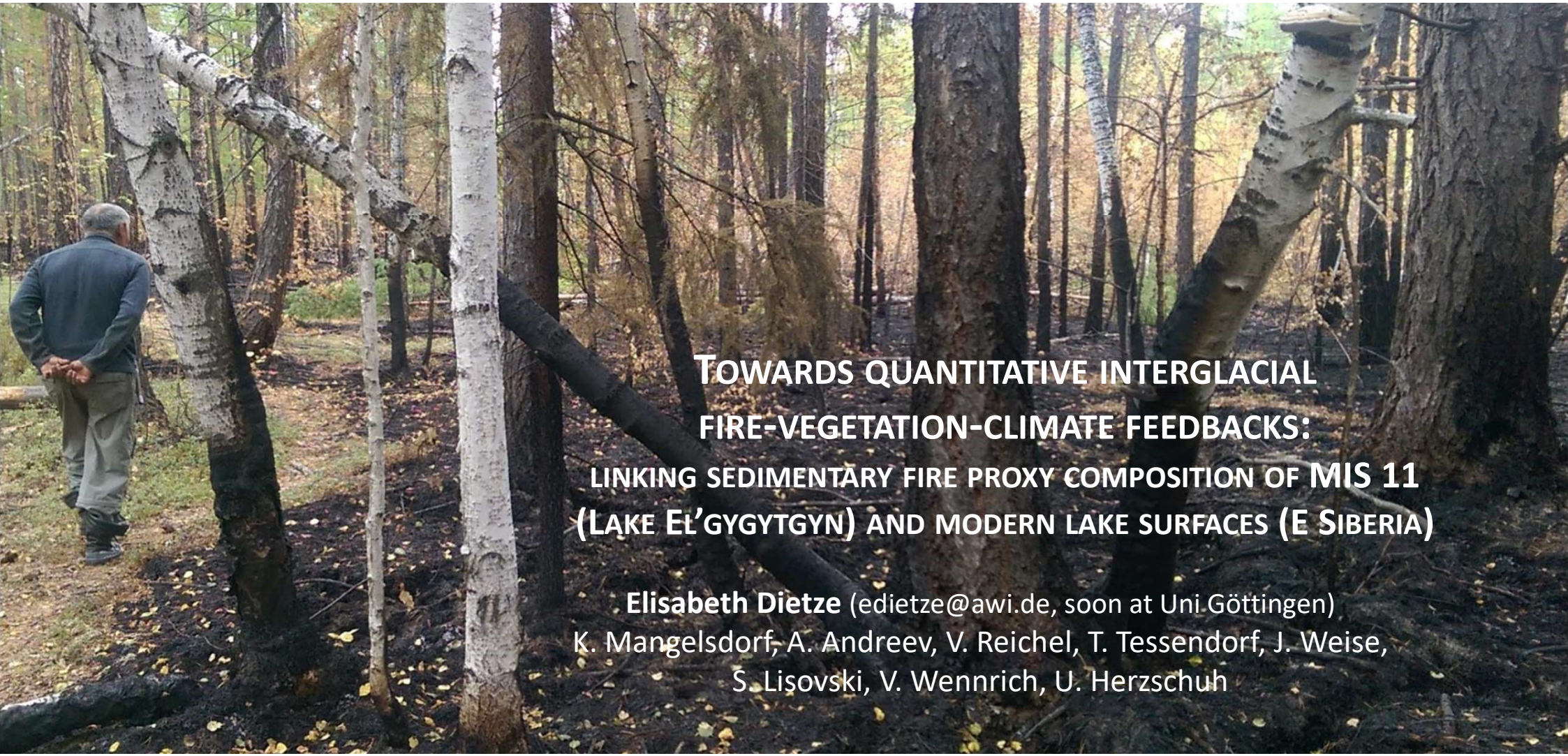


Towards quantitative interglacial fire-vegetation-climate feedbacks:

linking sedimentary fire proxy composition of MIS 11 (Lake El'gygytgyn) and modern lake surfaces (E Siberia)

Elisabeth Dietze (edietze@awi.de, soon at Uni Göttingen)
K. Mangelsdorf, A. Andreev, V. Reichel, T. Tessendorf, J. Weise, S. Lisovski, V. Wennrich, U. Herzschuh

AWI

GFZ Helmholtz-Zentrum Potsdam

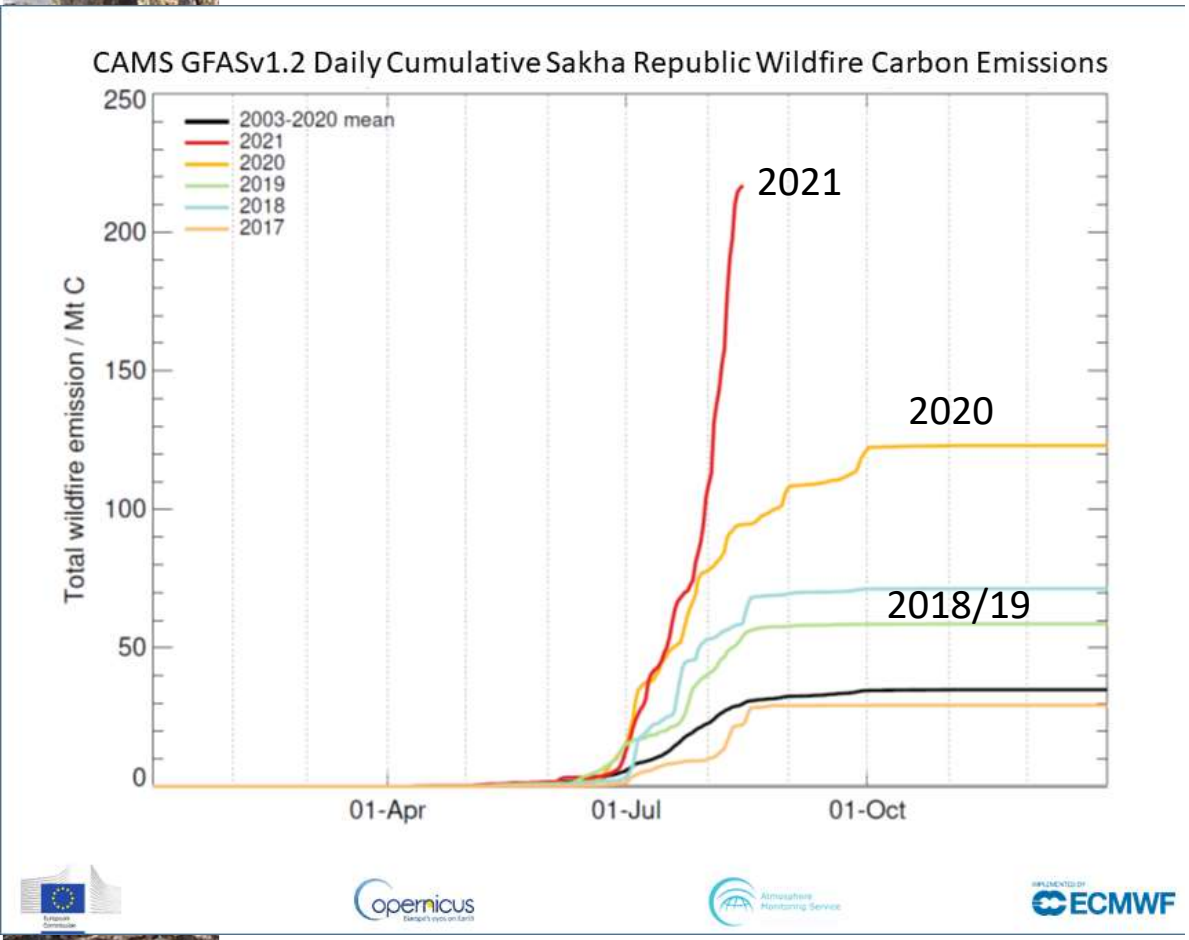
DFG Deutsche Forschungsgemeinschaft

icdp International Continental Scientific Drilling Program

International Paleofire Network

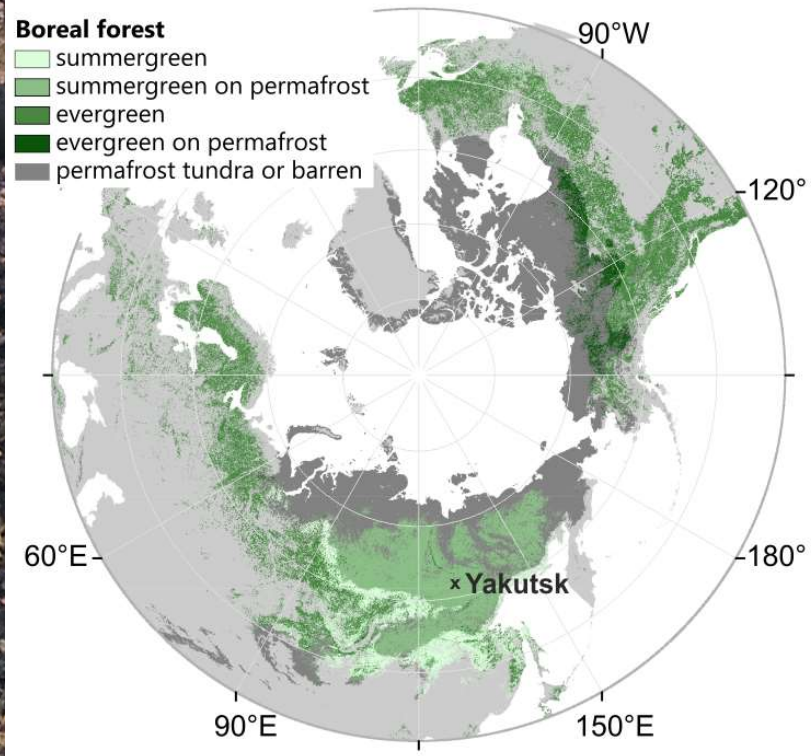
Why studying eastern Siberian fire regimes?

Current boreal and Arctic wildfires are unprecedented on historical timescales

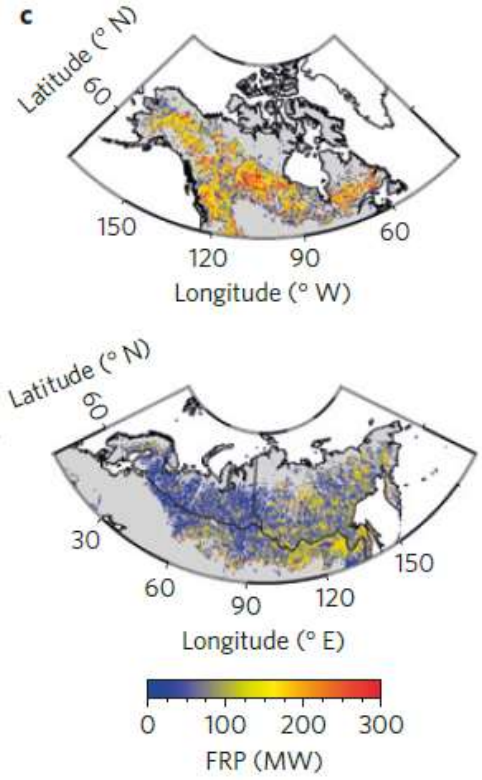


Modern and past boreal and Arctic fire regimes and permafrost extent

Hypothesis: **Surface fires in E-Siberian forest preserve vegetation and permafrost state.**



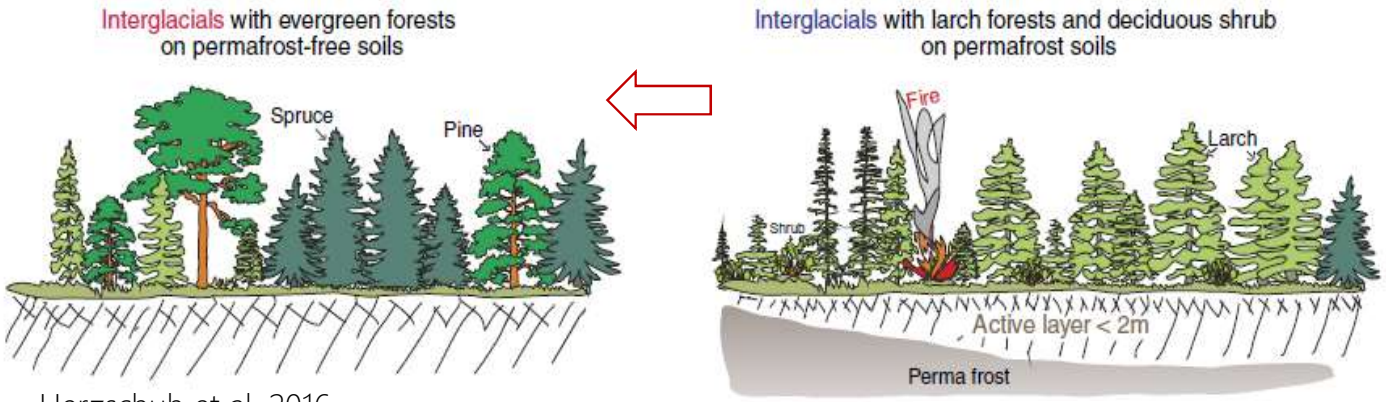
Photos: S. Kruse, E. Dietze, 2018/19



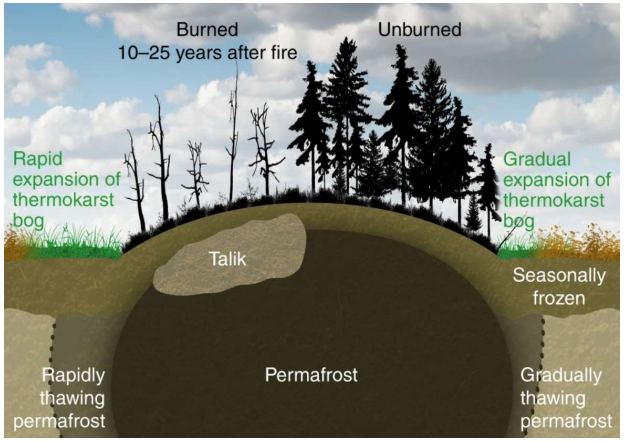
Rogers et al. 2015

Modern and past boreal and Arctic fire regimes and permafrost extent

Hypothesis: **Surface fires in E-Siberian forest preserve vegetation and permafrost state**



Herzschuh et al. 2016



Gibson et al., 2018

Will the currently intensifying fire regimes lead to biome shifts and permafrost thaw?

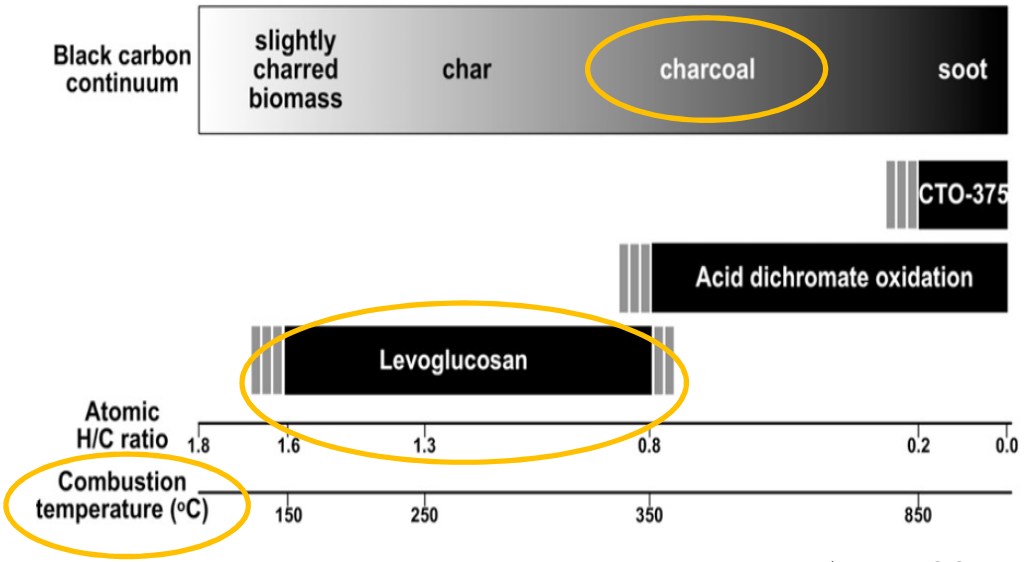
→ Learn from paleofire regime reconstructions

Sediment-based reconstruction of fire regimes

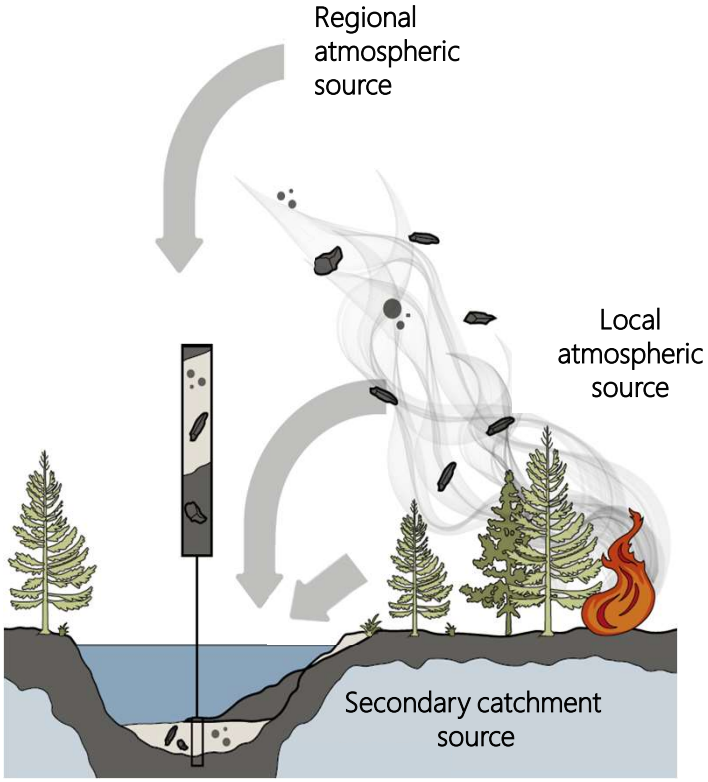
Intensity-specific fire proxies

- sedimentary charcoal: medium-to-high-intensity fires
- monosaccharide anhydrides (MA): low-intensity fires

How to quantify past fire regime changes?
→ a source area problem (among others)

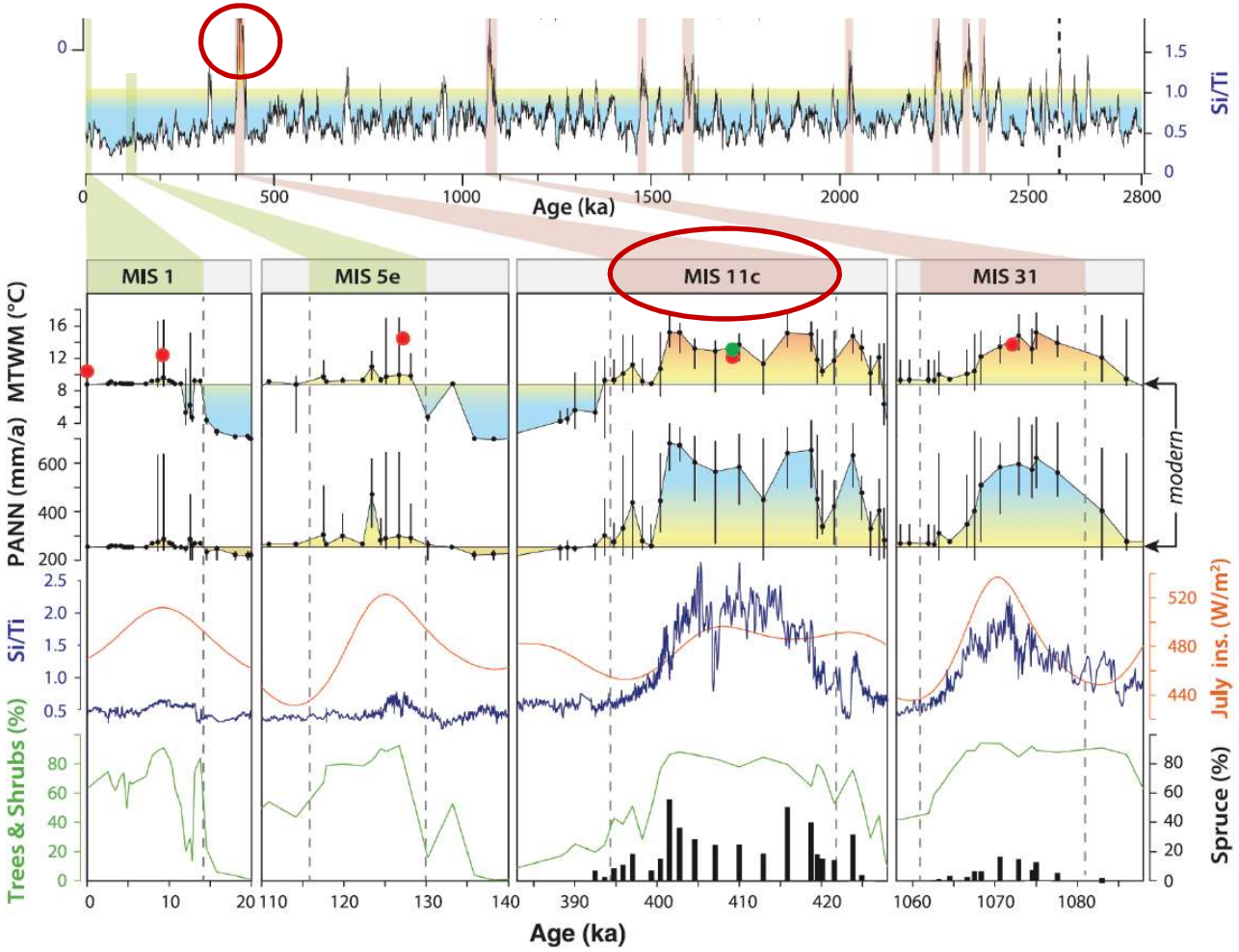


Kuo et al., 2008, OG



Interglacial Siberian fire regimes reconstructed from El'gygytgyn lake sediments

Marine isotope stage 11 = „superinterglacial"



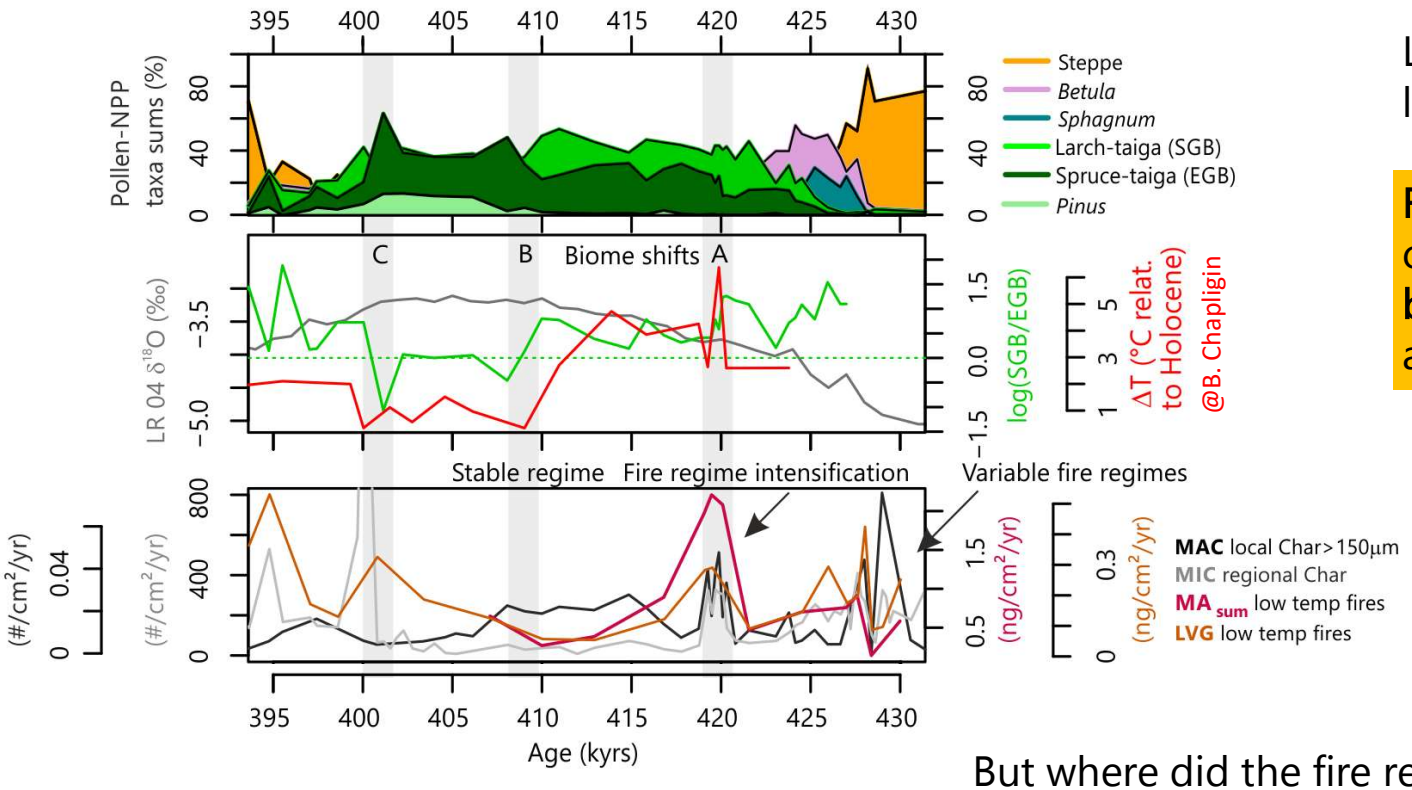
Low-temp. fire markers & pollen suggest

stable links between **surface fires** and **summergreen boreal forest** – even on **millennial-orbital** scales.

Dietze et al., 2020, ClimPast

Melles et al. 2012

MIS 11 fire regimes reconstructed from El'gygytgyn sediments



Preliminary data!

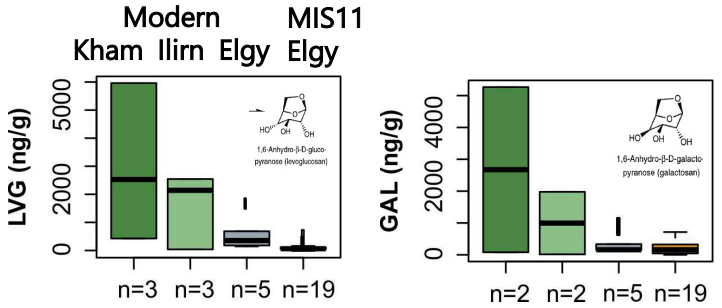
Lesson for current and future land management:

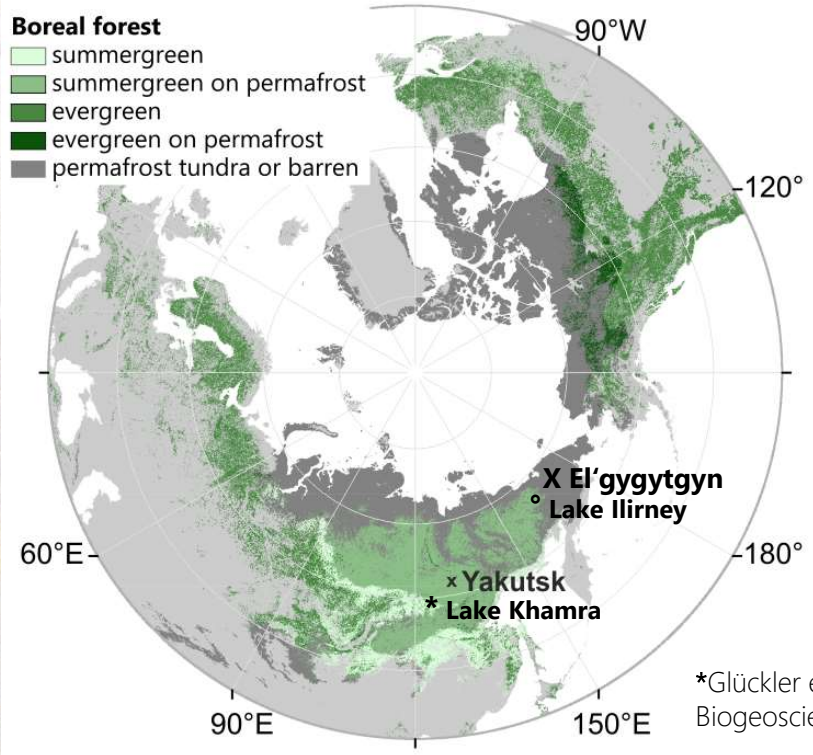
Fire regime intensification can lead to long-term **biome compositional changes** and **permafrost loss!**

But where did the fire regime change happen?
At the lake or far away?

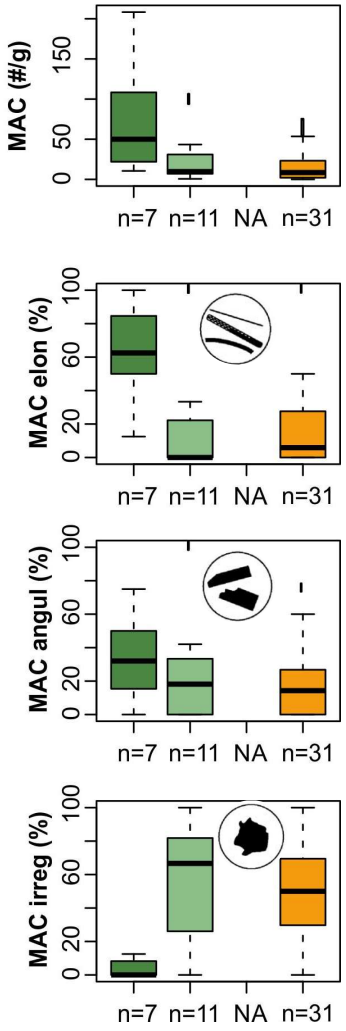
Understanding fire proxies from source to sink...

Understanding fire proxies: Modern vs. MIS 11 lake sediments



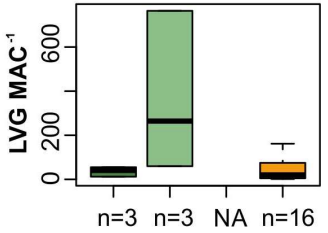


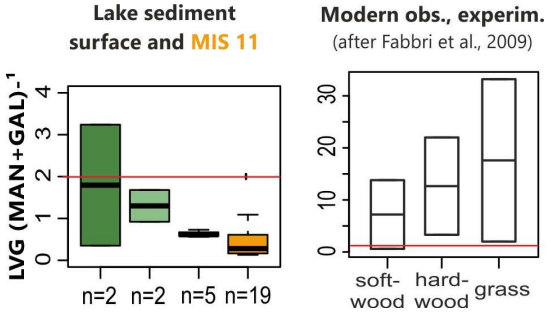
*Glückler et al. 2021, Biogeosciences



Fire proxy **concentrations** depend on sediment composition & sedimentation rates.

Fire proxy **compositions** (ratios) are biome-specific.

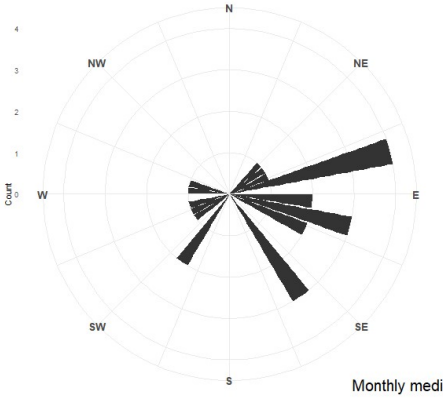


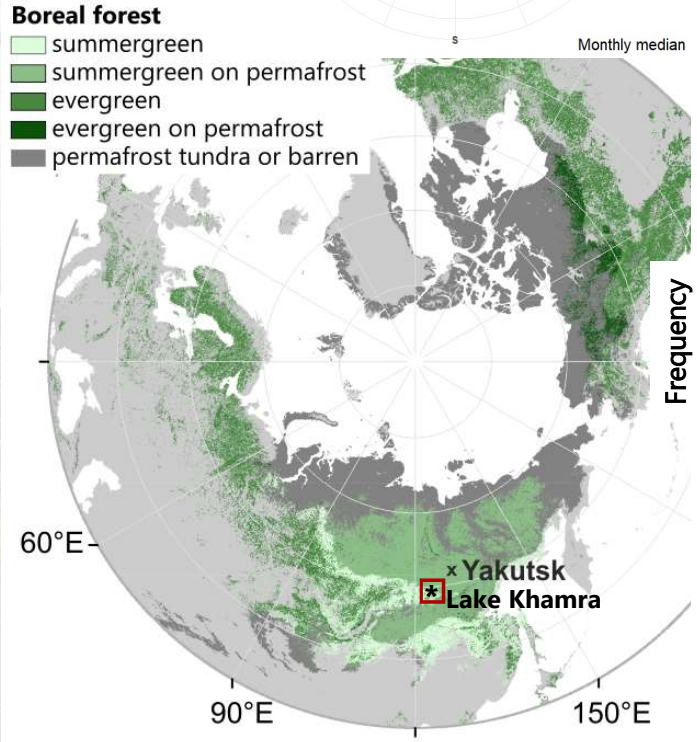


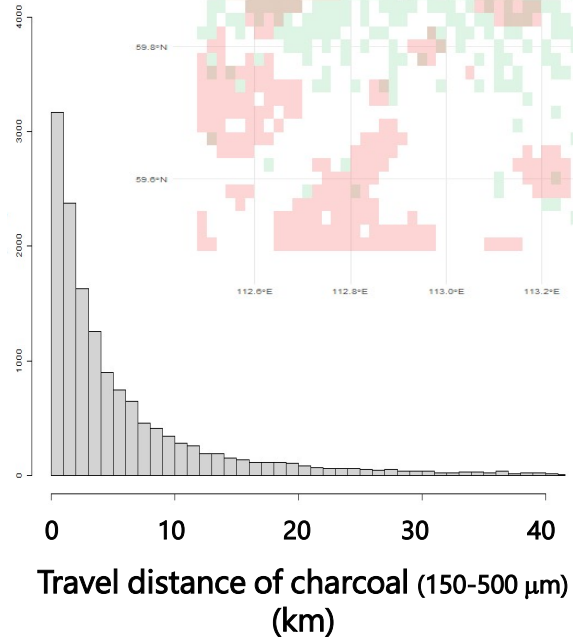
Understanding fire proxy pathways: Simulating macrocharcoal transport

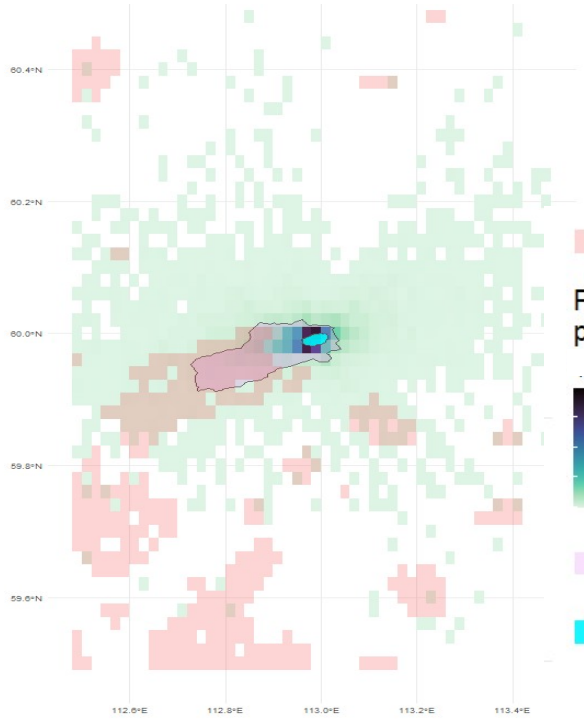
@Vivien Reichel using model of Vachula & Richter (2018)

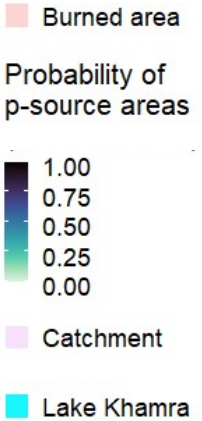
ERA5 wind field



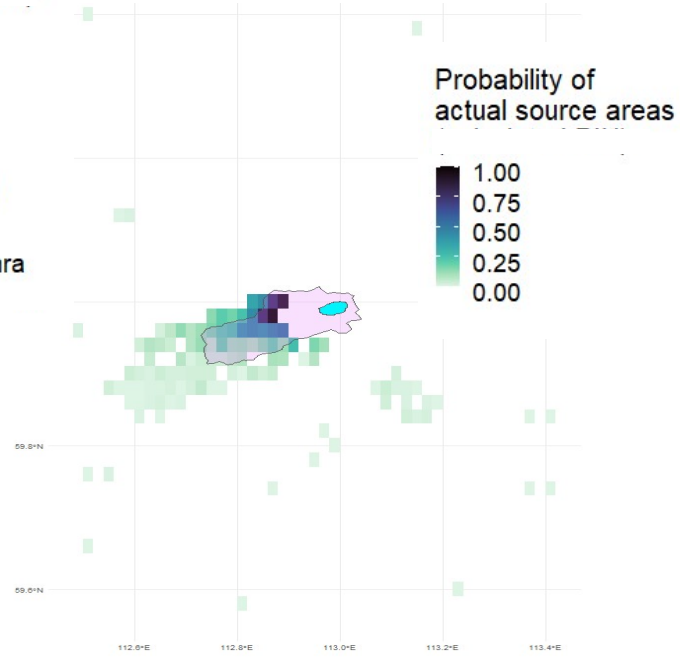








Fire proxy source area is not necessarily circular, several km away and wind-field & burn-pattern dependent.



Will the currently intensifying fire regimes lead to biome shifts and permafrost thaw?

Likely. MIS 11 showed it for some biome shifts, but **quantifying the necessary change** requires **understanding the fire proxy record** (composition) and solving the **source area** problem.

For questions and exchange,
please approach me during the conference or via
edietze@awi.de

OR join my new group as a POSTDOC (3+3 yrs):
elisabeth.dietze@uni-goettingen.de
https://www.uni-goettingen.de/de/644546.html?details=1140