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A stochastic ensemble-based model to predict crop water requirements from numerical weather forecasts and VIS-NIR high resolution satellite images in Southern Italy

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Irrigation agriculture is one the biggest consumer of water in Europe, especially in southern regions, where it accounts for up to 70% of the total water consumption. The EU Common Agricultural Policy, combined with the Water Framework Directive, imposes to farmers and irrigation managers a substantial increase of the efficiency in the use of water in agriculture for the next decade. Ensemble numerical weather predictions can be valuable data for developing operational advisory irrigation services.

We propose a stochastic ensemble-based model providing spatial and temporal estimates of crop water requirements, implemented within an advisory service offering detailed maps of irrigation water requirements and crop water consumption estimates, to be used by water irrigation managers and farmers.

The stochastic model combines estimates of crop potential evapotranspiration retrieved from ensemble numerical weather forecasts (COSMO-LEPS, 16 members, 7 km resolution) and canopy parameters (LAI, albedo, fractional vegetation cover) derived from high resolution satellite images in the visible and near infrared wavelengths. The service provides users with daily estimates of crop water requirements for lead times up to five days. The temporal evolution of the crop potential evapotranspiration is simulated with autoregressive models. An ensemble Kalman filter is employed for updating model states by assimilating both ground based meteorological variables (where available) and numerical weather forecasts.

The model has been applied in Campania region (Southern Italy), where a satellite assisted irrigation advisory service has been operating since 2006.

This work presents the results of the system performance for one year of experimental service. The results suggest that the proposed model can be an effective support for a sustainable use and management of irrigation water, under conditions of water scarcity and drought. Since the evapotranspiration term represents a staple component in the water balance of a catchment, as outstanding future development, the model could also offer an advanced support for water resources management decisions at catchment scale.