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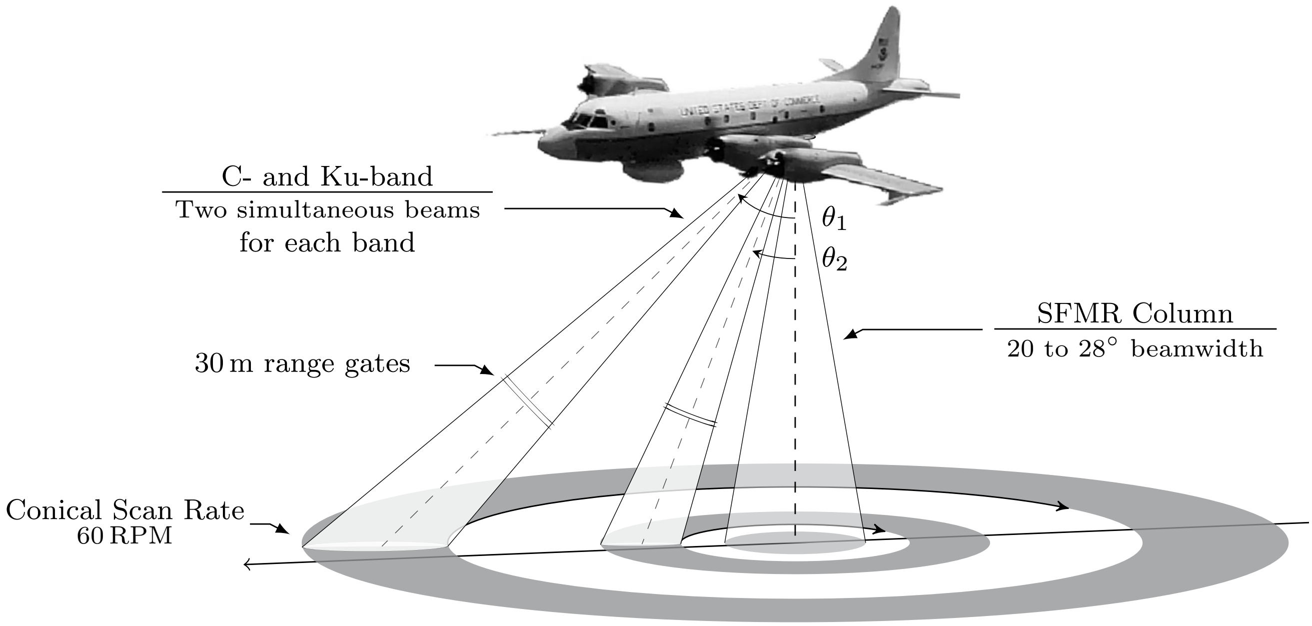
Coherent Turbulence in Hurricane Rita (2005) During an Eyewall Replacement Cycle

The destructive power of hurricanes is unlike anything else on Earth, with the proven capability to significantly damage the U.S. economy, devastate regions, and kill thousands of people even in the modern era. The boundary layer of a hurricane (surface to ~1-km height) is of prime importance for vulnerable coastal communities and for making accurate forecasts of storm intensity that can help mitigate the loss to life and property. Measurements of this intense and dangerous layer are difficult to make and have relied heavily on instruments dropped from aircraft (dropsondes). While valuable sources of wind information, the Lagrangian nature of the dropsonde (not a true vertical profile) with its coarse horizontal resolution significantly hinders the characterization of intense winds in hurricanes and limits our understanding of the storm physics.

New processing and analysis of data from the Imaging Wind and Rain Airborne Profiler (IWRAP) in intense Hurricane Rita (2005) is able to provide the nearly full structure of the turbulent boundary layer at very high resolution, filling a crucial measurement gap. The IWRAP is a downward-pointing, conically-scanning, dual-frequency (C- and Ku-band), dual-polarization, dual-beam airborne radar that measures surface backscatter and volume reflectivity/Doppler velocity from precipitation at 30-m range resolution. The IWRAP scans at 60 revolutions per minute, allowing wind retrievals with ~200-m horizontal and ~30-m vertical grid spacing. The radar has collected data in several high-impact storms from the NOAA WP-3D (P3) aircraft since 2003 and currently operates each hurricane season. Collocation of IWRAP with the Stepped Frequency Microwave Radiometer (SFMR), tail Doppler radar and dropsondes on the P3 aircraft allows a comprehensive characterization of the turbulent, convective, and vortex scales of motion.

The IWRAP measurements and calculations showed that Rita contained thin turbulent features



The Imaging Wind and Rain Airborne Profiler (IWRAP). **The measurement geometry of the downward-pointing, conically-scanning IWRAP Doppler radar and nadir-viewing SFMR instruments on the NOAA WP-3D aircraft. Angles θ_1 and θ_2 denote the outer (~40°) and inner (~30°) beam tilt angles, respectively. The IWRAP radar is well suited for studying the boundary layer and complements additional remote sensing and in situ measurements aboard the P3 aircraft for studying hurricanes.**