Instrument Concept of NEXRAD In Space (NIS) – A Geostationary Radar for Hurricane Studies

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The current Geostationary Operational Environmental Satellites (GOES) are equipped to make cloud top measurements only. In contrast, a millimeter-wave radar allows 3-dimensional measurements of precipitation associated with hurricanes and other convective systems. It will also provide important inputs for numerical weather prediction models for improving the accuracy of weather nowcasting and forecasting. The continuous advances in spaceborne radar technologies have made the implementation of such a geostationary radar a real possibility in a foreseeable future. Through the support of NASA's Earth Science Instrument Incubator Program (IIP), we have recently developed a conceptual design, and identified the critical technologies needed, for a 35-GHz Doppler radar for detailed monitoring of hurricanes, cyclones, and severe storms from a geostationary orbit. The acquired measurements would provide continuous, 3-dimensional information on the life cycle of hurricane rainfalls and their dynamics. Since this radar approach is analogous to putting a NEXRAD system in orbit, we refer to this notional instrument as "NEXRAD in Space (NIS)".

In this paper, several innovative radar concepts and breakthrough technologies associated with the realization of the NIS will be addressed. They include:

- A large deployable spherical antenna reflector instead of the conventional parabolic reflectors, allowing large angular scan without performance degradation;
- Transmit and receive antenna feeds that perform spiral scans over a excursion of 4° from bore-sight, providing one radar image per hour with equivalent circular surface diameter of 5300 km;
- A real-time pulse compression technique for 300-m vertical resolution, without sacrificing detection sensitivity or the use of high peak-power transmitter;
- An on-board data processing capability for the generation of 3-dimensional rainfall reflectivity and Doppler observations once per hour.

The research described in this paper was carried out by the Jet Propulsion Laboratory, California Institute of Technology, under contract with the National Aeronautics and Space Administration.

(Suitable in topic area F09 and F10)