A distributional model of simulation water distribution pattern under Center pivot irrigation and its impact on soil moisture

Imen Ben Charfi, Chiara Corbari, and Marco Mancini

Politecnico di Milano, civil and environmental engineering, Milano, Italy (imen.ben@polimi.it)

The water distribution uniformity in irrigation systems plays an important role in the wise use of water in agriculture, by a direct effect on water use efficiency and production. To reach this aim, the modelling of irrigation water distribution under the different irrigation systems have been under study in the last few decades towards increasing the efficiency.

The center pivot simulation models has been the subject of many research studies (Bellinger and Logenbaugh 1962) to compute precipitation under the machine with the objective is to define the optimal sprinkler spacing in order to obtain uniform water distribution, hence improving not only the design and but also the irrigation performance.

The research study aimed to develop in a first step a model that simulates the water distribution pattern in wind condition under sprinkler irrigation system by using the ballistic theory that computes the droplets trajectory discharged by the sprinkler's nozzle. With the main objective of developing a model that simulates water distribution of a center pivot irrigation system by using the water distribution radial curve of a single sprinkler (using the polynomial function approach).

The model was developed also to simulate and predict the water distribution of center pivots in different spatial (different sizes of pixels) and temporal basis (hourly and daily basis) from the simulated water distribution of the sprinkler. The computer model was developed using MATLAB software (The Mathworks Inc, MA, USA) to model the water distribution pattern under single sprinkler irrigation system and center pivot. The resulting model was tested and used in the case study area of Barrax, Spain.

The model performs several simulations in step by step operation, which are strictly done by order: simulating droplets trajectories, water distribution radial curve of single sprinkler, overlapped sprinklers patterns, center pivots water distribution radial curve and patterns. The results obtained from the simulation model are the water distribution pattern under center pivot irrigation system on daily and hourly basis not only for one center pivot but for two or more as desired.

After that the evaluation of the impact of the sprinkler irrigation technique on the water fluxes which were estimated through a distributed energy water balance model FEST-EWB has been done. The validation against ground and satellite data of land surface temperature and evapotranspiration and also the application of the optimization of irrigation were verified.