Evaluating conjunctive use of ground- and surface-water and crop yield in rural environments by means of simulation tools

Giovanna De Filippis[1], Federico Triana[1], Matteo Ghetta[1], Iacopo Borsi[2], Wolfgang Schmid[3], Rudy Rossetto[1]

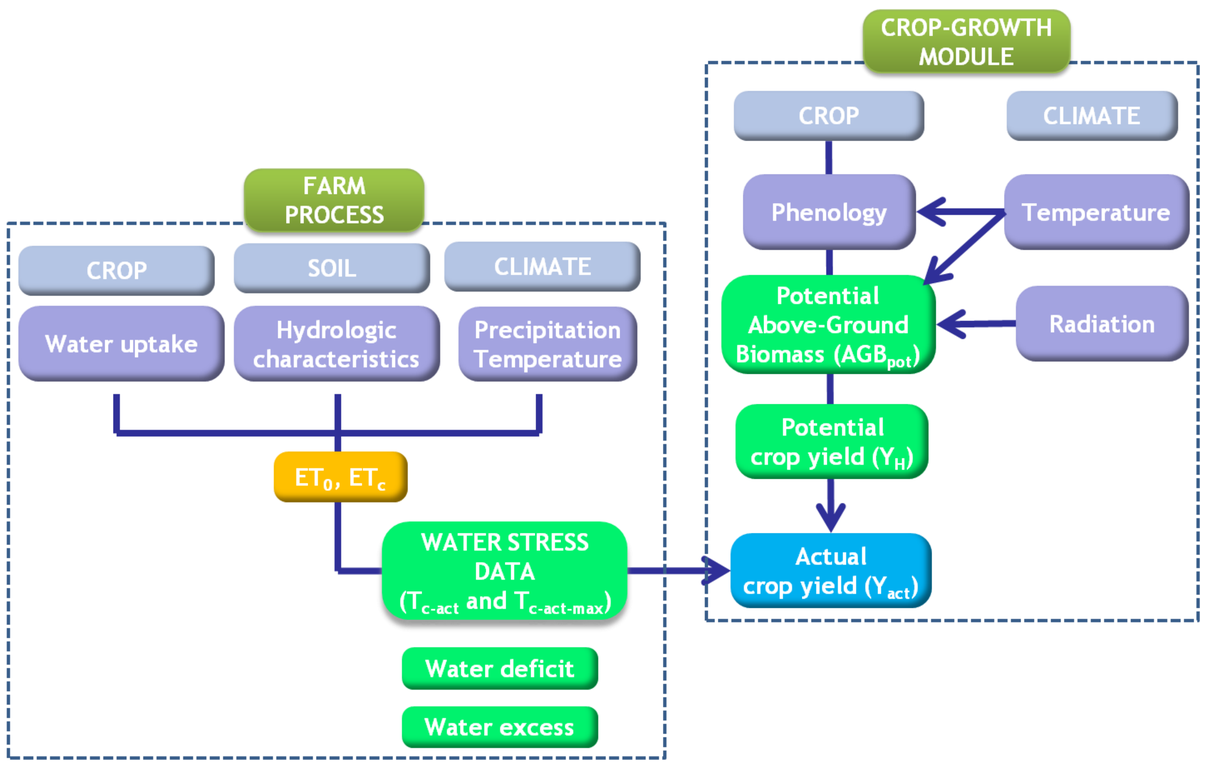
[1] Scuola Superiore Sant'Anna, Italy
[2] TEA Sistemi SpA, Italy
[3] Commonwealth Scientific and Industrial Research Organisation, Australia

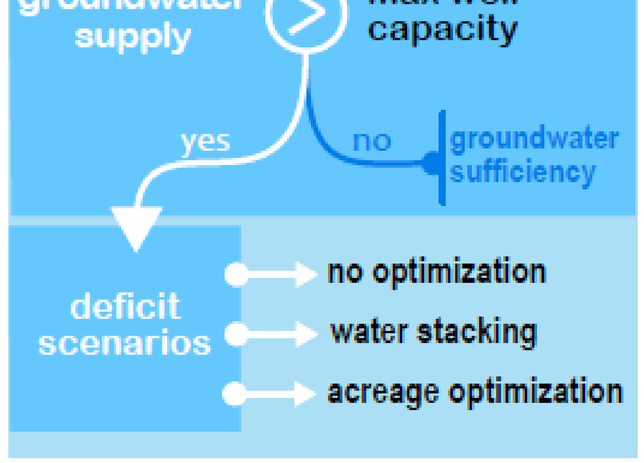
BACKGROUND AND MOTIVATIONS

Rural water management is a matter of concern, due to pressure related to overexploitation and climate change. Conjunctive use of ground- and surface-water may enhance management of water resources and meet crop production sustainability. ICT tools (e.g., GIS-integrated modelling engines) may allow data-based water resource management for agricultural purposes.
To this aim, the FREEWAT QGIS-integrated modelling platform (*Rossetto et al., 2018*) integrates the Farm Process (FMP), embedded in MODFLOW-OWHM, to evaluate supply-and-demand components of irrigated agriculture on a farm scale. Within the FREEWAT platform, FMP was coupled to the Crop Growth Module (CGM) belonging to the EPIC family, which is a radiation-based model, where the crop growth process is driven by intercepted radiation converted into above ground biomass using a radiation use efficiency coefficient. These processes are affected by climate variables and crop phenology. Crop yield at farm and basin scale is estimated by CGM.

FMP-CGM COUPLING APPROACH

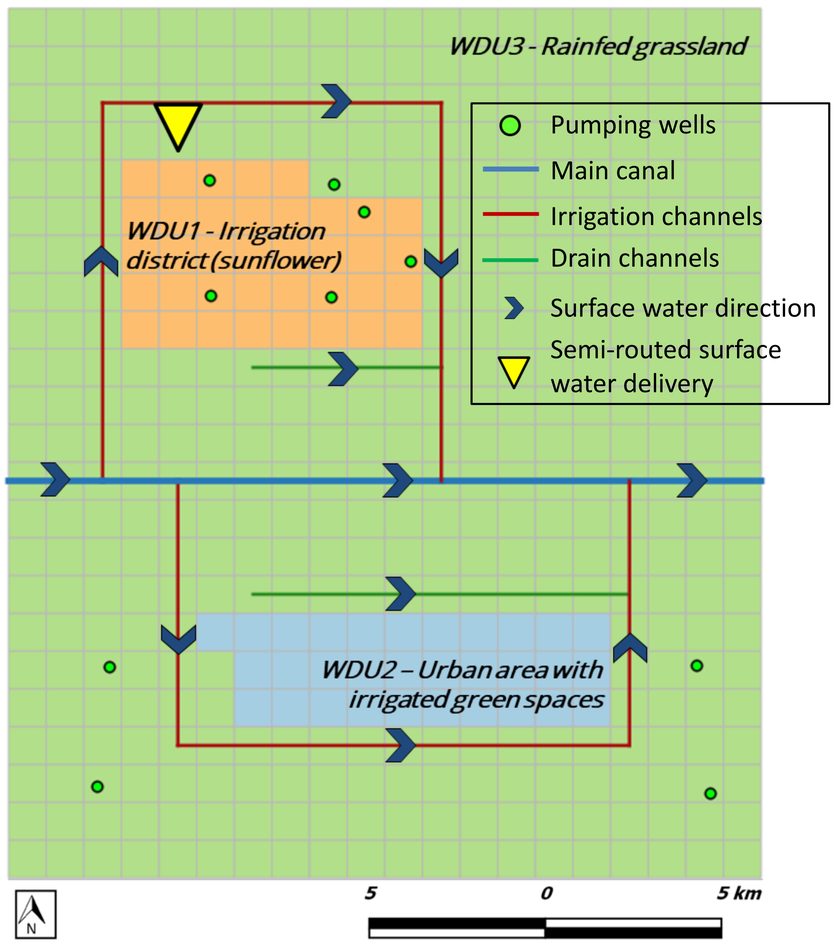
The coupling between CGM and FMP is guaranteed through variables Tc-act and Tc-act-max calculated by FMP and needed as input data to CGM to take into account water supply constraints. CGM is run sequentially after FMP and all over the growing season of the crop, from seeding to harvest.

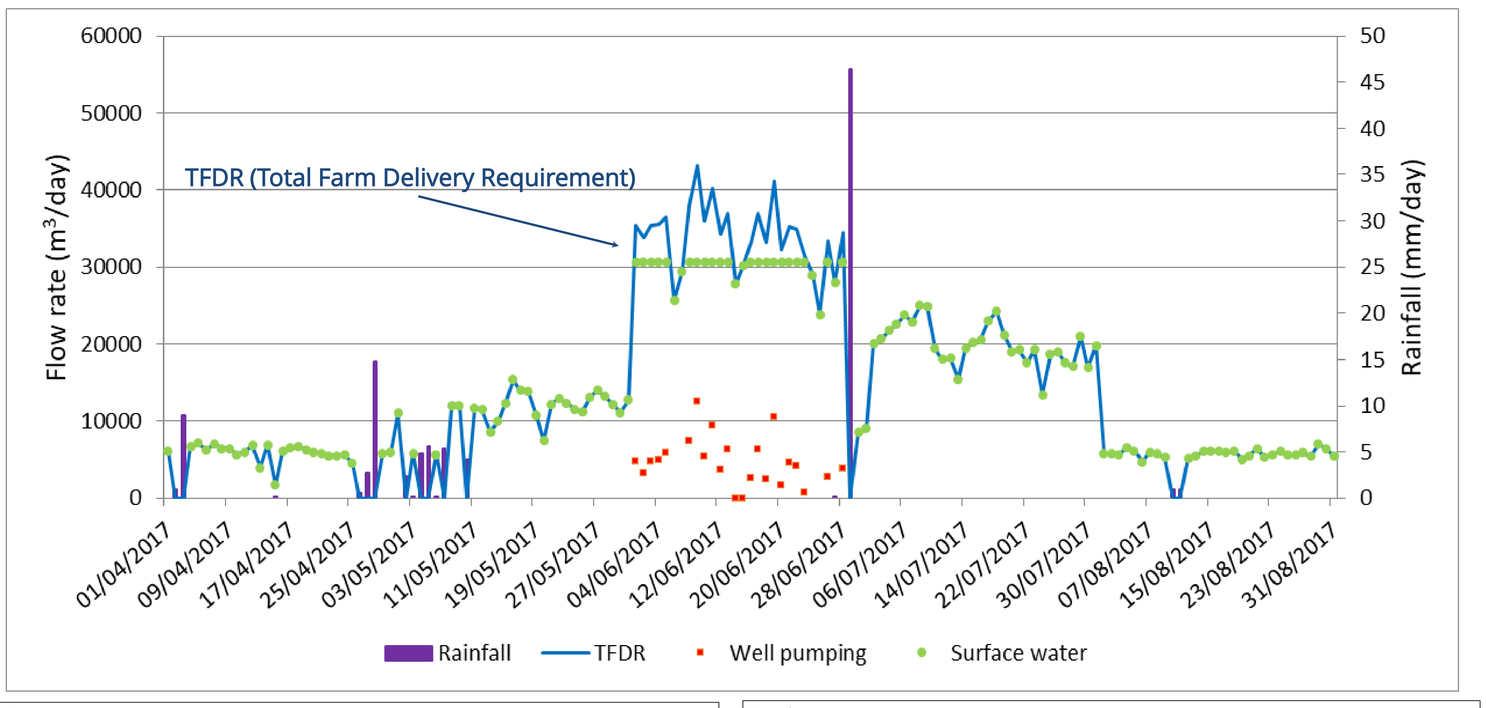


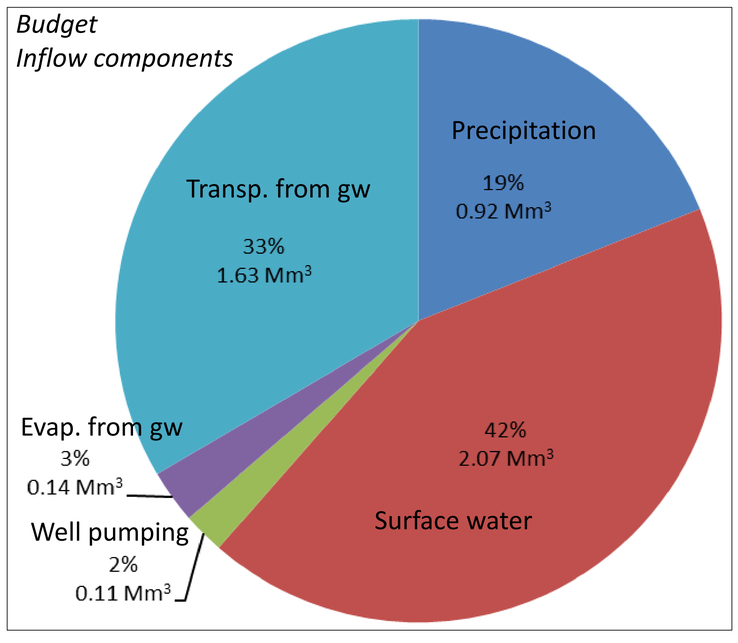


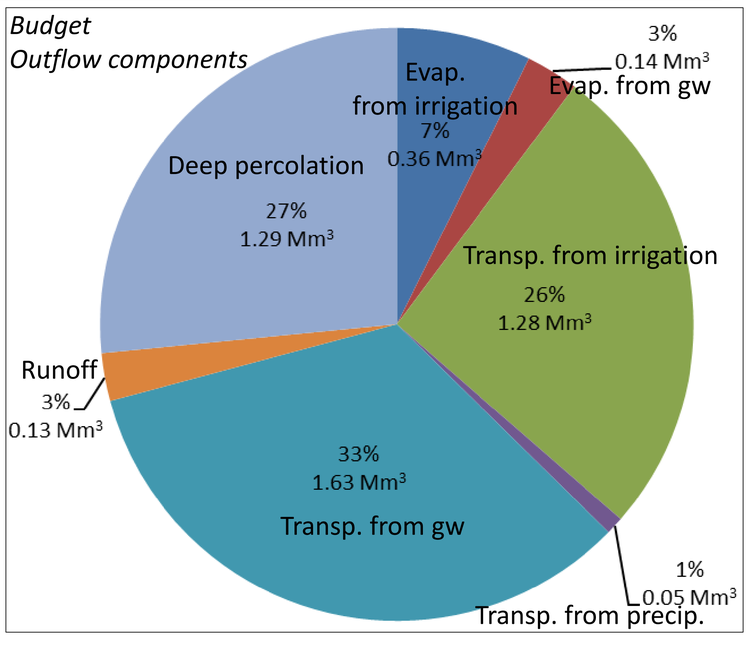
EXAMPLE APPLICATION

(modified after *Schmid et al. 2006*)









Application of CGM
Sunflower yield at harvest = 4850 kg/ha (sunflower dry matter)

AUTHOR'S CONTACT: Giovanna De Filippis – g.defilippis@santannapisa.it

Rossetto, R., De Filippis, G., Borsi, I., Foglia, L., Cannata, M., Criollo, R., Vázquez-Suñé, E., 2018. Integrating free and open source tools and distributed modelling codes in GIS environment for data-based groundwater management, Environmental Modelling & Software, 107:210-230
Schmid, W., Hanson, R.T., Maddock, T., Leake, S.A., 2006. User Guide for the Farm Process (FMP1) for the U.S. Geological Survey's Modular Three-Dimensional Finite-Difference Ground-Water Flow Model, MODFLOW-2000. U.S. Geological Survey, Reston, Virginia.

FREEWAT project website: www.freewat.eu
Twitter account: @H2020FREEWAT
Linkedin group: EU H2020 FREEWAT
Facebook group: FREEWAT