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

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1. Motivation

At high latitudes, the vegetation activity is limited by temperature [1], 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 increasing trends in temperature [2, 3] and in evapotranspiration [3]. In this work, the impacts of drought on vegetation were assessed, using a vegetation index and two drought indexes.

2. Data

- NDVI –MODIS, 16-day, 250m, covering the period February 2000 to January 2017
- SPI and SPEI with time scales of 1, 3, 6, and 12 months, computed with Precipitation and Temperature from Tartu meteorological station on the period 1951—2015.

3. Drought Indices

Figure 1 shows the time series SPI and SPEI in Tartu meteorological station on the common period 2000 to 2015. Drought events are identified in 2000, 2003, 2006, 2011 and 2014. A prolonged wet period occurred from 2007 to 2011.

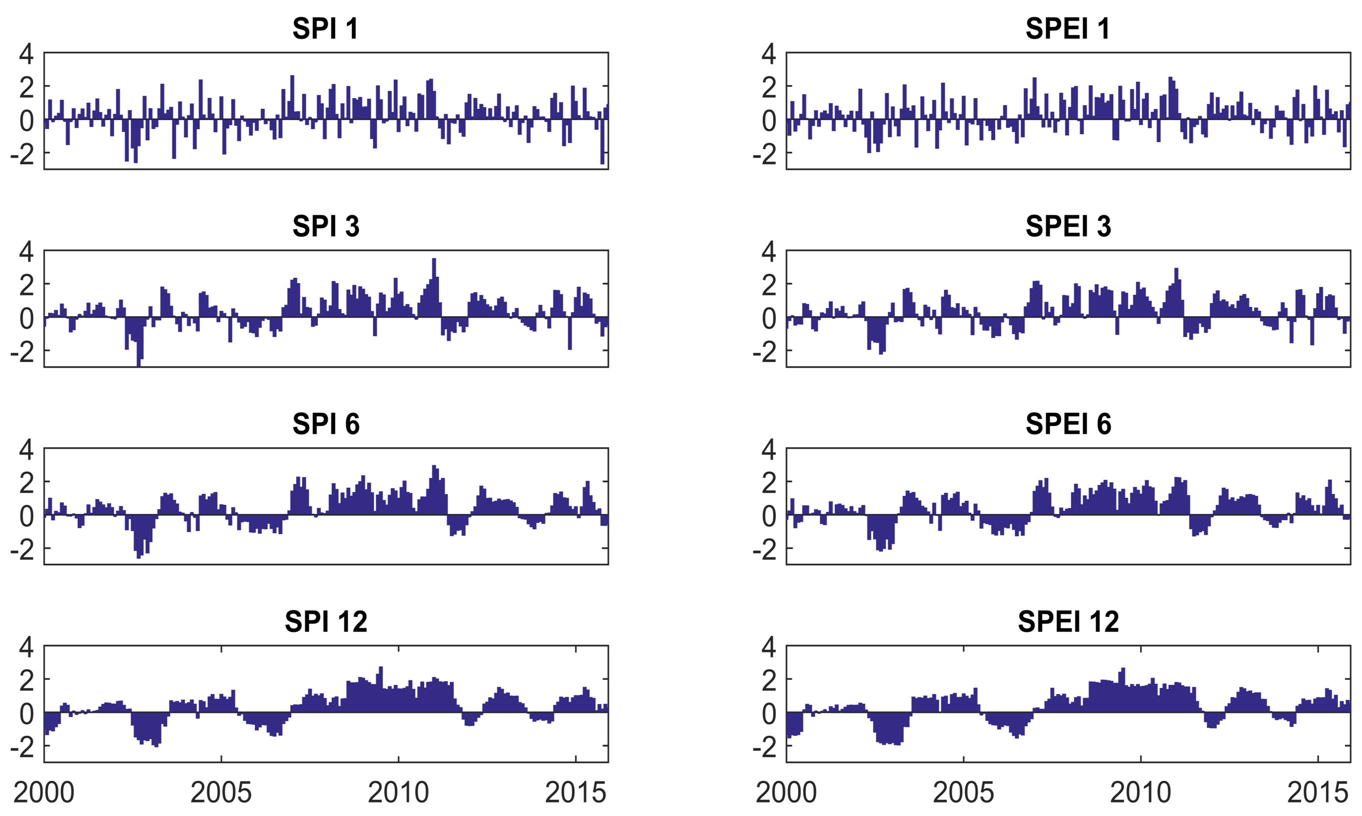

Fig. 1—SPI and SPEI in Tartu meteorological station

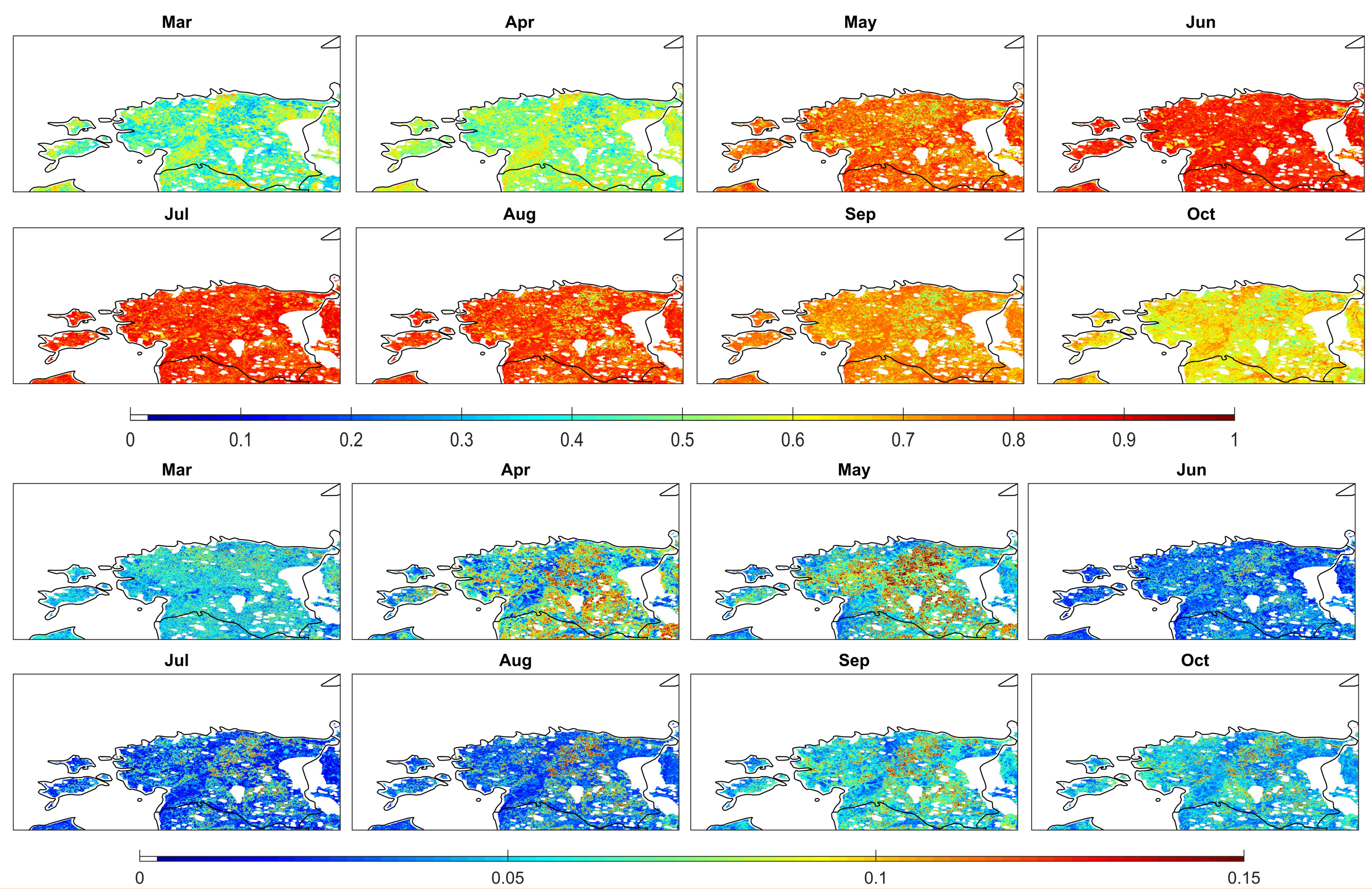

Fig. 2— NDVI monthly median (top) and standard deviation (bottom).

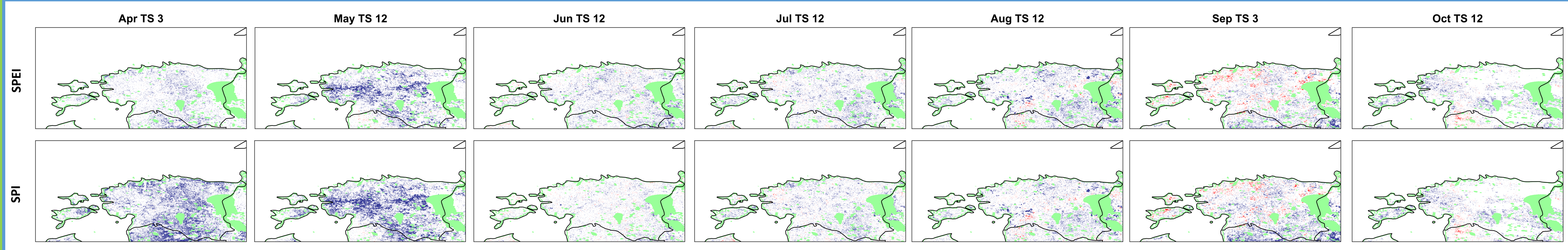

Fig. 3— Significant positive and negative correlations between NDVI and SPEI (top) / SPI (bottom), for selected months and time scales (TS). Green areas represent lakes, wetlands and shorelines.

4. NDVI—MODIS

From November to February, the ice and snow persistence led to a low number of valid NDVI values, and so these months were not included in the study.

Vegetation activity is highest in June and July, and lowest in March and April, as assessed by NDVI monthly median (Fig.2. top panel). From June to July the standard deviation is lowest, whereas in April and May it is highest (Fig.2, bottom panel).

5. Correlation between NDVI-MODIS and SPI/SPEI

The area presenting significant positive or negative correlations for each month and time scale is shown (Fig.4). March consistently presents low areas. Positive correlations are more common, except on June on time scales up to 6 months. The area presenting significant correlations is larger with SPI on April and May, for positive correlations, and on June, for negative correlations. On the remaining cases, the differences are small.

Significant correlations are mapped, for selected months and time scales of SPI and SPEI (Fig.3).

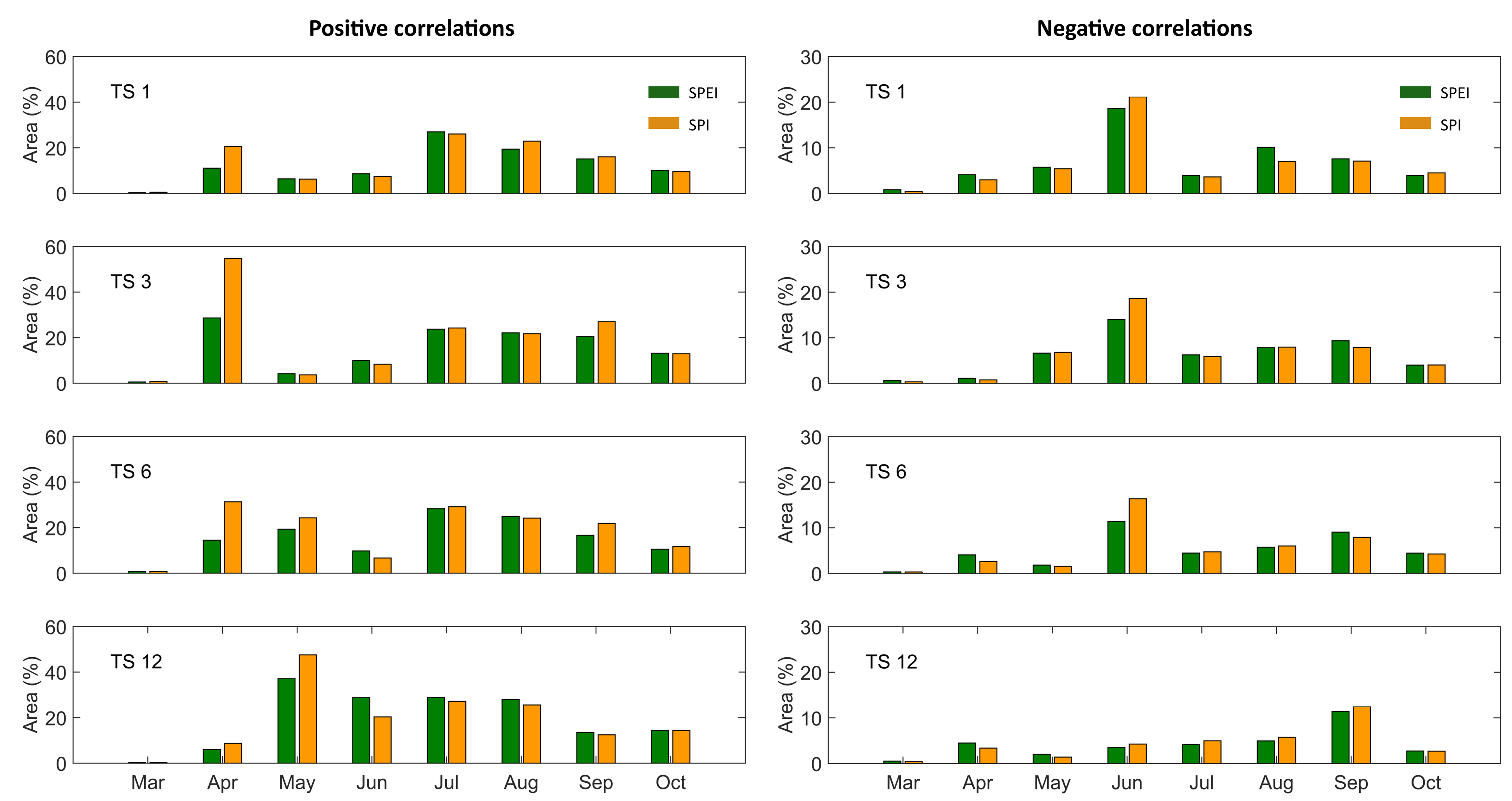

Fig. 4— Area of significant positive (left) and negative (right) correlations between NDVI and SPEI / SPI.

6. Concluding Remarks and Future Work

The months showing a larger area of significant correlations between NDVI and the drought indices are April and May, coinciding with the months showing a higher NDVI variability.

The use of more meteorological stations should provide a better understanding of the drought impacts on vegetation.

Information regarding and cover will allow to study the response of different vegetation types.

References

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