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Understanding the impact of irrigation on the hydrological cycle: a PhD project that includes the use of remote sensing data and a land surface model

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Human-induced changes on the hydrological cycle nowadays rival the geophysical processes and their short-term impacts are often larger than the effects of climate change, even if they are not independent. Among the anthropogenic activities that alter the natural hydrological cycle, the irrigation is the most impacting one. It is estimated that over 70% of global freshwater is used for irrigation practices (Foley et al., 2011), with the major contributions of water consumption for this purpose coming from North America and Eurasia (Zhou et al., 2016). Despite the important implications of irrigation on water scarcity and food production, data on irrigation practices over large areas and for long periods are lacking, that is, often there is no reliable information about where irrigation practices occur and how much water is used for them.

This PhD project is aimed to evaluate the effects of the irrigation on the hydrological cycle over two pilot Mediterranean areas, the upper Tiber river basin in Italy and the Ebro river basin in Spain. The project is structured according to two main research lines: the first one consists in estimating the amount of water used for irrigation through the adapted SM2RAIN method (Brocca et al., 2018), the second one consists in evaluating the irrigation effects through SURFEX, the land surface model developed by Météo-France. In order to estimate the amount of water used for irrigation, the adapted SM2RAIN method needs remotely sensed soil moisture data as input. Within this project, the method will be applied by using high-resolution soil moisture products. Pilot tests carried out over the Urgell area in Spain show promising results in terms of the capability to detect the irrigated areas of 1 km resolution DISPATCH downscaled SMOS and SMAP surface soil moisture data.

According to the general plan of the project, the amount of water used for irrigation in the study areas will be estimated by applying the adapted SM2RAIN method with high-resolution soil moisture products. Then, this amount of water will be introduced with the atmospheric forcings in SURFEX simulations in order to represent a human-altered, real, scenario and to evaluate the effects of irrigation practices. The coupling with a river routing model will be useful to study the consequences of the irrigation on the streamflow and to investigate from where water for irrigation is withdrawn (e.g., dams).

References:

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