30-years Vegetation Trends for Europe Derived from the TIMELINE NDVI Time-series

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Introduction

Monitoring vegetation using Normalised Difference Vegetation Index (NDVI) time-series can assist to understand the possible impacts of climate change on land ecosystems. Within the TIMELINE project (www.dlr.de/eoc/timeline), a set of NDVI composites at a 1 km spatial resolution based on Advanced Very High Resolution Radiometer (AVHRR) data for Europe and North Africa, currently spanning the period from 1981 to 2018 has been generated, which provides a valuable basis for long-term vegetation trend analysis.

Methodology

The TIMELINE monthly NDVI composites from the 30-year period 1989-2018 was used. Gaps in the time-series were filled and corrected via a four-stage approach combining intra-year interpolation for short gaps with inter-year interpolation for longer gaps and Savitzky-Golay filtering (Figure 1). Then, mean NDVI for spring (March to May), summer (June to August), autumn (September to November), and the growing season (March to November) was calculated for each year. A Mann–Kendall trend test was performed to analyse the time-series for consistent positive or negative trends.

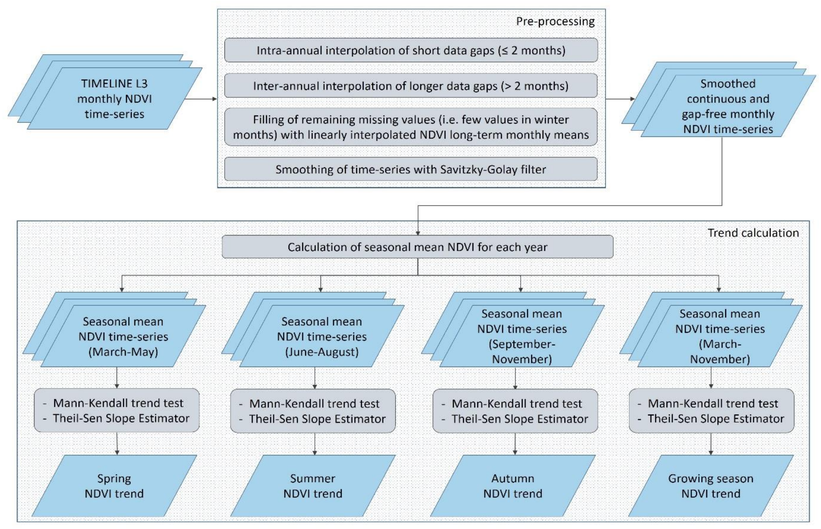

Figure 1. NDVI time-series pre-processing and trend calculation.

Direction and strength of the trends were calculated using the Theil–Sen Slope Estimator. The trends were analyzed over the TIMELINE project area and for biogeographical regions (European Environment Agency, EEA) in Europe.

Results

The NDVI shows significant ($p < 0.05$) negative and positive trends for 3.6% and 20.9% of the land area in spring, 6.2% and 21.6% in summer, and 4.6% and 25.3% in autumn, respectively (Figure 2). The growing season trend reveals a significant positive NDVI trend for 55.4% of the land in the TIMELINE project area. This confirms and reinforces previous findings of a greening of vegetation over Europe. Figure 3 presents the percent area with negative or positive NDVI trends within the biogeographical regions. In the growing season, the NDVI trend is significantly positive for more than 60% of the area in all regions except for the Steppic and Anatolian regions. For spring, summer and autumn, positive trends are less significant and larger areas experience negative NDVI trends. In summer and/or autumn negative trends can be identified for >40% of the area in the Steppic, Mediterranean, Anatolian and Arctic regions.

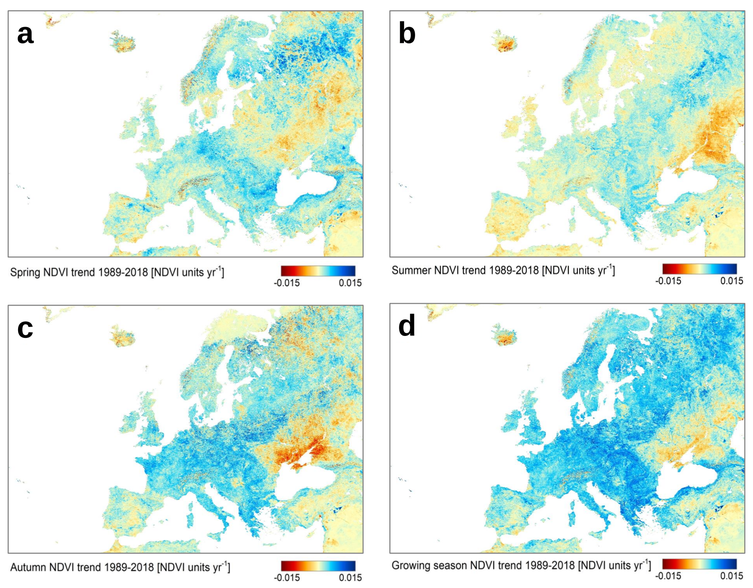

Figure 2. Seasonal NDVI trends for the period 1989-2018.

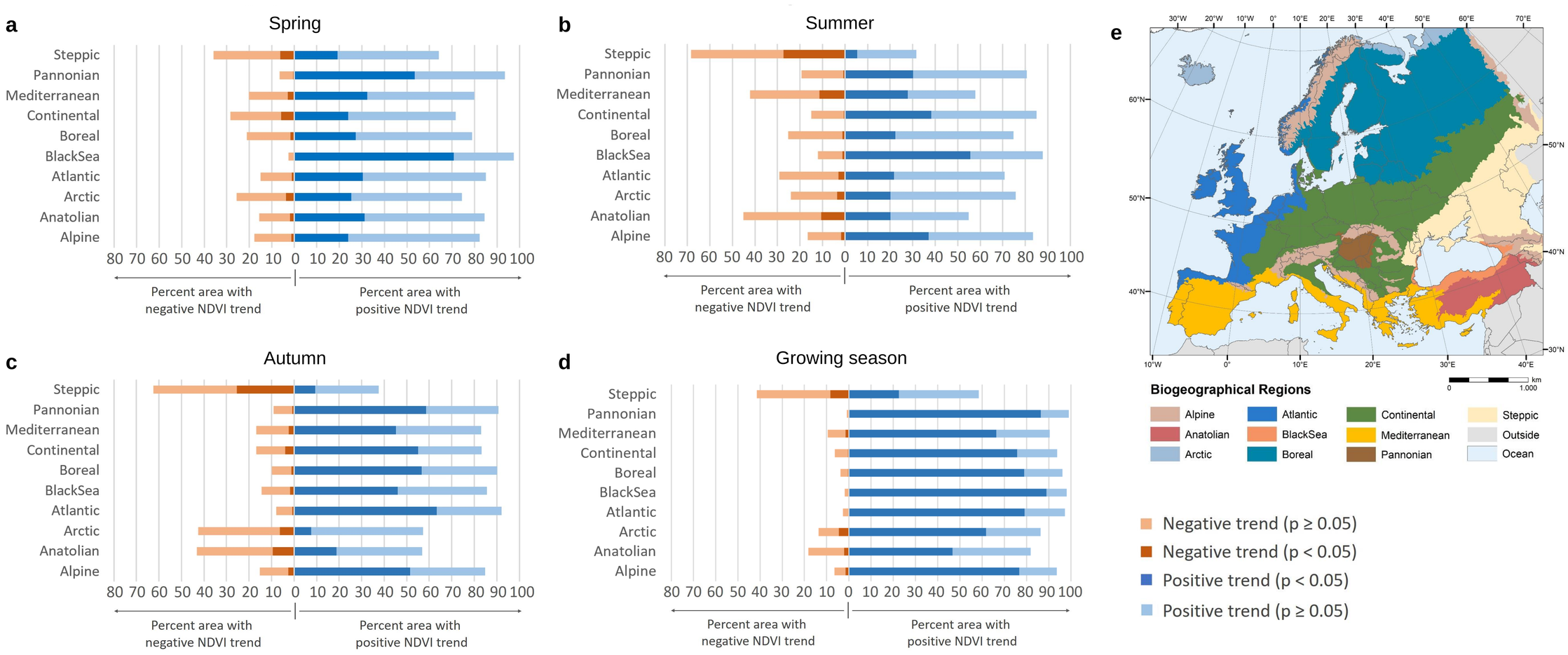

Figure 3. Percent area with negative or positive NDVI trends for (a) spring, (b) summer, (c) autumn, and (d) the growing seasons within (e) the biogeographical regions (EEA).

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