

Quality Control of Sea Clutter and Constant Power Function Artifacts for Operational U.S. Navy Shipboard Radar Data Assimilation

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The Marine Meteorology Division of the U.S. Naval Research Laboratory (NRL) has developed and transitioned a 3DVAR reflectivity data assimilation (DA) system into operations at Fleet Numerical Meteorology and Oceanography Center (FNMOC), located in Monterey, California. The system assimilates hourly, volumetric, radar reflectivity data into the Coupled Ocean/Atmosphere Mesoscale Prediction System (COAMPS[®])¹ high-resolution NWP model within the ship-following COAMPS –On demand System (COAMPS-OS[®])¹. Both Next-Generation Radar (NEXRAD) land-based radar data and also U.S. Navy shipboard SPS-48/Hazardous Weather Detection and Display Capability (HWDDC) are assimilated depending on the data coverage provided to the COAMPS[®] nested grids. The SPS-48/HWDDC units are installed on eighteen U.S. Navy aircraft carriers and amphibious assault ships, and when underway on a mission, the available units automatically transmit compressed, radar data files to FNMOC near the top of the hour. Through previously reported NRL and FNMOC demonstrations, and more recent operationally testing at FNMOC, the COAMPS-OS[®] radar DA system's nowcasting products have demonstrated their ability to provide improved predictions of precipitation events out to at least 6 hour forecasts compared to 3DVAR conventional DA into COAMPS[®] alone. Shipboard SPS-48/HWDDC radar data and their assimilation into COAMPS-OS at FNMOC provide critical environmental awareness in the data sparse oceanic regions of the world that the Navy warfighter encounters.

The SPS-48 radar is a S-band, phased-array, azimuthally scanning, air-search radar that scans electronically in elevation and completes a volume scan in four seconds. The HWDDC combines the volume scans into motion-compensated, one-minute composites with limited clutter filtering applied. The SPS-48 beams are combined to yield full PPI scans at 22 different elevation angles ranging from 0.1° to 24°. The azimuthal resolution of the data is 1° and the range resolution is 1 km. The maximum range for reflectivity (radial velocity) data is 250 (81) km. The Doppler data are only produced at the lowest three elevation scans whereas reflectivity data are produced at all elevation scans; all these data are archived in Universal Format and compressed before dissemination to FNMOC. Owing to the limited HWDDC Doppler data both in range and elevation, and the single-polarization of the SPS-48 radar waveform, reflectivity data quality control is particularly challenging. New algorithms have been developed to handle sea clutter and constant power function artifacts, such as bullseyes and sun strobos. There are two algorithms for sea clutter; the first one deals with evaporation duct sea clutter, and the second one deals with the more widespread and distant sea clutter due to surface, surface-based, and elevated electromagnetic ducts resulting from trapped moist air under temperature inversions often encountered off the coasts of California and the Arabian Gulf region. An overview of the algorithms and examples of their applications to SPS-48/HWDDC data will be presented.

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