

Motivation:

An understanding of spatial and temporal variation of soil moisture is essential for studying other hydrological, biological or chemical soil processes, such as water movement, microbial activity and biogeochemical cycling. However, the vegetation cover influencing the soil water regime is undergoing a gradual changes.

Research objectives:

- 1) To quantify the differences between the two most common tree species (spruce and beech forest) in terms of water fluxes
- 2) To analyze the effect of the spruce forest die off caused by bark beetle outbreak

Beech vs spruce forest



- Soil water regime measured by tensiometers
- Recorded 3 x week in a growing season at depths of 15, 30, 45, 60 and 90 cm
- SWBM-GA model for the soil water balance
- Period of interest 2000-2021
- Three sites covered by: beech (BEE), spruce (SPR), and grass (GRA)



METHODS

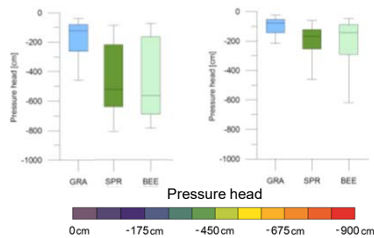
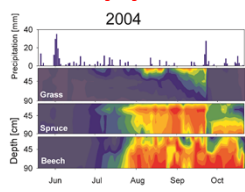
Spruce forest - effect of bark beetle outbreak



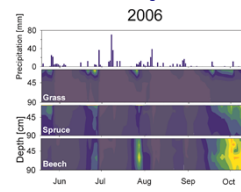
- Bark beetle outbreak in 2021
- 2 plots each with three TERROS 11 probes in two depths (20 & 40 cm)
- LAI - LiCor 2000
- Soil water retention curves
- Measurement period 05/2022-02/2023



Dry year



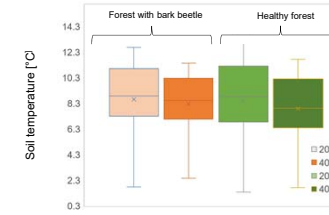
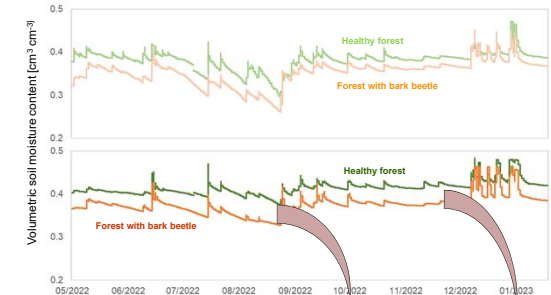
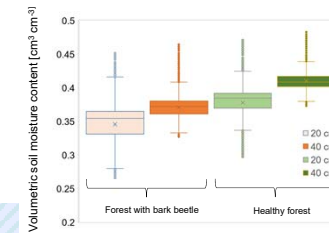
Wet year



- The beech site was attaining lowest pressure heads (drier soil) in dry years.
- In drier years, the beech forest extracted water more efficiently from higher depths. In the topsoil (depth of 0–37 cm), the median amount of water was slightly lower in the spruce forest.
- The soil was drier in the spruce forest in wet seasons.
- In wet seasons, the pressure heads in GRA/SPR/BEE sites can be characterised approximately by a similar uniform vertical distribution.

RESULTS

	SPRUCE	BEECH	SPRUCE	BEECH	SPRUCE	BEECH
	2001-2021		Dry year 2015		Wet year 2002	
Precipitation	851	477	1333			
Soil ET	263	355	229	311	283	366
Interception	243	201	155	137	321	253
AET	505	556	384	448	604	619
Drainage	357	307	149	123	673	648



- Very small differences in volumetric water content
- Summer -> up to 6 % VWC (healthy forest wetter)
- Winter -> up to 2 & 6 % VWC (healthy forest wetter)
- Differences in soil temperature are also small
- Summer -> up to 0.5 °C (healthy forest warmer)
- Winter -> up to 1.5 °C (healthy forest cooler)

- The differences in soil ET between beech and spruce trees gradually rose towards the mid-summer and then declined.
- In every single year the beech site had the highest rate of actual evapotranspiration and spruce site higher drainage.
- The discrepancies between spruce and beech forest were probably caused by the more economical water consumption of coniferous trees in dry periods compared to that of broad-leaves trees, different vertical root distribution, and different soil properties.

CONCLUSIONS

- No significant differences in soil water content and soil temperature within the first year after the bark beetle outbreak.
- The observed differences between sites are within the sensor accuracy level so far.