DR6 95424 - Satellite data applicability and accuracy at different spatiotemporal scales for sustainable agricultural water management (SAA4Water)

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The objective of the project is to evaluate the role of satellite earth observation (EOs), and in particular of optical-thermal-microwave data, in support of water management at different spatial scales (field, regional, and global). Satellite data can play an important role in assessing water availability as well as crop water needs and stress conditions, either as a stand-alone source of information or in combination with hydro-meteorological modelling tools. In this context, satellite data represent an optimal compromise between the need to monitor large areas in a cost-effective manner, and the need for detailed local estimations akin to ground data.

A large suite of satellite-based products is available for water balance modelling at multiple spatial scales, which are relevant to climate, meteorology, basin-scale water management models and field-scale precision irrigation. Nevertheless, there exists a need to understand how the accuracy of such data products affects the reliability of hydrological model simulations when used for operational applications at multiple spatial scales. These needs are exacerbated by the increasing expansion of areas devoted to water-intensive crops and the concurrent impact of climate change on water availability.

Examples of Chinese and Italian / European case studies will be presented on several practical topics to support the discussion on the SAA4Water project.

Chinese case studies will be presented and discussed in relation to the following application:

- Evaluating the Irrigation Performance Using Remote Sensing Data and the Budyko Hypothesis at a regional scale. A novel metric of consumptive irrigation water use was developed after partitioning the total actual evapotranspiration (ET) into green ET and blue ET, and it was applied to the irrigated areas in northwest China to evaluate the performance of irrigation. The irrigation water use efficiency, estimated as the ratio of BET to net irrigation water, was evaluated in detail. The results show that the irrigation water use efficiency has improved in the last 10 years, although some regions still face severe net irrigation water deficits.
- Monitoring cropland water use efficiency (WUE) at global scale. By combining the improved EF-LUE model with the ETMonitor model, a 20-year (2001–2020) global cropland WUE dataset was developed with a spatial resolution of 1-km. It is driven by consistent forcing data and considers the coupling relationship between the carbon and water exchange. This dataset can help to assess and explore the changes in the global cropland WUE and support the monitoring and assessment of the SDG 6.4.
- ET and precipitation derive from remote sensing observations in supporting drought's impact evaluation at continental scale. We investigated the impact of drought on water availability in the Belt and Road region using high-resolution remote sensing data from 2001 to 2020. An overall decreasing trend in water availability is observed with an expanding water deficit area and increasing of the water deficit intensity associated with drought frequency. The critical role of ET drived from remote sensing observations in assessing seasonal variability of water availability evaluation is also highlighted.

European / Italian case studies will be presented and discussed in relation to the following application:

- Precision irrigation supported by satellite information was analysed, providing a discussion on the required satellite spatial resolution and temporal frequency.
- Estimation of evapotranspiration using observations from several satellites, ground data and hydrological models at different spatial and temporal resolutions.
- Water balance analysis using a suite of satellites observations, ground data and hydrological modelling for operational water availability detection at river cross sections in basins of different sizes.

The results reinforced the synergistic use of satellite data in water and energy balance models is a robust approach for irrigation.