European Geosciences Union General Assembly 2012
Vienna, Austria, April 22th – 27th 2012

UNIVERSITÄT BAYREUTH

Bayceer
Bayreuth Center of Ecology and Environmental Research

ExchanGE processes in mountainous Regions (EGER)

Investigation of exchange processes at a forest edge – clearing interface with a horizontal mobile measuring system

JÖRG HÜBNER (1), JOHANNES OLESCH (1), HUBERT FALKE (2), FRANZ X. MEIXNER (3,4), THOMAS FOKEN (1,5)

(1) University of Bayreuth, Department of Micrometeorology, 95440 Bayreuth, Germany (2) GAF – Gesellschaft für Akustik und Fahrzeugmesswesen mbH, 08058 Zwickau, Germany
(3) Max-Planck-Institute of Chemistry, Department of Biogeochemistry, 55020 Mainz, Germany (4) University of Zimbabwe, Department of Physics, Mount Pleasant, Harare, Zimbabwe
(5) Member of Bayreuth Center of Ecology and Environmental Research (BayCEER), University of Bayreuth, 95440 Bayreuth, Germany

EGER

MAX-PLANCK-GESELLSCHAFT

Motivation

Future forest ecosystems will be more and more heterogeneous due to wind throws and pests. At the resulting forest edges the gradients are very large at the transition from a dense forest to an open clearing, with major effects on meteorological parameters and exchange processes in the soil-vegetation-atmosphere boundary-layer system.

The third intensive observation period of the EGER project was conducted in June/July 2011 in a disturbed forest ecosystem with focus on energy and matter exchange at a forest edge. As a result of the hurricane "Kyrill" the dense spruce forest at the FLUXNET site (DE-Bay) at Waldstein-Weidenbrunnen in the Fichtelgebirge Mountains (North-Eastern Bavaria, Germany) has a more than 200 m wide clearing (Figure 1).

To obtain more information about horizontal gradients in this heterogeneous forest ecosystem, a Horizontal Mobile Measuring System (HMMS) was constructed. The transect of the HMMS passes 75 m in the dense spruce forest and 75 m on the open clearing vertical to the forest edge (red line in Figure 1).

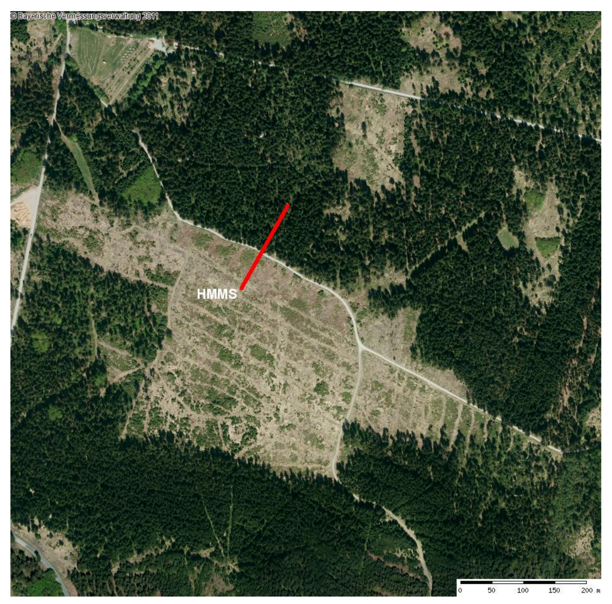

Figure 1: Investigation site with the path of the HMMS (red line).

Technical Description of HMMS

A garden railway system of the manufacturer LGB serves as the drive mechanism for the HMMS. Two powerful 24 V DC engines allow a controlled speed of approximately 0.5 m s^{-1} for the 17 kg heavy HMMS up to an ascending slope of 8°. The railway system is mounted 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	Accuracy	No. in Figure 2
Temperature / Humidity	Vaisala HMP 155 (shielded and ventilated)	~ 13 s (Temp) / ~ 19 s (rH)	± 0.1 °C / ± 1 % rH	**3:** Shielded and ventilated tube with sensor
Shortwave radiation	Kipp & Zonen CMP3 (amplified)	< 4 s	< 15 W/m²	Not visible from this site
Longwave radiation	Kipp & Zonen CGR3 (amplified)	~ 4 s	< 15 W/m²	**1:** Sensors on 0.5 m long beam
CO_2	Edinburgh Instruments Ltd. Gascard NG 1000 ppm	~ 1 s	± 4% of range	**6:** Inlet - **8:** Pump **9:** Sensor
O_3	Enviscope Ozone sonde	< 0.2 s	Calibrated with MLU 49i	**4:** Inlet - **5:** Sensor **7:** Pump
Bar code scanner	Sick AG CLV412-1010	-	Resolution: 0,1 ... 0,2 mm	**2:** Code 39 **16:** Sensor
Data acquisition system	National Instrumens i/o Micro PC and TFT	-	-	**10:** i/o controller **11:** TFT - **12:** Micro PC

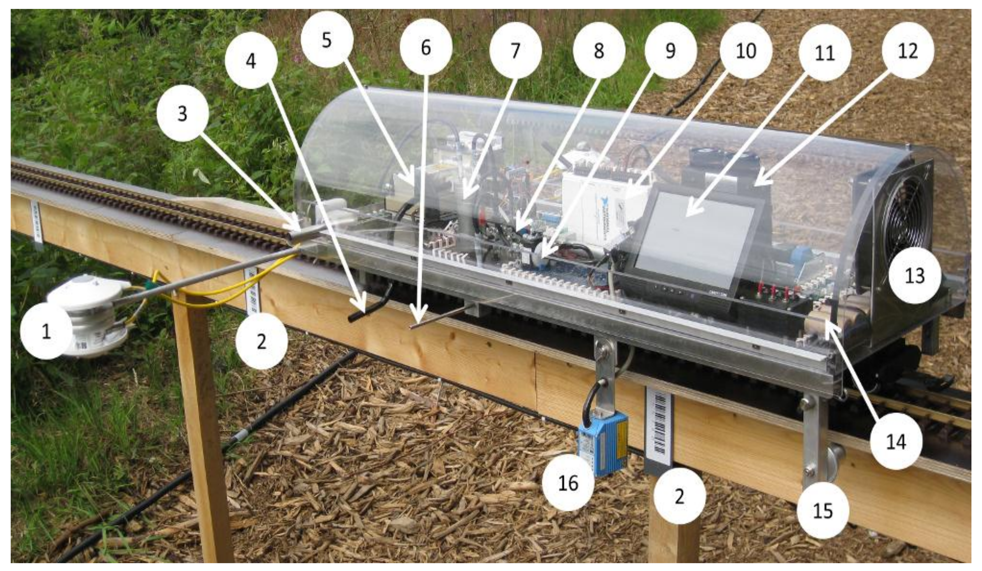

Figure 2: Lateral view on the HMMS. Find in Table 1 the specification of the numbers 1-12 and 16. The specification of the remaining numbers 13-15 are:
13: Fan for cooling the entire system
14: On board storage battery
15: Lateral holder to protect the HMMS for downfalls

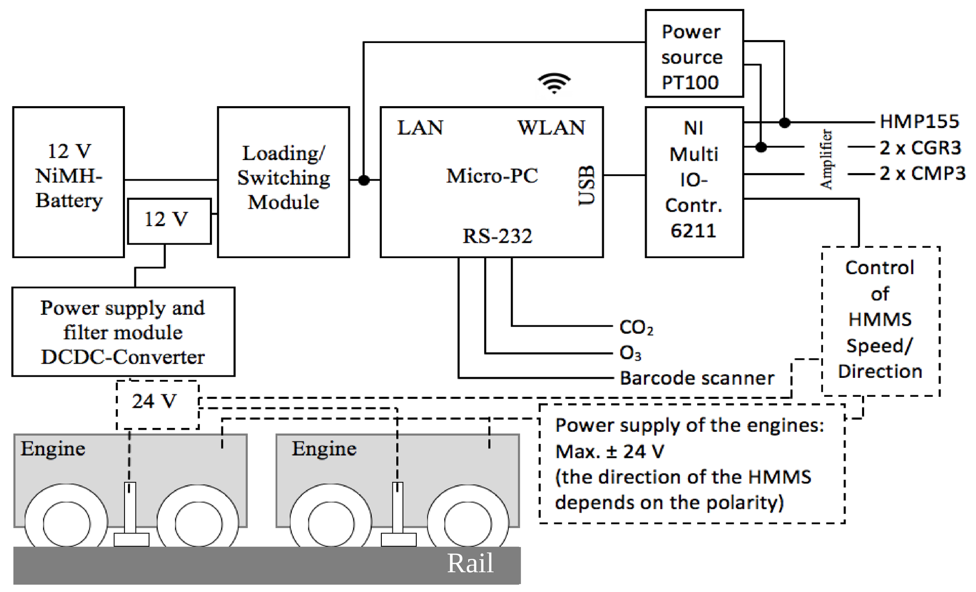

Figure 3: Schematic draft of the HMMS wiring. Sliding contacts tapped the power from the rails. The dashed lines show wiring of the engine power supply (24 V). Solid lines show wiring of the power supply of PC and sensors (12 V).

Results of HMMS measurements

The subplots in Figure 4 show daily cycles for the 150 m long path for all measured quantities at the 16th of July 2011. High gradients at the transition from the forest to the clearing can be observed for each quantity.

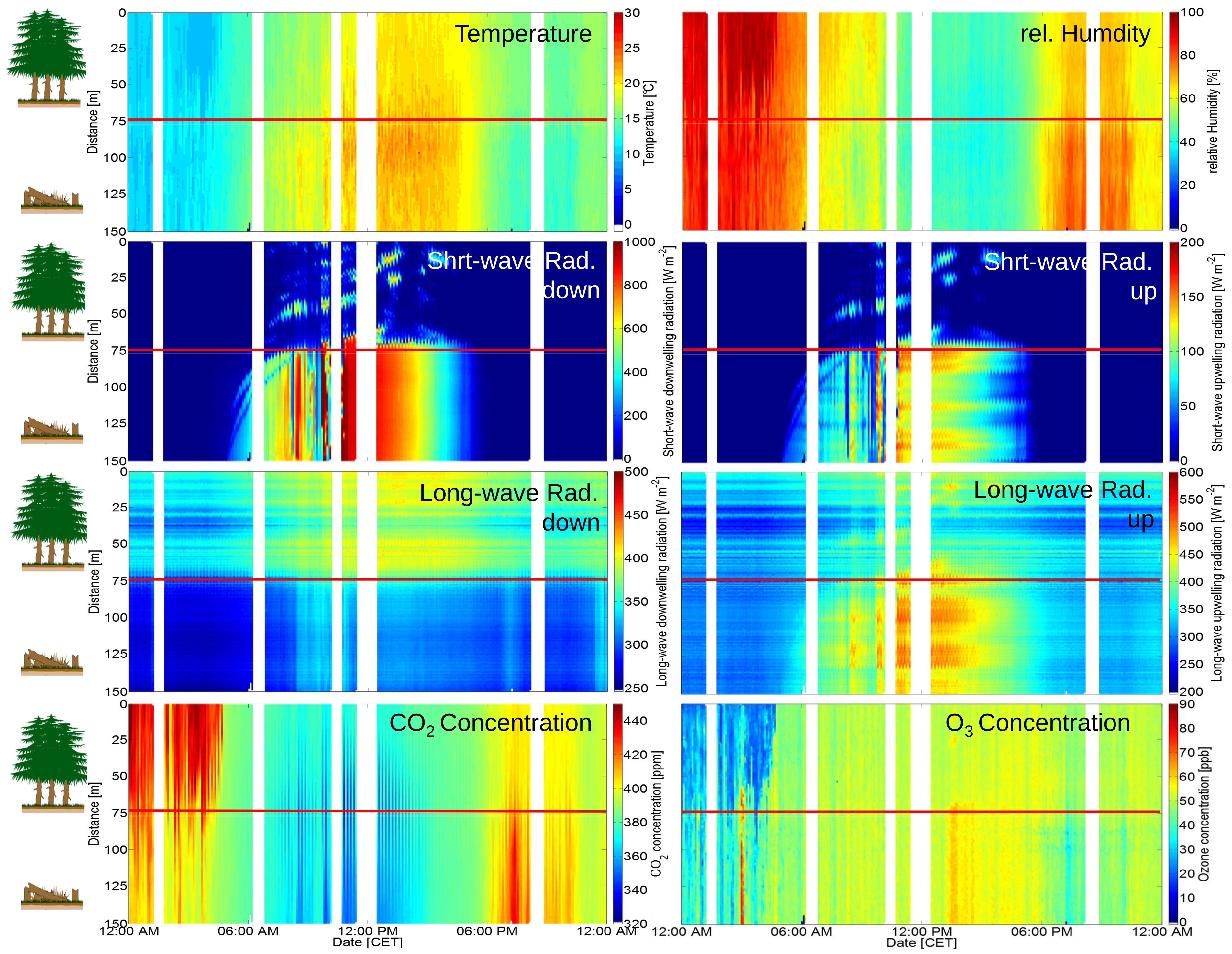

Figure 4: Subplots of daily cycles for each quantity at the 16th of July 2011. The red line indicates the forest-edge. Above the red line the measurements are located in the forest, below on the clearing.

Conclusion and Outlook

- Typical gradients along the transect with the highest changes direct at the edge
- Cold air outflows from the forest to the clearing during nighttime observable
- Evaluation of the shown results with more data and comparison of the mobile measurements with static measurements
- Correction of the measured values by applying the time constant τ for each sensor

Contact: joerg.huebner@uni-bayreuth.de
http://www.bayceer.uni-bayreuth.de/eger_iop3

Acknowledgements:
enviscope GmbH, Sick Vertriebs-GmbH, Qianqian Liu, Lisa Dirks, Kilian Huber, Gerhard Müller, and Michael Riederer

Bayceer