Title of the project:
The effect of spatial scales in modelling crop water use in the Netherlands

Assignment no.: 27.16	**Internal/ external:** Internal/external (in overleg)
Head graduation committee: Dr. Maarten Krol	**Daily advisor:** Rick Hogeboom (UT) Jaap Kwadijk (Deltares)
Name(s) of participating companies or institutes: Deltares	**Start of the project:** Flexible

Required courses:
Water Footprint Assessment

Short description and objective of the project
Introduction:
Water scarcity and food security are high on national and international policy agenda's. Water and food are closely linked, because crops use water to grow. The agricultural sector is the highest water consuming sector in both the Netherlands and the world. While globally wheat, rice and maize are the most important food crops, in the Netherlands maize, potatoes and wheat are the most prominent commodities produced (FAO, 2008).

The water consumption of crops can be estimated on multiple spatial scales, most often through modelling exercises. Local water policy is based on national or sub-national, high resolution models that use local datasets on e.g. climate, soil, management and crop parameters. Global models operate on coarser resolution models, generally forced by global datasets. The premise is that local models provide better estimates than their global counterparts. But will this premise hold? How well do the different scales compare? And would the difference affect policy decisions?

Objective
The objective of this research is to assess total crop water consumption of the Netherlands (or the Rhine basin) using both a local and global model, to compare the results and to interpret the difference.

Approach
For a local model, viable options are the National Hydrologic Instrument (NHI) for the Netherlands or Rhine basin models available from Deltares. These models can be used to assess crop water consumption at a very high spatial resolution of several hundred meters (NHI, 2015).

For a global model, our Water Management group's Aqua21 water use model can be used. Aqua21 estimates crop water use with FAO's water-productivity engine AquaCrop (Steduto et al, 2012). This crop engine, for which we have an executable and some scripts available, simulates plant growth on the basis of local daily rainfall, evapotranspiration, temperature, soil properties, crop properties and farm/irrigation management practices and has a spatial resolution of ~10 x10 km.

Resulting crop water use estimates of both models can be compared to each other, to other indicators such as soil moisture content maps. If you like, the difference between the models can be illustrated taking a real-life policy case and assess whether policy decisions for this case would differ depending on the model/scale selected.
Please note that to successfully carry out this assignment, you will have to have or acquire some programming (python) and GIS skills.

References

FAO (2008). Country Report on the State of Plant Genetic Resources for Food and Agriculture – The Netherlands. Rome, Italy.
URL: http://www.fao.org/docrep/013/i1500e/Netherlands.pdf Mekonnen MM and Hoekstra AY (2010). The green, blue and grey water footprint of crops and derived crop products. Value of Water Research Report Series, vol No. 47. UNESCO-IHE, Delft, The Netherlands. NHI (2015). NHI website at www.nhi.nu Steduto, P., Hsiao, T. C., Fereres, E., & Raes, D. (2012). Crop yield response to water FAO Irrigation and Drainage paper 66. Rome, Italy: Food and Agriculture Organization of the United