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Hydrology and Earth System Sciences Discussions

Interactive comment on "The Hydrological response to climate change of the Lesse and the Vesdre catchments (Wallonia, Belgium)" *by* A. Bauwens et al.

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Dear referee, First of all we would like to thank you for your review. Please see our comments for the 3 main issues you raise. 1. Our study differs from most of the existing studies about impacts of climate change on the hydrology of river catchment in three points. a. The use of a physically based model: The broad palette of available models was previously highlighted by Booij (2005) . This author clearly stated that an optimal model has to be found regarding the specific modeling objectives and data availability. In the present study, we used a physically based model which includes a vegetation

subroutine (crop growth, water and nutrient uptake, ...). It permits to tackle the complexity of phenomenon occurring in water-soil-plant continuum and the influence of climate change on this continuum. Our point is to assess whether or not, vegetation will play a role in catchment response to climate change. So we need a "water-soil-plant" physically based model to do so. Regarding water balances for these two catchments, we can see that approximately 50% of the water input in the catchments is exported by actual evapotranspiration and that this ratio varies between catchments mainly because of their land use. The Lesse catchment is less urbanized but presents more grasslands, and deciduous forests and less coniferous forests than the Vesdre catchment. It is a non negligible quantity of water transported by plants. It deserves more attention. Moreover, lots of adaptation and mitigation measures recommend renaturation of some areas aiming at increasing natural water retention. A correct modeling of the relationships between water, soil and plant is thus very important in order to simulate the behavior of the catchment before and after such adaptation measures. In the Vesdre and Lesse Catchments MNT, soil and land use data are available with a 20 meters resolution, weather data are interpolated using thiessen polygons on 1km^2 grid cells. The EPICgrid model uses this cell size for hydrological simulations.

b. The use of the CCI-HYDR Perturbation Tool : The CCI-HYDR perturbation tool takes into account a broad range a climate models coming from the IPCC AR4 database and the PRUDENCE project. These models bring into consideration different SRES scenarios, different GCMs and different RCMs and the tool has been specially designed to fit to the Belgian climate. Like the study of Teutschbein et al. (2010) proved it, the use of an ensemble model avoids biased climate results and permits to consider the inter-variability of models. Indeed, every GCM-RCM coupled is able to reproduce long term seasonal changes for temperature and precipitation but with various accuracies and bias. Thus, the spread of the ensemble members, representing by the low, mean and high scenarios in the CCI-HYDR perturbation tool, allows the evaluation of uncertainties of climate change impacts for Belgium. In this study, we didn't work with the mean scenario, we have used the low and high scenarios which permit to take into account the width of possible impacts on hydrology due to climate change. Indeed, the mean scenario represents mean conditions but it is not the best future guess (Ntegeka and Willems (2008)). CCI-HYDR Perturbation Tool: a climate change tool for generating perturbed time series for the Belgian climate).

c. Management from upstream: A better knowledge of the sub-catchment Lesse and Vesdre is necessary in order to implement profitable mitigation and adaptation measures to climate change impacts on the Meuse hydrology. If some measures will have an effect on the hydrology of the sub basins, others will have a very located effect and will not have any influence in the downstream parts of the Meuse basin. One measure to fight against floods commonly proposed is natural water retention in the upstream parts of the catchment. The use of a physically based model is thus interesting to take into account impacts of climate change on the behaviour of the vegetation and the real impact of renaturation area on flood prevention. In this context, intrinsic characteristics of the two subbassins will be more deeply studied in the revised article.

2. The EPICGrid hydrological model: calibration and validation: The EPICGrid model developed by Gx-ABT is based upon the EPIC model developed by Williams et al. (1994). It has been modified to take into account the local pedology and geology description. Reservoirs depths of the root zone were adapted to fit the pedological description and new reservoirs were added under the root zone down to the groundwater table to take into account the geology. The runoff and interflow production functions are not calibrated. Transfer functions are calibrated on observed discharge series. The graphs below show validation periods for Lesse and Vesdre cathments. The Nash criteria amount to respectively 68.78% and 83.25%.

The revised paper will give more detail on this model but information are already available in Sohier et al, 2009 and Sohier and Degré, 2010 .

3. The CCI-HYDR Perturbation tool : For rainfall, the changes in number of wet days and intensities are considered. These changes are quantile based to account for the

fact that the magnitude and return period of the event might have an impact on the changes. Temperature is transformed by applying a monthly perturbation factor for every scenario. For further information please refers to Baguis et al., 2009 and Ntegeka et al., 2008b.

We will do our best to address your comments and concerns above in the revised manuscript. Thank you again for your comments.

References: Booij M.J., (2005). Impact of climate change on river flooding assessed with different spatial resolutions. Journal of hydrology, 303, 176-198. Sohier, (2009). See main paper. (Sohier C., Degré A., (2010), Modelling the effects of the current policy measures in agriculture: an unique model from field to regional scale in Walloon region of Belgium, Environmental Science & Policy (2010), 13 (2010), 754-765.)

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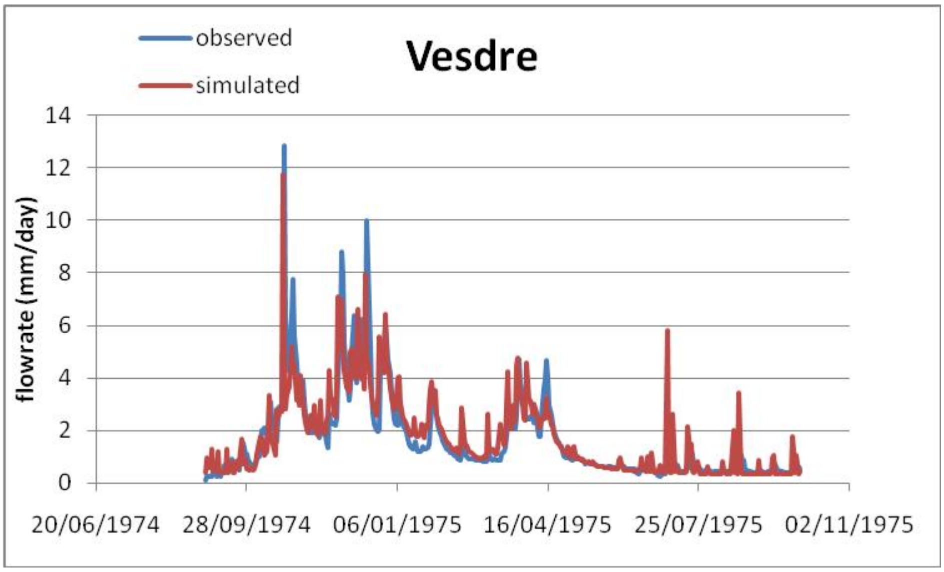

Fig. 1. validation periods for the Vesdre

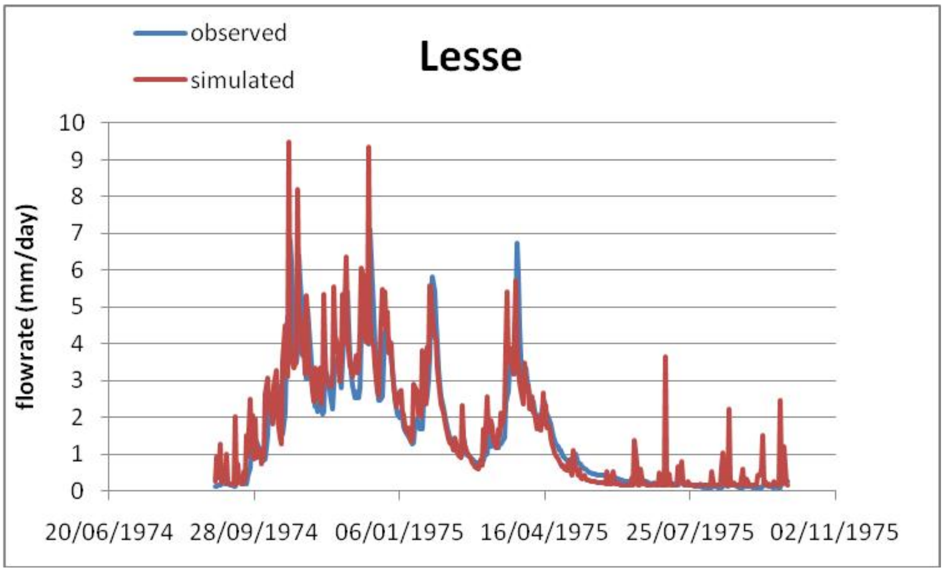

Fig. 2. validation periods for the Lesse