

Enhancing Coverage and Confidence of HF Radar Current and Wave Level-3 Products through Multi-Station Integration

Yakubos Samoria^{1*}, Li-Ching Lin², Hao-Yuan Cheng², Hsin Yu Yu³, and Hwa Chien¹

¹ *Graduate Institute of Hydrological and Oceanic Sciences, National Central University, Taoyuan, Taiwan, 320*

² *Advanced Research Center for Earth Sciences, National Central University, Taoyuan, Taiwan, 320*

³ *Central Weather Administration, Taipei, Taiwan, 100; Graduate Institute of Hydrological and Oceanic Sciences, National Central University, Taoyuan, Taiwan, 320*

** Corresponding author: yakubossamoria18@gmail.com*

Abstract

High-frequency radar (HFR) networks provide continuous observations of coastal surface currents and waves, but individual stations often have incomplete coverage, variable signal quality, and station-dependent errors. This study develops a multi-station framework to improve coverage, reliability, and continuity of HFR Level-3 current and wave products in northern Taiwan. For surface currents, quality-controlled radial velocities from multiple stations are combined through robust weighted reconstruction, followed by vector consistency checks and constrained spatial repair. The resulting fields are compared with CMEMS surface-current data using velocity components, speed, direction, and temporal variability. For waves, Level-2 significant wave height, mean wave period, and peak wave period are screened using second-order spectral quality information, station-specific masking, and physical limits, then integrated through station-balanced robust fusion. Remaining gaps are filled only when sufficient spatial or temporal support is available, while provenance and confidence flags identify direct, rejected, and repaired grid cells. Initial implementation indicates that complementary station coverage and observational redundancy increase usable coverage, reduce dependence on a single station, and support explicit confidence assessment. The wave application is presented as a transferable proof of concept, with independent validation planned as the next step.

Key words : HF radar, multi-station observation, surface current, ocean wave, quality control, robust fusion, data repair