BETUMICS
Towards more efficient Arctic research using dominant *Betula* species, spectromics and genomics

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UEF // University of Eastern Finland

UNIVERSITY OF HELSINKI

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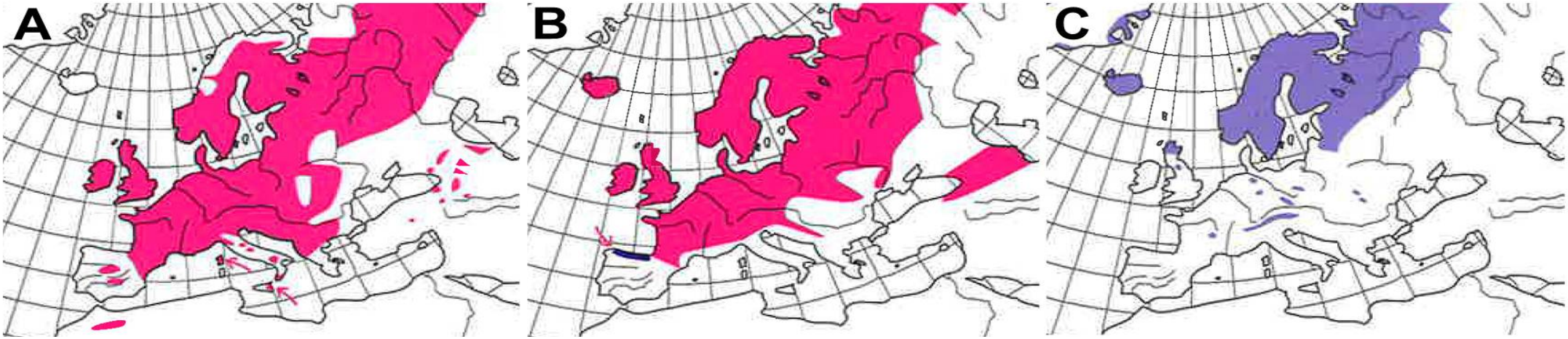
ACADEMY OF FINLAND

Teams

- **University of Eastern Finland (UEF, Joensuu)**
  - Prof Elina Oksanen, Dr Sarita Keski-Saari, Maya Deepak – field and laboratory experiments, spectral imaging
- **University of Helsinki**
  - Dr Juha Mikola, Dr Tarja Silfver – field experiments, ecology, soil
- **Natural Resources Institute Finland** (Luke, Vantaa)
  - Dr Kaisa Nieminen, Dr Matti Rousi – birch materials, genomics, field sites
- **National Research Council, CNR,** Florence, Italy
  - Dr Alberto Santini, Dr Luisa Ghelardini,– field studies: warming climate, marginal populations

Adaptation and acclimation of birch (*Betula* species) to warming climate



Distribution maps of A) *Betula pendula*, B) *B. pubescens* (including the northern sp. *czerepanovii*) and C) *B. nana* overlap. This enables their hybridization and eventual introgression. Modified from Ashburner K and McAllister HA, 2013 (*Kew Publishing, Royal Botanic Gardens, Kew, UK. 431 p.*)

Workpackages

- **WP1:** Field experiments with *B. pendula*, *B. pubescens*, *B. pubescens* subsp. *czerepanovii* and *B. nana* (existing and new common garden sites, Kevo experiment with warming)

- **WP2:** Complementary laboratory experiments (soil, photoperiod etc)

- **WP3:** *In situ* application of novel imaging techniques, i.e. spectromics, in field research, phenotyping and genetics

- **WP4**: Genetic studies

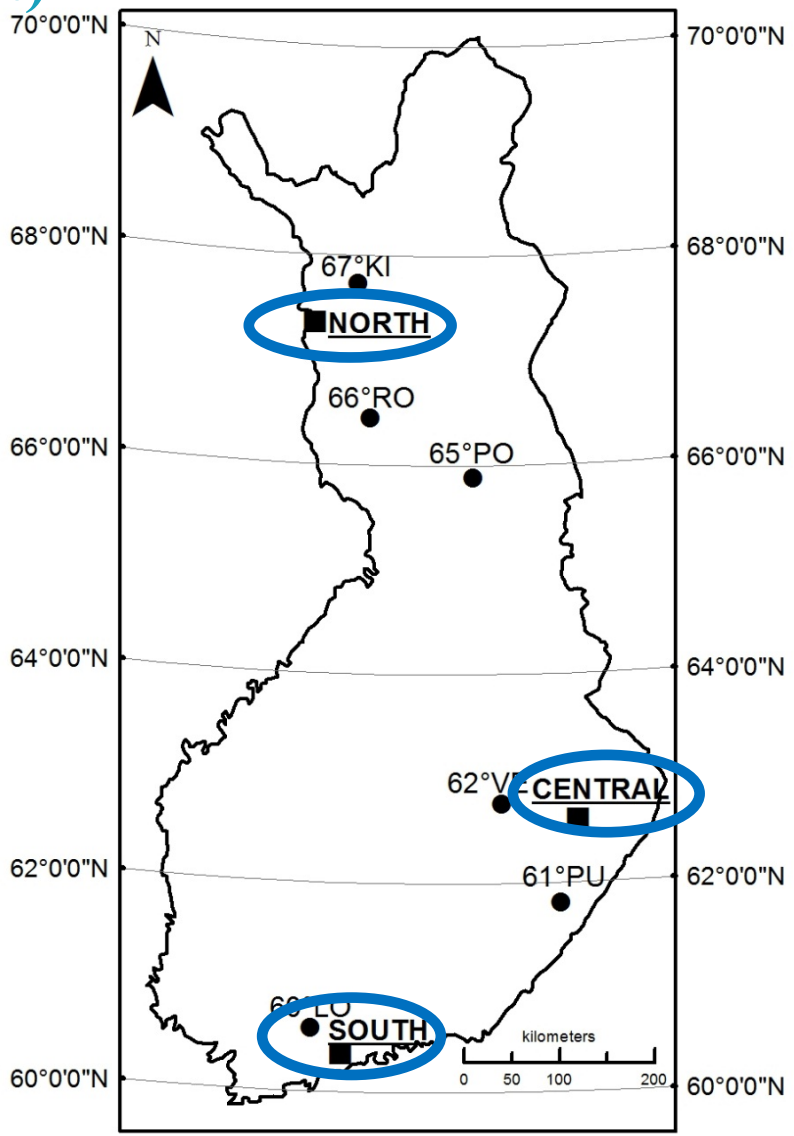
Progress 2015-present

- Collection of birch materials from natural populations (Finland, Italy)
- Soil sampling and analyses

Progress 2015-present

- Micropropagation

Harvesting the existing common garden sites with *Betula pendula* (2010-present)



3 common garden sites

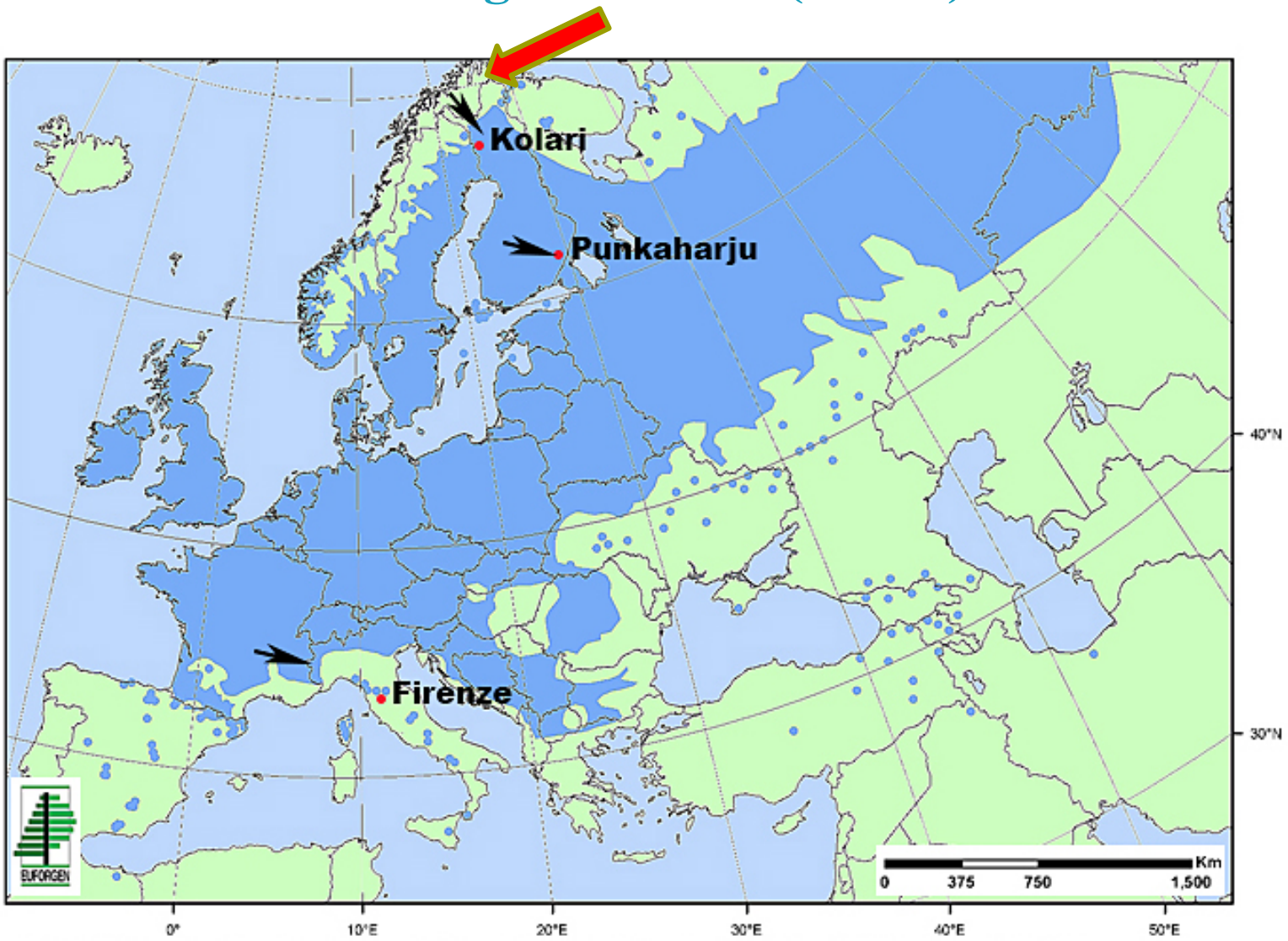
6 populations/5 genotypes > 260 trees/site = 780 trees total

Translocation study **simulating warming climate** using 'natural laboratory' and common gardens: 1°C drop/150 km polewards

Progress 2015-present

- Two laboratory experiments: Testing the impact of (1) soil and (2) photoperiod

Preparation of new common garden sites (2016-)

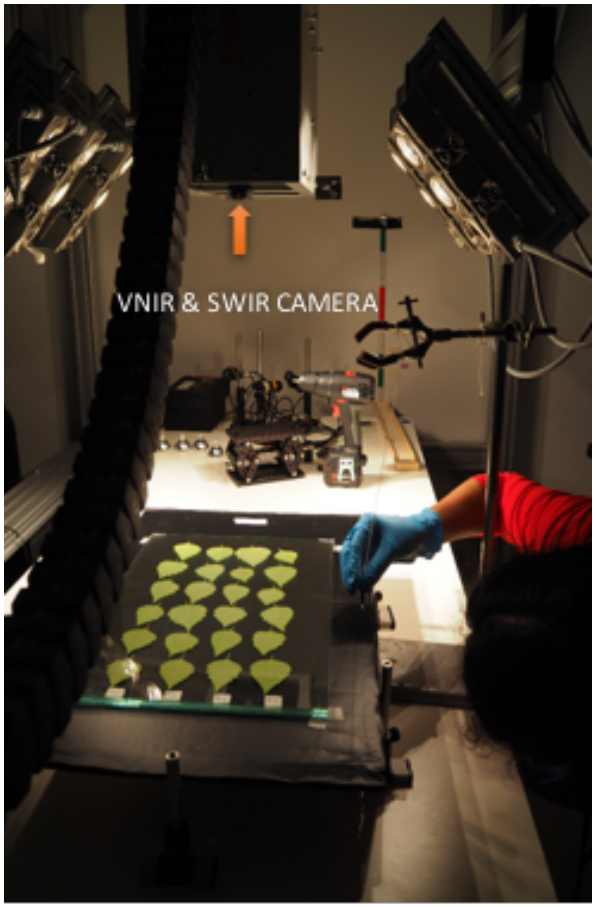


Poster by Mikola et al: Monitoring the effects of warming on a subarctic treeline ecosystem

Figure 1. The warming experiment will be established near the Kevo Subarctic Research Station, located in Utsjoki at the northernmost tip of Finland (69°45' N, 27°01' E) right next to the Kevo Strict Nature Reserve.

- A prototype for heating system - to be set up in Kevo in June 2016

Poster by Deepak et al: Leaf reflectance variation in silver birch tree using hyperspectral imaging



Spectromics laboratory
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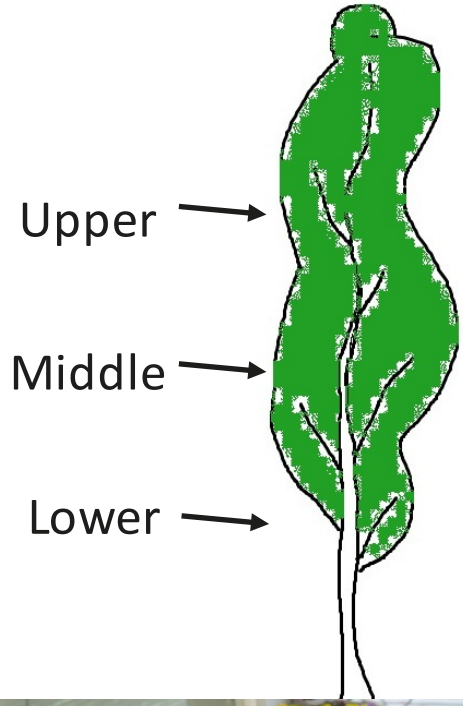
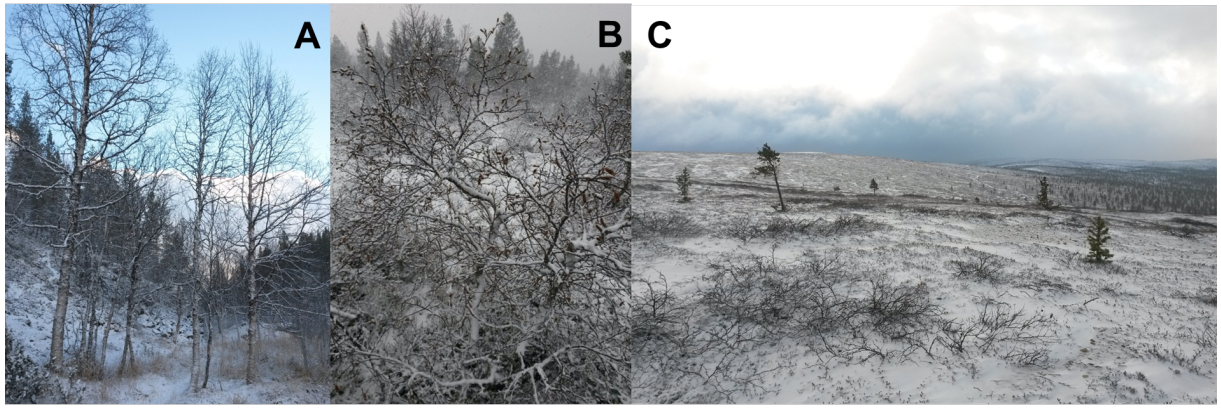
- How much there is variation in reflectance spectra within one birch tree and among the leaves?
- Connections to **chemical and structural composition** of the leaves
- Application to mapping the leaf traits, selecting leaf samples, environmental monitoring etc.



Poster by Nieminen et al. Genetics of adaptive arctic tree traits

- Genetic studies of several ecologically and economically important birch species – *B. pendula*, *B. pubescens*, B. *pubescens* subsp. *czerepanovii* and *B. nana* - ranging in distribution from temperate to boreal, sub-arctic and arctic areas.
- Genetic relationships of birch genotypes within and between populations, degree of hybridization and introgression (repeated backcrossing of an interspecific hybrid to its parent species) - basis of adaptive genetic variation?



High diversity of birch architectural forms:
A) *B. pubescens*, B) *B. pubescens* sp. *czerepanovii*) and C) *B. nana*: adaptive value to arctic environments.

Thank You!