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Multi-year assessment of ocean surface currents from Copernicus Sentinel-1 and HF radar in the German Bight

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Direct estimate of ocean surface motion sensed by the Doppler shift of the surface includes ocean surface current and a wind-wave induced artefact surface velocity (WASV). The Sentinel-1 (S1) C-band SAR mission includes direct ocean surface motion estimates as an operational Level-2 Ocean (OCN) Radial VeLocity (RVL) product. The existing operational RVL products suffer from significant uncorrected platform and instrument effects that presently prevent exploitation of the data. This paper proposes a simple method to calibrate and correct for these effects and evaluate the benefit of these corrections over 2.5 years S1A acquisition against ground truth measurements. A specific geometry for S1 has been chosen for S1-A over the HF radar (HFR) instrumented site in the German Bight. The 78 S1A snapshots end in 56 match-ups within 20 minutes of HFR measurements. HFR velocity fields were projected in the same radial direction as S1A. Land calibration corrects for constant snapshot biases of the operational products up to 2 m/s. Besides these constant biases there is persistent relative biases within snapshots between up to 0.4 m/s in addition to the TOPSAR uncorrected scalloping effect with an amplitude of 0.1 m/s. After calibration, corrected RVL are compared against HFR with various WASV correction. Applying WASV correction with a reduced 70% C-Dop model, gives the best results with a precision of 0.25 m/s and correlation in time of 0.9. This might be due to C-Dop amplitude in up/downwind being too strong for a coastal environment as encountered in the German Bight. Quadratic mean of all 78 S1A snapshots after all corrections applied exhibits coastal current jets in good agreement with bathymetry channels and is promising as a cheap way to infer local bathymetry channels.