Geophysical Research Abstracts,
Vol. 11, EGU2009-9633, 2009
EGU General Assembly 2009

Constraining distributed hydrological models with a high-resolution digital elevation model derived from Lidar data for a small watershed in a boreal landscape

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In high-latitude areas, landscapes with flat or moderate relief areas usually contain lakes and mires. The identification of flowpaths in such areas is a difficult issue. The increasing availability of high resolution topography from airborne Lidar measurements offers new opportunities for automatic or semi-automatic channel extraction from DEMs in small watersheds, substantially outperforming the hydrographic network in conventional digital maps.

This work describes an approach to automatically extract the spatial structure of a drainage network and thereby produce a partition of the catchment into drainage sub-basin polygons from Lidar data. We demonstrate the procedure for the test case of the 4.8 km^2 Langtjern watershed in southeast Norway. It represents a typical boreal low-productive landscape with a mosaic of forests, mires and lakes. Here, areal cover and local slope are intimately linked: lakes and ponds dominate in the flattest areas, low slope areas are occupied by peatbogs, and the steepest parts of the catchment are covered by forest. The results of the extraction, the hydrographic network, and the identification of bogs and lakes, are input to a distributed hydrological model (DEW model system, Beldring, 2008), constraining the model structure to a large extent.

An explicit description of the drainage network and the physical landscape properties in the watershed is warranted, providing the capability to predict hydrological state variables and fluxes from atmospheric data. As a result, the model accurately represents the heterogeneities in space and time of the various hydrological processes.

Reference

Beldring, S. 2008. Distributed element water balance model system. *Norwegian Water Resources and Energy Directorate, Report no. 4/2008*, 40 pp