

UKCEH and COSMOS-UK: The UK National Soil Moisture Measurement Network

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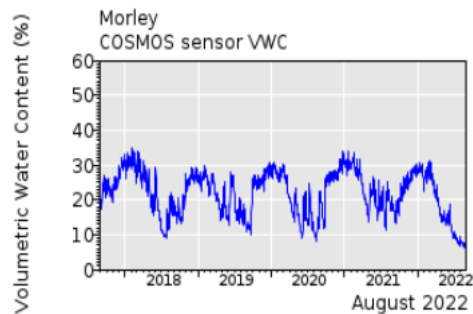
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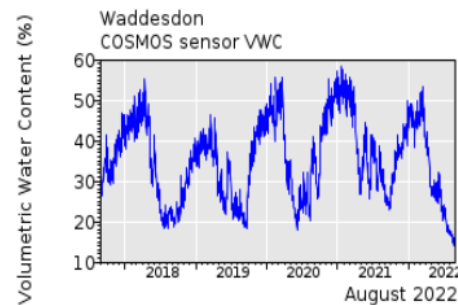


COSMOS-UK: Soil Moisture and other Land Surface Observations for EO Cal/Val Applications

- The COSMOS-UK Network – NERC National Capability operated by UKCEH
- Case Studies of EO data applications



Morley



Waddesdon



Rothamsted COSMOS-UK Station Phenocam



COSMOS-UK



UK Centre for Ecology & Hydrology

Acknowledgement: The UKCEH COSMOS-UK Team, UK-SCAPE and NERC National Capability funding

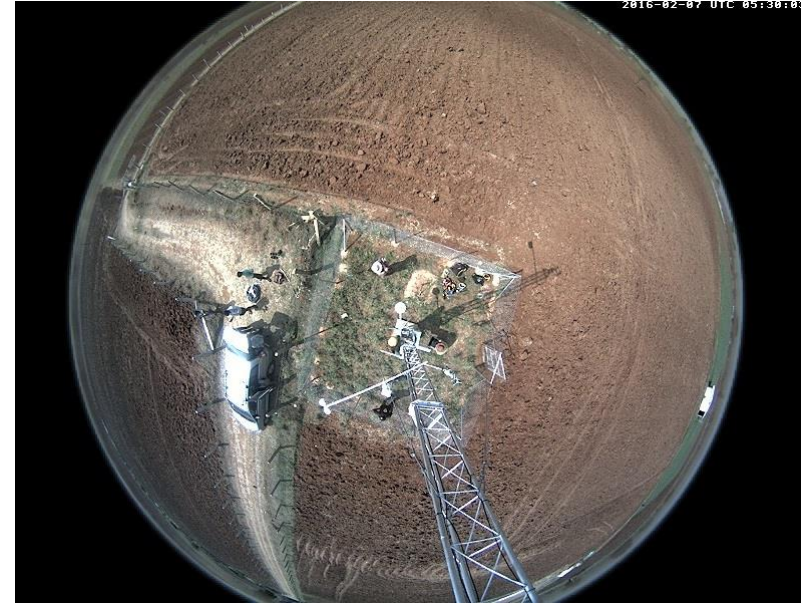
Point Sensor to Field Scale Soil Moisture



Acclima Time Domain Transmissometry (TDT) point soil moisture sensor (bottom left) & Soil heat flux plate (top right)



Cosmic Ray Neutron soil moisture Sensor (CRNS) or 'COSMOS' Probe – field scale measurement



Above: Phenocam photo from Berambadi Eddy Covariance flux tower & COSMOS site, Karnataka, India
Shows approximate COSMOS 'footprint' or measurement area

A typical COSMOS-UK monitoring site



48 Stations deliver continuous near real time data, from 2013 ongoing.

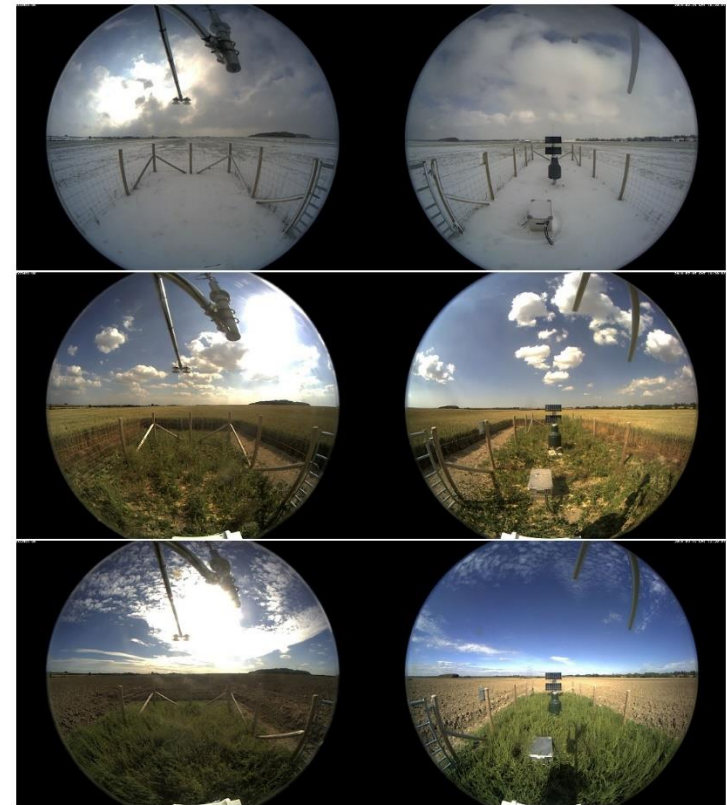
From: Cooper, H. M., et. al.(2021) "[COSMOS-UK: national soil moisture and hydrometeorology data for environmental science research](#)". Earth Syst. Sci. Data, 13, 1737–1757, doi: 10.5194/essd-13-1737-2021

COSMOS-UK website

The screenshot displays the COSMOS-UK website interface. At the top, the navigation menu includes: HOME, THE NETWORK, DATA, SCIENCE, SOIL & WATER, RESOURCES, and ABOUT. Below the menu is a banner image of a field with solar panels. A 'Data' sidebar on the left features a map of the United Kingdom with various colored markers indicating monitoring sites. The main content area is overlaid with a YouTube channel page for 'COSMOS-UK', which has 9 subscribers and a 'SUBSCRIBE' button. The YouTube page shows a grid of video uploads, including 'CosmosUK Precipitation 2018', 'Cosmos goes to India', 'COSMOS-UK Euston 2018', 'COSMOS-UK Soil moisture Distributions 2018', 'COSMOS-UK Soil moisture map 2018', 'COSMOS-UK 2018', 'CFH COSMOS', 'COSMOS-UK @ The Lizard 2017', 'COSMOS-UK @ Hillsborough 2017', and 'COSMOS-UK @ Harwood Home Farm 2017'. To the right of the YouTube page, two line graphs are shown. The top graph is for 'Chimney Meadows' and the bottom graph is for 'Chobham Common'. Both graphs plot 'Volume' on the y-axis against months from April to September on the x-axis. The Chimney Meadows graph shows a peak in August, while the Chobham Common graph shows a peak in September.

EO Cal/Val Applications

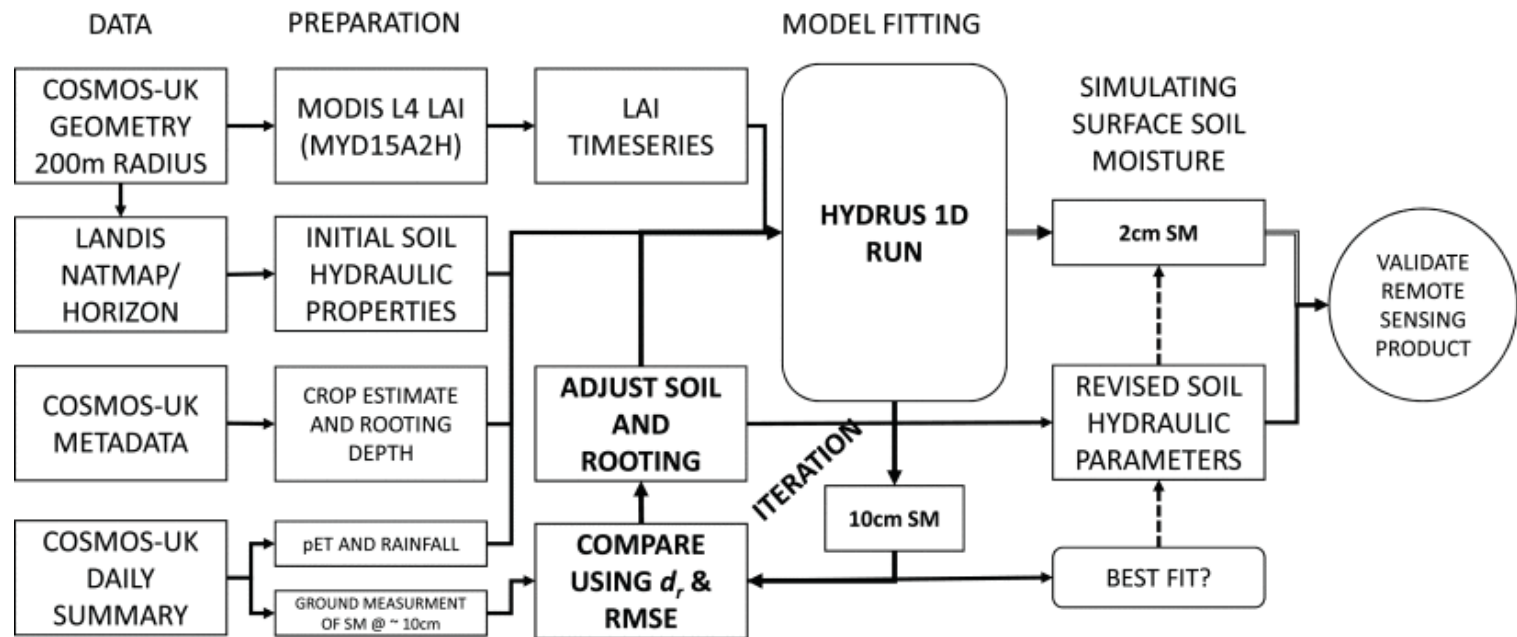
- Several studies have compared satellite soil moisture (SM) products with COSMOS-UK data.
- Mismatch in SM sensing depth has been addressed.
- Greenness product from the PhenoCams is available
- land cover change validation, land surface temperatures, evaporation products, soil temperatures etc.



Right: PhenoCam photographs from the Fincham COSMOS-UK site in East Anglia. From top: a snow event at the end of February 2018, rapeseed oil crop growing in surrounding field in July 2018, and the bare field in September 2018. From Cooper et. al. 2021, Earth Syst. Sci. Data, 13, 1737–1757

Comparing EO SM to COSMOS

- An approach to better match measurement depths, by modelling COSMOS SM, then simulating 2 cm Surface Soil Moisture (SSM).
- improvement of up to 8% in RMSD by validating the Copernicus SSM product at 2 cm compared to 10 cm



From Fig. 4 in J. Beale, T. Waine, J. Evans and R. Corstanje, "A Method to Assess the Performance of SAR-Derived Surface Soil Moisture Products," in IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing, vol. 14, pp. 4504-4516, 2021, doi: [10.1109/JSTARS.2021.3071380](https://doi.org/10.1109/JSTARS.2021.3071380)

Data Assimilation for SM Modelling

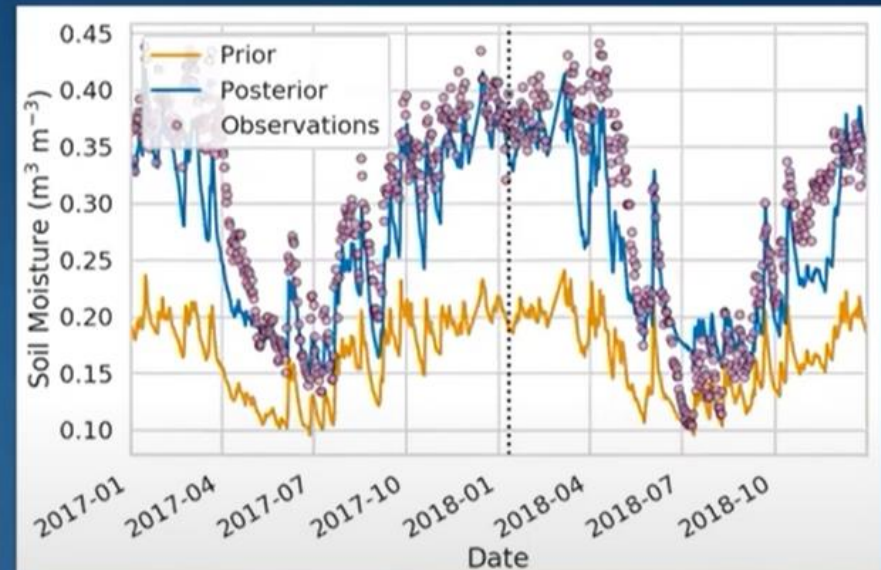
Combining JULES with observations to improve soil moisture estimates

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2021. Cooper, E., Blyth, E., Cooper, H., Ellis, R., Pinnington, E., and Dadson, S. J., "[Using data assimilation to optimize pedotransfer functions using field-scale in situ soil moisture observations](#)". Hydrol. Earth Syst. Sci., 25, 2445–2458, doi: 10.5194/hess-25-2445-2021

<https://www.youtube.com/watch?v=mxD0enCHq6E>

Where to Access the Data

1. COSMOS-UK website – view live data now:
<https://cosmos.ceh.ac.uk/data>
2. Download complete datasets from EIDC (currently to end of 2019): <https://doi.org/10.5285/b5c190e4-e35d-40ea-8fbe-598da03a1185>
3. Request recent data from CosmosUK@ceh.ac.uk
- **API to be launched late 2022**

Data is fully described and can be referenced via:
"[COSMOS-UK: national soil moisture and hydrometeorology data for environmental science research](#)". Earth Syst. Sci. Data, 13, 1737–1757, doi: 10.5194/essd-13-1737-2021