



Supplement of

Sensitivity of precipitation formation to secondary ice production in winter orographic mixed-phase clouds

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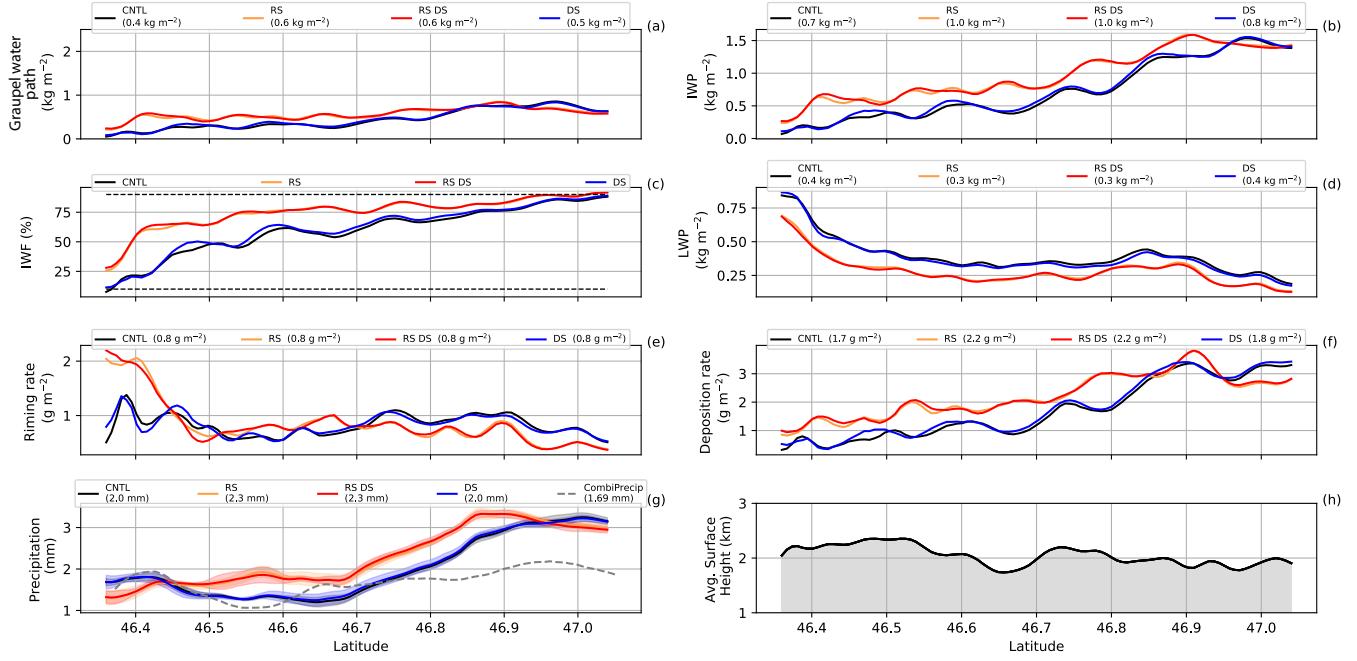


Figure S1. a) Graupel water path, b) IWP, c) IWF ($\text{IWP}/(\text{IWP} + \text{LWP}) \times 100$), d) LWP, e) riming rate, f) deposition rate over the cross-section. These quantities calculated in a) - f) were only over cloudy regions where the cloud area fraction is larger than 0. In brackets are the average over the the latitude. g) Is the precipitation mean (solid line), ensemble spread (shaded area) and CombiPrecip (dashed line) and j) the averaged topography over the cross-section.

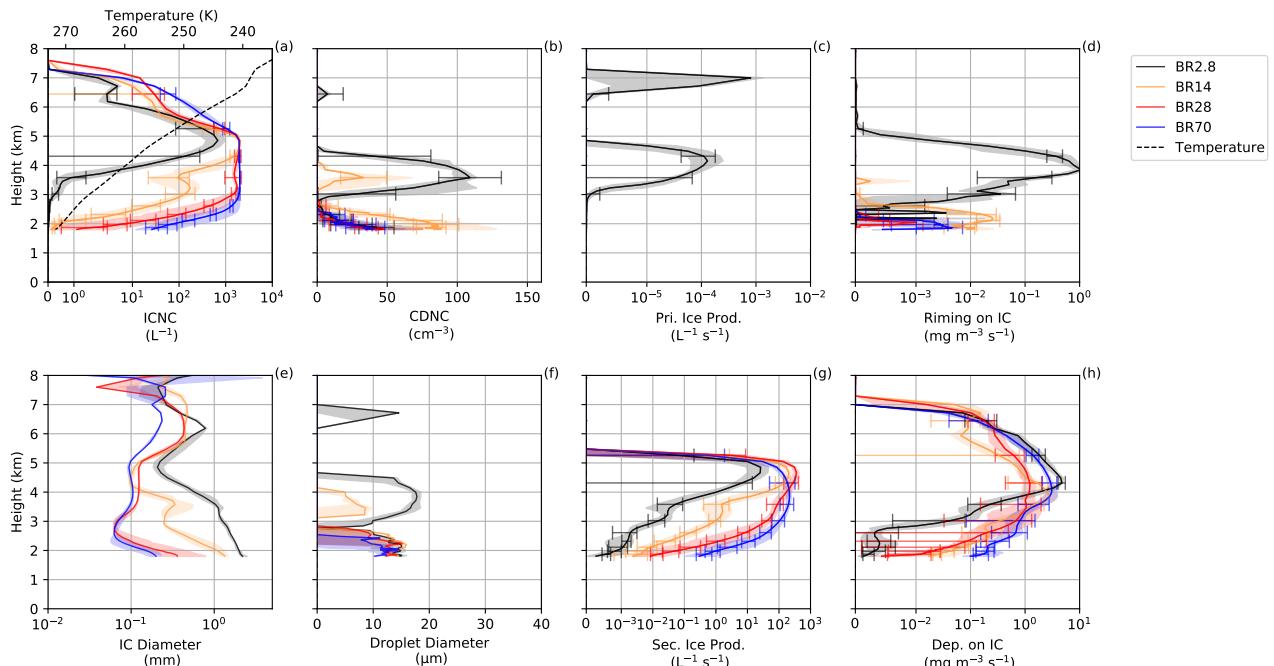


Figure S2. a) and e) Ice crystal number concentration (ICNC) and diameter, b) and f) cloud droplet number concentration (CDND) and diameter, c) and g) primary and secondary ice production, d) and h) riming and depositional (Dep.) growth of ice crystals at Gotschnagrat at 12:00 UTC for $\gamma_{\text{BR}} = 2.5$. The solid lines are the model mean with error bars showing model spread for each simulation. The shaded regions are the minimum and maximum values for the four closest model points. Ice crystals are denoted by IC.

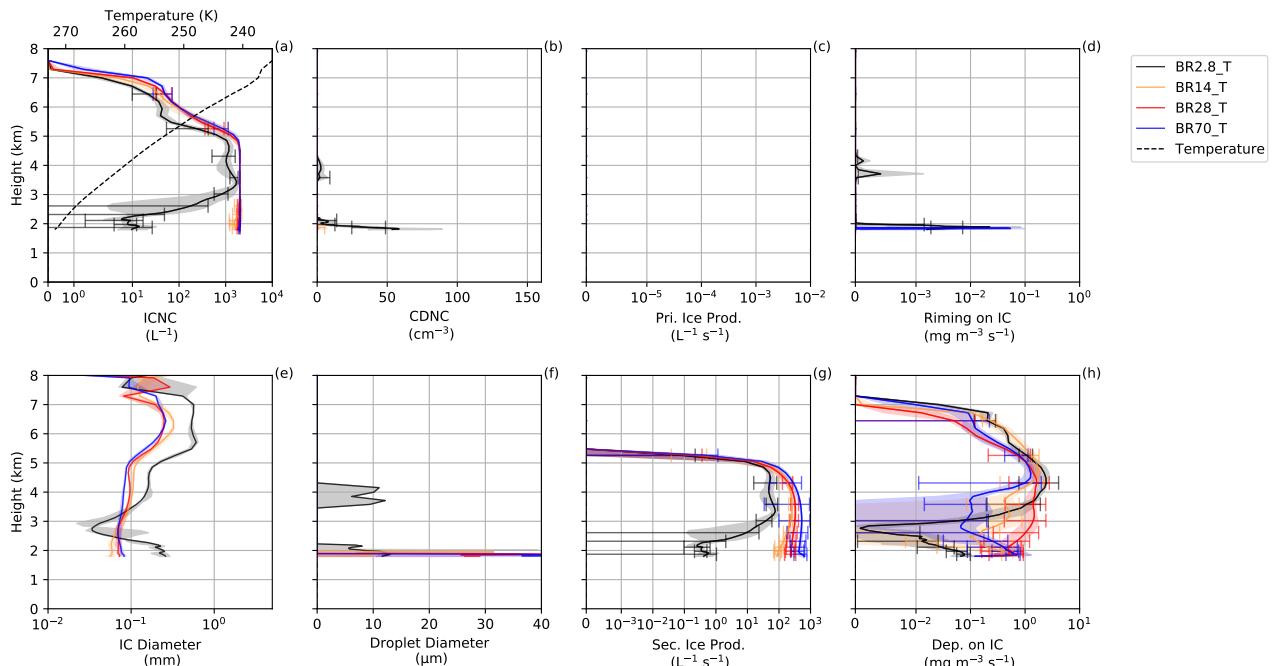


Figure S3. a) and e) Ice crystal number concentration (ICNC) and diameter, b) and f) cloud droplet number concentration (CDND) and diameter, c) and g) primary and secondary ice production, d) and h) riming and depositional (Dep.) growth of ice crystals at Gotschnagrat at 12:00 UTC for $\gamma_{\text{BR}} = 5$. The solid lines are the model mean with error bars showing model spread for each simulation. The shaded regions are the minimum and maximum values for the four closest model points. Ice crystals are denoted by IC.

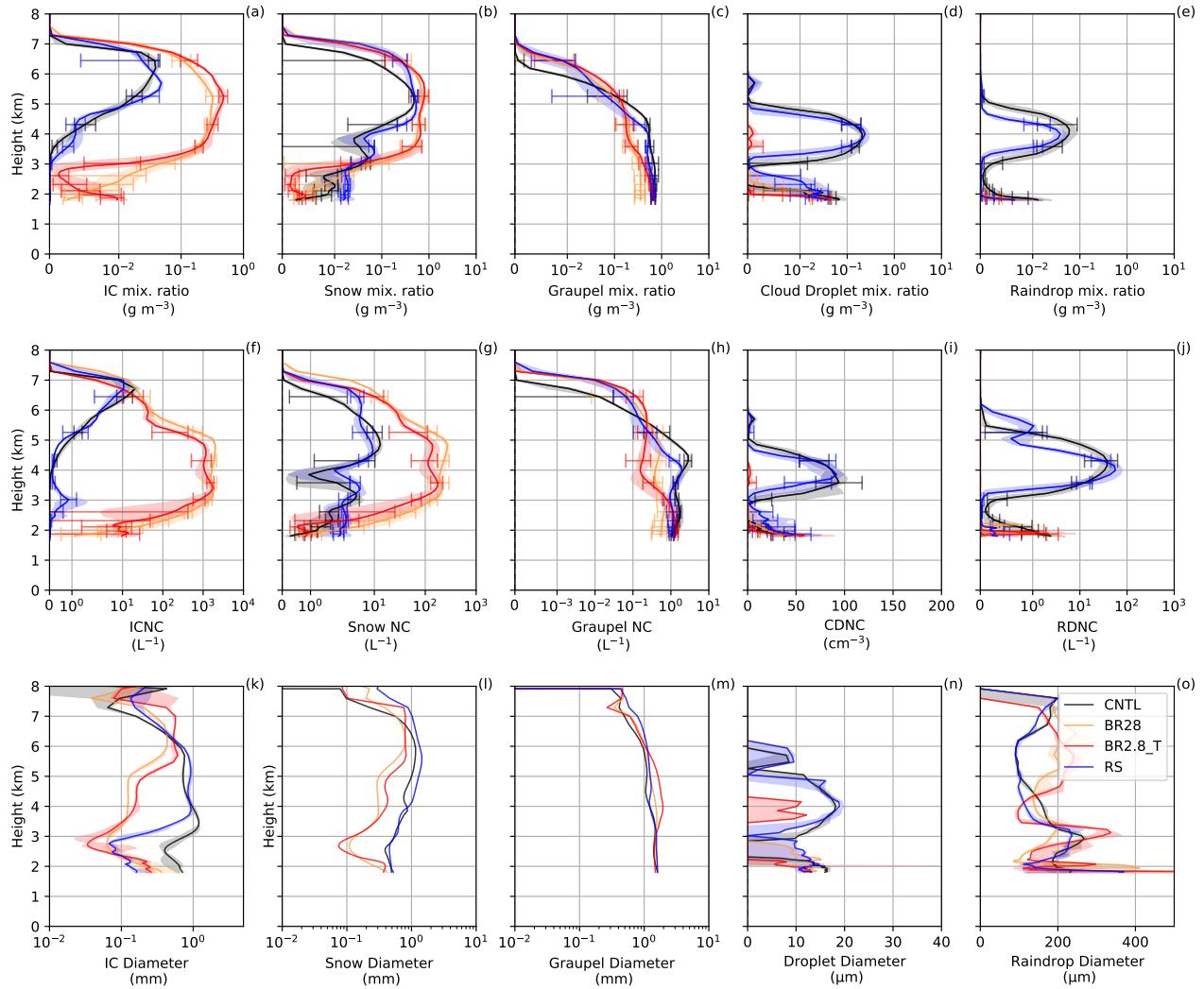


Figure S4. Hydrometeors mixing ratios, number concentrations and sizes at Gotschnagrat at 12:00 UTC.

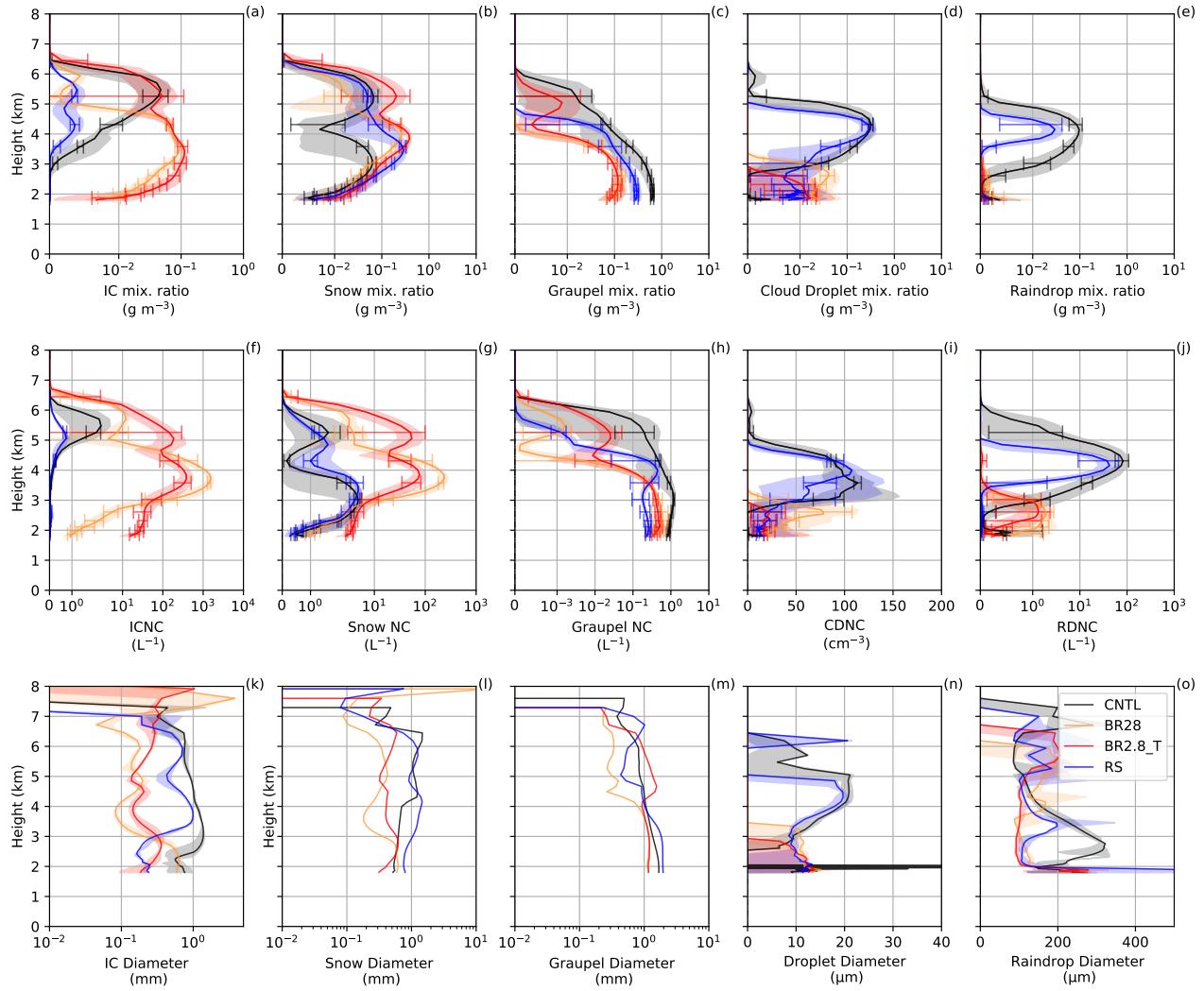


Figure S5. Hydrometeors mixing ratios, number concentrations and sizes at Gotschnagrat at 13:00 UTC.

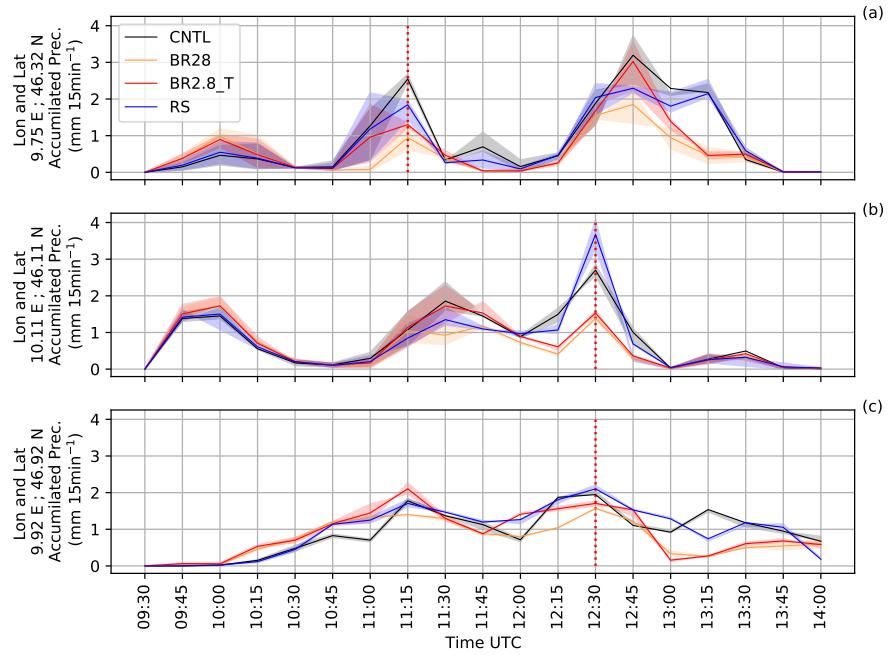


Figure S6. Three localized regions of high precipitation in the CNTL simulation which are suppressed in the collisional breakup simulations. The solid lines are the model mean and the shaded regions are the minimum and maximum values for the four closest model points. The red dotted lines are the selected times for the vertical profiles in Figure S7.

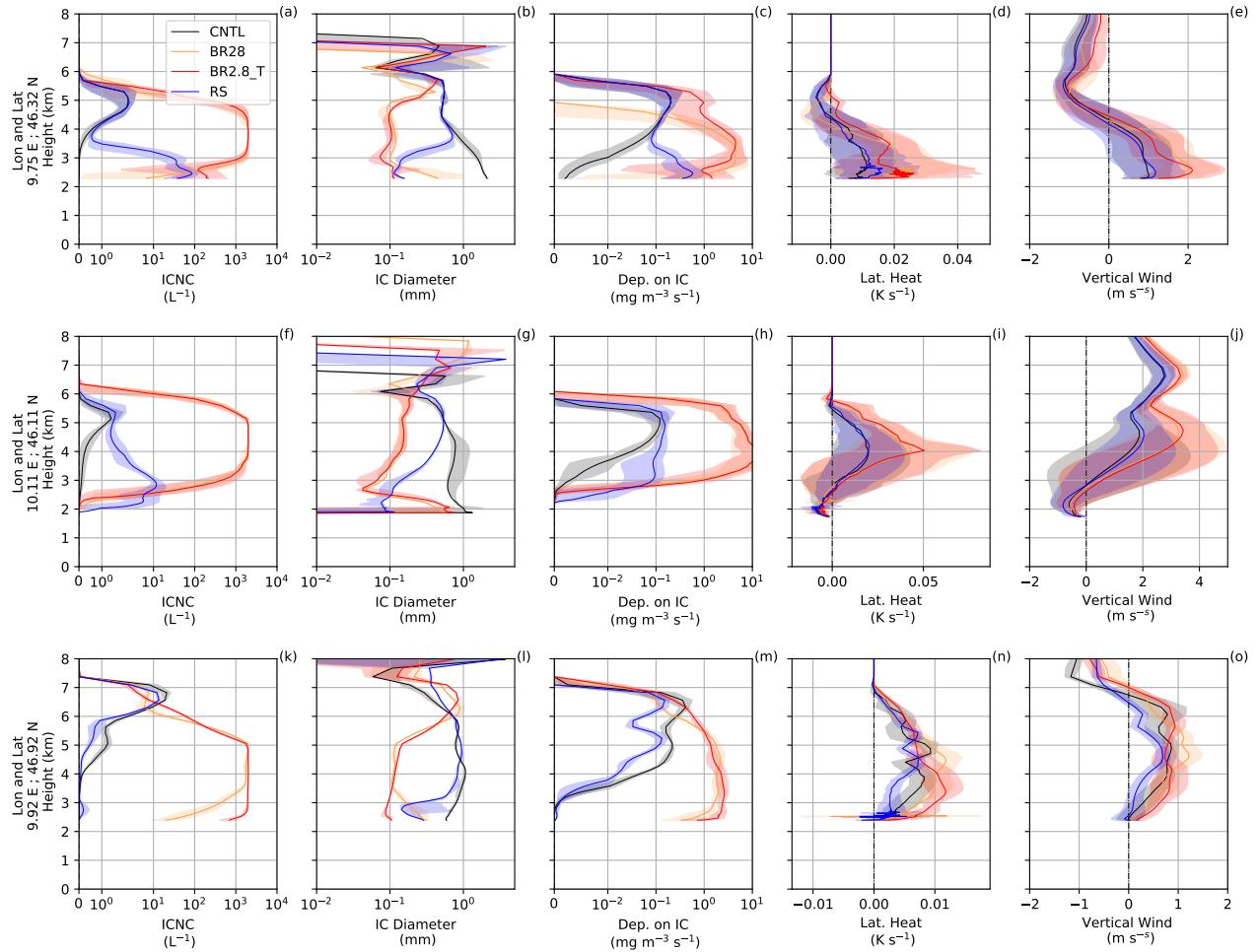


Figure S7. Vertical profiles of the a), f) and k) ice crystal number concentration (ICNC), b), g) and l) ice crystal diameter, c), h) and m) depositional (Dep.) growth of ice crystals, d), i) and n) latent (Lat.) heat release and e), j) and o) vertical wind velocity. The solid lines are the model mean and the shaded regions are the minimum and maximum values for the four closest model points. a) to e), f) to j) and k) to o) corresponds to the localized high precipitation regions of Figure S6 a), b) and c) respectively.

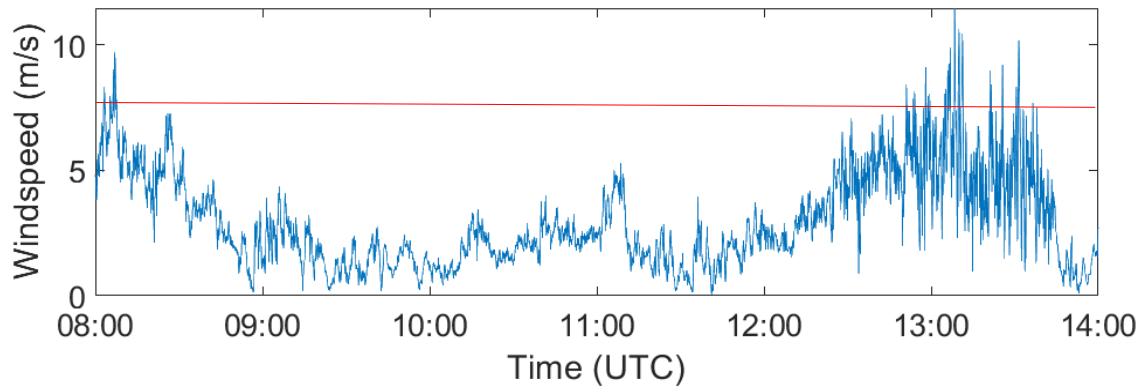


Figure S8. Wind speed recorded by the snow drift station on 7 March 2019. The red line is defined as the threshold to re-suspend snow particles (Walter et al., 2020). Data availability (Walter et al., 2019).

References

Walter, B., Huwald, H., and Gehring, J.: Snow Drift Station - Micro Rain Radar, EnviDat, <https://doi.org/10.16904/envidat.113>, <https://www.envidat.ch/dataset/snow-drift-station-micro-rain-radar>, 2019.

Walter, B., Huwald, H., Gehring, J., Bühler, Y., and Lehning, M.: Radar measurements of blowing snow off a mountain ridge, *The Cryosphere*, 5 14, 1779–1794, <https://doi.org/10.5194/tc-14-1779-2020>, 2020.