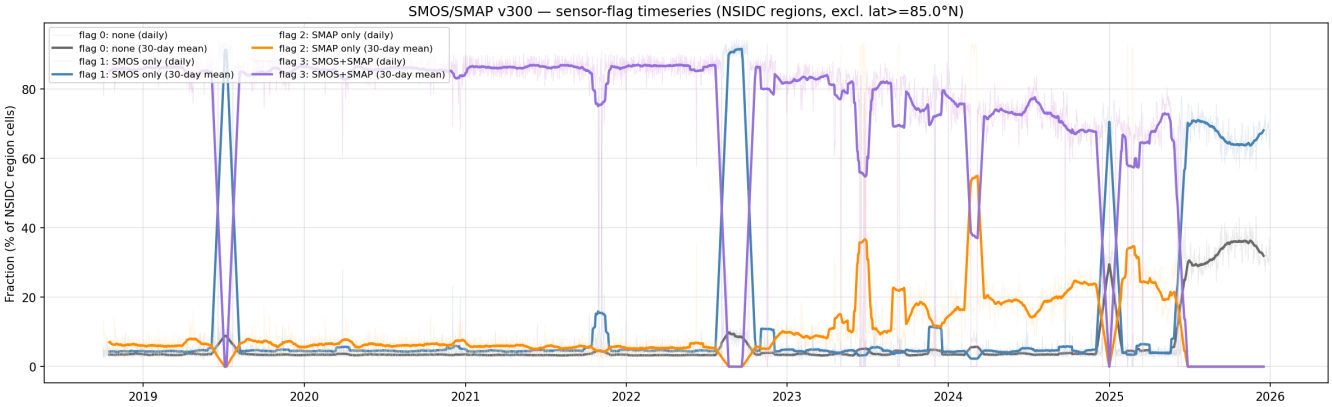

Figure S1. SMOS/SMAP sensor availability over the Bremen v300 daily archive (October 2018–December 2025). Analysis domain: NSIDC-0780 regions 1–18 on the Bremen 12.5 km grid, excluding the pole hole poleward of 85°N (∼148,200 cells). Daily fractions of cells in each `flags` state (0: none; 1: SMOS-only; 2: SMAP-only; 3: both); bold curves are 30-day running means. Dual-sensor (`flag==3`) coverage dominates when both instruments are available; SMAP-only fractions peak in late winter–spring. Episodic dips in SMAP availability (e.g. late 2022–early 2023 and December 2024–January 2025) produce transient SMOS-only or elevated no-data periods that reflect upstream processing outages rather than RFI.

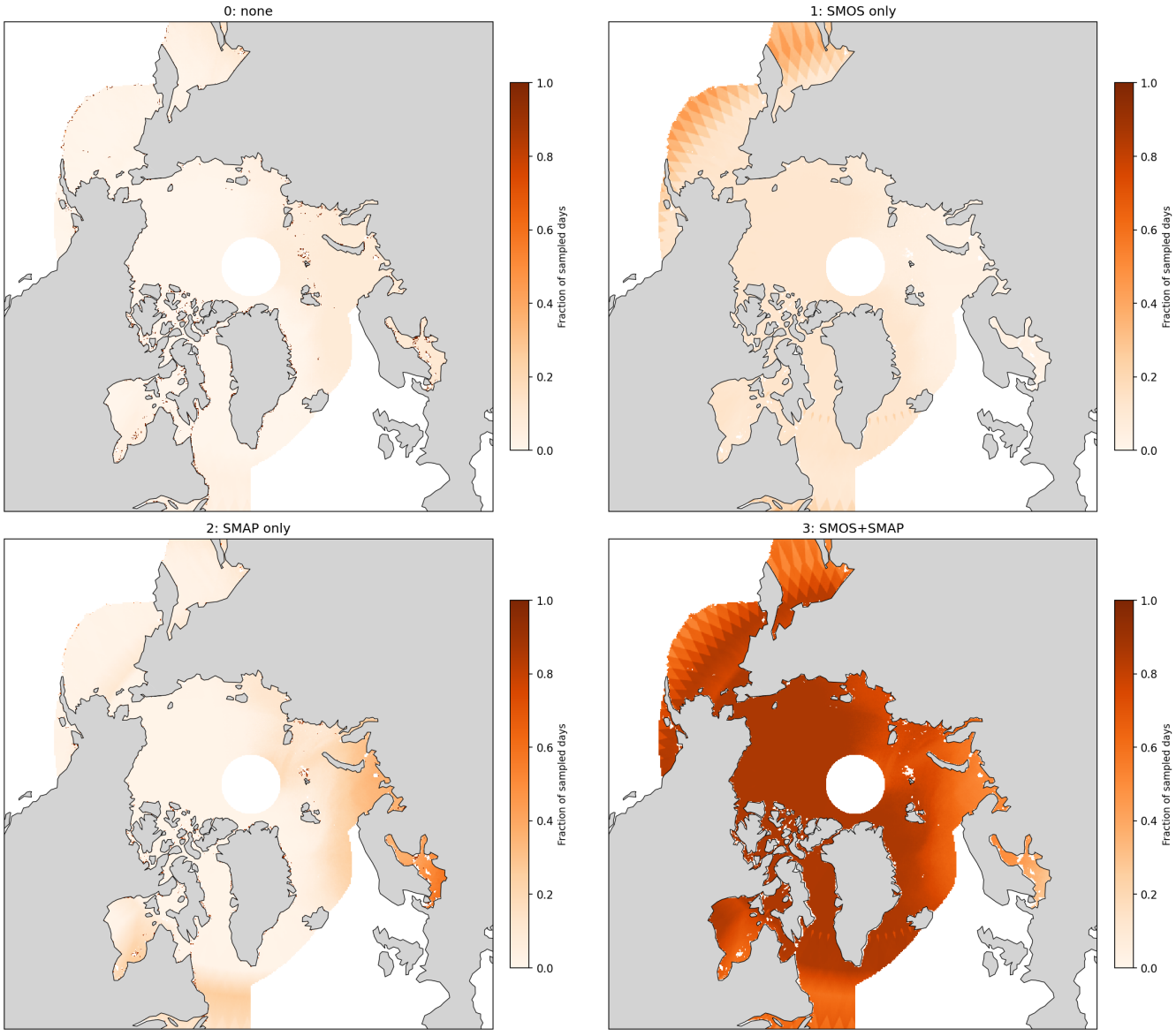

Figure S2. Climatological frequency of each U Bremen SMOS/SMAP data quality `flag` state (same domain as Fig. SS1), from a weekly subsample of daily v300 files (October 2018–December 2025). Each panel shows the per-pixel fraction of sampled days in that flag state.

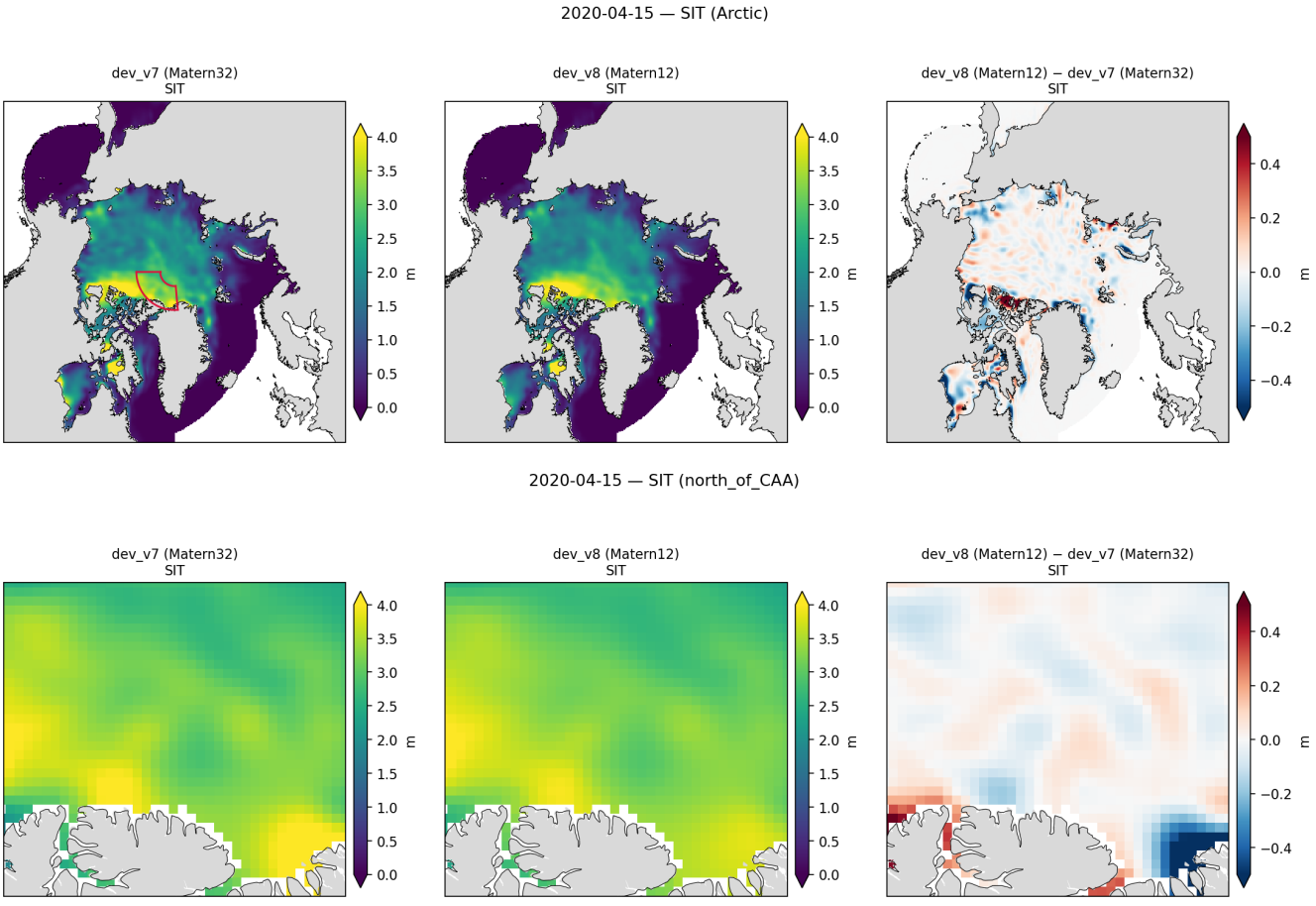

Figure S3. Kernel sensitivity test for 15 April 2020: gridded sea ice thickness from the production Matérn-3/2 configuration, the Matérn-1/2 test run, and their difference (Matérn-1/2 − Matérn-3/2). Top row: pan-Arctic; bottom row: zoom north of the Canadian Arctic Archipelago (82–87°N, 135–40°W)..

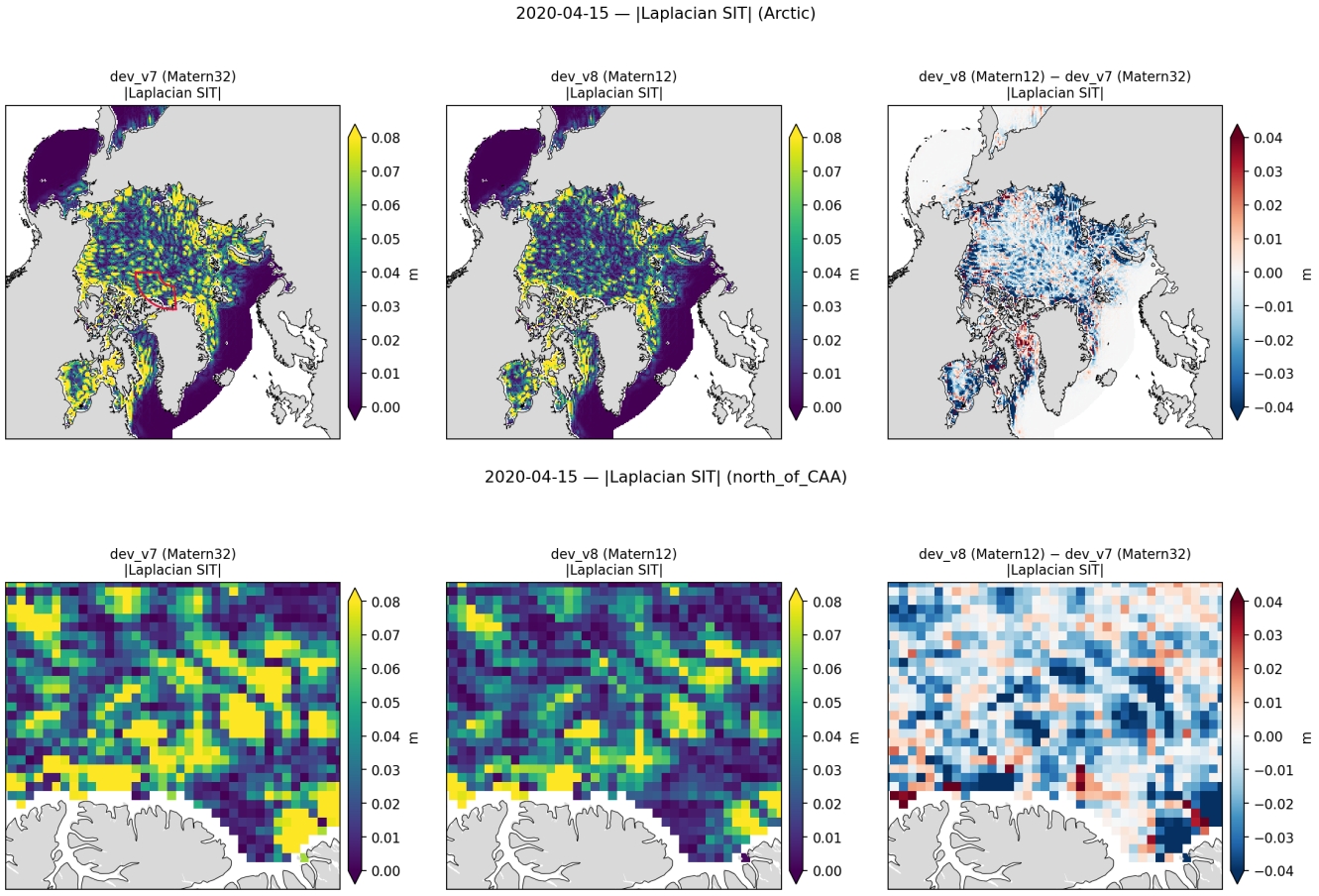

Figure S4. Five-point $|\nabla^2 \mathrm{SIT}|$ roughness diagnostic for the same kernel comparison and date as Fig. SS3. Top row: pan-Arctic; bottom row: north-of-CAA zoom in plot.

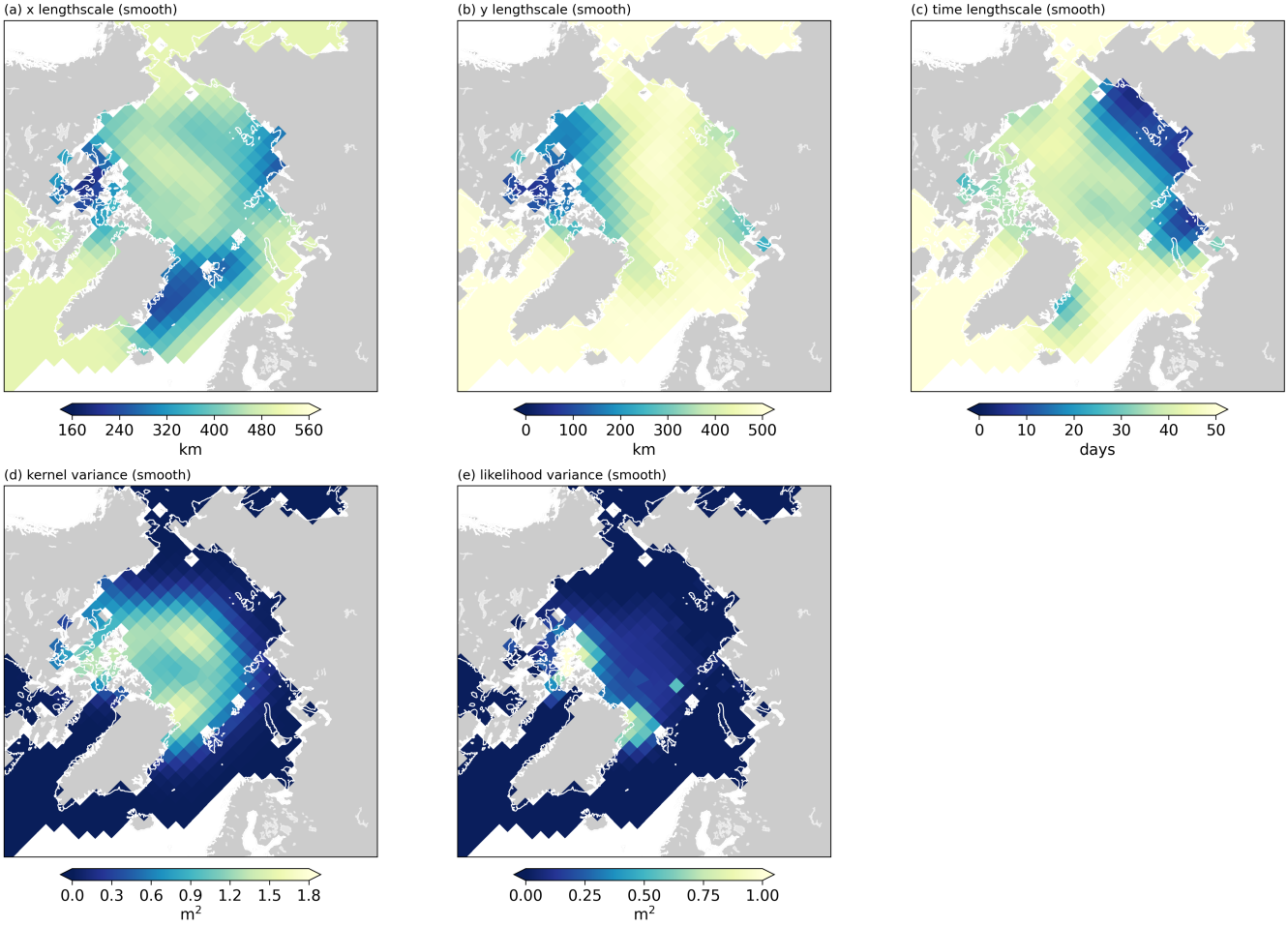

Figure S5. Spatially smoothed GP kernel hyperparameters for 15 October 2019 ($\pm$30-day window): ℓ_x, ℓ_y; ℓ_t; σ_f^2; σ_n^2. Spatial smoothing lengthscale ℓ_{smooth}.

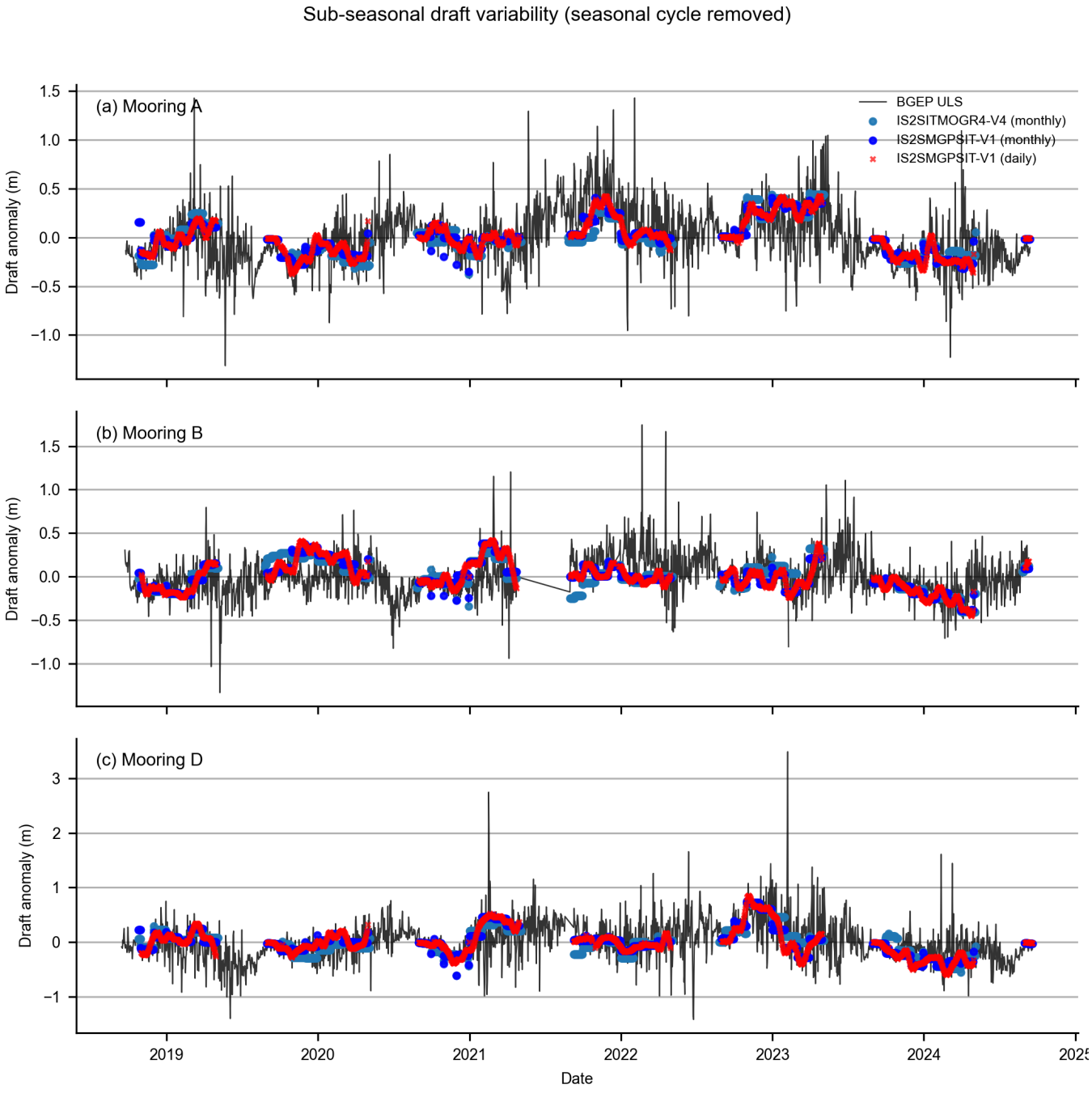

Figure S6. BGEP ULS ice-draft anomalies at moorings (a) A, (b) B, and (c) D (2018–mid-2024), after removing each mooring's multi-season day-of-year climatology. Black: daily ULS; blue crosses: IS2SITMOGR4-V4 monthly; dark blue circles: IS2SMGPSIT-V1 monthly-resampled; red crosses: IS2SMGPSIT-V1 daily.

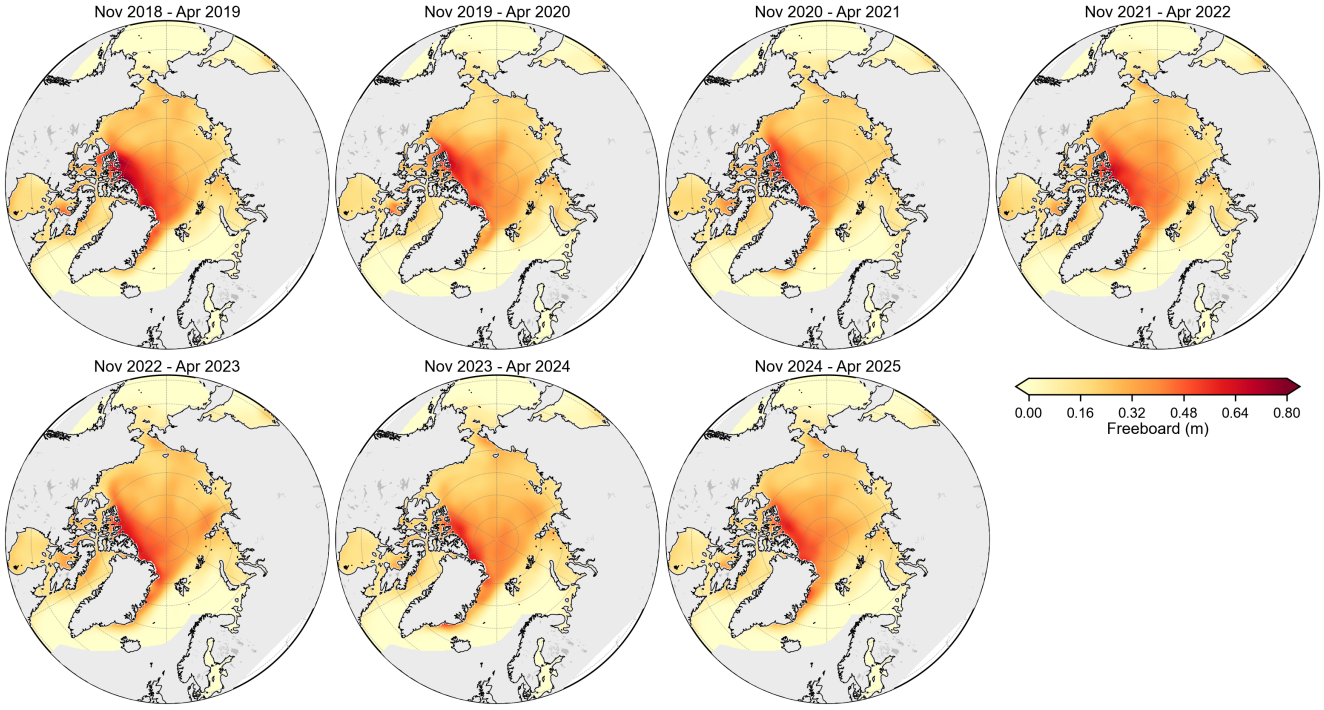

Figure S7. IS2SMGPSIT-V1 November–April winter-mean total freeboard (m) for winters 2018–2019 through 2024–2025. Winter means are computed from monthly-resampled daily fields, as in the main-text thickness maps.

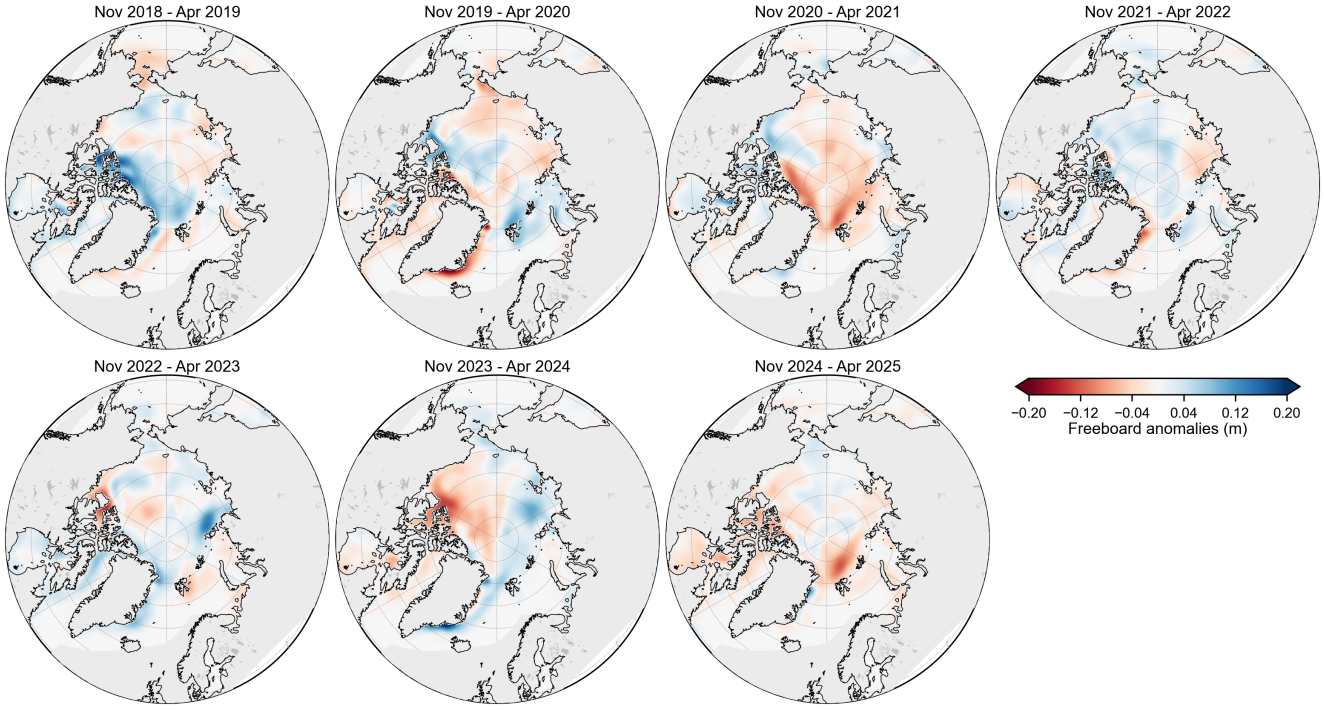

Figure S8. IS2SMGPSIT-V1 November–April winter-mean total freeboard anomalies (m) relative to the seven-winter mean (2018–2019 through 2024–2025).

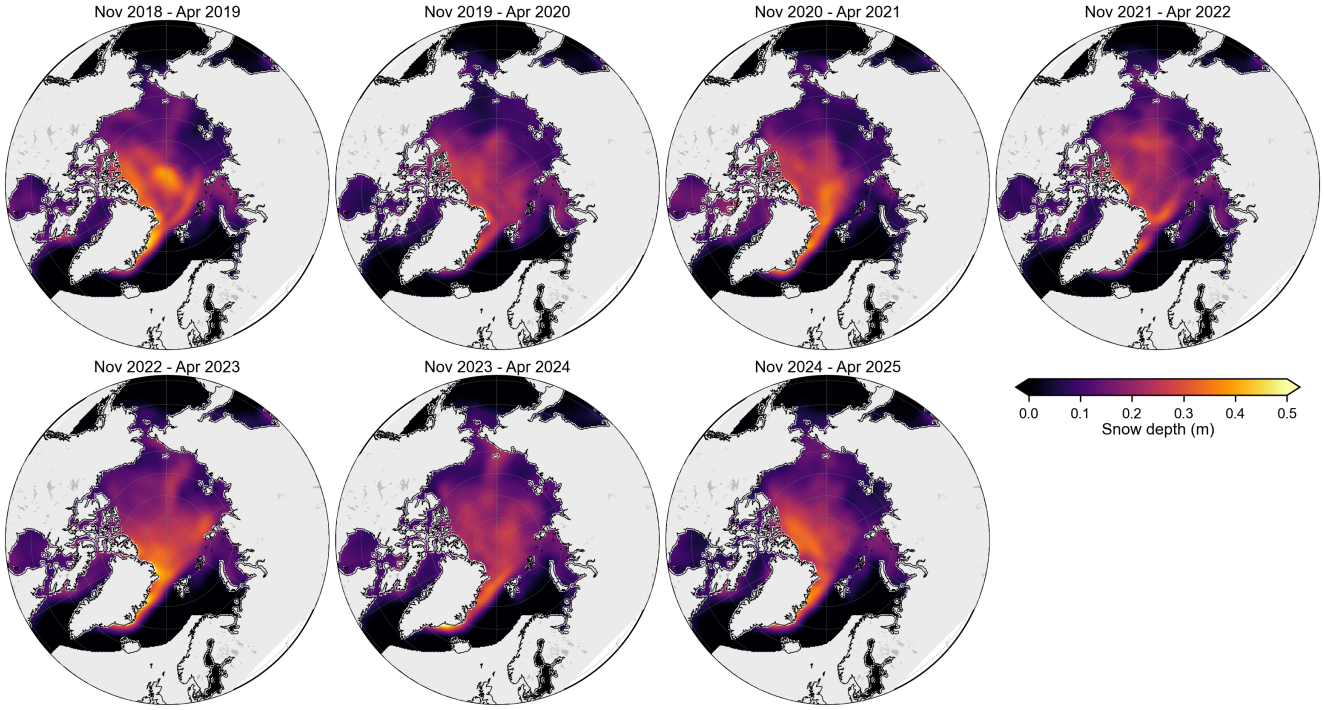

Figure S9. IS2SMGPSIT-V1 November–April winter-mean snow depth (m) for winters 2018–2019 through 2024–2025.

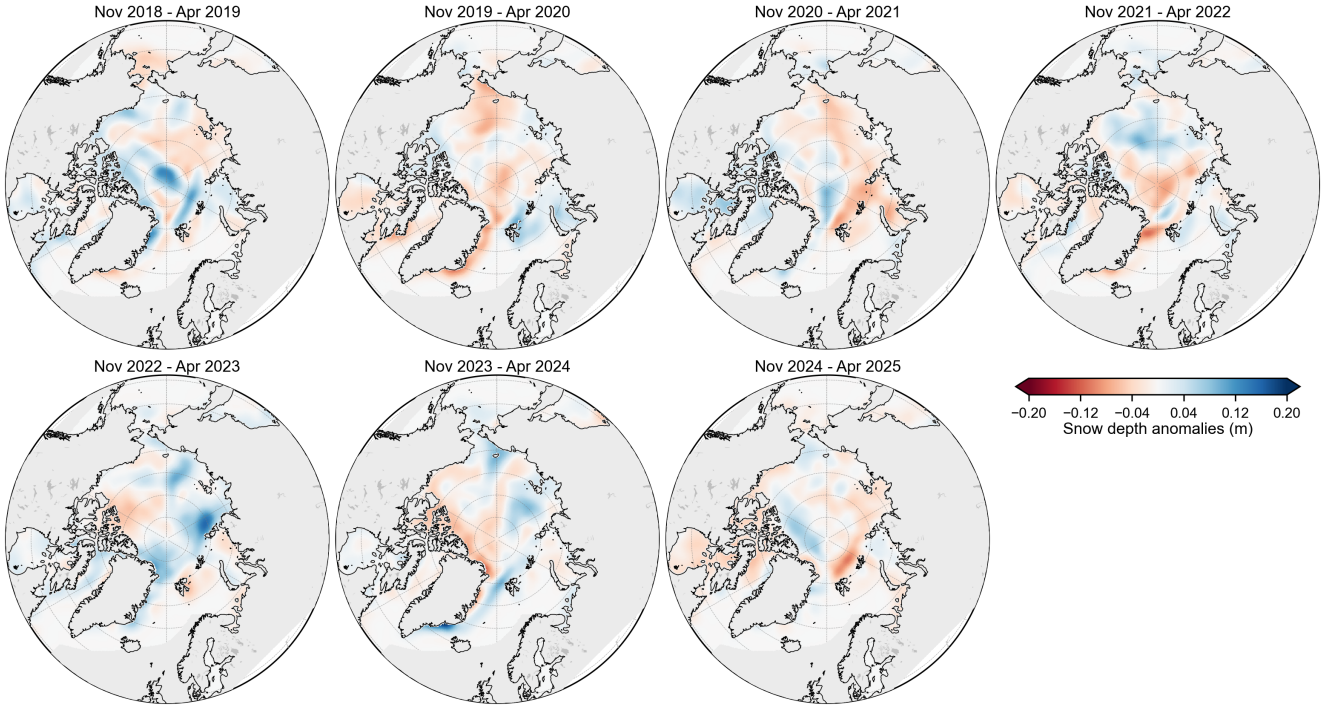

Figure S10. IS2SMGPSIT-V1 November–April winter-mean snow depth anomalies (m) relative to the seven-winter mean (2018–2019 through 2024–2025).

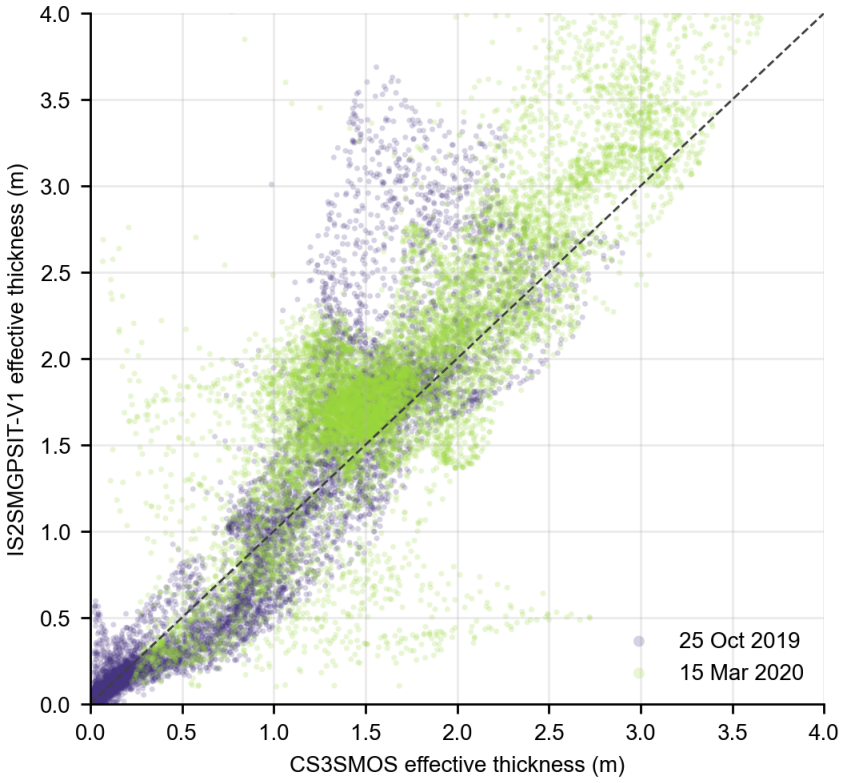

Figure S11. Common-footprint effective grid-cell thickness over the inner Arctic Ocean (IAO) domain for centred seven-day analyses on 25 October 2019 and 15 March 2020. CS3SMOS ice-only thickness is multiplied by the supplied sea ice concentration to obtain effective thickness; IS2SMGPSIT-V1 is already an effective (area-mean) field, so no concentration scaling is applied. CS3SMOS has been regridded to the 25 km IS2SMGPSIT-V1 grid; the dashed line shows 1:1.