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Agrohydrological analysis of groundwater and land use in the Pampas of Argentina

Kroes, Joop

Precipitation excess may cause flooding, but evaporation excess may cause drought. The latter one occurred this year 2018 in the Netherlands and Argentina resulting in severe problems when drought is followed by heavy rains which complicate harvest as occurred in Argentina this year. These dramatic events stimulate knowledge exchange between both countries. An example of such an exchange resulted from two projects: i) an EU-project SIGMA which intended to Stimulate Innovation for Global Monitoring of Agriculture (Kroes et al., 2017), ii) a Dutch project WaterVision Agriculture, which developed a generic model instrument suitable for all climates that can determine crop yield effects as a result of drought, too wet or too saline conditions (Hack-ten-Broeke et al., 2016). Within the EU-project a cooperation between Wageningen UR and INTA worked out an Environmental Impact Assessments (EiA) at multiple scales. The EiA in Argentina started with an analysis of N-content of soy but shifted to the impact of land use on groundwater because that seemed a more important environmental issue.

We developed a modelling approach that uses multiple spatial scales ranging from field to region and is summarized in Figure 1.

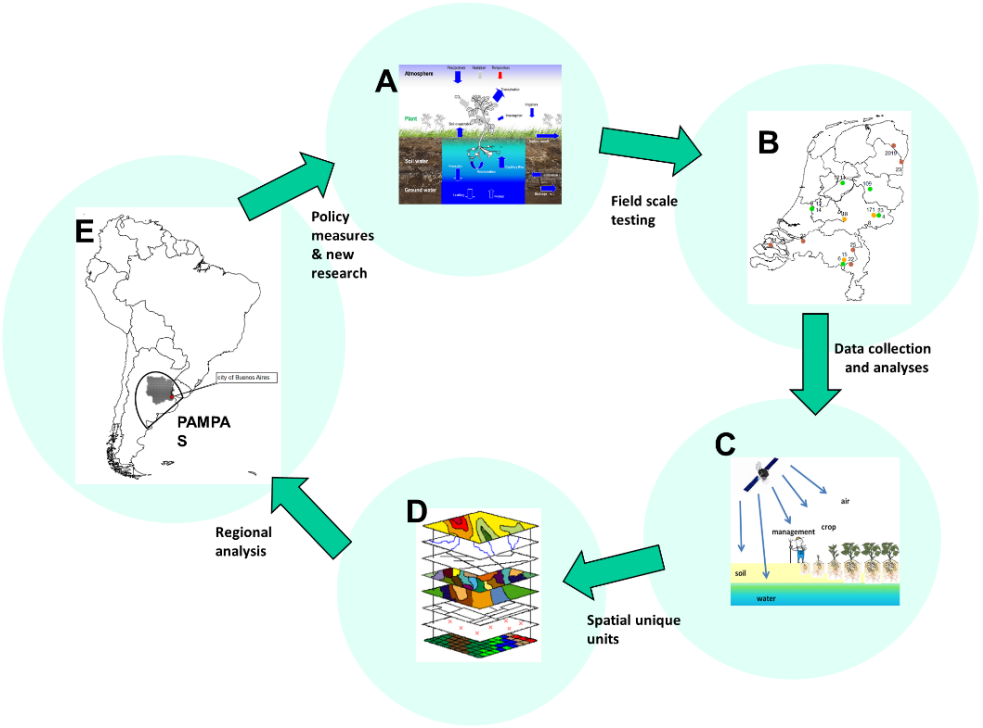

Figure 1. Model approach at multiple scales. Model development (A), Testing at field scale (B), Preparation (C, D) and application (E) of regional analyses.

We applied the modelling tool SWAP4 (swap.wur.nl) which is a combination of a soil hydrological and a crop growth model. It uses a so-called Richards equation for water flow which enables accurate predictions for upward water flow towards crops which becomes more important as groundwater levels reach the root zone of the soil. Rising groundwater may alleviate drought as capillary rise supports root water uptake and improves crop growth. However, rising groundwater may also limit soil water storage, cause flooding in metropolitan areas and have a negative impact on crop yields.

Changing land use from continuous soy bean into crop rotations or natural vegetation may decrease groundwater recharge and thus decrease groundwater levels. However in case of crop rotation leaching of nutrients like nitrate may increase. We quantified these impacts using a recently developed integrated dynamic crop growth and soil hydrology model. The model was tested at field scale using local datasets from Argentina. We then applied distributed modelling at regional scale to evaluate impacts on groundwater recharge and crop yields using long term weather data. The experiments showed that threats come from continuous monotone land use with low evapotranspiration. Opportunities are created when a proper balance is found between supply and demand of soil water using a larger

differentiation of land use. Increasing the areas of land use types with higher evapotranspiration, like permanent grassland and trees, will contribute to a more stable hydrology.

More information about the results from this study are given by De Wit et al. (2017) and Kroes et al. (2017, 2018).

References

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