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Scenario modelling of drainage impact of a groundwater-dependent heath ecosystem, Belgium

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Groundwater dependent heathlands are valuable ecosystems in need of protection (Habitats Directive, 92/43/EEC). Over the last 15 years the groundwater table below a military area near Houthalen-Helchteren in the North-East of Belgium has been lowered by a network of drainage ditches to improve on-site military operability and to intensify nearby agriculture. Dewatering has lead to a gradual deterioration of the local NATURA 2000 ecosystem that includes wet and dry heathlands, transition mires and depression bogs.

The studied area is located on the Campine Plateau about 70-80 m above sea level and covers an area of roughly 2200 ha. The local unconfined aquifer has a thickness of about 200 m and consists of several layers of Quaternary and Tertiary sands and fine gravels and occasional local clay lenses.

To analyze the impact of the presence of the system of drainage ditches on the groundwater table, percentage of time of open water in the area, and occurrence of valuable ecosystems a multi-layer transient (1990-2010) groundwater model and coupled simple vegetation prediction model has been set-up. The MODFLOW 2005 groundwater model combined geological and hydrogeological data from regional groundwater models with local time-series of water level observations, groundwater abstraction data and monthly recharge estimates from the WetSpass model. Satisfying model calibration was achieved using UCODE-2005 and the Double Constrained Method.

Simulated time series maps of the groundwater table were used to calculated for depressions the percentage of time that open water was present. The time series were also summarized in indicator maps as 'average groundwater level', 'average spring groundwater level', 'average highest groundwater level' and 'average lowest groundwater level', the last one was used to drive a decision rule for the occurrence 4 different habitat types. 19 scenarios considering varying options for adjustment of the drainage network were simulated and evaluated in terms of habitat improvement and limitations for military operability.

Compared to present situation the ditch reducing scenarios increase slightly the open water surface, however mainly in summer. The scenarios clearly decrease average lowest and much less average highest groundwater levels. Even partial closure of the drainage system result in considerable raising of the groundwater table. Habitat prediction shows even more possible improvement from 25% areal coverage to maximum 50%.