A merged CryoSat-2 Sentinel-3 freeboard product, its sensitivity to weather events, and what it can tell us about Ku-band radar penetration

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The co-existence of satellite missions provides a unique opportunity for making novel observations not possible with a single satellite. Here we process data from CryoSat-2, Sentinel-3A and Sentinel-3B satellites for the 2018-19 and 2019-20 winters. Basin-average radar freeboards from Sentinel-3A/B are shown to agree with CryoSat-2 to within 3mm. A merged product is developed combining data from the CryoSat-2 and Sentinel 3A/B missions, permitting basin-wide observations of Arctic sea-level anomaly and radar freeboard at synoptic time-scales. A comparison of 9-day radar freeboard variability with snowfall data from ERA5 reanalysis reveals a strong positive correlation over first-year ice, a result which appears to contradict traditional assumptions of Ku-band radar penetration of snow. A detailed spatial analysis including a comparison of freeboard before and after the passage of storms reveals for the first time the ability to detect synoptic scale weather events in the satellite radar freeboard record.