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Antarctic Sea-Ice Concentration and Extent from SARAL/AltiKa Radiometer over the Recent Decade

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Abstract

This study presents monthly Antarctic sea-ice concentration (SIC) and sea-ice extent (SIE) derived from SARAL/AltiKa using the SARAL/AltiKa Sea Ice Algorithm (SSIA) applied to bi-frequency radiometer brightness temperatures at 37 and 23.8 GHz on a 25 km Polar Stereographic South grid. Study period is for April 2013–December 2024, and SIE is computed using the standard 15% concentration threshold with coastline buffering to mitigate land spillover. Processing includes monthly resampling of daily AltiKa data, use of an Antarctic land mask, and application of NOAA Climate Data Record (CDR) monthly fields as spurious-ice masks; Antarctic tie-points are tuned from the Arctic SSIA for optimal performance. Against independent references, Antarctic SIC shows high agreement across all months: correlation, R = 0.92 with NOAA CDR, NASA Bootstrap, and NASA Team; RMSE = 9.38%, 9.28%, and 12.48%; and mean bias error (MBE) = +0.55%, +0.52%, and –8.39%, respectively. Seasonal analysis indicates stronger winter performance (R ≈ 0.95–0.96; RMSE ≈ 5.9–11.7%) and larger summer scatter (R ≈ 0.88–0.89; RMSE ≈ 12.3–13.5%) consistent with marginal ice zone sensitivities. The Antarctic SIE series exhibits near-perfect coherence with NOAA CDR, NASA Bootstrap, and NASA Team (R = 0.99 for all), with RMSE of 0.11, 0.12, and 0.28 million km^2 and MBE of –0.03, –0.08, and +0.25 million km^2, respectively. Across all datasets, SIE declined by approximately 0.29 million km^2 per year over the past decade. Together, these SIC and SIE products provide a coherent, validated Antarctic sea-ice record suitable for climatology, anomaly tracking, and model evaluation.

Keywords: Antarctic sea ice, Sea-ice concentration, Sea-ice extent, SARAL/AltiKa, Radiometer, Cryosphere

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