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Remote Sensing of Supercooled Cloud Layers in Cold Climate Using Ground Based Integrated Sensors System and Comparison with Pilot Reports and model forecasts

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In-flight aircraft icing is one of the major weather hazards to aviation . It occurs when an aircraft passes through a cloud layer containing supercooled drops (SD). The SD in contact with the airframe freezes on the surface which degrades the performance of the aircraft.. Prediction of in-flight icing requires accurate prediction of SD sizes, liquid water content (LWC), and temperature. The current numerical weather predicting (NWP) models are not capable of making accurate prediction of SD sizes and associated LWC. Aircraft icing environment is normally studied by flying research aircraft, which is quite expensive. Thus, developing a ground based remote sensing system for detection of supercooled liquid clouds and characterization of their impact on severity of aircraft icing one of the important tasks for improving the NWPs based predictions and validations. In this respect, Environment and Climate Change Canada (ECCC) in cooperation with the Department of National Defense (DND) installed a number of specialized ground based remote sensing platforms and present weather sensors at Cold Lake, Alberta that includes a multi-channel microwave radiometer (MWR), K-band Micro Rain radar (MRR), Ceilometer, Parsivel distrometer and Vaisala PWD22 present weather sensor.

In this study, a number of pilot reports confirming icing events and freezing precipitation that occurred at Cold Lake during the 2014-2016 winter periods and associated observation data for the same period are examined. The icing events are also examined using aircraft icing intensity estimated using ice accumulation model which is based on a cylindrical shape approximation of airfoil and the Canadian High Resolution Regional Deterministic Prediction System (HRDPS) model predicted LWC, median volume diameter and temperature. The results related to vertical atmospheric profiling conditions, surface observations, and the Canadian High Resolution Regional Deterministic Prediction System (HRDPS) model predictions are given. Preliminary results suggest that remote sensing and present weather sensors based observations of cloud SD regions can be used to describe micro and macro physical characteristics of the icing conditions. The model based icing intensity prediction reasonably agreed with the PIREPs and MWR observations.