

Dabrowska-Zielinska, K.¹, Golinski, P.², Jørgensen, M.³, Møllmann, J.³, Taff, G.³, Twardy, S.⁴,
Tomaszewska, M.¹, Golinska, B.², Budzyska, M.¹, Gatkowska, M.¹, Kopacz, M.⁴

¹Institute of Geodesy and Cartography, Remote Sensing Centre, Warsaw, Poland
²Poznan University of Life Sciences, Department of Grassland and Natural Landscape Sciences, Poznan, Poland
³Norwegian Institute of Bioeconomy Research - NIBIO, Holt, Tromsø, Norway
⁴Institute of Technology and Life Sciences, Malopolska Research Centre, Krakow, Poland
Contact: katarzyna.dabrowska-zielinska@igik.edu.pl



Introduction:

Studying the effect of climatic changes on environmental conditions of grasslands has been the subject of the Polish-Norwegian Research Project FINEGRASS

„Effect of climatic changes on grassland growth, its water conditions and biomass.”

In-situ measured soil-vegetation parameters and satellite observations have been combined and analysed to quantify the spatial and temporal variability of grassland conditions, as reflected in variations of surface temperature (Ts), soil moisture, biomass, and subsequently their yield.

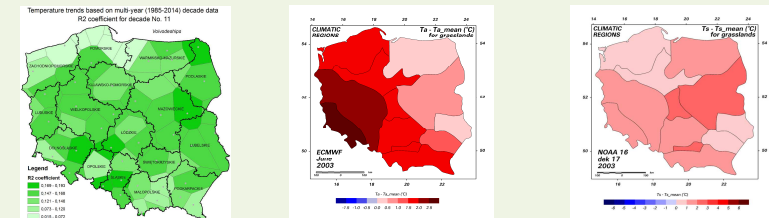
Materials and Methods:

- For Polish study sites, a grassland layer was derived from CORINE Land Cover (CLC) data.
- Ts collected from 10-day composite NOAA AVHRR satellite data (since 1997) was overlaid on the CLC grassland layer. For each of the administrative divisions (NUTS1) and climatic regions, Ts was averaged for the grassland pixels, and the trend between 1997 and 2015 was analysed.
- Annual yield data were collected for Poland from ca. 50 ha of grassland situated on mineral soils, utilized mainly for grazing, and of ca. 150 ha of grassland located on organic soils used for cutting for fodder. The effect of climate conditions over a 50-year period on yield of grasslands was analysed.
- Yield was compared with long-term averages of mean monthly and annual temperatures, monthly precipitation sum, and SPEI, which incorporates both these climatic elements and characterizes drought severity.
- Meteorological data were used from the Holt research station in northern Norway to assess temperature trends in spring, summer, and autumn since 1991.
- Meteorological data for Poland were taken from i) Meteorological stations ii) ECMWF database
- MODIS 16-day NDVI data were used in conjunction with a ground-truth phenology dataset at Holt to assess trends in snowmelt and green-up between the years 2000 and 2012.

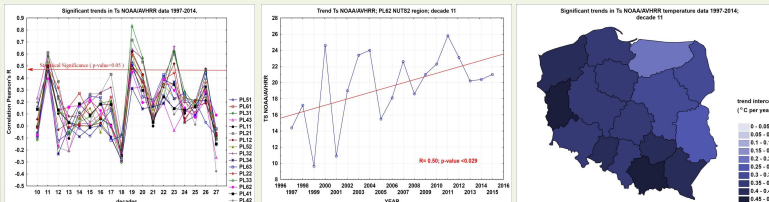
Results and Discussion:

- Significant trends in air temperature (Ta) in NUTS1 in Poland;
- Significant trend of increasing grassland surface temperature (Ts) in Poland, based on AVHRR satellite data;
- Comparable results between Ts – Ts_mean and Ta – Ta_mean for the years 1997–2015
- Significant positive relationship between the (April–September) standardized precipitation evapotranspiration index (SPEI) and grass yields in Poland;
- Temperature data present a trend towards earlier growth start in spring and increasing temperature sum in the growing season during the last ten years in Norway, however, with large variation between years;
- Trends towards warmer springs and autumns since 1991 in northern Norway;
- MODIS 16-day NDVI time series present consistent trends at the Holt research station in northern Norway towards earlier snowmelt and green-up in the early 2000's, somewhat later snowmelt and green-up in the late 2000's, and then again towards earlier snowmelt and green-up in the early 2010's

Trends in Ta in Poland NOAA AVHRR Ts-Ts_mean ECMWF Ta- Ta_mean

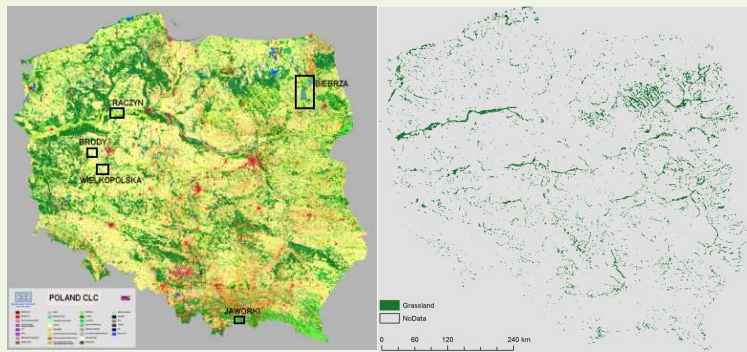


Trends in surface temperature in Poland



Corine Land Cover for Poland

Grassland areas in Poland from CLC



Polish test sites



Northern Norway test site, Holt research station, Tromsø

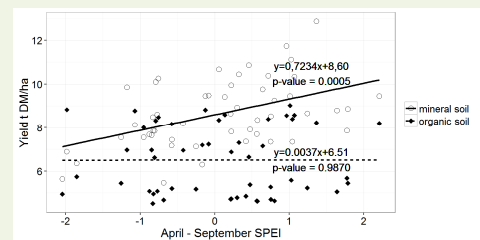


Photo: Karl Henrik Lillebye
Midnight sun in Holt

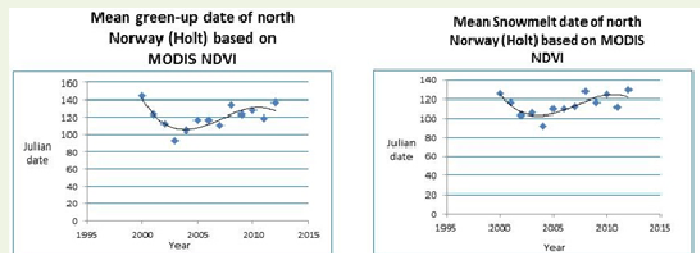
Photo: Odd-Arild Finnes
Harvesting in Holt

Photo: Rolf Johansen
Spring in Holt

Relationship between SPEI and grass yields in Poland



Trends in snowmelt and green-up in northern Norway



Acknowledgement:

This work was supported by the Polish-Norwegian Research Programme Project FINEGRASS (grant agreement 203426/82/2013).