EGU2020-20935
https://doi.org/10.5194/egusphere-egu2020-20935
EGU General Assembly 2020

Determination of Snow Water Equivalent with only one Global Navigation Satellite System receiver and a Virtual Reference Station

Patrick Henkel[1,3], Markus Lamm[1], and Franziska Koch[2]
[1]ANavS GmbH, Munich, Germany (patrick.henkel@anavs.de)
[2]BOKU University of Natural Resources and Life Sciences, Vienna, Austria (franziska.koch@boku.ac.at)
[3]German Aerospace Center (DLR), Oberpfaffenhofen, Germany (patrick.henkel@dlr.de)

The snow water equivalent (SWE) is a key parameter in hydrology. In the past years, the signals of Global Navigation Satellite System (GNSS) receivers were discovered to be very attractive for SWE monitoring. The set-up of GNSS-based SWE monitoring typically consists of two GNSS receivers, whereas one is placed on the ground to sense the signal attenuation and time delay being caused by the snow pack. A second receiver is placed above the snow and serves as reference receiver. The measurements of both receivers are differenced to eliminate the common effect of errors in the satellite orbits and clocks, satellite phase and code biases and atmospheric errors, while the information on the snow is kept.

In this talk, we discuss the replacement of the reference receiver by a virtual reference station (VRS). The VRS is a virtual GNSS reference station, whose corrections are obtained by interpolation of the corrections from multiple surrounding reference stations to achieve a higher accuracy at the user location. The concept of VRS was first developed by Trimble and is widely used in today's real-time kinematic (RTK) positioning receivers. The concept of VRS is also attractive for snow monitoring, since the GNSS reference receiver could be avoided resulting in a lower power consumption and less costs. Moreover, this could be a big advantage for applications in slopes, which are, e.g., potentially avalanche prone. Within the hardware setup of our GNSS SWE sensors, an internet communication link for the reception of the corrections from the VRS corrections at the SWE monitoring site is already available.

However, there are also two challenges: First, the SWE monitoring stations in Alpine areas are typically at a significantly different altitude than the geodetic reference receivers. The differential tropospheric zenith delay is not negligible for altitudinal differences of more than 100 m. Therefore, the differential tropospheric delay needs to be considered either in the determination of VRS corrections or alternatively in the SWE determination. For altitudinal differences of less than 1000 m, the differential tropospheric zenith delay could be approximated by a model with sufficient accuracy. The residual modelling error is projected to the SWE estimate. Second, the use of a VRS instead of a conventional GNSS reference station requires a stronger data link, since the GNSS raw data (pseudoranges, carrier phases and carrier-to-noise power ratio measurements from all tracked satellites) need to be transmitted besides the final SWE results. However, an LTE

link is totally sufficient.

Besides the methodology, we will also focus on specific hardware implementations.