EXTREME SUMMER PRECIPITATION INCREASES THAWING DEPTH OF PERMAFROST OVER MULTIPLE YEARS

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Introduction

Apart from an amplified warming trend, precipitation is projected to increase in Arctic regions throughout this century (fig. 1). Increased rainfall has the potential to conduct heat to the soil, potentially accelerating permafrost thaw.

We studied the effect of extreme precipitation during the summer months on permafrost in the Siberian lowland tundra.

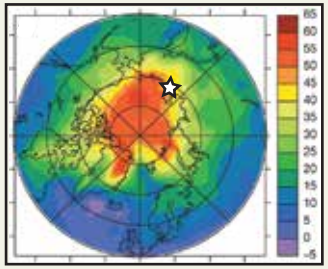

Fig 1) %-increase in annual Arctic precipitation 2015 - 2100. Source: Bintanja & Selten, 2014, Nature.
✶ Star indicates study site.

Methods

✶ An irrigation experiment was carried out during the summer of 2018 at the Chokurdakh Scientific Tundra Station (fig. 1).

✶ 10 Betula nana dominated tundra plots received **100mm additional precipitation** using a sprinkler & motorpump setup, 10 control plots received only ambient precipitation.

✶ In each plot, abiotic conditions were monitored throughout the summers of 2018 and 2019 (fig. 2).

✶ Differences among treatments were analyzed using **linear mixed effects models** with the lme4 package in R.

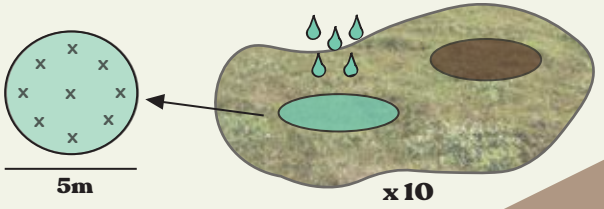

Fig 2) Experimental Design. Ten plots pairs were established in which Active Layer Thickness, Water Table and Soil Moisture were measured in nine points per plot, three times per summer

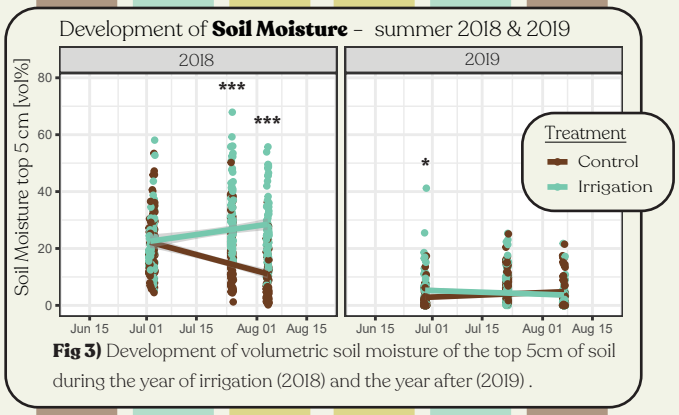

Fig 3) Development of volumetric soil moisture of the top 5cm of soil during the year of irrigation (2018) and the year after (2019) .

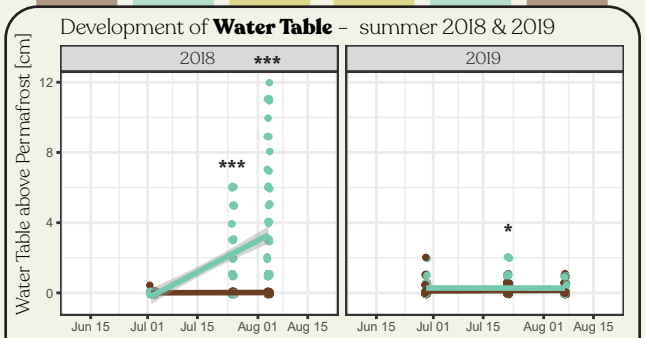

Fig 4) Development of the height of standing water above permafrost during the year of irrigation (2018) and the year after (2019).

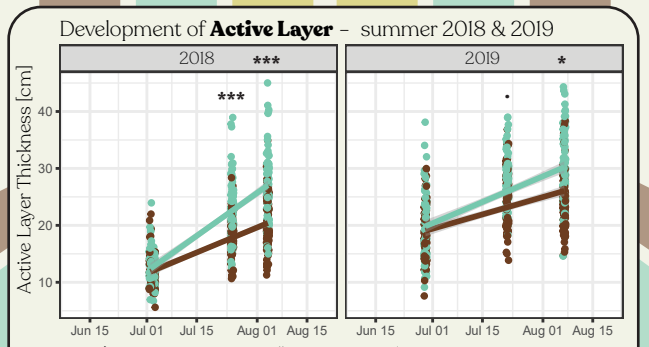

Fig 5) Development of the "Active Layer" (layer of unrozen soil above permafrost) during the year of irrgation (2018) and the year after (2019).

Results & Discussion

✶ Our results demonstrate that extreme precipitation in summer leads to accumulation of standing water on top of the permafrost and significant increases in soil moisture and thawing depth (fig. 3-5).

✶ Thawing rate [mm/day] was still increased significantly in the year after treatment: by **69% in 2018**, and by **44% in 2019** compared to the control plots (fig. 5). This indicates that extreme precipitation during one summer may affect thawing rates over multiple years.

✶ We will continue monitoring this experiment, to determine whether this amplified thaw triggers **thermokarst** pocesses and changes in **vegetation** composition.

Conclusion

Summer precipitation may be an imporant control on the annual thawing depth of permafrost. The magnitude of this effect should be studied further, so that it can be included in climate models.

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