Supplement Material

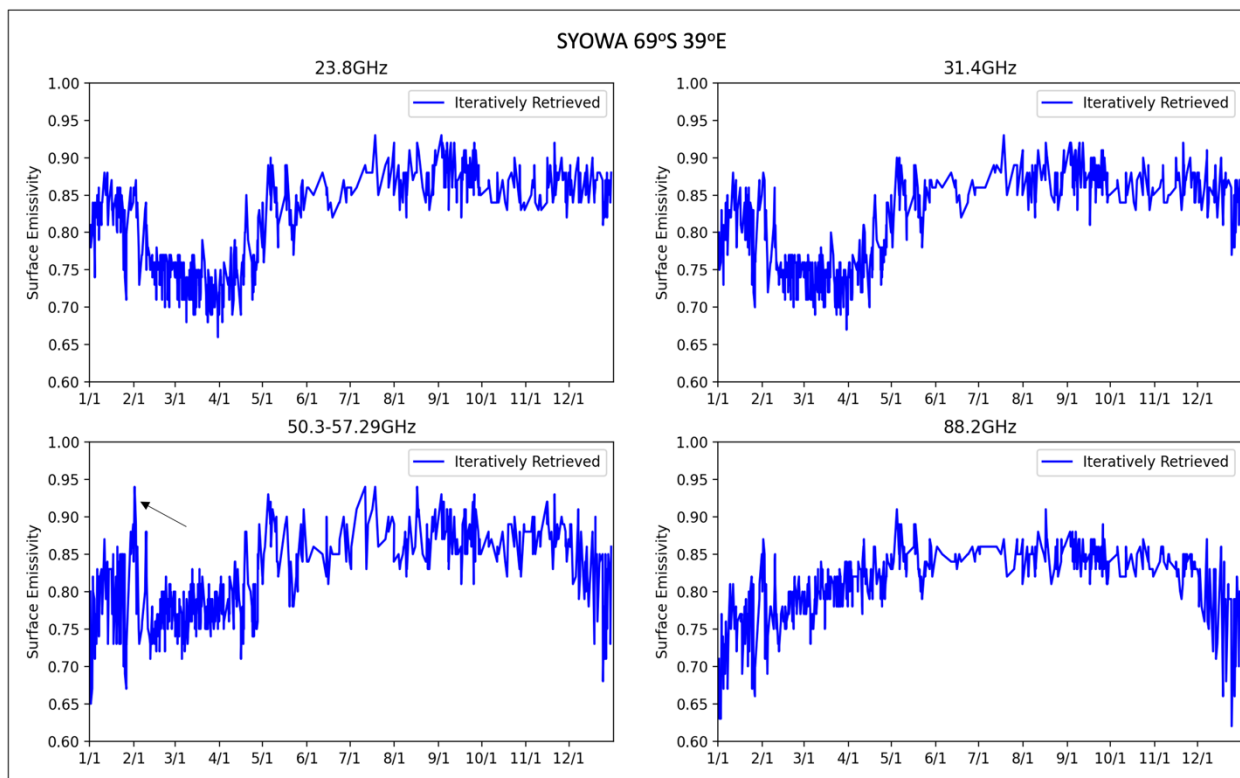
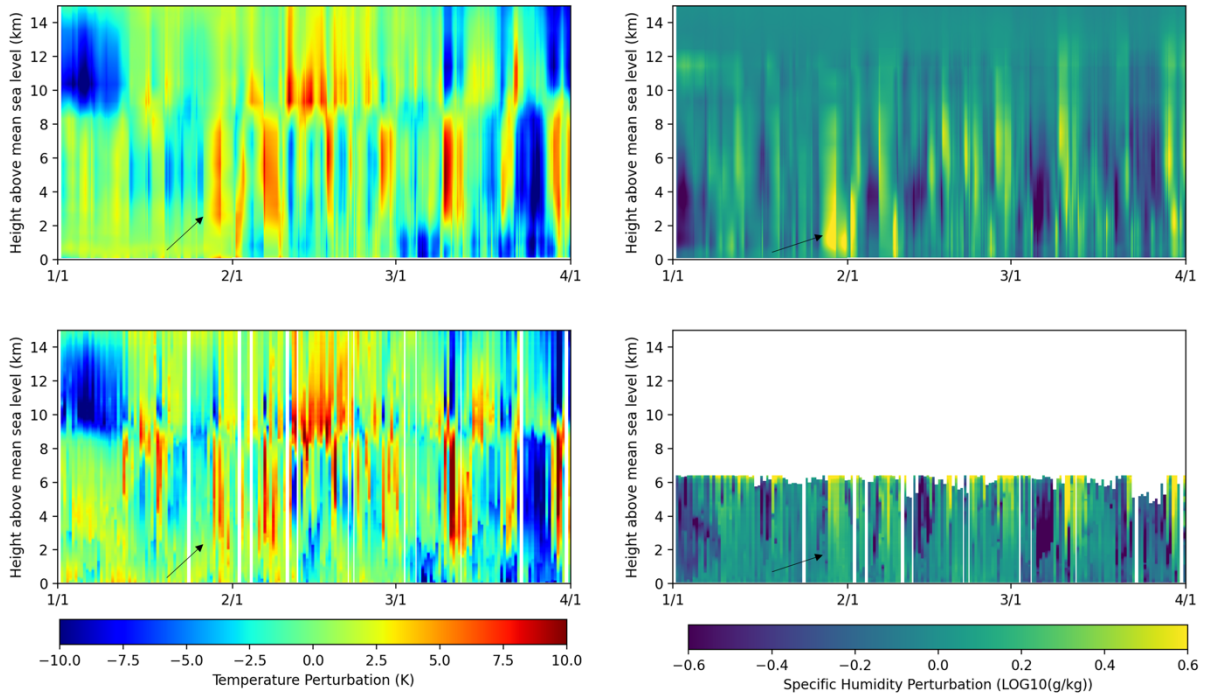
SYOWA Radiosonde Station

5   **Figure S1a.** Syowa Radiosonde Station (69ºS, 39ºE). Surface emissivity from January 2016 to the end of 2016 at three window frequencies (23.8, 31.4 and 88.2 GHz) and the oxygen absorption band (50 – 58GHz). The blue curve represents values from our iterative algorithm. The X-axis shows the month of the year, from 2016/1/1 to 2016/12/31. The melting events occurred in mid-January as pointer out by black arrows.

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Figure S1b. Syowa Radiosonde Station (69ºS, 39ºE). Temperature and specific humidity perturbations during January 2016 to March 2016. The deviations from average values are displayed for that period. The top row presents results from our iterative algorithm, while the bottom row shows data from radiosonde measurements. The X-axis shows the month of the year, from 2016/1/1 to 2016/3/31.

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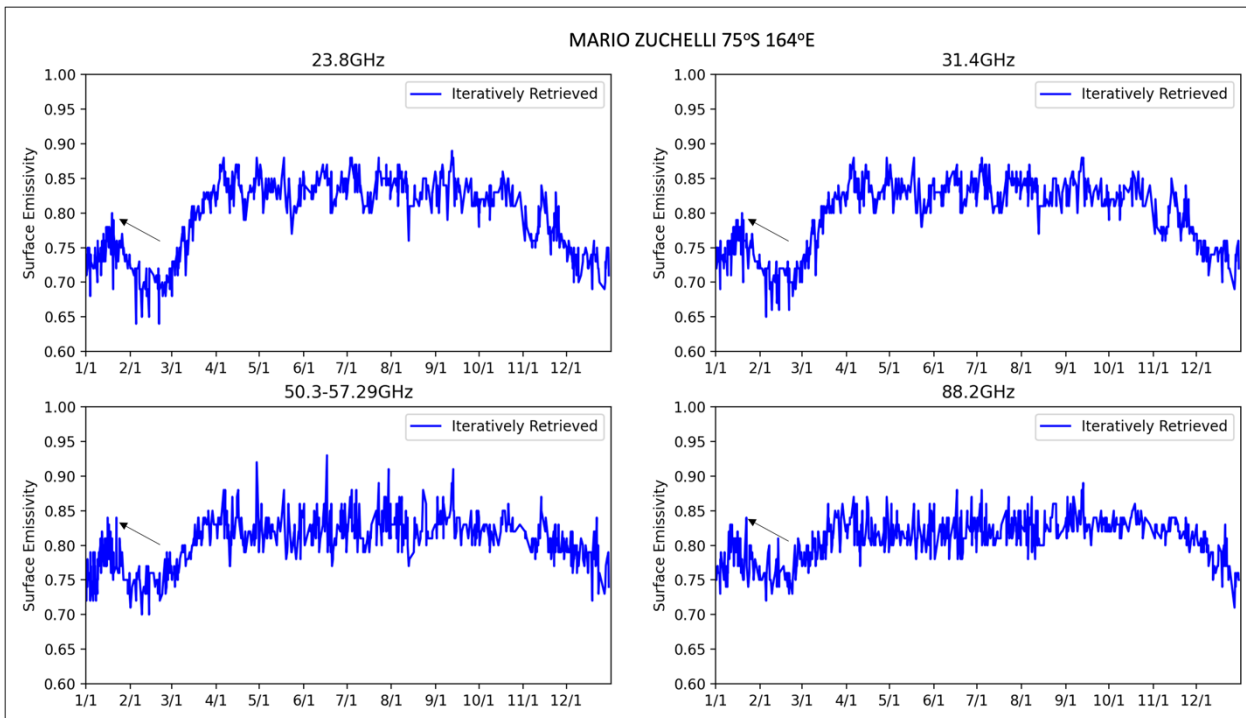
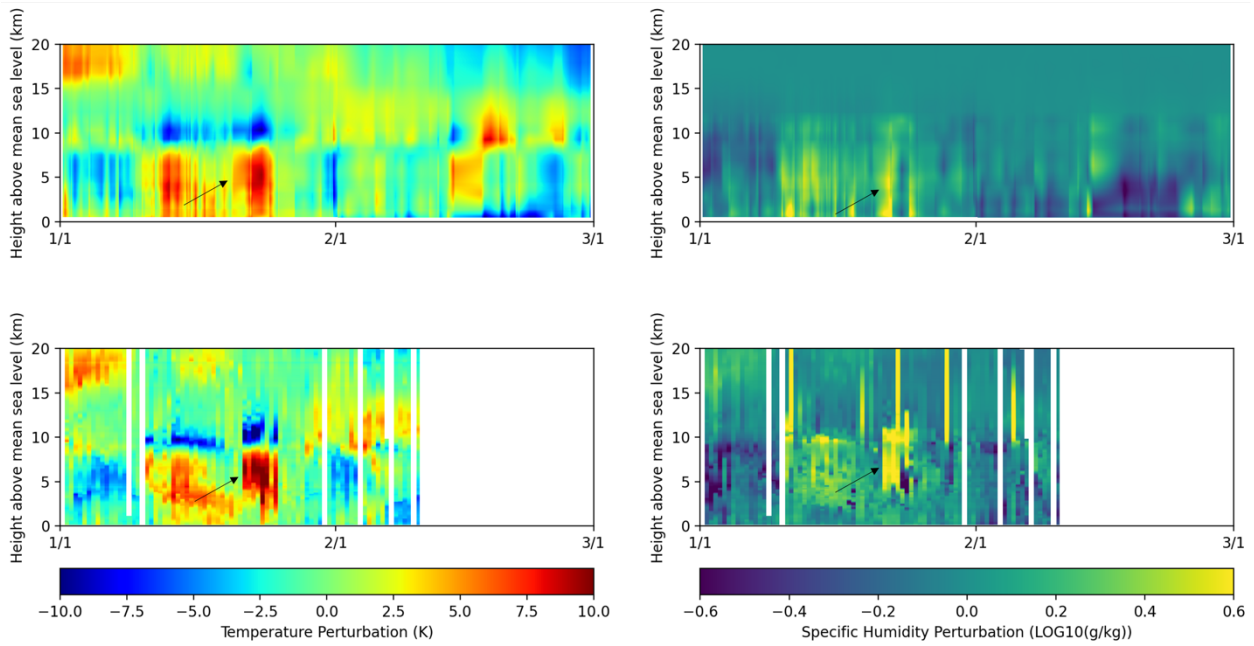
MARIO ZUCHELLI Radiosonde Station

30   **Figure.S2a** Mario Zuchelli Radiosonde Station (75°S, 164°E). Surface emissivity from January 2016 to the end of 2016 at three window frequencies (23.8, 31.4 and 88.2 GHz) and the oxygen absorption band (50 – 58 GHz). The blue curve represents values from our iterative algorithm. The X-axis shows the month of the year, from 2016/1/1 to 2016/12/31. The melting events occurred in mid-January, pointed out by the black arrows.

35 **Figure S2b.** Mario Zuchelli Radiosonde Station (75°S, 164°E). Temperature and specific humidity perturbations during January and Febuary 2016. The deviations from average values are displayed for that period. The top row presents results from our iterative algorithm, while the bottom row shows data from radiosonde measurements. The X-axis shows the month of the year, from 2016/1/1 to 2016/2/29.