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The economic value of ensemble numerical weather forecasts combined with remote sensing data and hydrological modeling for irrigation scheduling: an application to Southern Italy

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The use of numerical weather prediction (NWP) outputs in hydrological modeling combined with remote sensing data for forecasting irrigation water demand in the short-medium term, has becoming one of the key actions adopted in precision farming for decreasing water and energy consumptions in the long-term perspective of sustainability.

In the last decades, ensemble prediction systems (EPS) have been developed to support operational decision-making processes in many environmental fields. Unlike traditional deterministic forecasts where the numerical weather prediction model is run only once, in EPS the NWP model is run several times from very slightly different initial conditions and perturbed model parameters, to produce an ensemble of forecasts that are used to account for uncertainty in initial atmospheric conditions and NWP model errors. Moreover, in recent years, limited area ensemble prediction systems (LEPS) have been developed as dynamic regional downscaling of global ensemble prediction systems, opening new opportunities for the application of weather forecasts in agriculture and water resource management. Indeed, high resolution probabilistic forecasting may allow water irrigation managers to set-up agrometeorological advisory services based on a more reliable risk analysis.

This study exploits the potential economic benefit (i.e., economic value) related to the use of an ensemble numerical weather prediction model, such as COSMO-LEPS (20 members, 7 km of spatial horizontal resolution) for irrigation scheduling at farm scale in Southern Italy, by combining its outputs with high resolution satellite images in the visible and near infrared wavelengths for crop parameter estimations. An adaptive ensemble Kalman filter is employed for bias correcting weather forecasts by assimilating ground based meteorological variables. Then, a bucket model for soil-vegetation-atmosphere modeling is implemented for providing spatial and temporal estimates of crop water requirements and irrigation schedules along with their predictive uncertainty.