

## **CLOUD AEROSOL INTERACTION AND PRECIPITATION ENHANCEMENT EXPERIMENT (CAIPEEX) OVER INDIA: AN OVERVIEW**

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Surrounded by warm oceans leading to high level of humidity coupled with high level of aerosol loading over the region, makes the modification clouds by aerosols over the Asian Monsoon region intriguing and challenging to understand. Lack of adequate simultaneous high resolution observations of aerosols and cloud microphysical properties leaves estimation of indirect effect of aerosols on climate uncertain. The Cloud Aerosol Interaction and Precipitation Enhancement (CAIPEEX) is being conducted in India by the Indian Institute of Tropical Meteorology (IITM) with the objective to understand the pathways through which aerosols modify clouds and precipitation processes. Under this program an instrumented aircraft was used for the measurements of aerosols and cloud parameters together with supporting ground based observations.

CAIPEEX has two components viz. Phase I is devoted for intensive cloud and aerosol observations over different parts India using an instrumented aircraft. The instrumented cloud physics aircraft flown over 200 hrs over different parts of India during the period May-September 2009 with the following scientific objectives:

- To measure background concentrations of aerosols and cloud condensation nuclei (CCN) during pre-monsoon and monsoon seasons over different parts of the country.
- Observations of hydrometeors and measurement of different cloud microphysical parameters in the clouds.
- Preparation of climatology of cloud microphysical properties
- Selection of sites for the second phase randomized cloud seeding experiments

During pre-monsoon as well as monsoon conditions high aerosol concentrations were observed at surface as well as at higher altitudes and were found to control the rain processes in the convective clouds. Super cooled water was found till  $-18^{\circ}\text{C}$  in the growing convective clouds. Ice particles were found at  $-4^{\circ}\text{C}$  over the Indian sub-continent (Maheskumar et al., 2010). The cloud droplets were found to trigger the collision coalescence process at effective radius of  $10\mu\text{m}$ , more significantly above  $12\mu\text{m}$ . Over the sea, sea salt was found to naturally seed the convective clouds resulting in early rain formation. Over land, high concentrations of cloud condensation nuclei push the cloud depth even up to 6 km for onset of precipitation, indicating the formation of super cooled water. Over the rain shadow areas aerosols were found to suppress warm rain process and precipitation was observed to start in mixed phase (Konwar et al., 2010). The aircraft observations also gave a rare insight into the microphysical processes, especially the cloud droplet size distributions in clouds over different environments in the Indian tropical region during southwest monsoon season of 2009 (Morwal et al., 2010). Also presence of thick haze over the Arabian Sea region were also documented (Padmakumari et al., 2010).

In a country which is largely dependent on agriculture, cloud seeding is considered to be an alternative technique for the source of water. CAIPEEX Phase-II, first-year program was carried out during the period 4 September -7 November 2010. The objectives of the program were: (1) to carry out test cloud-seeding using hygroscopic salt powder and flares (2) aerosol and cloud microphysics observations using aircraft and (3) cloud observations using radar. An instrumented research aircraft and an agricultural seeder aircraft were utilized during Phase-II. The research aircraft was equipped with the probes for aerosol, cloud microphysics, radiation, trace gases, black carbon, and state parameters and had the provision for seeding using hygroscopic flares. The seeder aircraft was equipped with flare racks and salt spreader. In addition, randomized precipitation enhancement experiment will be carried out with respective type of aerosols under the suitable conditions during 2011. The salient results obtained will be discussed. More details about the CAIPEEX operations are available in <http://www.tropmet.res.in/~caipeex/>.

### References :

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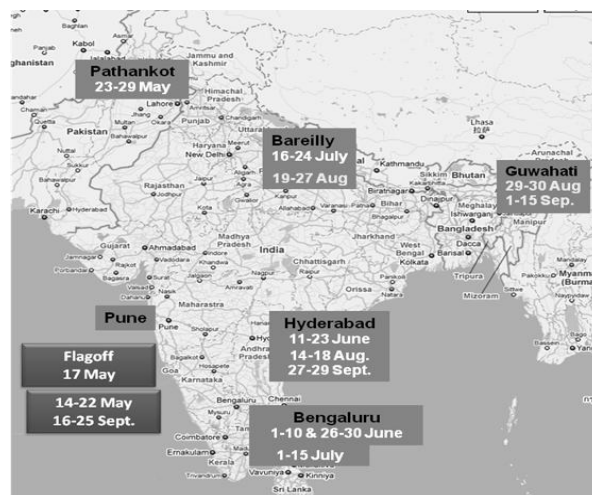


Fig1. The bases and periods when the aircraft flights were conducted for the aerosol and cloud microphysical observations during CAIPEEX phase I.