Status of Data Analysis Related to the Ground-Based Aerosol Measurements Performed in Antigua and Puerto Rico

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Scientific Objectives

- Two of RICO fundamental questions are:

  – What is the spatial and temporal variability of aerosol chemical and physical properties in the trade wind environment?

  – How do aerosols impact the microphysics of trade wind cumuli?

- Our group (UPR-ITES) interest is to determine for easterly trades:

  – the size, concentration, and composition of marine aerosols.

  – the contribution of the different aerosol chemical species to CCN (fraction of the aerosol capable of forming cloud droplets).

Sampling Periods

- Period 1:
    - December 4 – 21 (CSJ, East Peak, and Dian Point)
    - December 6 – 18 – RICO together with Puerto Rico Aerosol and Clouds Study (PRACS)

- Period 2: January 4 – 25, 2005 (Dian Point and CSJ). East Peak was not fully operational because most of the PRACS participants were present only during December.

CSJ and East Peak – Puerto Rico

Dian Point (DP) - Antigua

Ongoing Activities

- Chemical Characterization of:
    - Aerosol filter (bulk and size-resolved) samples – water-soluble ions, organic carbon, elemental carbon, water-soluble organic carbon – December and January periods, DP and CSJ stations
        - Product: fine ($D_p < 2$ μm) and size-resolved (0.1 to 10 μm) mass concentrations of chemical species (size distributions)

    - Individual aerosol particles – sulfate, nitrate, ammonium, and organics (AMS at CSJ and East Peak, only during December)
        - Product: real-time mass concentrations of those four species

    - Cloud water samples – water-soluble ions and dissolved organic carbon – January period, East Peak station (mainly during January, only few samples in December)
        - Product: cloud water pH, concentrations (ueq/L) of chemical species

Ongoing Activities (cont.)

- Physical Characterization of:
  - Aerosol particles – SMPS (10 to 700 nm), PCASP-X (0.1 to 10 μm), ASASP-X-volatility system (time series, volatility spectra), ceilometer (cloud base and vertical distribution of particles, nephelometer, aethalometer, particle hygroscopicity, CN, CCN, SEM, and TEM - December and January periods; DP, CSJ, and EP stations (not all instruments/analyses are for all stations)
  - Cloud water – LWC, particle surface area, effective radius, droplet size distribution – East Peak (December period)

- Case studies: "Clean" (January 5-11, 16-20), "Saharan dust" (Jan 11-16) and "Anthropogenic pollution from North America" (Jan 20-24)

- Comparison between CSJ and DP

Classification of Dian Point and CSJ Samples (January) based on Origin of Air Masses (HySplit) and on Preliminary Chemical Characterization

| Sample No.	Initial Date	Final Date	Initial Time (GMT)	Final Time (GMT)	Origin of Air Masses
4	5-Jan-05	7-Jan-05	1:30 PM	4:45 PM	"Clean Air"
5	7-Jan-05	11-Jan-05	6:00 PM	9:33 PM	"Clean Air"
6	11-Jan-05	14-Jan-05	2:10 PM	12:51 PM	"Saharan Dust"
8	14-Jan-05	16-Jan-05	2:40 PM	4:30 PM	*"Saharan Dust or AnthropogenicPollution"*
9	16-Jan-05	18-Jan-05	5:30 PM	7:09 PM	"Clean Air"
11	18-Jan-05	20-Jan-05	10:04 PM	7:00 PM	"Clean Air"
12	20-Jan-05	21-Jan-05	8:13 PM	8:27 PM	"Pollution from North America"
13	21-Jan-05	24-Jan-05	9:30 PM	12:40 PM	"Pollution from North America"

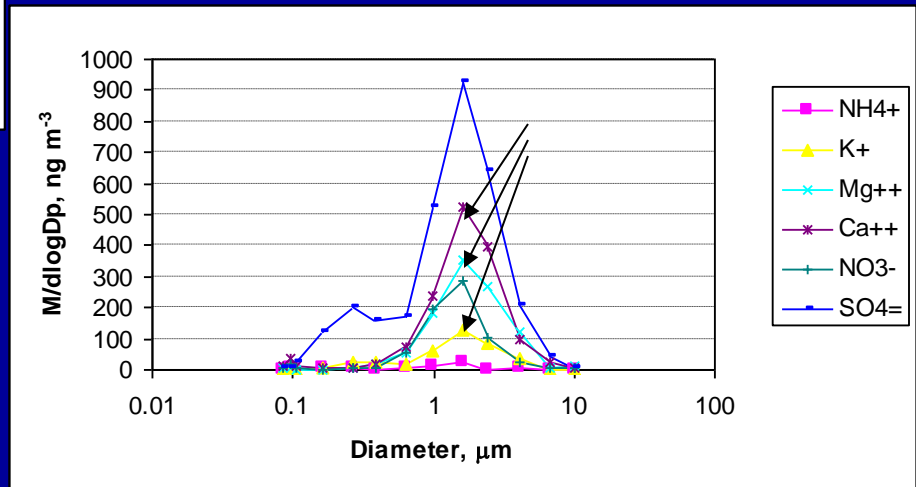# Preliminary Aerosol Chemical Apportionment ($D_p < 2 \mu m$)
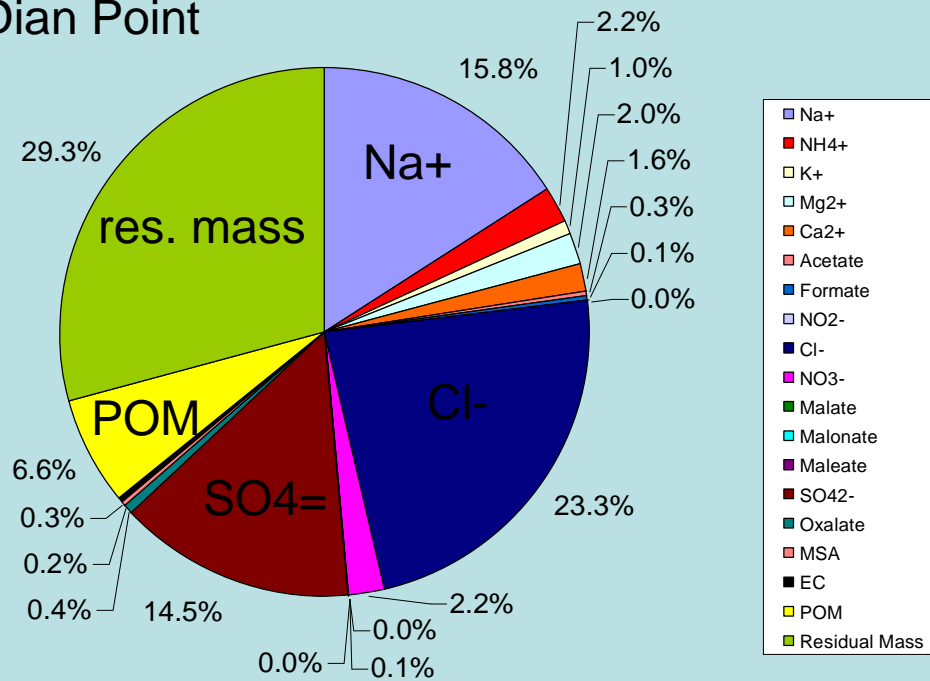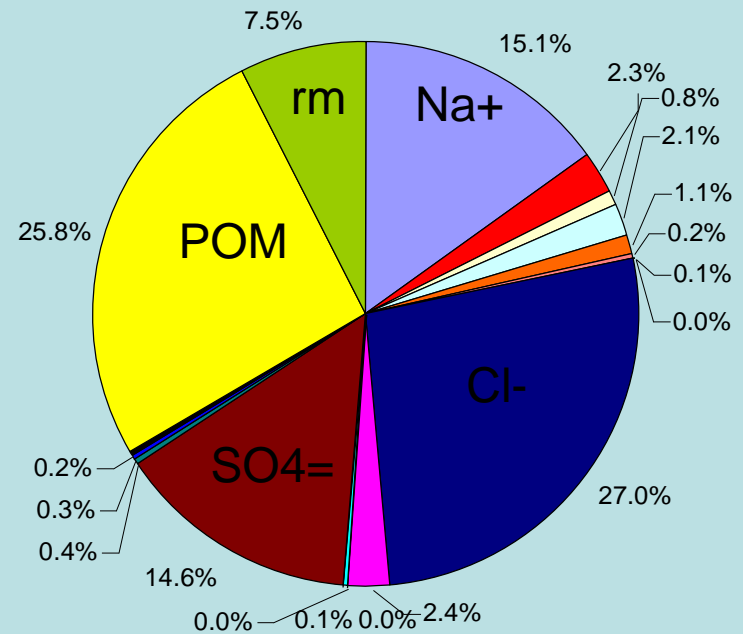
Size-Resolved Preliminary Aerosol Chemical Composition
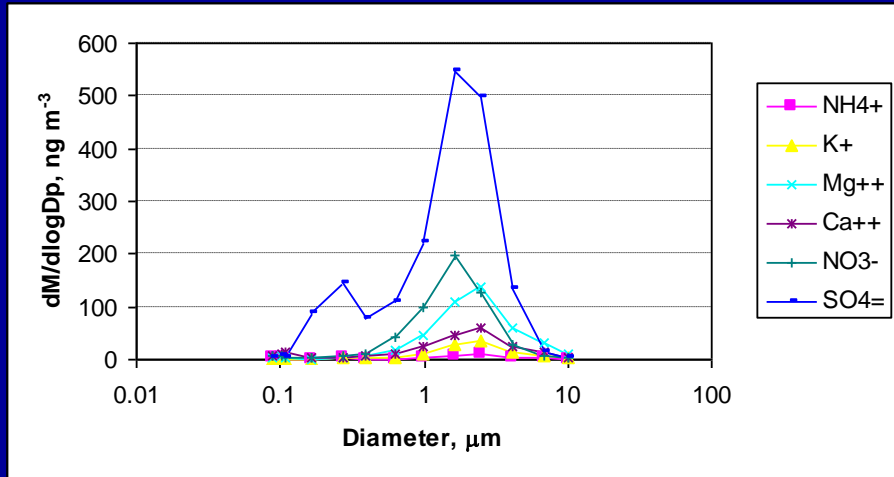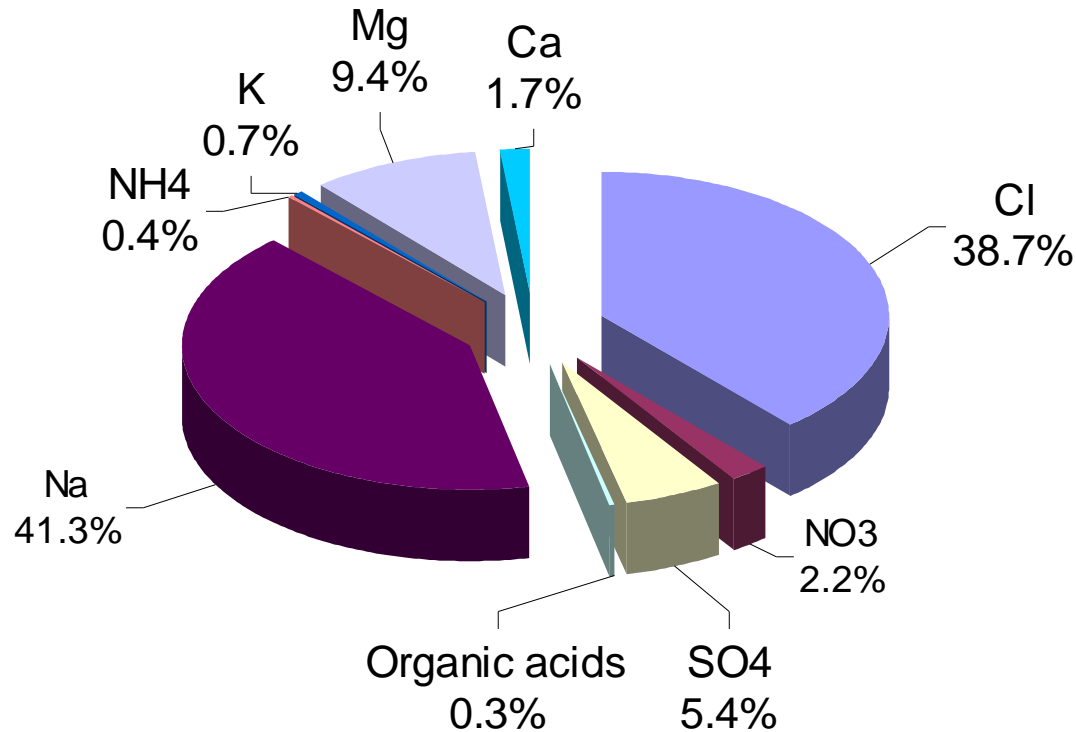

Clean period, Jan 16-18, 2005.

Dian Point

"Saharan" dust event, Jan 11-14, 2005. Note the increase in the concentrations of Ca2+ and Mg2+ and K+, ions present in the dust.
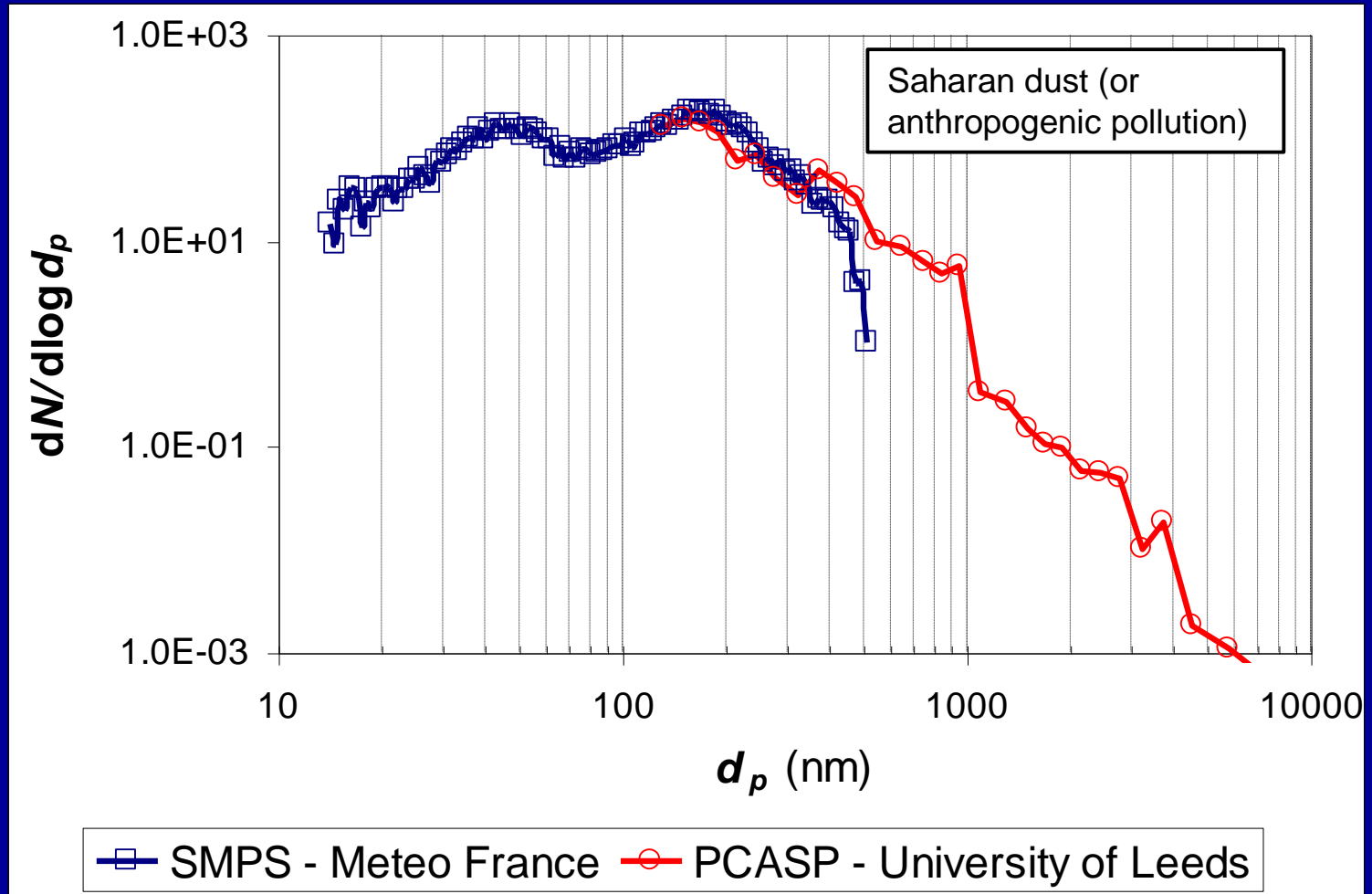
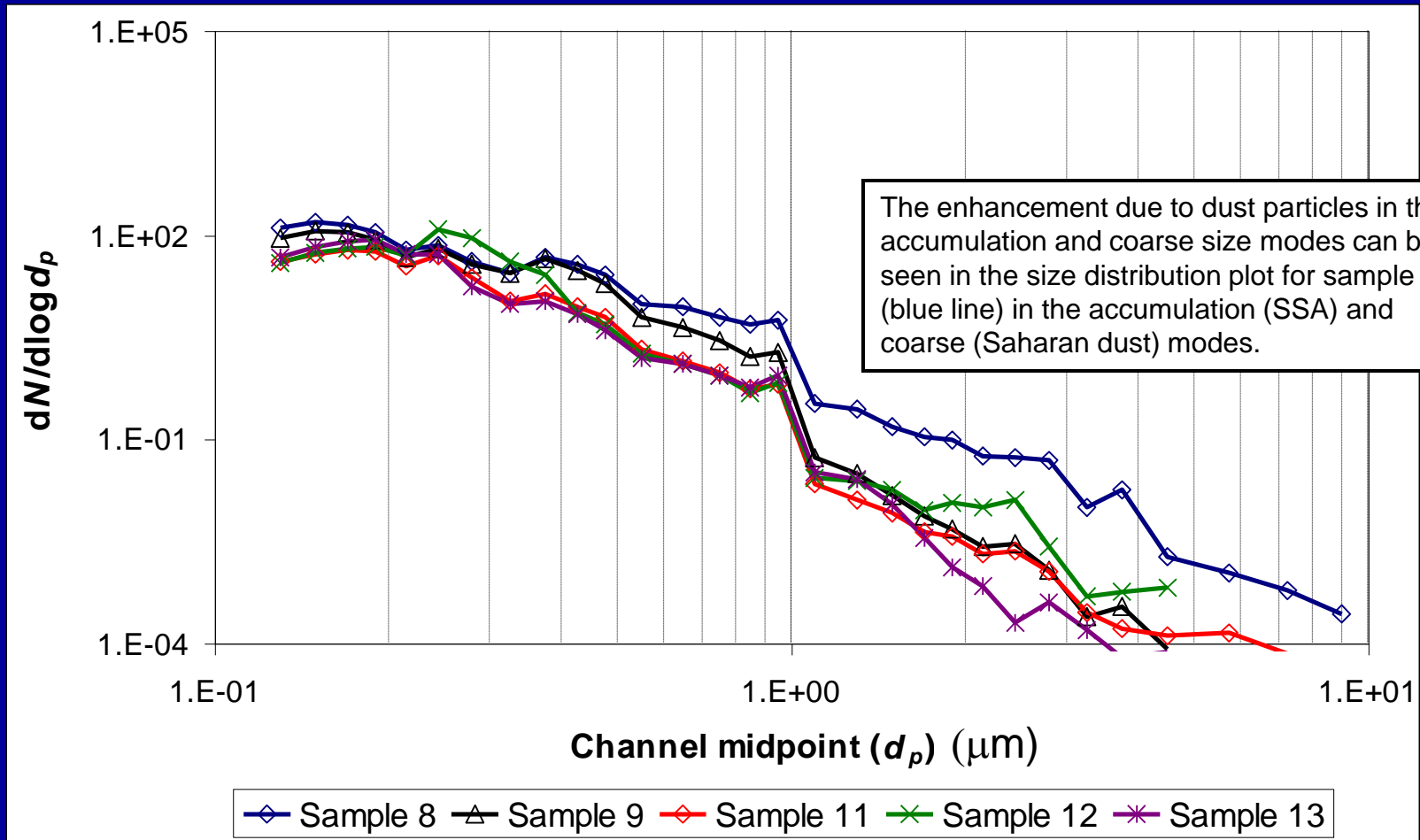# Preliminary Bulk Chemical Composition of Cloud Water (January period)

Water-soluble ions at **East Peak** cloud water samples. Organic acids = ∑ [Ace, For, MSA and Ox].

Physical Characterization of Aerosols: Combination of SMPS and PCASP Data: Mean Particle Size Distribution Plots – Sample 8 (Log Scale) Jan 14-16

Saharan dust (or anthropogenic pollution)

SMPS - Meteo France   PCASP - University of Leeds

d_p (nm)

$dN/d\log d_p$

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Physical Characterization of Aerosols
PCASP Data: Mean Particle Size Distribution Plots – All Samples
(January period – Dian Point)

The enhancement due to dust particles in the accumulation and coarse size modes can be seen in the size distribution plot for sample 8 (blue line) in the accumulation (SSA) and coarse (Saharan dust) modes.

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Next Steps

- Complete data/sample analysis
- Same detailed study we are doing for the January period will be performed for the December period
- **Determination of the contribution of different aerosol chemical constituents to CCN** (role of organic aerosols?)
- Answer questions such as:
  - Why EC is not observed in DP samples with what we think is anthropogenic influence from North America?
  - Why the differences between DP and CSJ stations?
- Collaboration with other RICO PIs (e.g., C-130, met data from other locations), special interest in the case studies.