WegenerNet Feldbach Region Site News 2020: from a 2D Climate Station Network to a 3D Open Air Laboratory for Climate Change and Managed Ecosystems Research

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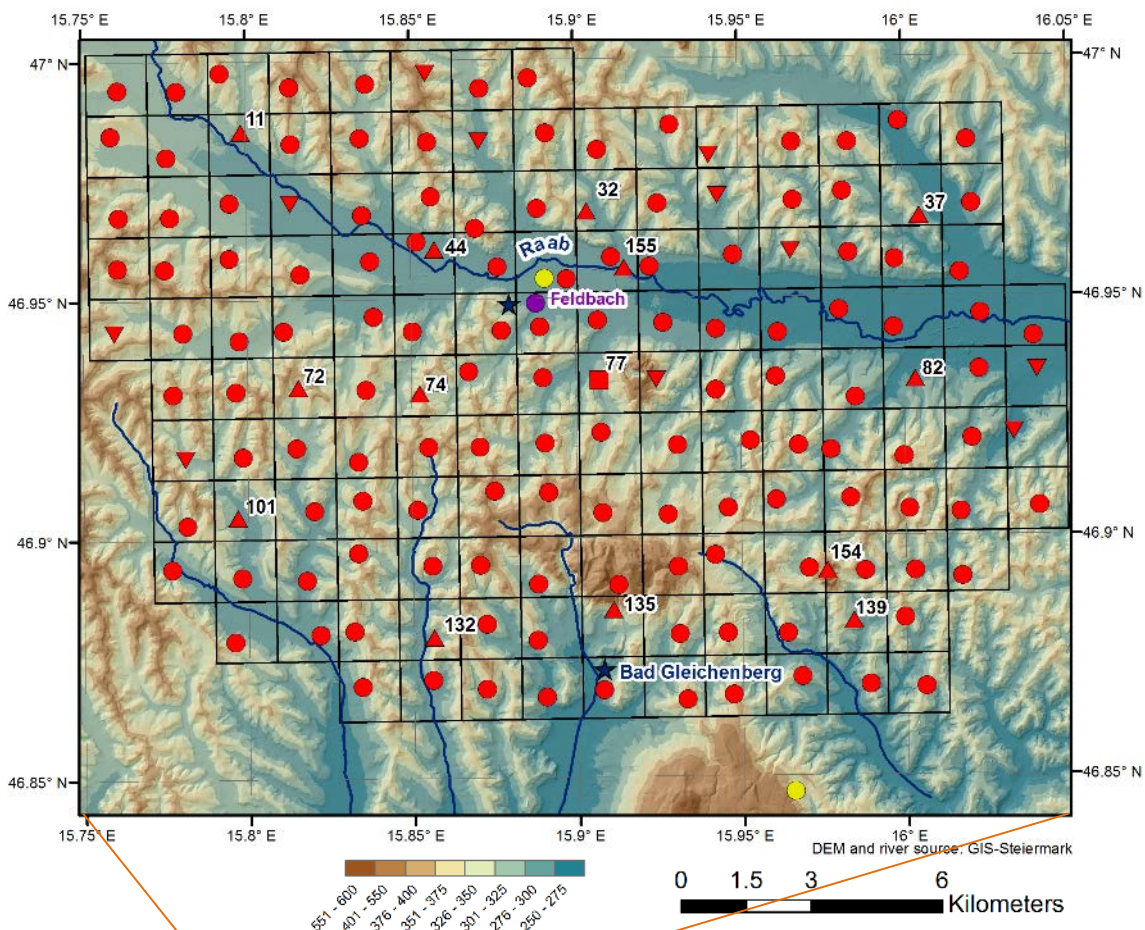
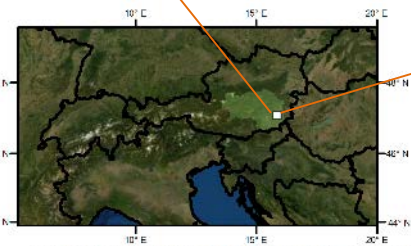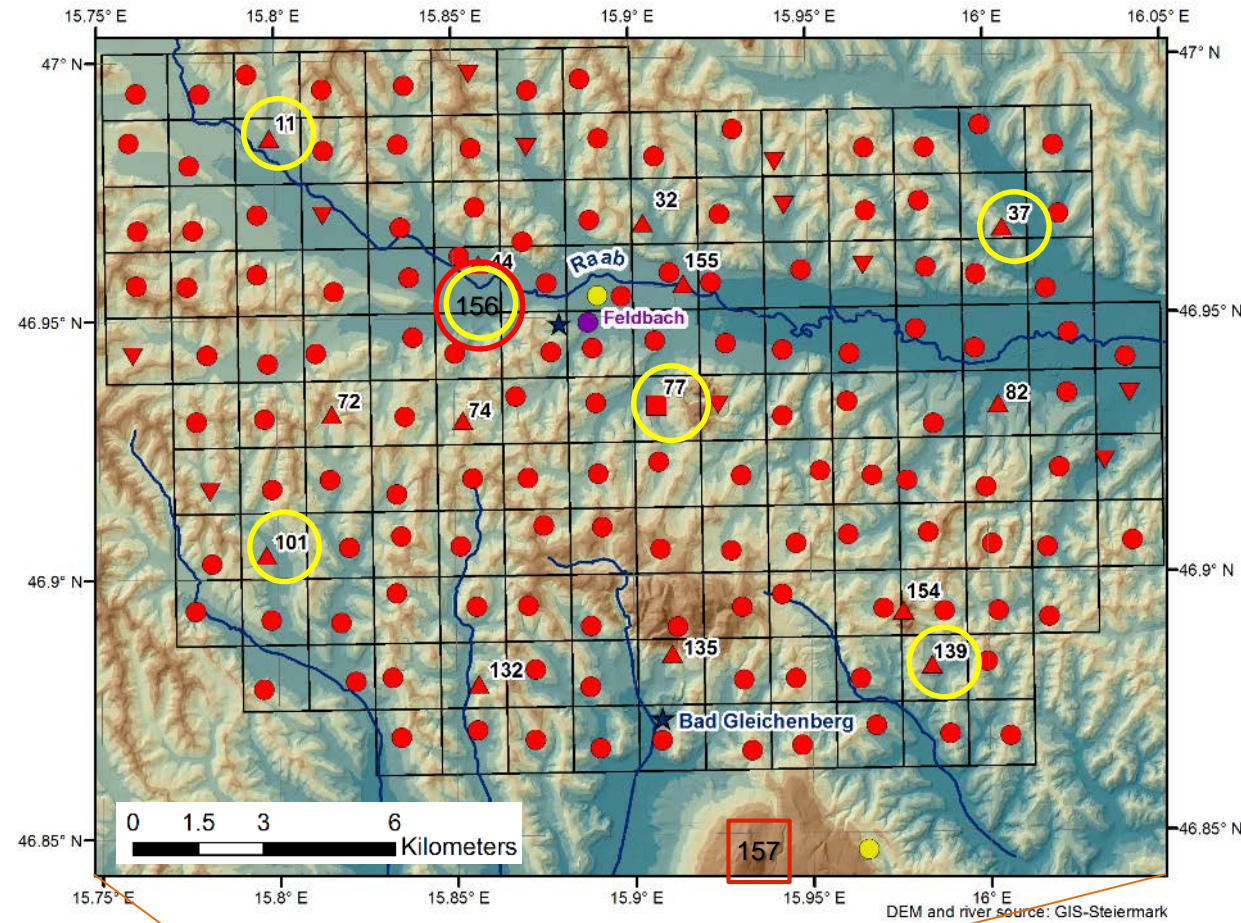Further info on partners & sponsors: www.wegcenter.at/wegenernet

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: from 2D to 3D open-air laboratory as of 2020

DEM and river source: GIS-Steiermark

Currently, the WegenerNet is being converted into a 3D open-air laboratory for climate change research

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 new components are marked by these symbols in the map:

⬜ Wetterradar Stradnerkogel

🟡 Sechs GNSS Wasserdampf-Sensoren

🔴 Troposhärenprofiling-Radiometer

Location: Mount Stradnerkogel at 609 m above sea level.

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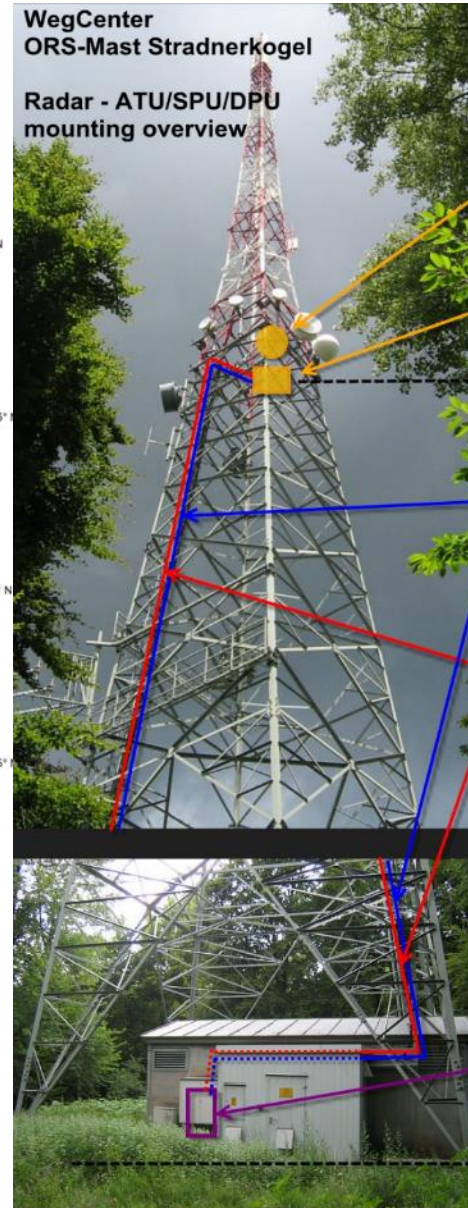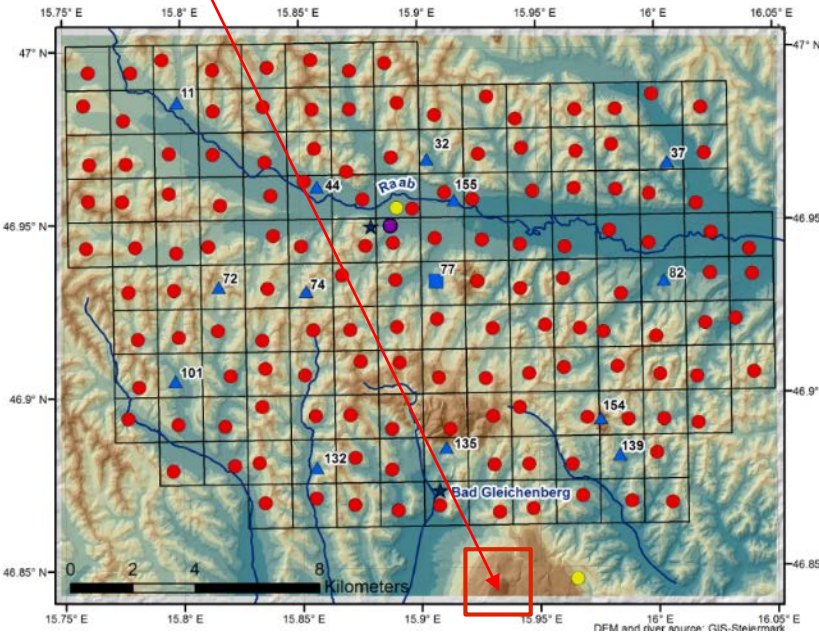
WegCenter
ORS-Mast Stradnerkogel

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/converter (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

Polarimetric X-Band precipitation radar: just mounted 20th May 2020:)

# Polarimetric X-Band precipitation radar: Specifications and data products

- 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 Zh and Zv (dBZ), Doppler velocity V (m/s), Doppler velocity width W (m/s), Cross polarization difference phase φdp (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

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

Picture source: GFZ Potsdam

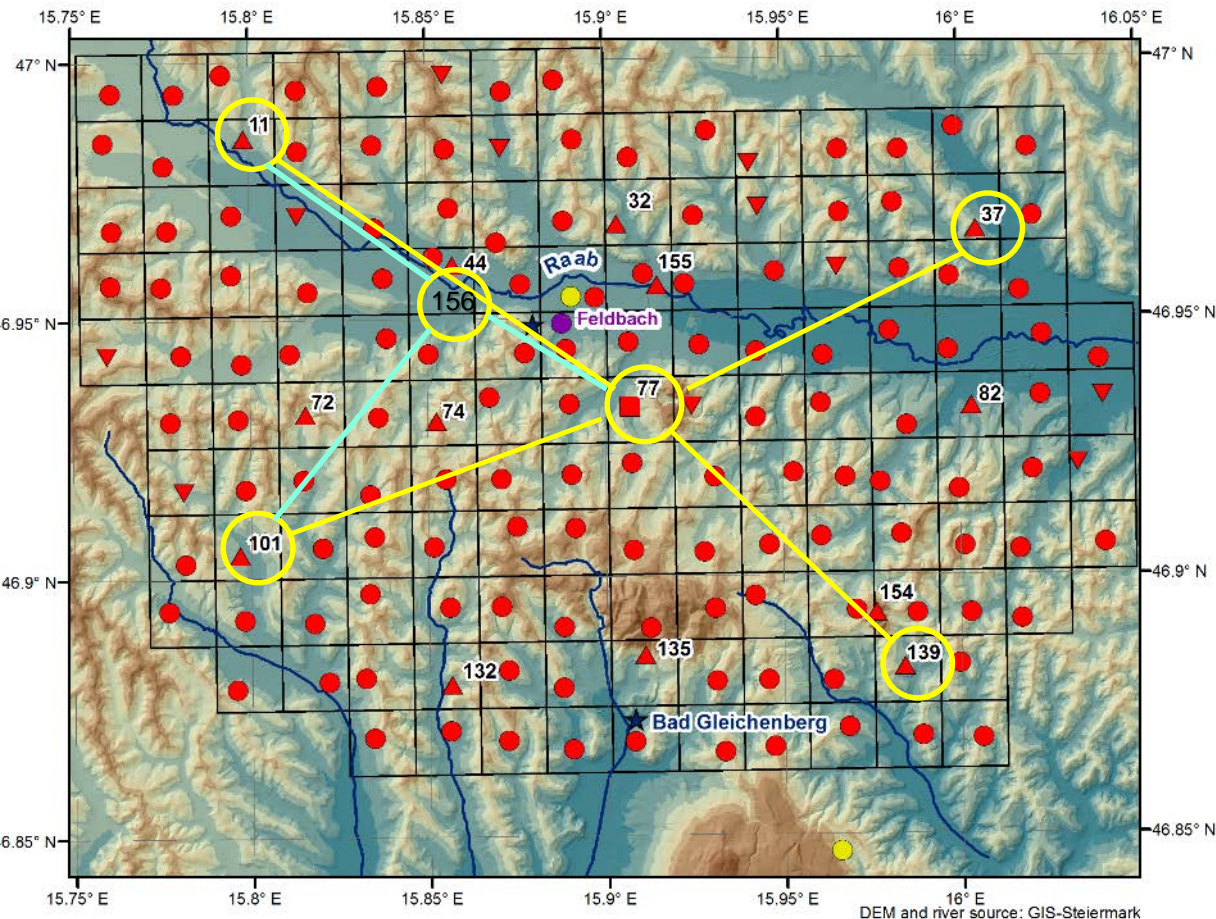# Tropospheric profiling radiometers: Specifications and data products
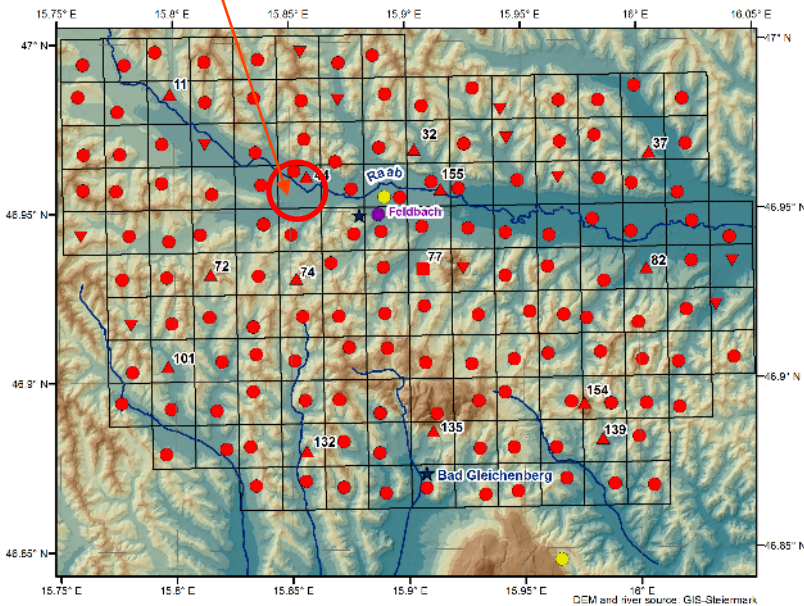
Picture source: GFZ Potsdam

- Type: RPG-HATPRO-G5
- Humidity and temperature profiling microwave 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)
- Plus IR radiometer at 9.6-11.5 μm band, for cloud-related properties
- 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

Station locations:

- 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 GRUAN[1] standard (Choke-ring antenna, collocated tropospheric profiling radiometer measurements, etc.)
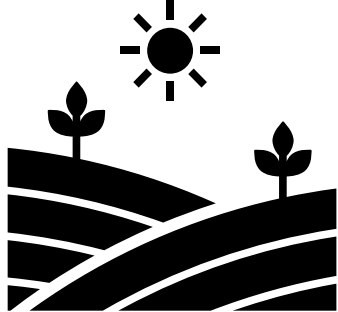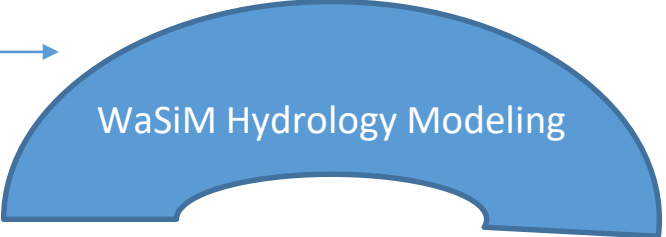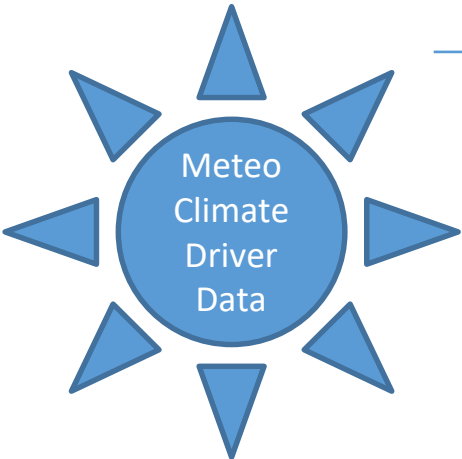
————— GNSS-StarNet "Main Star"

————— GNSS-StarNet "Embedded Star"

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

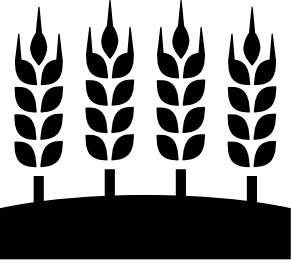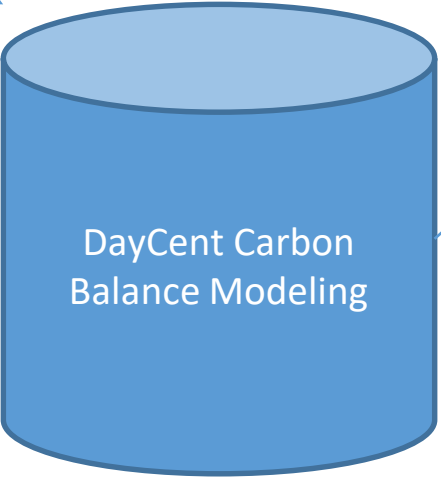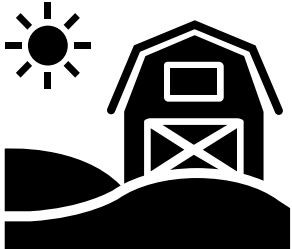# GNSS-StarNet: Specifications and data products

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

Towards including Managed Ecosystems Reserarch and towards the WegenerNet Open Data & Science Superegion Southeastern Austria

Meteo Climate Driver Data

WaSiM Hydrology Modeling

DayCent Carbon Balance Modeling

Land use and management

Soil data

Sustainable whole system ecosystem research

We work for **tomorrow**

Preliminary example results DayCent (1)

Total Soil Organic C
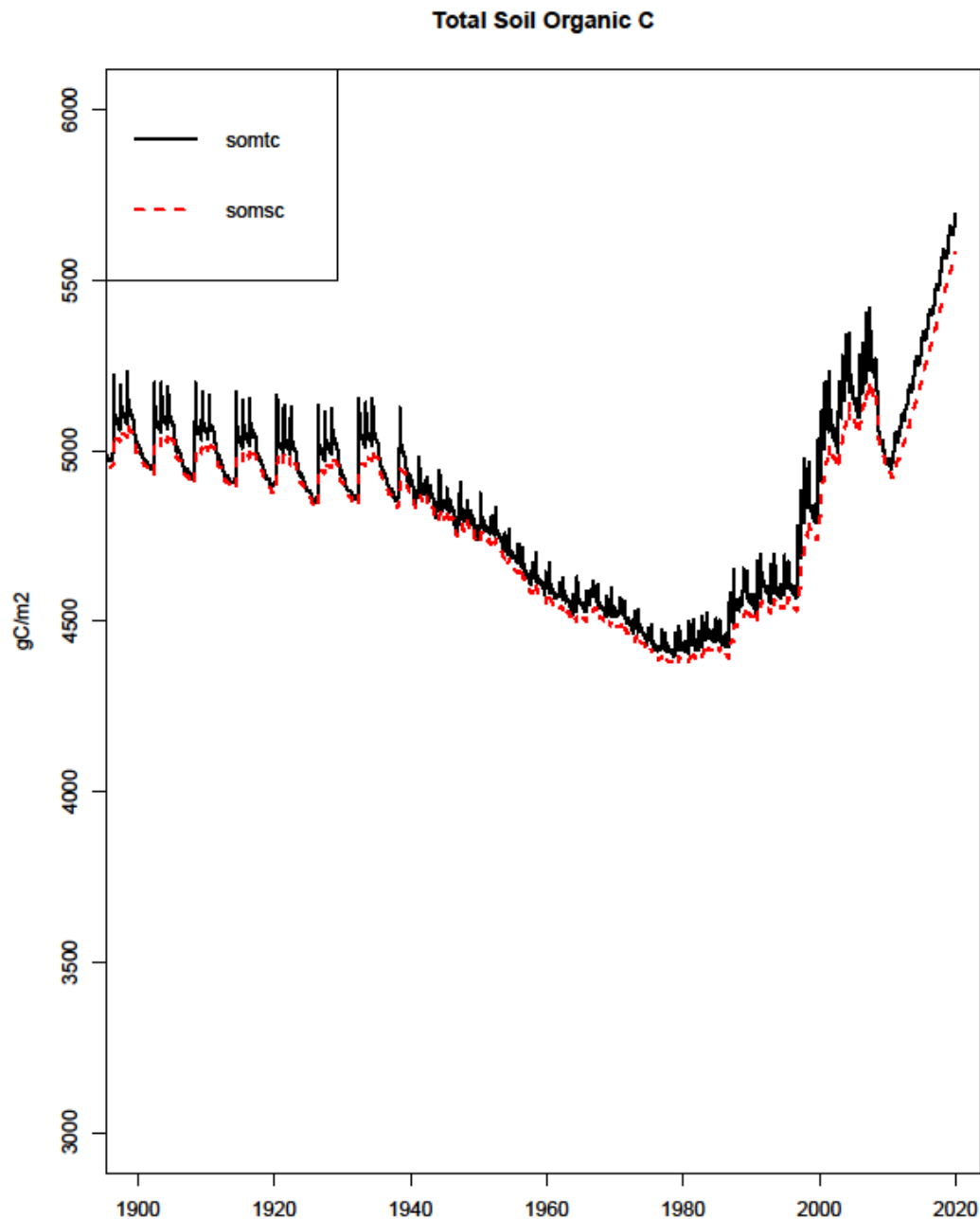
- Development of total and soil carbon at Feldbach station
- Modeled using DAYCENT
- Increase in 2000 conincides with the planting of Miscanthus on former agricultural fields
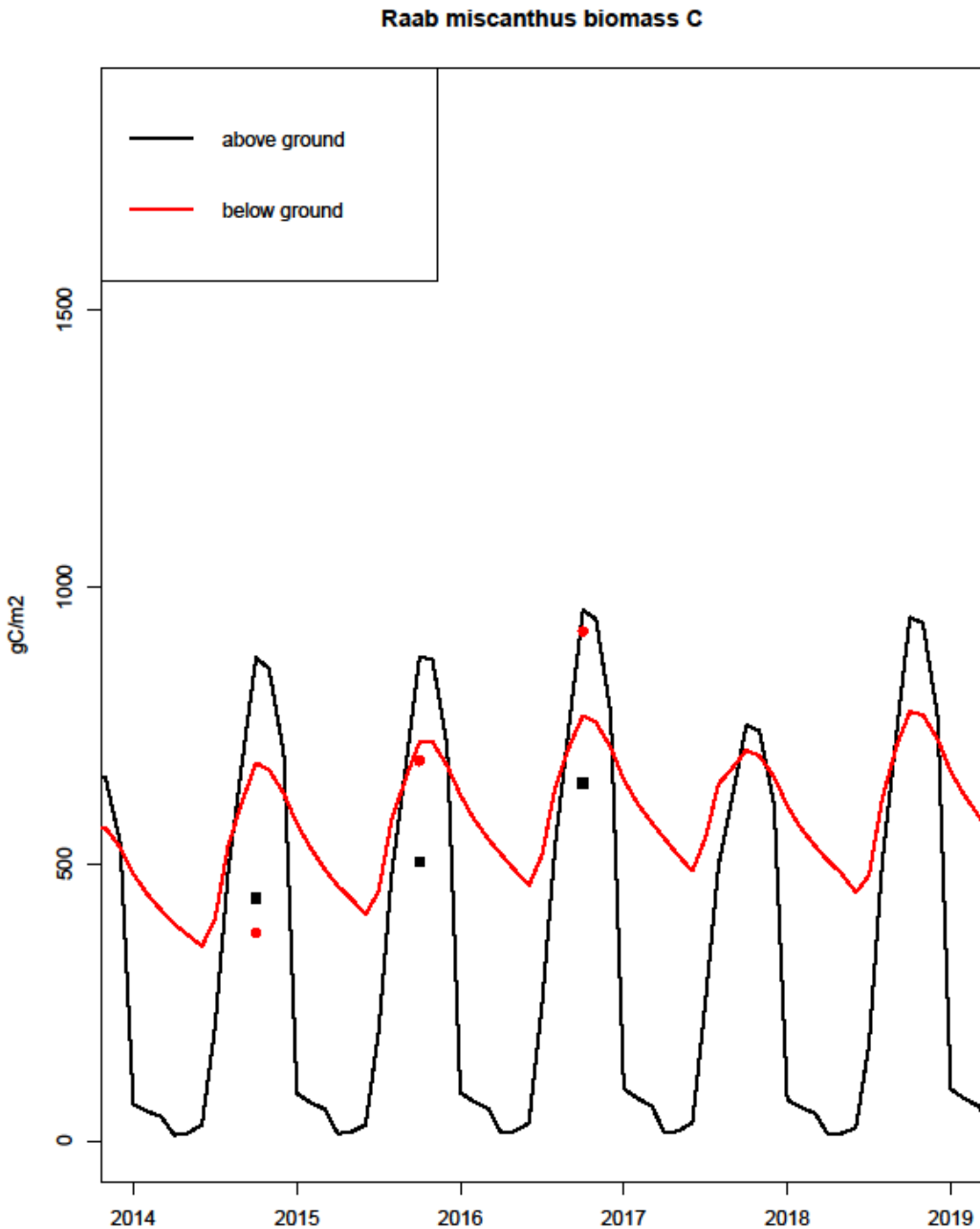
We work for **tomorrow**

Preliminary example results DayCent (2)

Raab miscanthus biomass C

- Development of above and below ground carbon under Miscanthus at Feldbach
- Modeled using DAYCENT

We work for **tomorrow**

Preliminary example results DayCent (3)

Live and Dead GrassTree C (miscanthus)
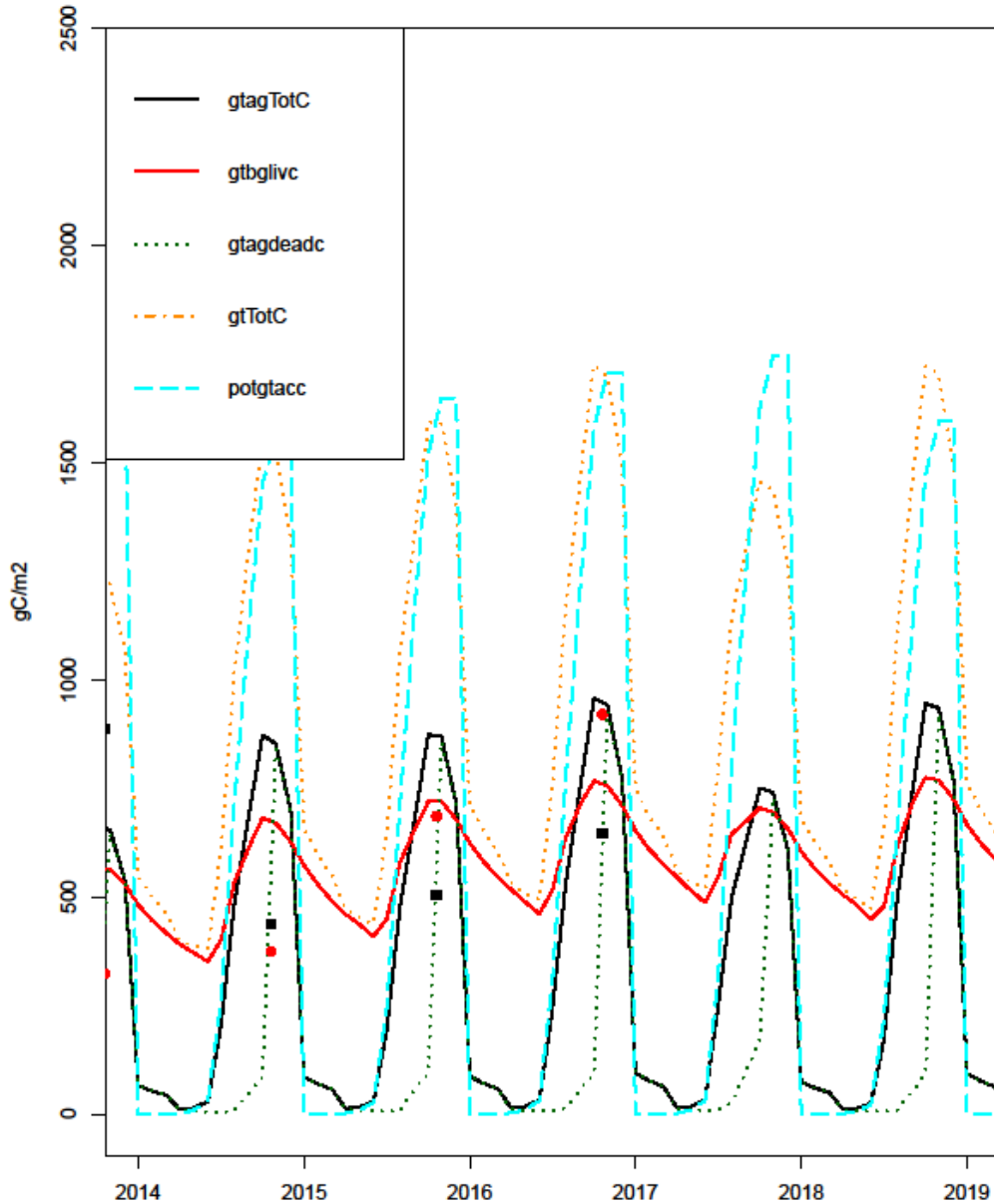
- Development of carbon in living and death Miscanthus
- Modeled using DAYCENT

We work for **tomorrow**

References and further Information

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/