Action title:

FAIR NEtwork of micrometeorological measurements

Action No.: **CA20108**

Acronym: **FAIRNESS**

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Deliverable: **D3.4 – Inventory of region-specific stakeholder and user needs (M45)**

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1. Background and purposes of the inventory

The purpose of this inventory is to collect and analyze information on region-specific stakeholder and user needs related to micrometeorological data. Understanding these needs is essential to ensure that the data and services developed within the project are relevant, usable, and adapted to local contexts. The inventory supports the identification of priorities across regions, highlights differences in data use and accessibility, and provides insights into how micrometeorological information can be better integrated into research, decision-making, and practical applications.

To achieve this, a structured questionnaire was developed and distributed using Google Forms. This approach enabled efficient collection of input from a wide range of stakeholders and users, ensuring representation of diverse sectors and geographic regions. The resulting dataset forms the basis for mapping current demands, identifying potential gaps, and guiding future project activities to align more closely with stakeholder requirements.

2. Stakeholder groups and their micrometeorological data needs

The effective use of micrometeorological data depends on the capacity to match observations with the needs of diverse user communities. Within the FAIRNESS Network, stakeholders range from research and educational institutions to governmental bodies, private enterprises, and local organizations. Understanding their specific data requirements supports the design of interoperable, FAIR (Findable, Accessible, Interoperable, and Reusable) data infrastructures and facilitates the uptake of high-resolution environmental observations for decision-making, modelling, and education.

Stakeholders can be broadly grouped as follows:

- **Chambers of Farmers**: Rely on micrometeorological data to optimize crop management, irrigation scheduling, and pest/disease risk assessment. Daily data on temperature, humidity, soil water content, wind speed, and extreme weather are essential for agricultural advisories and yield prediction.
- **Universities and Faculties**: Require comprehensive datasets for research and education purposes. These include all core meteorological variables, biophysical parameters (e.g., evapotranspiration, energy balance components), and atmospheric composition (e.g., greenhouse gases, ozone). Data are needed at daily or sub-daily resolutions to support process-based modelling and climate studies.
- **High Schools and Secondary Schools**: Use simplified, aggregated datasets (often monthly averages) for educational purposes, focusing on basic parameters such as temperature, precipitation, and humidity to support teaching in environmental sciences and geography.
- **Related Ministries** (e.g., Agriculture, Environment, Energy): Require integrated, high-resolution datasets to support policy development, early warning systems, and environmental monitoring. This includes not only classical meteorological variables but also pollution indicators, greenhouse gases, and extreme event information.

- **Municipalities**: Utilize micrometeorological information for urban planning, heat island mitigation, flood management, and public safety. Data on temperature, precipitation, wind, and air quality are particularly relevant.
- **Local Organizations and NGOs**: Employ data to raise awareness, support community-based adaptation, and develop local-scale environmental monitoring initiatives.

- **Private Companies**: Include those in agriculture, energy, and environmental services. They demand high-quality, continuous data streams for operational decisions, risk management, and sustainability reporting.
- **Insurance Companies**: Use micrometeorological information for risk modelling and loss assessment, especially regarding extreme weather, precipitation, and temperature extremes.

Stakeholder needs reveal clear differences in the spatial and temporal scales of required data (Table 1). Research and policy institutions often need high-frequency (sub-daily) and spatially explicit datasets, while education and outreach users typically benefit from aggregated or simplified formats. Moreover, variables such as evapotranspiration, greenhouse gas fluxes, and energy balance components are primarily relevant to research, policy, and precision agriculture users. Conversely, air temperature, humidity, and precipitation remain universally important across all groups. To ensure the FAIRness and long-term usability of micrometeorological data, it is crucial to develop standardized metadata, interoperable formats, and stakeholder-specific interfaces that enhance accessibility and interpretability.

Table 1: Inventory of region-specific stakeholder and user needs

Region-specific stakeholders	User needs																					
	Tmean,max,min	**Relative Humidity**	**Radiation**	**Precipitation**	**Soil water content**	**Wind Speed**	**Weather forecast**	**Evapotranspiration**	**Extreme weather events ***	**Yield prediction**	**Air pollution**	**Ozone**	**Phonology**	**Heat map**	**Education material**	**Atmospheric pressure**	**Clouds**	**Surface temperature**	**Leaf wetness**	**UV index**	**Greenhouse gasses**	**Energy balance components**	**Data time scale**
Chambers of Farmers	x	x		x	x	x	x		x	x			x		x		x	x	x				Daily
Universities/Faculties	x	x	x	x	x	x	x	x	x		x	x	x	x		x	x	x	x	x	x	x	Daily
Highschool and secondary schools	x	x		x		x	x		x		x		x		x								Monthly
Related ministries	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	Daily
Municipalities	x	x		x		x	x		x		x	x		x		x		x					Daily
Local organizations	x	x		x		x	x		x		x	x		x	x	x		x			x		Daily
Private companies	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	Daily
Insurance companies	x	x	x	x	x	x	x		x	x	x		x	x		x							Daily

***frosts, hail, drought, heavy rain, etc.**

3. Results of the questionnaires

To complement the identification of stakeholder groups and their micrometeorological data needs, a questionnaire was distributed among participants of the FAIRNESS Network. A total of 20 responses were received, representing a diverse range of geographical and institutional backgrounds.

In terms of country representation, the largest proportion of respondents originated from **Serbia** (25%), followed by **Italy** (20%), the **Slovak Republic** (15%), and **Montenegro** (10%). Additional contributions were obtained from **Bosnia and Herzegovina, Colombia, Egypt, Ethiopia, Switzerland**, and **Turkey**. This diversity illustrates the international reach of the Network and highlights the relevance of micrometeorological observations in a wide variety of climatic and institutional contexts.

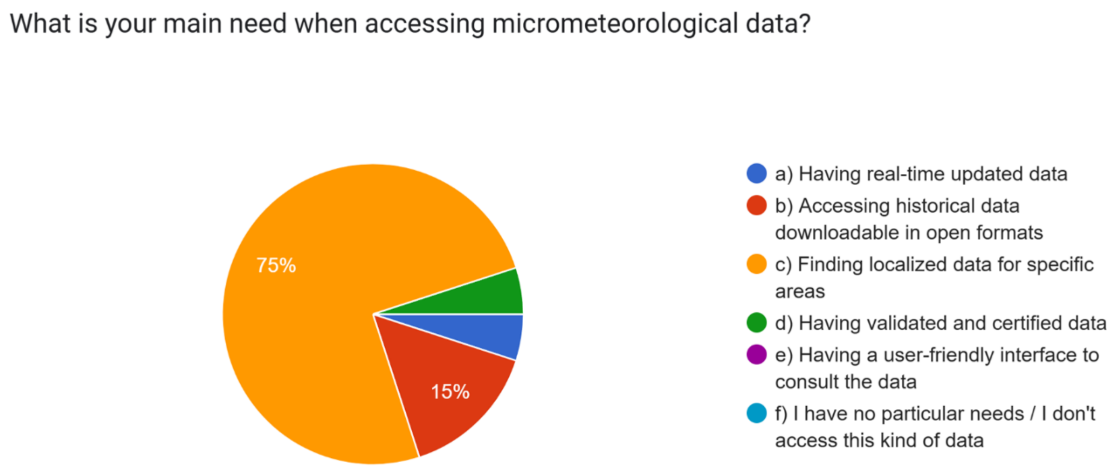
Regarding the professional background, the majority of respondents (approximately two-thirds) were affiliated with universities and research institutions, reflecting a strong academic and scientific orientation within the Network. The remaining participants were employed in scientific or environmental organizations, including governmental agencies and private entities engaged in environmental monitoring, agriculture, and policy support.

Overall, the questionnaire results confirm that the primary users of micrometeorological data within the FAIRNESS Network are academia and the broader scientific community, with a growing engagement from applied and decision-support sectors. This distribution emphasizes the importance of ensuring high-quality, interoperable datasets and training resources that support both research and operational applications across regions.

When asked about their main need when accessing micrometeorological data, most respondents emphasized the importance of localized information. Specifically, 75% of participants indicated that their primary need is to find localized data for specific areas, highlighting the demand for spatially detailed and site-specific datasets to support both research and practical applications.

A smaller proportion (15%) prioritized access to historical data in open and downloadable formats, reflecting interest in long-term trend analysis and model validation. Only a few respondents (each 5%) selected real-time data availability and validated and certified datasets, suggesting that while data quality and timeliness are relevant, spatial coverage and accessibility remain the dominant priorities among users in the FAIRNESS Network.

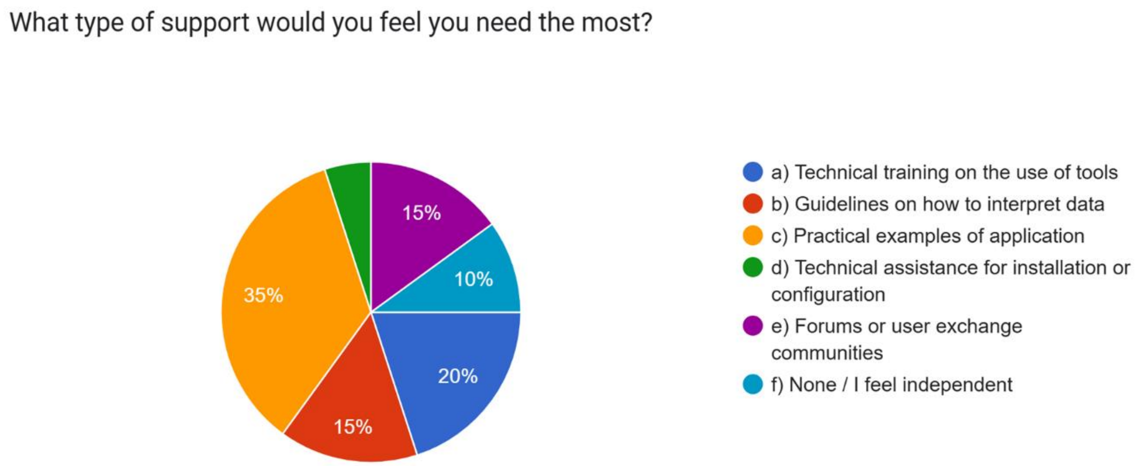
Figure 1: Distribution of responses to the question "What is your main need when accessing micrometeorological data?"



In response to the question "What type of support would you feel you need the most?", the majority of participants (35%) expressed interest in receiving practical examples of application, emphasizing the importance of hands-on, context-specific demonstrations of how micrometeorological data can be used in practice (Figure 2). A smaller but still significant share of respondents indicated a need for technical training on the use of tools (20%), guidelines on data interpretation (15%), and forums or user exchange communities (15%), reflecting both educational and networking priorities within the FAIRNESS Network. Only 5% of participants selected technical assistance for installation or configuration, while 10% felt they were independent and required no additional support.

Overall, the results suggest that capacity building efforts should focus on applied training materials and real-world use cases, complemented by community-driven knowledge exchange platforms.

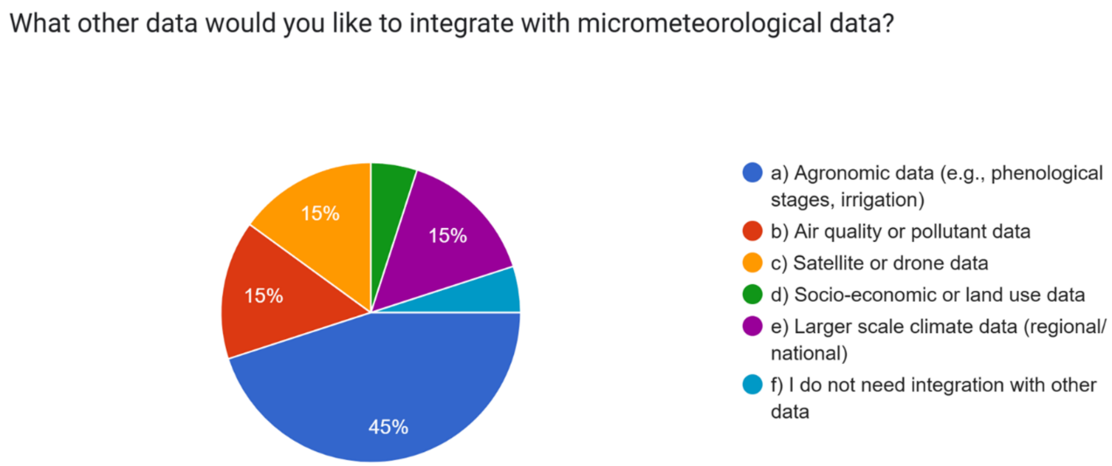
Figure 2: Distribution of responses to the question “What type of support would you feel you need the most?”



Participants were also asked “What other data would you like to integrate with micrometeorological data?” to identify potential areas for cross-disciplinary linkage. The majority of respondents (45%) indicated agronomic data—such as phenological stages, irrigation practices, and crop management—as their main integration priority (Figure 3). This reflects the strong agricultural and environmental research orientation of the FAIRNESS Network and the need to connect atmospheric observations with ecosystem and crop processes. A smaller but significant portion of respondents (15% each) expressed interest in integrating air quality or pollutant data, satellite or drone observations, and larger-scale climate datasets (regional or national), suggesting a demand for multi-source data fusion to support modelling and decision-making. Only 5% of participants mentioned socio-economic or land use data, and another 5% reported no need for integration.

Overall, these responses underline the importance of developing interoperable systems capable of combining micrometeorological measurements with agronomic and remote-sensing information to enhance analysis, forecasting, and application potential.

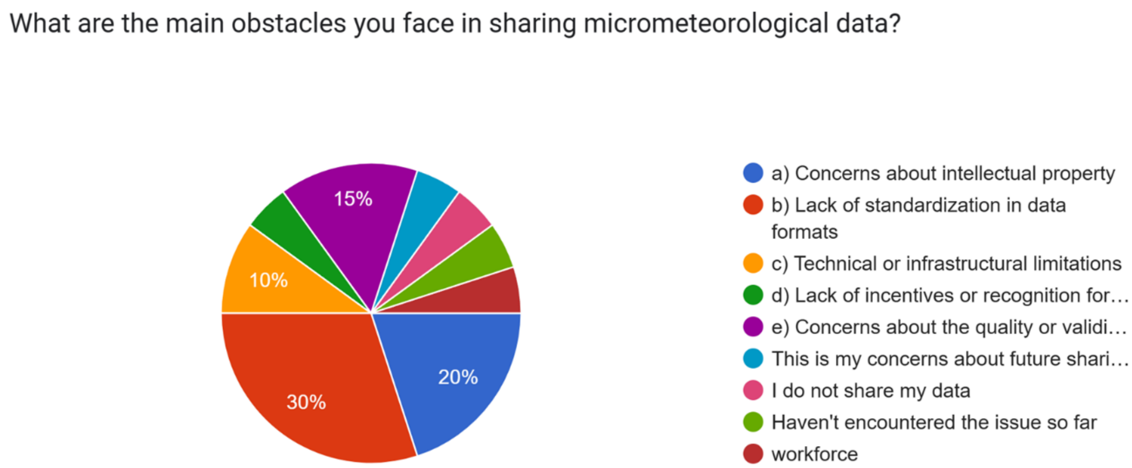
Figure 3: Distribution of responses to the question “What other data would you like to integrate with micrometeorological data?”



Respondents also identified several barriers that limit open data exchange in micrometeorology (Figure 4). The most frequently mentioned challenge (30%) was the lack of standardization, including inconsistencies in data formats, metadata, and measurement protocols, which complicate interoperability and integration across platforms. Concerns about intellectual property (20%) and data quality or uncertainty (15%) were also significant issues, reflecting the need for clear data governance policies and transparent quality control procedures. A smaller proportion of respondents mentioned technical or infrastructural limitations (10%), as well as other factors such as lack of incentives or recognition, insufficient workforce capacity, or the choice not to share data (each 5%).

These findings suggest that while technical challenges persist, sociocultural and institutional factors—such as data ownership concerns and limited reward mechanisms—remain equally important barriers to achieving fully FAIR micrometeorological data practices.

Figure 4: Distribution of responses to the question "What are the main obstacles you face in sharing micrometeorological data?"



4. Conclusions

This inventory highlights the diversity of stakeholders involved in the collection, use, and management of micrometeorological data within the FAIRNESS Network and underscores the importance of aligning data services with real user needs. The responses gathered through the questionnaire demonstrate that most users belong to the academic and research sectors, although engagement from governmental, private, and local organizations is increasing. Stakeholders emphasized the need for localized, site-specific data as their main priority, followed by open access to historical datasets. This finding confirms the demand for spatially detailed, interoperable information that supports both scientific research and practical applications such as agriculture, environmental management, and policy development.

Respondents also expressed a strong preference for practical examples of application and technical training, reflecting a desire for capacity building through applied, hands-on learning. Integration with agronomic, air-quality, and remote-sensing data was considered essential for improving analysis, modelling, and decision-support capabilities. At the same time, several persistent barriers to data sharing were identified, notably the lack of standardization, concerns about intellectual property, and issues related to data quality and infrastructure.

Overall, the results emphasize that improving standardization, promoting data interoperability, and providing user-friendly access tools are critical to enhancing the value and use of micrometeorological information. Strengthening collaboration among institutions and investing in targeted training and communication activities will be key to ensuring that the FAIRNESS Network delivers data and services that are relevant, accessible, and effectively support research, innovation, and societal needs across regions.