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Enhancing Passive Microwave Satellite Retrievals Through Spatial Multi-Channel Sensitivities

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Modern passive microwave retrievals of ocean and sea ice properties—including sea ice concentration, snow depth on sea ice, sea ice thickness, and sea surface temperature—frequently rely on data collected across multiple frequency channels. Traditionally, these channels are spatially homogenized by resampling to match the lowest-resolution channel, ensuring they convey comparable spatial information. However, this practice often reduces spatial resolution of some retrieved variables by up to a factor of 10, disregarding crucial high-resolution data. In this study, we integrate multi-resolution channels within a spatially aware inversion framework that incorporates exact footprint geometries. This approach enables the simultaneous retrieval of multiple geophysical parameters while addressing the primary technical hurdles associated with the traditional inversion methodology.