A unique dataset for investigating hydrological extremes: WegenerNet and the research laboratory region Raab catchment in southeastern Austria

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1 WegenerNet - Brief Overview

a) Feldbach Region (FBR)

- 154 meteorological stations within 23 km x 18 km area
- main parameters: air temperature, relative humidity, precipitation, wind and soil moisture
- 5 minute sampling
- automatic processing system (data transfer, quality control, generation of weather and climate data products)
- interpolated gridded data for main parameters (200 m x 200 m UTM)
- processed data provided at data portal (www.wegenernet.org)
- data available since January 1, 2007

b) Johnsbachtal (JBT)

- 11 meteorological stations (plus 1 hydrographic station)
- stations operated by Wegener Center and several partner organizations
- alpine setting, altitudes ranging from below 700 m to over 2100 m
- main parameters: air temperature, relative humidity, precipitation, wind, radiation, and snow depth
- 10 minute sampling
- automatic processing system
- quality controlled data provided at data portal (www.wegenernet.org)
- data available partly since October 2010, partly since January 2007

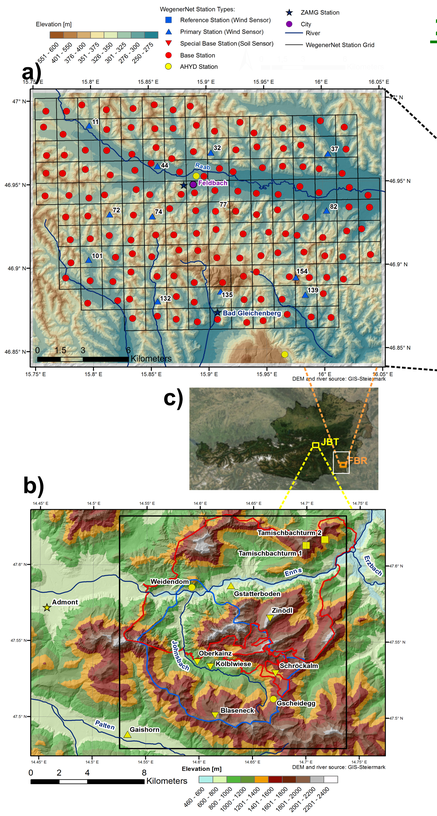


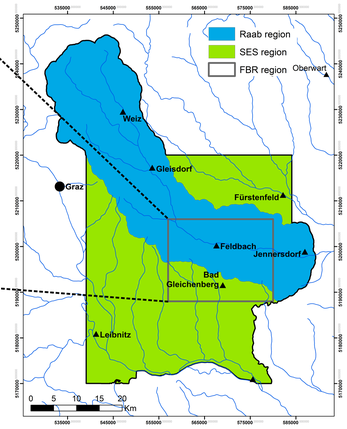
Fig. 1a: WegenerNet Feldbach Region (23 km x 18 km, mean alt. ~330 m) and station locations in the station grid.
Fig. 1b: WegenerNet Johnsbachtal area (16 km x 17 km, black rect.), station locations (yellow), catchment (blue), and border of Gesäuse National Park (red).
Fig. 1c: Location of study areas in Austria.

2 The Raab Catchment Hydro-pedologic Dataset (RCHD)

The **RCHD** is a **set of hydrological and hydro-pedological characteristics with a resolution of 100 m x 100 m** for the Raab catchment and the surrounding South-eastern Styria (SES) region.

2.1 Raab Catchment overview

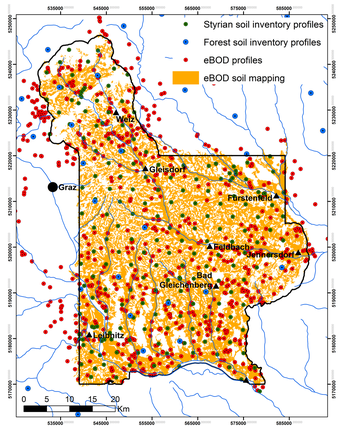
RCHD study areas



The Raab catchment (marked in blue in the above figure) covers an area of 987 km². It includes the highly instrumented WegenerNet (gray rectangle) and is surrounded by the South Eastern Styria (SES) region. They serve as focus regions for investigating hydrological extremes.

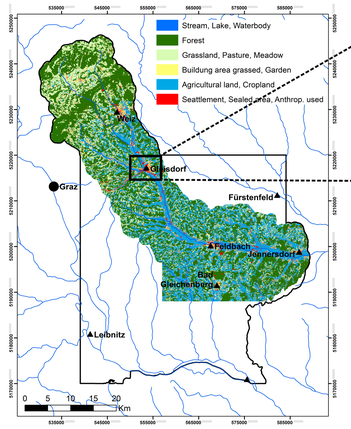
2.2 Input Data

Soil profiles and data

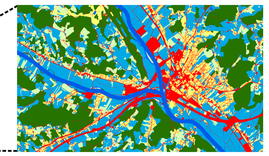


Soil data for the RCHD are taken from the digital soil archive eBod (yellow color and red circles, respectively), from the Styrian government's soil inventory profiles (green circles), and from forest soil inventory profiles (blue circles).

Land use and land cover



Detailed land use / land cover data were generated using a digital cadaster map, data from the Austrian forest map, from the EU's Integrated Admission and Control System (IACS/INVEKOS) and from orthophotos. The resulting map shows clear improvements over the widely used CORINE data.



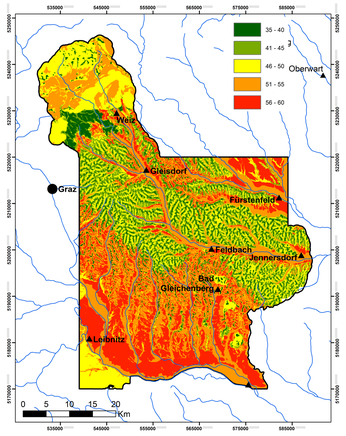
Detail of land use / land cover data for the city of Gleisdorf and surroundings

Further input data

- Geological data with 125 geological/lithological classes
- Austrian forest map (ÖWK) with 5 classes
- Digital elevation model (10 m resolution)

2.3 Output Data

Soil type



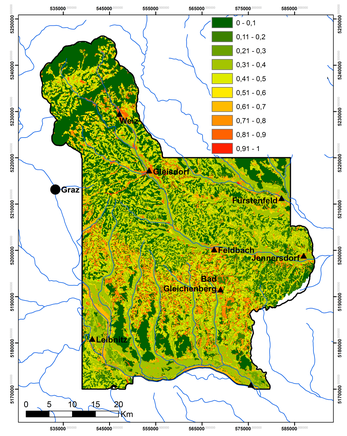
Soil type has been calculated as content of silt, clay and sand for three depth layers (0-20 cm, 20-50 cm, and >50 cm). The above image shows the modeled silt content of the 20-50 cm soil layer.

Hydro-pedologic data:

Hydrological and hydro-pedological characteristics have been derived using a special pedotransfer function (see Klebinder et al. 2017 for references).
Output values include:

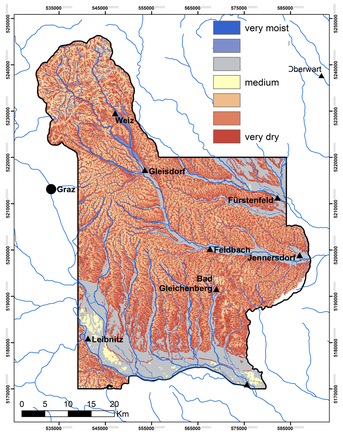
- Saturated hydraulic conductivity k_{sat}
- Total pore volume
- Air capacity
- Permanent wilting point
- Available water capacity
- Mualem-Van Genuchten parameters Θ_r, θ_s, α, and n
- Runoff coefficients
- Soil moisture distribution

Surface runoff coefficient



Runoff coefficients were modeled using the HYDROBOD model (see Klebinder et al. 2017 for references). The model calculates runoff for various layers (infiltration, soil, and geology), for instance, surface runoff coefficients for a rain event (1 h, 64 mm) in the above map.

Soil moisture distribution



Distribution of soil moisture was also calculated using the HYDROBOD model.
The final runoff coefficients were modeled using different precipitation and soil moisture scenarios including heavy precipitation with a frequency of up to 100 years.

3 Applications

Applications whith use of WegenerNet data include:

- Evaluation of high-resolution precipitation models, data, and observations (Kann et al. 2015, Hiebl and Frei 2017, O et al. 2017 and 2018, Tan et al. 2018)
- Generation of high-resolution windfields for the WegenerNet FBR and JBT (Schlager et al. 2017 and 2018)
- Derivation of fundamental spatial resolution dependence of extreme precipitation intensity (Schroeer et al. in review 2018, Abstract EGU2018-7598)

Applications using both WegenerNet and RCHD include:

- Hydrological modeling of extremes in the Raab catchment (Hohmann et al. 2018, Poster A90 in Hall A on Friday)
- Modeling and study of a local landslide event period with over 3000 landslides in summer 2009 (Easiclim project, work in progress)

All references can be found online at
www.wegcenter.at/wegenernet -> publications
Future PhD theses topics with focus on the SES region can be found on http://dk-climate-change.uni-graz.at/en

WegenerNet Cooperations:

LTER Austria – Austrian Long-Term Ecosystem Research Network
International Soil Moisture Network
LINET – Lightning Detection Network

References:

Kirchengast, G., T. Kabas, A. Leuprecht, C. Bichler, and H. Truhetz (2014): WegenerNet: A pioneering high-resolution network for monitoring weather and climate. *Bull. Amer. Meteor. Soc.*, 95, 227-242, doi:10.1175/BAMS-D-11-00161.1

Klebinder, K., B. Sotier, V. Lechner, and P. Strauss (2017): Hydrologische und hydro-pedologische Kenndaten Raabgebiet und Region Suedoststeiermark. Innsbruck, Austria.

Further information, data access and references:
www.wegcenter.at/wegenernet