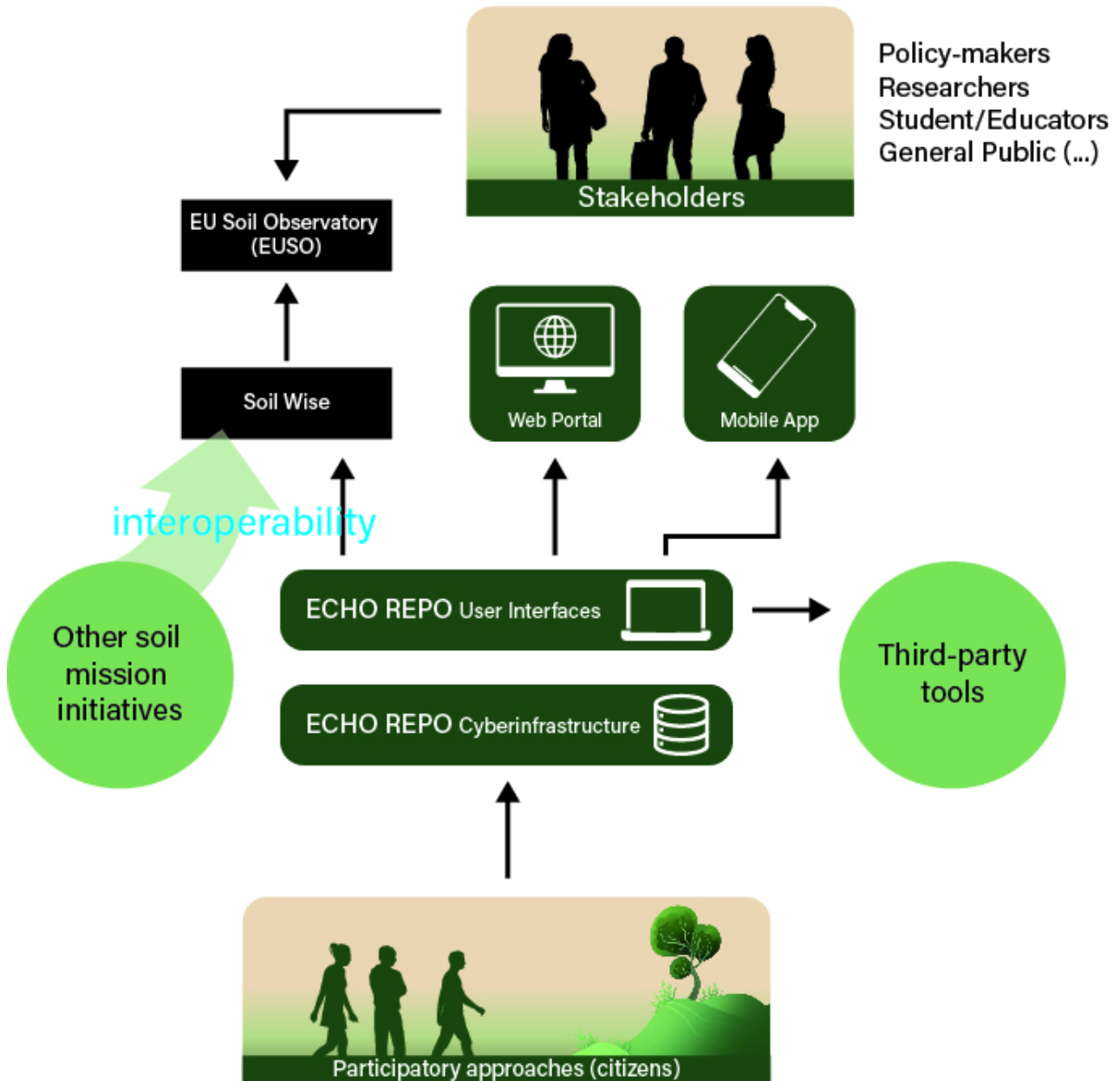


Advancing the soil deal for Europe through cyberinfrastructure and citizen science

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This article explores advancements in soil health across Europe, highlighting innovative cyberinfrastructure for soil citizen science. This initiative, led by the Quanta team, allows citizens to actively participate in environmental stewardship

Unhealthy soil poses a serious threat to our environment, diminishing its ability to act as a carbon sink, lowering agricultural productivity, and contributing to biodiversity loss. Prioritizing improved soil management practices is imperative for a sustainable future.

In the era of rapid technological advancement, the integration of comprehensive and high-quality data is essential for addressing global challenges. Data-driven insights enable scientists, policymakers, educators, and stakeholders to make informed decisions that lead to sustainable practices and impactful solutions. The collection, analysis, and dissemination of accurate soil data are pivotal for understanding soil conditions and trends at various scales and depths.

Leveraging advanced cyberinfrastructure to manage and utilize this data ensures that efforts to improve soil health are based on reliable and actionable information, ultimately leading to more effective environmental management. Furthermore, integrating citizen science with cutting-edge cyberinfrastructure presents a transformative opportunity for environmental research. [The ECHO project](#), at the forefront of this initiative, aims to harness the collective power of citizen scientists across Europe to map and analyze soil parameters.

Revolutionizing soil health through participatory science and cyberinfrastructure

ECHO features a novel open-source cyberinfrastructure (ECHOREPO) designed by Quanta, an SME based in Barcelona, Spain. This infrastructure enables individuals and communities to contribute to the Soil Deal for Europe, a pivotal strategy aimed at enhancing soil health and sustainability in response to the urgent need for comprehensive soil data.

By leveraging the insights and observations of non-specialists, we aim to enrich our understanding of soil conditions and trends at unprecedented scales and depths. This approach requires innovative cyberinfrastructure for data curation and management, integration with existing data networks, and methodologies to ensure data reliability and usability.

The synergy between technological innovation and public participation is poised to revolutionize soil science. We encourage the academic community, technology developers, policymakers, environmental organizations, industry stakeholders, agricultural professionals, and the public to engage with the ECHOREPO platform and help drive forward the mission of sustainable soil management across Europe.

Data gaps and challenges in the EU Mission ‘A Soil Deal for Europe’

While the ECHO project presents a significant advancement, several gaps and challenges need to be addressed to optimize the impact of soil data management in the EU.

Integrating data from diverse sources, including citizen science, presents significant challenges in standardization and interoperability. Ensuring that data collected by non-specialists can be seamlessly integrated with existing scientific databases is crucial for a

comprehensive understanding of soil health across Europe. Standardized data helps different systems work together, which is essential for creating insightful data products and avoiding data silos.

Implementing FAIR (Findable, Accessible, Interoperable, Reusable) data principles is essential for maximizing the utility of soil data. This involves not only making data available but also ensuring that it is structured and documented to facilitate reuse by various stakeholders and maintain transparency and accountability, which are core principles of European policies.

Developing and maintaining a robust cyberinfrastructure that supports the long-term needs of the soil community is critical. This includes ensuring high availability, backup and failover mechanisms, long-term data preservation, cybersecurity, and privacy aspects. The ECHO project addresses these through its distributed IT system and software stack, which automates the entire data pipeline from collection to dissemination.

Effective stakeholder engagement is crucial for the success of any citizen science initiative. This involves not only involving citizens in data collection but also ensuring that the data they collect is valued and used in decision-making processes. The ECHO project focuses on engaging a wide range of stakeholders, including farmers, land managers, scientists, and policymakers, to ensure that the data collected is relevant and useful.

Another significant challenge is ensuring the quality and reliability of data collected by citizen scientists. The ECHO project addresses this by integrating a data quality assessment framework into its platform, in a controlled, transparent, and documented manner, which helps validate data and makes it suitable for use in scientific research and policy-making.

A cyberinfrastructure for soil deal

The ECHO initiative, which is focused on advancing soil health across Europe, leverages cutting-edge cyberinfrastructure (ECHOREPO) to allow citizens to play an active role in environmental management. This platform not only facilitates the collection and analysis of soil data but also integrates seamlessly with external databases, enhancing the scope and accuracy of environmental assessments and augmenting the soil data lifecycle. Our approach ensures that stakeholders from all sectors are equipped with the tools and knowledge necessary to make informed decisions and contribute to a healthier planet.

The cyberinfrastructure designed for the Soil Deal for Europe project features an open-source interface, ensuring that the system is accessible and adaptable for a wide range of users and applications. It is a scalable solution constructed on open standards, supporting both data preservation, open access, and effective data harvesting through established open protocols and adhering to FAIR principles. This robust framework facilitates seamless interaction with external soil databases, allowing for an integrated approach to soil data collection, analysis, and dissemination.

The infrastructure's emphasis on openness, interoperability, and the use of best engineering practices makes it a pivotal tool in advancing soil science and promoting sustainable environmental practices across Europe. This includes ensuring high availability, backup, and failover mechanisms, as well as data preservation, cybersecurity, and privacy aspects. The ECHO project addresses these through its distributed IT system and software stack, which automates the entire data pipeline from collection to dissemination. Our sustainable strategy relies on collaborative efforts within the EU Mission: A Soil Deal for Europe, the MINKA citizen observatory, and advancements of the European Open Science Cloud (EOSC).

ECHO at the forefront of the European soil data ecosystem

The ECHO project represents a significant step forward in integrating citizen science with advanced cyberinfrastructure to enhance soil health across Europe. By addressing current gaps and challenges, particularly in data management and interoperability, the project aims to create a comprehensive and sustainable framework for soil data collection, analysis, and dissemination.

This initiative not only enhances our understanding of soil health but also empowers citizens to take an active role in environmental management, democratizing data access, fostering greater awareness and engagement with soil health issues, and helping to create a society that is more informed and proactive in protecting our environment.

As we continue to develop and refine the ECHO platform, we invite the academic community, technology developers, and the public to join us in this endeavor and contribute to a sustainable future for Europe's soils.

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More About Stakeholder

[ECHO Project- Engaging citizens in soil science: Towards healthier soils](#)

ECHO is a Research and Innovation Action co-funded by the European Union through the Horizon Europe program and UK Research and Innovation (UKRI). Its objective is

to more actively involve citizens in the protection and restoration of soils From June 2023 to May 2027, the project aims to involve citizens in the protection and restoration [...]

