Seasonality and long-term trends of NDVI values in different land use types in the eastern part of the Baltic Sea basin

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Introduction

- This study analyses changes in Normalized Difference Vegetation Index **(NDVI)** values in the eastern Baltic region. Like many other vegetation indices, NDVI is calculated using reflections from the surface in the near-infrared **(NIR)** and visible spectrum **(VIS)** (Eq. 1).

$$NDVI = (NIR - VIS) / (NIR + VIS), \quad (1)$$

- The **main aim** of the work is to **evaluate changes in growing season indicators** (onset, end time, time of maximum greenness and duration) and their relationship with meteorological conditions (air temperature and precipitation) in 1982–2015 **in different types of land use.**

Data and methods

- In this research we define the eastern part of the Baltic Sea basin as an area between **53°** and **60°N** and from **20° to 30°E.**
- A total of 2621 grid cells were obtained, covering the study area
- **Five types of land use** were distinguished (321 cells in total) using CORINE land cover data with reference years 1990 (CLC 1990) and 2012 (CLC 2012): **pastures** (4 cells), **wetlands** (3), **mixed forests** (80), **coniferous forests** (25) and **arable lands (209)**.
- **0.2 threshold value** of NDVI was used to determine the **start** and **end** dates of the growing season.
- **Correlation analysis** was used to assess the impact of air temperature and precipitation amount on NDVI values

Results

- **Seasonality of NDVI**

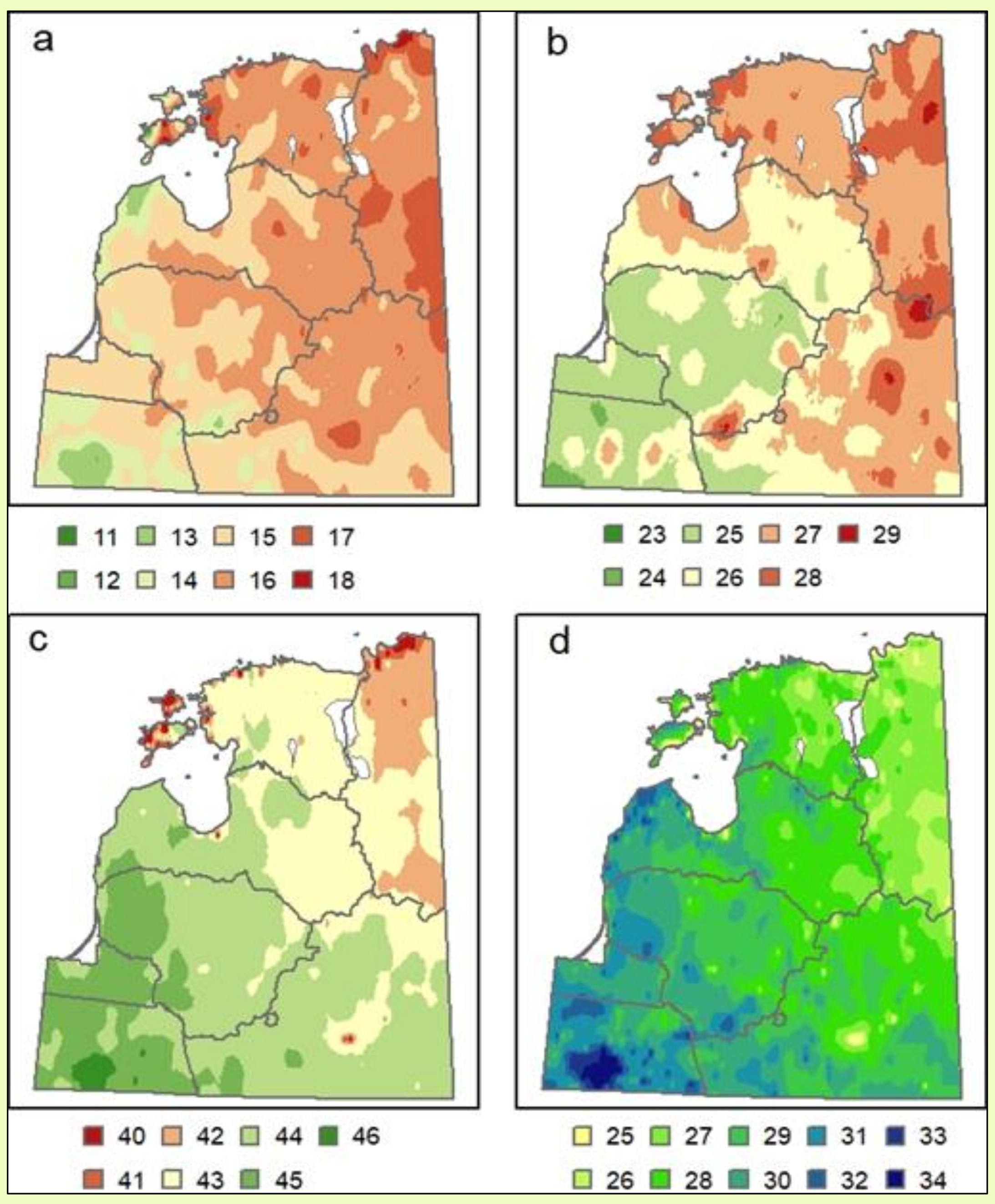

Fig. 1 Average dates of onset of vegetation period (a), maximum greenness (b), end of vegetation period (c) as well as duration of vegetation period (d) in the eastern part of the Baltic Sea basin

- **Relationship between NDVI values and meteorological parameters**

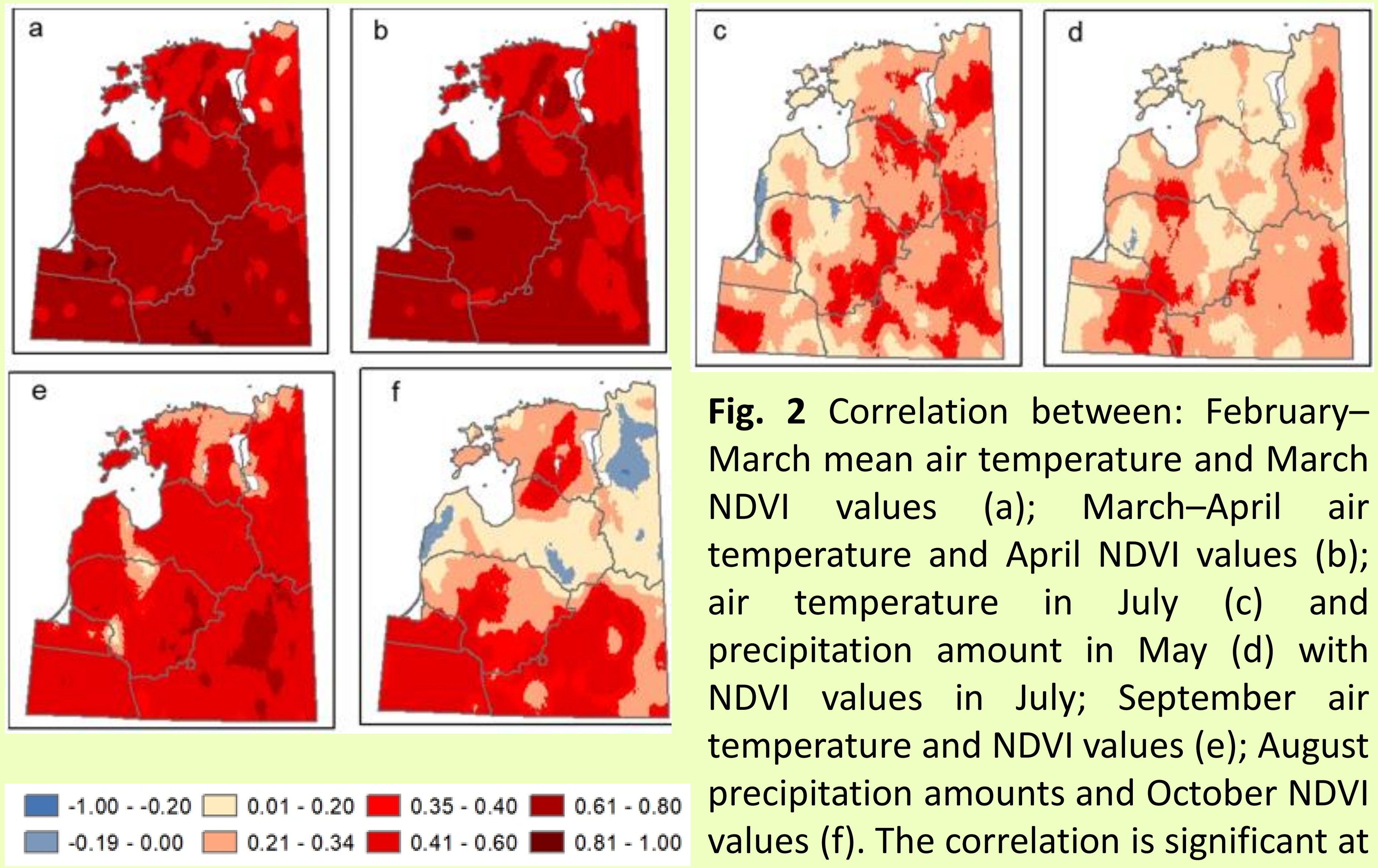

Fig. 2 Correlation between: February–March mean air temperature and March NDVI values (a); March–April air temperature and April NDVI values (b); air temperature in July (c) and precipitation amount in May (d) with NDVI values in July; September air temperature and NDVI values (e); August precipitation amounts and October NDVI values (f). The correlation is significant at $p < 0.05$ level when $r > |0.34|$

- **NDVI trends**

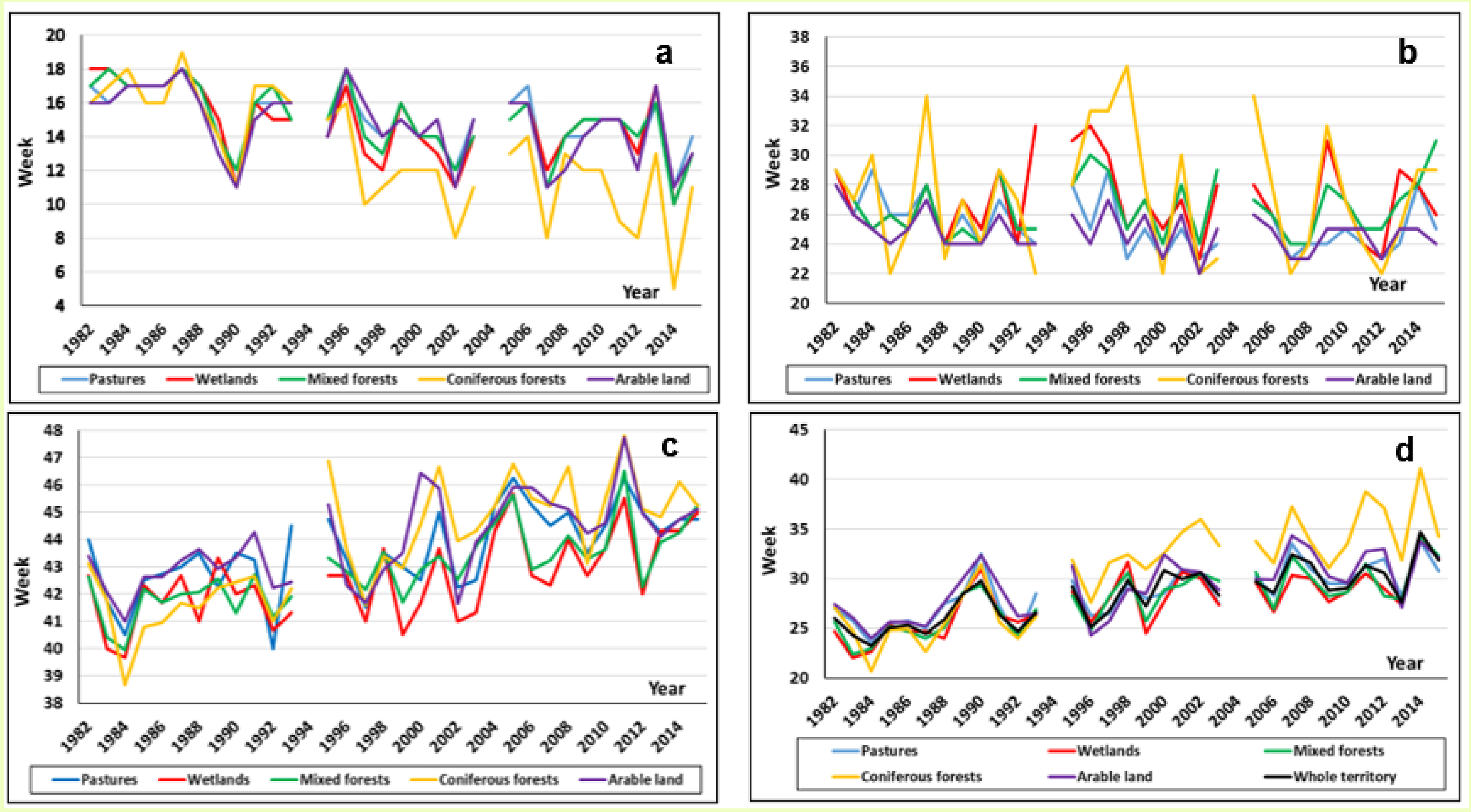

Fig. 3 Changes in the beginning (a), maximum greenness (b), end (c) dates of vegetation period and duration of vegetation period (d) for different types of land use 1982–2015

Conclusions

- The vegetation season varies from six months in the northeast to eight months in the southwest.
- Maximum greenness was reached earliest on arable land and pastures. The highest NDVI values during the period of maximum greenness were observed in deciduous forests.
- February to March air temperature is the most important factor determining the start of the growing season while September air temperature has the strongest impact on growing season's end date.
- Precipitation impact is weak throughout all phases of vegetation season.
- The duration of the vegetation period increased by 6-7 weeks. The changes were statistically significant. Maximum greenness time remained almost unchanged.

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