P2.13 A CLOUD MICROPHYSICS EXPERIMENT OVER NORTHEAST BRAZIL

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1. INTRODUCTION

It is recognized that global and regional climate are strongly influenced by cloud coverage and cloud radiative optical and microphysical properties. From the viewpoint of radiative transfer, clouds play a very important role in the energy budget. The global energy cycle, with distinction to the poleward transport of energy from the tropics also depends upon the latent heat release in tropical convective clouds. Cloud radiative properties such as shortwave albedo, as well as the distinctive heating profiles associated with tropical convection (for instance, the well known signatures of convective and stratiform atmospheric columns), are strongly related to the microphysics.

However, there are only few cloud microphysics measurements over tropical regions. Over South America, the Ceará experiment (Costa et al. 2000) and the TRMM−LBA campaign (e.g., Oliveira et al. 2002, this Conference) were the only opportunities to attain detailed information on cloud microphysics.

With the purpose of providing microphysical data in tropical clouds in order to study the relationship between CCN and cloud microphysics as well as the interaction between clouds and large−scale thermodynamics, a field campaign was planned to take place in Ceará state, over northeast Brazil (NEB), the so−called *Experimento de MicroFÍsica de Nuvens* (EMfiN!) or Cloud Microphysics Experiment, involving a pool of institutions: the State University of Ceará (*Universidade Estadual do Ceará* − UECE), the Federal University of Ceará (*Universidade Federal do Ceará* − UFC), the Aerospace Technical Center (*Centro Técnico Aeroespacial* − CTA) and the Meteorology and Water Resources Foundation of Ceará (*Fundação Cearense de Meteorologia e Recursos Hídricos* − FUNCEME). As part of the field campaign, exploratory weather modification missions were proposed as the *Experimento de Semeadura de Nuvens* (ESN) or Cloud Seeding Experiment. This paper presents the field campaign rationale and objectives, as well as the instrumentation to be used (aircraft, radar and soundings, helped by large−scale analysis, satellite, surface station and raingauge data). Preliminary EMfiN!−ESN data will be presented at the Conference.

2. METEOROLOGICAL BACKGROUND

Northern NEB comprises a large semi−arid region, in general showing significant rainfall only during the rainy season (February to May). The rainy season is mainly associated with the southward displacement of the Intertropical Convergence Zone (ITCZ).

A significant variability of convective activity in space and time is often observed during northern NEB's rainy season. Part of this variability is due to heterogeneous surface forcing (i.e., topographical effects, sea−land contrasts), etc. Part of it is associated with diurnal to intraseasonal oscillations. As a consequence, a multiplicity of weather conditions is found during northern NEB's rainy season, from severe convective storms to suppressed convection. Hence, different types of clouds are formed, from large mesoscale systems and isolate deep convective clouds to shallow cumuli/stratocumuli.

A previous study of cloud microphysics over northern NEB suggested that different aerosol sources add another important cause of regional variability in cloud microphysical properties. As observed by several authors in different regions, Costa et al. (2000) showed that, over NEB, "maritime", "coastal", "urban" and "continental" shallow cumuli have significant differences in their microstructures (e.g., droplet concentration, droplet mean diameter and shape of the distribution−function).

3. OBJECTIVES

Based on the context presented in the previous section, EMfiN! has the following objectives: 1. To investigate microphysical properties (e.g., hydrometeor concentration, mean diameter, etc.); 2. To evaluate and quantify how different aerosol sources influence cloud microphysics; 3. To study precipitation formation mechanisms; 4. To determine representative distribution−functions of hydrometeor (particularly cloud droplets and

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raindrops) as a basis for development and/or calibration of physical parameterizations in atmospheric models; 5. To investigate different cloud properties as a function of vertical stability and large−scale flow; 6. To carry out exploratory cloud seeding; 7. To investigate the evolution of seeded clouds as opposed to similar non−seeded clouds.

4. INSTRUMENTATION

EMfiN! instrumentation comprises an instrumented aircraft, a meteorological radar and a radiosonde station. The instrumented aircraft of the State University of Ceará, *Avião Laboratório para Pesquisas Atmosféricas* − ALPA/UECE, is a Embraer Bandeirante, equipped with a global positioning system (GPS), static pressure, dynamic pressure, temperature, dew−point temperature and liquid water sensors, along with a cloud condensation nucleus counter (CCNC), a forward−scattering spectrometer probe (FSSP−100) and two optical array probes (OAP−200X and OAP−200Y). Table 1 shows a list of the instrumentation installed on board ALPA and Figure 1 shows the aircraft and its instrumentation.

Table 1 − Instrumentation on board ALPA

Measured Parameter	***Sensor (s)***
Temperature	Rosemount 102AU1AF/510BF
Static Pressure	Rosemount 1201F
Dynamic Pressure	Rosemount 1221F
Latitude and Longitude	Trimble GPS
Dew−Point Temperature	EG&G 137−C3−S3
Liquid Water Content	Csiro−King LWC, Johnson Williams CT43
Aerosols	CCNC UW 83−1
Hydrometeors	FSSP−100, OAP−200X, OAP−200Y
Shortwave radiation	EPPLEY PEP
Longwave radiation	EPPLEY PEP

Figure 1 − UECE's instrumented aircraft, ALPA. Part of its instrumentation is also shown: liquid water sensors and FSSP−100 (upper right), OAP−200X and OAP−200Y (lower right)

Along with the instrumented aircraft, a major platform for cloud physics studies involved in EMfiN! Is FUNCEME's X−band meteorological radar. The radar is located at UECE's Itaperi campus, in Fortaleza, Ceará and has a range up to 120 km. The radar facilities and the radar coverage are depicted in Figure 2.

In order to obtain the characteristics of the atmospheric flow, launching of radiosondes are planned, using CTA's instrumentation (Marwin−Vaisala stations using RS−90 radiosondes). Data will be complemented by large−scale analysis, satellite, surface station and raingauge data.

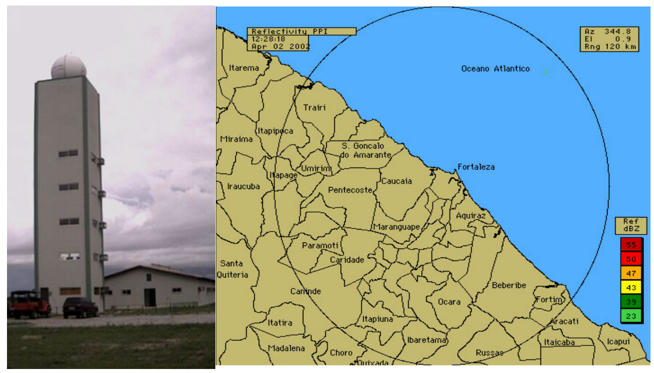

Figure 2 − FUNCEME's X−band radar, installed at the "meteorological tower" at UECE's Itaperi campus (left), and radar 120 km coverage (right).

ACKNOWLEDGEMENTS

EMfiN! received support from the Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq, Brazil) and ESN received funding from the Fundação Cearense de Apoio ao Desenvolvimento Científico e Tecnológico (FUNCAP)

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