

## Meeting Notes Barbados Workshop, 24-25.10 MPI-M, Hamburg

Overview talks by Louise (MPI interests in long-term statistics), Holger/Birgit (Overview of Golden Days/Themes for ACTOS) & Heike (Variability in ground-based measurements of aerosol at Ragged Point)

Short talks by:

- Emiliano Orlandi (Cologne/ HATPRO radiometer)

HATPRO data shows some issues (diurnal cycle in WVP), and is currently not working. Analysis of WVP/LWP from HATPRO would benefit from MRR and Ceilometer data (rain/cloud classification) and a better radiosonde dataset. E.O.: Barbados has all the instruments needed for CloudNet; CloudNet algorithms could provide a nice cloud classification.

- Jan Handwerker (KIT / cloud radar)

A different scanning strategy (RHI scanning) can provide unique information about the turbulent structure of clouds. After deriving wind direction from a PPI scan, the cloud radar can do RHI scanning into the wind direction. One issue with this for Barbados is the lack of cases where scans are filled with enough hydrometeors to apply such algorithms, but it would be worthwhile exploring for a few (deeper) convection cases.

- Sylvester Arabas (Warsaw)

Warsas is interested in model validation with Barbados data and would benefit greatly from soundings & droplet spectra from ACTOS, or velocity fields derived from LES.

- Frank Werner/Andre Ehrlich (LIM, Leipzig)

Overview of HELIOS and Eagle data. Issues are lack of days without cirrus, that complicate the derivation of effective radii and optical thicknesses, but is currently (partly) corrected for.

### Discussion Points for this meeting:

1. Golden Days/Themes : which ones are we most interested in? How far will we follow up on them?
2. Calibration / Validation Needs
3. Synthesis:
  - a. Cloud reactors (processing of aerosols)
  - b. Role of the sea surface (e.g., giant nuclei)
  - c. Cloud - precip - aerosol interactions
4. Modeling
5. Data distribution
6. Publication strategy

## **Discussion point 1. Golden Days/Themes**

As favorite themes are mentioned: Giant Nuclei (and CCN), New particle formation near clouds, both of which could be characterized as Aerosol - Cloud Interaction.

H.W.: note that these selected themes yet miss the aerosol to CCN pathway.

B.S.: perhaps the overall question that combines these two themes can be: "What controls the background concentration of CCN / and how important are the unusual ones (GN)?"

We decide to follow up on this question i.e., what controls the accumulation mode, or activated part of the aerosol distribution, which shows a large variability? (in the data)

A first step towards answering this question is the creation of a synthesis dataset that contains the "minimum" of variables/parameters that we need. This dataset will include Meteo + Cloud macrostructure data (MPI/Cologne), Ground-based aerosol data (IfT) and ACTOS data (IfT), for the two campaigns of CARRIBA (Nov 2010 & Apr 2011)

### **SYNTHESIS DATASET SPECIFICS:**

The time series in these datasets will have a time stamp of "bco\_day" = Barbados Cloud Observatory Day, "days since 2010-4-1 00:00:0.0 (UTC)"

Louise will send around a file that includes the following time units: bco\_day, YYMMDDHHMMSS, Unix time, local time Barbados, local time HH

#### **Meteo + Cloud Macrostructure (MPI & Cologne):**

**(coordinated by Louise)**

1 hourly values - time is centered

- Cloud fraction (ceilometer / lidar/ if ready all-sky camera) for cloudy detections below 3 km, 3 - 7 km, > 7 km
- Rain fraction (MRR/SPOL)
- WVP (Raman / HATPRO)
- LCL (Ragged Point tower data)
- wspd / wdir (RP tower data)

#### **Ground-based aerosol sampling (IfT):**

**(coordinated by Heike)**

daily values - time is centered

- Aerosol number concentration (total & > 80 nm)
- Insoluble fraction
- Back trajectories (coordinates or flags for different regions), - 5 / - 10 days?

### **ACTOS (IfT):**

#### **(coordinates by Holger)**

mean values (+ stddev, RMS) per flight - time stamp is the average time during each flight

Flights to be divided into below 500 m and above 700 m up to 2.5 km (clear sky & clouds)

- Theta, pressure, water vapor mixing ratio
- Aerosol (and droplet?) number concentrations, for aerosol: total & > 80 nm
- Time spent in clouds/number of cloud penetrations
- Effective droplet radius / mean diameter
- LWC normalized by adiabatic value (?)

### **SMART-HELIOS:**

#### **(coordinated by Frank/Andre)**

- Optical thickness & derived effective radius

All data should be in one file per campaign; filename should include CARRIBA 1 (or "2") - Sensor/parameter and contact person should be included

**DEADLINE: December 1, 2011**

Further discussion on selected themes:

Nucleation / New particle formation: the Ragged Point aerosol sampling data shows a large number of Aitken mode aerosol at certain times. Data suggest they are a few days old, yet how they are created, and what is their origin, is unclear. How many events do we need to explain this Aitken mode?

Related questions are the spikes of extremely high particle numbers measured by ACTOS, can we find out the time scales needed for such peaks to disappear (dispersion)? Does a cloud produce its own CCN by nucleation? Are organics better in making new particles than SO<sub>2</sub>? Does condensation occur on just any particle (even on pure dust)?

And what can CARRIBA add that helps understanding the marine aerosol distribution?

-> One idea is to explore whether there is indeed a continuous feed of aerosol due to cloud processing. IfT will explore whether a budget study is useful.

Giant/Ultra Giant CCN: what would be good is to figure out the mass versus number concentration of the giant CCN measured by ACTOS. What is the height-dependence? Can we relate the giant CCN signal to particle backscatter measured by the Raman lidar, and to wind speed? Can Giant CCN explain drizzle drops

?(coalescence process simulated by DNS -> see modeling interests METSTROM/Schumacher).

It might be useful to explore the recent Steve Schwartz (2010) paper/old Woodcock paper.

Transition layer / well mixed boundary layer:

What is the motivation behind looking at transition layer statistics in more detail? -> It regulates cloudiness e.g., tends to limit cloud formation in case the transition (stable) layer is located at a height below the saturation level.

The humidity and temperature profiles measured by ACTOS can add to the transition layer statistics derived from the Raman lidar water vapor profiles.

## **Discussion point 2. Calibration / Validation Needs**

Raman Lidar:

- water vapor/humidity: it is planned to validate the Raman water vapor and temperature profiles using the profiles measured by ACTOS on selected flights. This may shed some light on the apparent bias of Raman water vapor values in the lowest few kilometers of the atmosphere as compared to ECMWF analysis.
- particle backscatter: work is ongoing to study the variability in particle backscatter and relate it to variability in measured aerosol/CCN concentrations (Daniel Buettner- MPI). For this the ground-based and ACTOS data of the number/spread/mean particle size of the accumulation mode aerosol at a certain (0.3%?) supersaturation would help.

## **Discussion point 3. Synthesis**

Some synthesis themes were mentioned: Cloud reactors / The role of the sea surface. Both have been more or less covered during the discussion of favorite themes (New particle formation / Giant CCN).

## **Discussion point 4. Modeling**

Institutes interested in modeling are:

IFT /H. Siebert with METSTROM/Schumacher: interested in cloud dynamics and cloud turbulence processes

Warsaw / S. Arabas: interested in aerosol-cloud interaction and testing and validation of their sophisticated microphysical scheme.

MPI / A. Seifert - HerZ clouds and convection group: interested in cloud dynamics and precipitation parameterization

L.N/B.S. : Our first feel is that we do not set up a "Barbados LES case", because this requires a lot of work and there is the existing RICO case that might not

differ much from a mean/composite Barbados case. We will compare the RICO case set-up with meteorological conditions during the CARRIBA campaign (Louise / Heiner Matthias Brueck), to find out how different these are. The RICO case can then be used as a modeling framework, complemented with more detailed aerosol data collected during CARRIBA that are missing for RICO.

### **Discussion point 5. Data distribution**

Data will be put on the ACTOS Wiki or FTP server at MPI - possibilities will be explored.

### **Discussion point 6. Publication strategy**

The upcoming International Conference on Clouds and Precipitation in July in Leipzig is of interest to many of us. ICCP abstracts are submitted by individuals and we don't focus on fitting into our own session. Ideal would be a session that combines the RICO/VOCALS/Barbados/CARRIBA/Azores campaigns. Deadline for submitting a short abstract is: December 15, 2011.

We agreed that there will not be a special issue on CARRIBA/Barbados, but we will write one overview paper that describes the big picture (motivation, questions of interest) and the observational strategy & instrumentation.

### **Next Meeting**

Next meeting in **April at IfT** with more individual short presentations including an outline of individual work/publication.