

The WegenerNet 3D Open-Air Laboratory for Climate Change Research: A unique facility for high-resolution weather and climate studies

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The WegenerNet Feldbach Region is a unique weather and climate observation network comprising 156 hydrometeorological stations measuring temperature, humidity, precipitation, and at particular locations wind speed and direction as well as other parameters. The measurement stations are placed in a tightly spaced grid within a core area of 22 km x 16 km centered near the city of Feldbach (46.93°N, 15.90°E), in southeastern Austria. Each station has provided fully automated regular measurements with 5-min time sampling since January 2007.

In 2020, four major new components were added to the station network, expanding it from a 2D ground station hydrometeorological network into a 3D open-air laboratory for climate change research with very high spatiotemporal resolution. These new atmospheric 3D-observation components consist of:

1. A polarimetric X-band Doppler weather radar for studying precipitation parameters in the troposphere above the ground network, such as rain rate, hydrometeor classification, Doppler velocity, and approximate drop size distribution and number: it can provide 3D volume data (at about 500 m horizontal and vertical resolution and 2.5 min time sampling) for moderate to strong precipitation. Together with the dense ground network, this allows detailed studies of heavy precipitation events with high resolution and accuracy.

2. An azimuth- and elevation-steerable microwave atmospheric-profiling radiometer with built-in auxiliary infrared radiometer for vertical profiling of temperature, humidity, and cloud liquid water in the troposphere above the WegenerNet area (with about 100 m to 1 km vertical resolution and 10 min time sampling), also capable of measuring cloud-base heights, vertically integrated water vapor (IWV), and slant IWV at arbitrary azimuth and elevation settings.

3. An infrared cloud structure radiometer at similar spatiotemporal sampling for further refining gridded cloud-base height calculations and enabling multi-layer cloud-field reconstruction over the WegenerNet area, providing 3D cloud-field (multi-layered cloud fraction) estimates.

4. A water-vapor-mapping high-resolution GNSS station network named GNSS-StarNet, comprising six ground stations and spatially forming two star-shaped subnets across the

WegenerNet area, for providing slant IWV, vertical IWV, and precipitable water, among other parameters, at 2.5 to 15 min time sampling.

The new components, together with the existing ground network, provide a unique setup for studying extreme meteorological events such as heavy precipitation, hailstorms, droughts, and heat waves at very high resolution. We will present the up-to-date status of the WegenerNet 3D and show examples of its output products.

Source:

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WegenerNet high-resolution weather and climate data from 2007 to 2020

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