

Exchange processes in mountainous Regions (EGER)

Measuring of characteristic atmospheric quantities at a clear-cutting with a horizontal mobile measuring system



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Introduction

In future forest ecosystems, the heterogeneity will increase due to winds and pests with significant influences on the climate system. It must be assumed that these heterogeneities increase the loss of trace gases. To achieve more information about horizontal gradients in this heterogeneous forest ecosystems, we built a horizontal mobile measuring system (HMMS). During the third intensive observation period (IOP-3) of the EGER (Exchange processes in mountainous Regions) project in June/July 2011, the HMMS was installed vertically to a forest edge near the FLUXNET site Waldstein-Weidenbrunnen (DE-Bay), located in a low mountain range in the north east of Bavaria, Germany, the Fichtelgebirge Mountains (Figure 1). The path of the HMMS leads 75 m through a dense spruce forest and 75 m over a big clear-cutting, caused by hurricane "Kyrill" in the year 2007 (Figure 2).

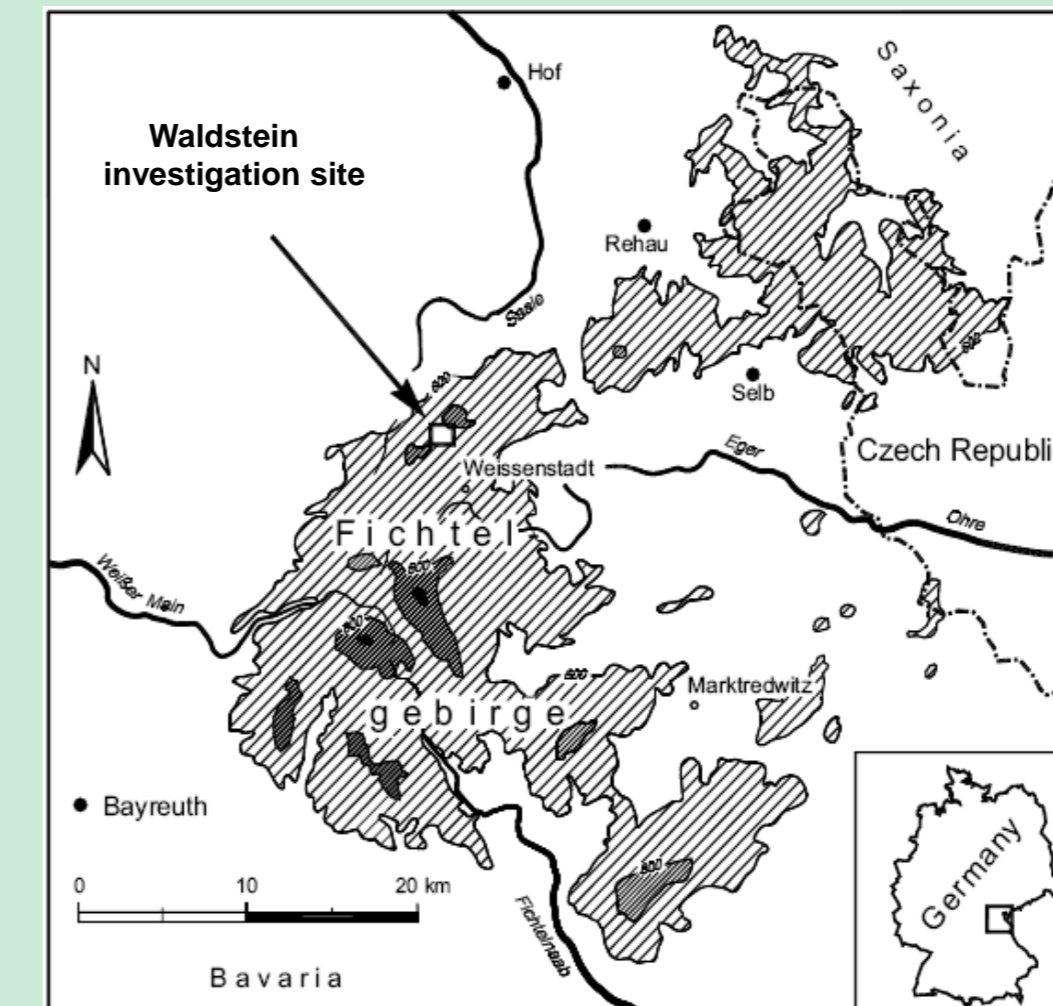


Figure 1: Location of the Waldstein investigation site.

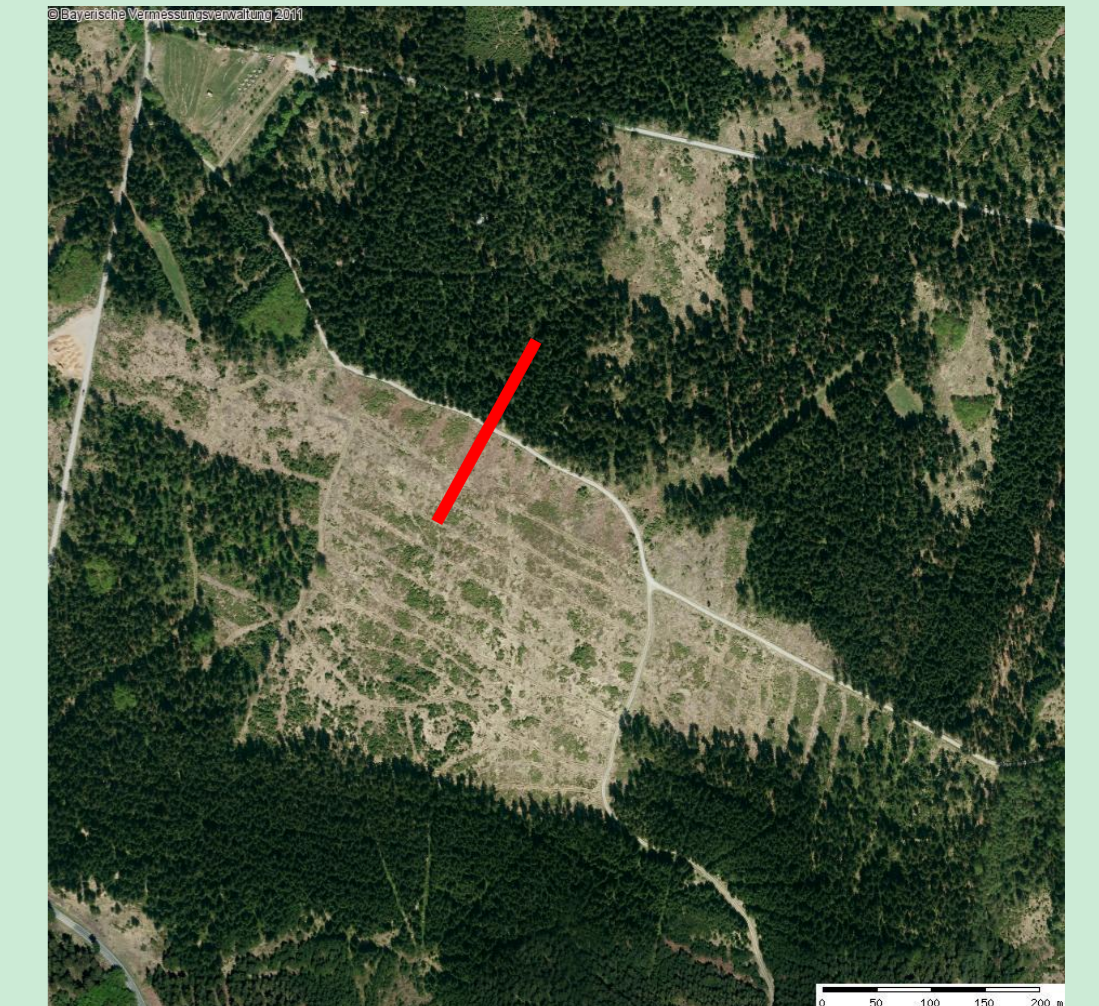


Figure 2: Investigation site with the path of the HMMS (red line).

Technical Description of HMMS

The HMMS works completely automatic on a model railroad system from LGB (scale: 1:22.5) installed on a wooden construction one meter above the ground. Determination of position, control of speed and the turnovers are realized by a software and a barcode scanner with barcodes each meter. A PC in combination with a National Instruments USB-6211 (16-bit analog i/o controller) is responsible for data acquisition of each sensor and for data logging. A scheme of the HMMS system is shown in Figure 3.

Table 1: Sensors on the HMMS during EGER campaign 2011.

Quantity	Sensor (Modifications)	Time constant τ_{63}	Accuracy
Temperature / Humidity	Vaisala HMP 155 (shielded and ventilated)	< 20 s (Temp) / ~ 20 s (rH)	± 0.1 °C / ± 1 % rH
Shortwave radiation	Kipp&Zonen CMP3 (amplified)	7 s	< 15 W/m ²
Longwave radiation	Kipp&Zonen CGR3 (amplified)	7 s	< 15 W/m ²
CO ₂	Edinburgh Instruments Ltd. Gascard NG 1000 ppm	2 s	± 4 % of range
O ₃	Enviscope Ozone sonde	< 0.2 s	Calibrated with MLU 49i
Barcode scanner	Sick AG CLV412-1010	-	Resolution: 0,1 ... 0,2 mm

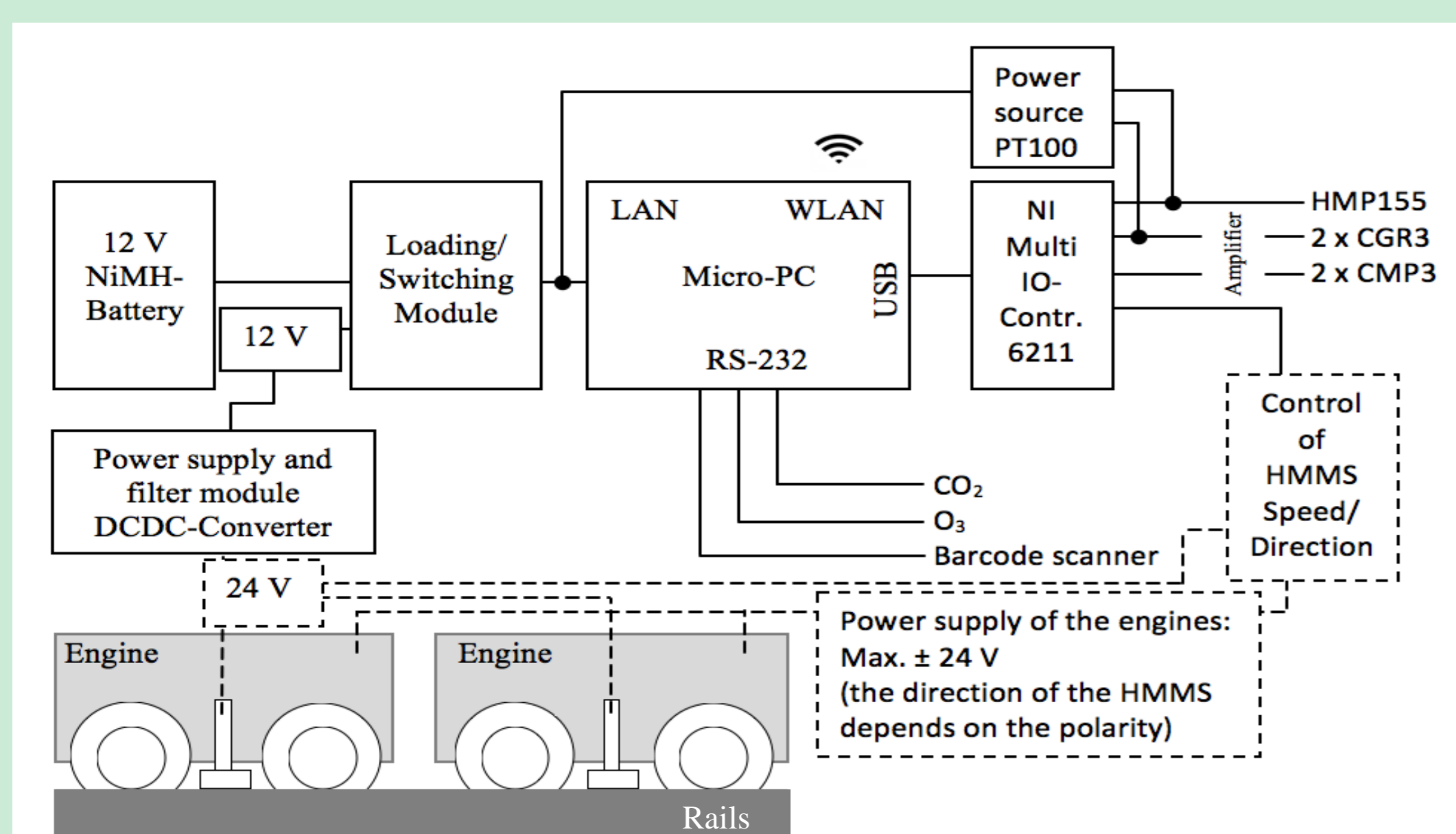


Figure 3: Schematic draft of the HMMS wiring. Sliding contacts tapped the power from the rails. The dashed lines show wiring of the engine power supply (24 V). Solid lines show wiring of the power supply of PC and sensors (12 V).

Preliminary results of HMMS measurements

The subplots in Figure 4 show daily cycles for the 150 m long path for all measured quantities at June 26th, 2011. High gradients at the transition from the forest to the clear-cutting can be observed for each quantity.

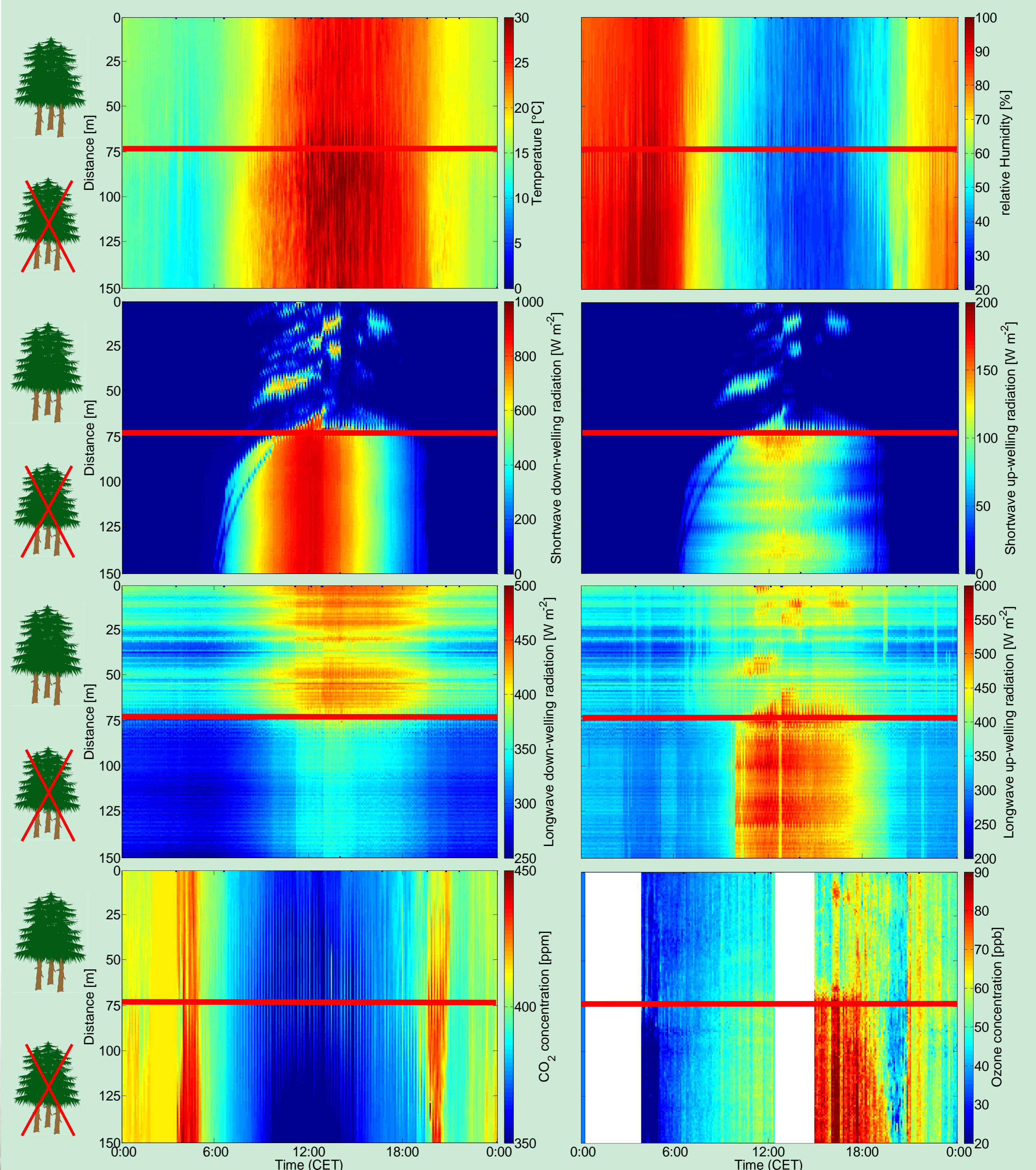


Figure 4: Subplots of daily cycles for each quantity at June 26th, 2011. The red line indicates the forest-edge. Above the red line the measurements are located in the forest, below on the clear-cutting. The white boxes in the subplot for ozone are data gaps caused by RS-232 communication problems between the sensor and the software.

Outlook

- Evaluation of the shown results with more data and comparison of the mobile measurements with static measurements
- Correction of the measured values in consideration of the time constant τ_{63} of each sensor
- Comparison of the gradient measurements of the HMMS with turbulent flux measurements from the same location

