

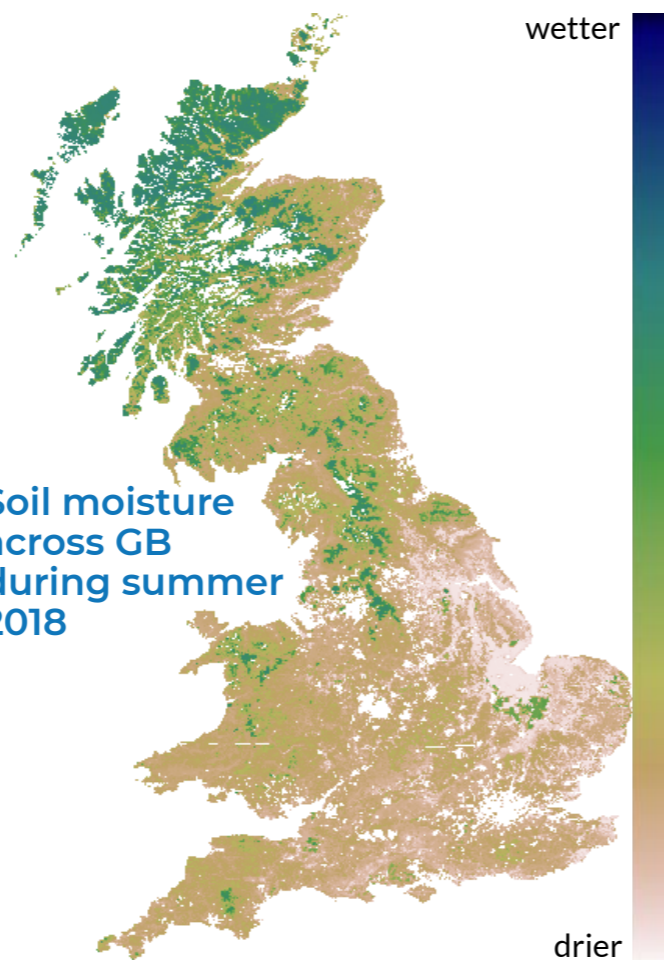
## Next steps

COSMOS-UK has revolutionised the way that soil moisture data are measured across the UK. The data are transforming how we understand and model the natural environment as it becomes more vulnerable to changes in climate and land use. This evidence can support adaptation options, such as investment in flood forecasting, reservoirs and irrigation. Greater use of soil moisture information in fire risk rating systems can lead to earlier warning of wildfire danger.

COSMOS-UK data are freely and publicly available and can be streamed directly into users' models and apps. At UKCEH, observations from representative sites are being used to calibrate and train models to estimate soil moisture across the UK. We are close to completing a real-time UK soil moisture map at a 1km<sup>2</sup> spatial resolution using COSMOS-UK data in conjunction with satellite data, gridded meteorological data (particularly precipitation) and other spatial information.

Looking ahead, we will be reviewing the existing network and, in particular, identifying any soil types which are currently under-represented. For these soils we may install new sites and gather additional data to fill these gaps and improve our national mapping.

Soil moisture  
across GB  
during summer  
2018



## How to access COSMOS-UK data

COSMOS-UK website:

[www.cosmos.ceh.ac.uk](http://www.cosmos.ceh.ac.uk)



International Soil Moisture  
Network website:

[www.ismn.earth/en](http://www.ismn.earth/en)



UK Water Resources Portal:

[www.eip.ceh.ac.uk/hydrology/  
water-resources](http://www.eip.ceh.ac.uk/hydrology/water-resources)



Environmental  
Information Data Centre:

[www.eidc.ac.uk](http://www.eidc.ac.uk)



Email: [cosmosUK@ceh.ac.uk](mailto:cosmosUK@ceh.ac.uk)

X: [@COSMOS\\_UKCEH](https://twitter.com/COSMOS_UKCEH)

## COSMOS-UK The UK's Cosmic Ray Soil Moisture Observing System



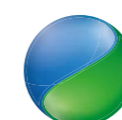
Chimney Meadows Nature Reserve

**Soil moisture refers to the water that is held in the spaces between soil particles. It is an important component of the water cycle, at the local field scale, for regional water resource availability, and for large-scale hydroclimate modelling and understanding of controls on soil functioning, such as greenhouse gas emissions affecting the whole climate system. The availability of soil water for evapotranspiration controls the partitioning of land surface energy fluxes – very dry soils increase convective heating of the air, and this information is vital for weather and climate modelling. Soil moisture status varies greatly with soil type, climate, drainage, vegetation and land management practices.**

Accurate information on current soil moisture status across the UK is needed for improved decision making, and current and future risk assessments. The currently available water storage capacity of soils is an important antecedent factor in flood risk – as soils become saturated, there is naturally more overland runoff, leading to rapid increases in river flow. Integrated with meteorological and hydrometric data, soil moisture enables us to better describe present environmental conditions and inform management of water resources for domestic, agricultural and industrial uses. Combined with future climate projections, we can, for instance, assess the change in drought likelihood and vegetation water stress that will impact farming and food production.



COSMOS-UK



UK Centre for  
Ecology & Hydrology

## The first decade

On the 2nd October 2013, a soil moisture monitoring site was installed at the Chimney Meadows Nature Reserve, adjacent to the River Thames in Oxfordshire. The site was equipped with a sensor that uses cosmic ray neutrons to sense soil moisture over a circular area around 400m in diameter. The Chimney Meadows site was quickly followed by sites at Sheepdrove Organic Farm in Berkshire and Waddesdon Estate in Buckinghamshire.



The subsequent widespread deployment of this state-of-the-art monitoring technique gave the national network of near real-time soil moisture monitoring sites its name: the Cosmic Ray Soil Moisture Observing System UK, or COSMOS-UK for short. The current COSMOS-UK network comprises 47 sites across the UK. The network is run by the UK Centre for Ecology & Hydrology (UKCEH) with funding from the Natural Environment Research Council (NERC) and UKCEH National Capability.

COSMOS-UK sites are located on land owned by charities, environmental organisations, higher education institutes, local and national government, research centres and, not least, independent landowners. Land uses at our sites include arable farming, forest, grassland, moorland, nature reserves, and even a vineyard. Sites are often co-located with existing research infrastructure and we have benefitted from collaborations with many organisations.

## How do we measure soil moisture?

Measuring soil moisture is not straightforward. *In situ*, near real-time field observations provide the highest quality data. The traditional method involves the frequent manual collection of samples which are weighed before and after drying in an oven. The difference in mass is used to calculate the soil moisture content. New methods, like the Cosmos probe, automatically and continuously collect data without disturbing the soil. The sensor is installed just above the ground and counts the number of naturally occurring neutrons, which are generated by cosmic rays, and relates this to the volumetric water content in the soil: the fewer neutrons detected, the higher the soil water content.

In addition to soil moisture, COSMOS-UK sites measure meteorological variables. Around half of the sites have instrument arrays which measure point soil moisture at different depths, to inform on wetting and drying dynamics in the vertical soil profile. Phenocams at many of our sites capture images which can be turned into time-lapse videos. When all these data are combined, they provide us with new information about how water behaves in the natural environment.

