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Theme 5. Environmental issues related to grassland
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Effect on climatic changes on grasslands in Poland using remote sensing

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Introduction

Climate change influences grassland productivity throughout Europe. The extremes of the weather in winter, often lack of snow cover together with low temperatures as well as often occurrence of the increased air temperatures early in spring, cause shifts in phenology and disturbance in water balance of the grasslands areas, which influence the grass yield. Also lack of precipitation and increase of temperature later in spring and summer cause diminishing of moisture causing changing water conditions in some of the areas.

There is a lack of tools for efficiently monitoring effects of climatic trends on grassland productivity on a regional or national level, and therefore there is a need for developing reliable methods for quantifying yields and collecting data on a large scale. Remote sensing technology may be applied to approach this. Satellite-based radiometers are useful for measuring vegetation characteristics over time across larger areas. Satellite imagery has been used to assess forage production levels over large areas by calculating the Normalized Difference Vegetation Index (NDVI) (Smit *et al*., 2008) or the Enhanced Vegetation Index (EVI) (Kawamura *et al*., 2005).This technology may also be used to assess the forage grassland production on farm, regional and national levels.

The aim of this paper was to assess the effect of climatic changes on grassland growth, its water conditions and biomass and subsequently their yield with the application of the remote sensing techniques.

Materials and Methods

The investigations has been performed within Polish-Norwegian Research Programme entitled: “Effect of climatic changes on grassland growth, its water conditions and biomass” – FINEGRASS and has been realized in Poland and Norway and is coordinated by the Institute of Geodesy and Cartography in Warsaw. The Project contributes to two Polish-Norwegian Programme Areas: Climate Change and Environment. In the FINEGRASS project, the newest and most innovative remote sensing and in-situ based methods will be applied on the national, regional and single grassland scales and has been designed to serve as an important tool in grassland management on all these levels. Half of 45 types of grassland in Poland are of semi-natural character. The applications of remote sensing observations were the main tool for examining the differences in grasslands biomass for the whole country. To get the spatial distribution of grasslands areas the CORINE (Co-ORdination of INformation on the Environment- CLC) database has been used as the geographical information system to provide information on localization of grasslands areas. In Poland grasslands cover about 13 % of the country area (22% of the agriculturally utilized area). The CLC Grassland Layer was intersected with AVHRR.NOAA data with resolution of 1000 m to create the grassland-mask. The pixels which characterized the grassland area were these, with the minimum of 50% of grassland. One of the objectives of the project was the assessment of vegetation indices derived from satellite data and describe the temporal and spatial variation of these indices. NOAA.AVHRR satellite data have been applied (since 1997) and current images recorded in visible and thermal channels have been used for calculation of vegetation indices for analyzing these indices for each year with the step of 10 days. The 10-day mosaic of Normalised Difference Vegetation Index (NDVI); Surface Temperature (Ts); VCI (Vegetation Condition Index) and TCI (Temperature Condition Index) has been elaborated. The grasslands mosaics were overlaid on DTM for the whole country. The vegetation indices were calculated also for NUTS2. The areas of climatic zones for Poland have been established for evaluating the vegetation indices within these zones.

Results and Discussion

The biomass calculated for each year (1997-2014) applying NOAA/AVHRR data has been compared to biomass from official Central Statistical Office data. The accuracy was high what shows the great possibility to use satellite data. It was also proved the differences in biomass due to variation of meteorological data in different years. Other indices that have been elaborated described moisture conditions and the start vegetation growth after winter which duration changed every year. The index describing soil moisture NDVI/Ts (Ts was surface temperature from NOAA satellite). The start of vegetation and grassland development has been also described within the climatic zones of Poland to find the differences in grassland development in particular zones. Also the deviation from the average for the examined period of time of particular indices for each year has been analyzed and compared to the data base of EMCWF data base.

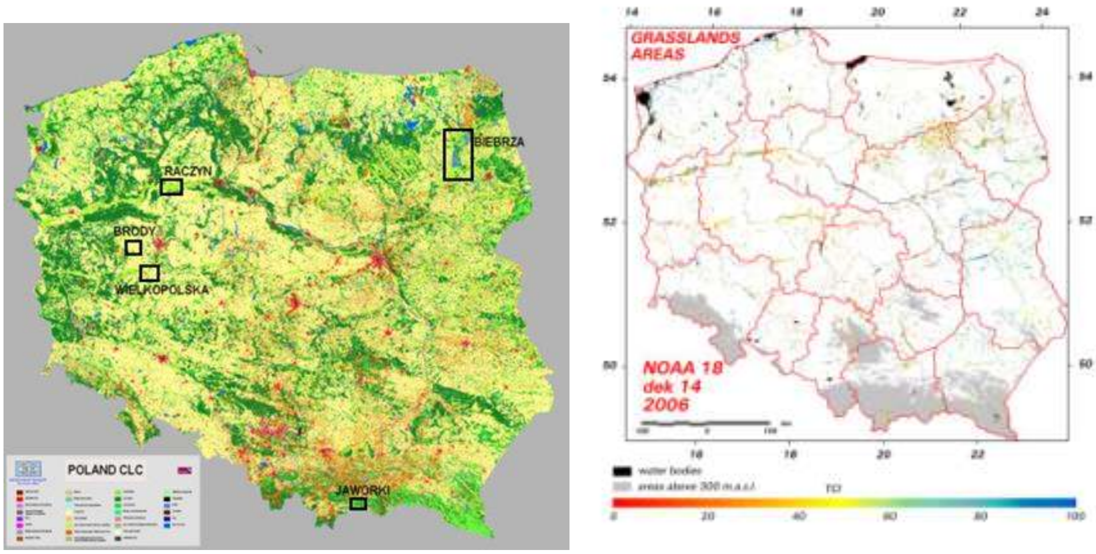

Fig. 1 A/ Corine Land Cover Map of Poland B/ The Map of Temperature Condition Index (TCI) for 2006 14 decade

For each administrative division of NUTS2 the data of grass biomass have been applied from official Central Statistical Office and the model for biomass has been established using satellite indices:

Y= 3.5*"NDVI-07" + 2.49*"NDVI-08" + 0.80*"NDVI-09" + 1.46*"NDVI-10" + 3.9*"NDVI-11" + 3.48*"NDVI-12" + 0.34*"NDVI-13" + 0.57*"NDVI-14" -0.42*"NDVI-15") + 0.010*"Ts-07" - 0.013*"Ts - 08" - 0.012*"Ts - 09" - 0.022*"Ts-10" – 0.024*"Ts-11" - 0.036*"Ts - 12" - 0.011*"Ts - 13" - 0.054*"Ts-14" – 0.019*"Ts-15")

The model consists of NDVI index and surface temperature Ts from NOAA AVHRR.

Conclusion

Climate changes in Poland may affect positively and negatively the grassland productivity. The projected climate scenarios point in different directions. It is therefore necessary to build new and efficient methods that can be used to monitor the productivity of grasslands to understand trends and anomalies that are likely to continue into the future. This can help in planning for agricultural practices and offsetting financial risks on large scales.

References

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