



Assessing the impact of historical land cover changes on the water balance, comparing a pixel and sub-pixel approach

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It is well known that land cover changes modify the surface water balance and could cause significant changes in e.g. groundwater availability and flood risk. The impact of land cover and land use changes on the hydrology has therefore been an important research topic during the last decades. In several previous studies remote sensing (RS) based observations are applied to generate historical or current land-cover maps of study areas. Nevertheless, the uncertainty on RS based land cover maps is significant and could have an important effect on the simulated hydrological response. Moreover, the often relatively large pixel size, especially of historical RS observations, represents a mixture of different land covers.

In this research we compare two methodologies to estimate the impact of historical urbanization on the water balance and investigate their uncertainty. WetSpass a GIS based, distributed water balance model is applied on the Kleine Nete basin, situated in the North of Belgium. Historical land cover data is derived from two Landsat images, one historical (1976-1988) and one recent image (2003). First, we apply a pixel based method to study the land cover changes that have taken place during the two Landsat observations. Instead of the traditional hard classification we apply a soft classification to generate the land cover map from the RS information. The soft classification algorithm calculates for each pixel the probability for each land cover type. These probability maps are applied to develop a series of possible land cover maps, which are applied in the WetSpass model. Secondly, we apply a sub-pixel classification on both Landsat images to incorporate the urbanization in the basin more accurately. Instead of assuming a constant imperviousness for all urban pixels we calculate a pixel based imperviousness value. An overlay of the recent Landsat image (2003) with a high resolution IKONOS image (2003) is applied to correlate the spectral information of the Landsat bands with its sub-pixel imperviousness obtained from the IKONOS image. The NDVI values of the historical and recent Landsat images are compared to filter out urbanized pixels. Afterwards, the IKONOS derived sub-pixel imperviousness fractions are applied to calculate also the correlation with the historical image. The obtained correlations are extrapolated to the entire watershed and validated. Both the historical and recent sub-pixel land cover information is applied in the WetSpass model. Finally, the difference of applying the pixel and sub-pixel land cover information in the WetSpass model is investigated.