



OBSERVER: Caring for our soils with the EU Space Programme



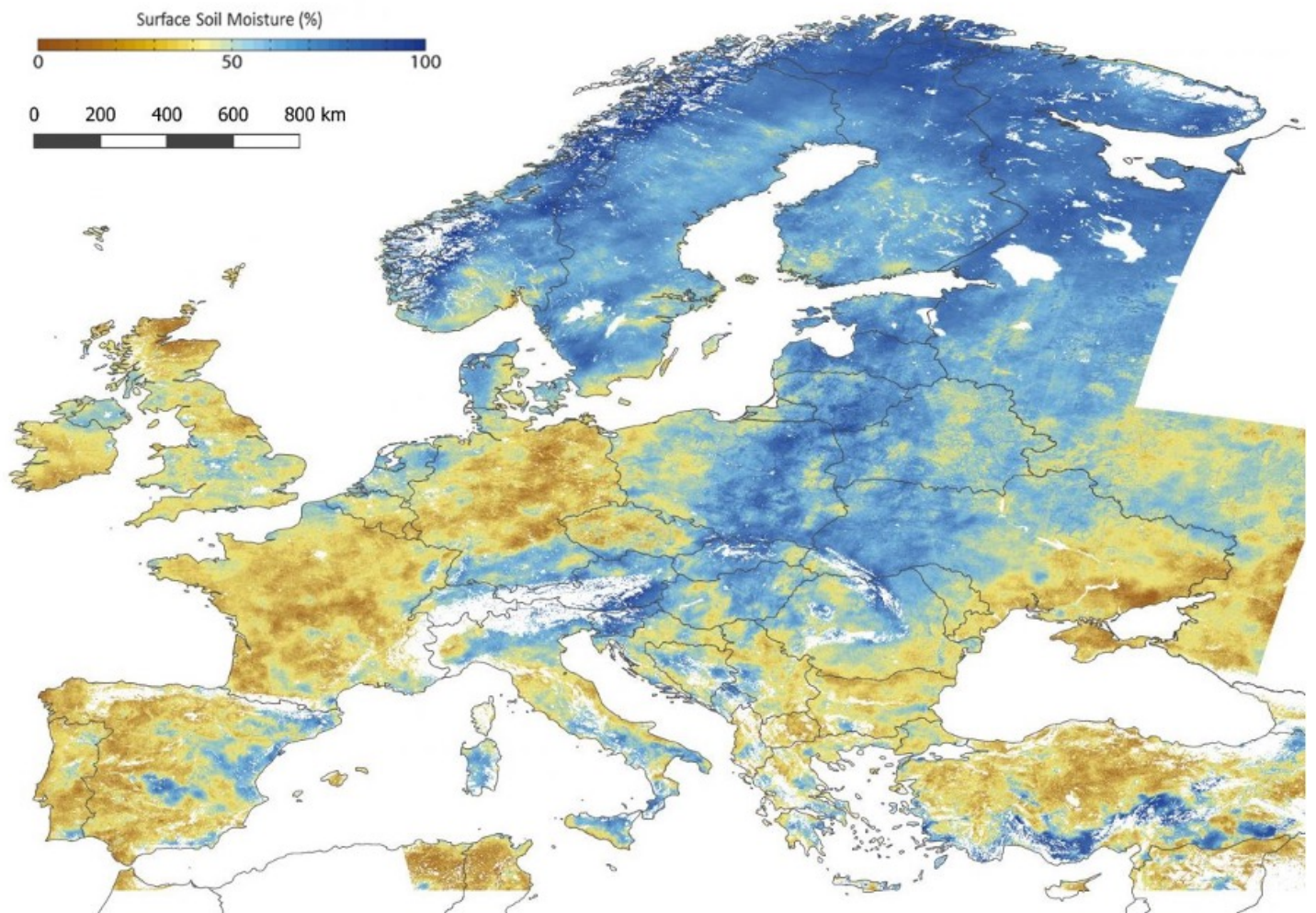
We rarely think about the health of soils, maybe because they are always under our feet, while they are actually incredibly important to our way of life. They are the bedrock of agriculture, supporting growth and availability of crops and the livelihoods of farmers around the world. Soils are also full of life, holding a large amount of the world's biodiversity. They play a crucial role in the fight against climate change as the second largest store of carbon after the oceans. Yet despite their importance, soils face unprecedented threats from unsustainable soil management practices and human activities. A third of the world's soils are already degraded, and if current trends continue, soil erosion could lead to a significant decline in crop yields by 2050. In response to these threats, there are ongoing efforts worldwide to restore and protect soils, and in this week's Observer we'll look at the many ways in which the EU Space Programme is stepping in to help.



Soils in bad shape

Soil degradation is a complex issue driven by unsustainable soil management practices, pollution, and agricultural expansion. Currently, around a third of the world's soils are degraded, and agriculture is usually the main driver. Practices such as tillage and monocropping, in which the same crop is grown repeatedly over the same parcel, contribute significantly to soil degradation by disrupting soil structure and depleting essential nutrients. Another major threat is deforestation. By cutting down trees and forests, humans have significantly accelerated soil erosion over millennia, altering natural ecosystems and exacerbating soil loss. Soil pollution is another problem — pesticides, fertilisers and microplastics all contribute to disrupting the complex web of life that makes up soil.

In Europe alone, over 60% of soils are currently classified as unhealthy. When considering how space technologies, in particular the EU Space Programme, can help to restore these soils, one obvious tool that comes to mind is the Copernicus Land Monitoring Service (CLMS). CLMS provides products on soil moisture, among others, which have applications in agriculture, water management, ecological modelling and nature conservation.



[Map showing surface soil moisture in Europe, showcasing one of the many CLMS products surveying soils across Europe.](#) Credit: CLMS

More recently, however, Copernicus has been supporting new EU-wide efforts to restore soils by assisting policymakers and soil scientists working on the new Soil Monitoring Law.

A Union-wide effort to restore soils

The EU's [Soil Monitoring Law](#) is a new piece of legislation that will establish a standard method for restoring soil health across the Union. The proposal was tabled in July 2023 and is currently under discussion in the European Parliament. The proposed legislation would require Member States to implement a series of measures to monitor the status of their soils. They would be required to collect data on soil health and assess it using a harmonised EU-wide methodology within a five-year timeframe. To achieve this, the proposal integrates various sources of soil data to provide guidance on the variables that Member States need to collect, including soil sampling data from the [EU's Land Use and Coverage Area Frame Survey](#) (LUCAS) and data from Copernicus. By combining these resources, the EU aims to create a consistent understanding of soil health across Member States, ultimately working towards the ambitious goal of healthy EU soils by 2050.

SOILS PROVIDE
95% OF OUR FOOD,
YET MANY SOILS ARE UNHEALTHY

#EUDataCrunch

MAKING **EU SOILS** HEALTHIER



The end-goal of the EU Soil Monitoring law will be to restore all soils across the Union to a healthy state by 2050. Credit: [European Commission](#)

The EU Soil Observatory

But there's more going on with EU soils. Launched in December 2020, the [EU Soil Observatory](#) (EUSO) is a dynamic new platform providing soil knowledge to policymakers and the wider soil user community. The EUSO produces reports on critical issues such as pesticide levels in soils, and provides innovative tools such as the [Soil Health Dashboard](#) — an interactive platform designed to monitor the implementation of soil policies and provide accessible data on soil health across the EU.

With the information it collects and provides, the EUSO supports EU policies, in particular those outlined in the European Green Deal, by ensuring that policymakers use the best and most up-to-date information on the state of EU soils. The Observatory is also supporting the ongoing discussions

on the new EU Soil Monitoring Law. And, similarly, Copernicus significantly contributes to the EUSO by providing data to the user community and the team building the Soil Health Dashboard.

How current Copernicus satellite missions support soil monitoring

Both Sentinel-1 and Sentinel-2 satellites play important roles in soil monitoring across the EU. Sentinel-2, equipped with the MultiSpectral Instrument (MSI), is a high-resolution, multi-spectral imaging mission able to provide a comprehensive view of the Earth's surface, with its wide swath width and high 5-day revisit time supporting close monitoring of changes in the Earth's surface. The MSI captures images across 13 spectral bands, allowing for the detailed analysis of the Earth's surface, including soil, vegetation, and water content. The twin satellites are crucial for monitoring soil health by assessing soil Organic Matter (OM) content, soil salinity, soil moisture, crop health, and stress, which are essential for supporting sustainable agricultural practices, ensuring food security, and implementing policies aimed at improving soil health. Sentinel-1, on the other hand, is equipped with Synthetic Aperture Radar (SAR) technology and provides high-resolution radar imagery of the Earth's surface, capable of measuring soil moisture data at a resolution of 1 km. This is crucial to assess irrigation needs, detect drought and predict agricultural yields.

Looking ahead - the role of CHIME

As we look to the future, there are new Sentinel satellites that will help us monitor soils beyond the capabilities of the current missions. The Copernicus Hyperspectral Imaging Mission for the Environment, or CHIME, is part of a suite of six new "Expansion" missions to be launched in coming years to complement the current Sentinel satellites. CHIME will address gaps in Copernicus user needs and support EU policies on natural resource management, particularly focusing on food security.

The CHIME mission consists of two satellites, CHIME-A and CHIME-B, both equipped with a HyperSpectral Imager (HSI) capable of imaging in over 200 spectral bands, which is a massive leap beyond Sentinel-2's already very impressive 13 bands. The HSI's spectral resolution and wide swath width of 130 km enable it to capture more detailed information about vegetation type and health, soil moisture, and other critical environmental parameters. Equipped with these new imaging spectrometers, the CHIME satellites will provide routine hyperspectral observations to monitor land cover change and assess soil properties. By providing key data to support sustainable agricultural practices and biodiversity management, CHIME will complement existing efforts such as the land cover mapping made possible by Copernicus Sentinel-2. CHIME's *raison d'être* is in line with several policies, including the EU Common Agricultural Policy and the EU Water Framework Directive. It will also provide data relevant to the UN's Sustainable Development Goals (SDGs). It will be a key step forward to make Copernicus even more useful in advancing environmental protection and sustainable development agendas.



The CHIME [Copernicus Expansion Mission](#) will carry a unique spectrometer to provide routine hyperspectral observations. These will support new and improved services for sustainable agricultural and biodiversity management. Credit: Thales Alenia Space

Healthier soil with Galileo-enabled agriculture

Soil protection doesn't have to be a Copernicus-only endeavour. Other components of the EU Space Programme, such as Galileo and EGNOS, can also play a role, especially when it comes to improving agricultural practices.

In combination with Copernicus, data from Galileo and EGNOS will help farmers by supporting solutions such as the guidance of farm machinery and precision farming. This is important for farmers: if Earth Observation technology can help determine exactly how much fertiliser or pesticide is needed in a particular corner of a parcel, then European GNSS can help guide tractors and release only those amounts that are required at a particular location with high precision, thus contributing to

the overall health of the soil. Galileo and EGNOS will also help farmers to maximise the efficiency of seed placement, leading to higher yields and production.

From agriculture to biodiversity and climate resilience, soil health underpins key aspects of our existence and cannot be overlooked. As this precious resource faces threats from degradation, pollution and unsustainable management practices, concerted efforts are underway to protect soil health across the EU. The EU Space Programme plays an important role in this endeavour by supporting the many initiatives aimed at restoring this essential resource that humbly lies beneath our feet.