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Drought-related vulnerability and risk assessment of groundwater in Belgium: estimation of the groundwater recharge and crop yield vulnerability with the B-CGMS

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Due to common belief that regions under temperate climate are not affected by (meteorological and groundwater) drought, these events and their impacts remain poorly studied: in the GroWaDRISK, we propose to take stock of this question. We aim at providing a better understanding of the influencing factors (land use and land cover changes, water demand and climate) and the drought-related impacts on the environment, water supply and agriculture. The study area is located in the North-East of Belgium, corresponding approximatively to the Dijle and Demer catchments.

To establish an overview of the groundwater situation, we assess the system input: the recharge. To achieve this goal, two models, B-CGMS and WetSpass are used to evaluate the recharge, respectively, over agricultural land and over the remaining areas, as a function of climate and for various land uses and land covers. B-CGMS, which is an adapted version for Belgium of the European Crop Growth Monitoring System, is used for assessing water recharge at a daily timestep and under different agricultural lands: arable land (winter wheat, maize...), orchards, horticulture and floriculture and for grassland.
B-CGMS is designed to foresee crop yield and obviously it studies the impact of drought on crop yield and raises issues for the potential need of irrigation. For both yields and water requirements, the model proposes a potential mode, driven by temperature and solar radiation, and a water-limited mode for which water availability can limit crop growth. By this way, we can identify where and when water consumption and yield are not optimal, in addition to the Crop Water Stress Index. This index is calculated for a given crop, as the number of days affected by water stress during the growth sensitive period.

Both recharge and crop yield are assessed for the current situation (1980 – 2012), taking into account the changing land use/land cover, in terms of areas and localization of the agricultural land and where the proportion of the different crops had considerably evolved through time (e.g., increase of grain maize and potatoes while winter cereals decrease). The preliminary results of the recharge lead to an average value in the area showing a significant negative trend, in both simulations with fixed (base = 1980) and changing land cover. In the same time, we could observe an increasing number of water stress periods, especially for maize, one of the main crops in the area. Finally, a preliminary test will be presented for the horizon 2040, for which we use meteorological time series (for high and low hydrologic impacts) given by the CCI-HYDR Perturbation Tool (Ntegeka V. and Willems P., 2009). This preliminary test aims to (1) evaluate the amplitude of the potential recharge deficit and, (2) especially, to define vulnerability zones, affected by frequent water stress, in connection with irrigation needs which could possibly increase the groundwater extraction.