9th Newsletter of the UFZ Green Roof Research

February 04, 2022

Research green roof
at the Helmholtz Centre for Environmental Research – UFZ

Europäische Union

Europa fördert Sachsen.
EFRE
Europäischer Fonds für regionale Entwicklung

This construction measure is co-financed by tax funds on the basis of the budget passed by the members of the Saxon state parliament.

Research partners:

UFZ HELMHOLTZ Zentrum für Umweltforschung

UNIVERSITÄT LEIPZIG

BfN Bundesamt für Naturschutz

Practice partners:

Ingenieurbüro Blumberg

ZinCo

Stadt Leipzig
Amt für Umweltschutz

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UFZ Green Roof Research

Working group „Climate study and climate modelling of the impact of green roofs on buildings and cities“

In order to determine the impact of the various roofs on urban climate, their energy fluxes are considered. One of these heat fluxes is the latent heat flux, which describes the water exchange between surface and atmosphere and includes evapotranspiration and condensation. **A seasonal analysis of the latent heat flux** indicates significant differences between the roofs types. While for the extensive and wetland green roof a clear diurnal and seasonal variation of evapotranspiration can be seen, in which (following the influence of available radiation) high values can be observed especially in the middle of the day and year. For the gravel roof, these patterns are less recognizable, but in contrast to the other roofs, the formation of dew before sunrise can be observed over almost the entire year.

However, the cooling effect of green roofs on the ambient air is particularly important during heat waves, which are often accompanied by a long-term lack of rainfall and thus drought conditions. During such dry periods, a significantly reduced evaporation capacity can be observed for the extensive green roof compared to the (additionally irrigated) wetland green roof, whereby the cooling effect of the extensive green roof also decreases strongly. This decrease may lead to even lower daytime evapotranspiration rates of the extensive green roof than that of the gravel roof, which still has a significant source of water due to the dewfall. Thus, the development of adapted irrigation concepts for the management of existing extensive green roofs represents an important measure for maintaining the cooling potential.

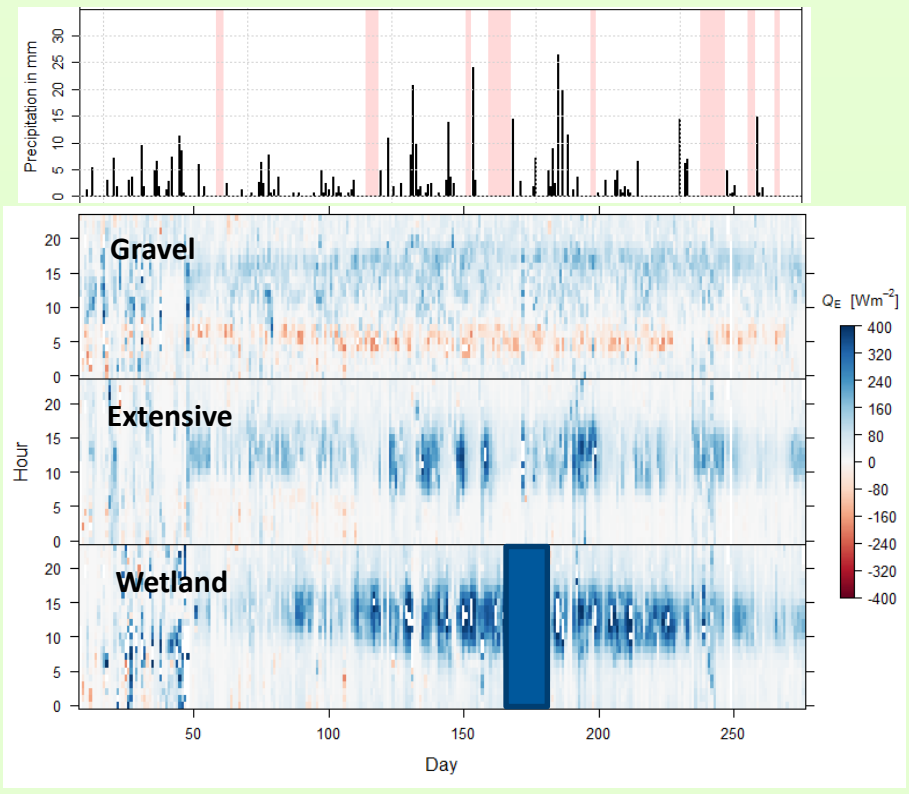

Figure 1: a) Daily precipitation totals and identified dry periods (i.e. absence of precipitation on at least 5 consecutive days = red bars) b) Comparison of the daily and annual course of the latent heat fluxes of the green roofs.
Author: Niels Wollschläger (SUSOZ)

9th Newsletter of the UFZ Green Roof Research

Working Group „Process-related indicators of different green roof variants“

Weather data such as rainfall intensity, wind speed, humidity, radiation, and temperature are a key foundation for answering many of the research questions we have on our UFZ research green roof. **Weather conditions** on roof tops are, generally, more extreme as compared to ground weather since they tend to be more exposed and experience disturbances through nearby buildings (think shadow effects and wind channeling) and infrastructure set on the roof such as AC vents and PV-panels. Since these data, however, are fundamental for many environmental studies, we continuously strive to improve the quality of the weather data we make available to all collaborators. In February, we will, therefore, upgrade our existing measuring infrastructure to include atmospheric pressure, dew point and thunderstorm-related measurements as well as increasing the temporal resolution of the data. So far, we have, e.g., seen larger diurnal temperature changes on the roof as compared to ground stations. To further evaluate the influence of the exposed location of our research green roof on the experience local microclimate we started a collaboration with the colleagues from TROPOS, the Leibniz Institute for Tropospheric Research, which operates several ground-based weather station here on campus.

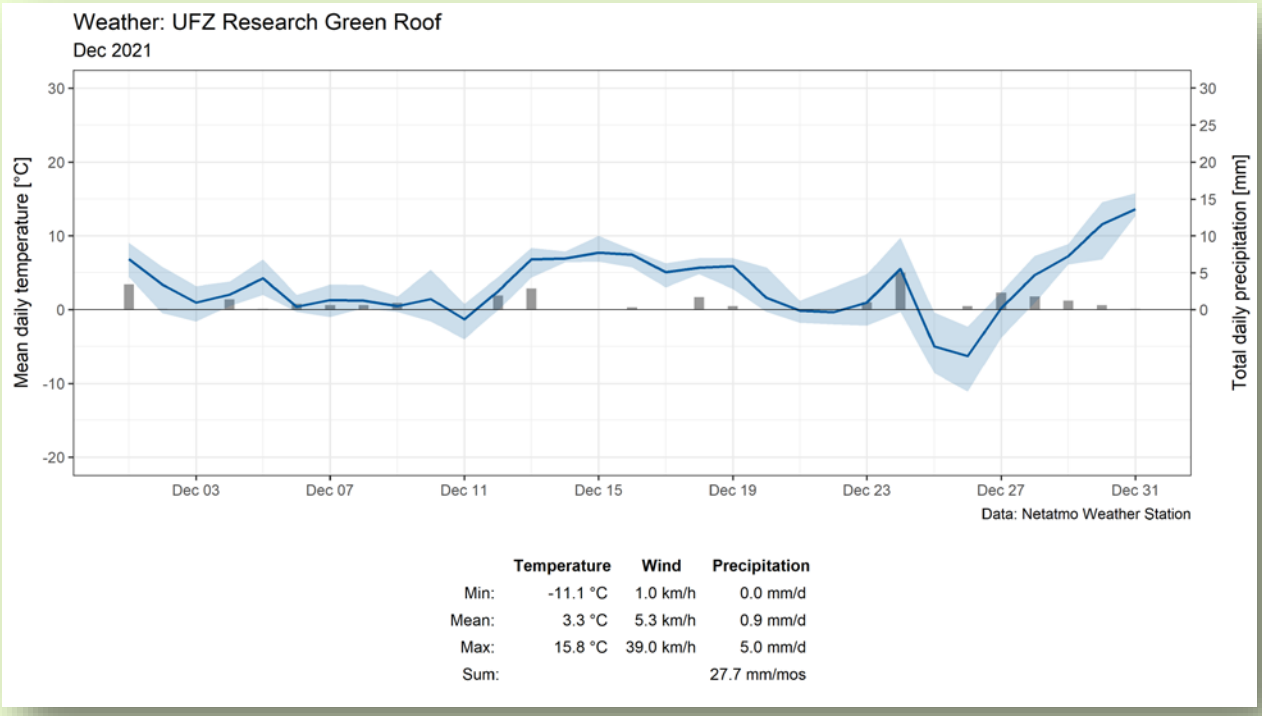

Figure 2: Weather on the Research Green Roof in December 2021. Author: Jan Knappe (UBZ)

9th Newsletter of the UFZ Green Roof Research

Working Group „Green Roofs as a Pollutant Sink“

In the thesis of **Johannes Heisig** (Dep. TUCHEM in cooperation with UBZ) the elimination of surfactants in a constructed wetland roof fed with real grey water is investigated. By determining influent and effluent concentrations of surfactants over several weeks, first results on the purification performance under variable weather conditions are expected. In addition, adsorption of a selected anionic surfactant on a typical plant mat and on activated carbon felt will be determined. Retention of surfactants in the graywater roof by adsorption may be an option to increase the degradation performance

In autumn 2021, the bachelor's thesis by **Johanna Sehrt** (University of Leipzig, supervised by Peter Otto and Dietmar Schlosser), which was rated as "very good", was completed. The thesis focused on the occurrence and diversity of fungi on the research green roof and their abilities with regard to the biotransformation of phthalic acid esters (environmental pollutants that are e.g. used as additives in plastics). A remarkable, roof- and plant-specific fungal colonisation was detectable on all green roof types examined. Fungal isolates obtained from different green roof types could be demonstrated to metabolise phthalic acid esters in laboratory investigations, and thus potentially contribute to the elimination of environmental pollutants on green roofs. The studies on the transformation of phthalic acid esters by fungi of the research green roof were continued in autumn 2021 as part of a research group internship at the Department of Environmental Microbiology (Stefanie Clauß, University of Halle). By including so far not investigated phthalic acid esters (especially diethylhexyl phthalate = DEHP) in the investigations, it was possible to expand the spectrum of environmental pollutants that can be attacked by fungi of the green roof.

Figure 3: Pictures of the positive Azur B reactions of the isolates E10 and E14 and of the positive ABTS reactions of the isolates S8, E10 and I3 (Author: Johanna Sehrt)

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The research green roof also played a central role in a particular part of the practical course "**Microbial Ecology and Environmental Biotechnology**" (MSc module Biochemistry of the Master's programme Biochemistry, University of Leipzig), which was focusing on the degradation of environmental pollutants by fungi, and carried out at the UFZ Department of Environmental Microbiology. To this end, the research green roof was sampled by students from the University of Leipzig in January 2022, thus involving them in current green roof research. The focus of the subsequent laboratory work was again on phthalic acid esters and also on synthetic polyurethane-based polymers as environmental pollutants, thus establishing a close thematic link to corresponding work being carried out by Dr. Rim Mtibaa at the UFZ-Department of Environmental Microbiology.

Figure 4: Sampling of the Research Green Roof within the practical course "Microbial Ecology and Environmental Biotechnology" (MSc module Biochemistry of the Master's programme Biochemistry, University of Leipzig) in January 2022..

Author: Lukas Wick (UMB)

9th Newsletter of the UFZ Green Roof Research

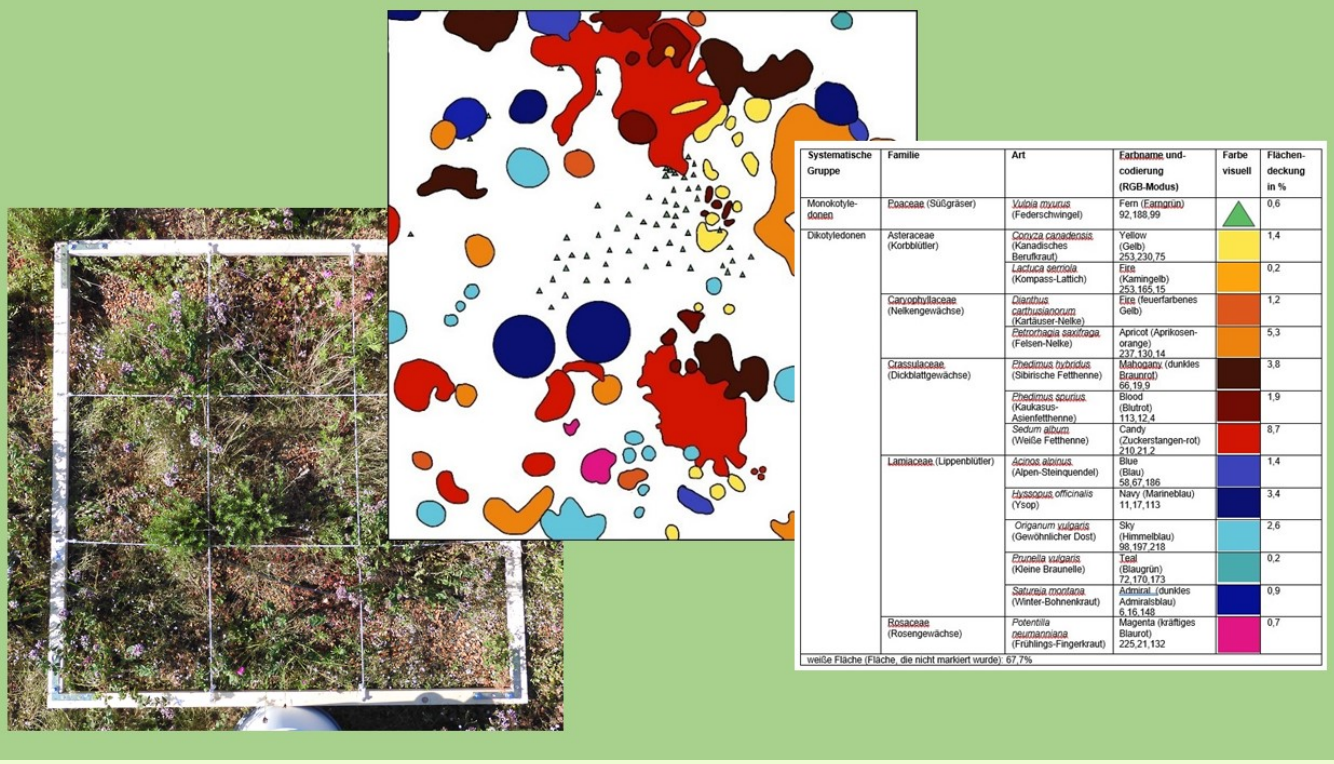
Working group „Biodiversity“

For last year's growing season, two botanical activities are of particular importance for the UFZ research green roof:

1. **The replanting of native species on the three green roofs to better address the conservation concern**.
   This means that for each roof, half of its area is planted with a conventional type of vegetation already in use in Germany, and the other half is planted with a conservation-oriented type of vegetation that is currently being tested, with attention to the promotion of native insect species.

2. **The establishment of study plots for the long-term recording and analysis of the stock of seed plants, mosses and lichens**, taking into account horticultural maintenance measures carried out or omitted ("management").

   In both summer and winter aspects, all species detected in the plots were identified and their occurrence mapped. The aim is to record the trend of vegetation development through repeated studies. Keywords in this context are: Competition and displacement of species, decrease in species numbers and loss of importance, need for maintenance of areas.



Systematische Gruppe	Familie	Art	Farbname und-codierung (RGB-Modus)	Farbe visuell	Flächen-deckung in %
Monokotyle-donen	Poaceae (Süßgräser)	*Vulpia myuros* (Federschwingel)	Fern (Farngrün) 92,188,99		0,6
Dikotyledonen	Asteraceae (Korbblütler)	*Conyza canadensis* (Kanadisches Berufkraut)	Yellow (Gelb) 253,230,75		1,4
		Lactuca serriola (Kompass-Lattich)	Fire (Kamingelb) 253,165,15		0,2
	Caryophyllaceae (Nelkengewächse)	*Dianthus carthusianorum* (Kartäuser-Nelke)	Fire (feuerfarbenes Gelb)		1,2
		Petrorhagia saxifraga (Felsen-Nelke)	Apricot (Aprikosen-orange) 237,130,14		5,3
	Crassulaceae (Dickblattgewächse)	*Phedimus hybridus* (Sibirische Fetthenne)	Mahogany (dunkles Braunrot) 66,19,9		3,8
		Phedimus spurius (Kaukasus-Asienfetthenne)	Blood (Blutrot) 113,12,4		1,9
		Sedum album (Weiße Fetthenne)	Candy (Zuckerstangen-rot) 210,21,2		8,7
	Lamiaceae (Lippenblütler)	*Acinos alpinus* (Alpen-Steinquendel)	Blue (Blau) 58,67,186		1,4
		Hyssopus officinalis (Ysop)	Navy (Marineblau) 11,17,113		3,4
		Origanum vulgaris (Gewöhnlicher Dost)	Sky (Himmelblau) 98,197,218		2,6
		Prunella vulgaris (Kleine Braunelle)	Teal (Blaugrün) 72,170,173		0,2
		Satureja montana (Winter-Bohnenkraut)	Admiral (dunkles Admiralsblau) 6,16,148		0,9
	Rosaceae (Rosengewächse)	*Potentilla neumanniana* (Frühlings-Fingerkraut)	Magenta (kräftiges Blaurot) 225,21,132		0,7
weiße Fläche (Fläche, die nicht markiert wurde): 67,7%					

Figure 5: The path from meticulous examination on the roof via identification work, archiving of evidence and photo documentation to a vegetation map with area calculation - the example "Simple intensive greening, optimized for nature conservation, without management" on the UFZ roof (area size: 1.5 x 1.5 m).

Author: Johanna Sehrt, University of Leipzig

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Working group „Biodiversity“

In the summer and fall of 2021, floristic and vegetation studies were carried out on various **green roofs in the city of Leipzig**. The methodology is based on that used for the UFZ Research Green Roof. For the purpose of optimizing the seed "**Leipzig Green Roof Mix**", roofs of private people were visited on which the seeds had been spread in recent years. The evaluation of the results has been largely completed. This year, an improved mixture will again be made available free of charge to interested citizens via the city's environmental information center.

New Projects and Publications

Wollschläger, N., Schlink, U., Raabe, A. (2021) **A Feasibility Study for Determining the Sensible Heat Flux to and from Small Green Roofs**. *Boundary-Layer Meteorology* 181, 145-166.

Moeller, L., Ueberham, M., Knappe, J. (2021) **Studierende entwickeln Gründachkonzept für einen Schulkomplex** (*Students develop green roof concept for a school complex*). GebäudeGrün 4/2021

Project „**Living walls - facade greening for multifunctional climate adaptation in the city**” (working group „Climate study and climate modelling of the impact of green roofs on buildings and cities “, funding: SAB, duration: Nov. 2021 - Nov. 2022).

Project „**Management of exceptional precipitation events in urban areas with the help of green roofs – MaNuGrün**“ (working group „Process-related indicators of different green roof variants“, funding: DBU, duration: March 2022 – February 2025, project partner: BDZ e.V. (coordinator), KWL, SEDD, HTWK, UFZ/UBZ).

More information on the UFZ Green Roof Research:

https://www.ufz.de/forschungsgruendach

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