



ArcticBiomass

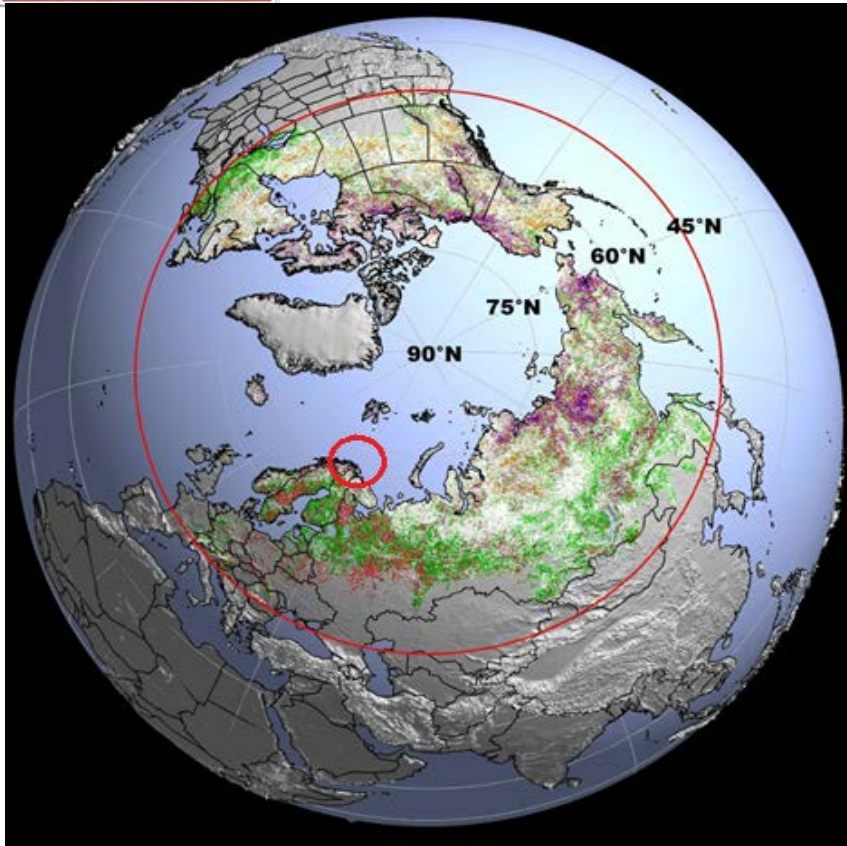
US-Norway Network project

Hans Tømmervik





Increase of plant growth per decade- 1982-2011



Trend in Arctic and Boreal Region Plant Growth with Respect to 1982 (% per Decade)

<-2.0	-1.0	0.0	1.0	2.0	3.0	4.0	5.0	6.0	7.0	>8.0
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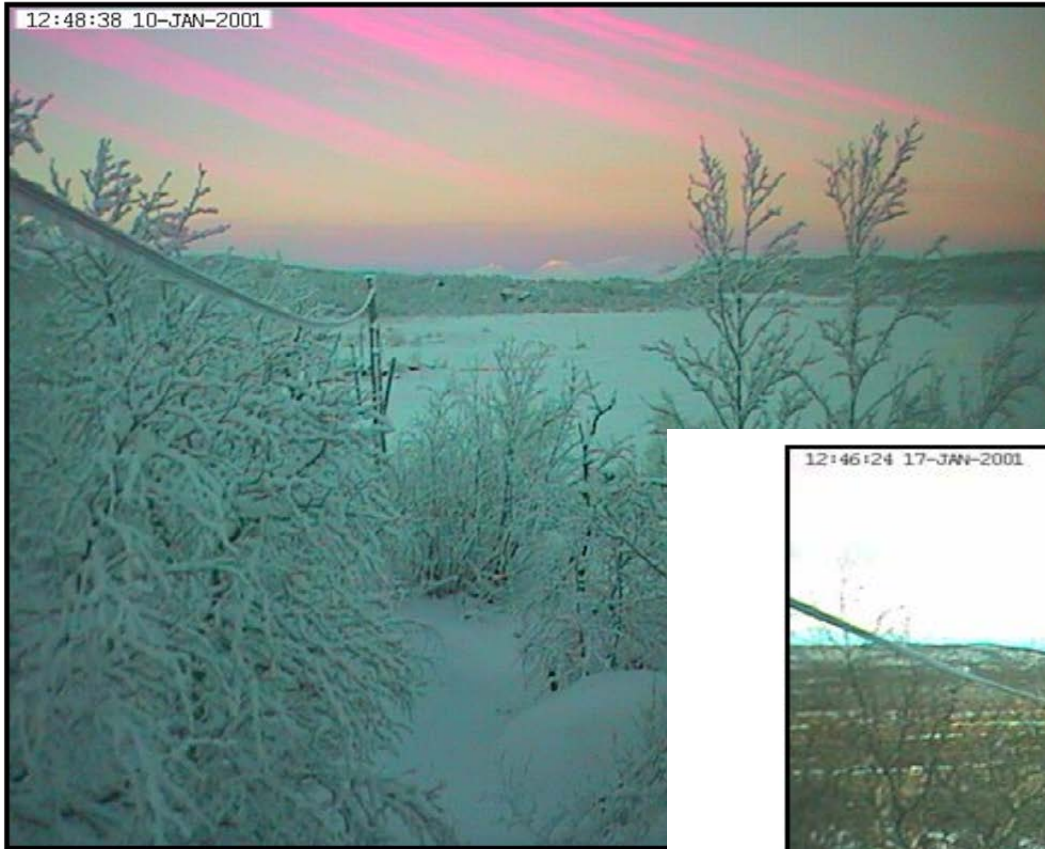
Greening/productivity increased in 32-39% of the Arctic

Browning: < 4%

Stable: 57-64%

Source: Xu, L., **Myneni, R.B.**, Chapin III, F.S., Callaghan, T.V., Pinzon, J.E., Tucker, C.J., Zhu, Z., Bi, J., Ciais, P., **Tømmervik, H.**, **Euskirchen, E.S.**, **Forbes, B.S.**, Piao, S.L., Anderson, B.T., **Ganguly, S.**, Nemani, R.R., **Goetz, S.J.**, **Beck, P.S.A.**, Bunn, A.G., Cao, C., Stroeve, J.C. 2013. Temperature and Vegetation Seasonality Diminishment over Northern Lands. *Nature Climate Change*, 3: 581-586.

«Melt and freeze episodes in mid-winter due to warming and ROS



Ground-ice episodes Ny Ålesund Svalbard Winter 2012



ArcticBiomass 2013-2016

US-Norway network project funded by the Research Council of Norway

- Boston University: Ranga Myneni and Taejin Park
- Woods Hole Research Center; Scott Goetz and Pieter Beck
- University of Alaska – Fairbanks: D.A. Walker, Martha Reynolds et al.
- Virginia University: Howard Epstein
- NINA: Hans Tømmervik, Jarle Bjerke, Olav Strand, Per Fauchald, A. G. Finstad
- Norut: Bernt Johansen, Stein-Rune Karlsen, Kjell-Arild Høgda, Rune Storvold, Eirik Malnes
- University of Tromsø: Lennart Nilsen

Objectives

- The main objective is to establish a joint American-Norwegian research team dealing with research on the combination of field and satellite remote sensing based plant biomass and plant production mapping in northern Alaska and in Svalbard, as well as on a circumpolar scale.
- A sub-objective is to compile existing plant biomass and production data from the North Slope of Alaska and from Svalbard, and to evaluate existing remote sensing based biomass products throughout the Arctic. This in order to improve the remote sensing based plant biomass and productivity monitoring.

Work packages

- The project seeks to address the following research questions and tasks:
- **WP 1:** Arrange workshops and joint field campaigns on Svalbard (Ny-Ålesund and Nordenskiöldland), and in northern Alaska for development of efficient field protocols for field measurements of biomass and productivity and in order to filling gaps in plant biomass and plant productivity data.
- **WP 2:** *Improvement of mapping methods of plant biomass and plant production in northern Alaska and on Svalbard, as well as on a circumpolar scale .*
- **WP 3:** This work-package aims to estimate, map and model the overall productivity of arctic landscape and vegetation of Svalbard/Fennoscandia and in Alaska.
- **WP 4:** Improvement of mapping methods of the growing season (phenology) .

Field campaign using UAS systems



Svalbard – Adventdalen July 2013



Plant species/ community*	NDVI in situ Species level (0.5 × 0.5 cm ²)	NDVI in situ Community level (0.5 × 0.5 m ²)	NDVI UAS Species level (10 × 10 cm ²)	NDVI UAS Community level (0.5 × 0.5 m ²)	NDVI Landsat ETM+ Vegetation type level** (30 × 30 m ²)
<i>Cassiope tetragona</i> ¹	0.525+/-0.205	0.441+/-0.304	0.862+/-0.091	0.494+/-0.132	0.220
<i>Dryas octopetala</i> ²	0.612+/-0.220	0.387+/-0.290	0.462+/-0.030	0.372+/-0.072	0.190
<i>Salix polaris</i> ³	0.648+/-0.166	0.443+/-0.284	0.638+/-0.099	0.509+/-0.078	0.350
<i>Aulacomium turgidum</i> ⁴	0.387+/-0.100	0.304+/-0.157	0.550+/-0.078	0.367+/-0.105	0.410

The correlation between surface measured NDVI and UAV NDVI was $R = 0.75$, $P = 0.01$.

15:00-16:00 Field campaign and field excursion continues in Adventdalen

Excursion to the phenological field sampling plots in Endalen and near by the EISCAT station in Adventdalen was carried out (Figure 5).



Figure 5. Excursion to the phenological field sampling plot near by the EISCAT station in Adventdalen Thursday 18th of July.

Friday 19th of July :

09:00 – 19:00 Field campaign and excursions in Adventdalen and Bjørndalen.

Spectrometer measurements (Figure 6) and field excursion continued in Adventdalen and Bjørndalen.



Figure 6. Spectrometer measurements in Adventdalen - Friday 19th of July.

USE OF UNMANNED AIRCRAFT SYSTEMS (UAS) IN A MULTI-SCALE VEGETATION INDEX STUDY OF ARCTIC PLANT COMMUNITIES IN ADVENTDALEN ON SVALBARD

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ABSTRACT

Alaska September 2014



Workshop in Fairbanks arranged together with the NASA Yamal project



Figure 1. Picture showing Martha Reynolds, Uma Bhatt and Skip Walker from University of Alaska – Fairbanks and Howard Epstein from University of Virginia.

Denali



***Empetrum nigrum* in Alaska (Denali highway) and Svalbard - 2014**



Damage to ***Cassiope tetragona*** – Denali highway 2014

Scientific Publications

- Høgda, K.A., Tømmervik, H. & Karlsen, S.R. 2013. Trends in the Start of the Growing Season in Fennoscandia 1982–2011. *Remote Sensing*, 2013, 5(9), 4304-4318; doi:10.3390/rs5094304.
- Karlsen, S.R., Elvebakk, A., Høgda, K.A. & Grydeland, T. 2014. Spatial and temporal variability in the onset of the growing season on svalbard, arctic Norway - Measured by MODIS-NDVI satellite data. *Remote Sensing* 2014, 6, 8088-8106, doi:10.3390/rs6098088
- Tømmervik, H., Karlsen, S.R., Nilsen, L., Johansen, B., Storbvold, R., Zmarz, A., Beck, P.S., Johansen, K.S., Høgda, K.A., Goetz, S., Park, T., Zagajewski, B., Myneni, R.B. & Bjerke, J.W. 2014. Use of unmanned aircraft systems (UAS) in a multiscale vegetation index study of Arctic plant communities in Adventdalen on Svalbard. *EARSeL eProceedings* 13 (S1), 47-52.
- Bjerke, J.W., Tømmervik, H., Zielke, M. & Jørgensen, M. 2015. Impacts of snow season on ground-ice accumulation, soil frost and primary productivity in a grassland of sub-Arctic Norway. *Environmental Research Letters* 2015, 10 (2015) 095007. doi:10.3390/rs6098088

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Focus on Recent, Present and Future Arctic and Boreal Productivity and Biomass Changes

Guest Editors

Hans Tømmervik Norwegian Institute for Nature Research

Bruce Forbes University of Lapland

Donald Walker University of Alaska Fairbanks

Scott Goetz Woods Hole Research Center



Credit: Bruce C Forbes, July 2014.

Scope

This focus issue will address recent changes in phenology, biomass and productivity and the mechanisms and drivers that control such changes, along with the consequences for local, regional and global scale processes. This includes impacts on vegetation, ecosystems and effects on human communities that are dependent on the resources in Arctic and Boreal regions. Examples of research topics the focus issue will address include:

- Changes in the physical environment over high latitude regions and associated ecological changes in Arctic/Boreal vegetation, including vegetation-mediated responses and climate feedbacks.
- Changes in phenology of vegetation (longer growth season) and in vegetation biomass and productivity responses to recent climate warming.
- Actual and potential biomass change influenced by (local) climate, natural disturbances, human impacts (e.g. resource extraction) and impacts on humans (e.g. reindeer herders).
- Transformation of open tundra vegetation to a more shrub dominated landscape, due to warming and other processes, influencing local and global climate, albedo and climate feedback mechanisms.
- - Integration of *in situ* observations and manipulation experiments with remote sensing and other data sources to advance methodological approaches for measuring and monitoring.

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WEB:

<http://www.nina.no/english/Research/Projects/ArcticBiomass>

The screenshot shows a web browser window displaying the NINA website. The browser's address bar shows the URL <http://www.nina.no/english/Research/Projects/ArcticBiomass>. The website header includes the NINA logo (Norsk institutt for naturforskning) and a navigation menu with options: HOME, RESEARCH (selected), ENVIRONMENTAL MONITORING, PUBLICATIONS, NEWS, CONTACT, and ABOUT NINA. A search bar is also present. The main content area features the title "ArcticBiomass" and a sub-header "Plant biomass studies in the Arctic." Below this is a large photograph of a pine tree in a natural setting. On the left side, there is a sidebar with a "Arctic Biomass" section containing links for "Project team" and "Publications". On the right side, there is a "ArcticBiomass Contact" section with the name "Hans Tømmervik" and a link to a "Focus issue Environmental Research Letter".

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ArcticBiomass
Contact

[Hans Tømmervik](#)

Focus issue Environmental Research Letter

[Focus issue Environmental Research Letter - Focus on Recent, Present and Future Arctic and Boreal Productivity and Biomass Changes](#)