WegenerNet Climate Station Networks: Overview and Examples

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WegenerNet - Brief Overview

a) Feldbach Region (FBR)

- 153 meteorological stations within ~22 km x 15 km area
- 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 regular grids for main parameters (200 m x 200 m UTM)
- data provided at data portal (www.wegenernet.org)
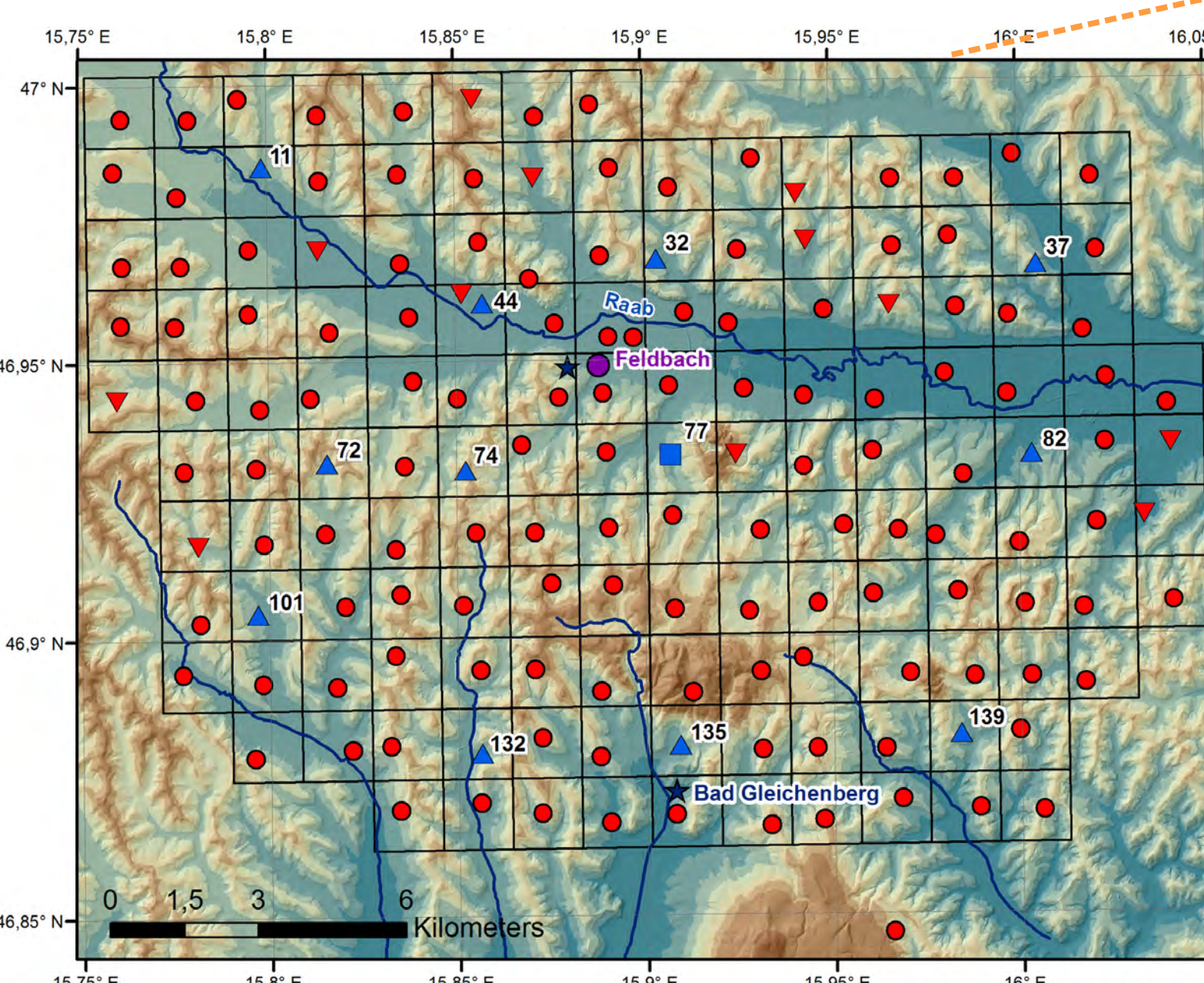- data available since January 1, 2007

Fig. 1: Location of study areas (FBR: orange rectangle, JBT: yellow rectangle)

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
- parameters: air temperature, relative humidity, precipitation, wind, radiation, and snow depth
- 10 minute sampling
- automatic processing
- quality controlled data provided via data portal
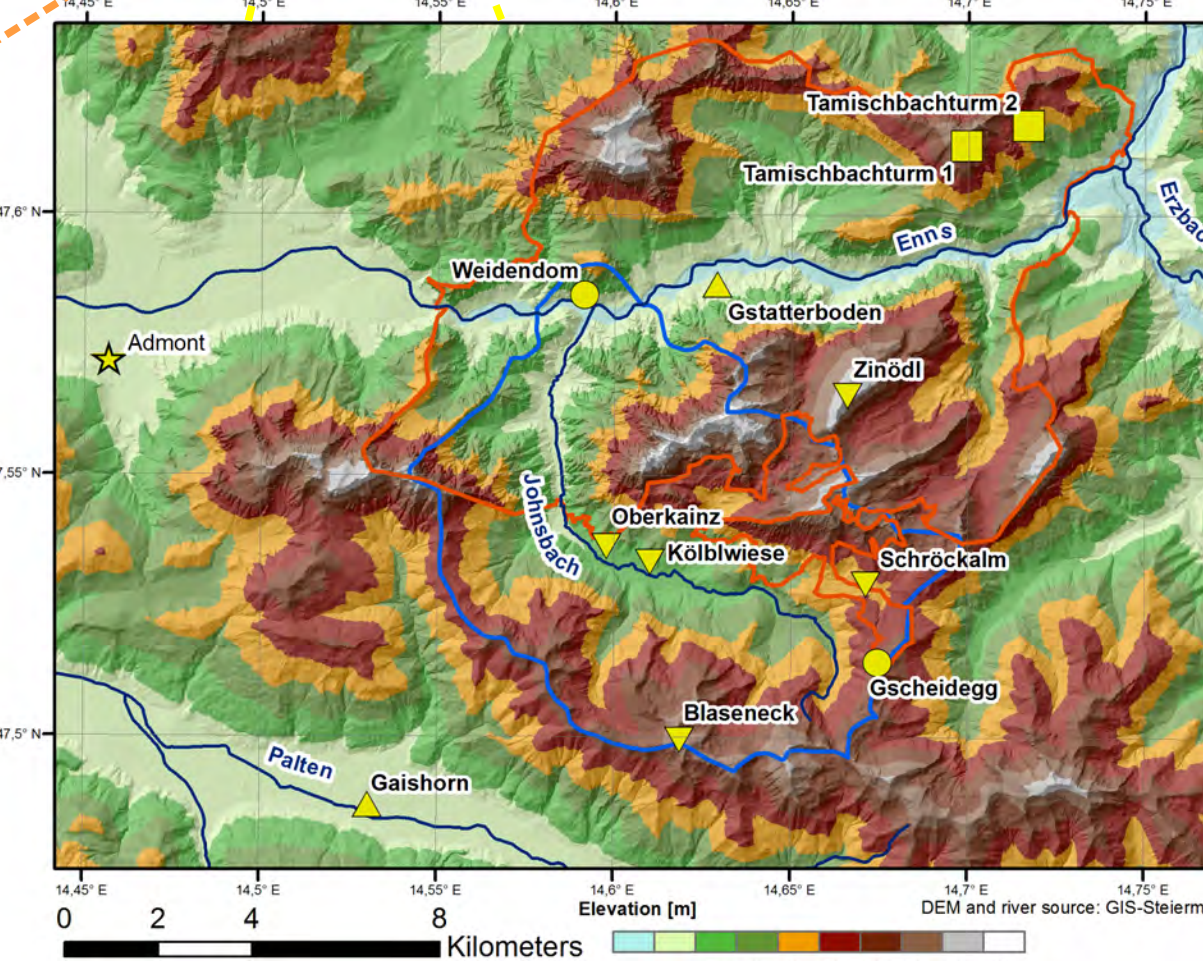- data available partly since October 2010, partly since January 1, 2007

Fig. 2a: WegenerNet Feldbach Region (23 km x 18 km, mean alt. ~330 m) and station locations in the station grid. ZAMG stations are marked by stars, stations with wind sensors by upward looking triangles and stations with soil sensors by downward looking triangles.

Fig. 2b: WegenerNet Johnsbachtal area (25 km x 18 km), station locations (yellow), catchment (blue), and border of the Gesäuse National Park (red). WEGC Stations (five) are marked by downward looking triangles, partner stations by upward triangles, circles, and squares; ZAMG reference station by a star.

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

Example 1: Climatological Temperature Fields and Trends

A monthly-mean temperature field (**Fig. 3a**), and a monthly-mean temperature field after noontime (13:00-14:00 LT) (**Fig. 3b**), for July 2008 show the ability to characterize local-scale climate: Data in **Fig. 3a** indicate a moderate urban heat island effect for the cities of Feldbach (center) and Bad Gleichenberg (south), while **Fig. 3b** clearly shows the topography, with the Raab valley being warmest and hilltops coolest.

Figs. 4a-c show temperature anomaly time series and trends from the period 1971-2015/16 using data from HISTALP Bad Gleichenberg (black), a regional mean of SE-Styria (yellow) and from WegenerNet FBR (red). The resulting trends were evaluated by the confidence ranges at the 95 % confidence level. **Fig. 4a** shows yearly anomalies with trends of 0.45 °C/decade, anomalies for summer (JJA) seasons in **Fig. 4b** give pronounced trends of around 0.7 °C/decade. **Fig. 4c** shows winter (DJF) anomalies with high variability of warmer and cooler periods resulting in slightly positive tendencies. WegenerNet FBR data was used for the time series since 2007/08 and confirm a high consistency compared to other independent data sources.
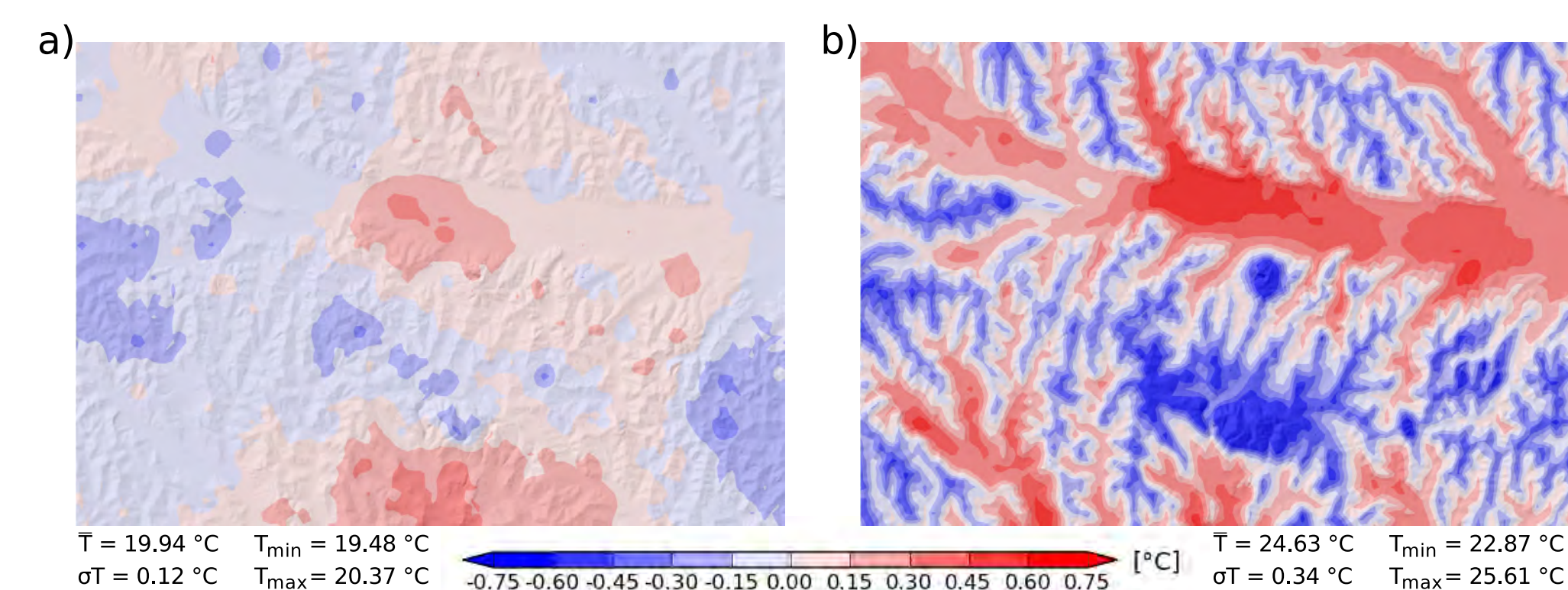
Fig. 3: Spatial grids of WegenerNet FBR climatological temperature data for July 2008. (a) Monthly-mean temperature anomaly and (b) monthly-mean temperature anomaly after noontime (13:00-14:00 LT).
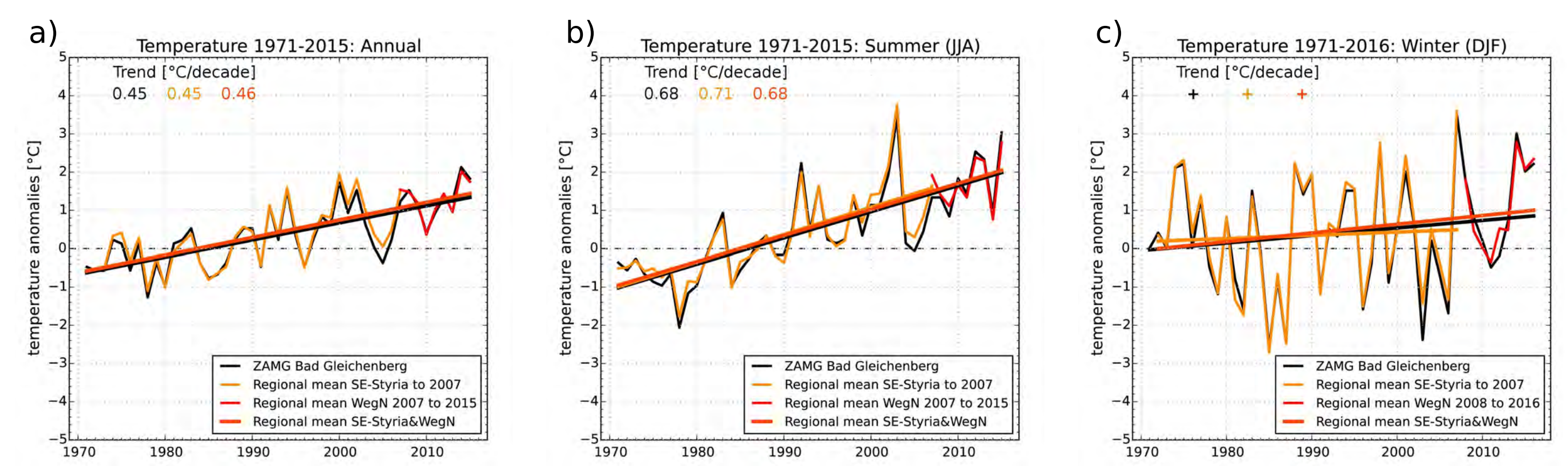
Fig. 4: Temperature anomalies and trends from 1971-2015/16. (a) Annual, (b) Summer (JJA), and (c) Winter (DJF). WegenerNet FBR data (red) was used for the time series since 2007/08. Only trends with confidence level greater than 95 % are listed, for non-significant trends only the sign of the slope is indicated.

Example 2: High-resolution Windfields

Windfields are derived by model-assisted, automatic post-processing from data of the 12 WegenerNet FBR wind stations. The resulting grids have a time resolution of 30 minutes and a spatial resolution of 100 m x 100 m.

Central part of the automatic wind field development is the California Meteorological Model (CALMET). The CALMET model is a diagnostic model which reconstructs 3D wind fields based on meteorological observations, terrain elevations and land use data.

Fig. 5 shows the modeled wind fields for thermally driven circulations (**Fig. 5a**) on 10th of August 2008 and strong wind speeds (**Fig. 5b**) on 15th of March 2013 at a height of 10 m. The upper left panel illustrates mountain winds with a down-valley direction caused by temperature and pressure gradients on a local scale. Fig. 5b displays a strong northerly wind, with maximum 30-min wind speeds around 8 m/s at 10 a.m. The **bottom panels of Fig 5** show gridded fields of gust speed and the corresponding gust direction. For strong winds, the gust direction follows the modeled wind direction with maximum gust speeds of around 21 m/s (Fig. 5b, bottom).
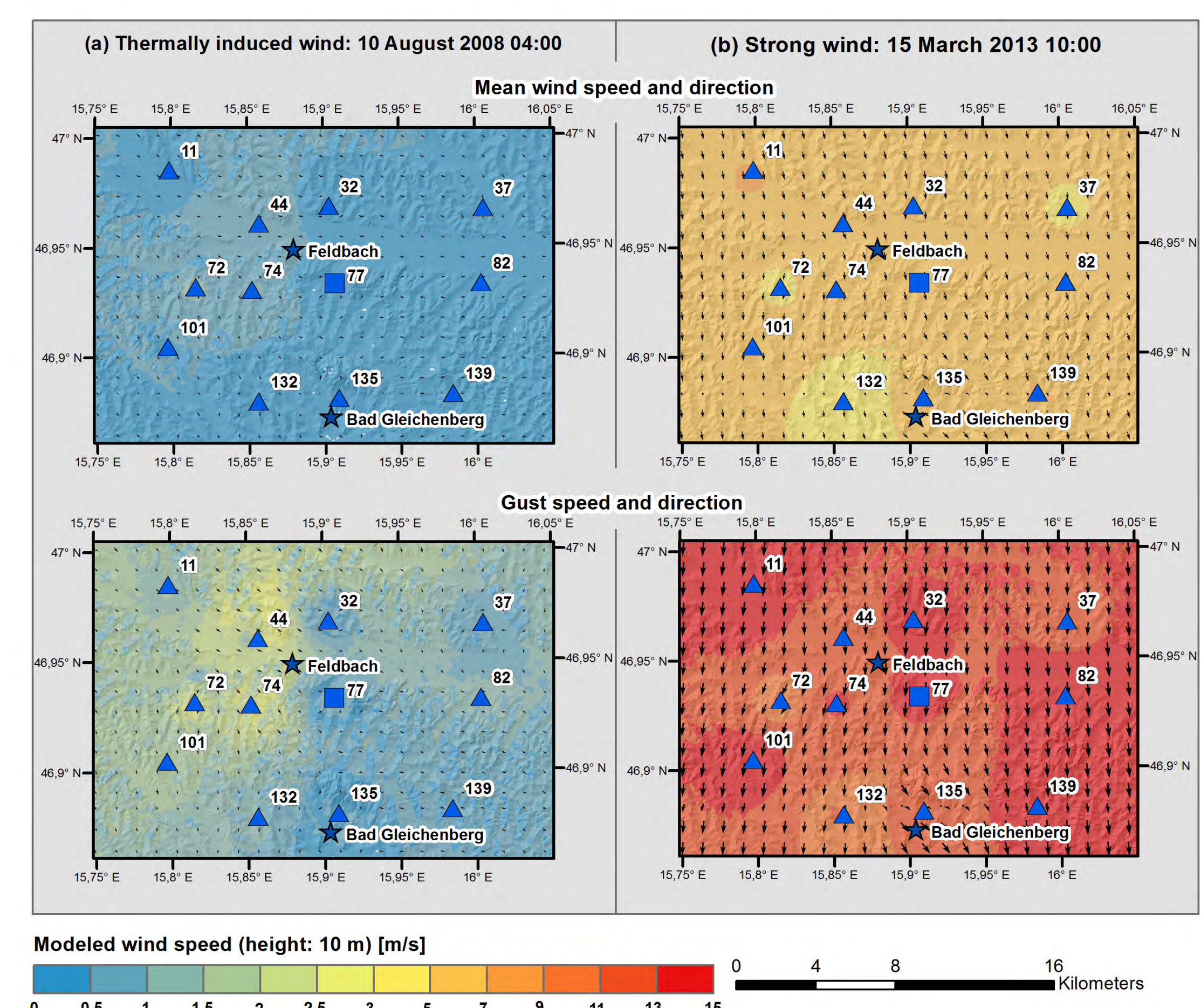
Fig. 5: High-resolution windfields derived from data of the 12 WegenerNet FBR wind stations (blue symbols). (a) Thermally induced (weak) wind on Aug. 10, 2008. Upper image: mean, lower image: gusts. (b) Strong northerly wind on March 15, 2013. Upper image: mean, lower image: gusts.

WegenerNet Cooperations:

LTER Austria — Austrian Long-Term Ecosystem Research Network

NASA

International Soil Moisture Network

LINET — Lightning Detection Network

Reference:
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.