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MAY 29 2012

EXAMINING CHANGES IN ARCTIC PLANT ASSEMBLAGES: PAST, PRESENT, AND FUTURE

Mary S. Wisz, Loïc Pellissier, Lærke Stewart + collaborators

Egevang

VERSITET UNI

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OUTLINE: MODELLING CHANGE IN ARCTIC PLANT COMMUNITIES

- Big Questions: Climate, history, biotic interactions, and dispersal
- Emerging data and collaboration
- Greenland, North America, Eurasia
- Tools for solutions?
- SDM, structural equation models, mechanistic models
- Modelling patterns and processes; past present and future
- PhD project (Lærke)
- Post doc (Loïc)

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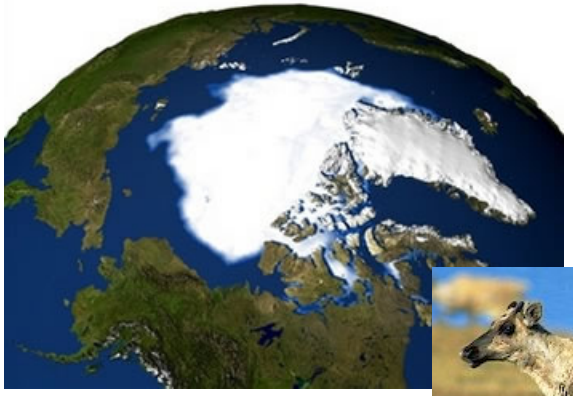
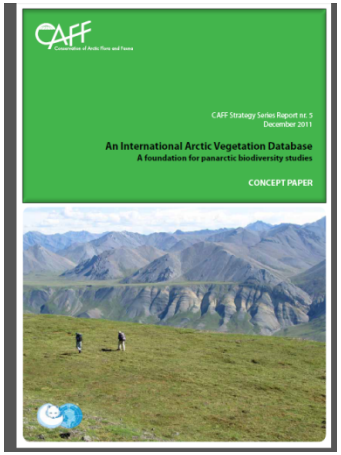
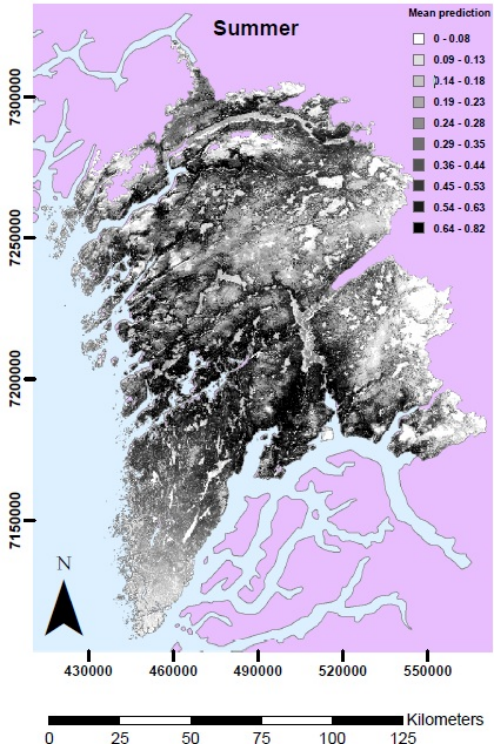
UNDERSTANDING AND PREDICTING CHANGES IN ARCTIC ECOSYSTEMS…

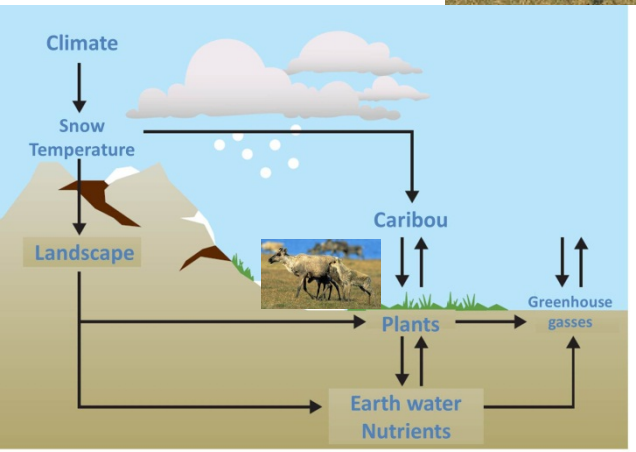




$$Y1 = \beta 1X + \gamma\,1Y{-}1 + e1$$
$$Y2 = \beta 2X + \gamma\,2Y{-}2 + e2$$
$$Yn = \beta nX + \gamma\,nY{-}n + en$$



Simonsen et al. 2011



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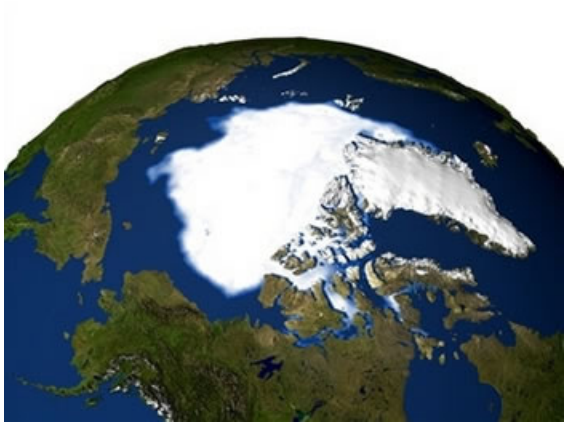
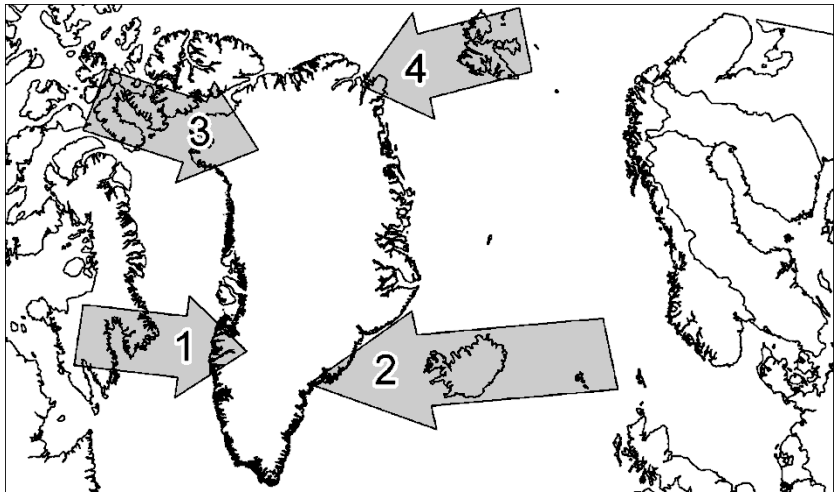
QUESTIONS: GREENLAND (REGIONAL SCALE AND BEYOND?)

Turnover: Which places and which groups of species will/ have experience/d the most/ least change? Consider:

› history, glaciation
› origin of species' pools
› velocity of climate change
› functional groups
› dispersal strategy
› ?





Bay: phytogeographic origins Greenland's flora

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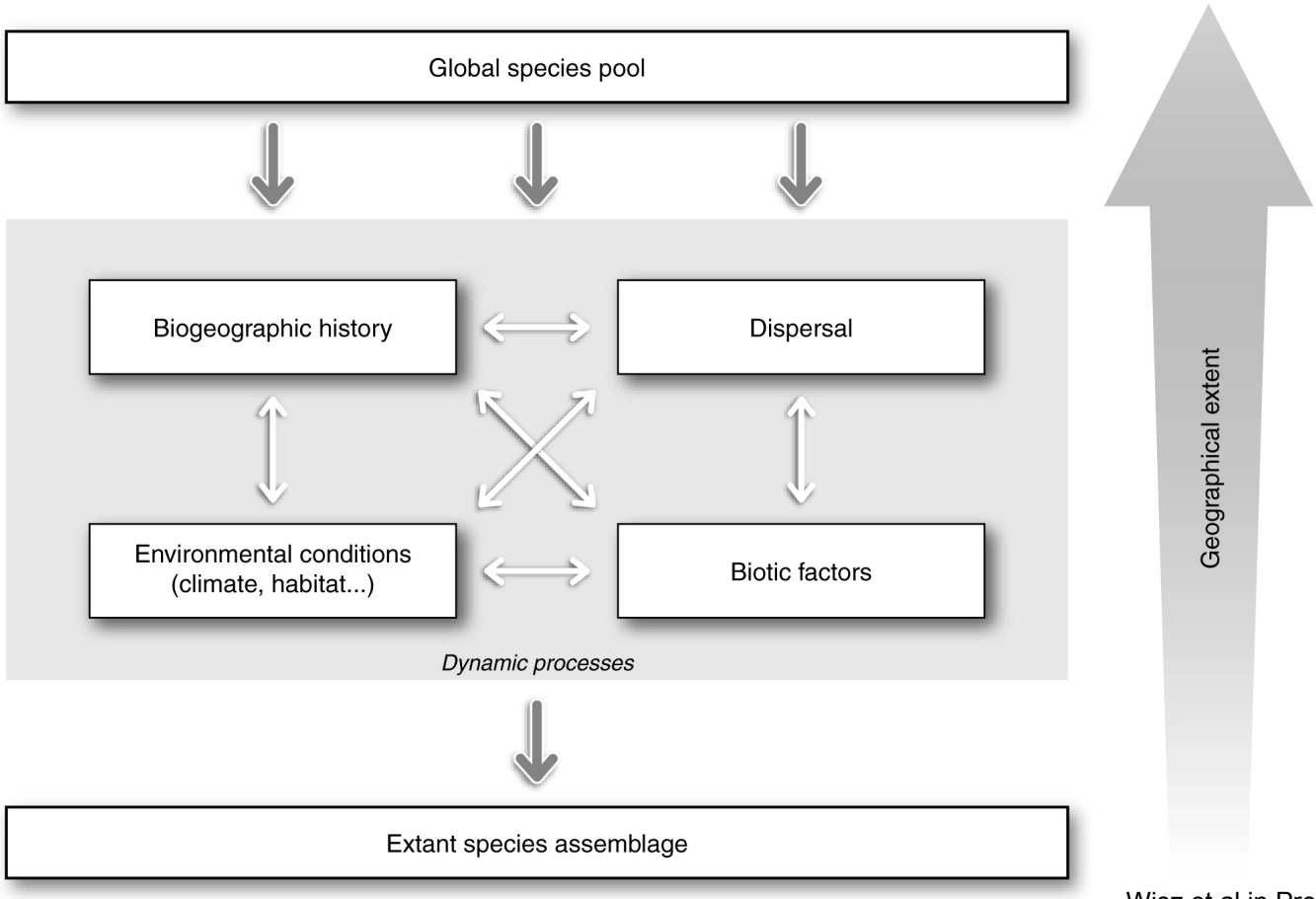
WHAT SHAPES SPECIES ASSEMBLAGES?

How do we quantify these relationships?



Wisz et al in Press *Biological Reviews*

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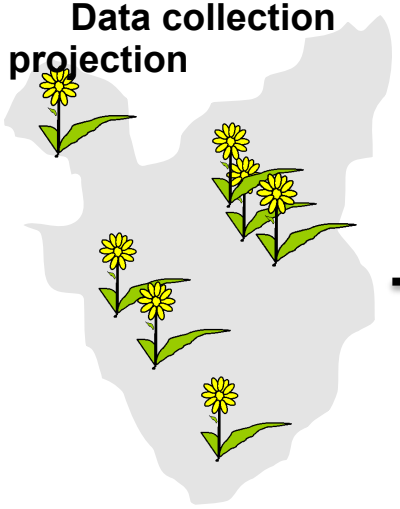
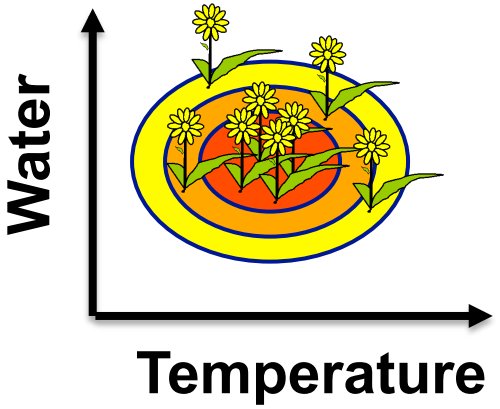
USING SPECIES DISTRIBUTION MODELLING TO PREDICT CURRENT AND FUTURE PLANT DISTRIBUTION

Data collection

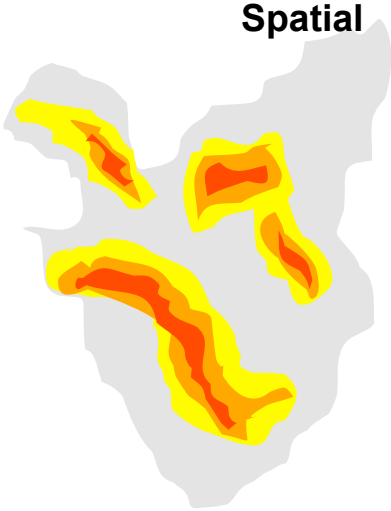
projection



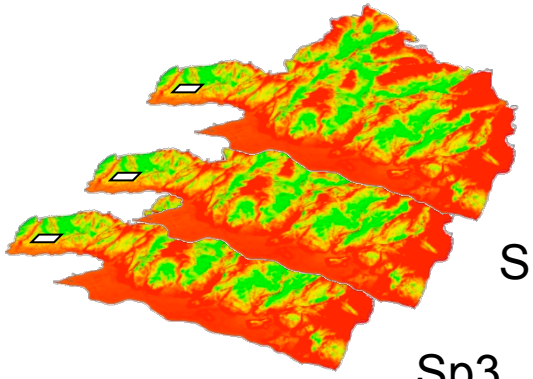
Statistical modelling



Spatial



Stacking SDMs



Communities

Accounting for:

- *Biotic interactions*
- *Dispersal*
- *Disturbances*

SDM APPLICATIONS

- Scenarios
- Diversity and richness patterns
- Turnover
- Role of functional groups
- Dispersal
- Historical events (glaciation, etc)
- Species' invasions
- Many, many others

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CANDIDATE PREDICTOR VARIABLES

› Predictors

› Temperature
› Precipitation + winter precipitation
› Solar radiation
› Potential evapotranspiration
› Terrain (DEM elevation, slope, aspect)
› NDVI, NDWI, Snow (250 M)
› Bedrock
› Large mammals (caribou, muskox)

› Scenarios

› (DMI- Greenland) 25 km assuming 2 scenarios of glacial melt
› IPCC
› Historical

DERIVATIVES/COMBINATIONS OF THESE RELAVANT FOR VEGETATION?

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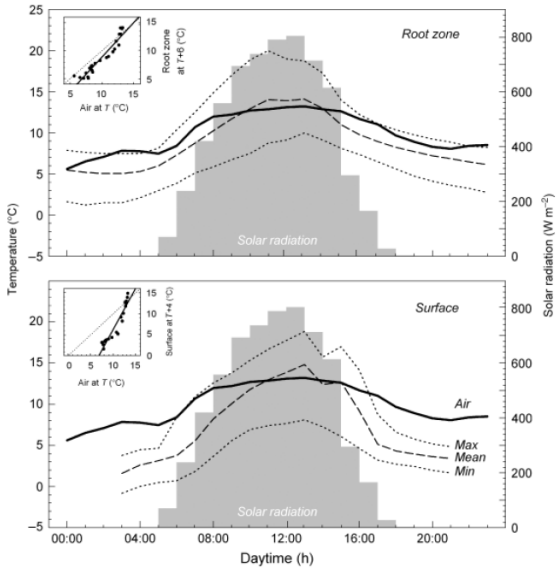
DESIGNING RELEVANT PREDICTORS FOR ARCTIC PLANT

Journal of Biogeography (J. Biogeogr.) (2011) **38**, 406–416

ORIGINAL ARTICLE

Topographically controlled thermal-habitat differentiation buffers alpine plant diversity against climate warming

Daniel Scherrer* and Christian Körner



Should 2-m air temperature or more proximal temperature (e.g. 5cm aboveground) be used?

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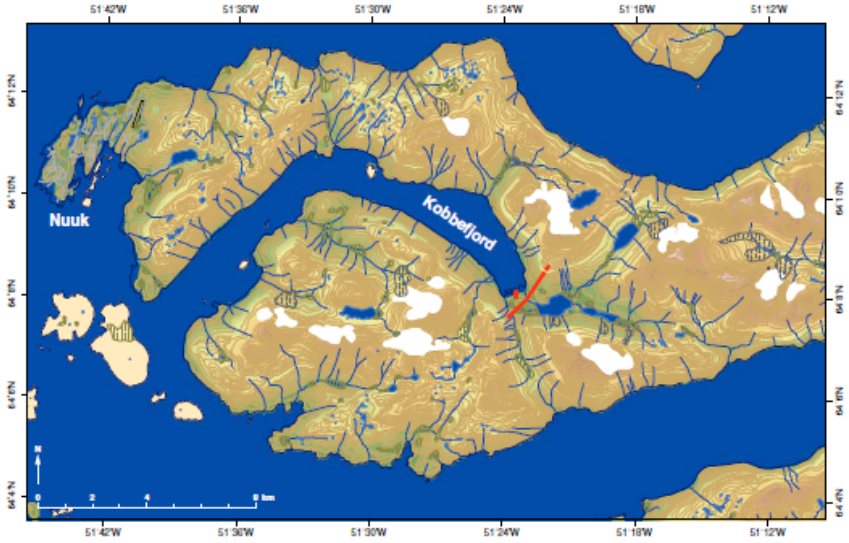
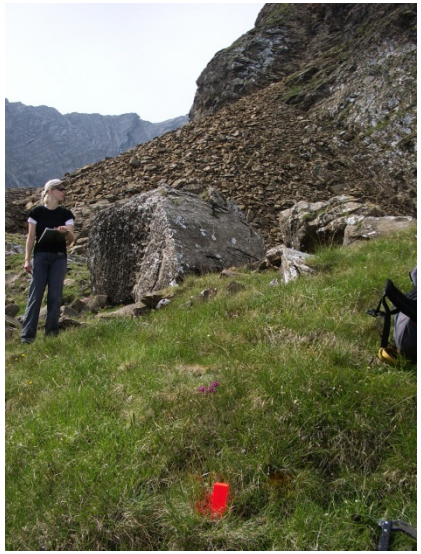
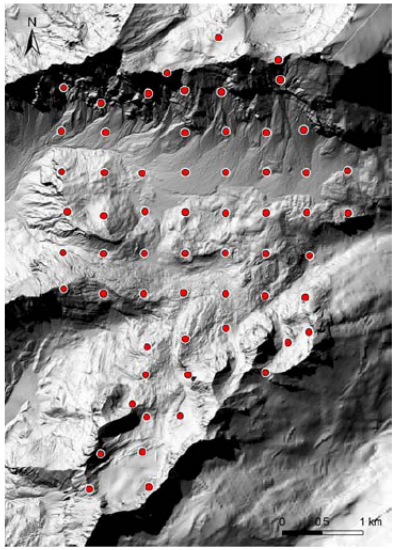
DESIGNING RELEVANT PREDICTORS FOR ARCTIC PLANTS USING



a) NERO, vegetation transect, Nuuk, GL





b) Design applied in the Swiss Alps

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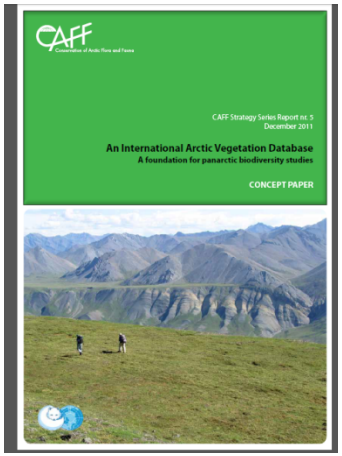
VEGETATION DATA

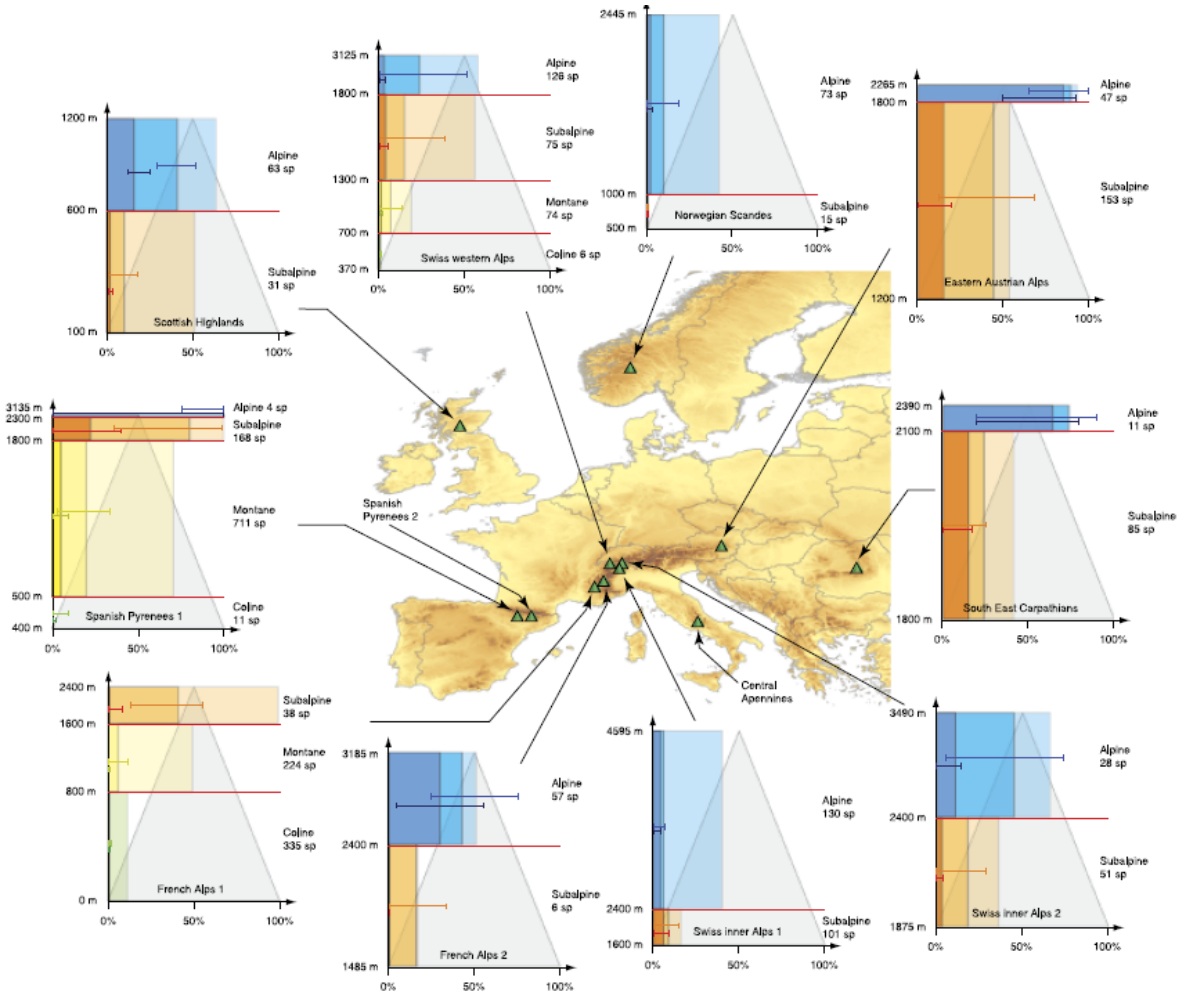
- Details in this workshop
- Daniels Data
- Bay
- IAVD collaborators?
- CBIONET collaborators?
- Others?



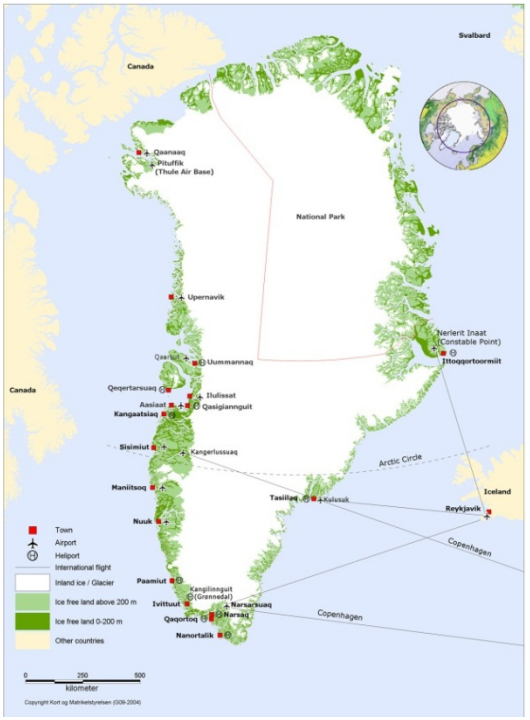
Global Change Biology

Global Change Biology (2011) 17, 2330–2341, doi: 10.1111/j.1365-2486.2010.02393.x

21st century climate change threatens mountain flora unequally across Europe



But what about Greenland?



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ARCTIC PLANT COMMUNITY MODELLING PHD PROJECT

- Lærke Stewart, Aarhus University
- (February 2012-January 2016) MS on the way:

- Funding: Greenland Climate Research Centre (500K), Greenland Ecosystem Monitoring (250K), NERI (250K) + AU (400K)
- Supervisors:

Mary S. Wisz (main)

Mads C. Forchhammer

Jens-Christian Svenning

- Key-collaborators: Bay, Schmidt, Guisan Group UNIL, Skip Walker-IAVD, Daniels, Miska Luoto and hopefully others

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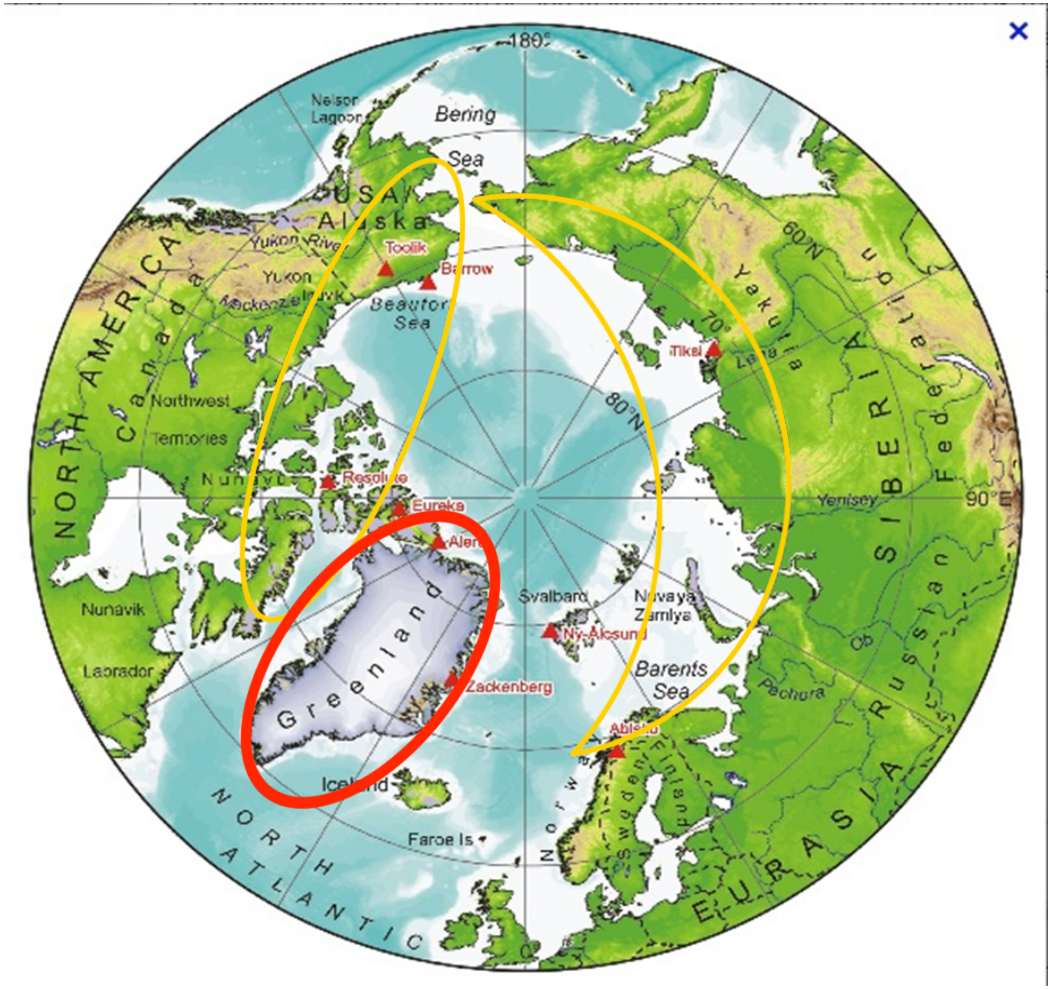
PHD PROJECT: AIMS PART 1

- Coordinate effort with Daniels, Walker, IAVD, etc
- Collate existing information: recent past + contemporary.
- Data sources: Daniëls, CAFF, GEM, GBIF, ITEX, Back to the Future etc.
  - Locations and functional traits
- Fieldwork and training



Picture: arctic.ac.uk, modified by Stewart

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PHD PROJECT: AIMS PART 2

Predicting contemporary distributions of plant species and assemblages in Greenland

› SDM methods
› Combining monitoring and biodiversity data
› New methods
› Herbivore distributions

PHD PROJECT: AIMS PART 3

- **How has glaciation and climate change shaped plant assemblages in Greenland for different species pools?**
- SDM based on contemporary data predicted to historical scenarios
- **Comparing historical, contemporary and future species assemblages in Greenland**
- Stability + resilience of species, functional groups (e.g. source pools, dispersal or reproductive strategies) & habitats
- Comparing future scenario modelling results with ITEX warming experiments

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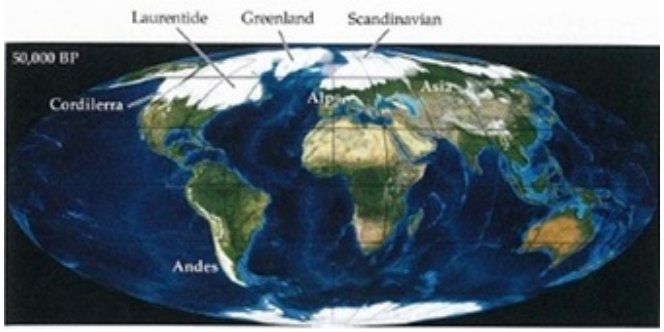
PHD PROJECT: AIMS PART 4

› **How has circumpolar glaciation history since LGM influenced plant assemblages?**



› Compare vegetation data to historical scenarios
› Which functional groups, dispersal strategies, etc predominate in a given region depending on velocity of climate change and glacial history?
› Multivariate stat analyses/SDM?

Picture: Lomolino et al. 2010

CONCLUSION

- The biggest challenge is preparing the vegetation data. These must be harvested in the most efficient way
- how we can we contribute to the IAVD? Discuss Day 3
- Flexible approach to project. Suggestions?
- Ecological and biogeographic questions are big but realistic progress can be made once the data are available