Project *brief*

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Temperature damping effects of forests at the Intensive Forest Monitoring Station Britz

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- **Forest stands damp temperature on heat days**
- **Species-specific differences observed between air, surface, and subsurface temperature**
- **Beech stands have the greatest damping effect, especially in surface temperatures on hot days**

Background and aims

As climate change progresses, the importance of microclimate in forests increase. With more intense and frequent weather extremes, forest ecosystems are exposed to significant stressors. However, little is known on the microclimatic properties of individual stand characteristics (e.g., tree species), yet, they play a major role in the effects higher temperature will have. The interrelationship between forest properties, which can be influenced by management decisions, and their effects on microclimate remain poorly understood, despite a tradition of research in the field of forest meteorology and climatology for over 100 years.

Figure 1: Photos of forest stands at IFSM Britz; left: beech and right: pine (Source: Natkhin).

Methods

In this project brief we present the microclimatic effects of the tree species European beech (*Fagus sylvatica*) and Scots pine (*Pinus sylvestris*) (Fig. 1) at stand level as well as the differences to an open area (grassland). In addition to the differences between the stands, we compare differences between different measuring heights. We evaluate weather time series at the intensive forest monitoring station Britz (IFSM Britz) near Eberswalde for the years 2018 to 2022. The analysis is based on hourly temperature timeseries at three measuring heights (air, earth surface, and soil temperature, Fig. 2).

Differences between the locations in terms of microclimatically relevant parameters become apparent, especially under extreme conditions. Therefore, heat days are considered here. According to the definition of the German Weather Service, a heat day is a day on which the maximum air temperature at a height of 2 m is greater than or equal to 30 °C (DWD, 2023). The absolute temperatures are here given in degrees Celsius (°C), temperature differences in the SI unit Kelvin (K).

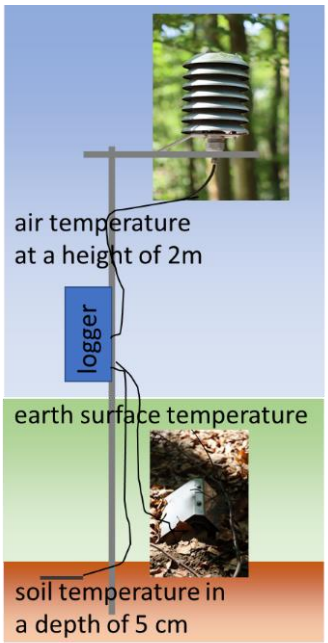
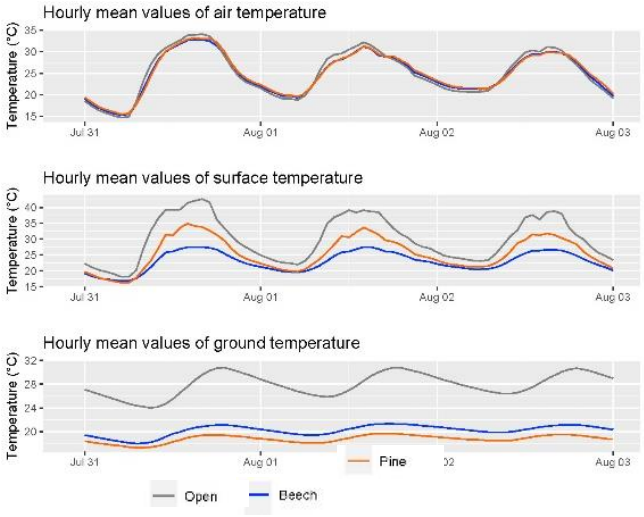


Figure 2: Schematic figure of the temperature sensors, protected from direct sunlight and their measuring height.

Results

Examples of mid-summer air temperature curves (Fig. 3) show amplitudes between day and night of up to 15 K. These amplitudes are similar for all stands. At air temperatures above 30° C in the open area (Fig. 4), the temperature is 0.5 K lower in the pine stand and 1 K lower in the beech stand. However, the scattering is very large (see curves in Fig. 4a).

Figure 3: Daily courses of hourly mean values of air, surface, and ground temperature for consecutive heat days (31.07. - 02.08.2018).

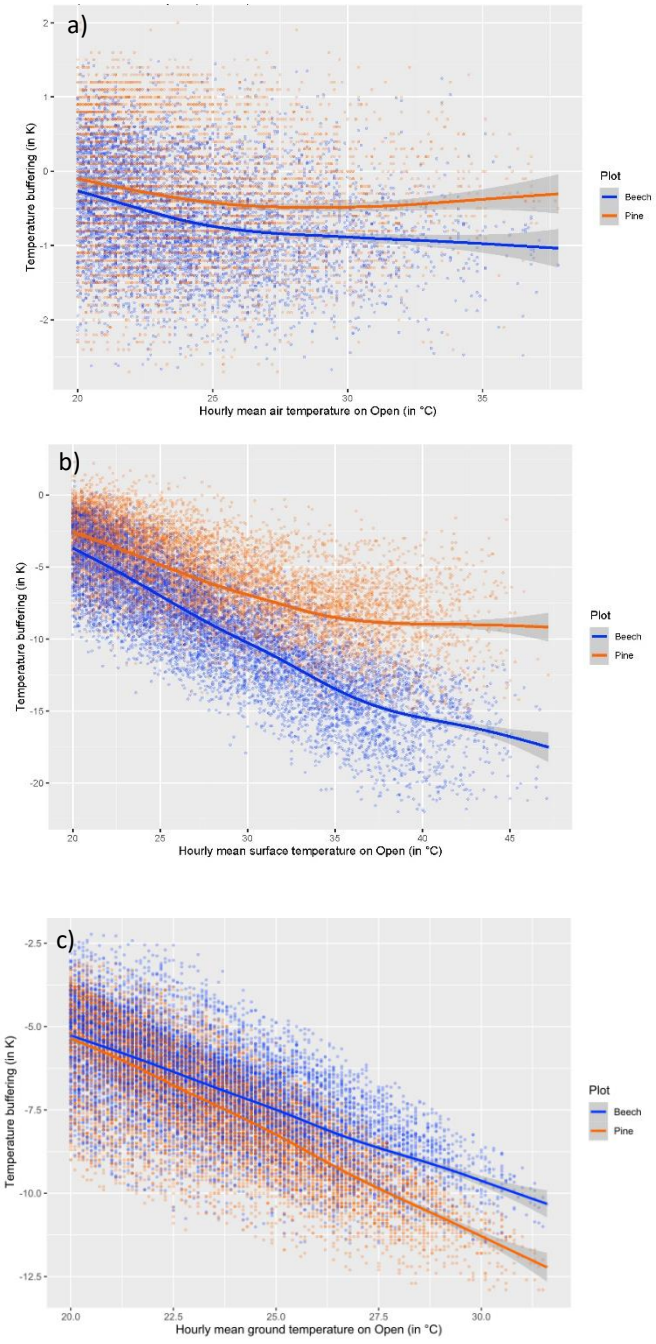


The surface temperature also shows pronounced diurnal fluctuations. The daily maximum values are highest in open areas. The temperature is lowest in the pine stand. The surface temperature is buffered most strongly in the beech stand. Fig. 4b shows clearly that the temperature differences increase as the open area temperature increases. With an air temperature of more than 30 °C in the open area, it is on average 7 K colder in the pine stand and 13 K colder in the beech stand. The well-closed canopy of beech trees allows little radiation to reach the ground, leading to the greatest temperature buffering.

Soil temperatures have the smallest diurnal fluctuations (Fig. 3). The differences between the pine and beech stands are small. During the researched period, the differences to the open area soil, which is always notably warmer, are 9 K in the pine soil and 7 K in the beech soil when air temperatures in the open area are above 30 °C (Fig. 4c). In contrast to the soil surface temperature, the pine floor is even cooler than the beech floor, with little variation. This is likely due to the ground vegetation in the pine stand. While no ground vegetation can develop under the beech tree due to the lack of light, we have mosses and grasses in the pine stand, leading to evaporation and a cooling effect.

In summary, we see differences in temperature measurements at the intensive forest monitoring station Britz are actually due to the stands, as soil properties and the macroclimate are the same. However, the proximity of the stands has the disadvantage that the areas are so small that they might influence each other through convective air exchange.

Figure 4: Regression curves with confidence intervals and data points for air temperature buffering of beech and pine (in K) as a function of hourly air (a), surface (b), and soil (c) temperature means on open area (in °C) upwards of 20 °C. Confidence level = 95 %.



Further Information

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Duration

Bachelor Thesis within the scope of a long-term study since 1972

Projekt-ID

2349

Publication

Thater Niklas (2023): Stand-level microclimatic effects of *Fagus sylvatica* and *Pinus sylvestris* in relation to open land between 2018 and 2022 at the Ecological Research Station in Eberswalde Britz. Bachelor Thesis, HNE Eberswalde.

Reference

DWD 2023, Online Wetter- und Klimalexikon, https://www.dwd.de/DE/service/lexikon/Functions/glossar.html?lv3=101162&lv2=101094

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