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Observations of precipitation and ocean surface from dual-frequency airborne precipitation radar (APR-2)

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Following the successful Precipitation Radar (PR) of the Tropical Rainfall Measuring Mission, a new airborne, 14/35 GHz rain profiling radar, known as Airborne Precipitation Radar – 2 (APR-2), has been developed as a prototype for an advanced, dual-frequency spaceborne radar for a future spaceborne precipitation measurement mission such as the Global Precipitation Mission (GPM). In GPM, a constellation of "drone" satellites will guarantee short revisit times ($<$ 6 hrs) while a main satellite carrying also a 14 and 35 GHz radar will provide high quality measurements necessary to improve the overall accuracy of retrievals obtained from the "drone" satellite measurements.

APR-2 is capable of making simultaneous measurements of rainfall parameters, including co-pol and cross-pol rain reflectivities and vertical Doppler velocities, at 14 and 35 GHz. Furthermore, it also features several advanced technologies for performance improvement, including real-time data processing, low-sidelobe dual-frequency pulse compression, and dual-frequency scanning antenna.

Since August 2001, APR-2 has been deployed on the NASA P3 and DC8 aircrafts in four experiments including CAMEX-4 and the Wakasa Bay Experiment. Raw radar data are first processed to obtain reflectivity, LDR (linear depolarization ratio), and Doppler velocity measurements. The dataset is then processed iteratively to accurately estimate the true aircraft navigation parameters and to classify the surface return. These intermediate products are then used to refine reflectivity and LDR calibrations (by analyzing clear air ocean surface returns), and to correct Doppler measurements

for the aircraft motion. Finally, the melting layer of precipitation is detected and its boundaries and characteristics are identified at the APR-2 range resolution of 30m. The resulting 3D dataset is used for validation of other airborne and spaceborne instruments, development of multiparametric rain/snow retrieval algorithms and melting layer characterization and statistics. In this paper we address the unique information that the APR-2 dataset provides in terms of simultaneous observation of the sea surface at 14 and 35 GHz by a cross-track scanning radar (necessary for any Surface Reference Technique used for GPM), and we analyze the statistics of the dual-frequency Path Integrated Attenuation expected from GPM measurements.

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