Action title:

FAIR NEtwork of micrometeorological measurements

Action No.: **CA20108**
Acronym: **FAIRNESS**
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WP No: **4**
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Deliverable: **D4.4 – Report on Long-term sustainability plan (M47)**

Date: 15.10.2025.

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Executive Summary

This deliverable (D4.4: Long-Term Sustainability and Legacy Plan) is the outcome of activities implemented under Task T4.2 “Long-term sustainability plan” of Working Group 4 (Beyond FAIRNESS Strategies). The task builds upon the results of D4.1–D4.3 and synthesises transferable activities, good practices, and analytical outputs of the Micromet_KSP (FMP2.0) to ensure FAIRNESS continuity beyond the Action’s lifetime.

The FAIRNESS COST Action (CA20108) has established a pan-European framework for advancing microscale atmospheric observations through FAIR (Findable, Accessible, Interoperable, and Reusable) data principles. Over four years, the Action built an interconnected community of researchers, practitioners, and stakeholders dedicated to improving the visibility, usability, and long-term value of micrometeorological data across rural, urban, and transitional environments. The Long-Term Sustainability and Legacy Plan (Deliverable D4.4) outlines how the FAIRNESS network, knowledge, and digital resources will persist and grow beyond the Action's lifetime. It integrates the outcomes of previous WG4 deliverables (D4.1–D4.3) and provides a roadmap for institutional, digital, educational, and financial continuity.

FAIRNESS leaves behind several key assets and legacies:

- FAIR Micromet Platform (FMP 2.0): an evolution of the original Micromet_KSP, serving as a digital hub for FAIR data inventories, metadata templates, quality standards, and open-access learning materials.
- Educational outputs and training legacy: including the Springer open-access book "Micrometeorological Measurements – An Introduction for Beginners" (2026), four COST summer schools, and a suite of online video tutorials and resources hosted on the FAIRNESS website.
- Transferable activities and tools: such as FAIR-ification of the data, community networks, and consultancy services supporting national agencies, research infrastructures, and SMEs.
- Strategic partnerships: with networks like ICOS, FLUXNET, GEOSS, EOSC, and the International Society of Biometeorology (ISB) to ensure knowledge exchange and alignment with global environmental data standards.

Sustainability is structured around four complementary pillars:

- Institutional and Network Continuity – maintaining the FAIRNESS Community of Practice within the EOSC framework and linking alumni through annual meetings and joint research projects.
- Infrastructure and Platform Evolution – preserving the FMP 2.0 as long-term open resources, expanding their functionalities and integrating MetObs Toolkit an open-source Python library for processing, quality-controlling, and visualizing meteorological observations through partnerships with European data infrastructures.
- Educational and Training Continuity – embedding FAIRNESS educational modules into university curricula and Erasmus+ micro-credential programs.
- Knowledge Transfer and Funding Strategies – establishing a FAIR Micromet Consultancy Node and pursuing Horizon Europe, ERA4CS, and EIT Climate-KIC collaborations for continued innovation.

The plan emphasizes the lasting impact of FAIRNESS as both a digital and human ecosystem, one that continues to foster open science, reproducibility, and sustainable environmental monitoring in Europe and beyond. Through its community, training legacy, and evolving infrastructure, FAIRNESS will remain a catalyst for integrating high-quality micrometeorological data into science, policy, and education for decades to come.

1. Introduction and Vision

The FAIRNESS COST Action (CA20108) established a European-wide collaborative framework to make micrometeorological data **Findable, Accessible, Interoperable, and Reusable** (FAIR). The initiative integrated experts across disciplines-from atmospheric sciences and agrometeorology to data stewardship - to ensure that high-quality micrometeorological data serve as a foundation for both scientific innovation and societal resilience.

The long-term sustainability vision of FAIRNESS is to **transform the project's outputs into enduring infrastructures, communities, and competencies**, ensuring that the FAIR principles remain embedded in European micrometeorology and beyond.

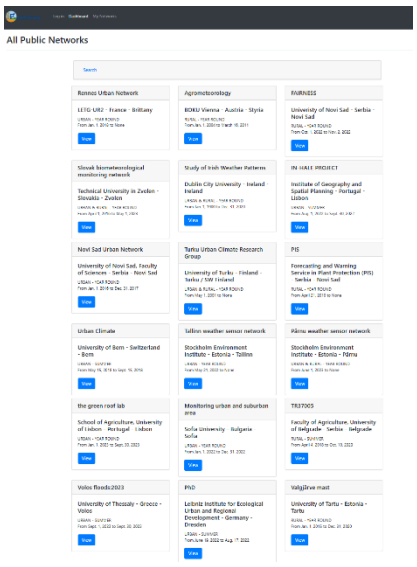
2. Core Achievements and Legacy Assets

The long-term sustainability of FAIRNESS builds on a set of tangible assets, tools, and networks developed during the Action. These outcomes ensure that the FAIR principles remain embedded in micrometeorological research, training, and practice across Europe and beyond.

2.1 FAIR Micromet Platform (FMP 2.0)

The FAIR Micromet Platform (FMP 2.0) is an evolution of the Micromet_KSP introduced in the Technical Annex which serves as the central digital environment of the FAIRNESS legacy. It provides an open-access portal that:

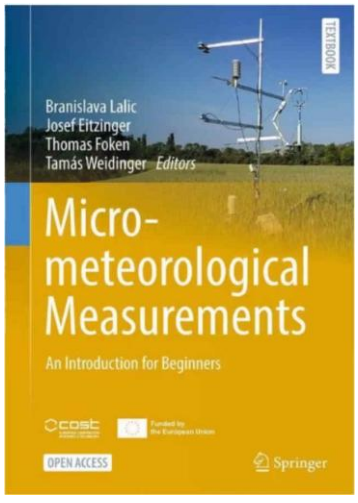
- Hosts inventories of European micrometeorological networks and datasets, including metadata and FAIRness self-assessments;
- Integrates metadata templates, controlled vocabularies, and FAIR maturity indicators to harmonise data structures;
- Offers educational resources, guidelines, and self-assessment tools for improving FAIR data management;
- Enables interoperability across sectors such as agriculture, forestry, urban meteorology, and health.



FMP 2.0 forms the conceptual and technical foundation for a future European Micrometeorological Database (EU-Micro_Met), complementing existing infrastructures such as the European Eddy Fluxes Database Cluster (EUROFLUX). The platform and its resources will remain accessible through the FAIRNESS web page and Zenodo community, ensuring 20-year open preservation of all Action outputs.

2.2 Book: Micrometeorological Measurements: An Introduction for Beginners (Springer, 2026) (Deliverable D4.2)

This open-access book represents the pedagogical cornerstone of FAIRNESS capacity building. It consolidates guidelines and best practices for designing and evaluating microscale measurement setups, ensuring data quality and comparability across diverse environments. The volume will serve as a standard reference in workshops, summer schools, and university courses supporting the training of early-career researchers. Promotion is planned at major conferences such as the International Congress of Biometeorology 2026, Novi Sad (https://www.nsucl.com/events/icb-2026), as detailed in Appendix 1.



2.3 Transferable Activities (Deliverable D4.1)

A structured inventory of transferable activities was established to enable the continuation and replication of FAIRNESS outcomes. These include:

- Community building through a "network-of-networks" approach linking research infrastructures, SMEs, and public institutions;
- Digital collaboration tools (LinkedIn, WhatsApp, and web platforms) supporting distributed teamwork;
- FAIR data standardisation and certification practices developed within FMP 2.0 and MetObs Toolkit;
- Educational content creation and communication-skill development for Open-Science training;
- Cross-disciplinary adaptability, fostering collaboration among agricultural, urban, forestry, and health sectors.

2.4 Capacity Building Outputs

FAIRNESS implemented an integrated training framework combining workshops, summer schools, and digital resources. Four COST summer schools, regional workshops, and an open-access training video: Low-Cost Radiation Shield Guide, have cultivated a community skilled in FAIR data management, micrometeorological measurement design, and Open-Science communication.

The FAIR Data Beginner's Framework, developed under WG2 and WG4, will be extended as an online course hosted on FMP 2.0. Further outreach through high-school environmental projects, citizen-science initiatives, and collaborations such as the GLOBE Programme demonstrates FAIRNESS's educational impact beyond academia.

2.5 MetObs Toolkit (Open-Source Python Library)

The MetObs Toolkit is an independent open-source software environment that emerged directly from FAIRNESS expertise. Developed by Action members, it provides comprehensive functionalities for reading, processing, quality-controlling, gap-filling, and visualising meteorological and micrometeorological data. The toolkit operationalises FAIRNESS methodological recommendations, particularly those concerning data quality control, reproducibility, and transparency, within a modern, community-maintained software package.

By enabling users to apply FAIR data workflows programmatically, MetObs extends the FAIRNESS legacy into the open-source domain. It is continuously maintained and expanded by the developer community, ensuring both technical and institutional sustainability while exemplifying the FAIR principles in action.

3. Sustainability Pillars

The long-term sustainability of FAIRNESS rests on five complementary pillars that together ensure the persistence of its data resources, community, and methodological legacy. Each pillar translates the Action's achievements into an enduring framework for collaboration, learning, and innovation.

3.1 Institutional and Network Continuity

The FAIRNESS network will transition into a **Community of Practice (CoP)** formally registered within the **European Open Science Cloud (EOSC)** framework. This will secure institutional visibility and long-term inclusion within Europe's open-science ecosystem. To sustain interdisciplinary collaboration, FAIRNESS will:

- Maintain interoperability and dialogue with major research infrastructures such as ICOS, FLUXNET, GEOSS, and Copernicus-based initiatives;
- Establish a FAIRNESS Alumni Network that will continue collaboration through annual hybrid meetings, newsletters, and joint research proposals;
- Support citizen-science measuring programmes that extend the FAIRNESS ethos of openness and inclusivity to schools and local communities;
- Finalise and publish two overview papers—Urban Network of Networks and Non-Urban Measurements—summarising FAIRNESS achievements and future directions;
- Prepare a methodological article synthesising experiences from the four COST FAIRNESS summer schools to guide the organisation of future events and enhance knowledge-transfer efficiency.

3.2 Infrastructure and Platform Evolution

To preserve and expand the Action's digital legacy, FAIRNESS will maintain and further develop the **FAIR Micromet Platform (FMP 2.0)** as an open-access environment hosting network inventories, metadata templates, and FAIR self-assessment tools. Planned upgrades include:

- New modules for FAIR certification and self-assessment;
- A continuously updated repository of best practices and teaching resources;
- Interfaces for uploading and linking real micrometeorological datasets to open repositories such as Zenodo;
- Strategic partnerships with European data infrastructures including WEkEO, GEOSS, ICOS Carbon Portal, International Society of Biometeorology to ensure hosting and maintenance sustainability.

In parallel, independent digital assets such as the **MetObs Toolkit** will remain maintained by the developer community, ensuring complementary technical continuity and practical implementation of FAIRNESS methodologies.

3.3 Educational and Training Continuity

FAIRNESS educational materials will be embedded within higher-education and professional-training structures to secure long-term knowledge transfer. Planned activities include:

- Integration of the FAIRNESS Educational Framework into university curricula and European training networks, using Erasmus+ opportunities for course mobility and joint teaching;
- Development of micro-credential programmes on:
    - FAIR data management,
    - Open-science communication, and
    - Field measurement design and quality control (QC);
- Use of the Springer open-access book and FAIRNESS training videos as core teaching modules for upcoming COST Actions, Erasmus+ Intensive Courses, and national capacity-building initiatives.

These activities will ensure that FAIRNESS concepts continue to shape the competencies of the next generation of environmental scientists and data stewards.

3.4 Knowledge Transfer and Innovation

To sustain innovation and outreach, FAIRNESS will establish a **FAIR Micromet Consultancy Node** composed of experts from the four FAIRNESS Working Groups. The node will offer:

- FAIR data audits and certification support;
- Training services in micrometeorological measurement design, data management, and FAIR compliance;
- Advisory support for national meteorological services, universities, and SMEs.

In addition, FAIRNESS will:

- Encourage spin-off initiatives and start-ups—such as virtual weather stations, digital-twin services, and environmental data applications—derived from Action methods and collaborations;
- Organise dedicated micrometeorological sessions at major conferences (e.g. EMS, EGU, ICB) to maintain community engagement and visibility;
- Promote FAIRNESS results as a reference resource for citizen-science projects and local adaptation initiatives.

3.5 Funding and Partnership Strategies

Ensuring continuity beyond COST requires a diversified funding and partnership strategy. FAIRNESS members will:

- Apply for Horizon Europe, ERA4CS, and related calls focusing on data FAIRification, digital twins, and environmental intelligence;
- Engage with EIT Climate-KIC, the Copernicus Academy, and GEOSS for co-funded projects and knowledge exchange;
- Explore membership-based models to maintain FMP 2.0 and community services (e.g. institutional premium modules or training subscriptions).

To broaden impact and application, FAIRNESS will strengthen scientific synergies with biometeorology, aerobiology, and allergology. Recent research has demonstrated that temperature-driven shifts in pollen seasons strongly influence allergic responses and respiratory health, underscoring the relevance of microscale meteorological observations for human wellbeing. Furthermore, the network will:

- Define best-practice guidelines for communicating micrometeorological measurements to policy makers, including shared terminology and narrative framing for climate-change adaptation;
- Strengthen links with urban-climate research, showcasing FAIRNESS contributions to improved city-level temperature monitoring and heat-risk assessment;
- Provide FAIRNESS data and methods as input to citizen-science activities, reinforcing the Action's social and educational legacy.

4. Dissemination and Impact Maintenance

Effective dissemination and long-term visibility are central to maintaining the FAIRNESS impact beyond the Action's duration. The sustainability of FAIRNESS communication will rely on both dedicated dissemination tools and integration with established scientific and professional networks.

Building upon the outcomes of FAIRNESS dissemination questionnaires and WG3 activities, the following actions will ensure continuity of outreach, engagement, and visibility.

4.1 Continued Digital and Social Media Presence

FAIRNESS will maintain its presence on **LinkedIn** and **ResearchGate**, ensuring regular updates on:

- New open data resources and FAIRNESS-related publications;
- Success stories demonstrating the application of FAIR micrometeorological data in policy, agriculture, forestry, and health;
- Announcements of training opportunities, conference sessions, and open calls for collaboration.

These channels will continue to act as entry points for the broader research and stakeholder community, supporting recruitment of new members and strengthening the visibility of FAIRNESS outputs.

4.2 FAIR Micromet Newsletter and Community Repository

An annual **FAIR Micromet Newsletter** will be launched to share updates on:

- Upcoming events, joint projects, and publications;
- Case studies and data resources emerging from the FAIRNESS network;
- Announcements from related European initiatives and COST Actions.

In parallel, a **Community Repository of Success Stories** will be maintained within the FAIR Micromet Platform (FMP 2.0) and on the FAIRNESS website. This repository will highlight examples of how FAIR micrometeorological data have been used to support decision-making, improve agricultural and urban resilience, and enhance public understanding of local climate impacts.

4.3 Integration with Partner and Thematic Networks

To multiply impact, FAIRNESS will link its dissemination efforts with other European and international networks. In particular:

- Collaboration with the International Society of Biometeorology (ISB) will ensure global outreach. Information on new FAIRNESS outputs, such as the upcoming Springer open-access book, will be regularly featured in the ISB Students and New Professionals (SNP) Newsletter, reaching an active community of over 150 members.
- Where possible, FAIRNESS materials will also be shared through ICOS, EUMETNET, Copernicus Academy, GEOSS, and EOSC Association newsletters, ensuring cross-disciplinary visibility.
- Additional dissemination will be pursued through partnerships with EIT Climate-KIC, ERA4CS, and other open-science or digital-twin communities with overlapping missions.

Particularly important is continuation of FMP 2.0 and The Guidelines life in the framework of CA24155 CRIM Cost action.

This networked dissemination strategy ensures that FAIRNESS results remain visible across both the environmental sciences and the broader Open Science ecosystem.

4.4 Publications and New Educational Outputs

Beyond the forthcoming book *Micrometeorological Measurements – An Introduction for Beginners* (Springer, 2026), additional publication initiatives are planned to maintain momentum:

- A follow-up book series tentatively titled Microscale Environmental Measurement and Calibration for Beginners will expand the FAIRNESS educational offer, including practical guidelines for sensor calibration and data traceability;
- Peer-reviewed overview papers (e.g., Urban Network of Networks and Non-Urban Measurements) will synthesise FAIRNESS case studies and methodological insights;

- FAIRNESS experts will continue contributing to open-access journals and conference proceedings to promote knowledge exchange and methodological standardisation.

4.5 Long-Term Impact Vision

The overarching goal is to sustain visibility and stakeholder engagement through **consistent digital communication**, **active participation in partner networks**, and **continued open-access publishing**. By embedding FAIRNESS outputs within existing scientific societies, European infrastructures, and Open Science initiatives, the Action's influence will extend well beyond its formal lifetime supporting a living, evolving community dedicated to FAIR micrometeorological data.

5. Governance and Coordination Framework

5.1 Beyond the FAIRNESS

The **Steering Committee (SC)**, composed of former Core Group members and Working Group leaders, will act as the main coordination body of the FAIRNESS legacy. The SC will:

- Meet annually online and biennially in person (preferably aligned with major conferences such as EMS, EGU, or ICB);
- Oversee the maintenance of the FAIR Micromet Platform (FMP 2.0) and related repositories (Zenodo community, website, newsletter);
- Coordinate updates of the FAIRNESS website and digital communication tools;
- Support integration of FAIRNESS outputs into ongoing and new European initiatives (e.g., EOSC, GEOSS, ICOS, Copernicus, ERA4CS, and EIT Climate-KIC).

The SC will be chaired by a rotating coordinator elected from among its members every two years to ensure continuity and distributed leadership.

5.2 Long-Term Vision

This lightweight governance model ensures that FAIRNESS remains an active, evolving community embedded in the broader European Open Science landscape. Through annual coordination, open membership, and integration with digital infrastructures such as **FMP 2.0** and **MetObs**, the FAIRNESS legacy will continue to advance FAIR data management, methodological innovation, and training in micrometeorology across Europe and beyond.

6. Conclusions and Recommendations

The FAIRNESS COST Action (CA20108) has successfully established a lasting foundation for FAIR micrometeorological data management in Europe. Through the creation of the **FAIR Micromet Platform (FMP 2.0)**, the **MetObs Toolkit**, and a vibrant network of experts, researchers, and institutions, FAIRNESS has demonstrated how collaborative open science can transform fragmented, project-based data into an enduring, interoperable resource for research, education, and society.

The **Sustainability Plan** outlines how these achievements will continue to evolve through a distributed governance framework, anchored in the **FAIRNESS Community** and guided by a **Steering Committee** of committed members. Educational materials, open-access publications, and the continued visibility of FAIRNESS

through partner networks, such as the **International Society of Biometeorology**, **EOSC**, **ICOS**, and **Copernicus Academy**, will ensure the Action's relevance far beyond its formal duration.
FAIRNESS has become more than a project—it is now a living ecosystem that bridges measurement, data stewardship, and application.

By sustaining its community, digital tools, and shared values, FAIRNESS will continue to empower scientists, institutions, and citizens to produce and use high-quality micrometeorological data in the service of climate resilience, open science, and sustainable development across Europe and beyond.