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Snow evaporation quantification during a Foehn event in a subalpine environment

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Snow evaporation can considerably contribute to the water balance of mountainous environments. If low relative humidity concurs with air temperature well above the freezing level and considerable wind speed, large amounts of melt water adhering to the grains of the snow cover will evaporate into the atmosphere. In the European Alps, such weather conditions occur frequently during Foehn events where the large scale synoptic patters force the air masses to cross the mountains from south to north.
An innovative experimental set-up, consisting of a cosmic ray neutron snow sensor (CRNSS) and a snow lysimeter, was used in order to quantify the evaporation of a snowpack during a Foehn event in April 2016. The subalpine study site (1250 m ASL) is located in the Ammergauer Alps in southern Germany. The CRNSS measures the snow water equivalent (SWE) from the attenuation of cosmic-ray-produced neutrons and can therefore be used to estimate the total amount of water loss during the Foehn event. Simultaneously, the snow lysimeter was used to measure the amount of actual melt runoff from the snowpack. The evaporation from the snowpack was calculated from the difference of both observations for a period of four days during the main phase of the event on daily time-steps. Average air temperature and relative humidity were 12.9°C and 48.3% during that period, respectively. Average wind speed was 0.7 m/s with a maximum of 2.2 m/s. Total SWE loss at the CRNNS was 143.7 mm during the considered period. In the same time, total melt water outflow from the snowpack was 69.6 mm, resulting in a snow evaporation fraction of 51.6%. The average snow evaporation rate was 20.0 mm/day with a standard deviation of 8.1 mm/day. The study presents interesting insights into the dynamics of snow evaporation during Foehn conditions in a subalpine environment.