

Disentangling the Manaus pollution plume from the
biomass burning plume during the second
GoAmazon 2014/5 Intensive Operating Period
(IOP2)

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WLMLA VIII
Cayo Coco, Cuba – April 21th 2015

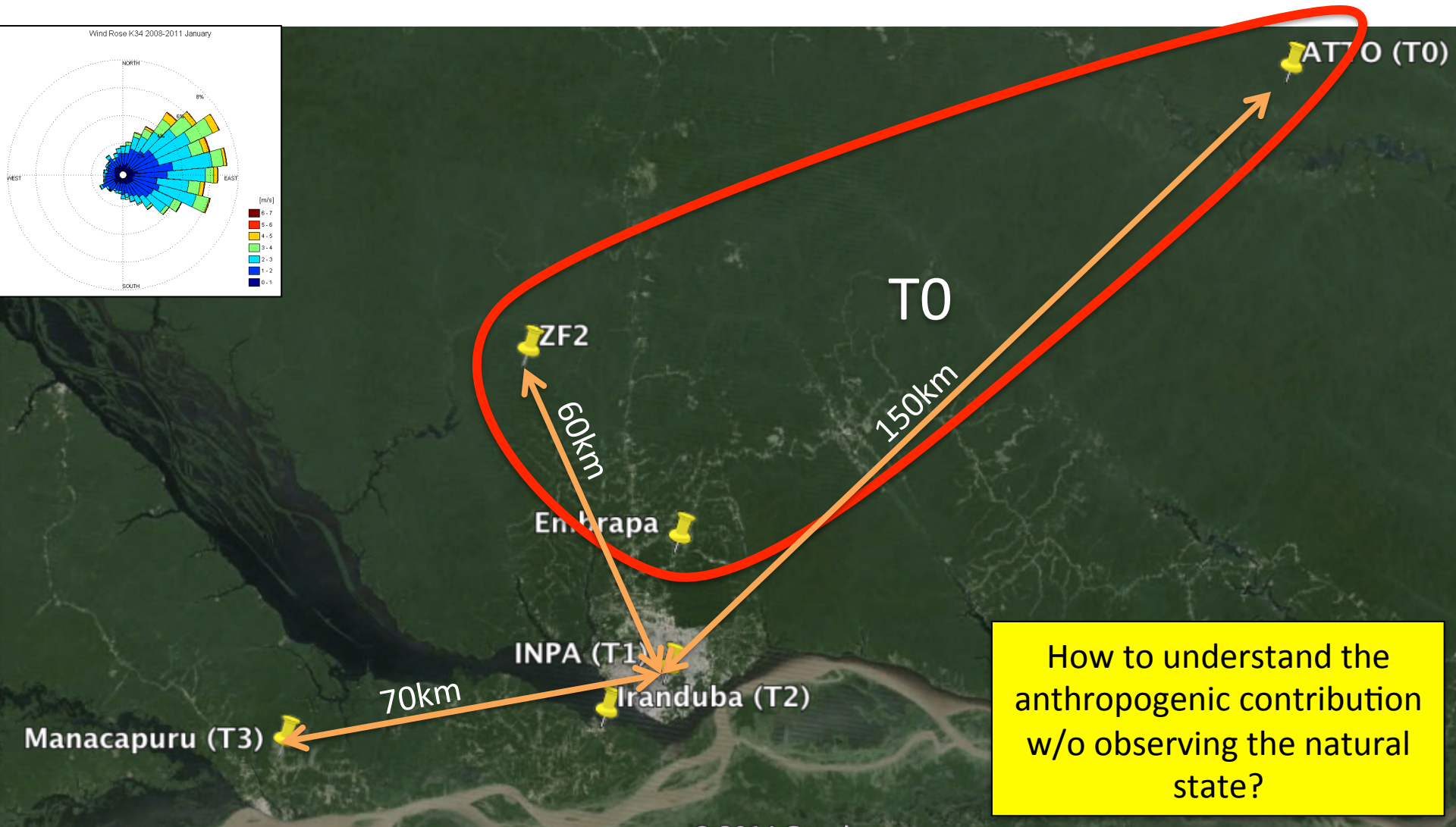
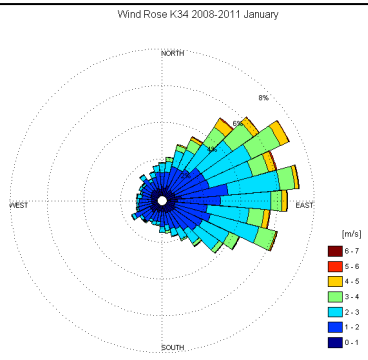
Goals of GoAmazon

1. to **measure and understand** the factors affecting **particle size distribution** over a tropical rain forest, especially **the effects of anthropogenic pollution** as a perturbation to natural state;
2. to **develop and implement** an **upscaling** analysis from above results to prognosticate possible **climatic impacts** of present-day urban pollution and possibly greater pollution in the future.

The GoAmazon 2014/15 project

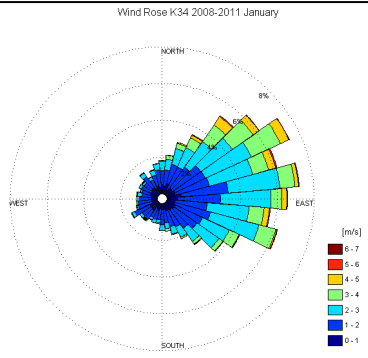


Experimental Sites

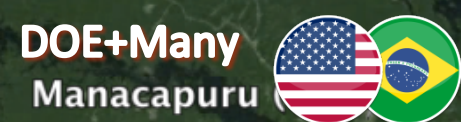
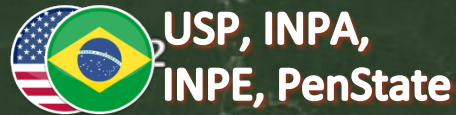


How to understand the anthropogenic contribution w/o observing the natural state?

Experimental Sites



UEA, INPA, USP,
MaxPlanck



Measurements Up/Down wind

- Size distribution: T3, **T2**, ZF2, **ATTO**
- Optical properties: T3, **T2**, Embrapa, ZF2, **ATTO**
- **Vertical profiles: T3, T2, Embrapa**
 - **Lidar**, Ceilometer ...
- Precursors: T3, T2, T1, ZF2, ATTO
- Cloud related: T3, T2, Embrapa, ATTO
 - Size resolved CCN, Ceilometer, Radar, ...

T0 site - ATTO



- 76 m tower
- Suite of aerosol and gas-phase measurements
- Free from local pollution



T0 Embrapa, upwind but close



- Mostly remote sensing instruments for aerosols and clouds
- Upwind of Manaus

T2 site – Close to Manaus



- 12 m tower
- Suite of aerosol and gas-phase measurements
- Little to none local emissions
- Meeting point of dolphins , alligators, monkeys, etc.



Intensive Airborne Research in Amazonia (IARA)

G1 Aircraft

- 15 February until 26 March 2014 (wet season). Part of IOP1.
- 1 September until 10 October 2014 (dry season). Part of IOP2.



All Flight Paths of IOP 1



Imagery Date: 4/9/2013 3° 7.481' S 60° 17.327' W elev 56 m eye alt 250.06 km

FLIGHT TRACK, GoAmazon2014/5, IOP1, 17 March 2014, 16:24 to 17:31 UTC

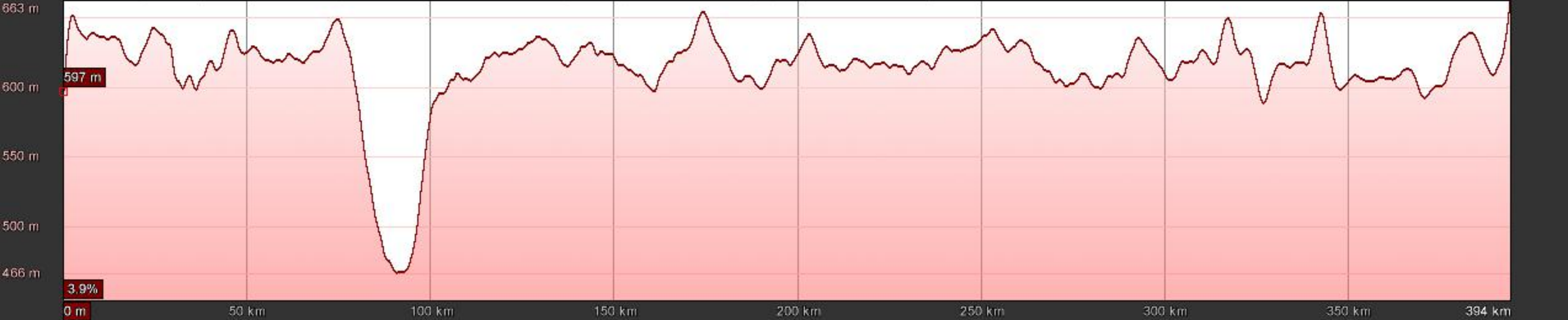
Forward trajectories from Manaus at 12:00 and 18:00 UTC are shown for 39 m, 124 m, 223 m, and 610 m. Each tick mark is typically 50 mni.



Image © 2014 DigitalGlobe
Image Landsat

Imagery Date: 4/9/2013 3°07'28.65" S 60°09'01.51" W elev 26 m eye alt 23.17 km

Graph: Min, Avg, Max Elevation: 466, 614, 663 m
Range Totals: Distance: 394 km Elev Gain/Loss: 867 m, -802 m Max Slope: 3.9%, -2.1% Avg Slope: 0.4%, -0.4%



FLIGHT TRACK, GoAmazon2014/5, IOP1, 17 March 2014, 16:24 to 17:31 UTC



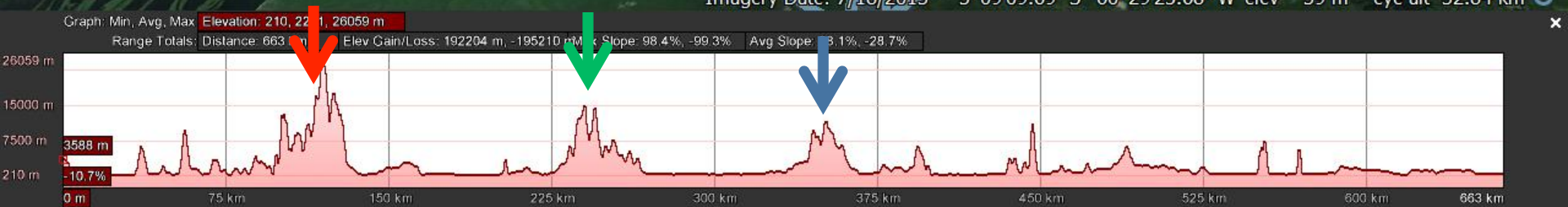
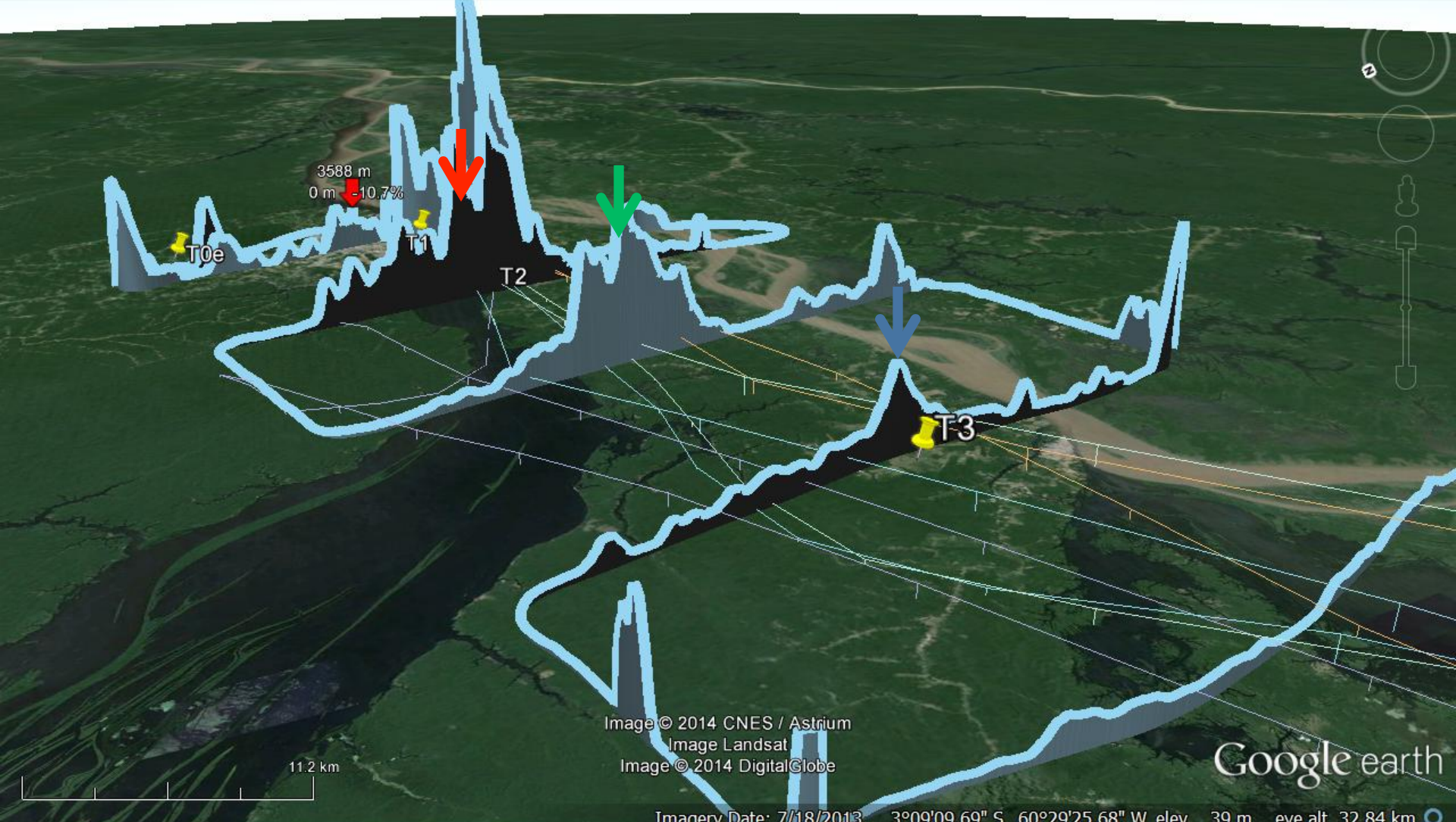
Forward trajectories from Manaus at 12:00 and 18:00 UTC are shown for 39 m, 124 m, 223 m, and 610 m. Each tick mark is typically 50 mni.



Image © 2014 DigitalGlobe
Image Landsat

Google earth

CPC COUNTS, GoAmazon2014/5, IOP1, 17 March 2014, 16:24 to 17:31 UTC



ISOPREN, GoAmazon2014/5, IOP1, 17 March 2014, 16:24 to 17:31 UTC



Image © 2014 DigitalGlobe
Image Landsat

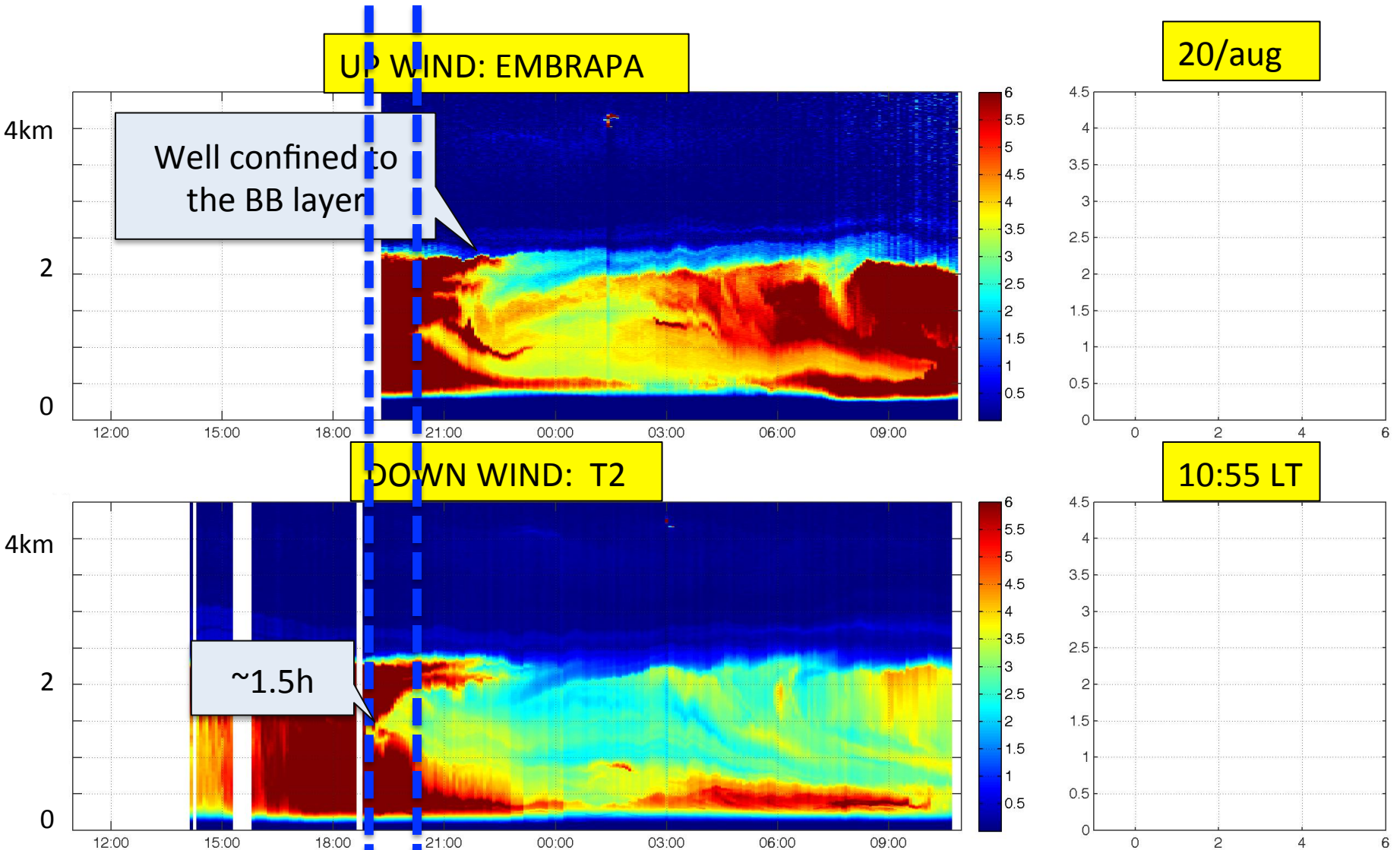
Image © 2014 CNES / Astrium

Imagery Date: 7/18/2013 3°09'09.69" S 60°29'25.68" W elev 39 m eye alt 32.84 km

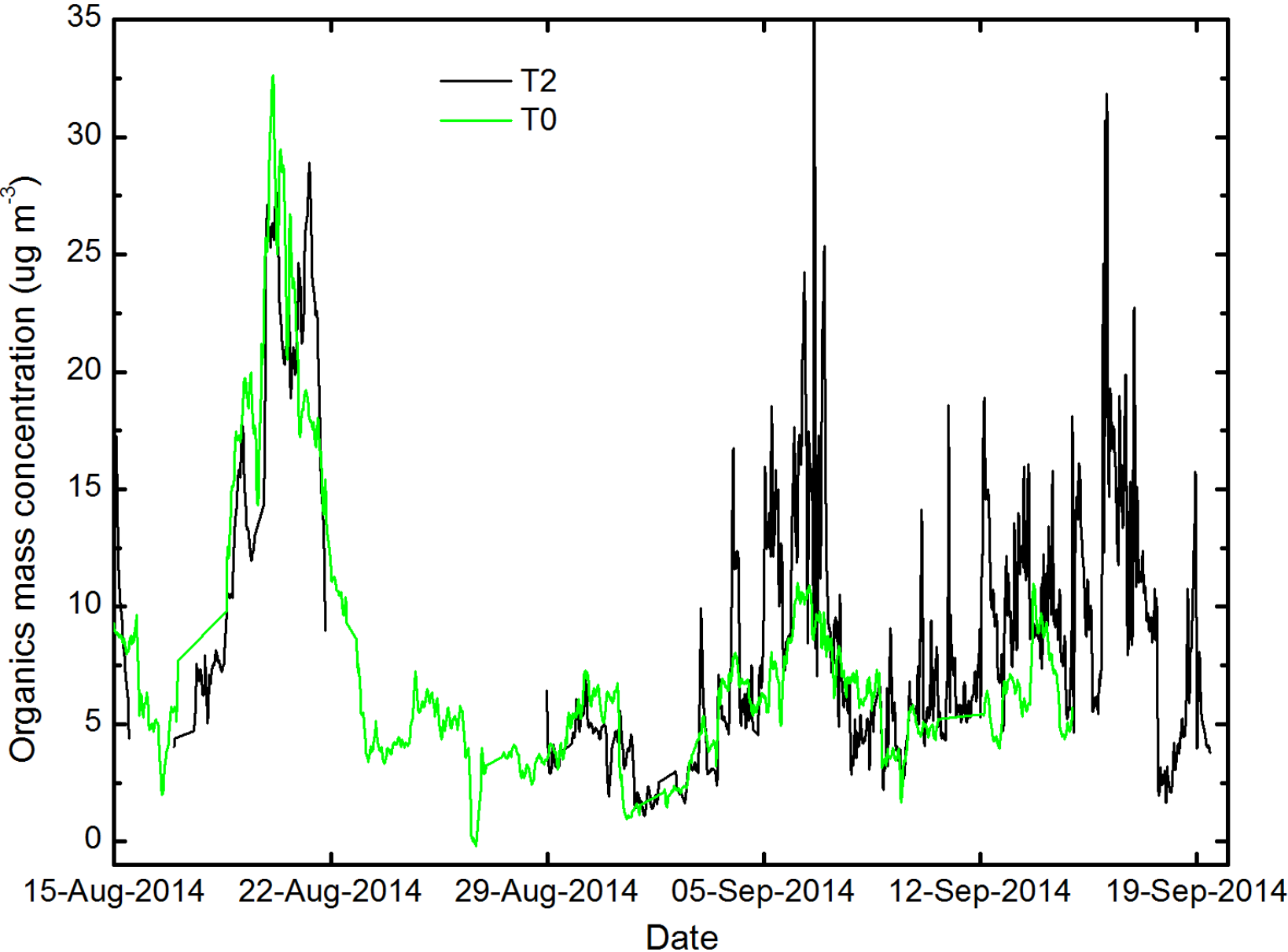
Graph: Min, Avg, Max Elevation: 504, 4986, 13103 m
Range Totals: Distance: 465 km Elev Gain/Loss: 98010 m, -100185 m Max Slope: 89.8%, -89.6% Avg Slope: 33.8%, -32.2%



Backscatter (Mm^{-1}) vertical Profiles

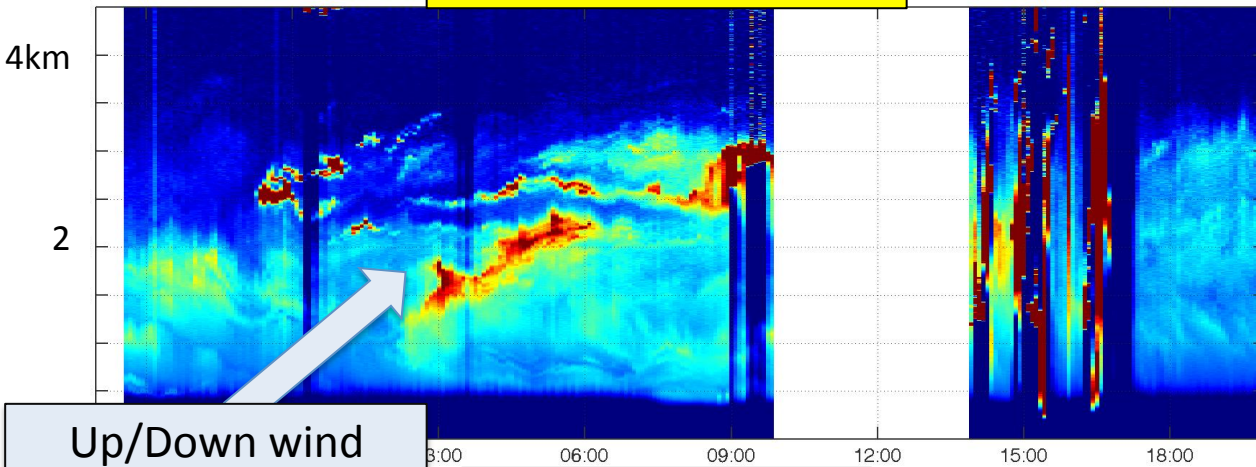


OA concentration – IOP2

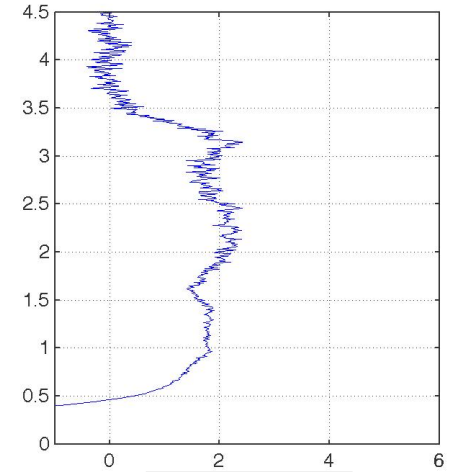


Backscatter (Mm^{-1}) vertical Profiles

UP WIND: EMBRAPA

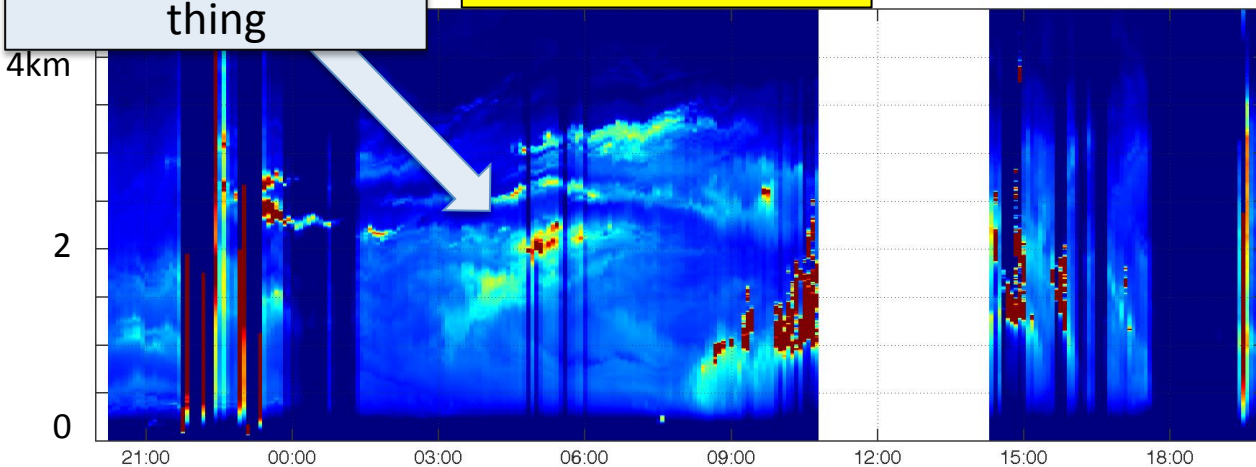


27/aug

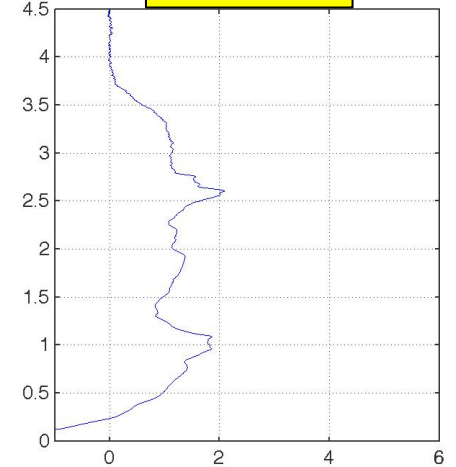


Up/Down wind
"see" the same
thing

DOWN WIND: T2

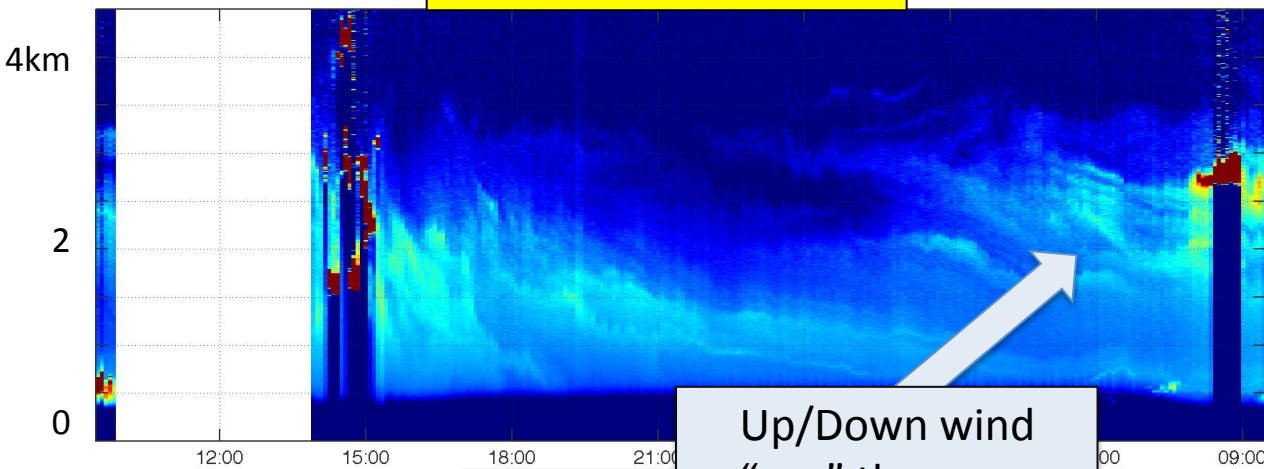


19:55 LT

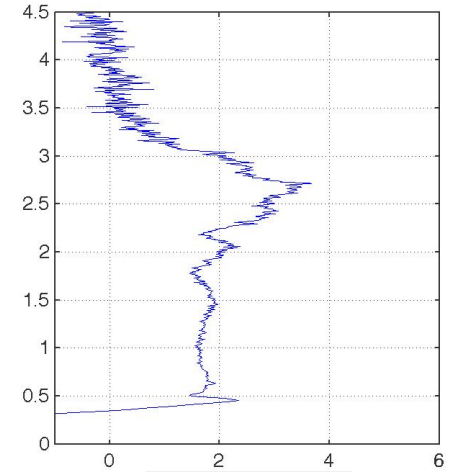


Backscatter (Mm^{-1}) vertical Profiles

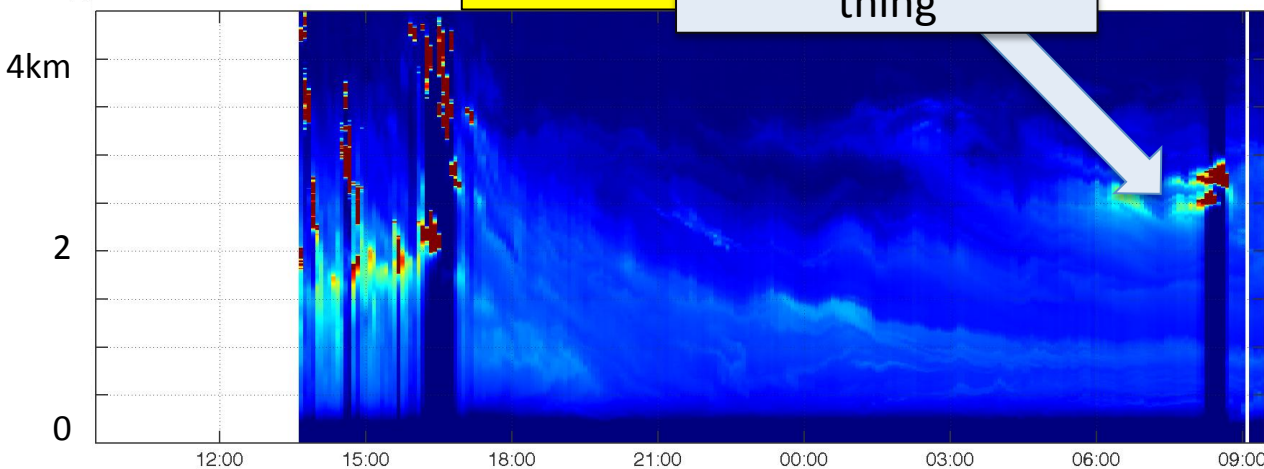
UP WIND: EMBRAPA



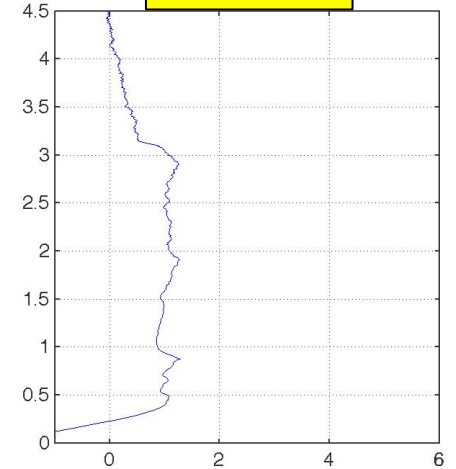
30/aug



DOWN WIND



9:25 LT

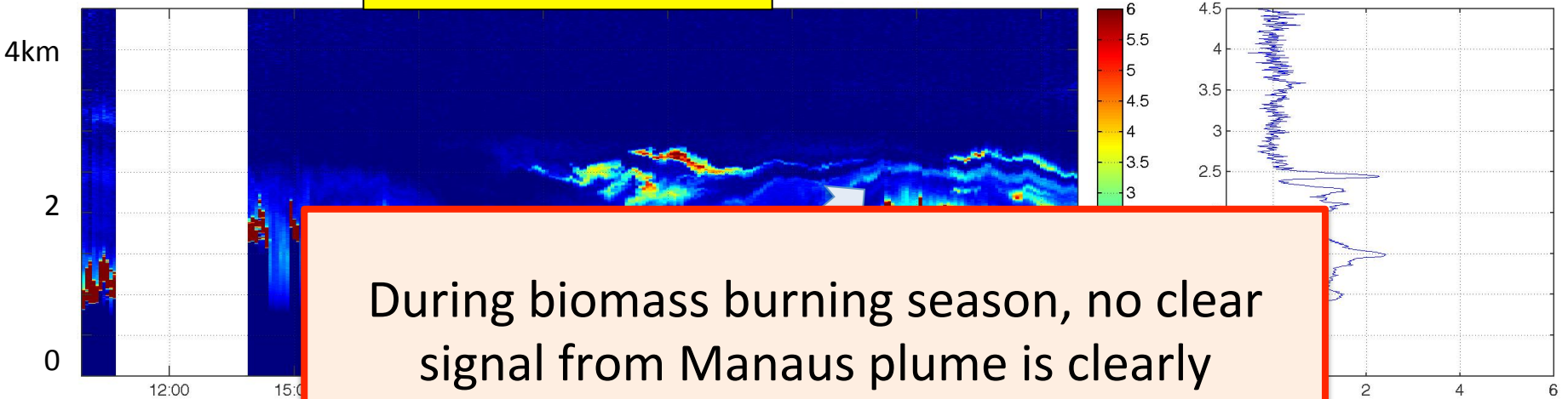


Up/Down wind
"see" the same
thing

Backscatter (Mm^{-1}) vertical Profiles

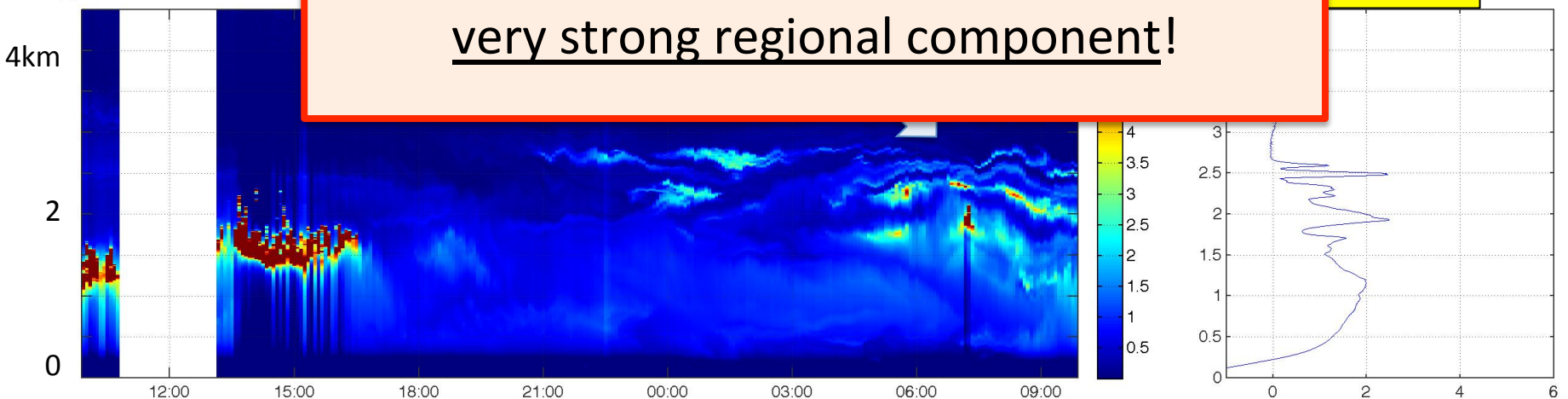
UP WIND: EMBRAPA

15/aug



During biomass burning season, no clear signal from Manaus plume is clearly distinguished in the **backscatter** profiles:
very strong regional component!

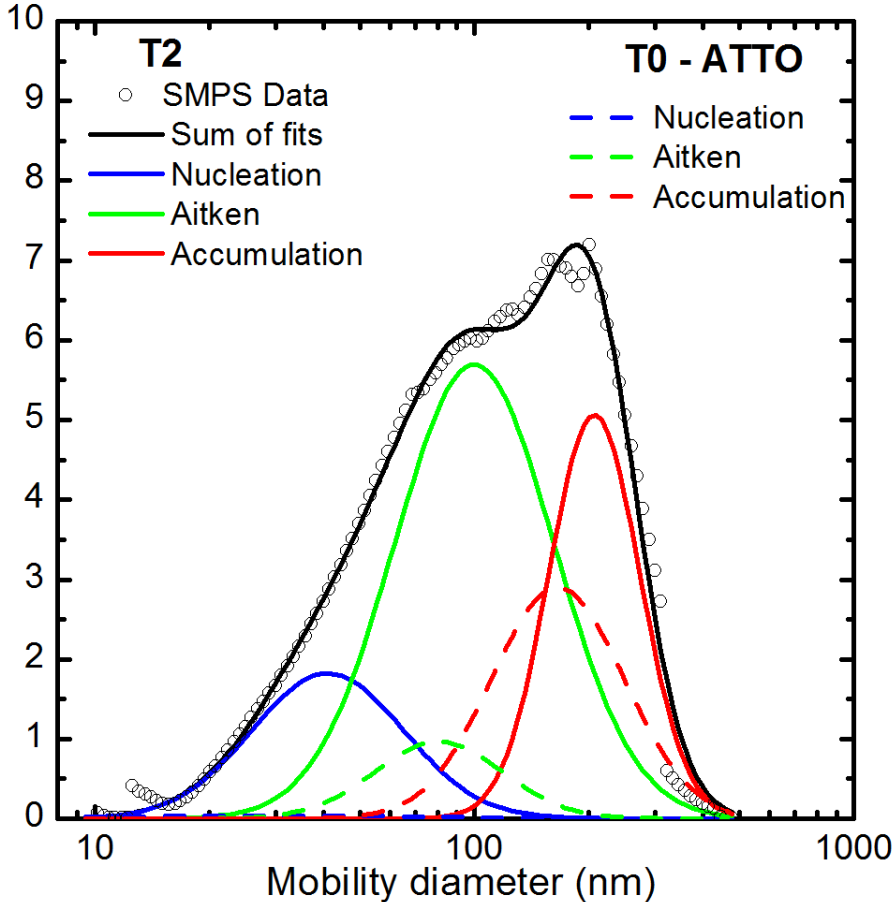
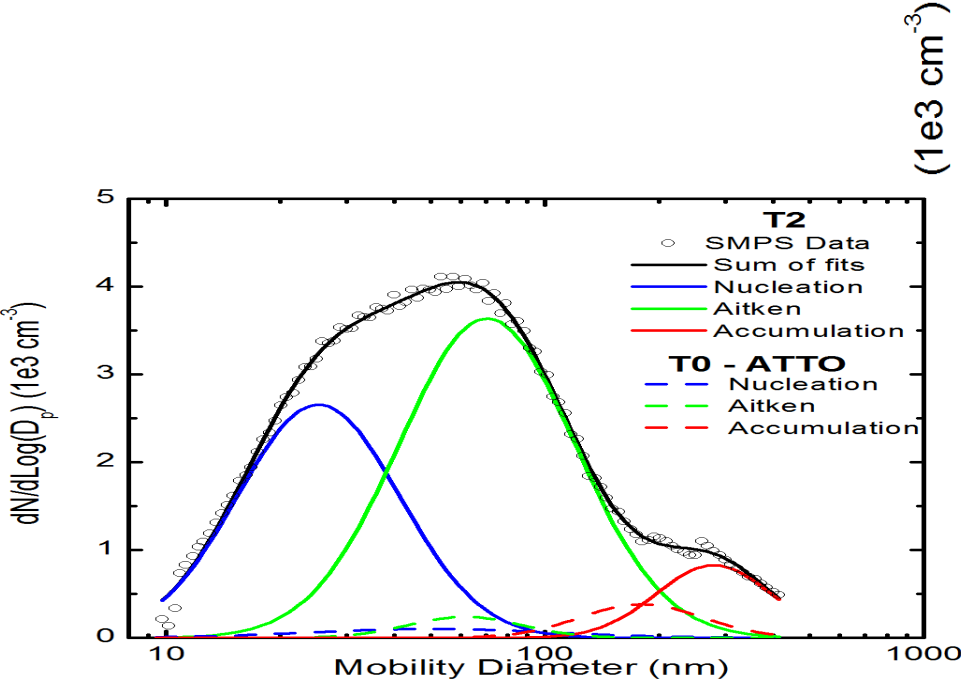
10:50 LT



Size distribution

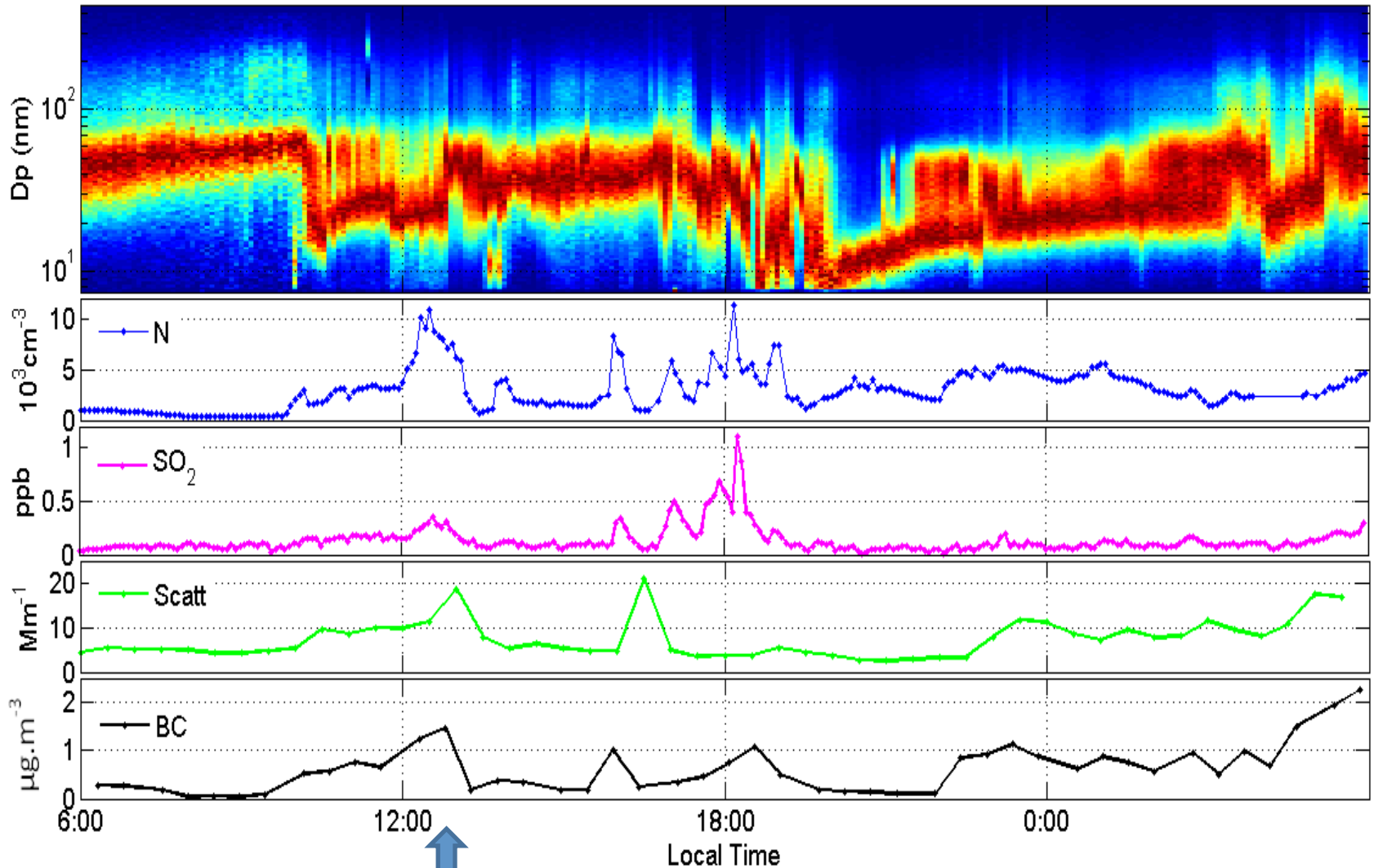
Wet season – IOP1

Dry season – IOP2

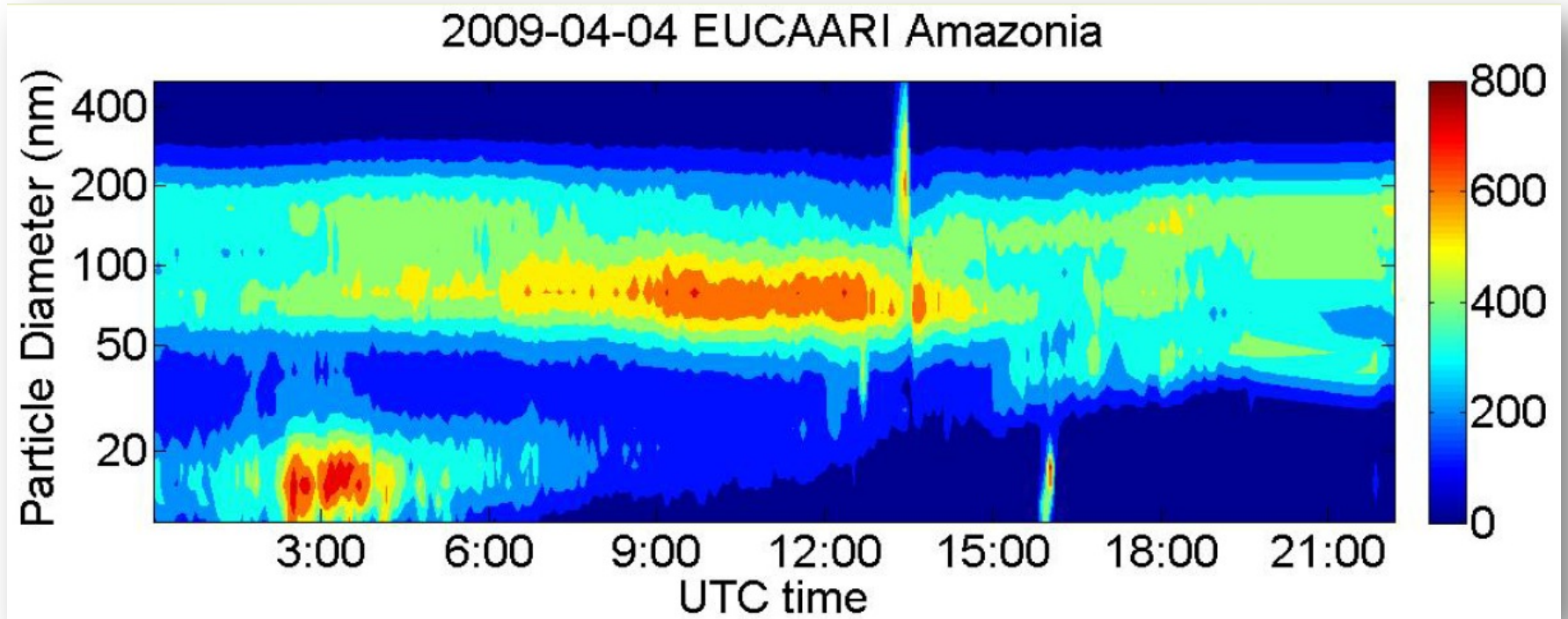


T2 - Size distribution, number, SO₂, light scattering and BC

Go Amazon T2 - 02apr2014



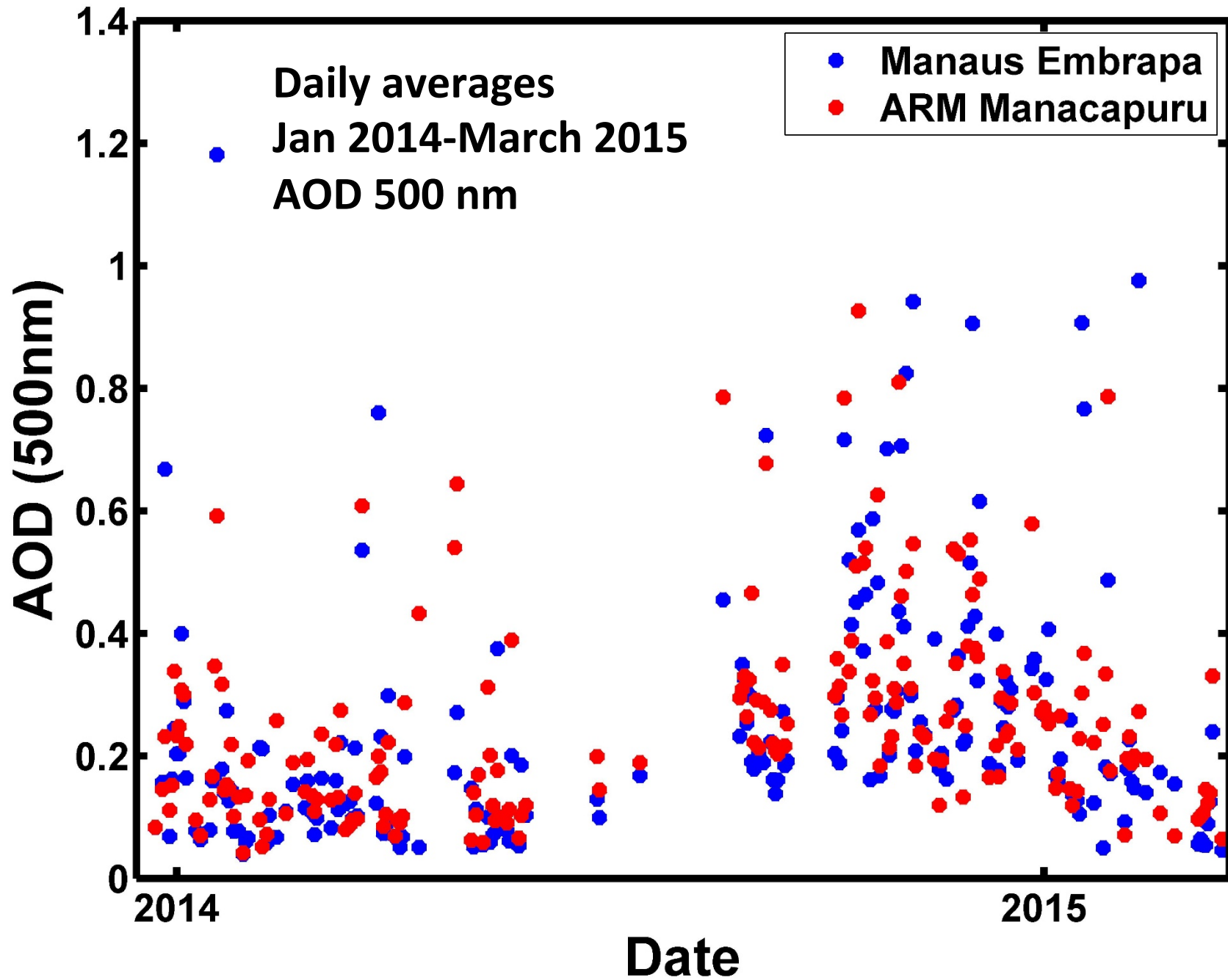
New particle formation? Bursts of particles $10 < D_p < 30$ nm.



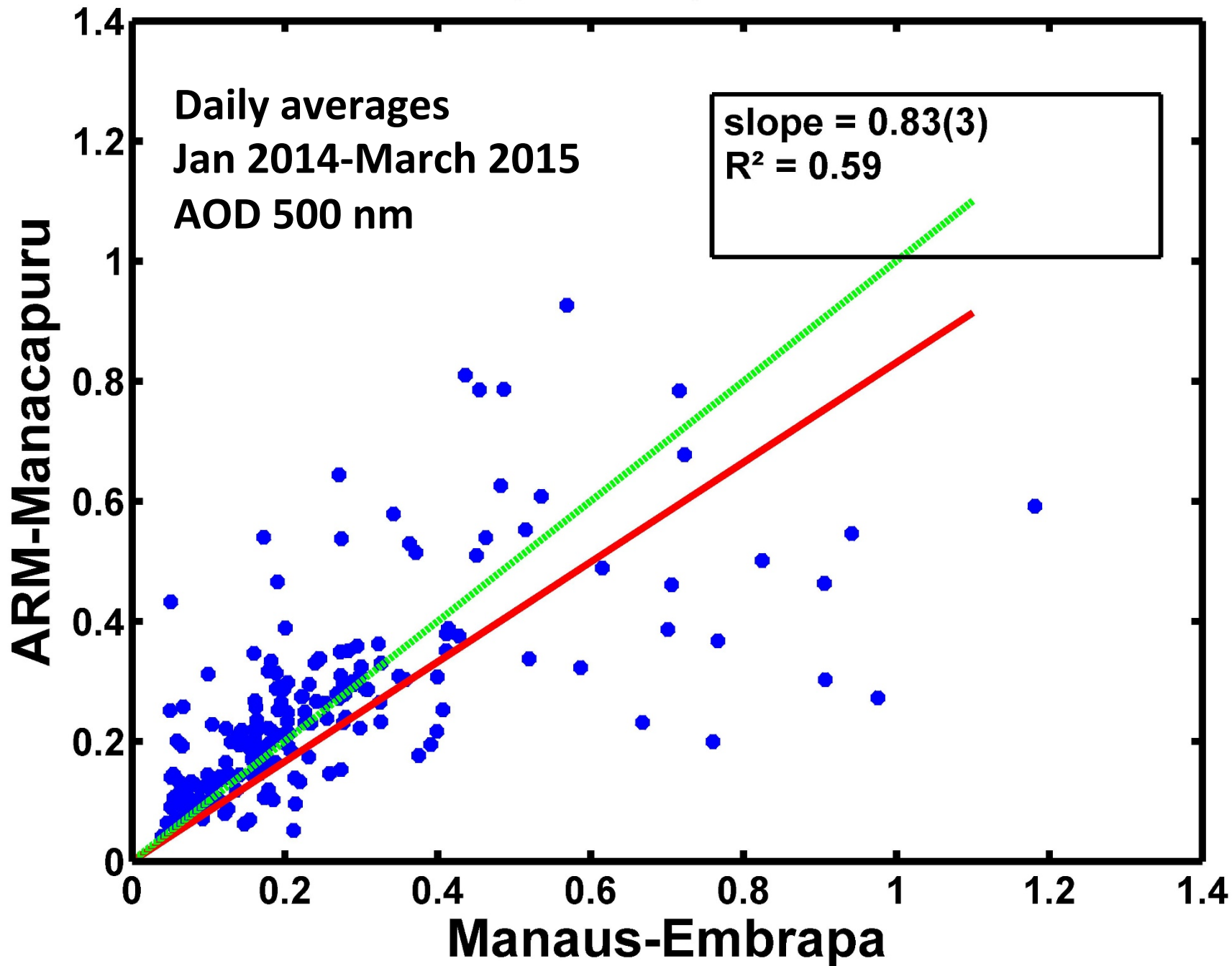
Aerosol size distributions measured in 2009 Apr 4th. There was a burst of ultrafine particles from 2:00 to 4:00 UTC time.

New particle formation and subsequent growth was seldom observed along two years of measurements. Nevertheless, in 70% of the days, bursts of particles with diameters in the range 10-40 nm were detected. The events usually lasted from 20 to 120min, and the subsequent growth to larger sizes was not always clearly observed.

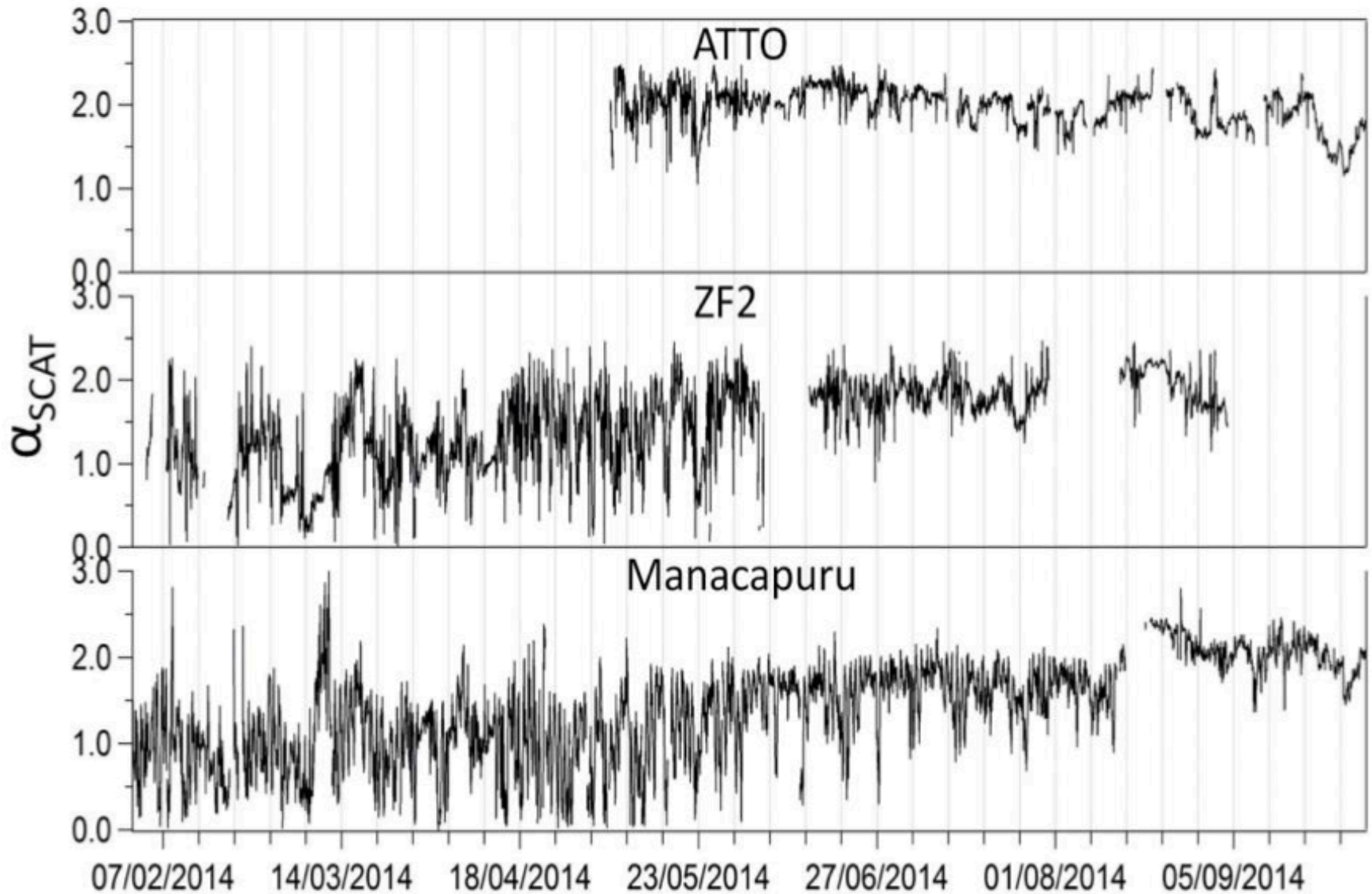
AERONET data level 1.5



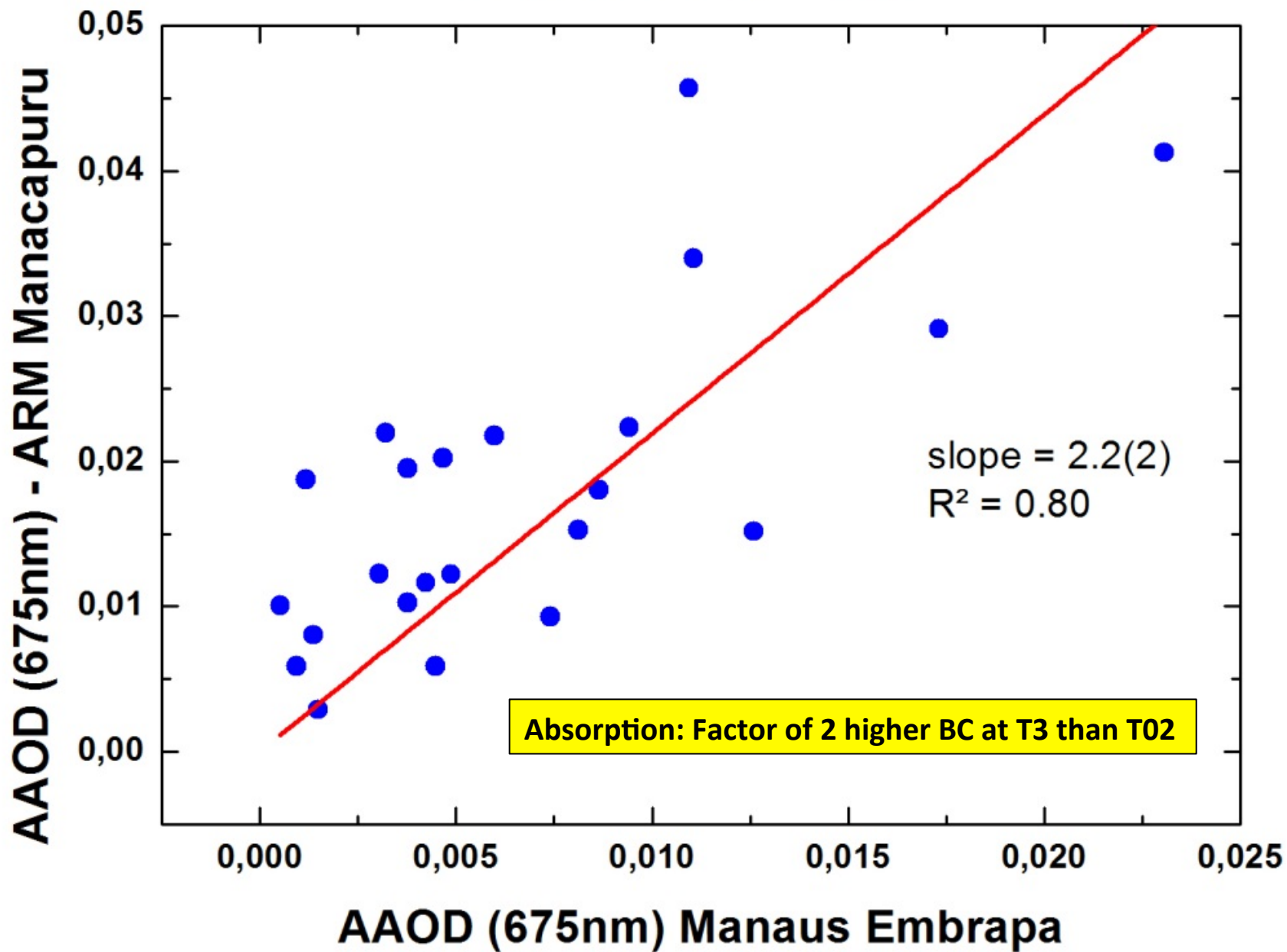
AOD (500nm) - level 1.5



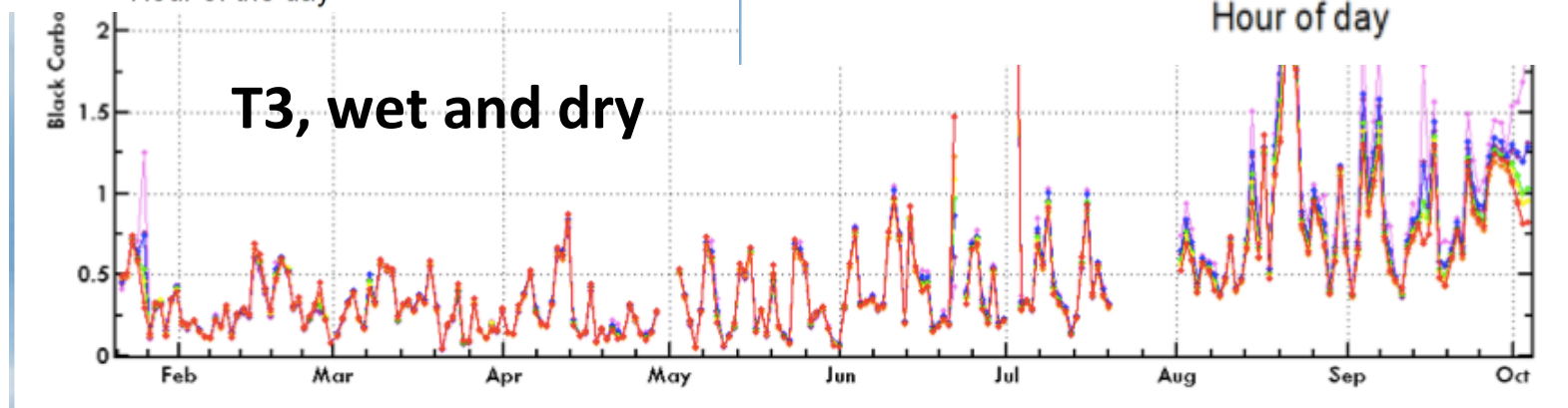
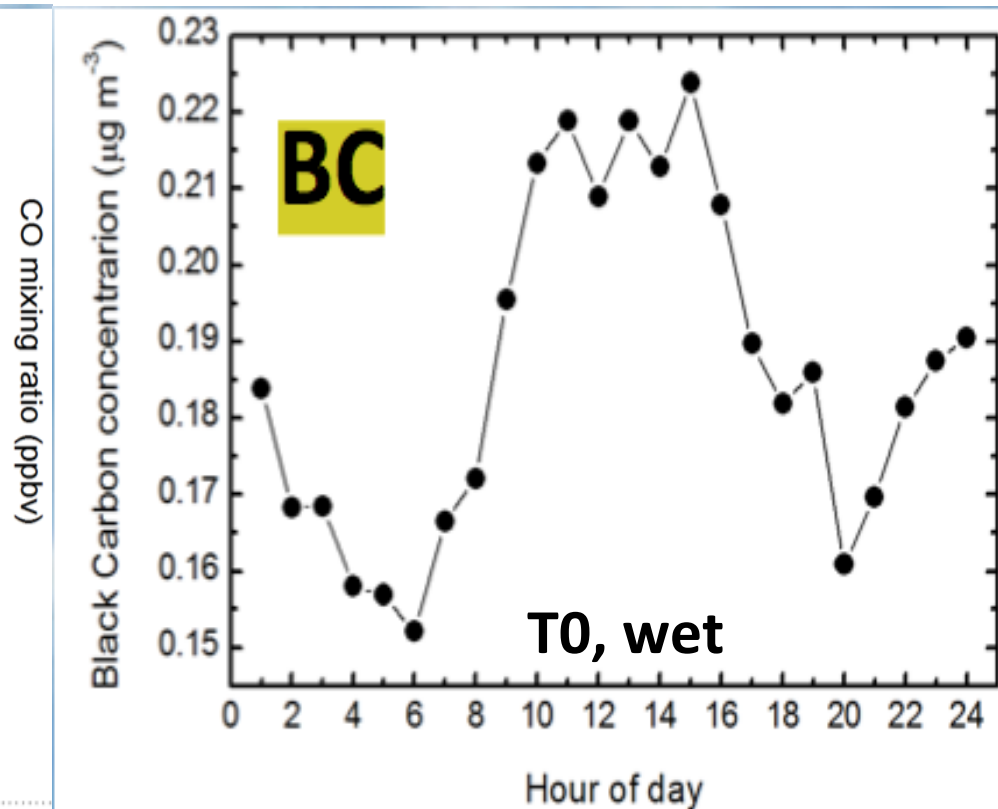
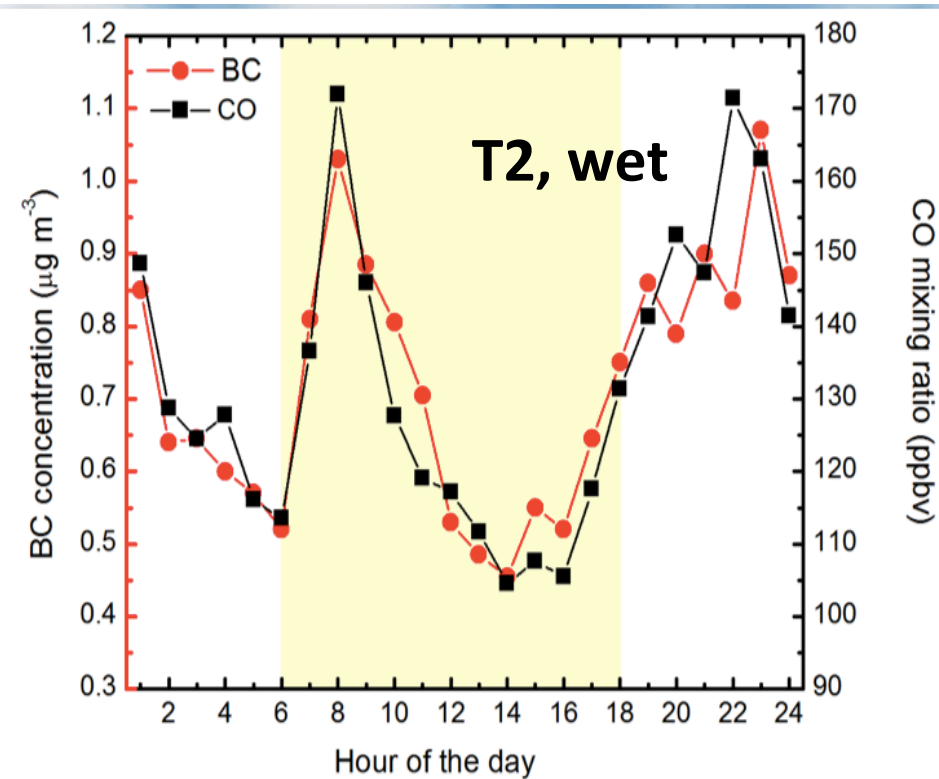
Light Scattering



AERONET Data level 1.5



BC



Conclusions and Future perspectives

- Backscattering profiles from the up- and down-wind lidars do not show the Manaus plume
 - plume is composed of particles of small size that don't contribute much to scattering, but shows strong absorption
- We plan to do Raman inversion of the night-time data to check if we can see the plume in the extinction profiles