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**Title:** Towards SSS Fiduciary Reference Measurements: An Overview of Sub-Footprint Variability, Stratification, and Calibration-Validation Methods

**Abstract:** The concept of Fiduciary Reference Measurements (FRM) has emerged in recent years to describe in-situ measurements that closely resemble what is being sensed by satellite sensors. As satellite remote sensing of sea surface salinity (SSS) is still a comparatively young discipline compared to measurements such as sea surface temperature or ocean color, the last decade has provided rapid advances in our understanding of the variability of salinity within the footprint of a satellite sensor. Additionally, salinity stratification near the air-sea interface has been the subject of four NASA field campaigns, and measurements of salinity in the top 5 meters have become much more common than they were before the advent of SSS remote sensing.

Here, we look back at what we have learned over the last 15 years of satellite SSS remote sensing, particularly our understanding of the horizontal variance of salinity and its generation through patchy precipitation patterns, riverine inflow, and ice melt in the ocean. In this time, we have measured both sub-footprint variability using instruments such as the salinity snake, the salinity surface profiler, wave gliders, and similar platforms, and have increasingly deployed floats and buoys that are capable of measuring salinity much closer to the surface than the original generation of Argo floats. Through data from the SPURS-1, SPURS-2, and SASSIE field campaigns, we show the relationship between observation depth and horizontal salinity variability, with variance increasing closer to the surface.

We compare methods of utilizing these measurements to improve calibration-validation methods and show that traditional match-up methods typically overestimate SSS retrieval errors, while other statistical methods such as triple (or quadruple) point collocation analyses can provide better estimates. We also provide an outlook of future FRMs, particularly during the FRESH field campaign.

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