WEGENERNET
Climate Station Network

A new dataset supporting weather and climate studies at 1 km-scale resolution

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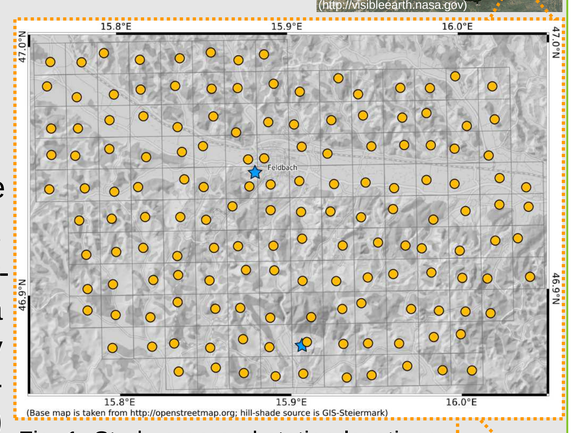
WegenerNet - Brief Overview

The WegenerNet climate station network (WegenerNet) is a pioneering weather and climate observation experiment at very high resolution in south-eastern Austria. The network comprises 151 meteorological stations within an area of about 20 km x 15 km in the Alpine foreland (one station per ~2 km²). Measurements every 5 min include the meteorological parameters air temperature, humidity, precipitation, and others at selected sites (e.g., wind speed and direction). The data processing is part of an automatic system containing four steps: (1) data transfer, (2) quality control, (3) product generation, and (4) presentation. The resulting data set consists of station data and gridded data on various temporal scales since Jan 1, 2007. All data are provided at the WegenerNet data portal and represent a new resource for climate and environmental reasearch on regional to local scale.

- pioneering experiment of 151 meteorological stations (~1.4 km x 1.4 km station grid)
- air temperature, rel. humidity, precipitation (main parameters) complemented by wind and soil parameters at selected sites, and air pressure and net radiation at one reference station
- measurements with 5 min sampling (30 min for soil parameters)
- automatic processing system including data transfer, quality control, product generation, and presentation
- interpolated regular grids for the main parameters (200 m x 200 m UTM grid)
- station and gridded data since Jan 1, 2007 (5 min, half-hourly, hourly, daily, monthly, seasonal and annual data)
- data provision at the data portal with data latency less than 1-2 hours in standard operation

(1) Data Transfer



At the inital step of the automatic processing system, the measurements are transfered via GPRS/internet-attached data loggers (hourly transfer in standard operation) and are stored in a relational database.

Fig. 1: Study area and station locations in the station grid (~1.4 km x 1.4 km). Within the WegenerNet two synoptic stations of the ZAMG are marked by stars. Data transfer is performed by i-logs.

Example Results

Heavy Precipitation Event

On June 24, 2009, a NE-SW oriented precipitation cell caused daily rain amounts of up to 90 mm. Maximum rain rates of almost 25 mm per hour were observed at stations located in the Northeast. This event illustrates the unique resolving power of the network.

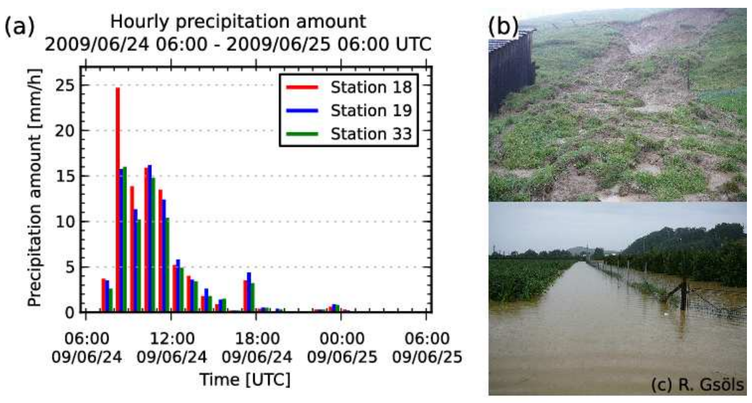


Fig. 4: (a) Hourly precipitation of selected stations in the Northeast of the study area on June 24, 2009, and (b) resulting property damage.

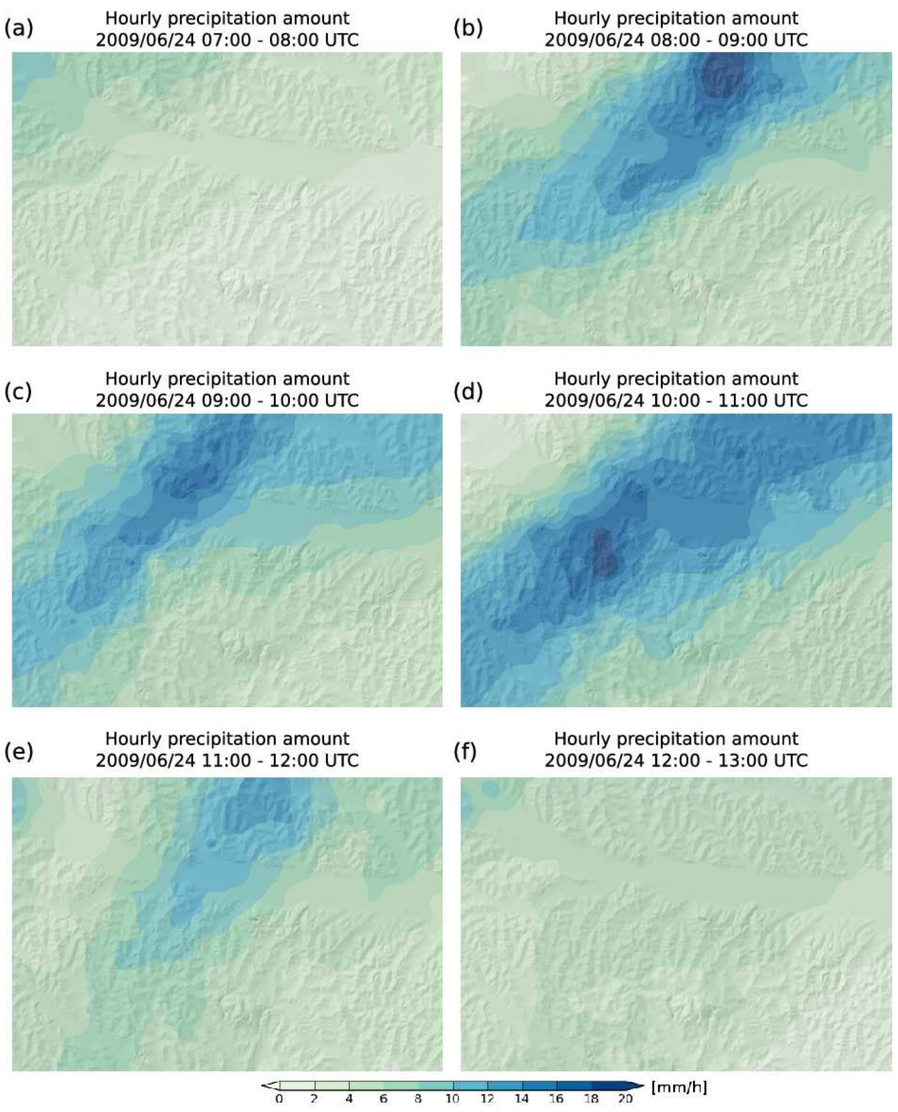


Fig. 5: Spatial distribution of hourly precipitation in the study region on June 24, 2009, 7:00 to 13:00 UTC (hill-shade source is GIS-Steiermark).

Variability of Winter Temperature

Winter temperatures were characterized by a high variability in the last four years. In the warm winter 2007/08, the seasonal area-mean temperature was about 1.3 °C. Cooler conditions occured in the following years and in winter 2010/11 the area-mean temperature was about -0.9 °C. Within the study region, cold areas are mainly found in the northwestern valleys. Higher temperatures are observed in the more southern part due to higher altitudes and a lower fog frequency. The network resolves local-scale differences in the climate conditions.

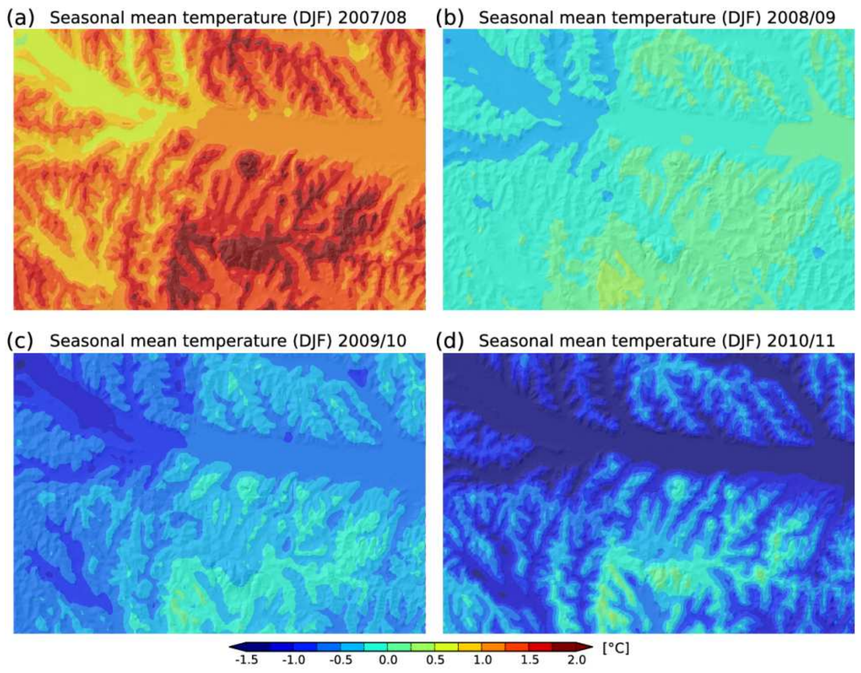


Fig. 6: Winter temperatures in the WegenerNet region from 2007/08 to 2010/11.

(2) Quality Control System

The incoming raw data are tested for their technical and physical plausibility by a quality control system. Each data value gets marked by an appropriate quality flag as follows:

- problems detected in layer *i*: quality flag = *i*-th bit of the flag
- no problems occurred: quality flag = 0

Layer No.	Quality layer
0	operations check
1	availability check
2	sensor check
3	climatological check
4	time variability check
5	intrastation check
6	interstation check
7	external check

Table 1: Quality layers of the quality control system include basic checks for data availability and technical threshold values up to tests of higher complexity.

station_id	meas_time	data_value	quality_flag
47	2007-07-25 05:00:00+00	13.8	0
47	2007-07-25 05:05:00+00	13.86	0
47	2007-07-25 05:10:00+00	13.78	0
47	2007-07-25 05:15:00+00	13.67	0
47	2007-07-25 05:20:00+00	13.72	0
47	2007-07-25 05:25:00+00	13.7	0
47	2007-07-25 05:30:00+00	13.68	0
47	2007-07-25 05:35:00+00	13.8	0
47	2007-07-25 05:40:00+00	13.83	0
47	2007-07-25 05:45:00+00	14.3	0
47	2007-07-25 05:50:00+00	14.67	0
47	2007-07-25 05:55:00+00	15.21	0
47	2007-07-25 06:00:00+00	-61.21	4
47	2007-07-25 06:05:00+00	223.33	4
47	2007-07-25 06:10:00+00	208.94	4
47	2007-07-25 06:15:00+00	212.71	4
47	2007-07-25 06:20:00+00	208.88	4
47	2007-07-25 06:25:00+00	206.57	4
47	2007-07-25 06:30:00+00	22.15	64
47	2007-07-25 06:35:00+00	19.74	0
47	2007-07-25 06:40:00+00	18.15	0
47	2007-07-25 06:45:00+00	18.65	0
47	2007-07-25 06:50:00+00	18.85	0
47	2007-07-25 06:55:00+00	18.95	0
47	2007-07-25 07:00:00+00	19.43	0
47	2007-07-25 07:05:00+00	19.62	0
47	2007-07-25 07:10:00+00	19.84	0
47	2007-07-25 07:15:00+00	20.66	0
47	2007-07-25 07:20:00+00	20.54	0
47	2007-07-25 07:25:00+00	20.23	0

Fig. 2: Example for the detection of erroneous values in the temperature series of the WegenerNet station No. 47.

(3) Data Product Generator

Weather and climate data products are derived on the basis of best quality station data (flag 0) for single stations and regular grids on various temporal scales ranging from 5 min to annual data.

Regular UTM grids (200 m x 200 m) are generated by inverse distance-weighted interpolation, for

- *temperature* (1/r; at reference altitude of 300 m and two orographic grids based on a DEM at 10 m x 10 m resolution),
- *precipitation* (1/r²) and
- *relative humidity* (1/r).

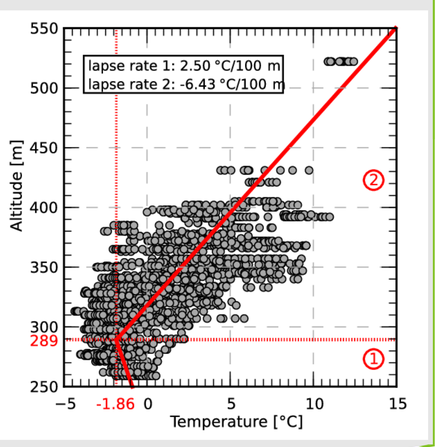
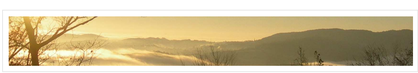


Fig. 3: Example for piecewise-linear regression line for vertical temperature interpolation; 1 hour time window of station data at all altitudes centered at 2011/02/07 07:25 (UTC).

Conclusions & Outlook



The WegenerNet provides a new data set of meteorological parameters with high temporal and spatial resolution for many climate and environmental research themes on regional to local scale. All measurements are integrated in an automatic processing system from the data transfer and preparation up to the provision of derived data products at the WegenerNet data portal (data latency less than 1-2 hours in standard operation).

The next steps focus on further development of the data processing and the data products including gridded data of other measured and derived parameters (e.g., wind, heat index).

For further information on the WegenerNet (incl. sponsors and support partners) and for data access see:

- WegenerNet homepage: www.wegcenter.at/wegenernet
- WegenerNet data portal: www.wegenernet.org

(4) WegenerNet Data Portal

All data products and further meta-information on the network (incl. observational sites and sensors) are provided at the WegenerNet data portal. Station data and gridded data are prepared for download (csv, NetCDF) and visualization (quick-look feature).

References

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