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Root zone soil moisture Estimates at the daily and agricultural parcel scales for Crop irrigation management and water use impact – a multi-sensor remote sensing approach

Results in Brief

Novel remote sensing algorithm brings direct measurement of soil moisture one step closer to reality

Increasing water use efficiency in agriculture is linked to water scarcity and drought. An EU initiative has set out to optimise on-farm irrigation management by adjusting irrigation to crop water requirements during the entire growing season.

FOOD AND NATURAL RESOURCES

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The Mediterranean region is one of the most sensitive areas to climate change. Increased temperatures will shrink water resources, and more rainfall will compromise irrigation potential and expansion plans, and increase competition and conflict over limited water resources. On the other hand, irrigation performance assessments at field scale show a mismatch between irrigation requirements and the amount of irrigation water that's actually applied. Over-irrigation of crops implies an increase in both water use and exported pollutants, while under-irrigation means a reduction in crop yield.

The EU-funded REC project has proposed “a cutting-edge solution to the need for root-zone soil moisture at the field scale for irrigation management by developing an innovative and operational algorithm,” says coordinator Dr Maria Jose Escorihuela. For the first time, this algorithm estimates the timing and amount of irrigation throughout an agricultural season. “Monitoring irrigation is essential for efficient management of water resources in both arid and semi-arid regions.”

Remote sensing methodologies and satellite data to better manage crop irrigation

The REC team carried out its research efforts using remote sensing observations collected by Soil Moisture Ocean Salinity, Sentinel 1, 2 and 3 and Landsat satellites, among others. It validated findings at a modern irrigated area in Segarra-Garrigues, Spain, and at an irrigated perimeter of Morocco’s Haouz plain, a part of the Tensift watershed. “The basic idea is to derive a first guess estimate of the soil moisture at the root zone, to assimilate those observations in a model that simulates the crop water fluxes all along the season and retrieve irrigation as a difference between daily root-zone soil moisture estimates,” explains project researcher Dr Olivier Merlin. The model is very efficient for the seasonal accumulated (including drip and flood) irrigation amounts (correlation of 0.9 and error of 40 mm), while acceptable errors (0.5 30 mm) are obtained for irrigations accumulated over 2 weeks.

The daily root-zone soil moisture and evapotranspiration – the return of water vapour to the atmosphere by evaporation from land and water surfaces – simulated from the retrieved irrigations are very close to those estimated by actual irrigations. The research demonstrates the usefulness of satellite data for estimating irrigation, and consequently for better closing the water budget over agricultural areas. It also shows that significant improvements can be expected at daily to weekly timescales by reducing the revisit time of remote sensing data.

Innovative approaches answer irrigation management needs

In addition, project partners developed new methodologies and improved current approaches for estimating surface soil moisture. High-resolution remote sensing surface soil moisture can now be provided every 3 days in all weather conditions. Intensive field experiments fully validated soil moisture and water fluxes that cover a wide range of soil moisture and irrigation settings.

“REC provided the conditions to make an important step forward in remote sensing estimation for root-zone soil moisture at the daily and agricultural parcel scales for

crop irrigation management," concludes Dr Escorihuela. "As a result, it laid the foundation for a complete remote sensing-based irrigation management system that improves the reliability of decisions involving water use efficiency in agriculture." This research was undertaken with the support of the Marie Curie programme.

Keywords

REC, soil moisture, crop, irrigation management, root-zone soil moisture, agriculture, remote sensing algorithm

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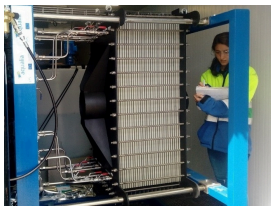

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