

The WegenerNet 3D weather and climate research facility: A unique open-air laboratory for high-resolution precipitation studies

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Online display @ EGU 2020 Sharing Geoscience Online - Sess. AS1.36, Pres. D3197 - 7 May 2020



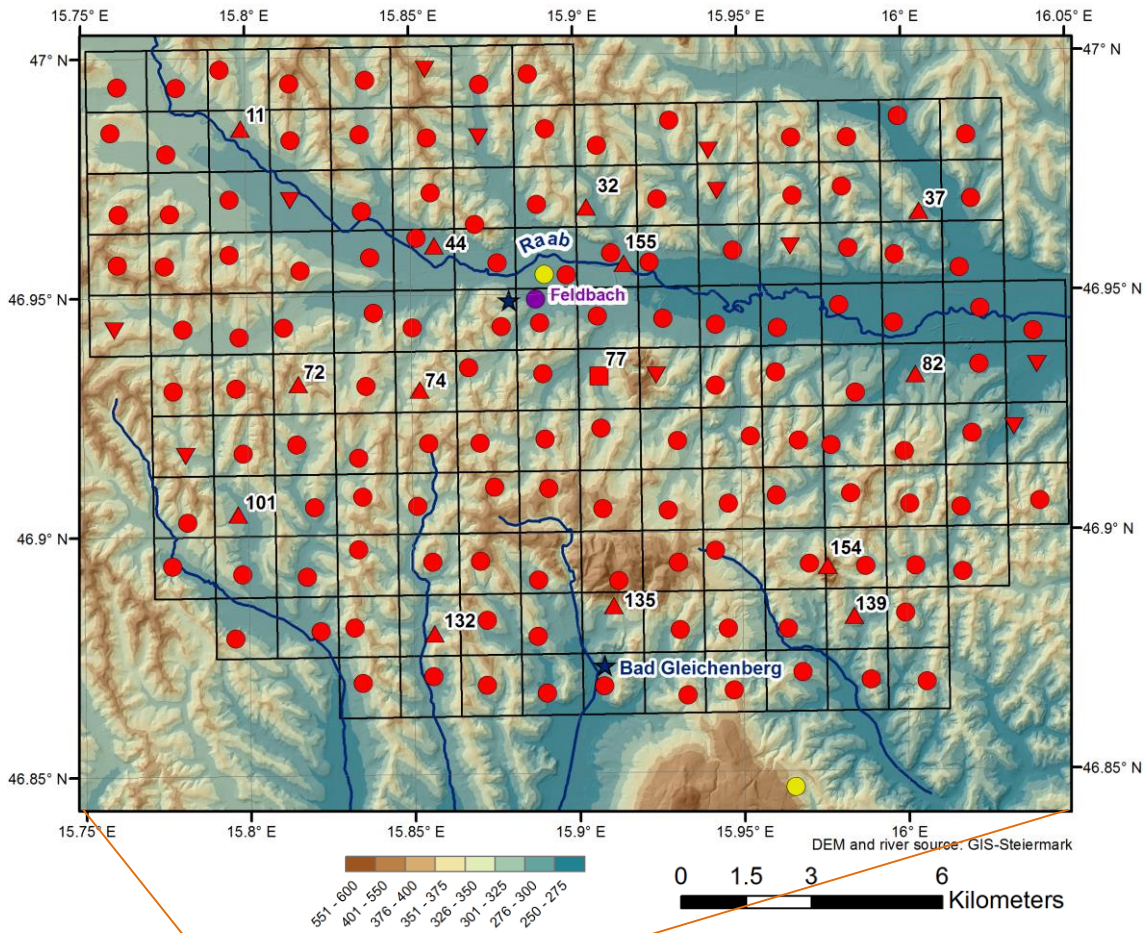
Das Land
Steiermark



Stadt **GRAZ** Wissenschaft

Further info on partners & sponsors: www.wegcenter.at/wegenernet

Introduction: The WegenerNet Feldbach Region



Key features of the WegenerNet:

- Pioneering high-resolution network for long-term monitoring of weather and climate
- 155 climate stations (red symbols in map) located in the southeastern Alpine foreland in Austria
- ~22 km x 16 km region
- Station grid with a station every about 2 km²
- Elevation range ~250 m to 600 m,
- Highest station elevation: 520 m
- More than 13 years of data (start: 1st January 2007)
- Main parameters: Temperature, rel. humidity, and precipitation, measured at all stations
- At 13 stations additional measurements of wind and solid precipitation (heated rain gauges)
- At 12 Stations soil moisture and soil temperature measurements
- Reference station additionally measures air pressure and net radiation balance
- Measurement sampling rate 1 min to 5 min
- Data available at www.wegenernet.org






WegenerNet extension: 3D open-air laboratory

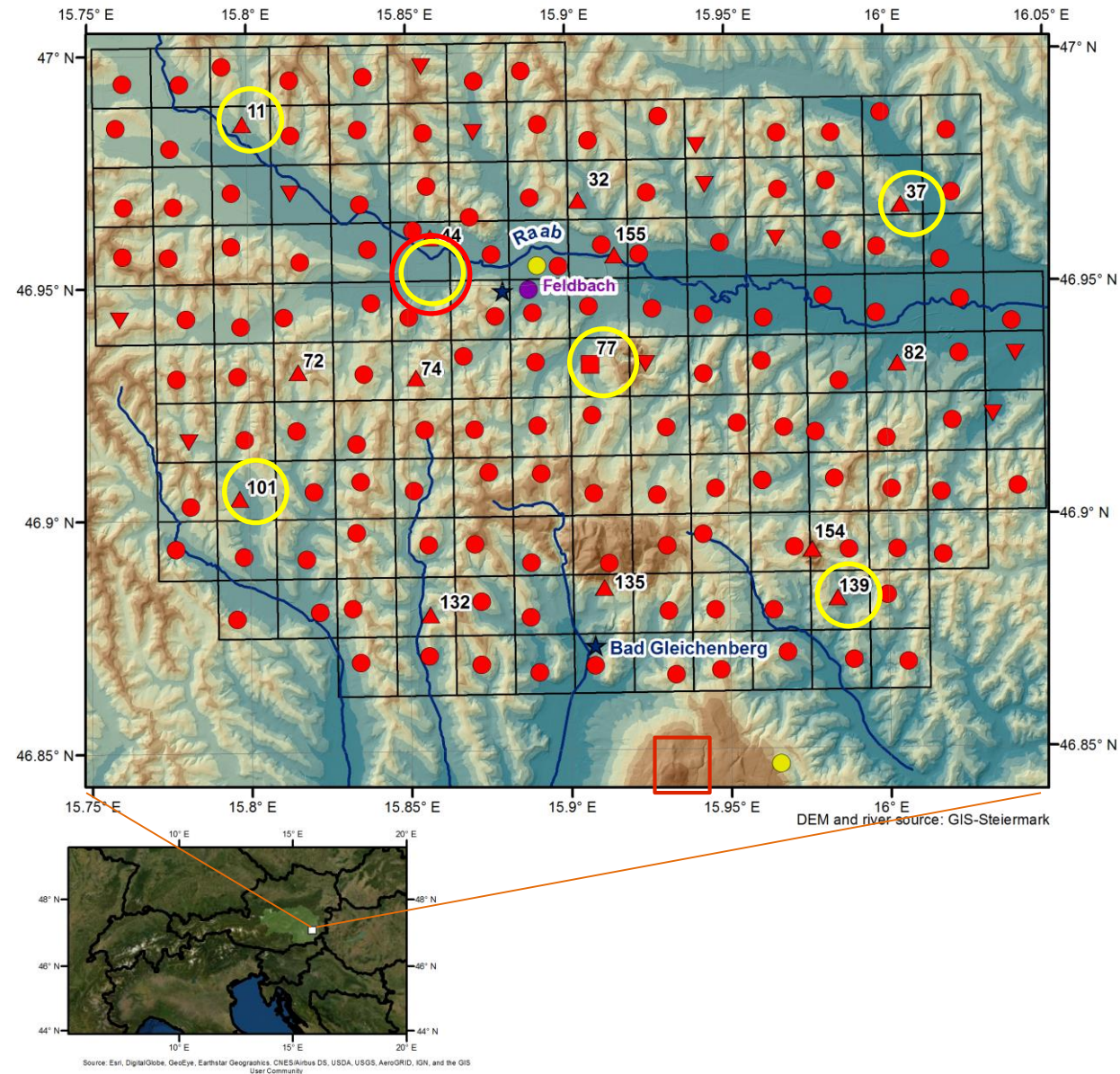
Currently, the WegenerNet is being converted into a 3D open-air laboratory for weather and climate research at very high resolution.

In this scope, three new types of observing components are added to the network:

- A polarimetric X-band Doppler precipitation radar
- An azimuth-steerable microwave/IR radiometer
- A water vapor mapping high-resolution Global Navigation Satellite System (GNSS) six-station network (“GNSS-StarNet”)

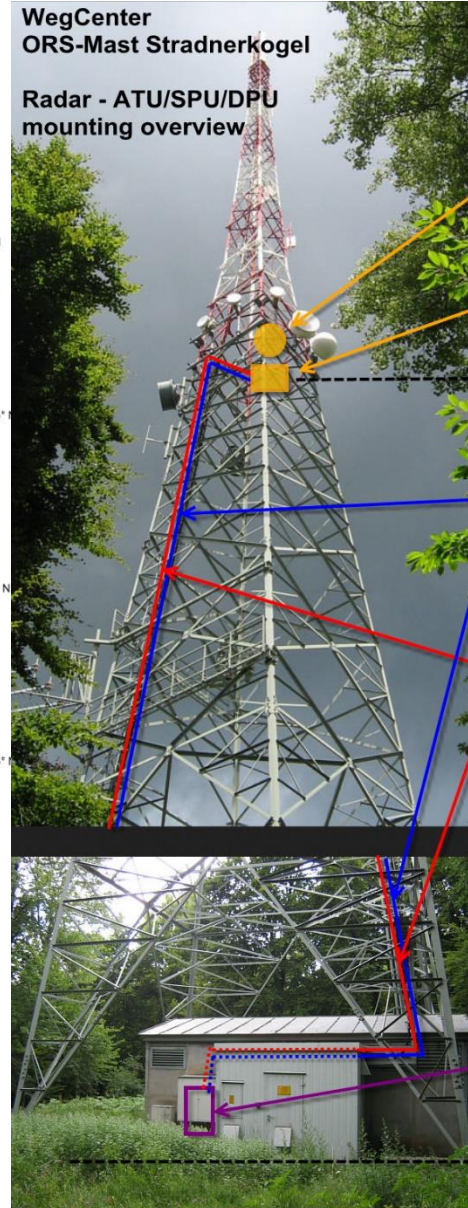
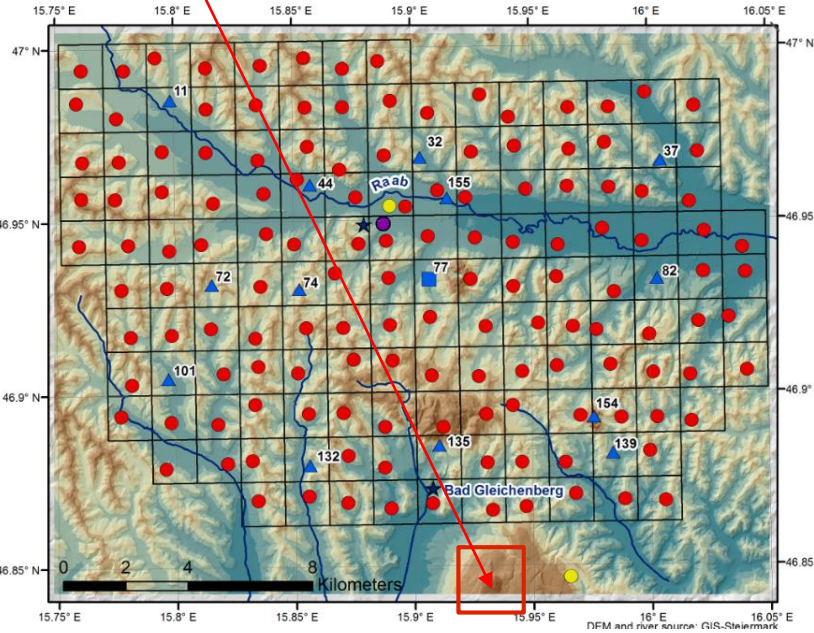
The three components are marked by these symbols in the map:

-  X-Band Precipitation Radar
-  GNSS-StarNet (6 GNSS sensors)
-  Tropospheric Profiling Radiometer



Extension 1: Polarimetric X-Band precipitation radar Stradnerkogel

Location: Mount Stradnerkogel at 609 m above sea level.



WegCenter
ORS-Mast Stradnerkogel
Radar - ATU/SPU/DPU
mounting overview

ATU
(Radar Dome, on
Dome Mount
Platform)

SPU
(within Dome
Mount Platform)

41m / ~ 650m ü.d.M

Data line
(optical fiber)
MM, 1GBs min, OM3 ok,
outdoor, LC connectors
confected (beware/secure
when installing cable on mast
the LC connectors)

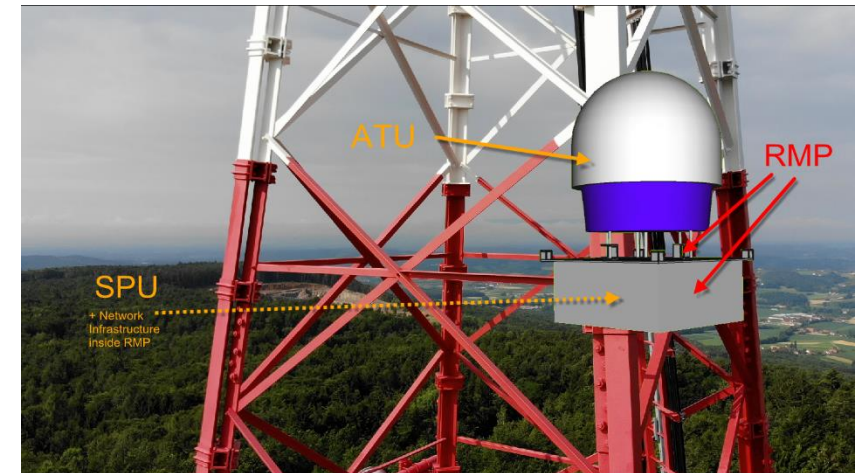
Power Line
(5x 1,5 mm², NYCY)
Helukabel 32220-100 Erdkabel NYCY
5 x 1.50 mm² Schwarz 100 m

1x 2 power for
adapters/switch/convert (durable)
1x 2 power for SPU unit only (variable
operation, ground controlled)
1x 1 ground (replaces green/yellow)

**DPU & further
equipment**
(within 19" rack within
ORS-shelter)

0m / ~ 609m ü.d.M

Mounted on a 81 m tall radio mast,
about half-level, at 41 m height.



SPU
+ Network
Infrastructure
inside RMP

ATU

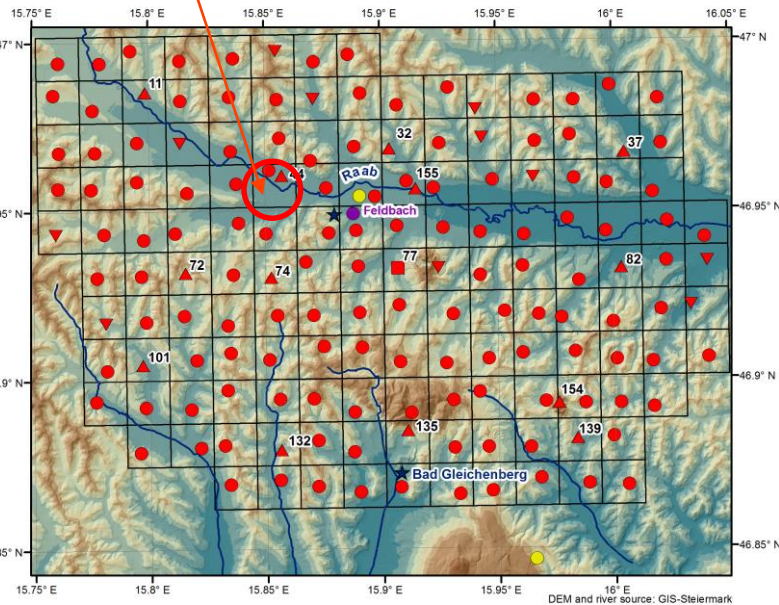
RMP



- Type Furuno WR-2120
- Polarimetric X-band weather radar operating at ~9.4 GHz
- Native resolution: 2.7° angular, 300 m radial
- Resolution of processed 3D volume data: 1 km x 1 km horizontal, 500 m vertical
- Observation range: 35 km (up to 70 km for case studies)
- 5-min time sampling (full 3D volume; down to 30 s for case studies)
- Peak output power: 100 W
- Advanced pulse compression techniques
- Output products: Rainfall intensity R (mm/h), Reflectivity Z_h and Z_v (dBZ), Doppler velocity V (m/s), Doppler velocity width W (m/s), Cross polarization difference phase ϕ_{dp} (deg), Specific differential phase KDP (deg/km), Correlation coefficient between the two polarizations, Horizontal and Vertical Differential reflectivity ZDR (dB)
- Further derived products: Hydrometeor classification, drop size distribution
- Deployment on the radio mast and start of operations in May 2020

Extension 2: Tropospheric profiling microwave/IR radiometer

Location “Central Station Raabtal” (156):
Rooftop (~27 m above ground) of office
building in central valley of the region



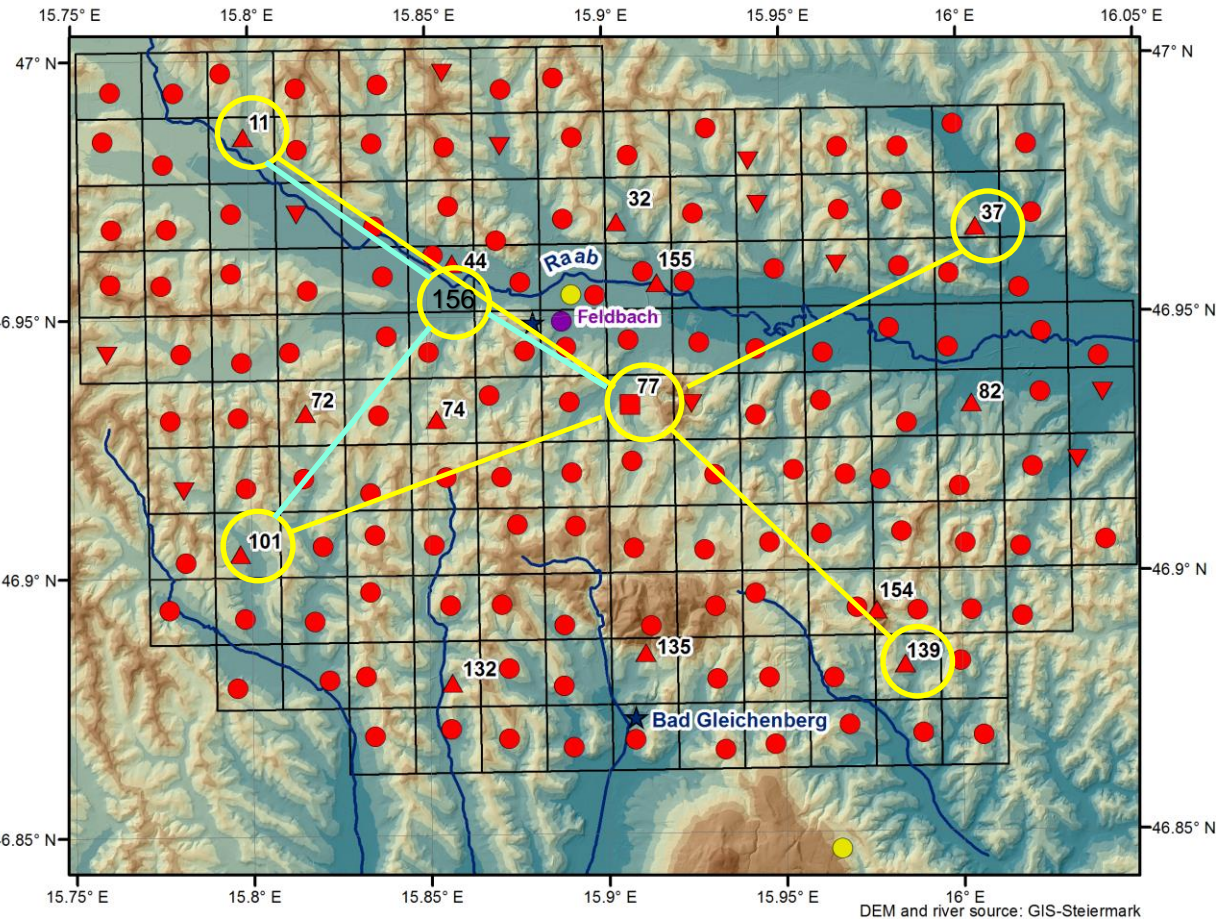


Picture source: GFZ Potsdam

- Type: RPG-HATPRO-G5
- Humidity and temperature profiling microwave/IR radiometer
- Multi-directional azimuth and elevation scanning
- 7 channels between 22.24 GHz and 31.40 GHz (focus humidity)
- 7 channels between 51.26 GHz and 58.00 GHz (focus temperature)
- IR radiometer at 9.6-11.5 μm band
- Vertical grid resolution of ≤ 60 m in boundary layer (at < 1.5 km altitude) and ≤ 300 m in free troposphere (1.5 km to 10 km)
- Observation range: 0 m to 10000 m
- 5-min time sampling (for full 3D scene for chosen ops mode)
- Capable of GNSS satellite tracking for GNSS-line-of-sight integrated water vapor (IWV) observations
- Output products: temperature, humidity, and liquid water profiles; IWV, liquid water path, cloud base height
- temperature profiling with an accuracy of ~ 0.5 K or better in boundary layer and ~ 1 K or better in free troposphere
- relative humidity profiling with an accuracy of ~ 5 % or better in the lower troposphere (< 5 km altitude);
- Installation in September/October 2020 timeframe

Extension 3: GNSS six-station network “GNSS-StarNet”

Station locations:



- GNSS-StarNet “Main Star”
- GNSS-StarNet “Embedded Star”

- 6 GNSS stations within WegenerNet region (at WegenerNet station no.s 11, 37, 77, 101, 139, 156), built and operated jointly with the GFZ Potsdam (J. Wickert and Team)
- Two star-shaped subnets:
 - „Main Star“: 5-star with ~10 km interstation distances, consisting of stations 11, 37, 77, 101, 139
 - „Embedded Star“: 4-star with ~5 km interstation distances, consisting of stations 11, 156, 77, 101
 - Station 156 (center of the Embedded Star) will be GRUAN¹ standard (Choke-ring antenna, collocated tropospheric profiling radiometer measurements, etc.)

¹Global Climate Observing System Reference Upper-Air Network (www.gruan.org).



Picture source: GFZ Potsdam

- Receiver type: Septentrio PolaRx5 FULL
- Antenna type at five standard stations: Septentrio PolaNt-x MF
- Antenna type at GRUAN station (at Central Station Raabtal, 156): Septentrio PolaNT Choke Ring B3/E6
- Mapping of water vapor columns
- 15-min time sampling (slant total delays 2.5 min)
- Main data products: Vertically Integrated Water Vapor [kg m^2], Zenith Wet Delay [mm], Zenith Total Delay [mm], Slant Total Delay [mm]
- Installation in Summer 2020
- Operated in cooperation with GFZ Potsdam, providing station monitoring and processing towards the main data products

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.

<https://doi.org/10.1175/BAMS-D-11-00161.1>

Fuchsberger, J., G. Kirchengast, and T. Kabas (2018):

Release Notes for Version 7 of the WegenerNet Processing System (WPS Level-2 data v7). Wegener Center, University of Graz, Graz, Austria, WegenerNet Tech. Report No. 1/2018, Version 1.1.

https://wegenernet.org/downloads/Fuchsberger-etal_2018_WPSv7-release-notes.pdf

Data availability:

DOI:

Fuchsberger J., G. Kirchengast, C. Bichler, A. Leuprecht, and T. Kabas (2020):

WegenerNet climate station network Level 2 data version 7.1 (2007–2019).

University of Graz, Wegener Center for Climate and Global Change, Graz, Austria. <https://doi.org/10.25364/WEGC/WPS7.1:2020.1>

Data portal: www.wegenernet.org

Homepage: www.wegcenter.at/wegenernet

Provider information:

Weather radar: <https://furuno-weather-radar.com>

Radiometer: <https://www.radiometer-physics.de>

GNSS infrastructure: <https://www.gfz-potsdam.de/en/section/space-geodetic-techniques/projects/gnss-infrastructure/>