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Monitoring of snow height and snow water equivalent with GPS

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In this research project, the potential of GPS techniques for the observation of snow heights and snow water equivalent is investigated. For this purpose, permanent GPS stations were installed at the Weissfluhjoch test site of the Institute for Snow and Avalanche Research SLF in Davos, Switzerland. A feasibility study was carried out at the test site at the end of winter 2011/2012. Since October 2012, a GPS monitoring system is operated continuously. The availability of reference data for snow heights and snow water equivalent from state-of-the-art sensors operated by the SLF allows for a validation and calibration of the results from the GPS monitoring.

Mainly two methods are investigated. The first method is based on the multipath effects caused by the reflection of the GPS signals at the surface of the snow cover. The influences of the multipath effects on the delay between the time of reception of the direct and the reflected GPS signal are analyzed, as well as the influences on the signal to noise ratio, yielding information on the snow height. The second method is based on the analysis of the refraction of the GPS signal during its propagation in the snow cover, providing information on the snow water equivalent. The preliminary results are very promising in terms of accuracy and show an excellent agreement with the reference data.