Documentation of dataset: "Daily snow water equivalent and snow depth data from the valley Wattental in the Tuxer Alpen, Tyrol, Austria [dataset]"

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## **Station description**

The measuring facility operated by BFW to record snow water equivalent and snow depth is located in the catchment of the river Lizumbach in the valley bottom of Wattental in the Tuxer Alpen, Tyrol, Austria (N47.16820, E11.63858). The measurements are obtained at the tree line in an altitude of 1,995m a.s.l. (Fig. 1). The herein published dataset contains daily snow depth (HS) and daily snow water equivalent (SWE) data. Measurement data are available from January 11 2010 until September 30 of 2022. The repository will be updated during the coming years.



Figure 1: Measuring facilities: ultrasonic snow depth sensor above the snow pillow area mounted on a mast (left). Detail of the 3x3m snowpillow area that is covered with a sheet for UV protection (right).

The measuring site is equipped with a snow pillow from the company Sommer Messtechnik GmbH measuring the weight of the overlying snowpack, and a snow depth sensor (USH-8) which measures the snow depth contact-free by means of ultrasound. It is mounted on a mast that is braced with steel cables and provides the snow depth directly on the snowpillow surface.

The measuring principle of the snowpillow is based on the detection of the hydrostatic pressure caused by the snowpack. To keep the influence of possible bridging in the snowpack on the measured values low, it has large dimensions (3x3m). The pressure compensation capillary integrated in the sensor cable hinders measurement errors by compensating barometric air pressure fluctuations.

By combining the data of these measuring devices ( $\rho$  =weight/snow depth), mean density of the snow cover can be determined. It is noted that the accuracy of the measuring equipment is limited because of sensor accuracy (snow depth +/- 3cm, snowpillow +/- 6mm snow water equivalent). Furthermore, the measurement data are basically point data, which allow only

limited conclusions on surrounding conditions due to the influence of weather and topography on the local snowpack.

# Data format

The daily data is reported in a text format with custom CSV dialect. The header consists of six rows containing meta data that are separated with an equal sign (=) from the field name, e.g.:

Stationname=Snowpillow - Wattener Lizum latitude=47.16820 longitude=11.63858 elevation=1995 nodata=-99 unit=%Y-%m-%dT%H:%M:%S;cm;mm;

*Longitude* and *Latitude* are in WSG 1984 decimal system, *elevation* is in meter above sea level. The *nodata* field indicates a numeric NaN representation of missing values. *Unit* give the printf-format for the timestamp and the SI unit for each data column.

The meta data is followed by the column names, e.g.:

Timestamp;HS;SWE;flag

The following data block consists of semicolon separated float values with a dot as decimal sign. The first column is the timestamp for each row.

2010-01-11T12:00:00;30.8;76.4;-99

Make sure to replace any value -99 with NaN.

## Data preview

The repository also contains a plotly HTML file that has the same data as the CSV file and can be used for a quick overview. Just open the HTML file in a web browser for an interactive view.

### **Data correction**

The snow water equivalent data (SWE) and snow depth data (HS) are recorded with a 10minute resolution. The published data are averaged daily values, the raw data is available upon request.

### Averaging

Daily averages are estimated between 00:00 and 23:59 CET (e.g. UTC+1) and reported on mid-day 12:00 o'clock.

### Offset correction

We estimated an offset correction for HS and SWE in the timespan 1. June to 1. Oktober of each year using the median to neglect potential short summer snowfall events. The identified offsets for each year are similar (+/-2cm in HS, +/-1mm in SWE), therefore we use a common offset for all seasons that is the mean of all yearly median-derived offsets.

The finally applied SWE offset is 131.79mm, and the finally applied HS offset is 138.03cm.

Note: There is often an undercatch in SWE at late fall before the first bigger snowfalls of up to -15mm (for example in December 2016). Because of this undercatch situation, the SWE data of the first snowfall must be taken with care. We believe that this is due to the low air temperatures that cools down the snow pillow fluid (glycol/water 1:1, freezing point roughly -40°C). This results in a slight increase in density, respectively, in a reduce of the pressure reading. We see a recovering of the undercatch in roughly 1 week after a major snowfall, e.g. the fluid heats up close to 0°C by the geothermal flux and the insulating snow cover.

### Snow-free thresholding

We set the data of snow free situations to zero by thresholding the data to the sensor accuracy. For SWE we threshold any value below 6.25mm (e.g. from datasheet 0.25% of full-scale 2,500mm). For HS the threshold is given by 0.1% of full-scale 10m, but since the mast moves slightly depending on the steel rope tension, we define the HS threshold to 3cm. All data that is zero-ed by these thresholds is marked with correction flag=-10.

#### Manual corrections

There stayed a couple of data points that required manual correction. We use the following flag system to indicate why and how the data has been manually corrected. All flags are negative values to avoid confusion with measured values.

The first number after the minus sign give the column that has been altered:

"-1\*" both SWE and HS have been manually altered

"-2\*" only HS value has been manually altered

"-3\*" only SWE value has been manually altered

The second number give the correction method:

"-\*0" The raw value is set to zero as part of the snow-free thresholding procedure.

"-\*1" The raw value is manually set to zero.

"-\*2" The raw value is manually set to NAN.

"-\*3" The raw value is manually set to the average of neighbouring values.

"-\*4" The raw value is manually excluded from the snow-free thresholding procedure.

When the correction flag is -99 (Nan representation), the raw daily values are reported, e.g. no correction was needed.

# **Additional resources**

For further information regarding the monitoring station, the datasets, additional further data or original datasets please contact the data owner:

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## Usage agreements

Please contact the responsible persons (see above) prior to using the data set, and properly cite the data repository:

Hagen, K.; Köhler, A.; Markart, G.; Fromm, R.: *Daily snow water equivalent and snow depth data from the valley Wattental in the Tuxer Alpen, Tyrol, Austria [dataset]*, 2023, Zenodo, doi: 10.5281/zenodo.7845618

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