Abstract

NASA has an ongoing activity to develop remote sensing technologies for the detection and measurement of icing conditions aloft. As part of that effort NASA has teamed with NCAR to develop software that fuses data from multiple instruments into a single detected icing condition product. The multiple instrument approach, which is the current emphasis of this activity, utilizes an X-band vertical staring radar, a microwave radiometer that measures twelve frequencies between 22 and 59 GHz, and a ceilometer. The radar data determine cloud boundaries, the radiometer determines the sub-freezing temperature heights and total liquid water content, and the ceilometer refines the lower cloud boundary. Data is post-processed with a LabVIEW program with a resultant supercooled LWC profile and aircraft hazard identification.

Ground-based remotely sensed measurements and in-situ measurements from Convair and Twin Otter research aircraft were gathered during the international 2003-2004 Alliance Icing Research Study (AIRS II). Comparisons between the remote sensing system’s fused icing product and the aircraft measurements are reviewed here. While there are areas where improvement can be made, the cases examined indicate that the fused sensor remote sensing technique appears to be a valid approach.

Results

Remote sensor data was compared to aircraft data. The remote sensor data was analyzed at both the beginning and ending time of each flight maneuver. For each comparison case, the remote sensor data and flight data was broken down into 100 m altitude increments. In each increment the data was analyzed for agreement (both positive and negative), for a remote sensor false alarm, or for a remote sensor missed detection. For all cases flight data was assumed to be true. Due to the nature of flight data, it may be desired in the future to refine the examination of flight defined icing.

2. National Center for Atmospheric Research, Boulder, CO
3. Meteorological Service of Canada, Toronto, ON, Canada

Conclusions

Ground remote sensor and aircraft in-situ data from the AIRS II field project were analyzed to quantitatively assess the accuracy of different remote sensing icing detection algorithms. In general, agreement with in-situ data for the techniques examined appears promising. Detection skill is evident, but there is still plenty of room for algorithm improvement. The data examined identified several issues that will need to be addressed in the future. 1.) Range of comparison strongly influences quantitative agreement statistics, full range comparison is desirable for case-to-case comparisons, but smaller range comparisons can be more helpful in pointing out agreement problems. 2.) Variability of conditions during aircraft maneuvers can have an effect on the agreement assessment, and will need to be addressed for determining how to relate changing conditions to users. 3.) Flight “truth” data must be examined carefully to determine the boundaries of icing conditions.