Geophysical Research Abstracts
Vol. 18, EGU2016-866, 2016
EGU General Assembly 2016

Analysis of anthropogenic impacts on the hydrological state of a Pleistocene catchment area using remote sensing techniques

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The water budget of a catchment area can be depicted by the complex interaction between topography and discharge as well as anthropogenic and climatic impacts. Over the last decades, the Pleistocene lowlands of North-Eastern Germany have experienced extensive anthropogenic modifications. The hydrological system has been significantly altered by the installation of artificial drainage, such as surface ditches and subsurface tile drains. It has been shown, that artificial drainage systems provide pathways for diffuse nutrients and pollutants leaching into surface and also subsurface water bodies, which is especially pronounced in lowland areas. The detection of these transport paths is important for obtaining an understanding of the regional water and substance balance and the development of strategies to improve hydrological conditions. Unfortunately, detailed data about locations of historic artificial drainage are rare or not available at all.

The aim of this study was to identify the extensive anthropogenic modifications, like artificial drainage networks and land use changes, over the last decades with the aid of photogrammetric data and multispectral imagery. The detection of anthropogenic modifications is based on the method of Tetzlaff, et al. (2009), who developed an approach by interpreting aerial photographs for drained areas. We used color-infrared (CIR) aerial photographs, in order to apply different spectral techniques for obtaining information about water content and vitality status of plant cover. Although this method is sensitive to daily variations of soil moisture and plant growth as response to climate conditions, and the type of drainage pipe installation technique, we were able to identify different locations of artificial drainage. Complementary to this approach we utilized spectral classification methods for land cover in order to extract different land cover categories, and evaporation rates, depending on the land cover and surface characteristics, such as relief and slopes, calculated from aerial photographs by photogrammetric methods. By combining these datasets we were able to build a multitemporal hydrological model, based on GIS-based analysis, to interpret effective hydrological processes in the catchment area of the Quillow. This allows tracing of changes in the water balance in relation to anthropogenic influences. This model is adapted to the Quillow catchment which is located in the Uckermark region, representing a typical young Pleistocene landscape of NE Germany which exhibits a strong anthropogenic impact over the last decades.

Tetzlaf, B., Kuhr, P. , Wendland, F., 2009. A new method for creating maps of artificially drained areas in large river basins based on aerial photographs and geodata. Irrigation and Drainage, 58: 569–585.