



# Aerosols (CN) and cloud constituents (LWC & IWC, CCN and IN)

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## GENERAL INTRODUCTION, INSTRUMENTATION, PROJECTS

### 1. INTRODUCTION: Instrumentation dedicated to CCN, IN, CN particle analysis

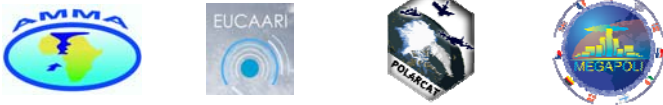
The poster is dedicated to the **CVI inlet** and aerosol measurement instrumentation developed within the frame of the LaMP airborne measurement platform. The CVI cloud inlet has been developed to segregate hydrometeors from surrounding air and to extract subsequently particulate (**originally CCN and IN nuclei**) and gaseous matter from individual hydrometeors. The CVI inlet has been designed with a backward facing interstitial inlet (**INT**) to analyse alternatively the non activated particles within cloud systems.

The **instrumentation** downstream the CVI inlet can be switched from **CVI** to **INT** in clouds and even to the community aerosol inlet (**CAI**), operated by SAFIRE, to sample outside cloud systems. The entire system serves to analyse **condensed water content (LWC and/or IWC)**, **chemical, physical**, and **optical** aerosol properties of residual particles (former CCN, IN), interstitial and clear sky aerosol particles (CN). The aerosol instrumentation has been partly built, partly modified and adapted at LaMP for use on aircraft.

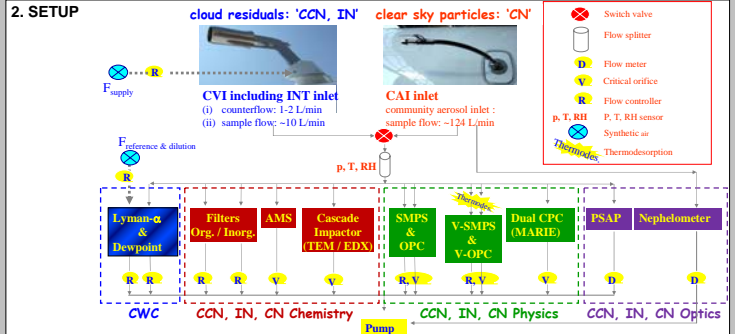
This part of the PMA measurement platform of LaMP has been successfully utilized within the frame of AMMA, POLARCAT, EUCAARI, and MEGAPOLI projects.

### 3. PROJECTS: with LaMP measurement platform on French ATR-42 for CCN, IN and CN analysis

- AMMA (2006):** African Multidisciplinary Monsoon Analysis
- POLARCAT (2008):** POLAR study using Aircraft, Remote sensing, surface measurements and models of climate, Chemistry, Aerosols and Transport
- EUCAARI (2008):** European Integrated project on Aerosol Cloud Climate and Air Quality Interactions
- MEGAPOLI (2009):** Megacities: Emissions, urban, regional and Global Atmospheric POLLution and climate effects, and Integrated tools for assessment and mitigation



### 2. SETUP

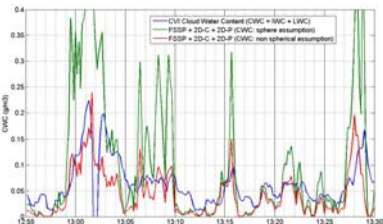


CVI (in cloud CWC and CCN & IN measurements)	INT = interstitial inlet (in cloud CN measurements)	CAI (clear sky aerosol measurements)
- Cloud CWC (LWC, IWC): CVI: Lyman-alpha & Dewpoint monitor		
- Aerosol chemistry of volatile and non-volatile particulate matter (CCN, IN, clear sky and interstitial CN): Aerodyne Aerosol Mass Spectrometer AMS, Multistage Impactor for subsequent individual particle TEM-EDX analysis		
- Aerosol physics (aerosol size distribution & number concentration, particle volatility of CCN, IN, clear sky and interstitial CN): SMPS (scanning mobility particle sizer), OPC (optical particle counter / spectrometer), (UCPC) counters (MARIE type controlled counters), V-SMPS and V-OPC (spectrometers combined with thermodesorbers)		
- Aerosol optics (particle absorption & scattering coefficient, backscattering coefficient of CCN, IN, clear sky and interstitial CN): PSAP (particle soot absorption photometer), TSI aerosol nephelometer		

## MEASUREMENT EXAMPLES

### 4. CLOUD LWC & IWC contents

Example of CVI **HYGROMETRY** from Lyman-alpha & Dew-point measurements: comparison with FSSP + 2D-C



### POLARCAT spring campaign:

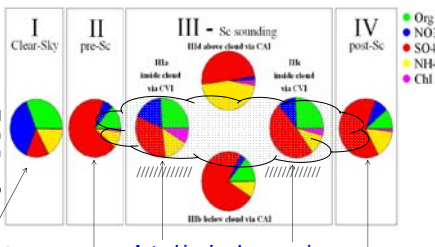
CWC measurements (CWC = IWC and/or LWC) CWC measurements with CVI inlet are considered to be the reference method for direct condensed water content measurements

### 6. AEROSOL (CN, CCN, IN) CHEMISTRY:

Examples of AMS & TEM-EDX Measurements

### EUCAARI (right):

AMS analysis of aerosol & cloud residual particles (CCN) collected with ATR-42 during EUCAARI flight 51 from Rotterdam to Newcastle. Nitrate enrichment in CVI samples also observed during return flight.



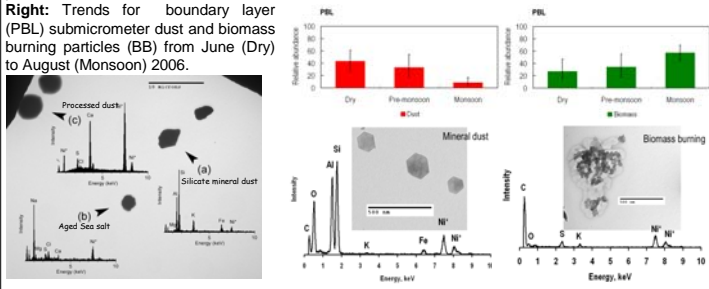
Non-scavenged air mass (High nitrate concentrations!)

Actual in cloud scavenging (CVI-AMS data: nitrate enriched!)

Air mass after drizzle scavenging (CAI-AMS data: nitrate depleted!)

### AMMA (below):

TEM-EDX analysis of aerosol & cloud residual particles (CCN) collected with ATR-42:  
 Left: TEM images of CCN and CN particles  
 Right: Trends for boundary layer (PBL) submicrometer dust and biomass burning particles (BB) from June (Dry) to August (Monsoon) 2006.



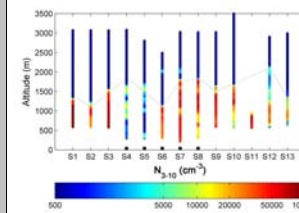
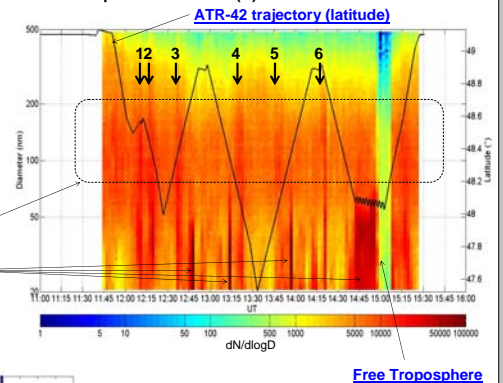
### 5. AEROSOL (CN, CCN, IN) PHYSICS: Examples of SMPS and (U)CPC measurements

**MEGAPOLI (right):** Aerosol size distributions observed on ATR-42 flights with distinct nucleation and accumulation modes

**ATR-42 crossing pollution plume from Paris (1 to 6)**

**Accumulation mode**

**Aerosol Nucleation Event**



### EUCAARI (left):

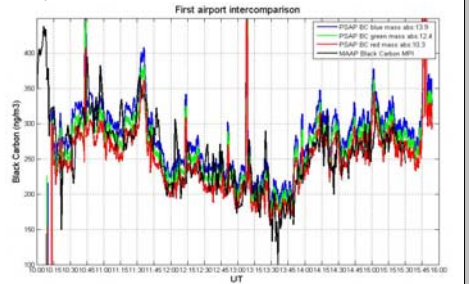
Aerosol nucleation particle concentrations (3-10nm) for all ATR-42 soundings where nucleation has been observed during EUCAARI flights. Nucleation seems to be limited to BL.

- Soundings performed over the sea
- Boundary layer (BL) top estimated from thermodynamical data

### 7. AEROSOL (CN, CCN, IN) OPTICS: Example of PSAP measurements (BC derived from absorption coefficient)

### MEGAPOLI (right):

Black carbon concentrations calculated from PSAP absorption photometer on ATR-42 and the MAAP instrument on the MPI mobile van (ATR-42 and mobile van side by side on the tarmac ...)



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