TECHNISCHE UNIVERSITÄT DRESDEN

[UC]² Urban Climate Under Change
Stadtklima im Wandel

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DRESDEN concept

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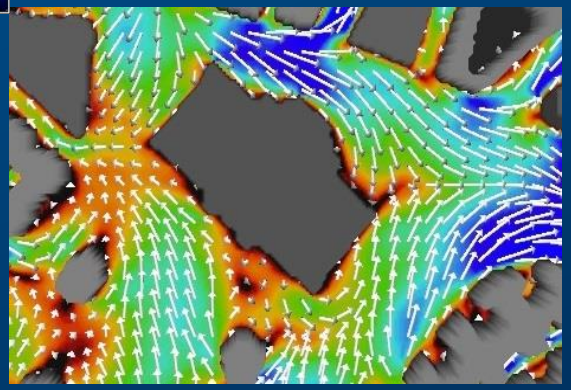
# Cumulative thermal exposition of pedestrians and bikers in an urban environment

Team during the field work in Berlin, summer 2017, 2018

Validation

Application



PALM-4U

ICUC10, New York
August 10, 2018

related presentations:
**2A.5**, 3B.2 , 35, 3E.1, 4E.5 , 5D.1, 9C.3 , 9C.4, 12D.8, 13D.4

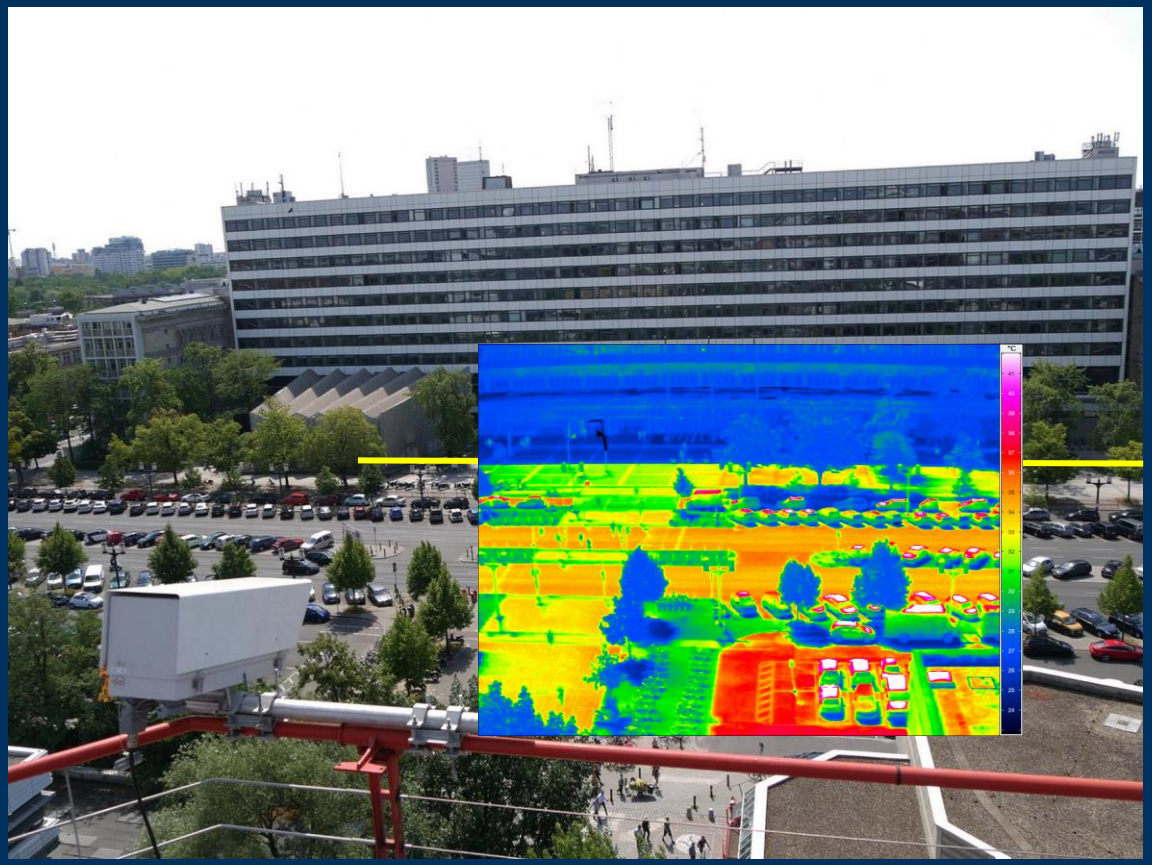
# Task

**2) Data for evaluation**
Comparison with numerical models has two constraints:
- resolution of the simulation
- ideal conditions (e.g. other clouds)

**3) Thermal comfort**
State of the art are indices for stationary situations. How to account for changing conditions?

**1) Setup (**mobile measurement)
How to gain reliable data with high spatial resolution?

scale of significant environmental changes **~ 1m**

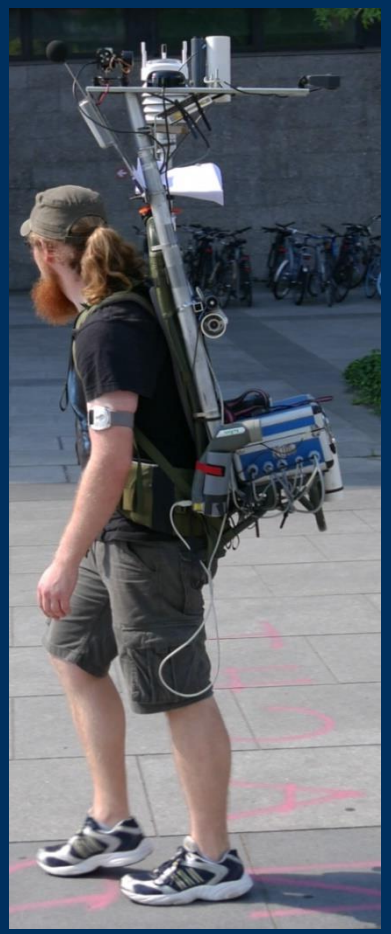


# Mobile platforms

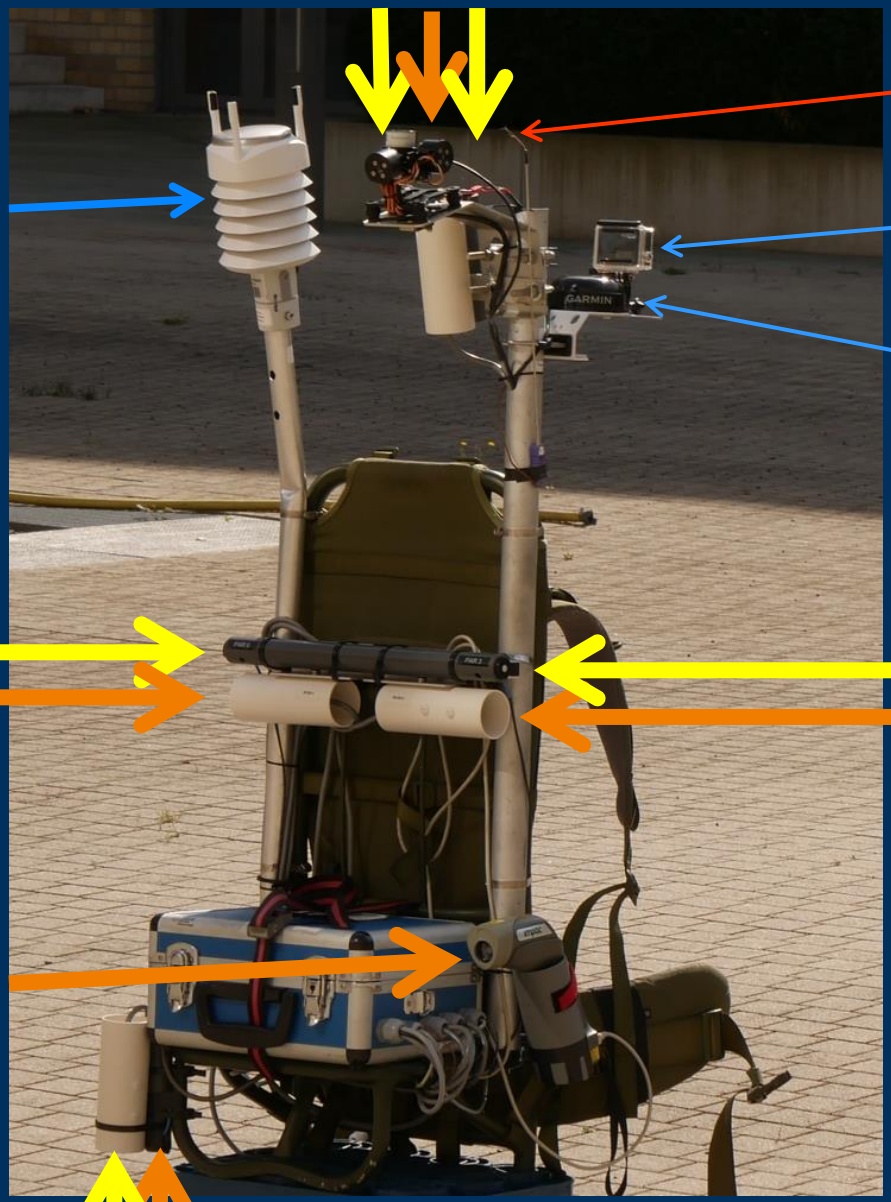
## Backpack and Bicycle

Intensive observation periods: Summer 2017 / 2018

- measurement frequency 1Hz
- multidirectional radiation, short- and longwave
- wind
- temperature,
- humidity
- GPS
- action cam
- body functions
- 25 runs (140 km / 550 km)



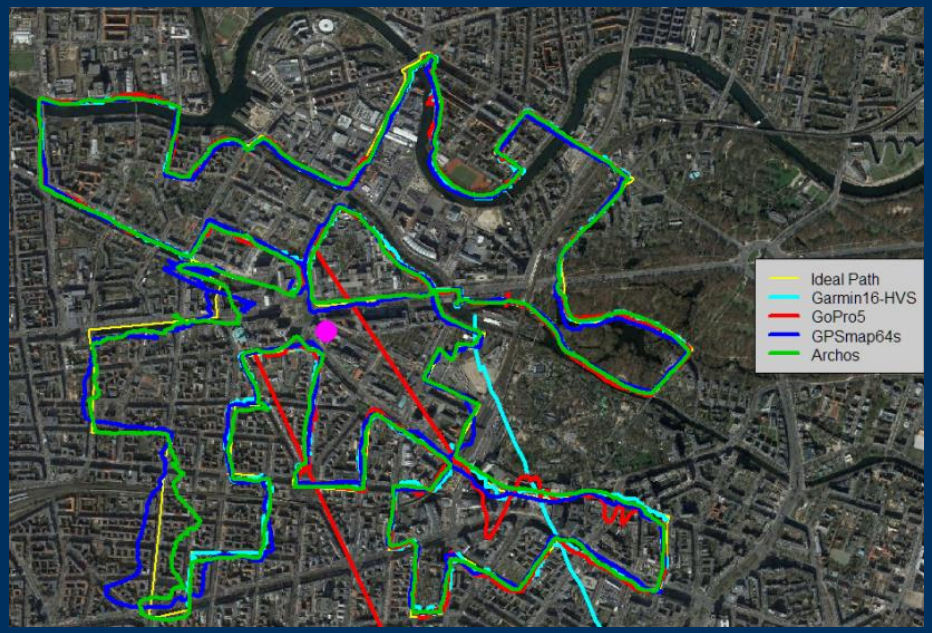
**Setup**
Backpack

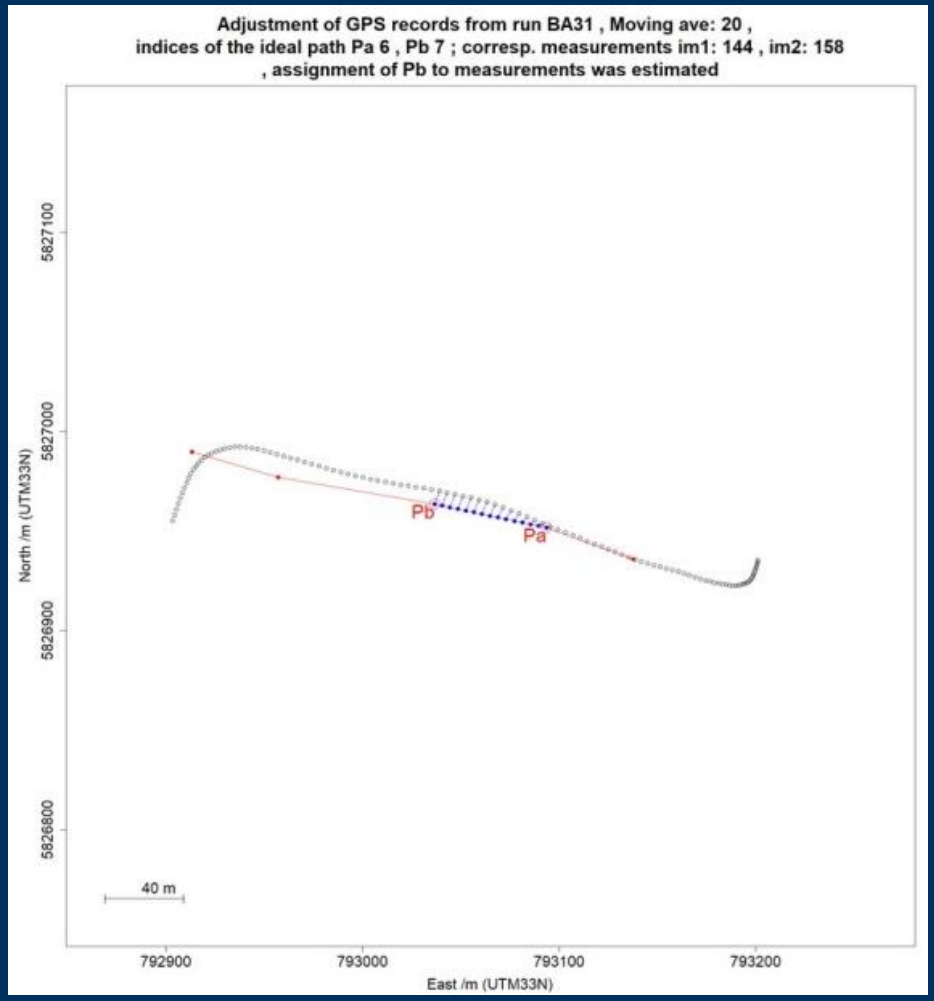


# Problems

**Are there other solutions?**

- GPS does not work properly within cities (~~DGPS, RTK~~)
- Determination of the tracks using maps and photos
- Fitting of the GPS records



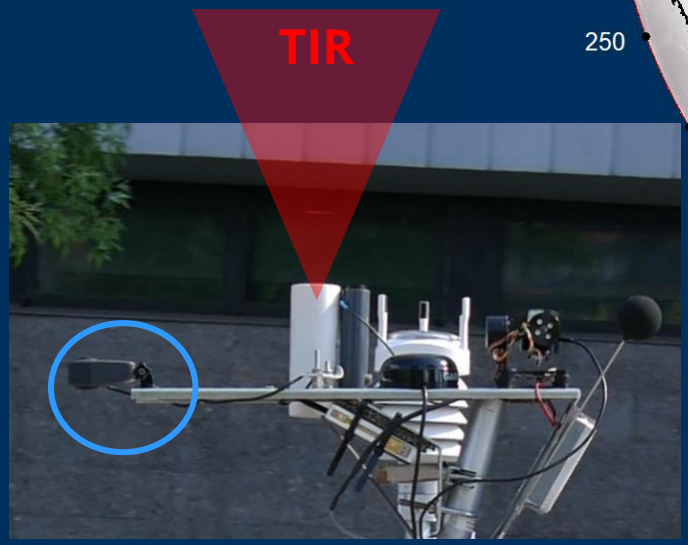



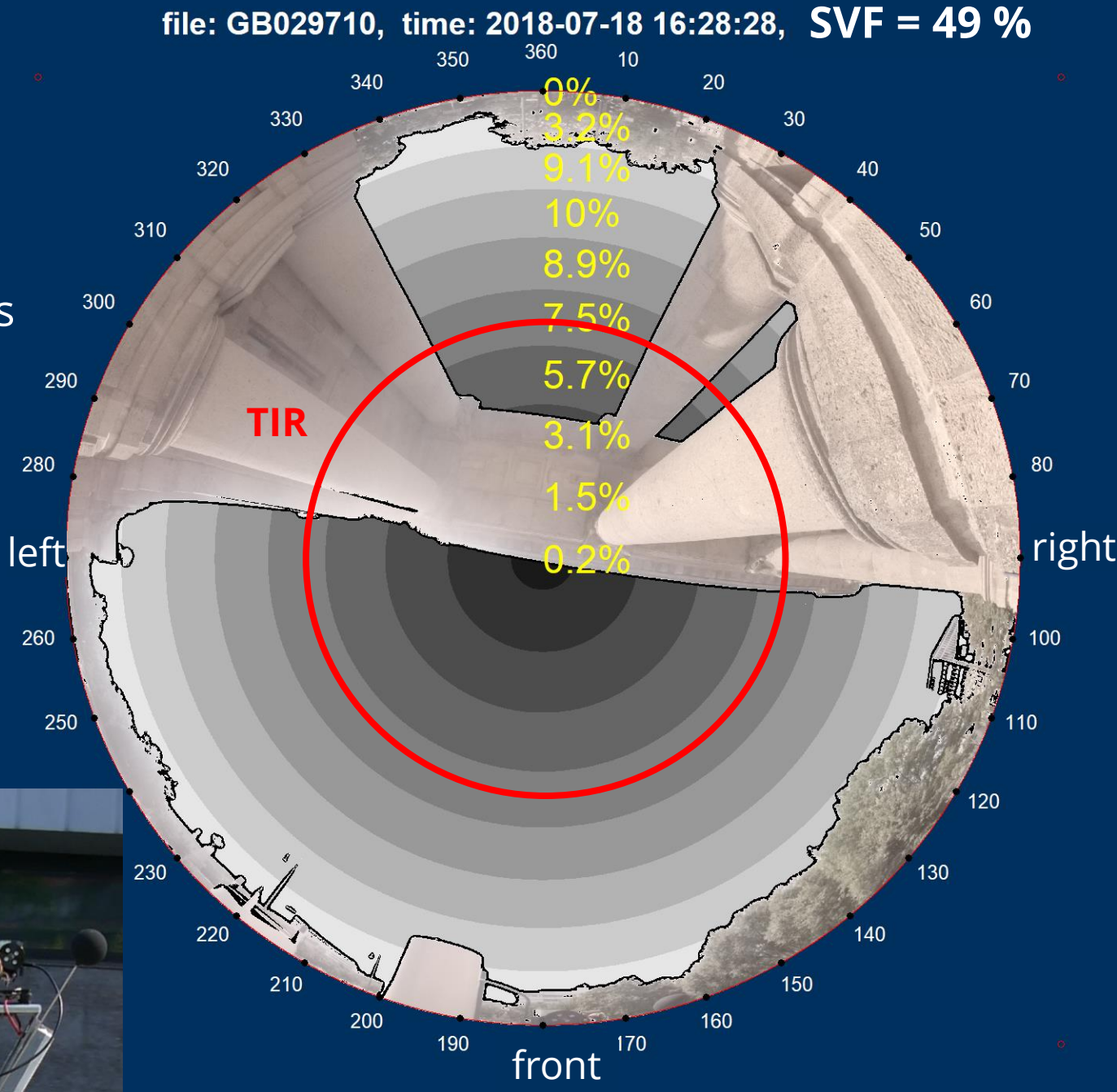
## Camera recordings:

- GoPro 3, 5 and  Fusion (360°, only 2018)
- exact position for each second
- weather conditions

# 360° Camera

- exact position of the system
- weather conditions
- sky view factor
- view of the radiation sensors



# Data for Evaluation

➔ high spatial variability

**Bicycle, 2017-07-18 10:30, color: Tmrt, size: turb. exchange ( 1/(1+u*vpd)**

# Data for Evaluation

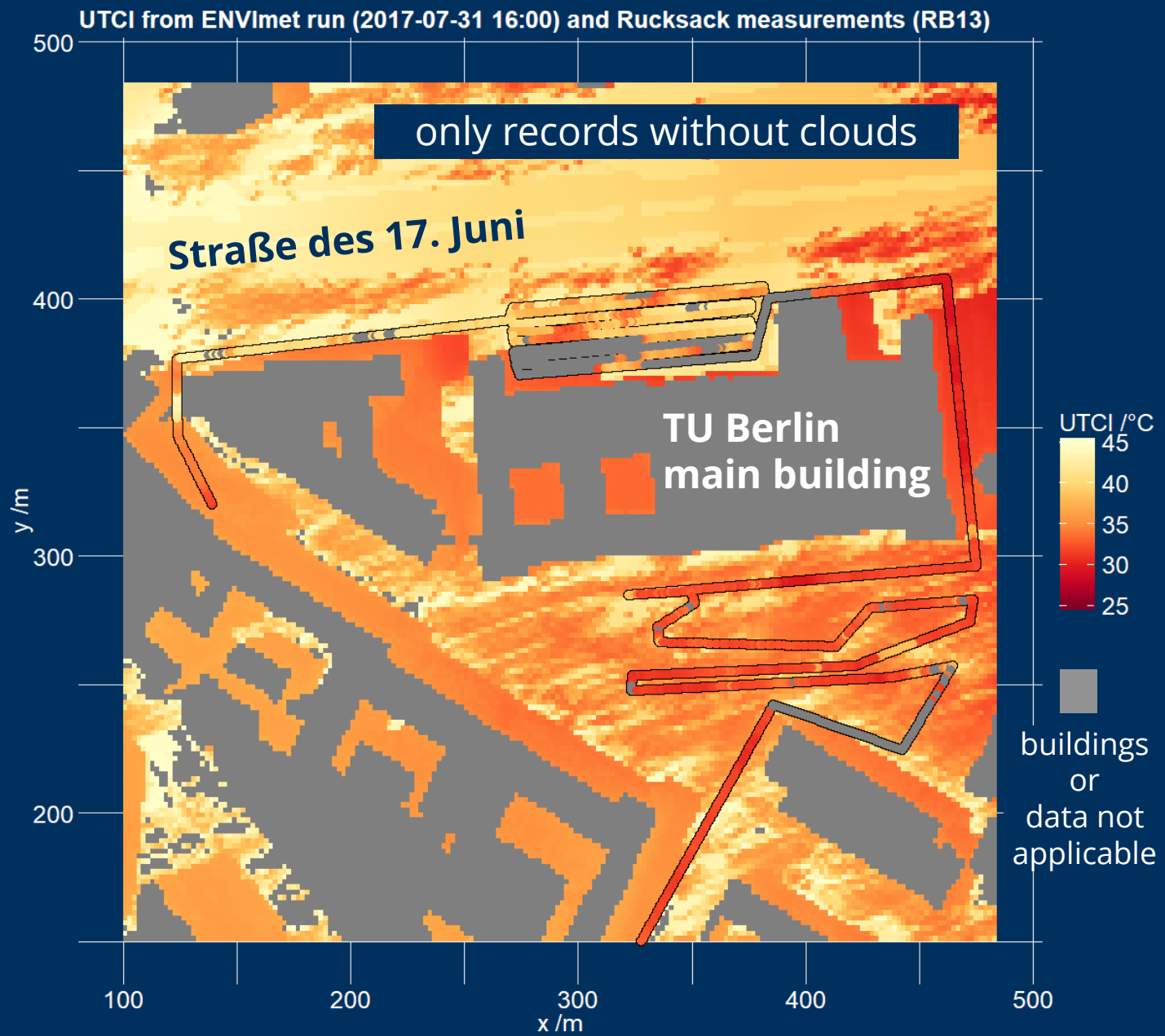
Example given by the urban climate model ENVImet

UTCI
Universal Thermal Climate Index

Asphalt is cooler than the pavement?

Sharper changes in the model results?

Measurements seem cooler due to airflow caused by the movement of the pedestrian



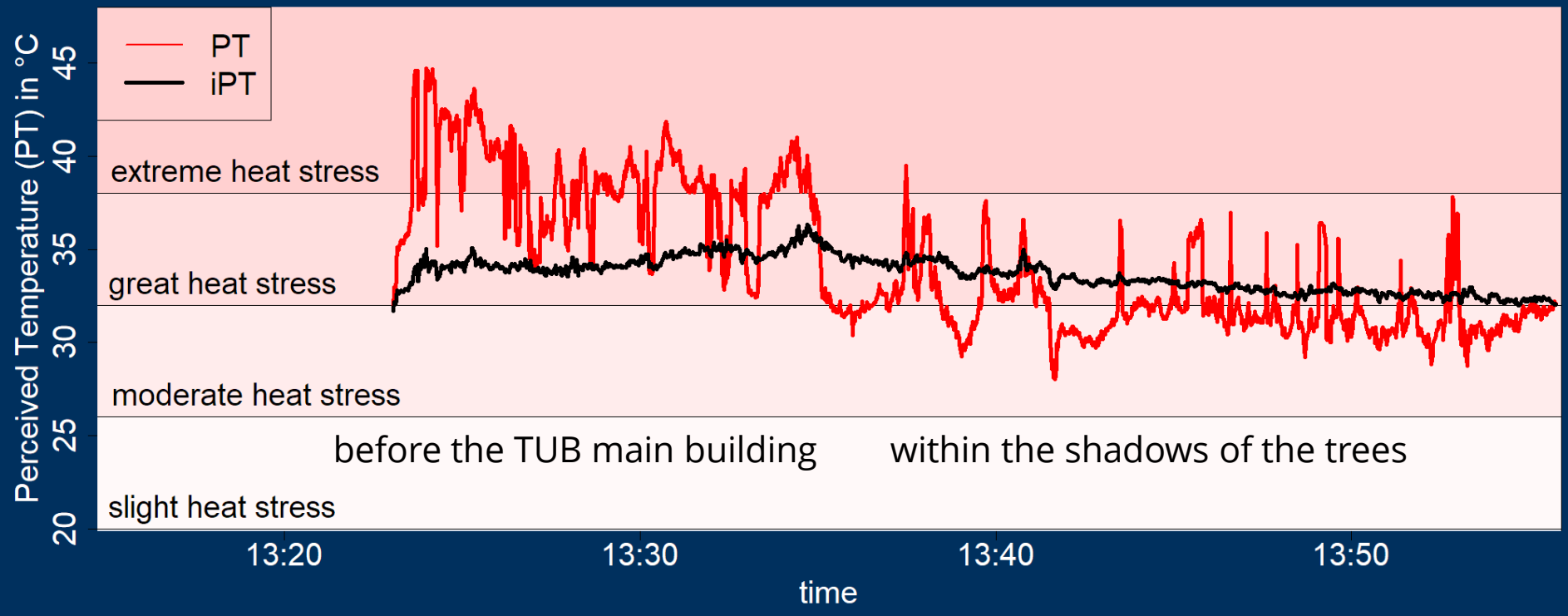
# **Thermal Comfort:** Test of the HTCM of PALM-4U

Human Thermal Climate Module – HTCM (Fröhlich, Matzarakis, DWD)

In-stationary approach: additional heat storage for body and clothing

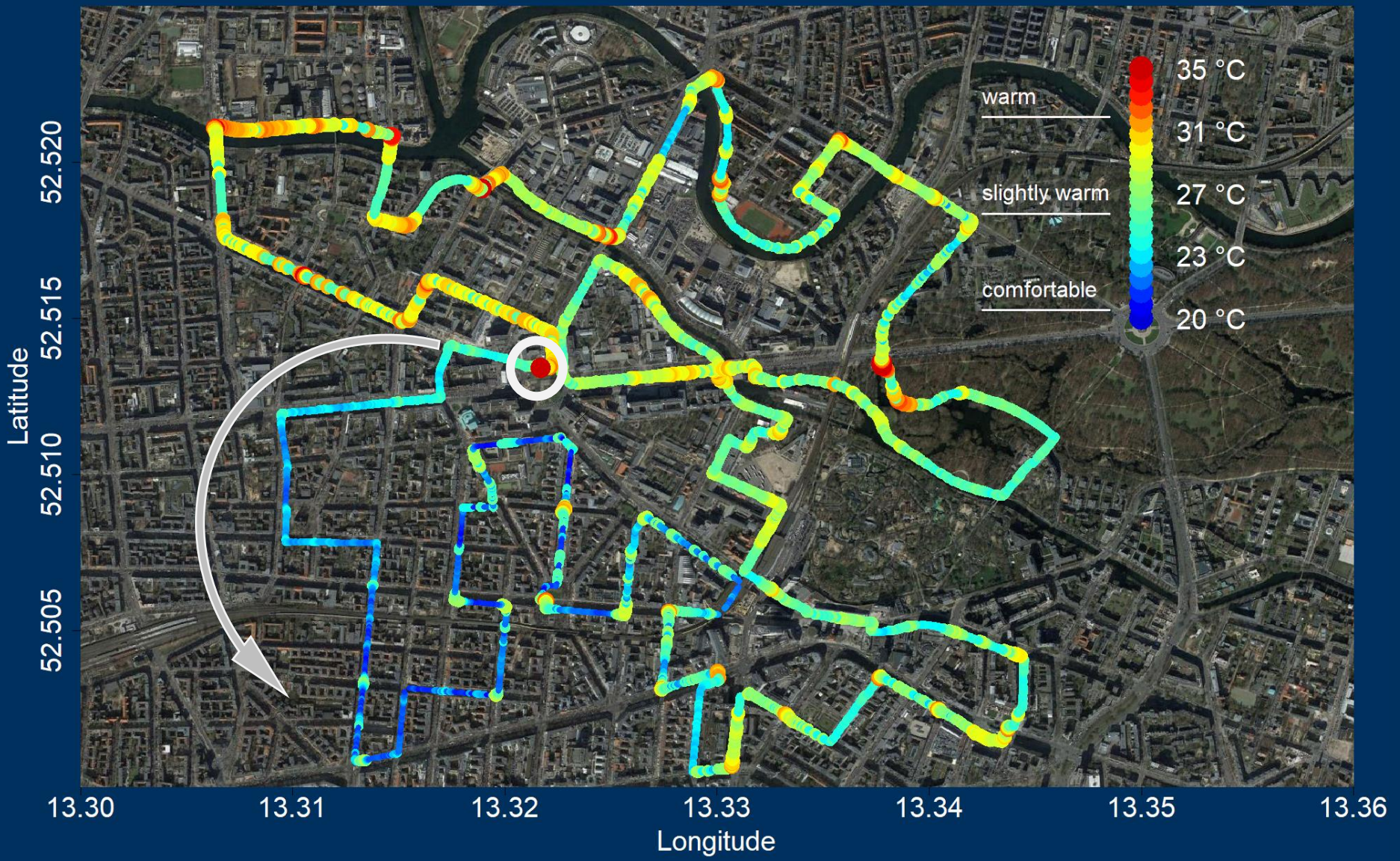
## **Perceived Temperature: PT ➔ iPT**

Backpack, 2017-07-31 16:00



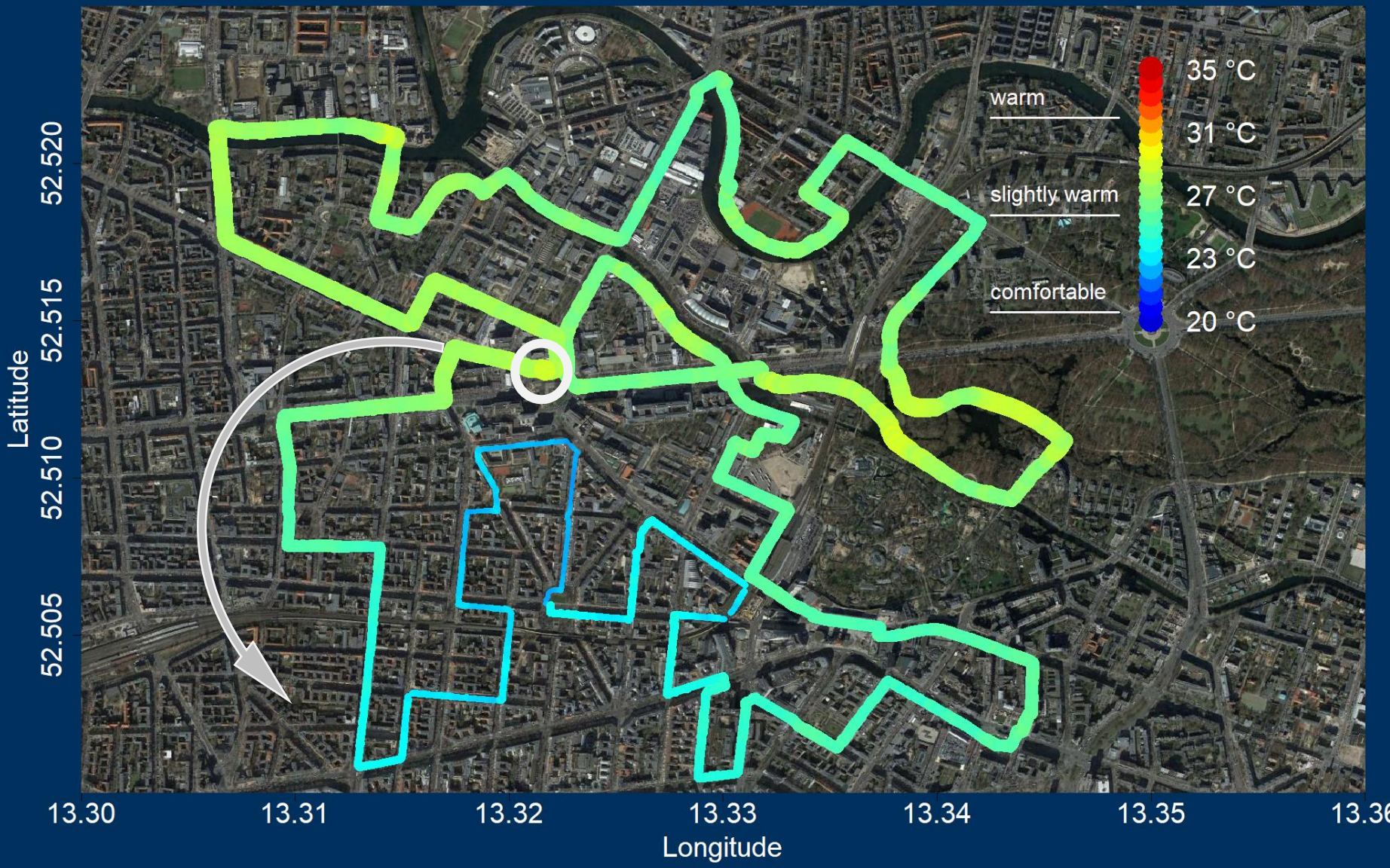
# **Thermal Comfort:** Test of the HTCM of PALM-4U

**Bicycle, 2017-07-18 10:30,  Perceived Temperature - PT**



# **Thermal Comfort:** Test of the HTCM of PALM-4U

## Bicycle, 2017-07-18 10:30, integral Perceived Temperature - iPT



# Summary

- setup and methods for mobile measurements with high spatiotemporal resolution
- selection of measurements within a major European city for model evaluation
  (see http://uc2-program.org/ for access)
- tests of the Human Thermal Comfort Module of PALM-4U

# Selected observed features

- thermal factors have a high spatiotemporal variability
- the suggested in-stationary iPT introduces a memory for the received heat and smooths the thermal factors strongly
- However, experimenters report that heat stress for cyclist cumulates on some parts of the track and at crossings seriously.
  (Is this important for attentiveness disorder at crossings?
  What is the effect of these stress peaks on our cardiovascular system?)

# Investigation area

representative data for a special location - but also covers the typical cruising radius of city residents was developed and tested in the summer IOP 2017 in Berlin.