

## Software Description

# Data Browser Matsch | Mazia: Web Application to access microclimatic time series of an ecological research site

Martin Palma<sup>‡</sup>, Alessandro Zandonai<sup>§</sup>, Luca Cattani<sup>‡</sup>, Johannes Klotz<sup>§</sup>, Giulio Genova<sup>§</sup>, Christian Brida<sup>§</sup>, Norbert Andreatta<sup>‡</sup>, Georg Niedrist<sup>§</sup>, Stefano Della Chiesa<sup>§</sup>

<sup>‡</sup> Eurac Research - Department Information Technologies, Bozen/Bolzano, Italy

<sup>§</sup> Eurac Research - Institute for Alpine Environment, Bozen/Bolzano, Italy

Corresponding author: Martin Palma ([martin.palma@eurac.edu](mailto:martin.palma@eurac.edu))

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## Abstract

### Background

Easily accessible data is an essential requirement for scientific data analysis. The Data Browser Matsch | Mazia was designed to provide a fast and comprehensible solution to access, visualize and download the microclimatic measurements of the IT 25 LT(S)ER Match | Mazia research site in South Tyrol, Northern Italy, with the overall aim to provide straightforward data accessibility and enhance dissemination.

### New information

Data Browser Matsch | Mazia is a user-friendly web-based application to visualize and download micrometeorological and biophysical time series of the Long-Term Socio-Ecological Research site Matsch | Mazia in South Tyrol, Italy. It is designed both for the general public and researchers. The Data Browser Matsch | Mazia drop-down menus allow the user to query the InfluxDB database in the backend by selecting the measurements,

time range, land use and elevation. Interactive Grafana dashboards show dynamic graphs of the time series.

## Keywords

Open Data; FAIR; Micrometeorology; LTER Italy; Mountain Ecology; SnipeIT; Grafana; InfluxDB

## Introduction

Often, ecological research is restricted to 3-5 years due to short term funding policy. However, ecosystems are dynamic entities across space and time, and understanding their functions and reaction to Global Change (Climate and Land Use Change), require long-term ecological observations. Within the last 40 years, several Long-Term Ecological Research (LTER) sites have been established worldwide to address this need. These research infrastructures are connected through umbrella networks such as the [LTER-Europe](#) and International [ILTER](#). The [IT25 LT\(S\)ER Matsch | Mazia](#) (South Tyrol, Northern Italy) was officially established in 2014, with first microclimatic measurements from 2009. The IT25 LT(S)ER Matsch | Mazia monitoring infrastructure is represented by a network of 24 automatic microclimatic stations, logging several meteorological and biophysical variables. The stations are spread in a complex mountain catchment spanning between valley bottom and glacier areas, across an elevation gradient ranging from 1000 m to 2700 m. The [Data Browser Match | Mazia](#) was designed to provide a fast and comprehensible solution to access, visualize and download the microclimatic measurements with the overall aim to provide straightforward data accessibility and enhance dissemination. Numerous and diverse stakeholders would benefit from easily accessible and usable meteorological and biophysical data. The user friendly, accessible data can lead to new knowledge creation, innovation, integration with other data, creating ultimately, new unexplored outputs, and services. The [IT25 LT\(S\)ER Matsch | Mazia](#) supports the reuse of data and promotes the Findable, Accessible, Interoperable and Reusable ([FAIR](#)) Data Principles Wilkinson et al. (2016). This general approach is compliant with the memorandum for sharing data and information within the LTER-Italy network Bergami and Oggioni (2020). Further details on the IT25 LT(S)ER Matsch | Mazia site and metadata, can be found in [DEIMS](#) (Dynamic Ecological Information Management System; Wohner et al. (2019)). Overall, this new data retrieval and visualization tool are one of a kind within the Italian LTER network, and we believe it is a good practice to be embraced by the entire network.

## Sensors and data flow

The [IT25 LT\(S\)ER Matsch | Mazia](#) monitoring stations are equipped with 18 different multiparametric sensors, measuring overall more than 250 micrometeorological, biophysical and maintenance parameters every 15 minutes. Moreover, to monitor phenology, five stations are also equipped with [Phenocams](#) that capture RGB and IR

(Infrared) images of the surrounding landscape on an hourly basis. The list of the sensors can be found in Table 1. Images and data are transferred via mobile phone network to a file server located in the Eurac datacenter and preprocessed for consistency throughout a data quality check (DQC). At the same time, a monitoring system continuously checks the status of the sensors and the stations. To store metadata information and history of the whole hardware infrastructure, [SnipeIT](#) is adopted as an asset and metadata manager. A data feeder cross-checks entries in SnipeIT and processes the data and populates the [InfluxDB](#) database. [Data Browser Matsch | Mazia](#) is a web application composed of three parts: 1) Two backends: [InfluxDB](#) and [SnipeIT](#). 2) A frontend written in [Go](#) that talks to the backends. 3) A HTML/JavaScript client that implements the user interface and makes HTTP requests to the frontend.

Table 1.

List of the multiparametric sensors installed in the [IT25 LT\(S\)ER Matsch | Mazia](#) research site.

Sensors
Thermo-Hygrometer (air temperature and humidity)
Two-Dimensional Anemometer (wind speed & direction)
4-Component Net Radiometer (solar radiation - shortwave & longwave, incoming & outgoing)
Silicon-Cell Pyranometer (solar shortwave radiation)
Quantum Sensor (PAR Photosynthetically Active Radiation)
Line Quantum Sensor (PAR on the ground through the canopy & snow coverage detection)
Sunshine Sensor (solar radiation – total & diffuse component, sunshine detection)
SRS Spectral Reflectance Sensor (NDVI Normalized Difference Vegetation Index & PRI Photochemical Reflectance Index)
Tipping Bucket Rain Gauge (cumulated precipitation)
Weighing Rain Gauge (cumulated precipitation & precipitation intensity)
Sonic Ranging Sensor (snow/canopy height)
Infrared Radiometer (soil surface temperature)
Heat Flux Plate (soil heat flux)
Thermocouple (ST Soil Temperature – 0, 5, 10, 20 & 50 cm depth)
FDR Frequency Domain Reflectometer (Soil Water Content – 5 & 20 cm depth)
TDR Time Domain Reflectometer (Soil Water Content & Soil Temperature – 2, 5, 20, 40 & 50 cm depth)
water potential sensor (SWP Soil Water Potential & Soil Temperature - 5, 20, 40 & 50 cm depth)
LWS Leaf Wetness Sensor
Phenocam (RGB and IR Infrared Images)

## Usage

The Matsch | Mazia Data Browser is designed for the general public and expert users and is available in English, German and Italian. The platform distinguishes two kinds of users:

Not registered users (hereafter "public users") and registered users (hereafter "research users"). The public users have access to 20 monitoring stations for a subset of meteorological variables (air temperature, relative humidity, global radiation, precipitation, snow height, wind speed, gust and direction) with an open data [CC BY 4.0](#) license. The research users can access the full dataset with a simple registration process using several identity providers (Google, Microsoft, GitHub). The Scientific Network South Tyrol research users can register using the Scientific Network South Tyrol as identity provider. The research users have full access to all 24 monitoring stations' measurements with a specific data usage agreement Della Chiesa et al. (2020). The web application allows multiple queries that filter the available data (Fig. 1). Users can interact with leaflet Agafonkin (2016) graphical representation of all stations, download station coordinates and study area boundaries. Users can also filter by the station, type of measurement, land use, date range and elevation. The last week (updated near real-time) of the public measurements are viewable on [Grafana dashboards](#) by clicking on the view graph tab or by clicking the markers in the map (Fig. 2). Data time series can be exported as comma-separated values (CSV). The CSV format is compliant to tidy data frames Wickham (2014), both long (Suppl. material 1) and wide (Suppl. material 2) tables can be downloaded. The "info" tab shows further information about the data, data license, and additional info and glossary of the downloaded table. The registered users can also download a [Glossary](#) excel file Zandonai et al. (2020) with metadata and description of the measurements.

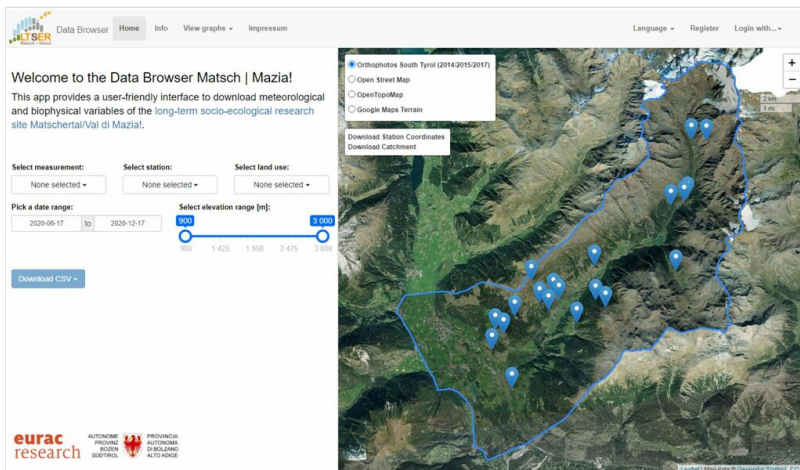


Figure 1. [doi](#)

Main dashboard of the [Matsch | Mazia Data Browser](#). Home, Info, View graphs, language, registration and login section, Map area. The elements of the page: Home (Query selectors for measurement, station, land use, date range, elevation and download CSV); Info (Basic info, Data license, disclaimer, and brief how-to); View Graphs ([Grafana dashboard](#) with dynamic graphs of the public data); Map area (point location of the stations, download coordinates and catchment boundaries).

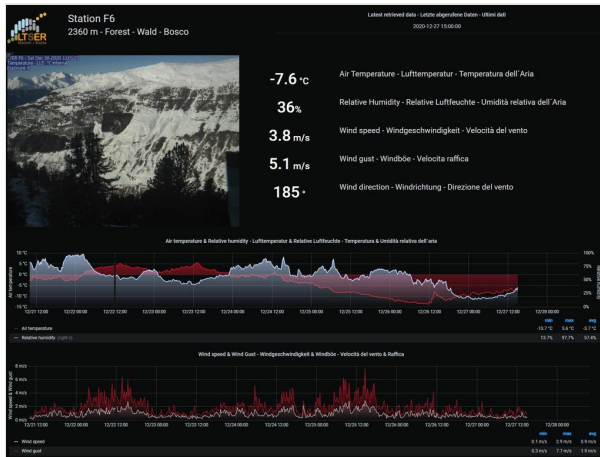


Figure 2. [doi](#)

[Example of a Grafana dashboard](#), showing one week of the near real-time publicly available data. Notice that some stations are equipped with webcams (Phenocam).

## Project description

**Funding:** This work was funded by the research grant 'LT(S)ER' of the South Tyrol (Italy). Department of Innovation, Research and University of the Autonomous Province of Bozen/ Bolzano, Italy.

## Web location (URIs)

**Homepage:** <https://browser.lter.eurac.edu/>

## Technical specification

**Platform:** Cross-Platform

**Programming language:** Go, HTML, JavaScript

**Interface language:** English, German, Italian

## Repository

**Type:** Git

**Browse URI:** <https://github.com/euracresearch/browser>

## Usage licence

**Usage licence:** Creative Commons Public Domain Waiver (CC-Zero)

## Additional information

Further information can be found in the IT25 LT(S)ER Matsch | Mazia project home page: <http://lter.eurac.edu/en/>.

## References

- Agafonkin V (2016) Leaflet - a JavaScript library for interactive maps. <http://leafletjs.com/>. Accessed on: 2020-9-04.
- Bergami C, Oggioni A (2020) Memorandum for sharing data and information within the LTER-Italy network. *Zenodo* <https://doi.org/10.5281/zenodo.3763377>
- Della Chiesa S, Pfatter H, Canu FA, Lehtsalu L, et al. (2020) Data use agreement - LT(S)ER IT25 Matsch | Mazia - Data Browser. *Zenodo* <https://doi.org/10.5281/zenodo.4395810>
- Wickham H (2014) Tidy Data. *Journal of Statistical Software* 59 (10). <https://doi.org/10.18637/jss.v059.i10>
- Wilkinson D, Dumontier M, Aalbersberg I, et al. (2016) The FAIR Guiding Principles for scientific data management and stewardship. *Scientific Data* 3: 1-9. <https://doi.org/10.1038/sdata.2016.18>
- Wohner C, Peterseil J, Poursanidis D, Kliment T, Wilson M, Mirtl M, Chrysoulakis N (2019) DEIMS-SDR – A web portal to document research sites and their associated data. *Ecological Informatics* 5: 15-24. <https://doi.org/10.1016/j.ecoinf.2019.01.005>
- Zandonai A, Klotz J, Christian B, et al. (2020) LT(S)ER IT25 Matsch | Mazia - Glossary. *Zenodo* <https://doi.org/10.5281/zenodo.4395990>

## Supplementary materials

### Suppl. material 1: Example long table

**Authors:** Stefano Della Chiesa

**Data type:** CSV table

**Brief description:** Example of the CSV Long-format table that can be downloaded.

[Download file](#) (672.37 kb)

### Suppl. material 2: Example wide table

**Authors:** Stefano Della Chiesa

**Data type:** CSV table

**Brief description:** Example of the CSV Wide-format table that can be downloaded.

[Download file](#) (231.17 kb)