The Colorado State University ship-based C-band dual-polarized radar: Deployments and early science results

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A new, advanced radar has been developed at Colorado State University (CSU). SEA-POL is a stabilized C-band, polarimetric Doppler radar specifically designed to deploy on research ships within the U.S. fleet. SEA-POL is the first such weather radar developed in the U.S. Ship-based weather radars have a long history, dating back to GATE in 1974. The GATE radars measured only reflectivity, without antenna stabilization to correct for ship motion. After GATE, ship radars also provided Doppler measurements, in addition to antenna stabilization using information from an antenna-mounted inertial navigation unit (INU), also known as a motion reference unit (MRU). SEA-POL represents the next advancement in ship radars by adding dual-polarization technology, with full antenna stabilization. The polarimetric capability provides information about hydrometeor size, shape and phase. As a result, superior rain rate estimates are afforded by the dual-polarization technology, along with hydrometeor identification to provide microphysical information. Polarimetric variables also allow improved data quality and attenuation correction.

SEA-POL has made two successful deployments since its construction phase was completed in spring 2017. The first deployment was on the *R/V Roger Revelle*, which conducted the SPURS-2 (Salinity Processes in the Upper Ocean Regional Study) cruise to the eastern tropical Pacific in October-November 2017. SPURS-2 was a field project to investigate the fate of freshwater deposited on the ocean’s surface, and as such, SEA-POL was used to generate various types of rain maps to guide studies of freshwater “lenses” on the ocean’s surface. Oceanographers are keen to understand how fast these freshwater patches mix out by wind and upper ocean turbulence, as the less dense rainfall sitting atop the salty ocean inhibits mixing through increased stability. The second deployment of SEA-POL was on board the *R/V Thomas G. Thompson*, which conducted two 30-day cruises for the PISTON (Propagation of Intraseasonal Oscillations) project to the W. tropical Pacific Ocean. The atmospheric component of PISTON focused on studying the kinematics and microphysics of precipitation events related to disturbed and undisturbed phases of the Boreal Summer Intraseasonal Oscillation (BSISO). An added bonus to the PISTON observations was outer rainbands associated with typhoons. During SPURS-2, SEA-POL produced rain maps identifying the location of freshwater lenses on the ocean’s surface thereby providing context for oceanographic measurements of SST and salinity. For SPURS-2 and PISTON, dual-polarization measurements provided insights into the microphysics of convective and stratiform rainfall. Over 50% of the total rainfall was contributed by roughly 4% of the echo area, which contained small, intense convective cores depicted by combination of moderate differential reflectivity and large differential phase. SEA-POL will next deploy on the R/V Sally Ride for PISTON 2019, either to the South China Sea west of Luzon, or back to international waters of the W. tropical Pacific Ocean. In 2020, SEA-POL will be part of the PRECIPE2020 project, operating from Yonaguni Island just east of Taiwan.

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