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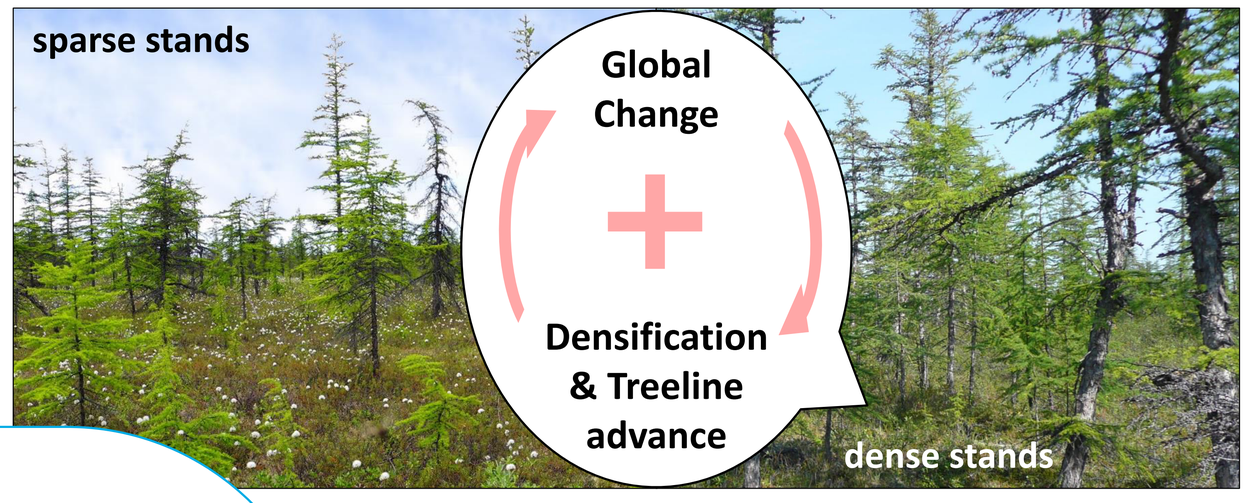
Running for PYRN Permafrost Researchers Young Network the PYRN Award

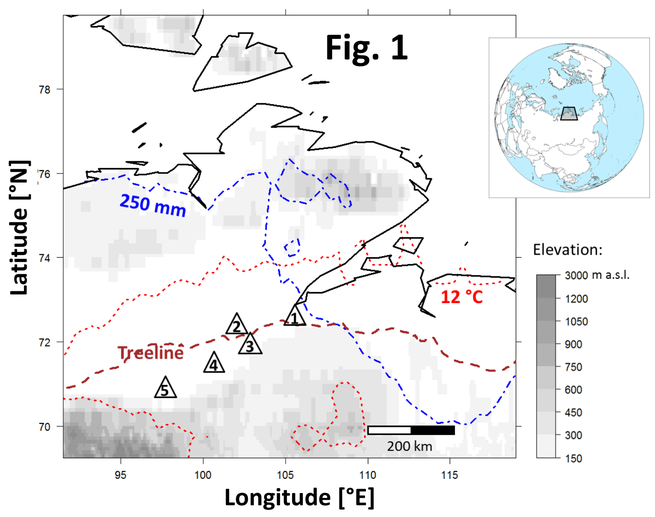
Time-lagged response of siberian treeline forests revealed by individual-based modelling

Why treeline research?

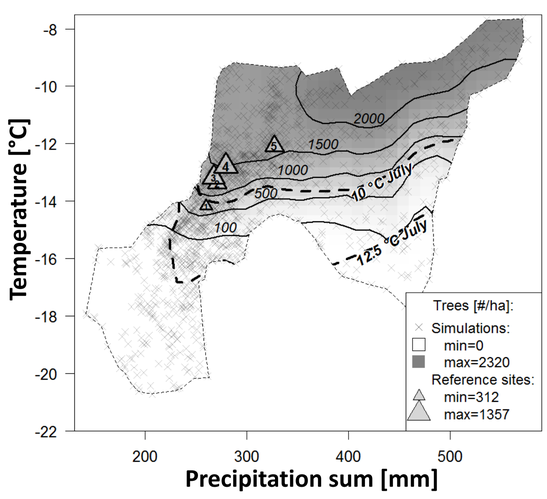
- **global change** forces arctic treelines towards dramatic changes
- warming leads to **densification** and to **northwards treeline advance** of tree stands
- triggered **albedo reduction increase local temperatures** which might **feedback globally**



Regional-scale simulations



- **simulating** tree stands with **modern climate** at the Taymyr Peninsula (64–80° N, 92–119° E)



- a simulated **treeline area** with open stands **formed between 10-12.5 °C July isotherm**

Questions

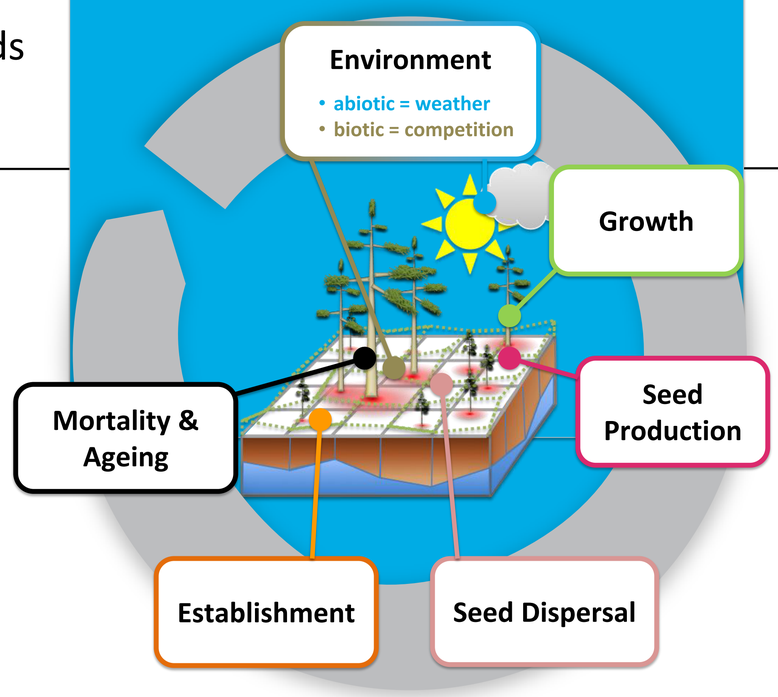
However, it remains **unclear**:

a) how fast these changes have and will occur (**time-lag effects**)?

b) which are the spatial patterns of treeline recruitment and spread (**migration patterns**)?

Conclusions

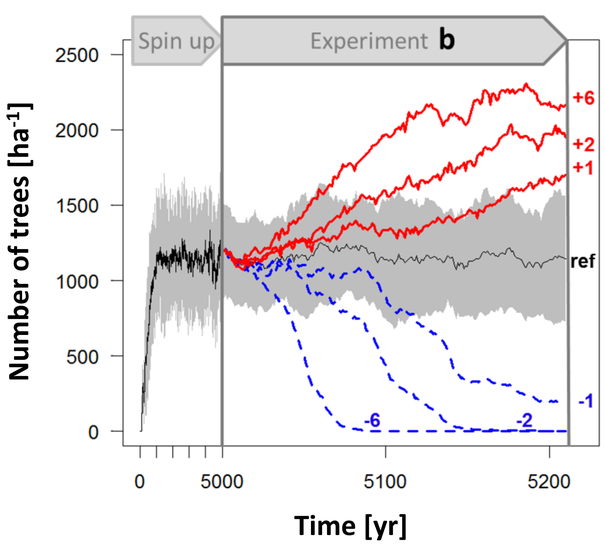
- the newly-developed model **LAVESI captures reliably the dynamics of the** Siberian latitudinal **treeline**
- after a first establishment **open tree stands will rapidly densify** and **advance into former tundra areas with a time-lag of decades**



A simulated year in LAVESI

Treeline responses to temperature change

- **simulations** to test effect of up to 6 °C, **warmer and cooler climates** on treeline populations



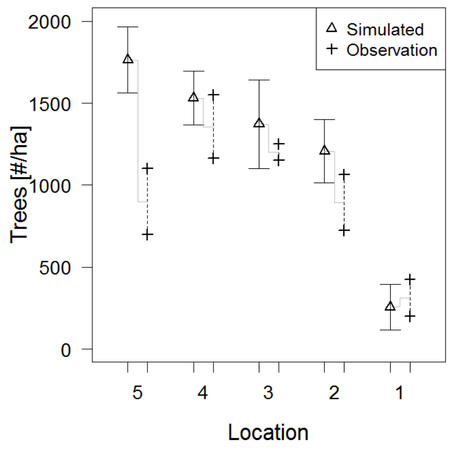
- warming caused populations to **densify but with a time-lag of decades**
- cooling triggers **die-back of populations** stronger than equal warming

Building the model - LAVESI -

LArix **VE**getation **SI**mulator

- we **parameterized** the full life-cycle of larches to observed patterns at visited tree stands in northern Siberia (Fig. 1)
  - processes depend on **temperature, precipitation and competition**
  - seed **dispersal is spatially explicit**
  - **all individuals** from seeds to mature trees are **handled individually**

- **validation** to field observations



- simulated populations **generally match**, but **overestimated in warm areas**

References:

Stefan Kruse, Mareike Wieczorek, Florian Jeltsch, Ulrike Herzschuh: **Treeline dynamics in Siberia under changing climates as inferred from an individual-based model for *Larix*.** In resubmission (June 2016), *Ecological Modelling*

Fig. 1: temperature data CRU TS 3.22 (Harris, Jones, Osborn, & Lister, 2014); northern tree limit CAVM (Walker *et al.*, 2005); elevation ETOPO-5 (National Geophysical Data Center, 1988) – see full references in Kruse *et al.* (in resubmission)

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