What's the bee-weather & how-to correct particulate-matter readings

(in Grafana, of course)

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The Hiveeyes Project

GrafanaC~~on~~ONline 2020
~~Amsterdam~~Cyberspace, May, ~~14th~~20th 2020

part #1: what's the (bee-)weather?

meteogram: past & future

how are the bees?

how is the weather for bees?

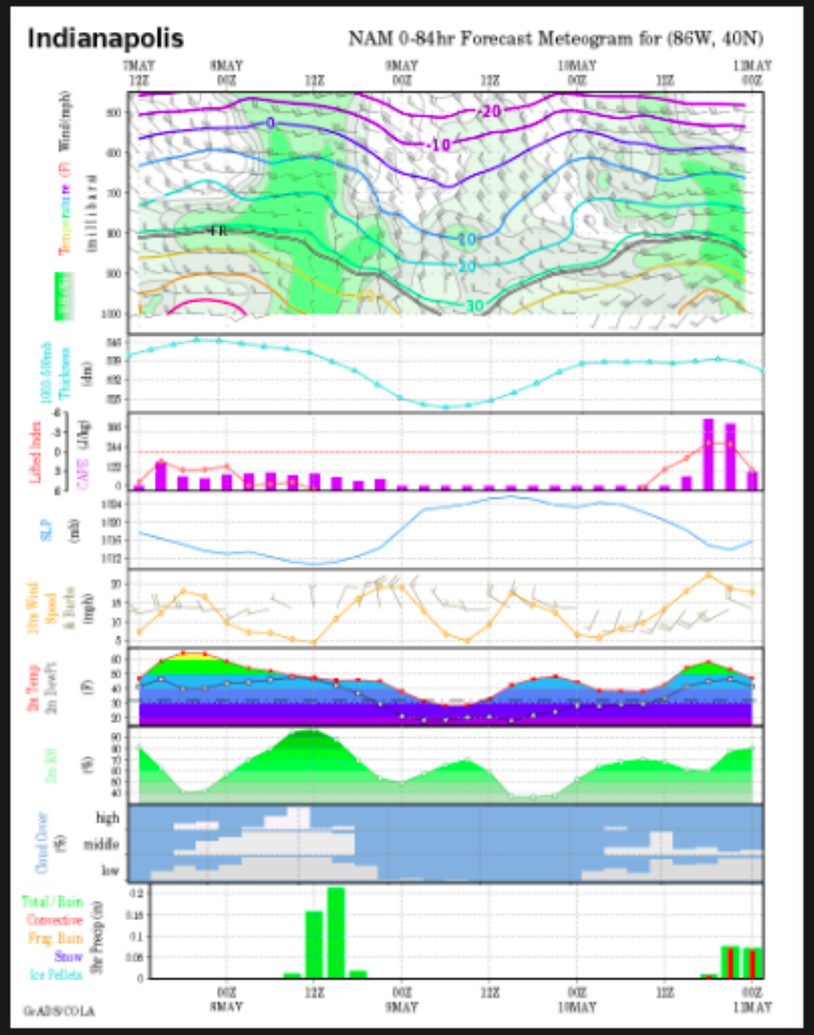
part #2: particulate matter: official vs. low-cost sensors

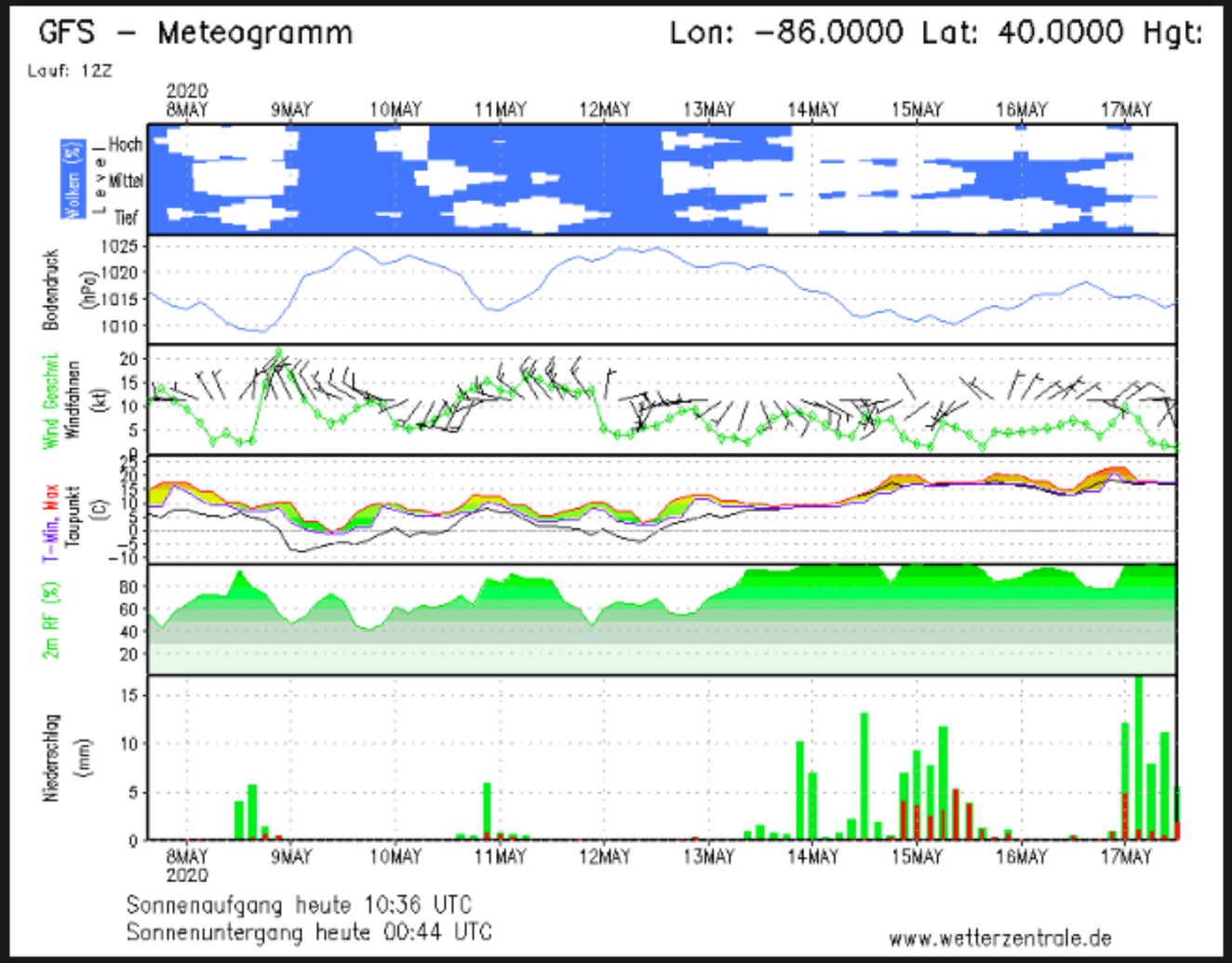
compare nearby stations

compensation at high humidities

part #1: what's the (bee-)weather?

meteograms (future only)



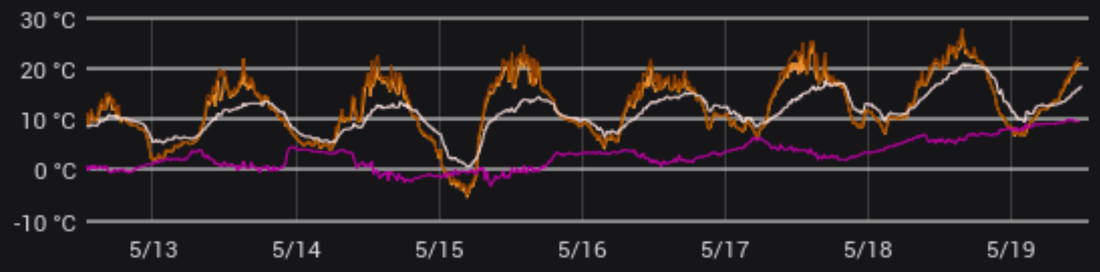


meteograms by NWS/weather.gov and wetterzentrale.de

my first meteogram (past only)

letzte...	Luft	bode...	Taupu...	Feuch...	Druck	Wind	Sonn...	Niede...	Rege...	Uhrzeit
11:20:00	16.5 °C	22.4 °C	9.5 °C	63.1 %H	1.015 bar	19 km/h →			0 mm	13:01:09

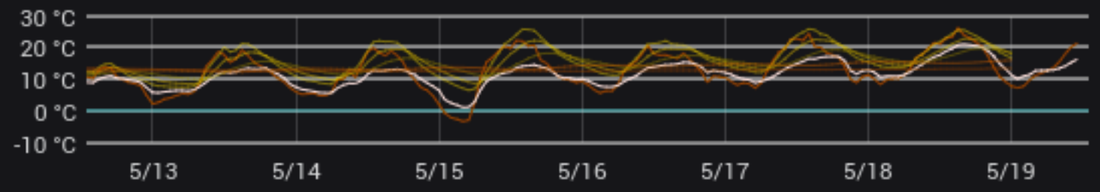
Temperaturen: Berlin-Tegel



Wolkenbedeckungsgrad je Schicht: Berlin-Tegel

Wolkenbedeckung insgesamt: Berlin-Tegel

Luft- & Bodentemperaturen: Berlin-Tegel



Feuchte & Sonnenstrahlung: lang, global, diffus: Berlin-Tegel

Wind & Luftdruck (Stationshöhe): Berlin-Tegel

Niederschlagsmenge & Sonnenscheindauer: Berlin-Tegel

combining past & future

1st challenge: two station-lists, no common ID

solution: manually generate a combined-list (using lon/lat)
to access different station-IDs with consecutive variable-queries

"nesting" of dashboard templating variables

$COMMON_CDC_NAME (cdc_name)
↳ $COMMON_CDC_ID (cdc_sta_id) || ↳ $COMMON_MOSMIX_ID (mosmix_id)

Wetter: DWD > CDC & MOSMIX: selection of a station-...

now-4d to now+10d

COMMON_CDC_NAME Berlin-Tegel | COMMON_CDC_ID 00430 | COMMON_MOSMIX_ID 10382 | COMMON_MOSMIX_NAME BERLIN-TEGEL

cdc_mosmix_common_point: meta-data, list of station-pairs

Time	cdc_lat	cdc_lon	cdc_name	cdc_sta_id	mosmix_id	mosmix_lat	mosmix_lon	mosmix_name
-	50.7983	6.0244	Aachen-Orsbach	15000	10505	50.8	6.03	AACHEN-ORSBACH
-	48.2156	8.9784	Albstadt-Badkap	00071	Q751	48.22	8.98	ALBSTADT-BADKAP
-	48.6159	13.0506	Aldersbach-Kriestorf	00073	P681	48.62	13.05	ALDERSBACH-KRIESTORF
-	51.9644	9.8072	Alfeld	07367	10442	51.97	9.8	ALFELD
-	52.4853	7.9126	Alfhausen	00078	E626	52.48	7.92	ALFHAUSEN
-	48.1479	9.4596	Altheim, Kreis Biberach	04189	Q771	48.15	9.47	BIEDLINGEN

1 2 3 4 5

variable COMMON_CDC_NAME=='Berlin-Tegel'

variable COMMON_MOSMIX_ID =='10382'

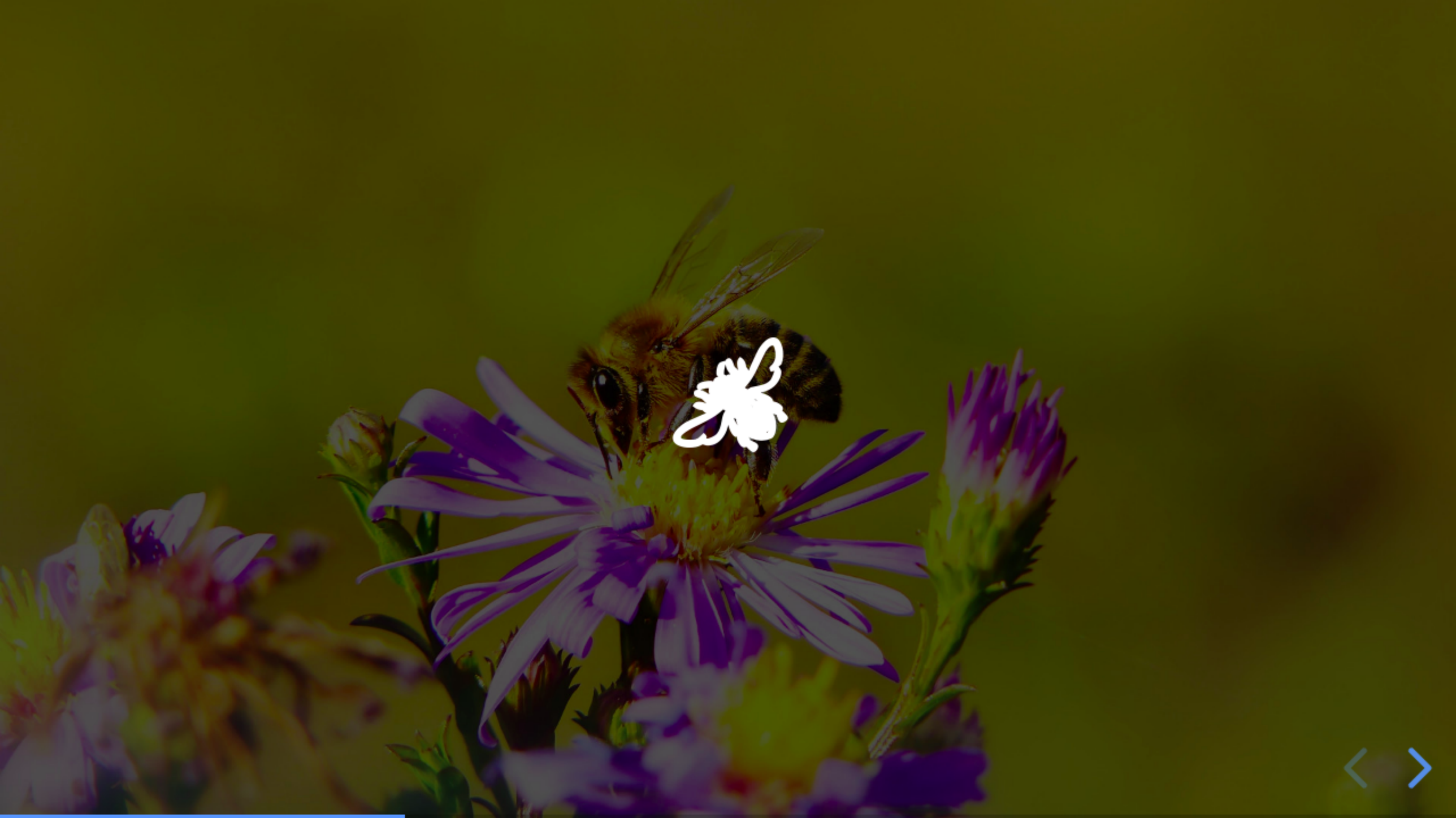
2nd challenge: (no) two equals are the same

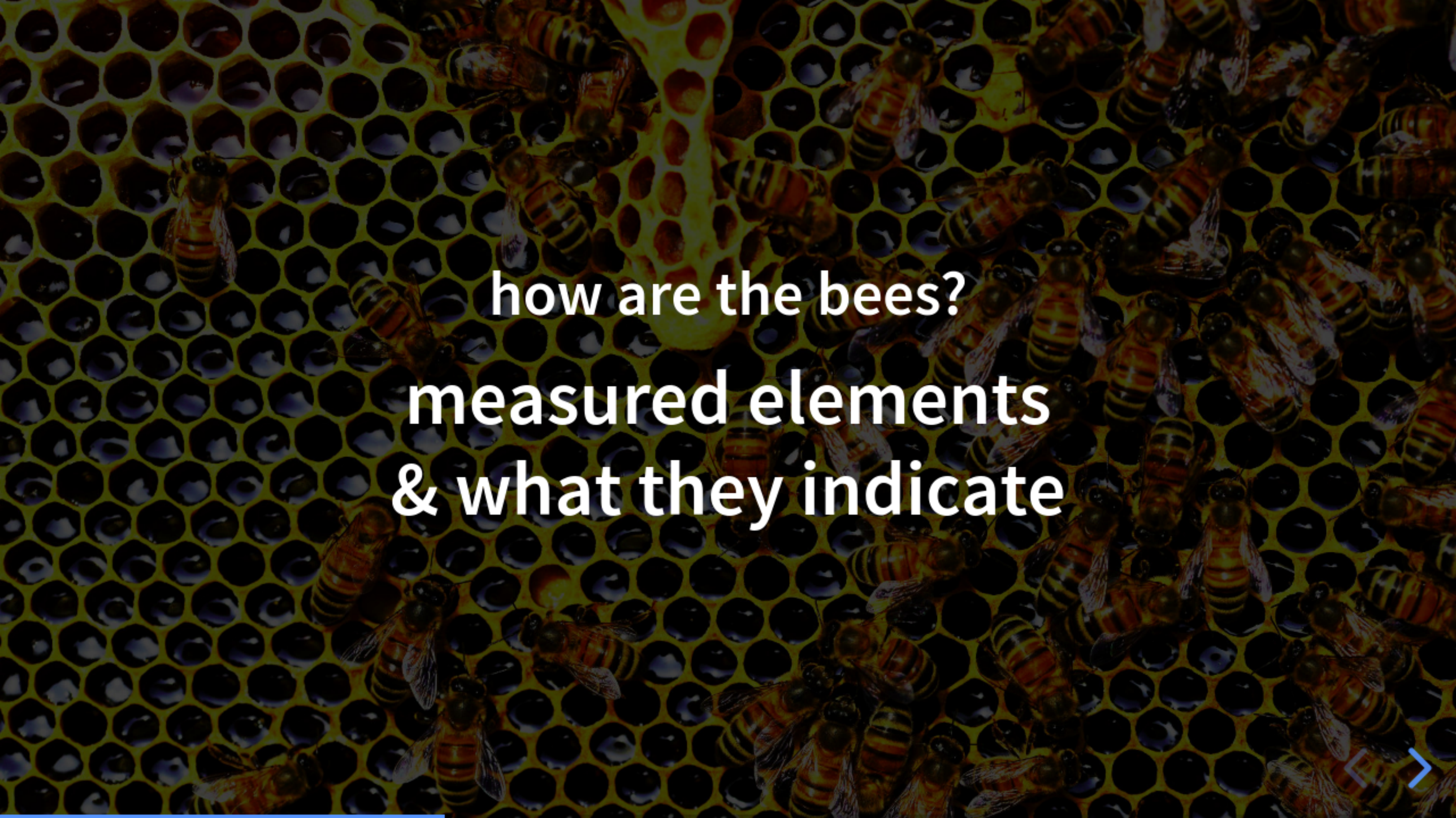
°C ≠ K -- but + 273.15 is

m/s ≠ km/h -- but × 3.6 is

sec/1hr ≠ min/10min -- but ÷ 3600 is

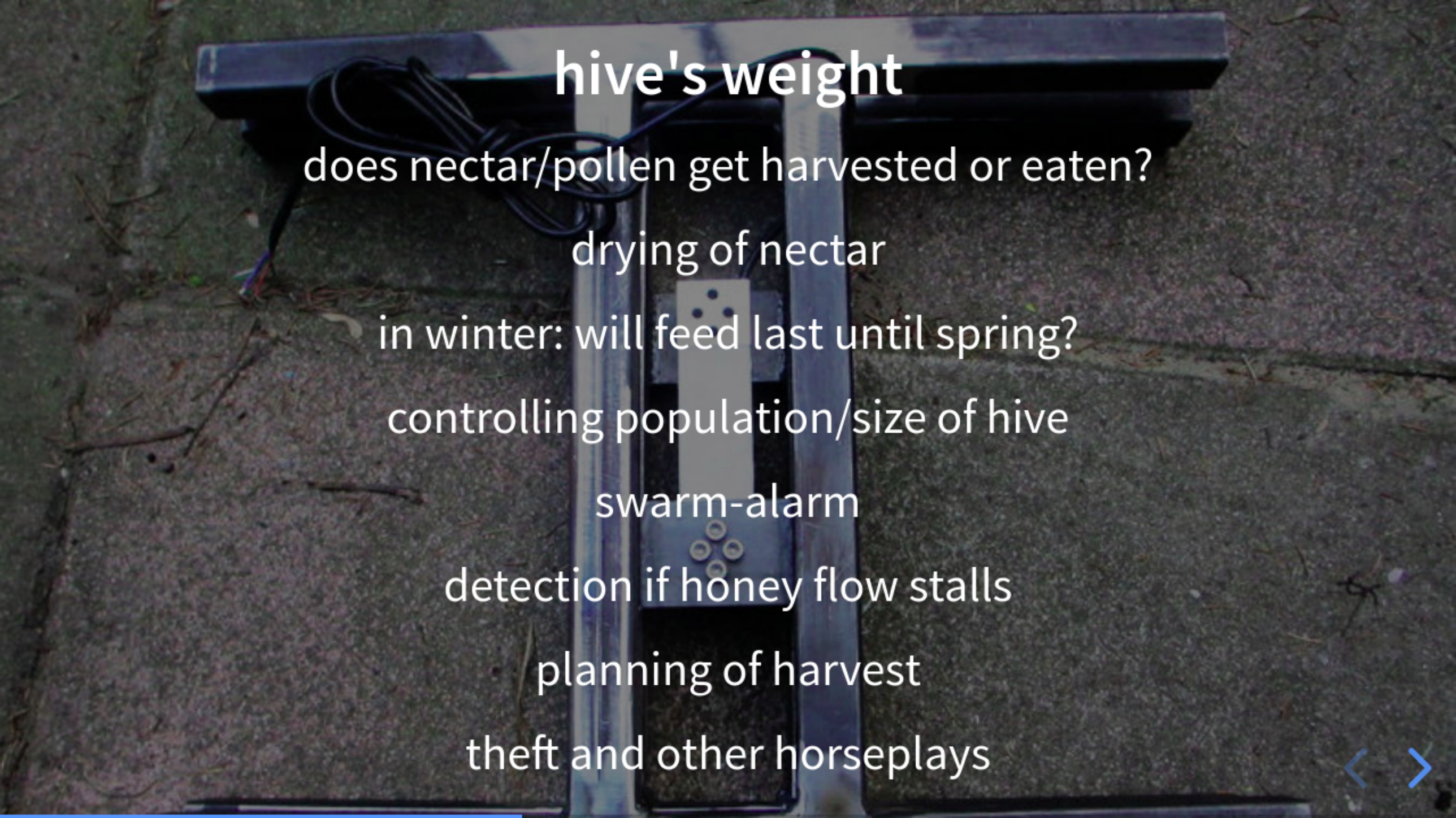
meteogram: past & future





how are the bees?

measured elements & what they indicate



hive's weight

does nectar/pollen get harvested or eaten?

drying of nectar

in winter: will feed last until spring?

controlling population/size of hive

swarm-alarm

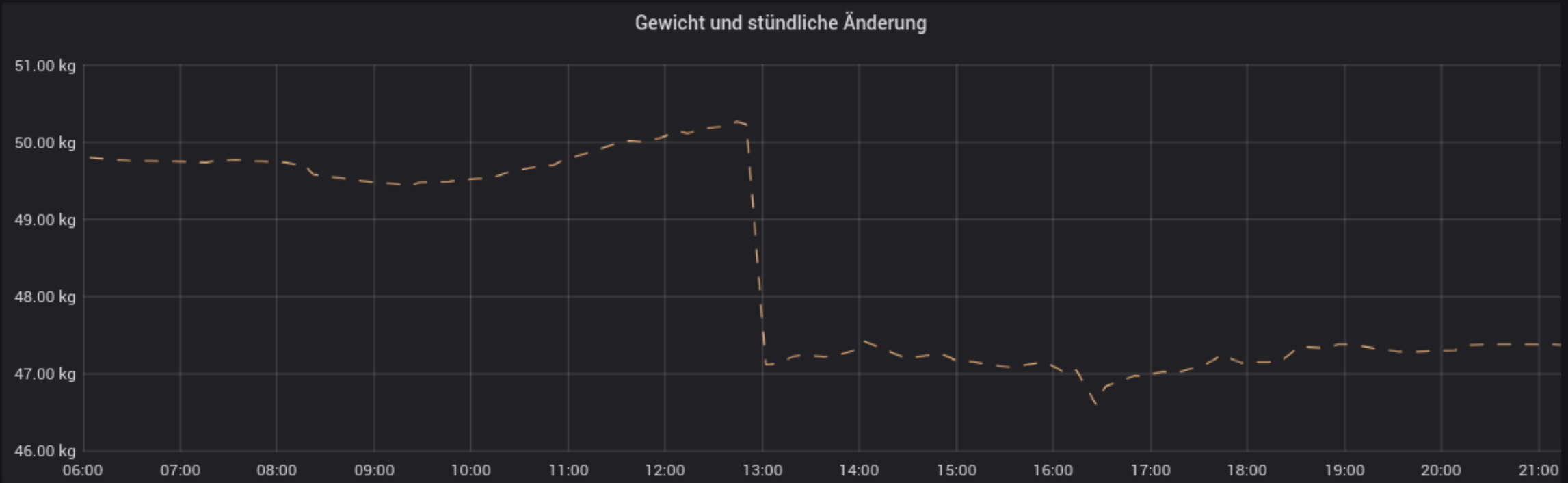
detection if honey flow stalls

planning of harvest

theft and other horseplays


scale and hive by karsten

latest swarm event



	min	max	current
Gewicht Total (temp.komp.)			
Gewicht Total (gl. Mittelwert)	46.89 kg	50.20 kg	47.39 kg
Gewicht Total (Rohdaten)	46.61 kg	50.26 kg	47.41 kg
Stündliche Gewichtsdifferenz (right-y)	-2.92 kg	292.00 g	50.00 g

weight of an untouched bee-hive

hive: Zentrum für Urbanistik, Berlin (no harvesting), 2019

temperatures & humidities

35±1°C inside hive? Brood: ✓! Queen: ✓!

mulitple sensors: position and size of brood-nest

planning of medical treatment

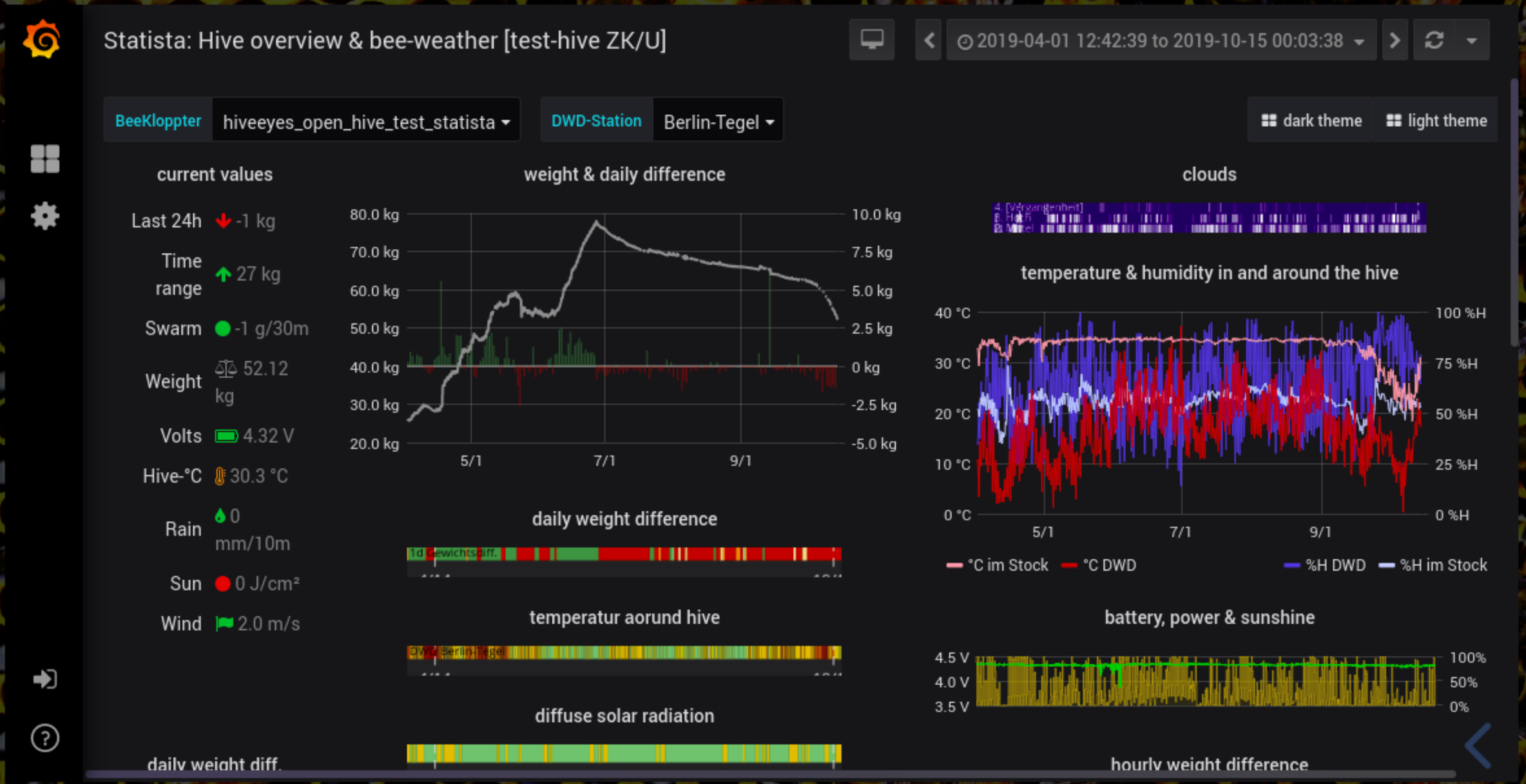
bee-weather: pre-flight conditions

as studied by german weather-service DWD

enough temperature, sun

not too much wind, rain

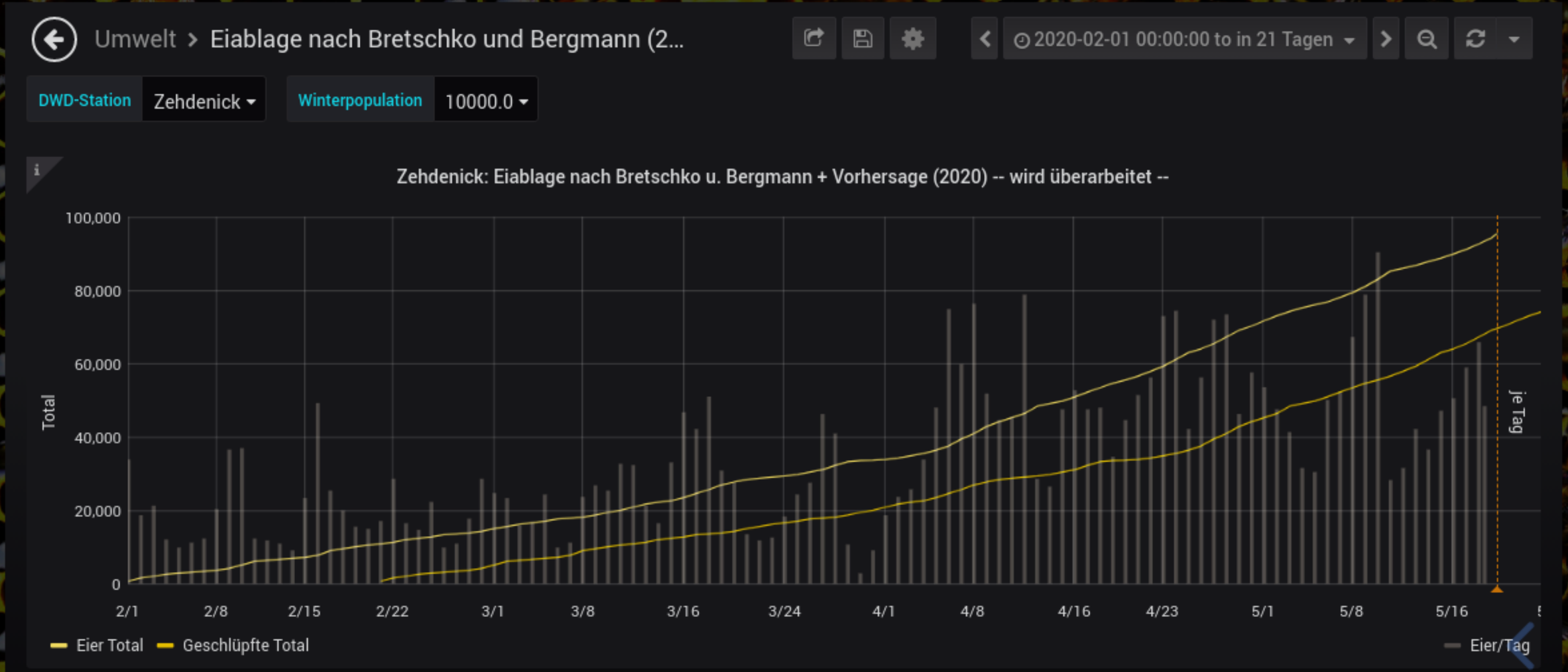
bee-hive & -weather dashboard



bee-hive & -weather dashboard

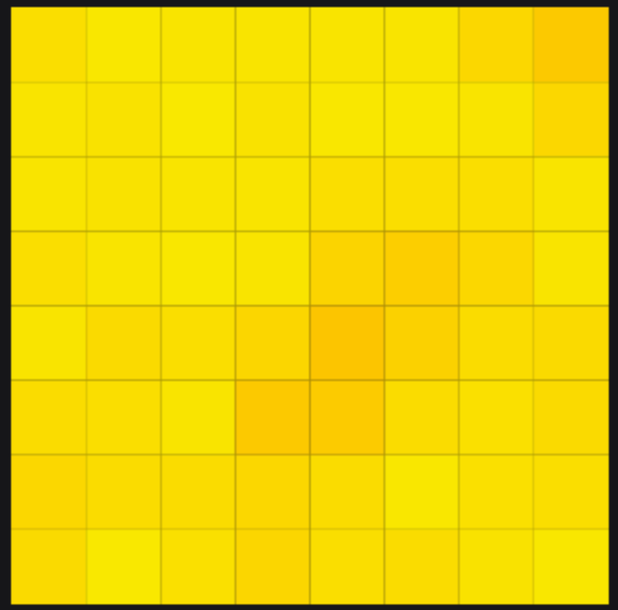
queen's egg laying rate

from temperature, according to Bretschko & Bergemann

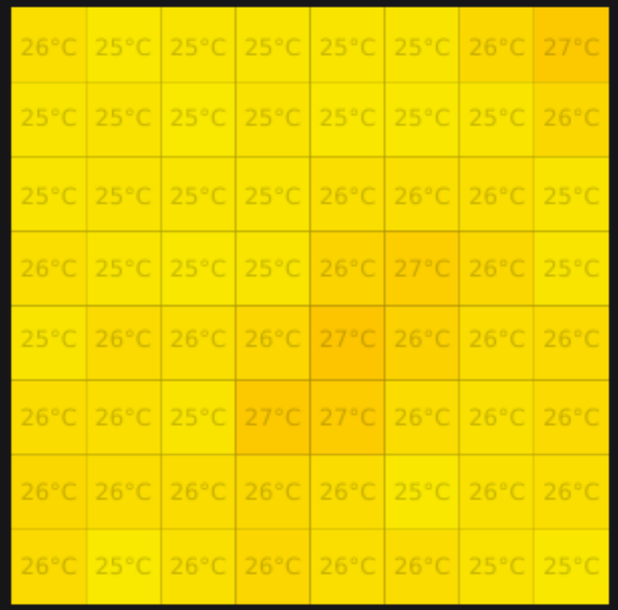


research: thermal image

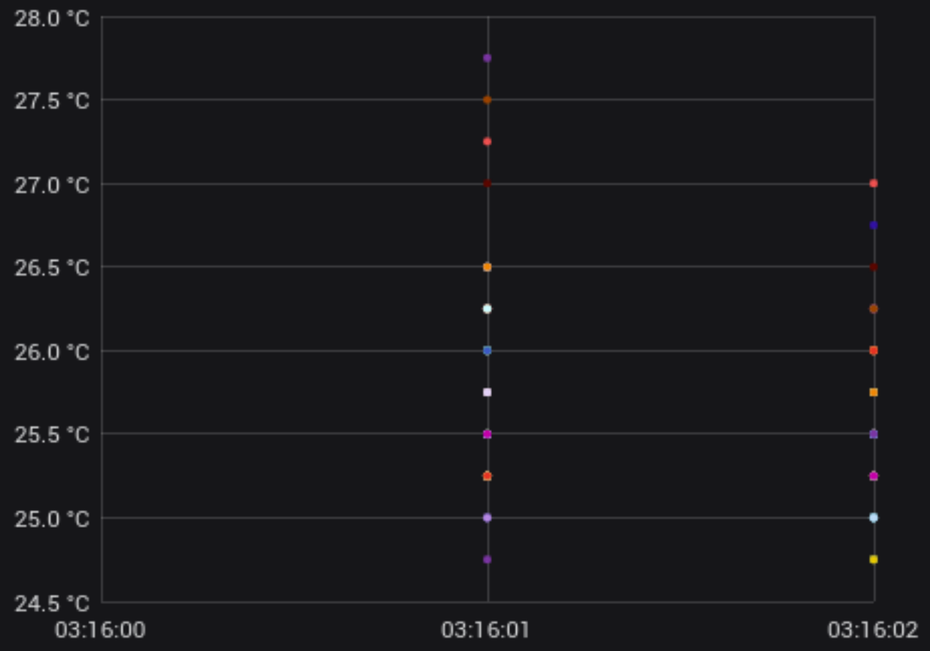
IR-Sensor SVG-Pixmap



IR-Sensor SVG-Pixmap text-test



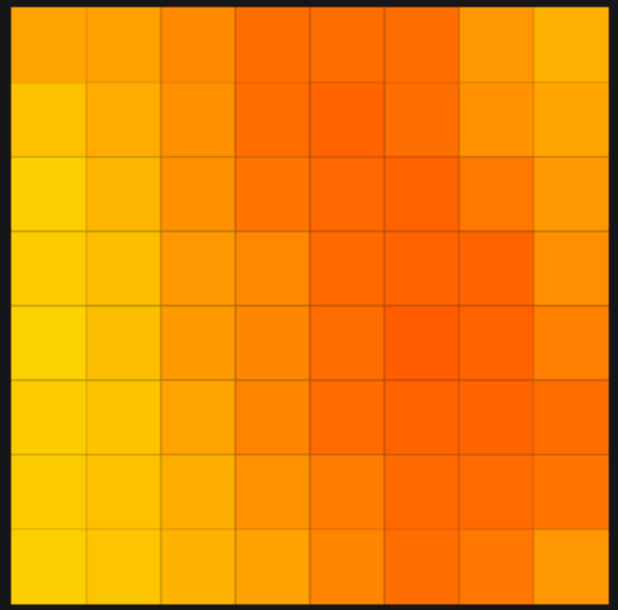
device=test1, site=default



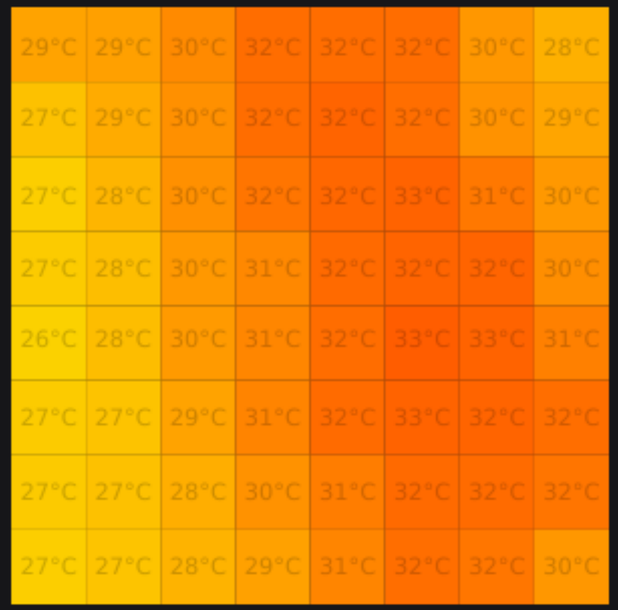
SVG-plugin by Marco Warm

research: thermal image

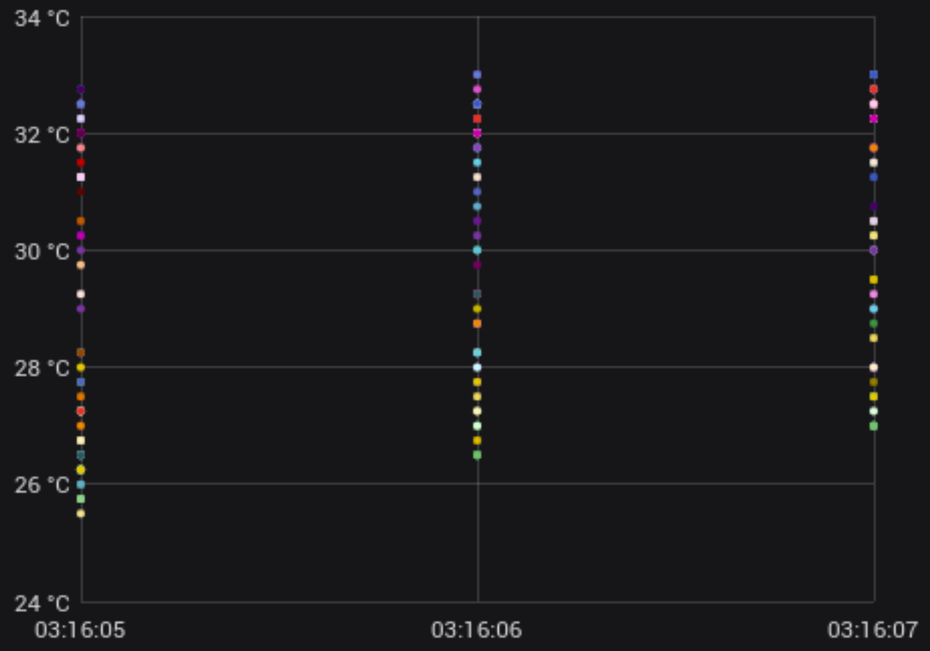
IR-Sensor SVG-Pixmap



IR-Sensor SVG-Pixmap text-test

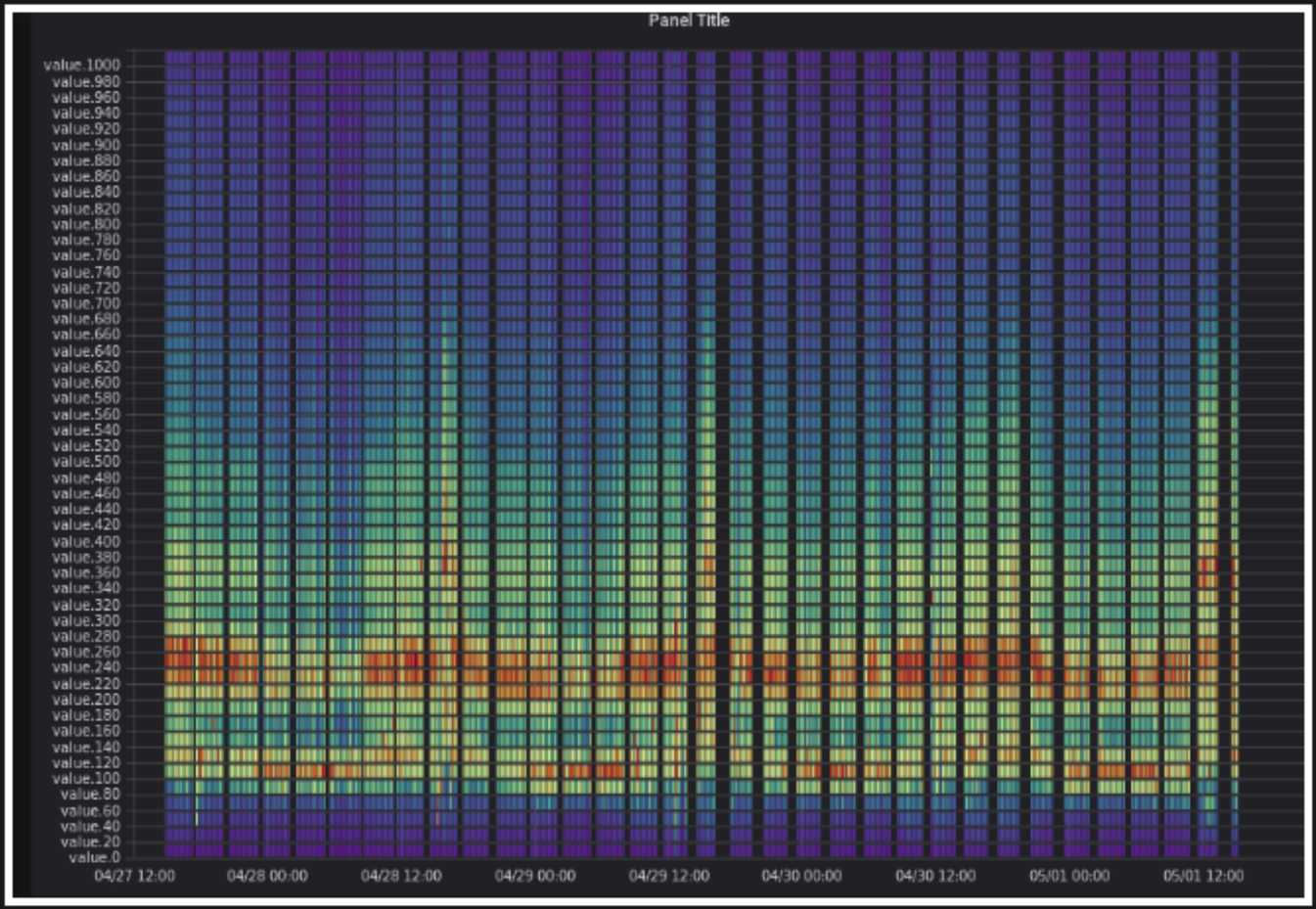


device=test1, site=default



SVG-plugin by Marco Warm

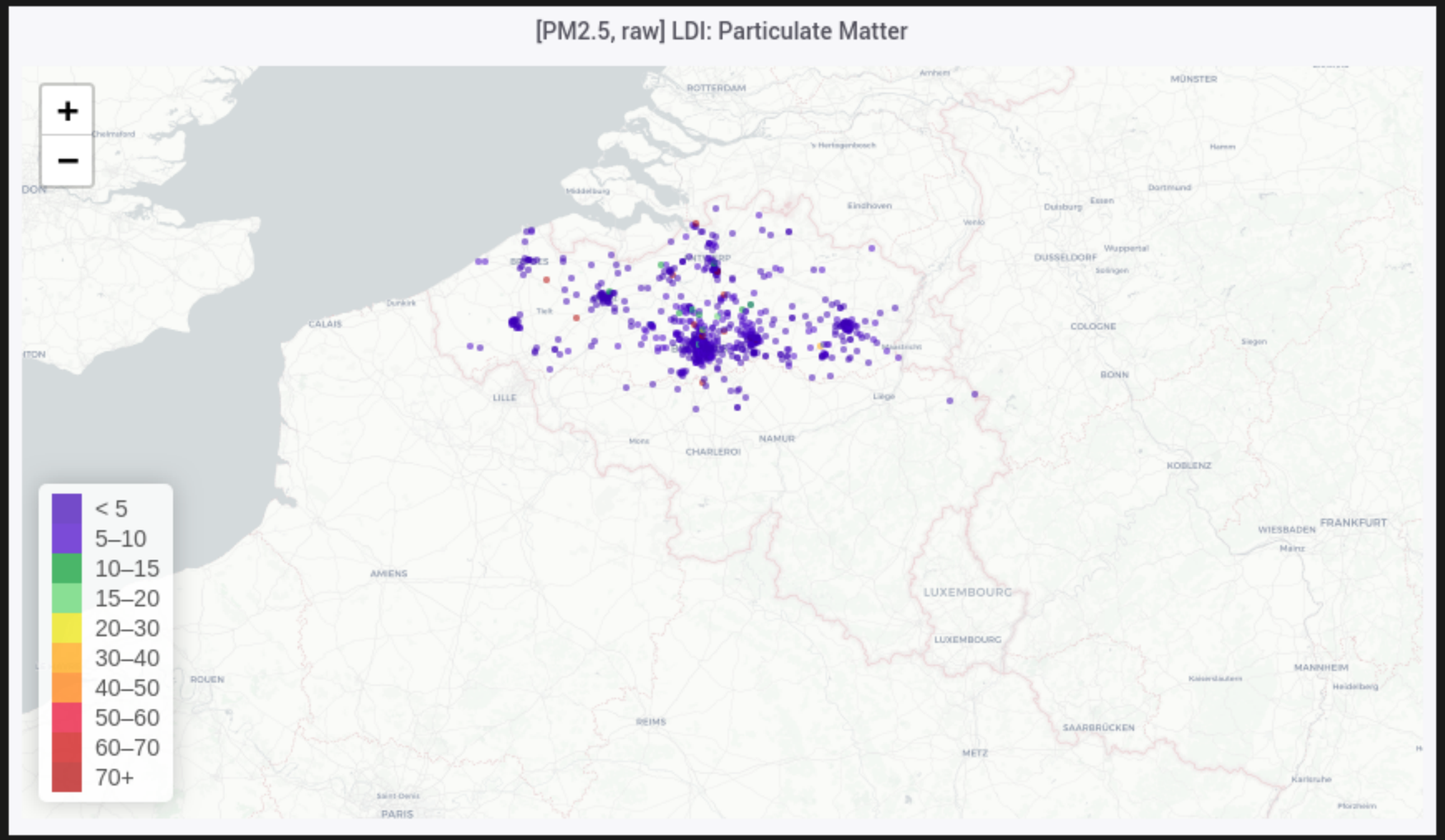
coming up: sound



Fast Fourier transform (FFT) < 1kHz of hive-sound with heatmap-plugin, by Diren

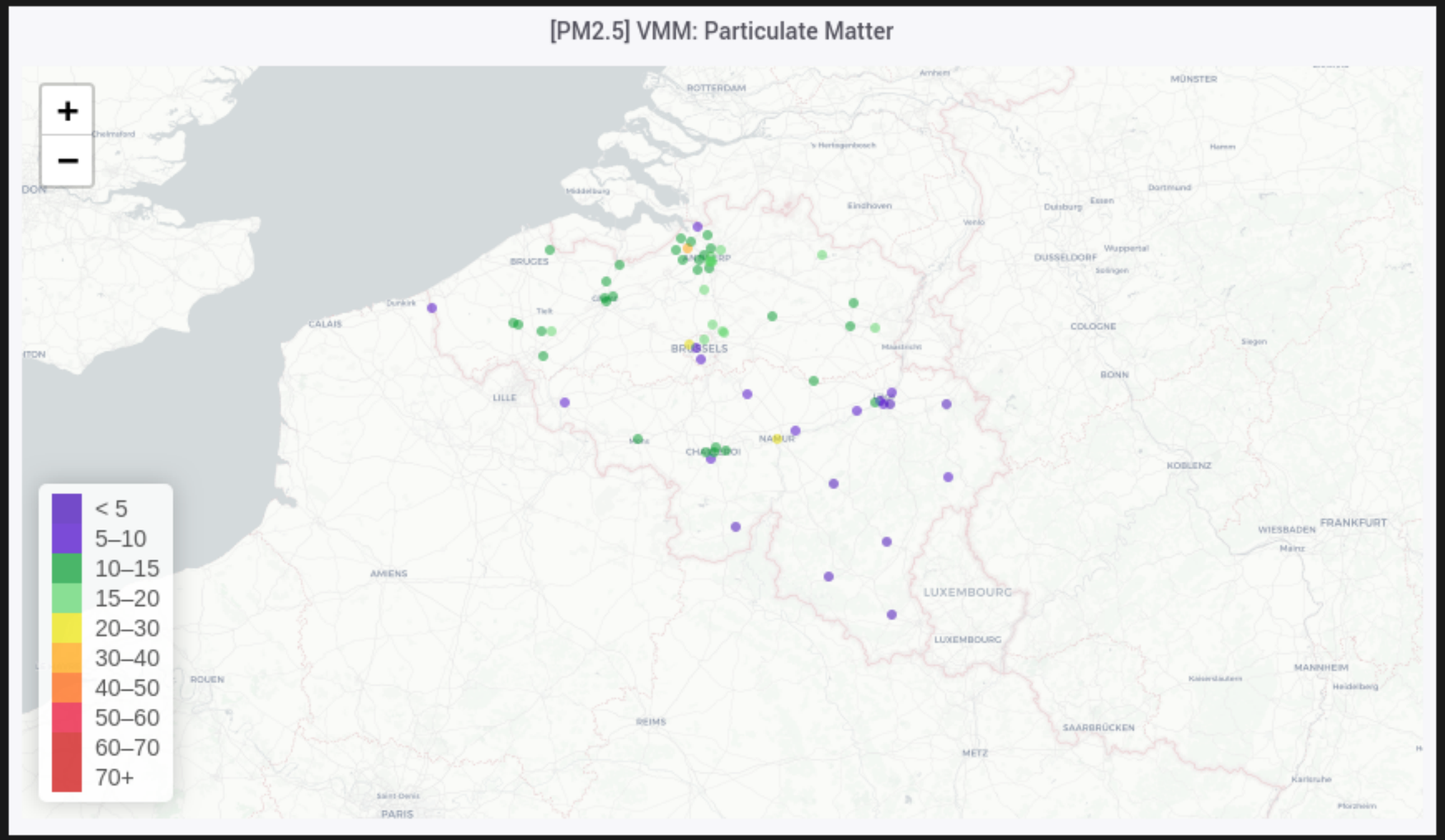
part #2: particulate matter (PM) comparing official and low-cost sensors

luftdaten.info (LDI) import & worldmap panel

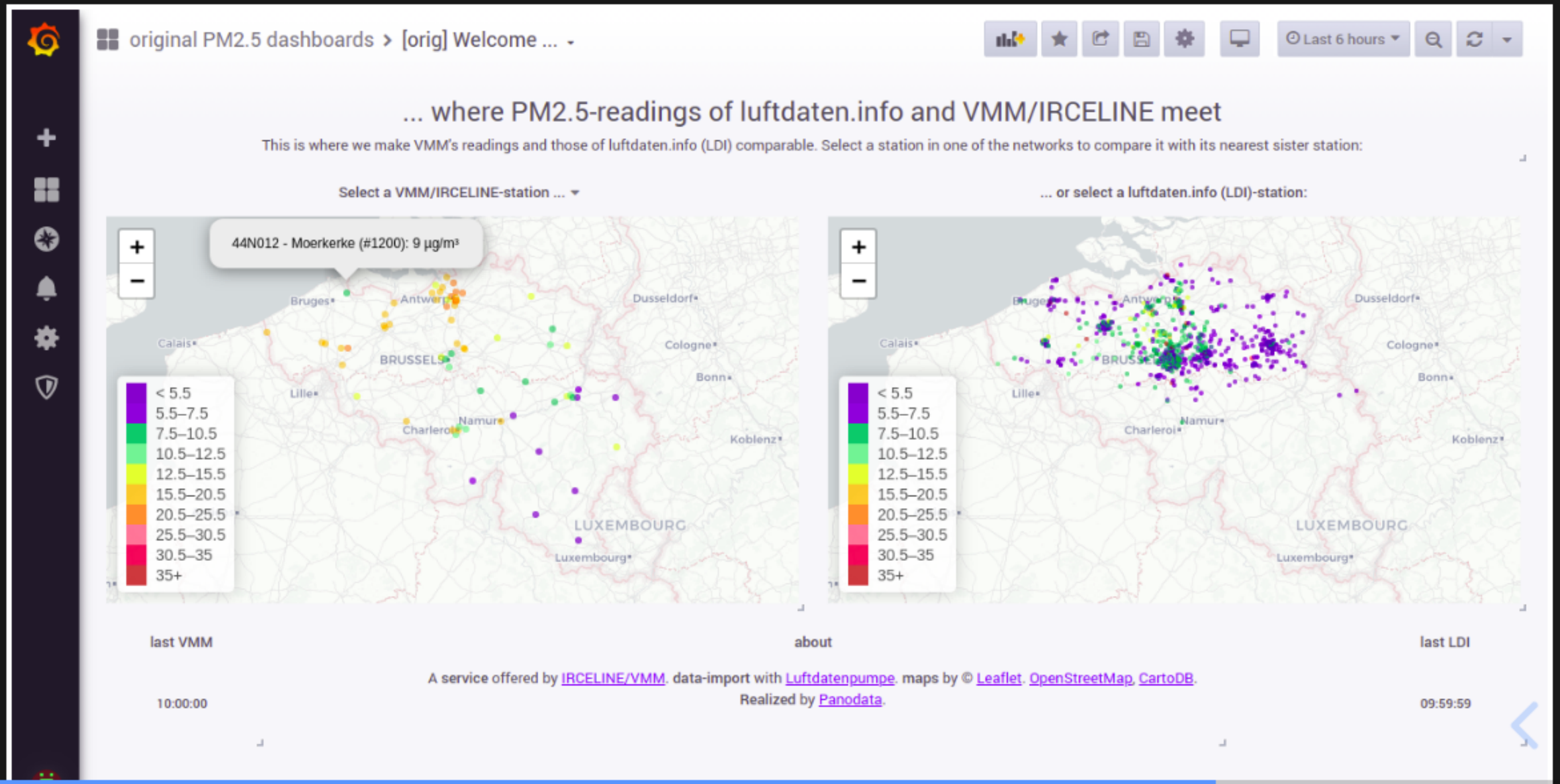


official	low-cost
e.g. Grimm EDM180	e.g. Nova SDS011

VMM/IRCELINE (Belgium): SOS Import



combined overview of both networks



compare view across both networks

bias of laser-scatter sensors for PM

vapour-particles are detected, too

assumption: values need compensation at high humidities

obviously underestimates, too

common low-cost humidity-sensors

DHT22

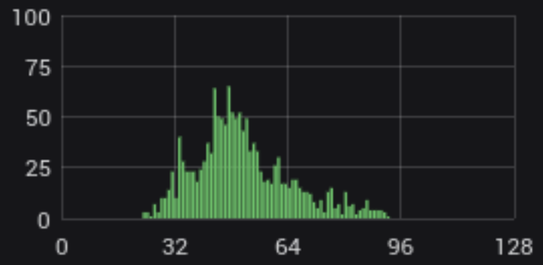
BME280

humidity data comparsion: offical with low-cost

Humidity-compare: DWD ./. LDI's BME280 & DHT22. last 2h

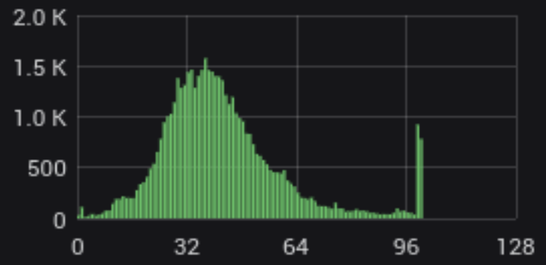
Germany: Deutscher Wetterdienst (DWD) ./. luftdaten.info (LDI). Alle Einzelwerte werden über die Zeit von 115 bis 130min vor Ende des ausgewählten Zeitraums gebildet, um eine vergleichbarere "Live"-Ansicht mit den bis zu 2h verzögerten Daten des DWDs zu erhalten.

DWD Feuchte Verteilung Last 2 hours



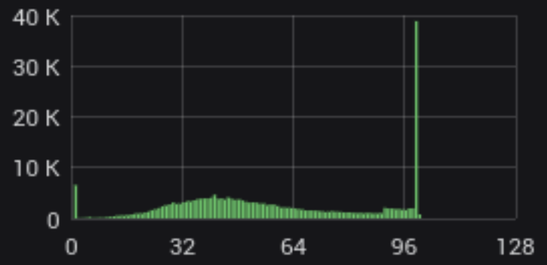
DWD>...

LDI BME280 Feuchte Verteilung Last 2 hours



BME2...

LDI DHT22 Feuchte Verteilung Last 2 hours

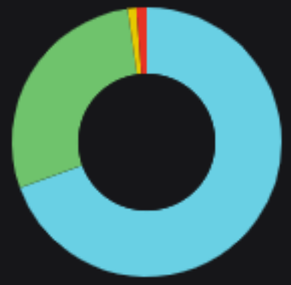


DHT2...

LDI: benutzte Feinstaub-Sensoren

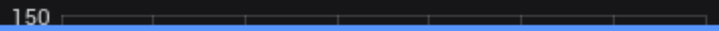
	total	percentage
SDS011	15971	97.1%
PMS5003	299	1.8%
PMS7003	148	0.9%
PMS3003	8	0.0%
PPD42NS	7	0.0%
SDS021	7	0.0%
PMS1003	7	0.0%

LDI: benutzte Temperatur(/Feuchte)-Sensoren

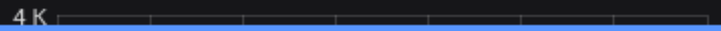


	total	percentage
DHT22	10486	69%
BME280	4269	28%
BMP180	153	1%
BMP280	139	1%
HTU21D	29	0%
DS18B20	17	0%
DHT11	1	0%

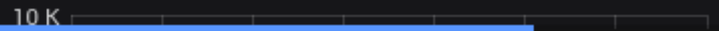
DWD Feuchte Verteilung <99%



LDI BME280 Feuchte Verteilung <99%



LDI DHT22 Feuchte Verteilung <99%



concliusio

let's use official humidity data

using PostGIS for meta-data due to nearest-neighbour-search

```
SELECT station_id FROM ldi_network WHERE sensor_type_name = 'SDS011' ORDER BY
geopoint <-> 'POINT($irceline_station_lon $irceline_station_lat)' LIMIT $limit;
```

actual compensation done in InfluxDB/flux-lang

```
import "math"

PM2.5 = from(bucket:"luftdaten_info")
  |> range(start:-7d)
  |> filter(fn: (r) =>
    r._measurement == "ldi_readings" and
    r._field == "pm-2-5" and
    r.sta_name == "$ldi_id"
  )
  |> aggregateWindow(every: 1h, fn: mean)

humidity = from(bucket:"vmm")
  |> range(start:-7d)
  |> filter(fn: (r) =>
    r._measurement == "irceline_readings" and
```

actual compensation done in InfluxDB/flux-lang

```
  |> range(start:-7d)
  |> filter(fn: (r) =>
    r._measurement == "irceline_readings" and
    r._field == "humidity" and
    r.sta_name == "$irceline_id"
  )
  |> aggregateWindow(every: 1h, fn: mean)

join(tables: {pm: PM2.5, hum: humidity}, on: ["_time"])
  |> map(fn: (r) => ({
    _time: r._time,
    _value:  r._value_pm / math.pow(x: 1.0-(r._value_hum*0.01), y: -0.3),
    _field: "PM2.5 (luftdaten.info), humidity-corrected with Hänel-formula"
    }))
```

expert-view with humidty-compensation

ideas & wishes

Thanks.

The Hiveeyes Project

https://hiveeyes.org/

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