Title of the project:
Non-stationary hydrological models for climate change impact assessment

Assignment no.: 08.16	**Internal/ external:** internal
Head graduation committee: dr. ir. Martijn Booij	**Daily advisor:**
Name(s) of participating companies or institutes: possibly Institute of Geophysics (Warsaw, Poland)	**Start of the project:** flexible

Required courses: Hydrology

Short description and objective of the project:

Climate change is expected to have large impacts on water resources availability and flow regimes of rivers. In particular, effects on floods and droughts can be considerable and might have large consequences for economy and society (Booij, 2005; Anderson *et al*., 2006; Jiang *et al*., 2007; Gosling *et al*., 2011; Demirel *et al*., 2013). Therefore, it is very important to assess impacts of climate change on hydrology and flow regimes of rivers. The output of global climate models (GCMs) is usually downscaled with a regional climate model (RCM) or employing a statistical approach to determine the change in climate for a particular region. The changed climate is then used as input for a hydrological model to assess the response of a catchment or river basin for future conditions and to compare with current conditions. Hereby, it is often assumed that the hydrological model is valid for future climatic conditions while being calibrated for current climatic conditions. This assumption can be questioned since changed and variable climatic conditions might seriously influence hydrological conditions and hence optimal model parameters and even model structures (Wagener *et al*., 2003; Van Werkhoven *et al*., 2008; Thirel *et al*., 2015a; 2015b).

It is therefore important to test the assumption of stationary hydrological models in a systematic and rigorous way. If the calibration conditions are significantly different from the future climatic conditions, the calibrated hydrological model might not be appropriate for climate change impact assessment resulting in biased effects on hydrology and hence non-optimal mitigation and adaption measures. The hydrological model then needs to become a non-stationary or transient model with parameter values and even model structures varying dependent on climatic conditions.

In this MSc project the focus is on the development of transient hydrological models which can be used for climate change impact assessment continuing the work of Knoben (2013). Moreover, similar methodologies as in this project can be followed to develop transient hydrological models to cope with land use changes or other anthropogenic influences. Parameter non-stationarity can be investigated and incorporated in models by calibrating those models for distinct climatic periods and determining relations between calibrated parameters and climatic characteristics of these distinct periods (Merz *et al*., 2010). These relations can then be validated and possibly applied to climate change scenarios. Alternatively, model structures can be adapted as well depending on climatic conditions.

The objective of this project is the estimation of non-stationary parameters and model structures based on historic data and application to future climate scenarios for different catchments in the world (e.g. UK, Belgium, Germany, US, Australia).

Short description of research approach:

1. Literature review (model structures, parameter estimation, non-stationarity, climate change).
2. Selection of test catchments and collection of data.
3. Selection of hydrological model(s).
4. Model structure identification and/ or calibration for distinct climatic periods.
5. Validation of model(s) and relations.
6. Possible application to future climate scenarios.
7. Summary of results, interpretation and conclusions and reporting.

This research project is part of a broad research activity on hydrological modelling, model calibration, regionalisation and climate impact assessment (see e.g. Foppes, 2005; Deckers, 2006; Huisjes, 2006; Booij and Krol, 2010; Deckers *et al*., 2010; Van den Tillaart, 2010; Knoben, 2013; Van Esse *et al*., 2013; Van den Tillaart *et al*., 2013). Several students might work on this project depending on interests and skills of the student and availability of supervisors.

References

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