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OVERVIEW OF MICROPHYSICAL AND STATE PARAMETER MEASUREMENTS FROM FIRE II

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1. INTRODUCTION

In this article we present data collected by the NCAR King Air and Sabreliner aircraft in the FIRE II cirrus project over southeastern Kansas and northeastern Oklahoma in November and December of 1991. We present state parameter and microphysical measurements in summary form for the cases which have been selected by the FIRE Science Team for intensive analysis, 25 and 26 November and 5 and 6 December. We will also evaluate the performance of "key" aircraft instrumentation.

2. STATE PARAMETER MEASUREMENTS

The data sets for both aircraft include temperature information from a Rosemount temperature probe, water vapor density and relative humidity from a Lyman–alpha probe and an NCAR–designed cryogenic hygrometer, and indication of the presence of liquid water from a Rosemount icing detector. The accuracy of the cryogenic hygrometer is estimated conservatively to be better than 10% based on measurements in wave clouds (Heymsfield and Miloshevich, 1993). The Lyman–Alpha probe detects changes in the water vapor density with a rapid response (10 Hz), and these measurements show that the time response of the cryogenic hygrometer (time constant of ~3 seconds) was adequate for our needs. The Rosemount icing probe can detect concentrations of liquid water less than 0.005 g m^{-3} (Heymsfield and Miloshevich 1989).

In–cloud penetration–averaged temperature and relative humidity measurements from the King Air and Sabreliner aircraft on the four case study days are shown in Fig 1; the standard deviations of the measurements are too small be be resolved in the figure. Also indicated in the figures are rawinsonde soundings released from the Coffeyville hub site, along with cloud base and cloud top heights as determined from calibration of our balloon–borne ice crystal replicators (Miloshevich et al. 1993), although the geographical locations and timing of the rawinsonde and aircraft measurements are different. Cloud base and cloud top as determined from the replicator measurements roughly match the cloud altitudes shown by the aircraft data plotted in the figure. Temperatures and temperature structure (e.g. isothermal regions, inversions, and lapse rate) as determined from the aircraft and rawinsonde measurements are unexpectedly similar. When combined with the cloud altitude information, this similarity suggests that the measurements from all platforms are accurate and that the temperature structure of the atmosphere was similar over the region of study and relatively constant in time.

Relative humidities from the in–cloud rawinsonde data are systematically below ice–saturation and are therefore unrealistically low, generally by about 20%. Conversely, the aircraft measurements are much more realistic when compared to the ice-saturation curve, and liquid water was detected only when the relative humidity exceeded 100%. Furthermore, the aircraft data also indicate that the in-cloud regions were consistently ice-supersaturated, especially when the aircraft encountered liquid water.

3. MICROPHYSICAL DATA

Representative 2D probe measurements from the King Air on 26 November 1991 at -44^{C} are shown in Fig. 2, upper two panels. The larger particles in the second panel have well defined "bullet-rosette" shapes. The smaller particles in the upper panel appear to have a compact, denser shape. Their shapes are similar to the larger particles measured with our replicator sonde (lower panel, Fig. 2.) about one hour later. Note that few particles below about 100 microns are imaged with the 2D probe yet many such particles are noted in the replicator data. Data from the 2D probes and video ice particle sampler (VIPS) onboard the NCAR Sabreliner will be available in the future, as will vertical profiles of ice particle size spectra and ice crystal habits from the replicators.

4. CONCLUSIONS

A data set was acquired that contains measurements which can be used to further our understanding of cirrus microphysical processes and microphysics-radiation interaction. The goals will best be achieved by coordinated case studies which make use of the diverse data sets collected both *in-situ* and remotely. Temperature measurements from both aircraft and from the rawinsondes appear to be highly accurate and amenable to coordination. The aircraft relative humidity measurements are accurate at least to within 10%; however, the rawinsonde relative humidity measurements are unrealistically low.

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Aircraft and Radiosonde: T and RH

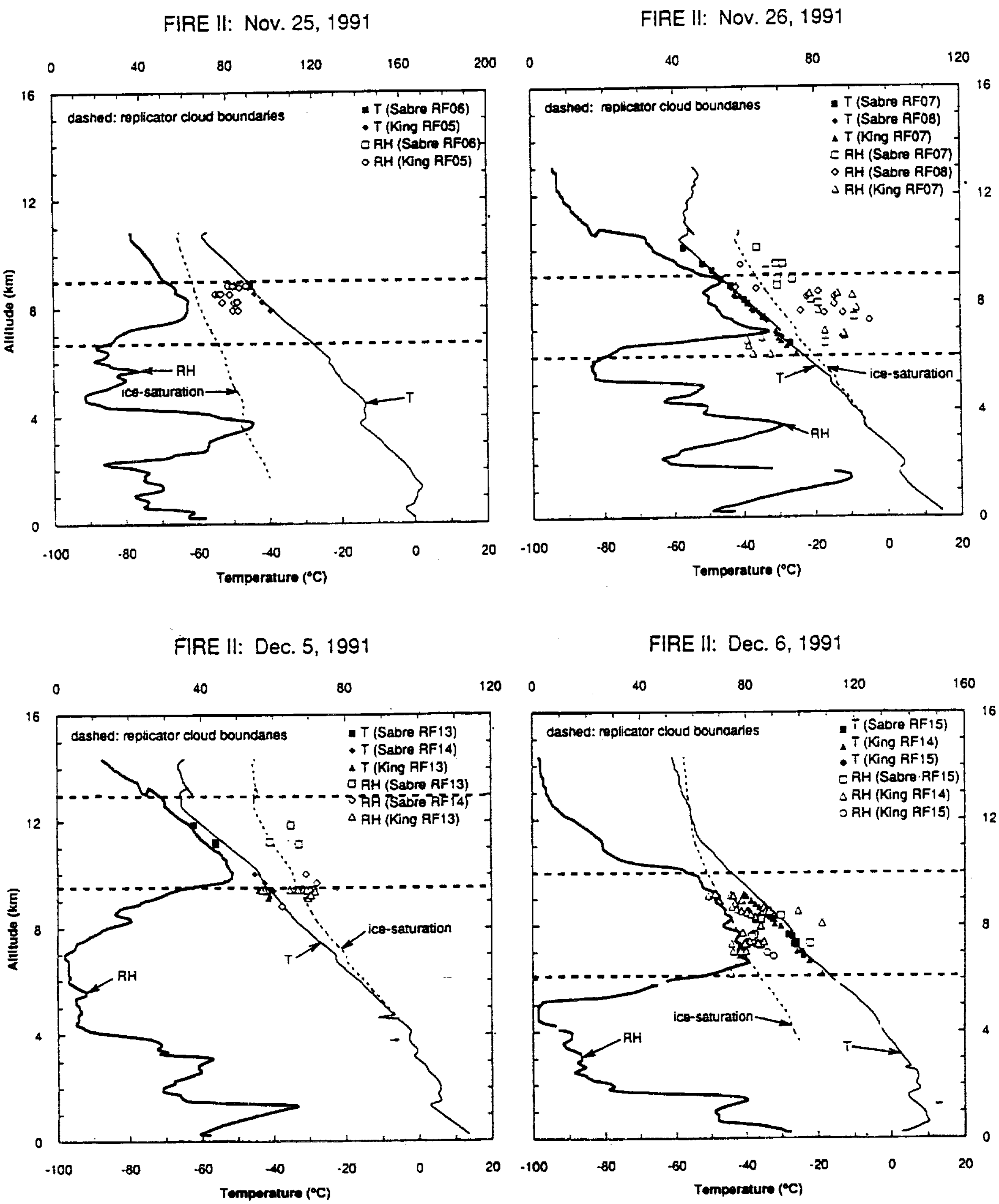

Fig. 1. Rawinsonde and penetration–averaged aircraft measurements of temperature (lower abscissa) and relative humidity (upper abscissa), on the case study days Darkened symbols show temperature measurements, and open symbols show relative humidity measurements.

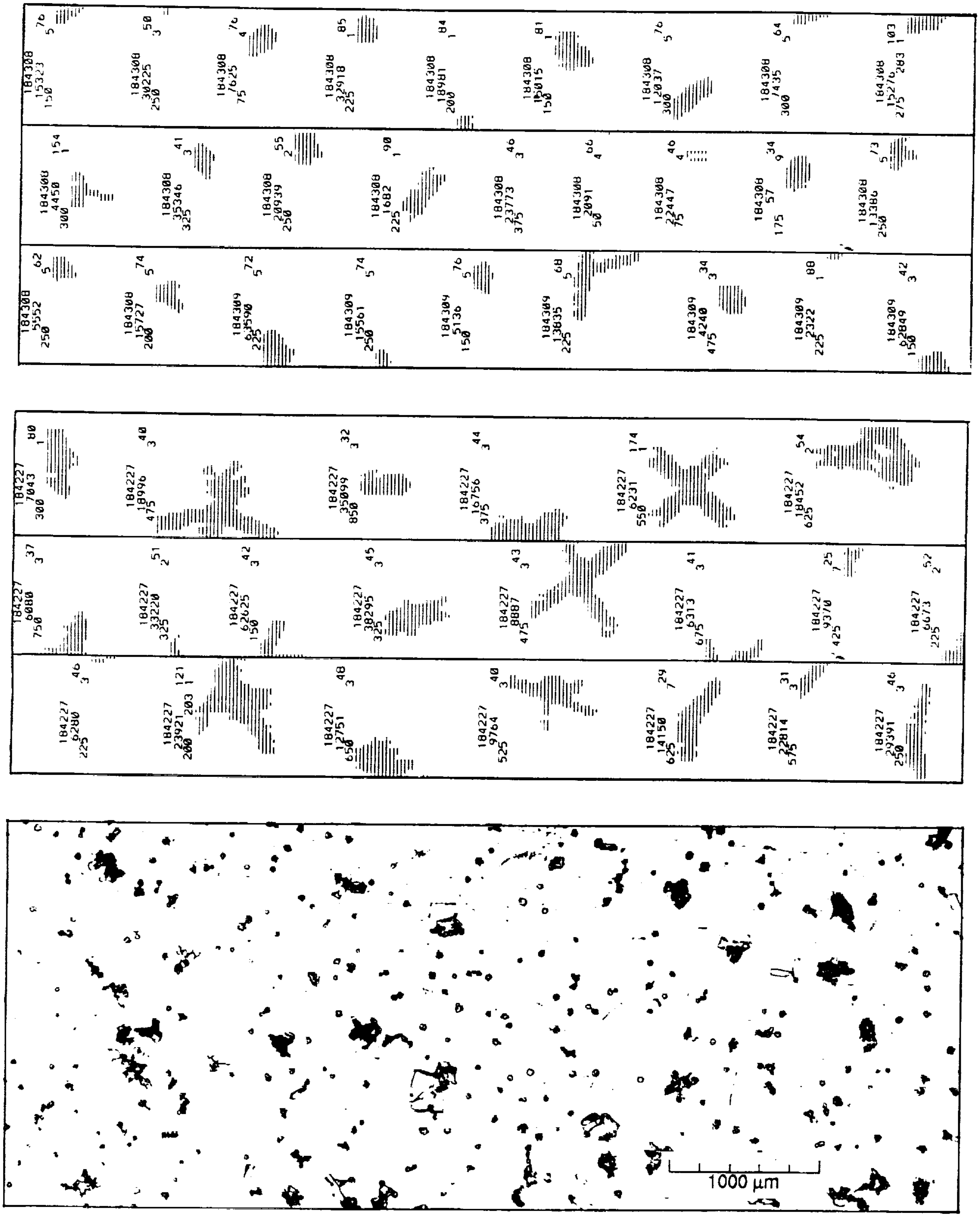

Fig. 2. King Air 2D–C measurements (upper two panels) and ice crystal replicator measurements (lower panel) on 26 November 1991.