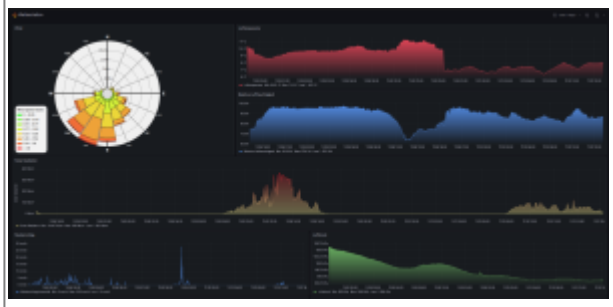
# Weather Stations in Kleve

## Interactive Dashboards of Real-Time Weather Data

| WeatherStation Obstbaum-Arboretum | WeatherStation Rathaus |
|---|---|
|  |  |
| Fig.: Interactive real-time data plots. **Click on the image** or **here** to open the Grafana dashboard. | Fig.: Interactive real-time data plots. **Click on the image** or **here** to open the Grafana dashboard. |

## Weather-Station Obstbaum-Arboretum

The weather station consists of a Vaisala WXT536 multisensor, which can measure wind speed, wind direction, barometric pressure, air temperature, relative humidity and rainfall. Global radiation is measured by a Kipp & Zonen CMP3 pyranometer. A raspberry pi zero is used to read the data from the weather station. From there the data is uploaded to a server running an influx database. The internet connection is provided by a **Teltonica router** using LTE. A LoRaWAN Gateway is installed next to the station to provide access to The Things Network in the park.

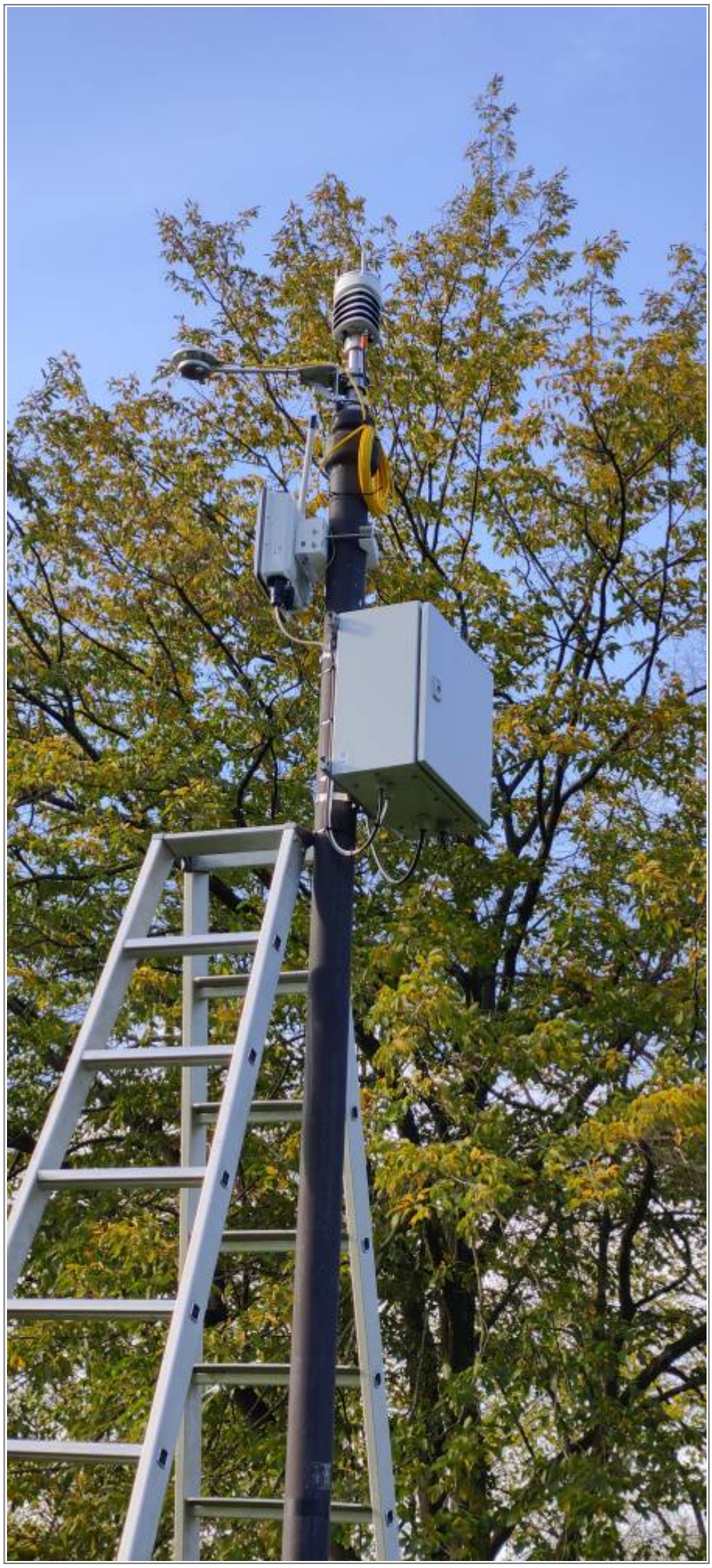


Fig.: Weather station mounted on a pole at Forstgarten in Kleve

# Sensors of the Weather Station

| Sensor / Component | Physical Quantity / Function |
|---|---|
| Vaisala WXT536 | Temperature, Humidity, Barometric pressure, Wind speed / direction, Precipitation |
| Kipp & Zonen CMP3 pyranometer | Global radiation |
| Teltonika Router | |
| Raspberry Pi | |
| ... | |

# Data Flow (under construction)

Physical:
Vaisala Sensors → (RS485) → Raspberry Pi → (Ethernet) → Teltonika Router → (4G) → MQTT Broker (kleve.cool)

Logical:
Vaisala Sensors → (API) → Raspberry Pi (MQTT Publisher) → MQTT Broker (kleve.cool) → Node-Red (MQTT Subscriber) → InfluxDB → Grafana

Remarks:

- Raspberry Pi does not provide permanent storage but buffers the sensor data in a local file in case the MQTT broker is unreachable.

# Accessing the data

The data of our weather station is **freely available** through MQTT!

The accessible variables:

| Key | Unit | Comment |
|---|---|---|
| wind_dir_min | ° | |
| wind_dir_avg | ° | |
| wind_dir_max | ° | |
| wind_speed_min | m/s | |
| wind_speed_avg | m/s | |
| wind_speed_max | m/s | |
| temperature | °C | |
| humidity | % | |
| pressure | hPa | |
| rain_accumulation | mm | reset after 100mm |
| rain_duration | s | |
| rain_intensity | mm/h | |

| Key | Unit | Comment |
|---|---|---|
| hail_accumulation | hits | |
| hail_duration | s | |
| hail_intensity | hits/h | |
| solar_radiation | W/m² | |

| MQTT Broker and Topic | |
|---|---|
| **URL** | kleve.cool |
| **PORT** | 1883 |
| **TOPIC** | weather/kleve/01 |
| **USERNAME** | weather-kleve-public |
| **PASSWORD** | IoTRocks |

# Tests in the IoTLab

*Fig.: First Test in the IOT-Lab with a USB-Connection*

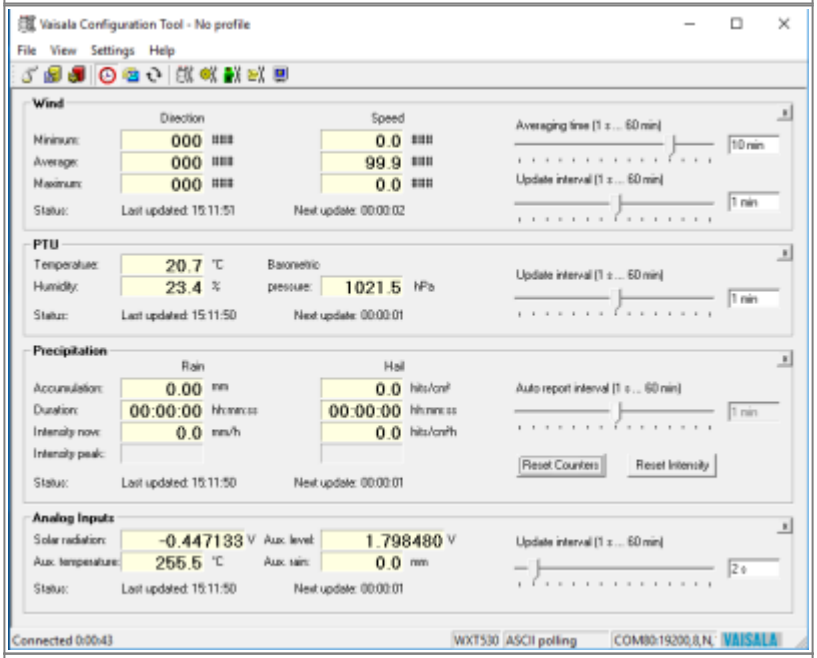



*Fig.: Reading the Data with the Vaisala Configuration Tool*

### RS485

To read the Data from the WXT536 Module we connected an rs485 to USB converter. This protocol will be used when the weather station is permanently installed in Kleve. The WXT536 accepts a voltage range from 6-24V, so we had to connect an external power supply.

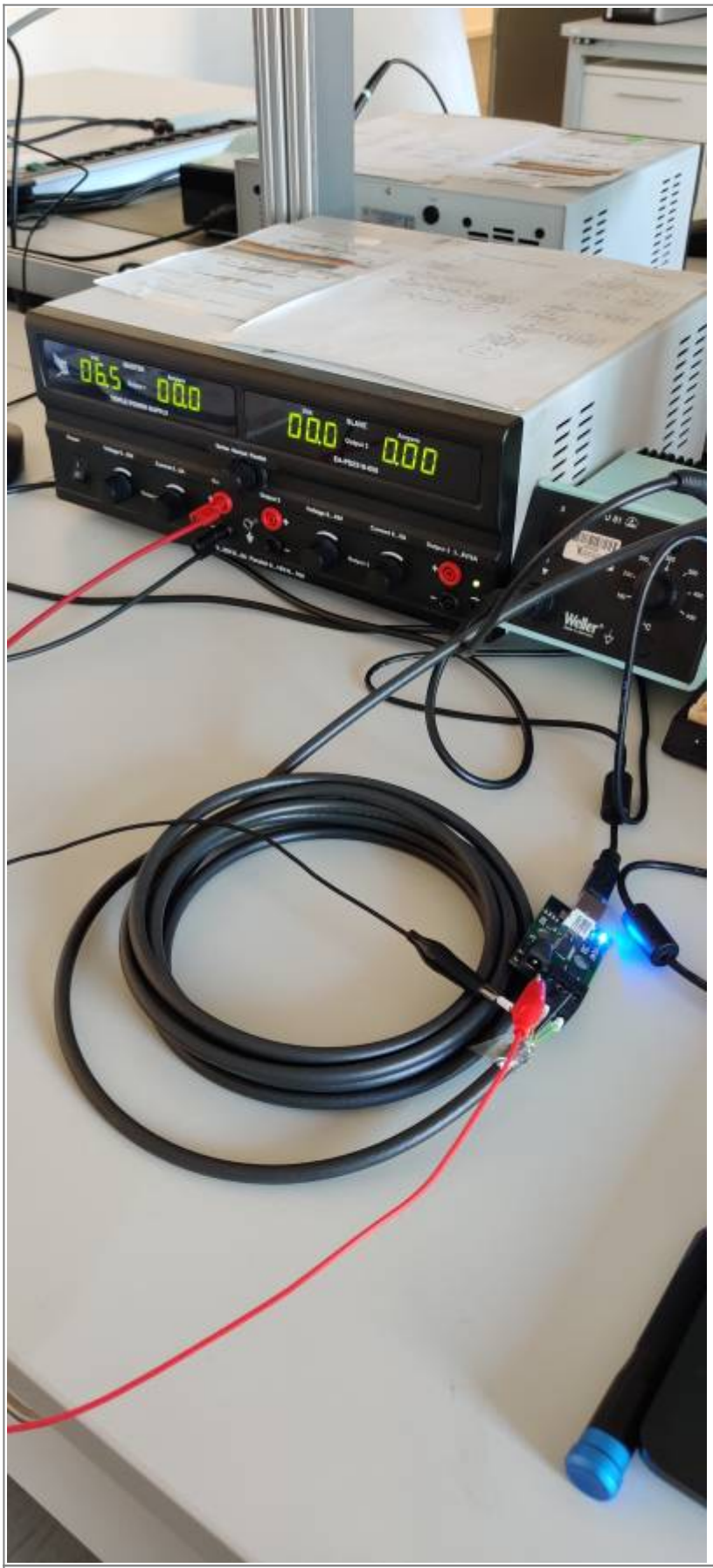



*Fig.: Connecting to the WXT536 with an rs485 to USB converter*

*Fig.: Connecting to the WXT536 with an rs485 to USB converter*

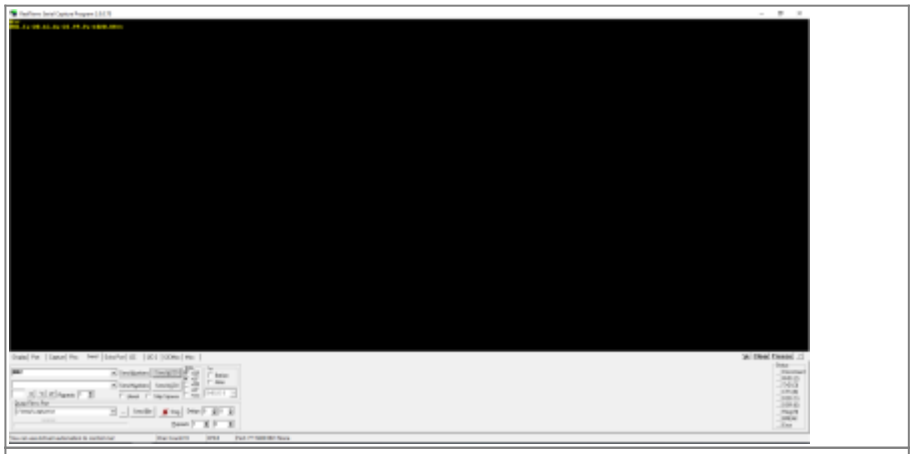


*Fig.: Serial response from the WXT536 after sending a data request*