Project information

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Grasslands, phenology, hyperspectral, waterlogging, productivity, ground truth, biomass, feed quality, remote sensing, phytotron

Project title
Effect of climatic changes on grassland growth, its water conditions and biomass, Year 2

Year
2015

Project leader
Gregory Taff

Participants

Dr. Marit Jørgensen, Dr. Jørgen Mølmann; Dr. Hans Tømmervik

Flagship
Terrestrial

Funding Source

Poland-Norway EEA grant

837 110 NOK for 2015

Summary of Results

We oversaw the collection of a second round of data by the Agricultural Advisory Service regional offices in Vesterålen and Harstad. They collected more data, in addition to what was collected from Terrestrial Flagship funds in 2014, so that we can have sufficient ground truth data for model creation to estimate grass biomass from satellite imagery (primarily using Landsat). They cut grass in 6 squares along transects in a total of 6 fields and measured wet and dry matter weight of grass from each cut square, and they also took "plate measurements" along the transects as well as in a 15-meter grid throughout each entire field. These plate measurements give an approximate measure of the average height of grass at that location, and can also be used as a proxy for biomass. In addition, Fram Center funds allowed us to add collection of handheld hyperspectral data using the Fieldspec3 instrument (to augment our sample size from data collected in 2014 using Terrestrial Flagship funds) in 3 fields near Tromsø where Mølmann and Jørgensen collected other data using funds from the Norway-Poland EEA grant (e.g., species mix, soil moisture and temperature, weighing grass biomass, chemical analyses of grass for feed quality parameters). We hired Francisco Murguzur from the UiT Arctic and Marine Biology Department to process the Fieldspec3 data, and work with the project team to use it to model grass dry weight. Murguzur partly built his competence on use of hyperspectral data analysis to estimate grass yields based on his work with the 2014 Fram Center FINEGRASS project. The combined 2014 and 2015 data have now been processed and are currently being analyzed by Murguzur under supervision of Taff and Mølmann. We contracted Norut to fly an unmanned aerial vehicle (UAV) over fields near Tromsø, however, their hardware broke down just before the planned flight (which was planned for a day just before harvest), and therefore this flight was not possible.

An analysis conducted in 2014 that compared an historical phenology dataset from Holt with 8-day composited NDVI maps taken from the MODIS satellites determined best NDVI thresholds for snowmelt and greenup in the north Norwegian context of grass fields. These thresholds were used to develop yearly phenology maps (snowmelt and greenup dates) for north Norway since 2001. Maps from 2001 to 2013, and a corresponding summary, are expected to be completed by November 25 (2015). Instead of using MODIS data, climate data was compared with grass yields between 1986 and 2011, using yield data from the Agricultural Advisory Service of Vesterålen as ground truth. Climate data was used as a more direct measure of climate (rather than satellite data), and because we have access to a longer historical time series, relative to MODIS data. Results showed decreasing trend of dry matter yields while the number of growing degree days increased.

With Fram Center funds, we are now completing a phytotron study of the effects of waterlogging on the most important cultivated grass, timothy (*Phleum pratense*). We are experimentally exposing plants to low,

present and higher autumn temperatures (as expected in the future) and checking the effects of waterlogging under these conditions on frost tolerance and winter survival of timothy. The study will be completed in spring 2016, and will be written up in summer/autumn 2016.

For the Management

The Mid-Hålogaland Agricultural Advisory Service works closely with us on the FINEGRASS and Fram Center projects. We will be presenting our results to them, especial regarding how biomass can be best modeled with remote sensing, how yields have been changing in the region since 1986, and how various water-logging conditions affect winter survival. 2016 is the final year of FINEGRASS, and we expect to obtain our results in 2016, at which point we will share our results with the Agricultural Advisory Service, as well as farmers and the Agricultural Administration.

Published Results/Planned Publications

We will finish our analyses and write up results in the form of scientific publications in 2016. Our planned publications for this work are:

1) using hyperspectral field spectrometer data and Landast satellite data to estimate grass biomass;
2) the effects of climate change and phenological trends in north Norway on cultivated grassland yields;
3) modeling grassland yield and field quality using remotely sensed data, environmental variables, species mix, and land management characteristics; and
4) effects of waterlogging and autumn temperatures on frost tolerance and winter survival of timothy (*Phleum pratense*).

We will also present our research at scientific meetings. The first planned meeting where we will present is the European Grassland Federation conference (EGF) in September in Trondheim. Others to be determined will follow.

Communicated Results

Gregory Taff, Marit Jørgensen, Jørgen Mølmann, “Research grants on northern cultivated grasslands”, presentation delivered at the final workshop for the ArcticBiomass project, October 20-23, 2015, Longyearbyen, Svalbard.

Gregory Taff, Jørgen Mølmann, Marit Jørgensen, Francisco Javier Ancin Murguzur, Ilina Kamenova, Monika Tomaszewska, Stanislaw Twardy, Piotr Golinsky, Piotr Golinski, Marek Czerwinski, Barbara Golinska, Katarzyna Dabrowska-Zielinska, Presentation: “Preliminary outcomes and challenges in modeling of grass biomass using remote sensing”, South Central Europe Regional Information Network (SCERIN)-3 meeting, Brasov, Romania, July 2015.

Interdisciplinary Cooperation

This project is a close collaboration between scientists focused on agronomy (Jørgensen – studying grass yields and effects of climate changes on winter survival), plant biology (Mølmann – field methods and yield/feed quality analyses), and geographic information science/remote sensing (Taff and Tømmervik – GIS and remote sensing of vegetation), and we also collaborate with the Agricultural Advisory Service.

Budget in accordance to results

Our total budget expenditures are expected to be our planned expenditures for the 2016 grant. We re-allocated some funds between activities, however. Because Norut was not able to fly the UAV because of hardware problems, we reallocated that money to analysis of the hyperspectral data and yield modeling, including Murguzur on the analysis team. In addition, we decided not to buy the ATCOR add-on to the computer package ERDAS – Imagine (image processing software) because we intended to buy this to atmospherically correct Landsat 8 data, however NASA now offers an atmospherically corrected Landsat 8 product, so the ATCOR add-on is not useful to us anymore. We reallocated this money to extra time for fieldwork and analysis for the project team at Nibio.

Could results from the project be subject for any commercial utilization

No

Conclusions

Utilizing Fram Center funds in 2014 and 2015, we increased our sample size and scope of ground truth, which are useful for both expanded and more robust statistical models of yield, as predicted from various remote sensing platforms. Data processing and model building is underway. An experiment and analysis of water-logging effects on winter survival of timothy grass is successfully underway, to be completed in spring 2016.

Phenology in north Norway is mapped in a new way with MODIS data, and maps are currently in production. All this work will lead to the writing of four planned scientific publications in 2016.