Modeling and measuring glacier-wide snow redistribution at Hintereisferner

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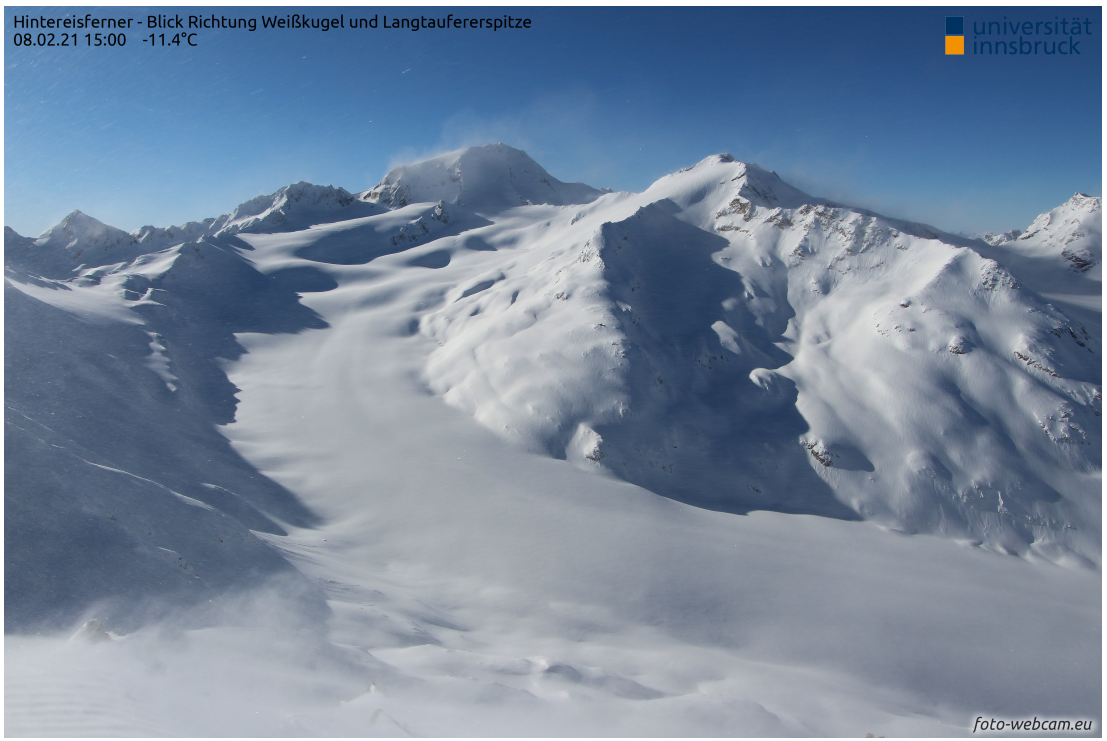
- Snow (re)distribution impacts the glacier mass balance
- Case study: 6-9 February 2021 at Hintereisferner glacier
- High-resolution observations with subdaily DEMs
- High-resolution simulation of snow distribution in WRF



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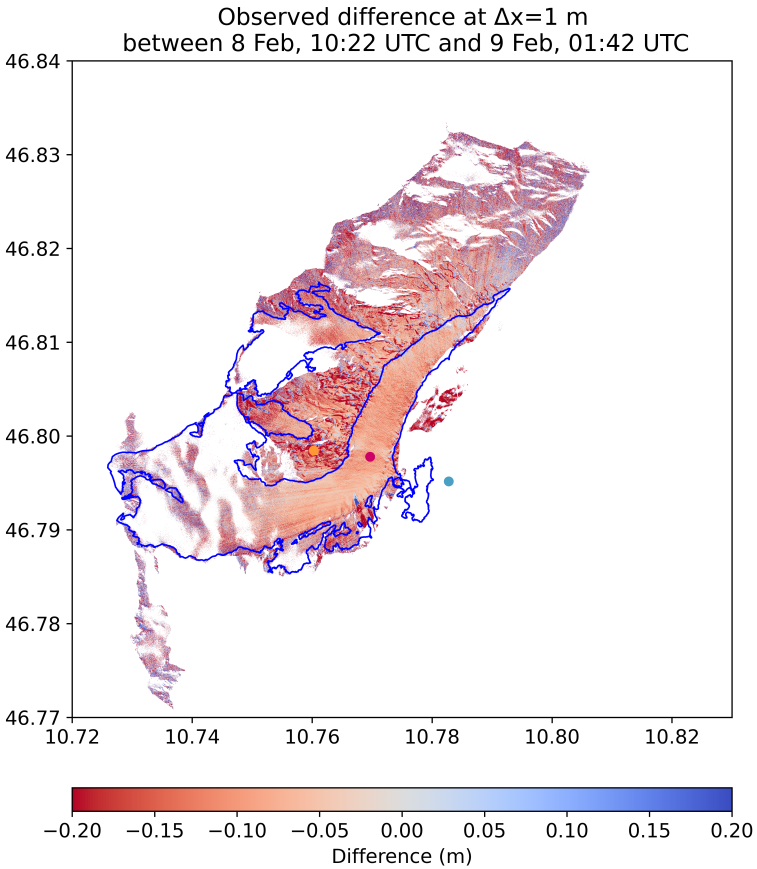

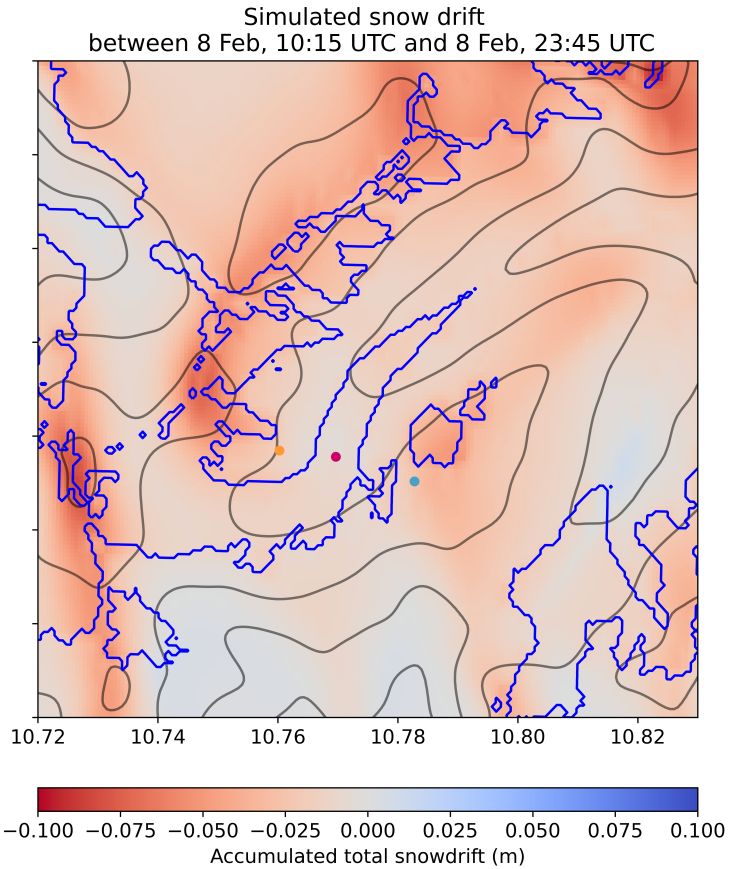

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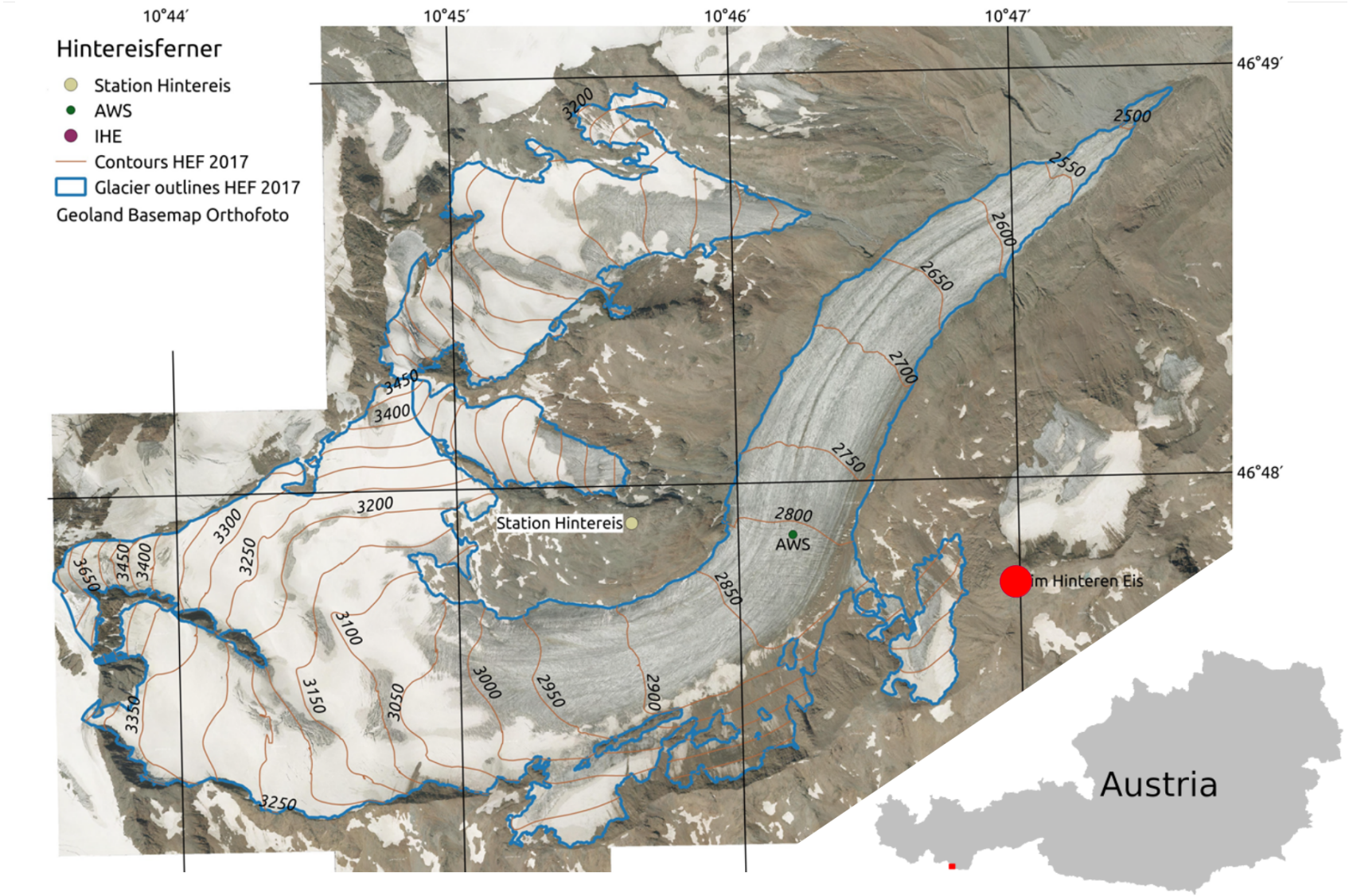

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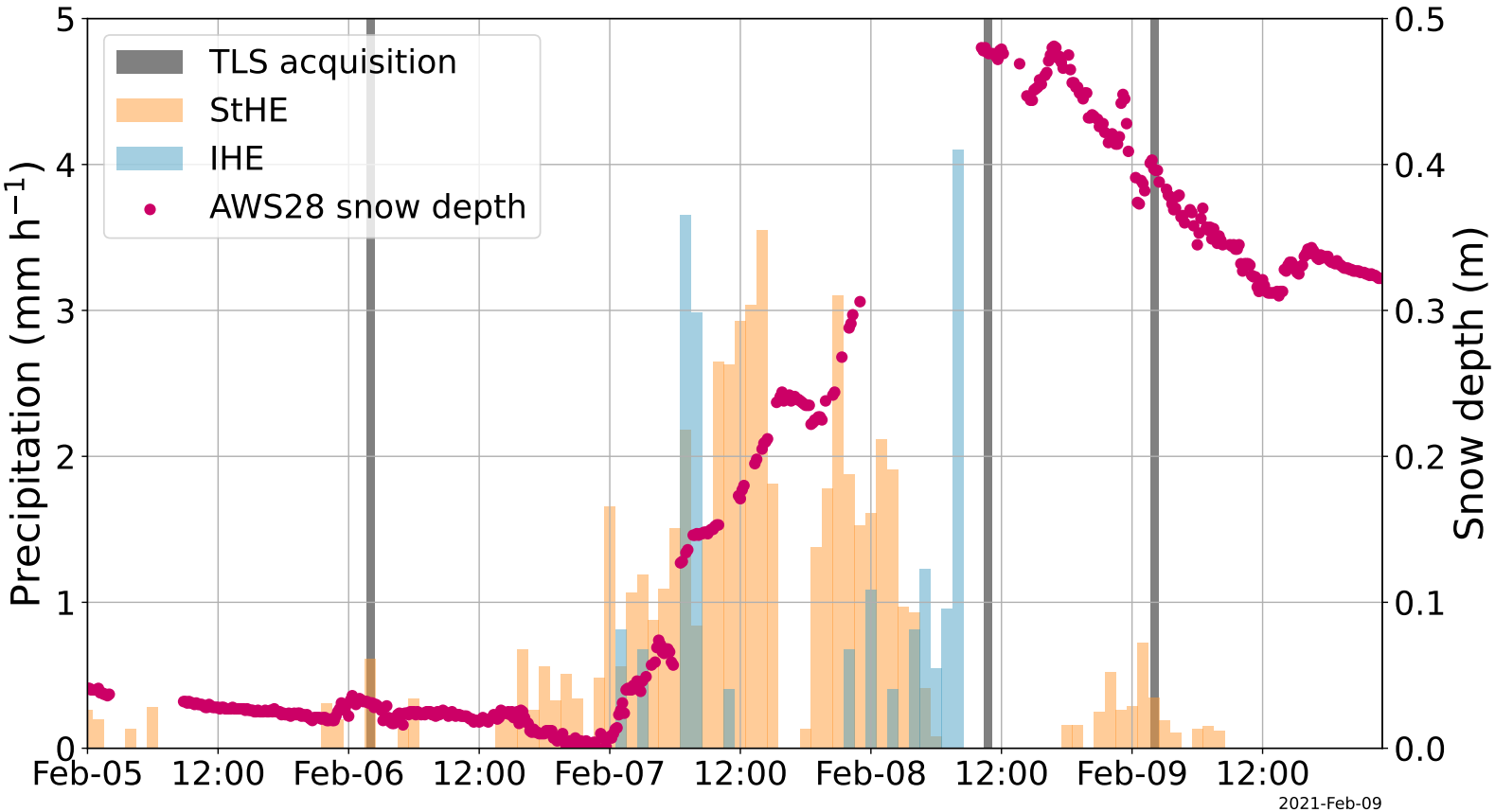
- Precipitation and snow depth change observed by 3 Automatic Weather Stations



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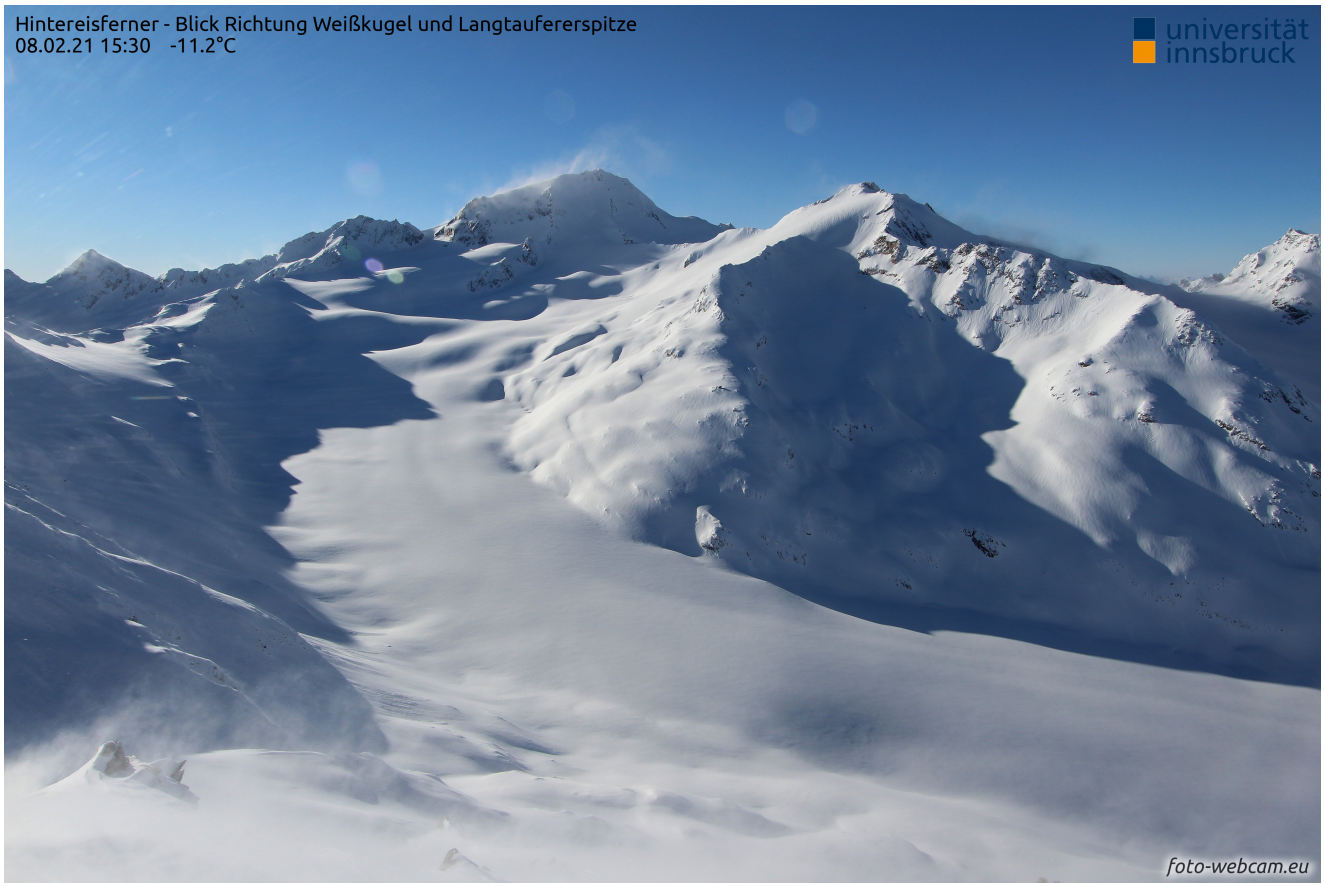
- Webcam images



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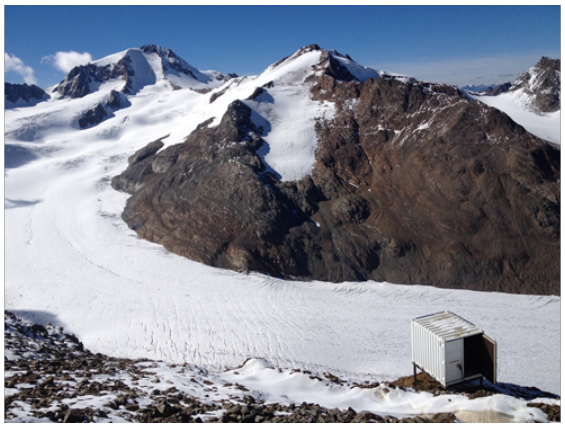
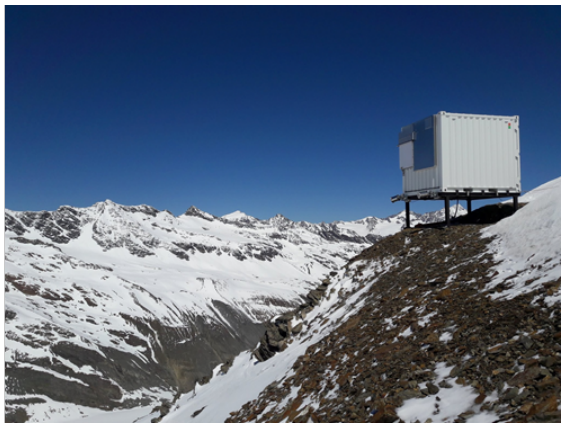
- Permanent Terrestrial Laser Scanner *Im Hinteren Eis* [1,2]
- Accuracy of $\pm 5\,\text{cm}$, $\Delta x = 1\,\text{m}$

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[1] A.B. Voordendag et al. "Automated and permanent long-range terrestrial laser scanning in a high mountain environment: setup and first results". In: *ISPRS Annals of the Photogrammetry, Remote Sensing and Spatial Information Sciences* V-2-2021 (June 2021), pp. 153–160. DOI: 10.5194/isprs-annals-v-2-2021-153-2021

[2] A.B. Voordendag et al. "Uncertainty assessment of a permanent long-range terrestrial laser scanning system for the quantification of snow dynamics on Hintereisferner (Austria)". In: *Frontiers in Earth Science* 11 (Mar. 2023). ISSN: 2296-6463. DOI: 10.3389/feart.2023.1085416

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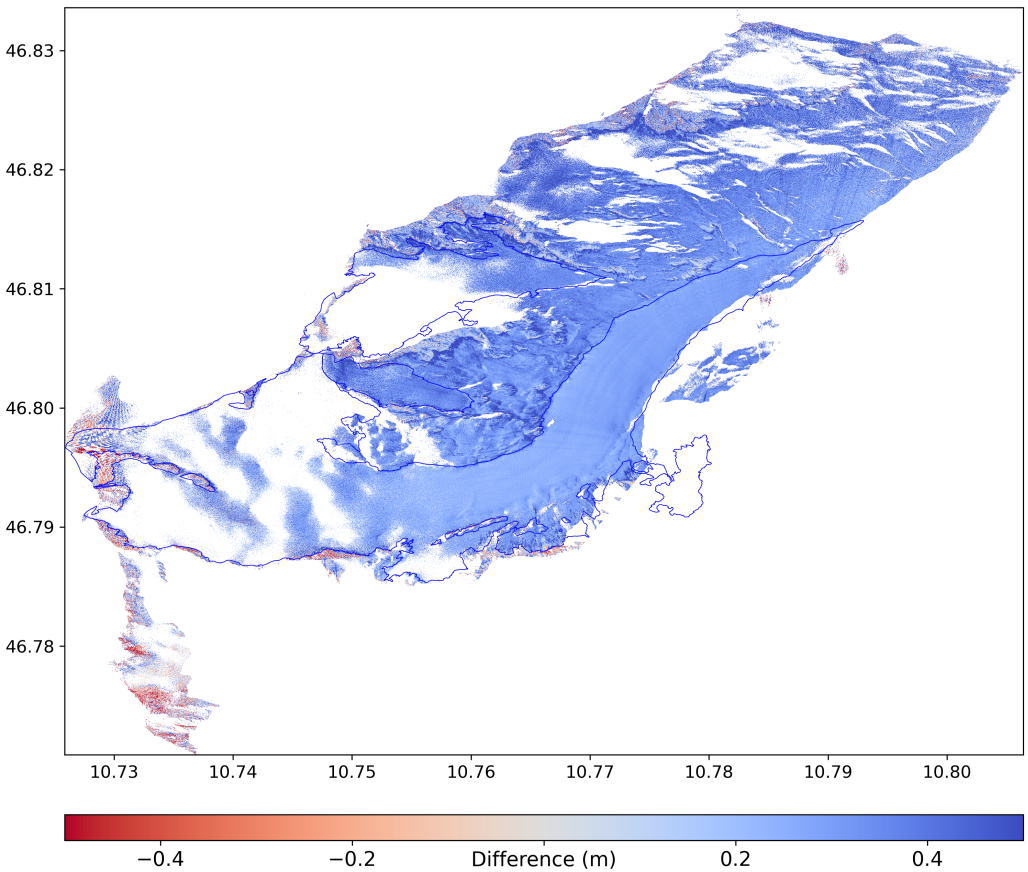
- 28 cm of snow fall between 6 and 8 February 2021



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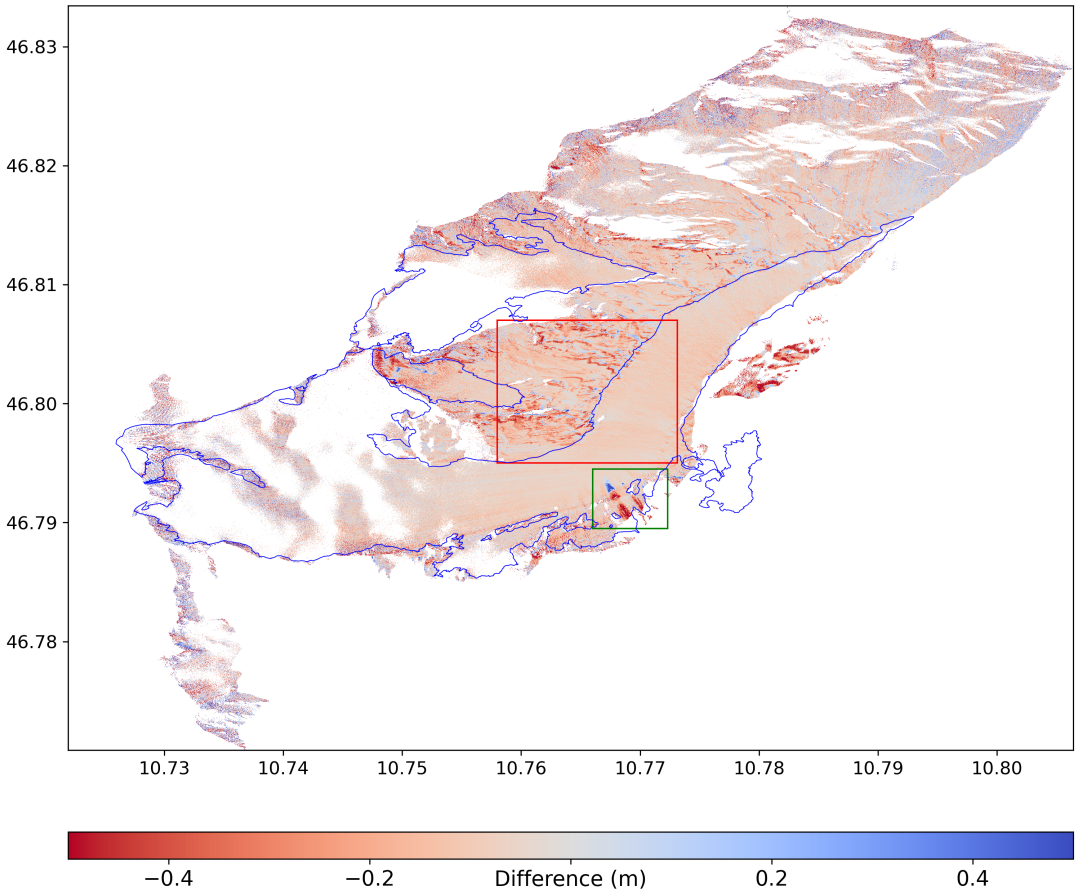
- 8 cm of snow drift and compaction between 8 February (10:45 UTC) and 9 February (1:42 UTC)



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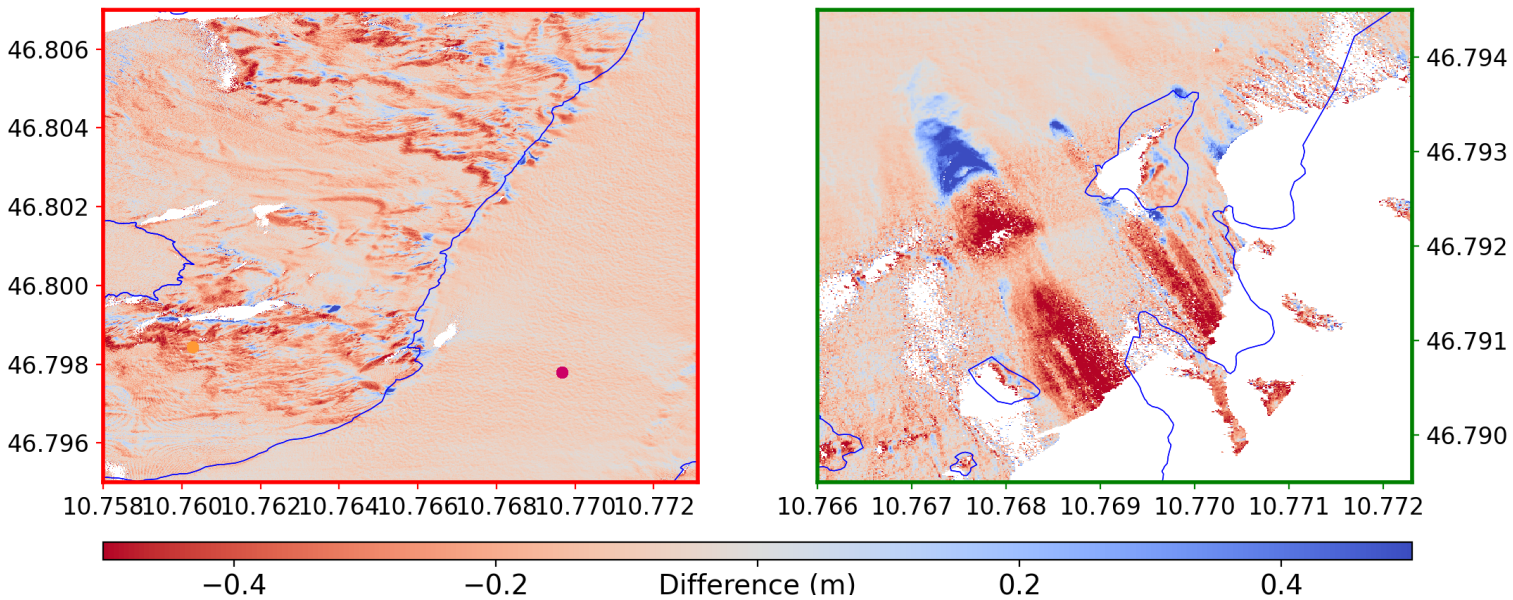
Snow drift patterns on and beside the glacier

Avalanches



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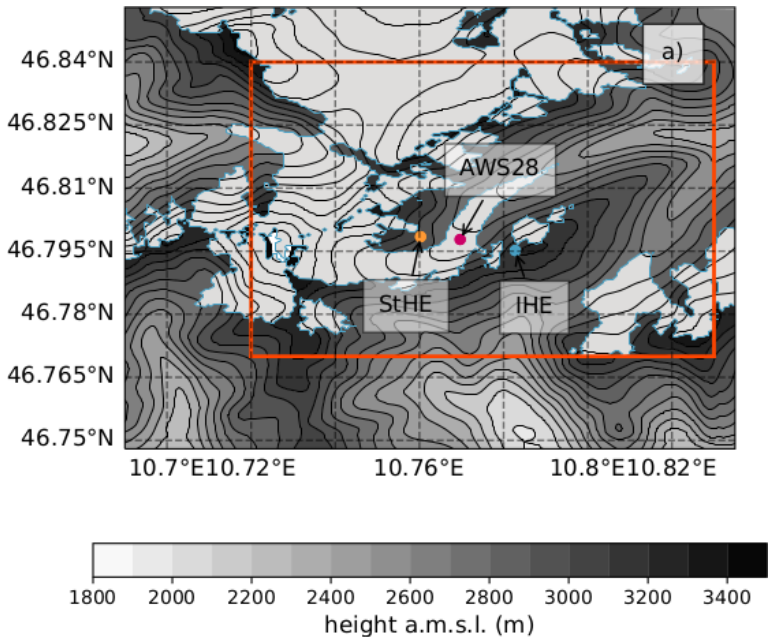
- WRF model v4.1 setup after Goger et al (2022)[3]
- Snow drift module for NOAH-MP (→PICO3a.5 - Manuel Saigger)
- Simulation of drifting and blowing snow on Feb 8, 2021 (24h)

- Innermost LES domain ($\Delta x = 48\,\mathrm{m}$)



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[3] B. Goger et al. "Large-eddy Simulations of the Atmospheric Boundary Layer over an Alpine Glacier: Impact of Synoptic Flow Direction and Governing Processes". In: *Quarterly Journal of the Royal Meteorological Society* (Mar. 2022). DOI: 10.1002/qj.4263

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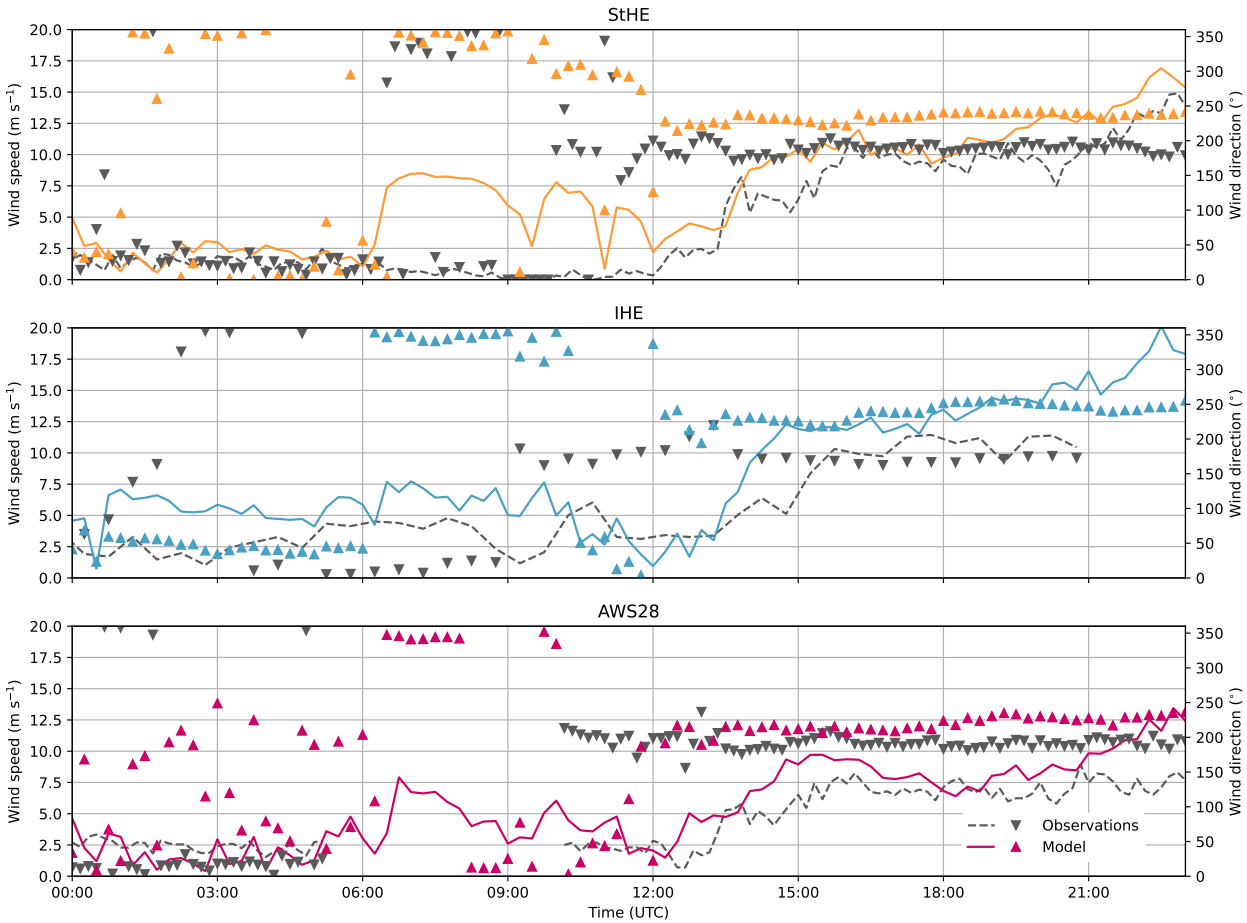
Simulated and observed wind speed and direction



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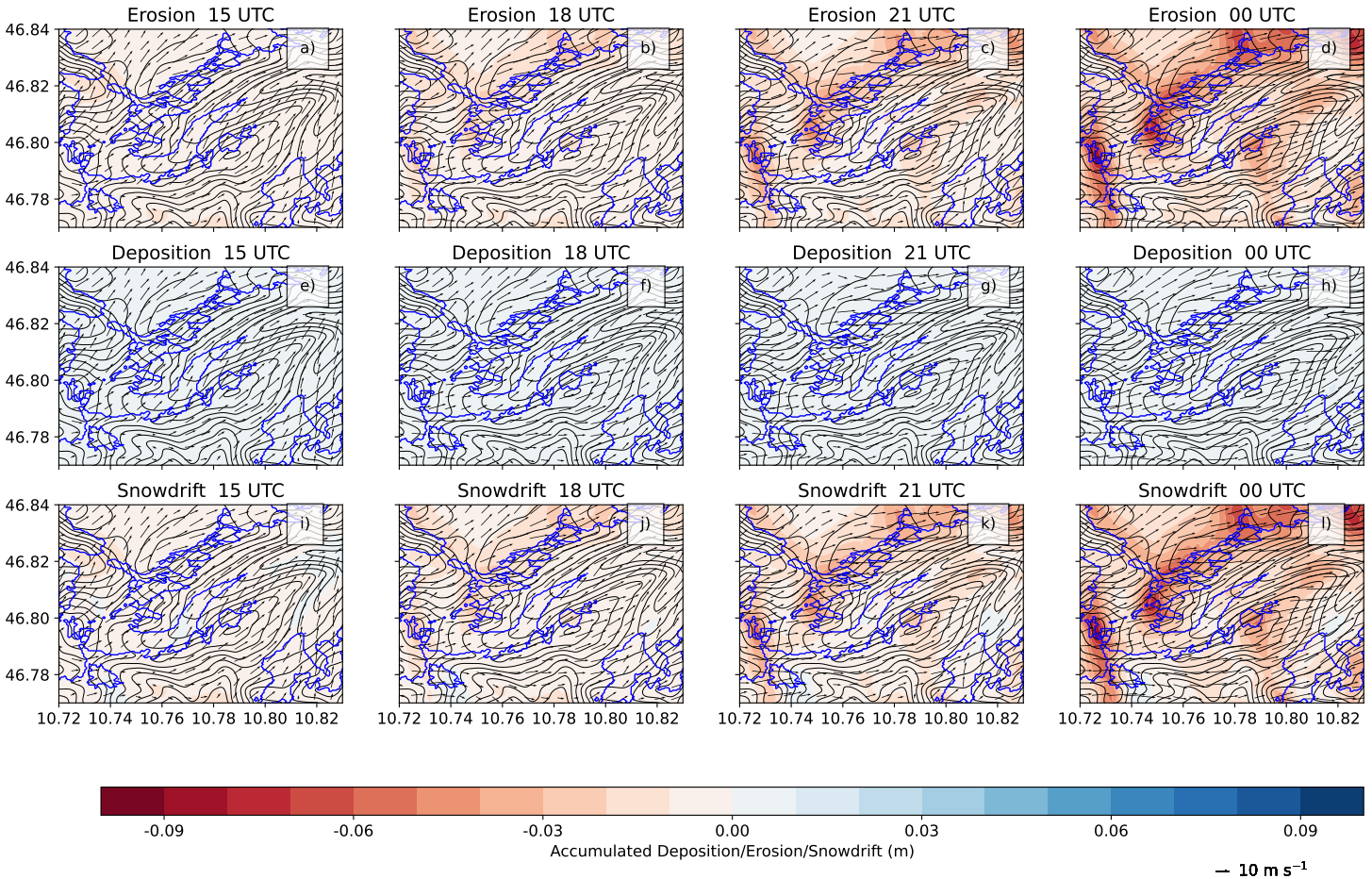
Simulated erosion, deposition and net snow drift



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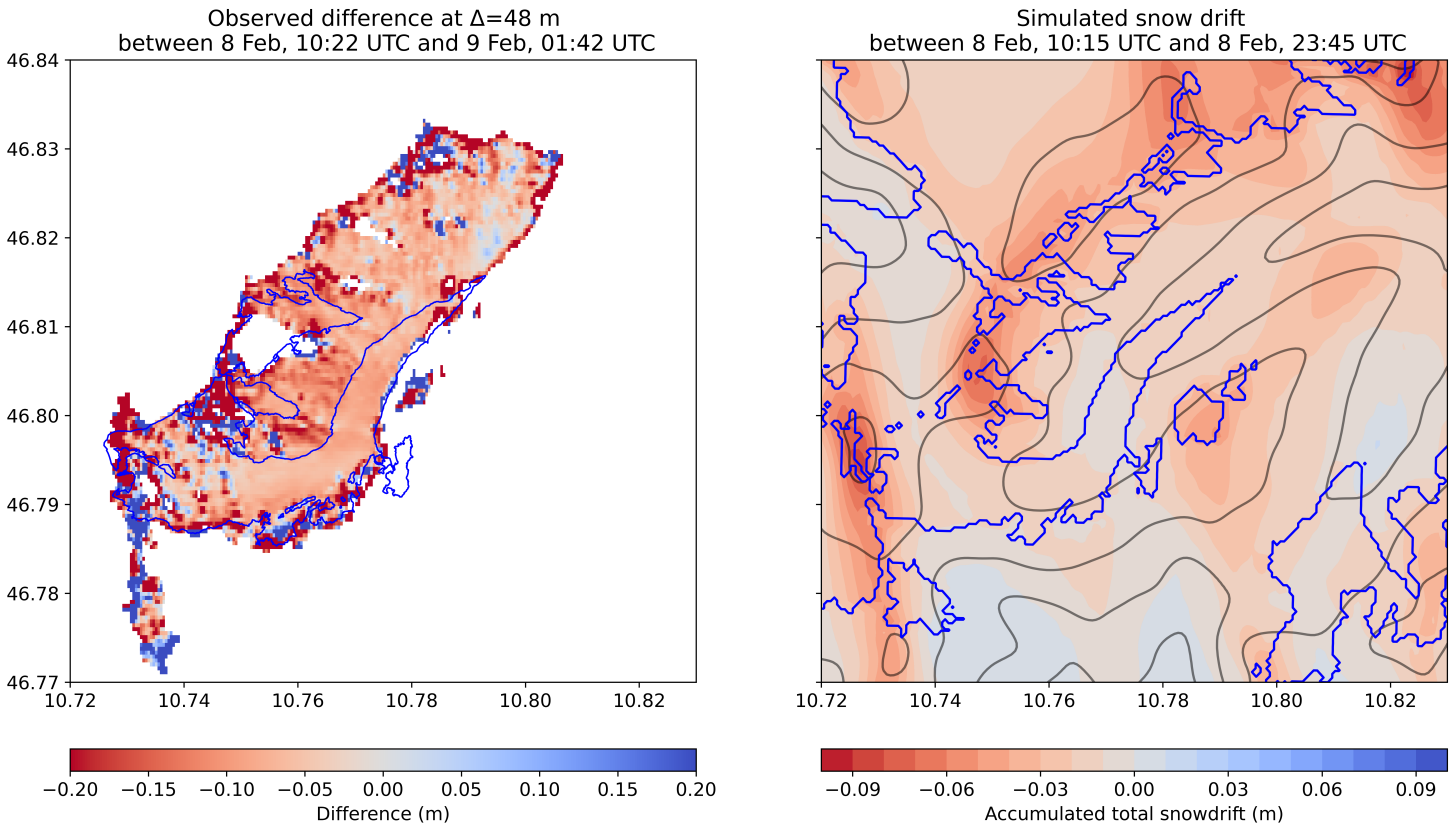
Observed surface height change and simulated snow drift



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Conclusion

- High-resolution setup (observations and model)
- Snow drift simulated with WRF agrees with observations
- Compaction is a main contributor to snow depth changes after this snow fall event
- Contribution of mass loss due to snow drift is estimated at 10%
- Outlook: distinguish between snow drift and compaction