 4785-4797, doi:10.5194/acp-16-4785-2016, 2016


Thanks for listening