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An investigation of growing season fluctuations of water table in a forestry-drained Scots pine peatland using weather data and spatial information

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Soil water table depth (WTD) is one of the most important factors controlling the net primary production such as tree growth on peatlands. The growing season WTD is known to be dependent on the weather conditions, stand evapotranspiration capacity and drainage structures on drained peatlands. In this study we used modeling approach to investigate how meteorological and spatial variables contribute to variation of the growing season WTD in a drained boreal peatland forest. The study data were collected from a Scots pine (Pinus sylvestris L.) dominated experimental peatland stand drained for forestry purposes 70 years ago in Rovaniemi, northern Finland. Double ditching was used to form ca. 0.5 ha artificial catchment in spring 2006. The spacing between 0.9 m deep ditches was 23 m and peat depth varied from 0.6 m to more than 2 m within the area. For monitoring the WTD, 50 perforated plastic tubes were inserted into the peat and spaced in a regular grid to evenly cover the whole catchment area. WTD was manually monitored from each tube at one or two week intervals during the frost free period (early June – end of October) in 2006 – 2009. To account for the hierarchical structure of the data, the linear mixed model technique was applied to construct a prediction model for the logarithm of the WTD in a tube. Meteorological variables were derived from observations of a weather station located 50 km away. The used meteorological variables were the cumulative precipitation, the precipitation of previous 28 days, cumulative evapotranspiration, and the evapotranspiration of previous 30 days. The spatial parameters were the local stand basal area (sum of tree basal areas within 2 m radius around the tube), the distance of a tube to the nearest ditch, and topography (elevation). The meteorological parameters were most important predictors in the model. The distance to a ditch and the elevation were most important spatial parameters. The relationship between the local stand basal area and the WTD became clearly visible in the late summer of the driest year 2006, but was less evident during the wet years. The model predicted rather well the behavior of the WTD in 2007 and 2009. However, in an exceptionally dry year in 2006 and in a wet and cool year 2008 the model underestimated and overestimated the depth of the water table, respectively. The results suggest that the used variables can be applied to construct a regression model for water table depth of a peatland forest stand but it is necessary to have more than four years weather data to more reliably estimate the relationships.