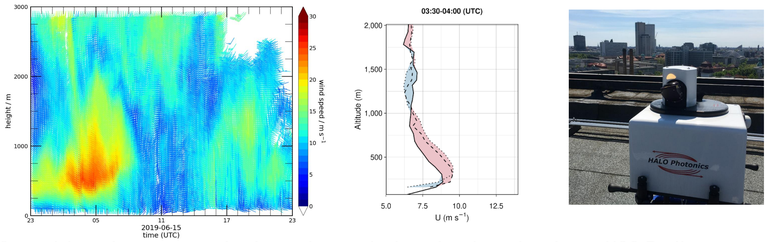
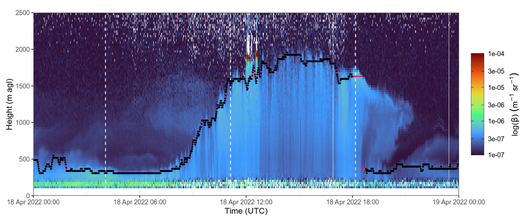
Urban Climate Observatory Berlin

The Urban Climate Observatory (UCO) Berlin is an open and long-term infrastructure for integrative research on urban weather, climate, and air quality. Quality-controlled observations are carried out in order to study the interaction between atmospheric processes and urban structures, as well as climate variability and climate change in urban environments. It enables multi-scale, three-dimensional atmospheric studies integrating observational and numerical modelling methods. UCO Berlin provides a data portal for search of meta data and download of open climate data in Berlin and surrounding (https://uco.berlin/en/dataportal).

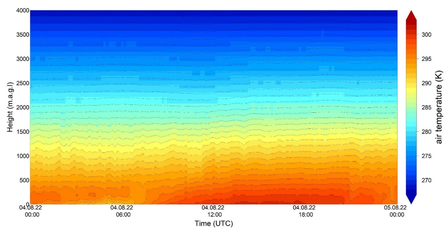
Ground-based remote sensing



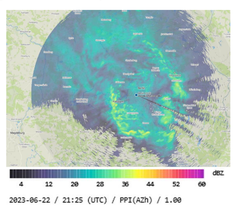
Ground-based remote sensing is used to study the urban boundary layer. UCO Berlin operates two Doppler LiDAR systems (Streamline XR, Halo Photonics) since 2018 and provides vertical profiles of wind speed and wind direction as well as information on atmospheric turbulence. The mid figure shows average vertical profiles of wind speed for the sites ROTH, TUCC and DWD-Lindenberg (solid line) and differences regarding nocturnal low-level jets .

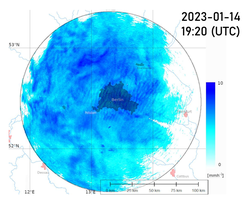


Cloud height, cloud cover and aerosol layers are recorded since 2017 with ceilometers (CHM 15k, Lufft) at sites Grunewald and TUCC, which is part of the E-Profile Network of the European meteorological services EUMETNET. The ceilometer range is 15 km, the vertical resolution is 15 m and the temporal resolution is 15 s. Figure shows daily course of aerosol backscatter and mixed layer at site TUCC (provided by Daniel Fenner).



A microwave radiometer (HATPRO-G5, RPG Radiometer Physics GmbH) provides vertical profiles of air temperature and absolute humidity up to an altitude of 10 km. Integrated liquid water path (LWP) and the integrated water vapor (IWV) are derived from measurements of the brightness temperature in 14 channels.

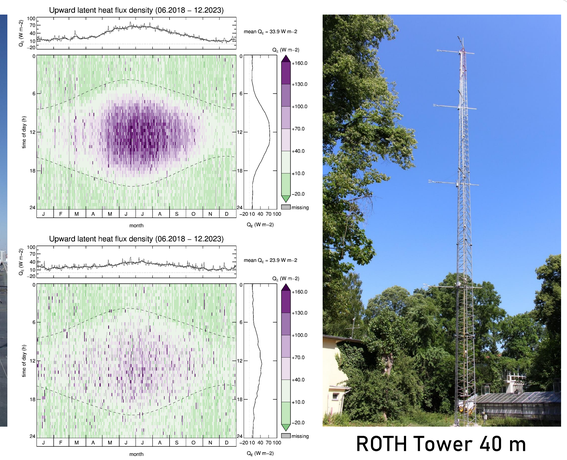




An X-band Doppler weather radar with dual polarization (GMWR-25-DP by GAMIC) for precipitation research has been in operation since autumn 2022. The weather radar is installed on the roof of the historical water tower (Institute of Meteorology, Freie Universität Berlin) on the Fichtenberg in Berlin-Steglitz. The weather radar has a range of 100 km.

Meteorological towers

TUCC Tower 10 m

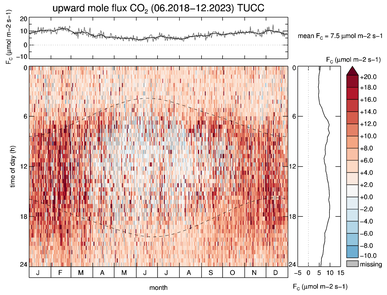


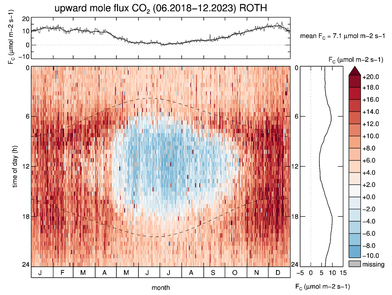
ROTH Tower 40 m

The towers are located at Rothenburgstrasse (ROTH) in Berlin-Steglitz since 2018 and on the roof of the main building of the TU Berlin at Campus Charlottenburg (TUCC) since 2014. Turbulent fluxes of sensible and latent heat as well as carbon dioxide are derived from eddy covariance (EC) systems (IRGASON, Campbell Scientific). The EC-systems at ROTH are installed at 40m, 30m, 20m, 10m and 2m above ground and at TUCC at 10m above roof (56m above ground). The sensors for down- and upwelling short-wave and long-wave radiation (CNR4, Kipp & Zonen) are installed next to the EC-systems. ROTH is an associate site of the Integrated Carbon Observation System (ICOS) network. PhenoCams observe the phenological development of urban vegetation at both sites.

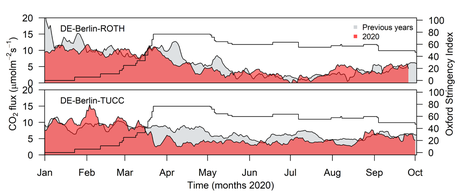
ICOS

PhenoCam





Directly measured local CO_2 emissions in 2020 compared to average values of previous years and in relation to the strictness of the lockdown periods (Oxford Stringency Index). Up to 40% lower CO_2 emissions were measured at the TU Campus Charlottenburg (TUCC) during the lockdown in spring 2020.



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- Jongen et al. (2022) Urban Water Storage Capacity Inferred From Observed Evapotranspiration Recession. Geophysical Research Letters, DOI:10.1029/2021GL096069
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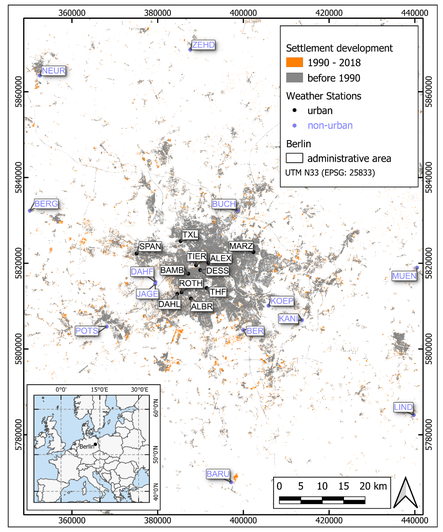
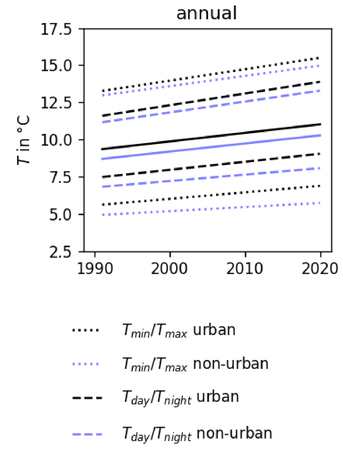
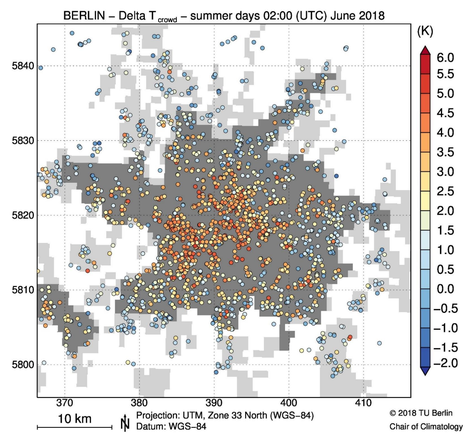
Urban Climate Observation Network

The Urban Climate Observation Network (UCON) Berlin provides long-term observations of atmospheric variables (air temperature, relative humidity, air pressure, global radiation, wind, precipitation) in the Urban Canopy Layer (UCL) at various locations since the 1990s. Including the DWD stations, it is thus possible for the first time to carry out dedicated analyses of a 30-year normal period (see figures below).





Since 2015 data has been systematically collected from Netatmo weather stations in Berlin and the surrounding area (crowdsourcing). The figure below shows the mean difference in air temperature between 1936 Crowd Weather Stations (CWS) and the 25% percentile of all rural CWS. Specifically developed quality assurance methods enable novel approaches for urban climate research with CWS. Further weather stations were installed in 2022 as part of the citizen science project OpenUCO (https://messi.openuco.berlin) particularly in allotment gardens in Berlin.



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