



The influence of drought on vegetation activity assessed by NDVI – MODIS on Estonia

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At high latitudes, the vegetation activity is limited by temperature, but even in humid biomes, water shortage may negatively impact vegetation, as plants may not be adapted to this condition. The second half of the 20th century in Estonia showed an increasing trend in temperature, particularly during winter and spring, which may increase evapotranspiration. In this work, the impacts of drought on vegetation were assessed, using a vegetation index and two drought indexes.

The Normalized Differences Vegetation Index was retrieved from the MODIS Terra V6 product, with 250m spatial resolution, covering the period February 2000 to January 2017. Due to high cloud and ice/snow annual persistence over the region, only values corresponding to the higher quality flag were considered and monthly time series were built choosing the maximum value at each month. This led to the months of November to February showing a small number of pixels with time series presenting valid values, and thus the analysis was performed on the months of March to October. The median and standard deviation of monthly NDVI time series were computed, in order to assess the vegetation dynamics in the study area.

Two drought indices were used to assess the influence of drought on vegetation activity: the Standardized Precipitation Index (SPI) and the Standardized Precipitation Evaporation Index (SPEI). The first is computed using precipitation data only, whereas for the latter a simple water balance is computed, using reference evapotranspiration and precipitation. To compute evapotranspiration it is necessary several meteorological parameters that are frequently not available. Therefore, as a first step and due to the relatively low altitude in almost all Estonian territory, the drought indices computed with data from the Tartu meteorological station were considered representative of the region. A correlation analysis between monthly NDVI and SPEI and SPI was then performed, at the time scales of 1, 3, 6, and 12 months.

Results show that the vegetation activity is highest in June and July, and lowest in March and April. The area showing significant correlations between monthly NDVI and the drought indices is generally low, reaching a maximum of 21% and 14% of the studied region, obtained with SPEI and SPI, respectively, in the month of May at the time scale of 12 months. The differences in the results obtained with SPEI and SPI are small. In general, the number of pixels with a significant correlation is higher when SPEI is used, except for the month of April (time scales of 1, 3, and 6 months) and May (6, and 12 months). In September the number of pixels obtained with SPI is also slightly higher at shorter time scale (3 months). There are large areas of positive correlations in the months of June, August, and September, pointing to a negative impact of drought on these months.

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