Relationship between Land Use and Microclimate based on Mobile Transect Measurements

Kathrin Häb[1], Ariane Middel[2], Benjamin L. Ruddell[3]

[1] Computer Graphics and HCI Group, TU Kaiserslautern, Germany
[2] School of Geographical Sciences and Urban Planning, Arizona State University, USA
[3] Fulton School of Engineering, Arizona State University, USA

Computer Graphics and HCI Group
AG Computergrafik und HCI

Technische Universität Kaiserslautern

ASU Decision Center for a Desert City
Arizona State University

Introduction

Mobile transect measurements in urban climatology result in a complex data set:

- Spatially dependent, multivariate, time-varying, and afflicted with uncertainties

Possible research topics:

- Canopy-Layer Urban Heat Island
- Park Cool Islands
- Impact of certain land-use configurations on the urban microclimate
- Derive implications about thermal comfort

Relate observations to surrounding land use and land cover

Background: TraVis

Data preprocessing

Geospatial Visualization

Data Analysis and Exploration

Häb et al. (2015): TraVis – A Visualization Framework for Mobile Transect Data Sets in an Urban Microclimate Context. In *Proceedings of the IEEE PacificVis*, Hangzhou, China, 2015.

Background: TraVis

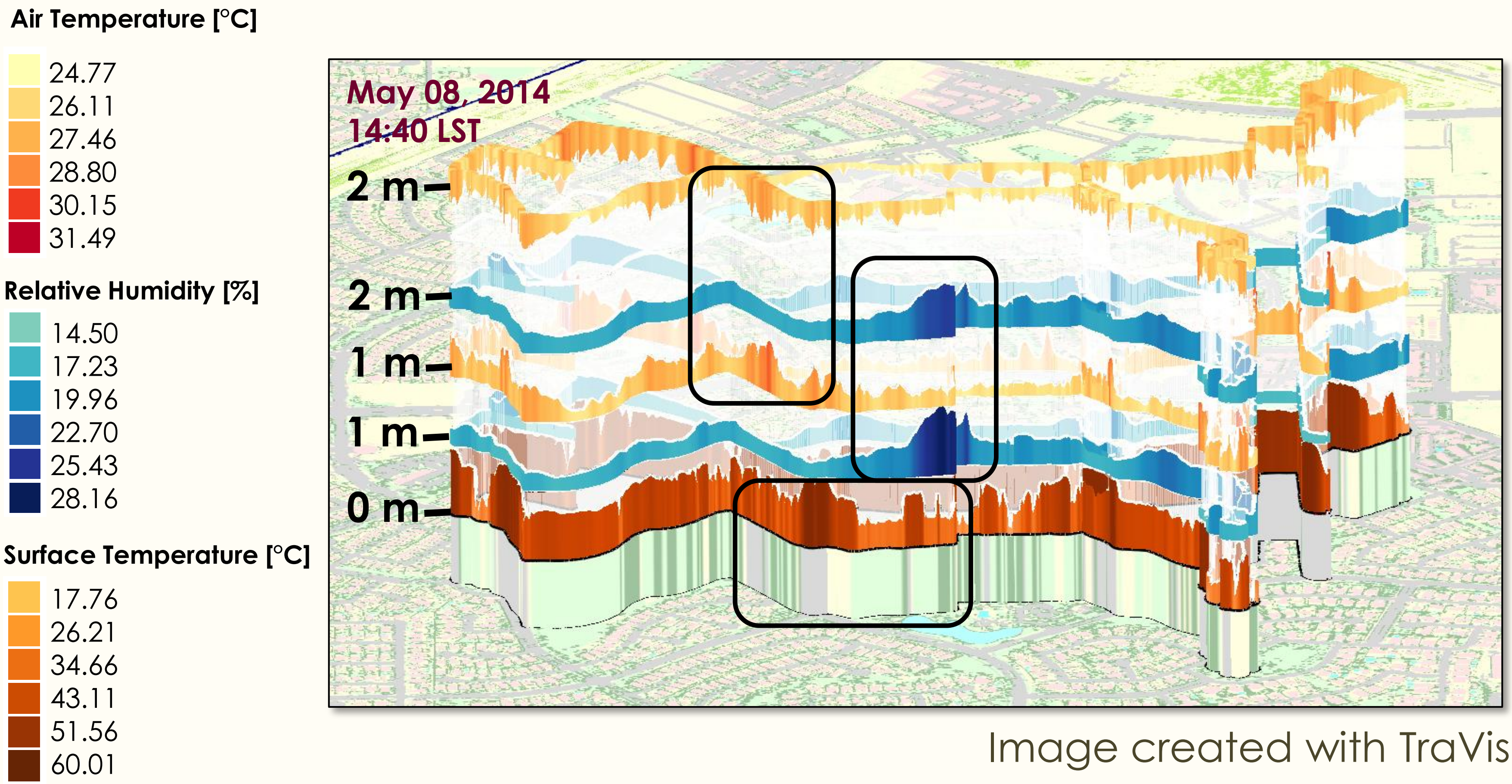


Image created with TraVis

Background: TraVis

Air Temperature [°C]

- 24.77
- 26.11
- 27.46
- 28.80
- 30.15
- 31.49

Relative Humidity [%]

- 14.50
- 17.23
- 19.96
- 22.70
- 25.43
- 28.16

Surface Temperature [°C]

- 17.76
- 26.21
- 34.66
- 43.11
- 51.56
- 60.01

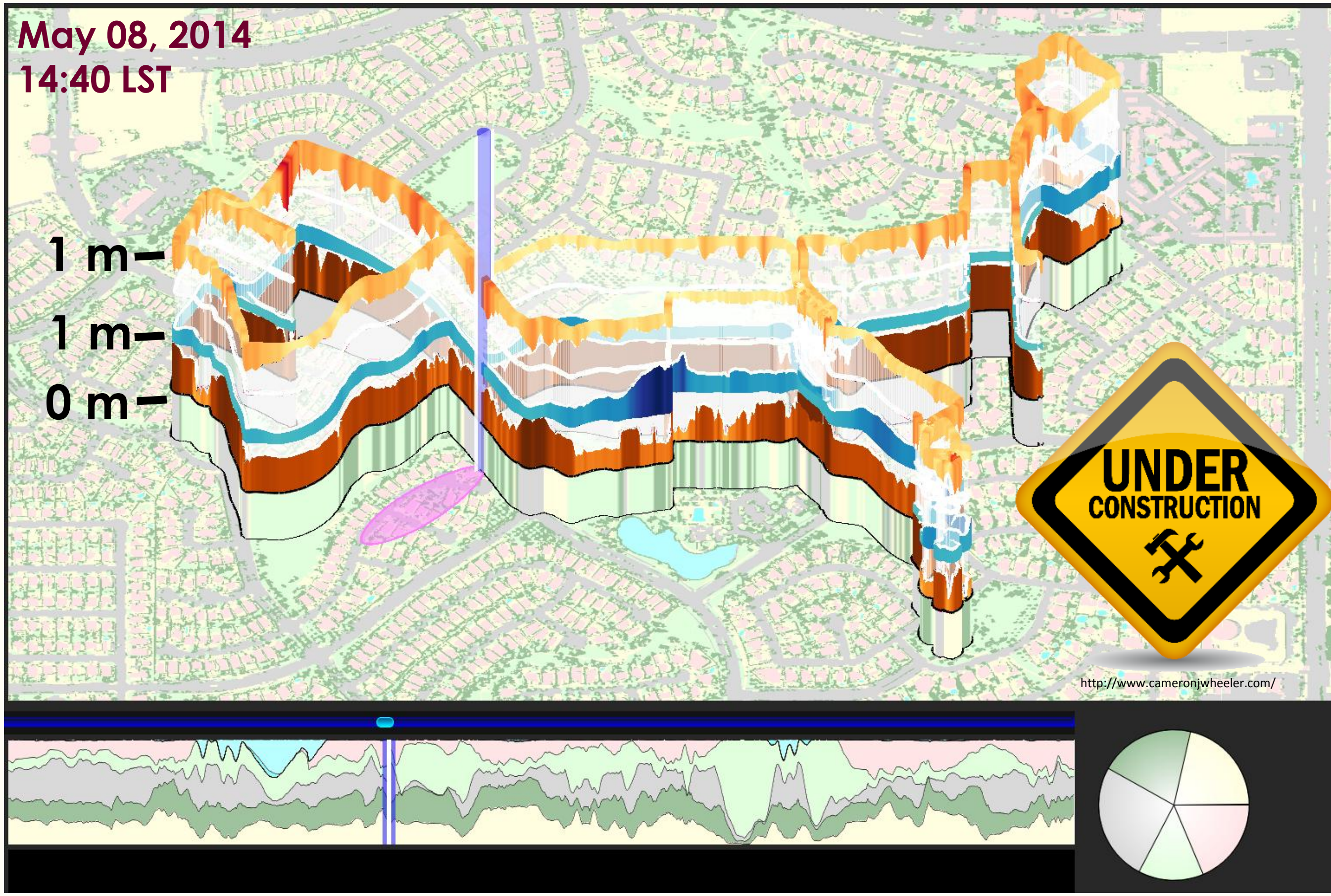
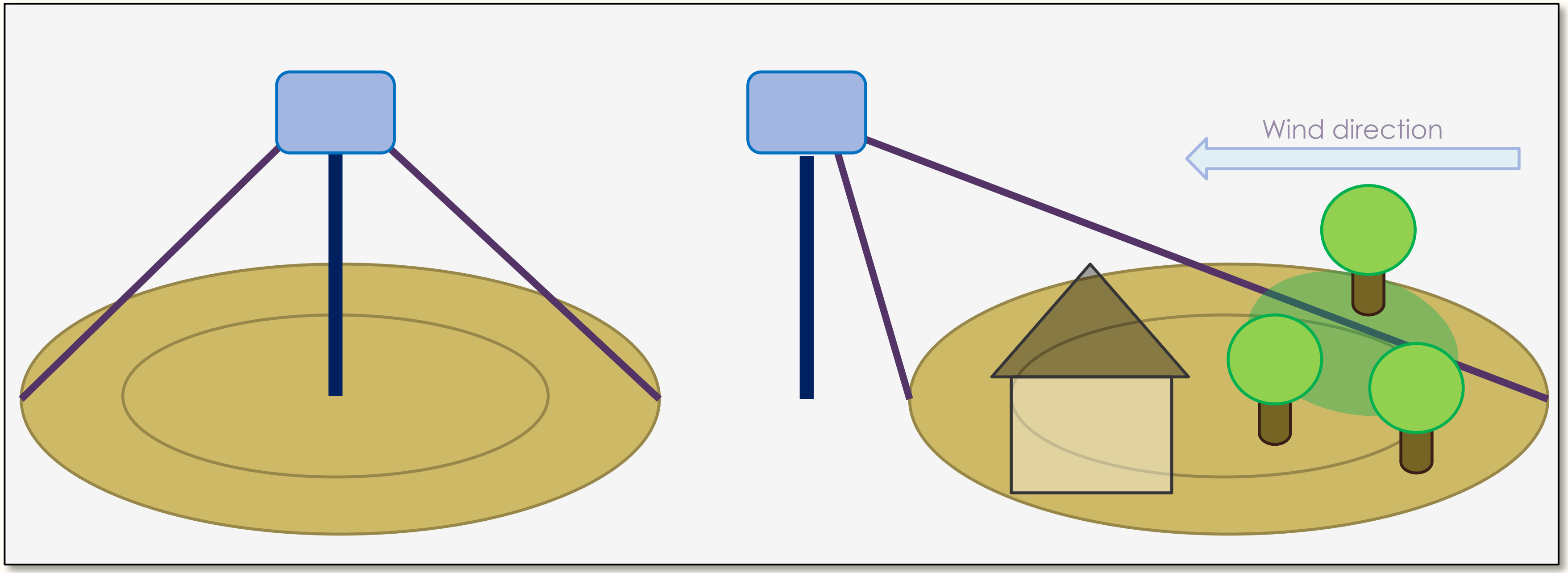


Image created with TraVis

Materials and Methods

The source area concept: How much of its spatial context can a sensor see?

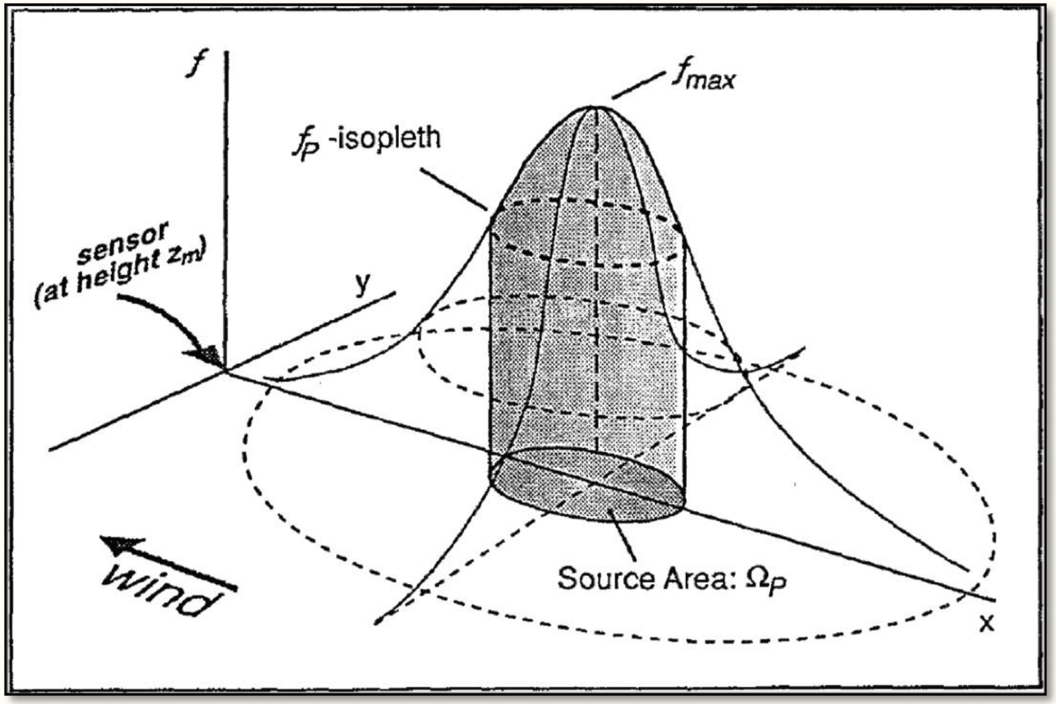


„Rule of Thumb“: $r = z_m * 100$

More complex techniques, taking wind direction into account

Materials and Methods

- mini-SAM-2 (Schmid 1994): Source area for a passive scalar (e.g., Air Temperature)



Schmid, H.P. (1994): Source Areas for Scalars and Scalar Fluxes. *Boundary Layer Meteorology* **67** (3), p. 293-318.

Materials and Methods

Observations: 21 transect runs in 3 seasons, recorded in Gilbert, AZ

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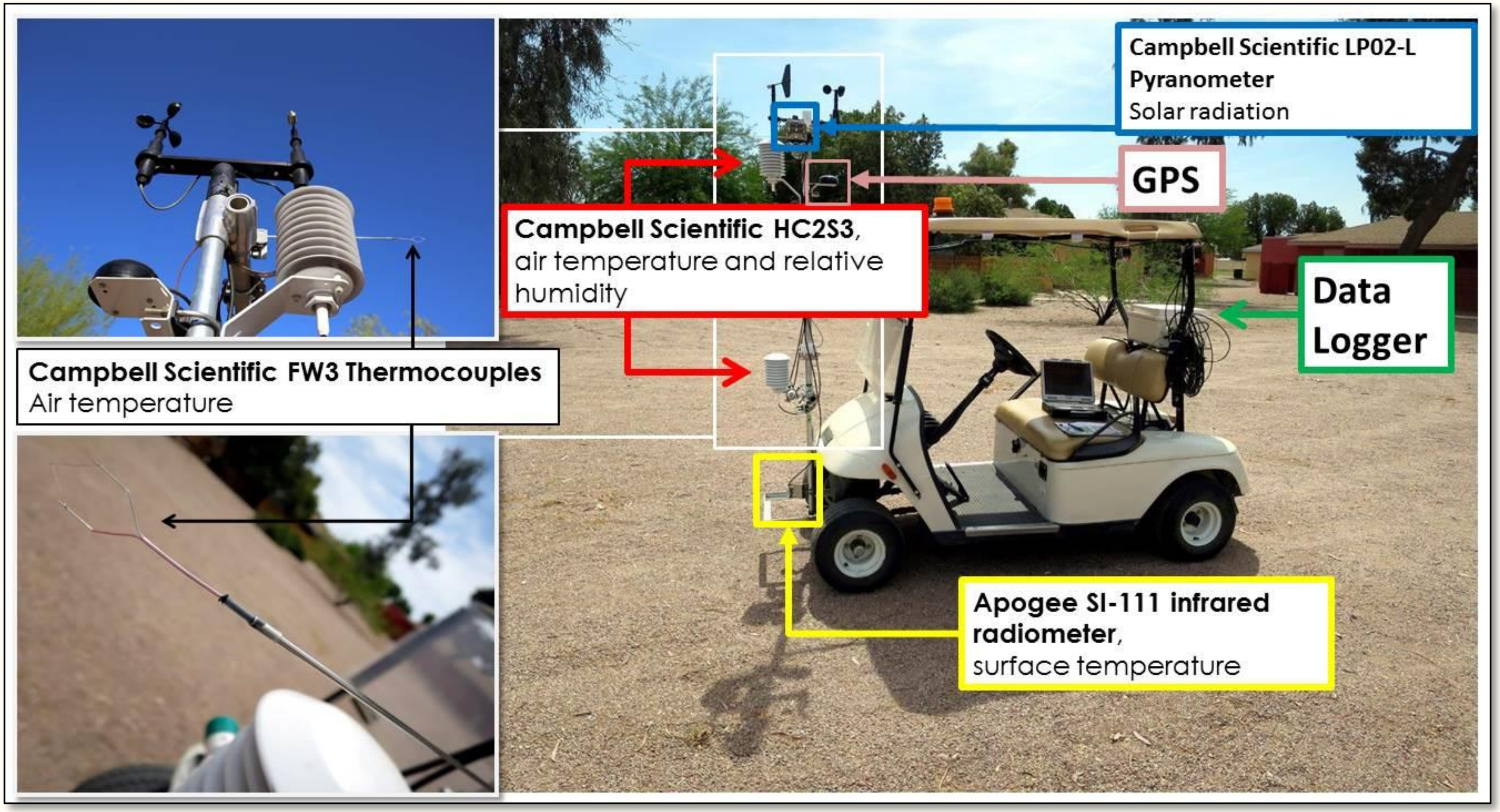

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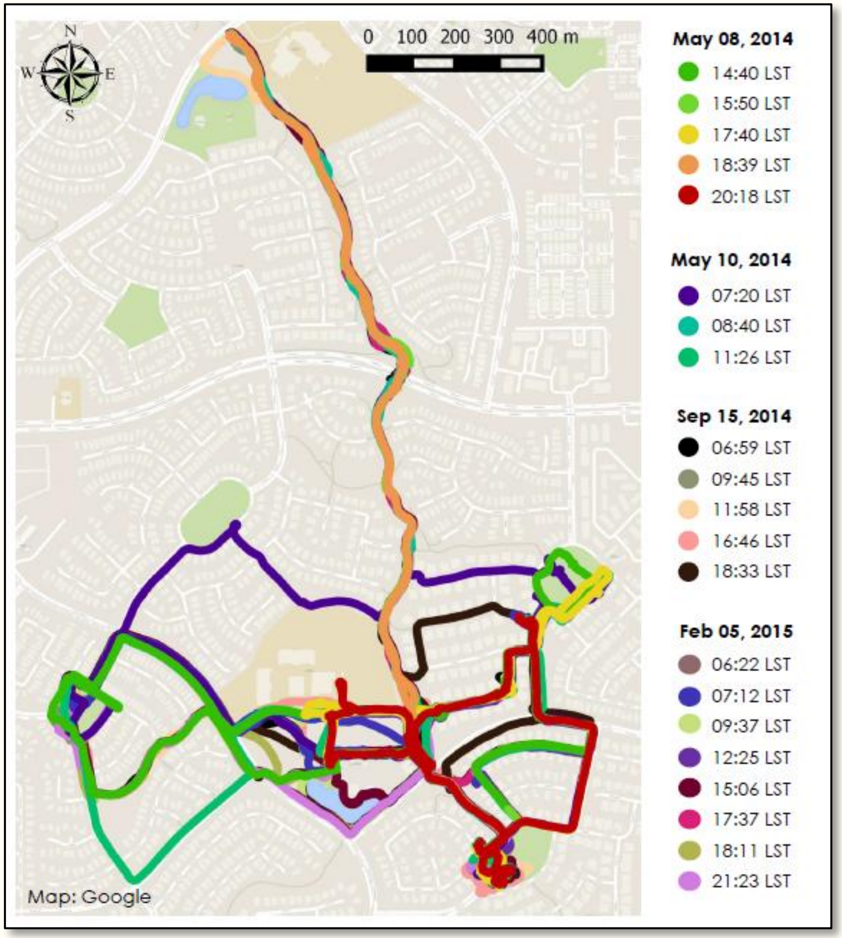
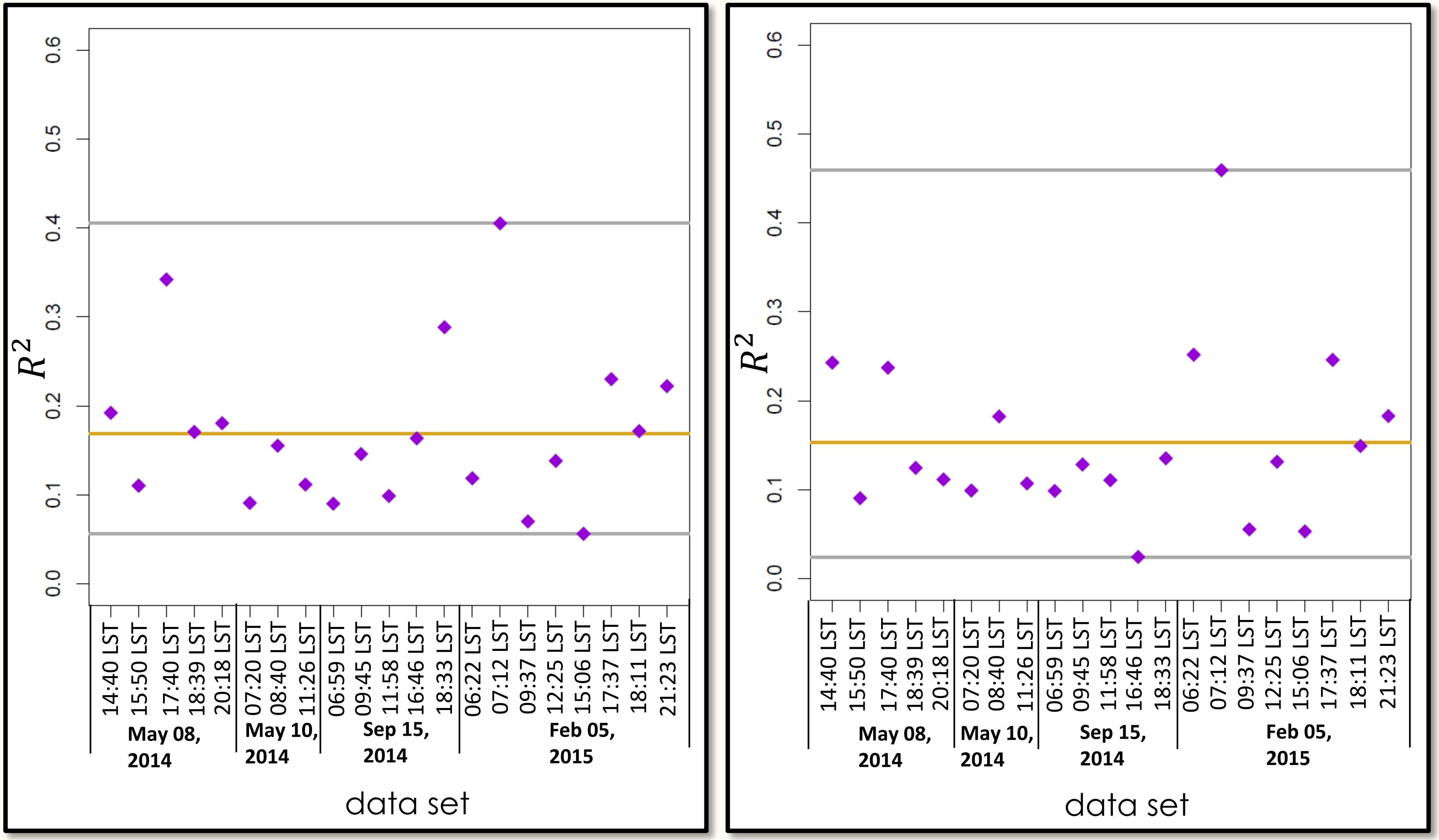


Correlating LULC Fractions in the Fetch with Air Temperature (z_m =1m)

„Rule of Thumb“: $r = z_m * 100$

Mini-SAM-2 (Schmid, 1994)



Discussion and Limitations

- Both approaches do not seem suitable for observations within the urban canopy layer
  - They have not been designed for this setting
  - They do not take the three-dimensional environment into account
- Parameters needed for the Mini-SAM-2 partially difficult to retrieve
  - Obhukov length, friction velocity, standard deviation of lateral wind: Not enough data to estimate these parameters
  - Need to take data into account, which have not been measured *in-situ*
  - For the example, they have been estimated based on the final source area's shape
- Both approaches are computationally inexpensive
  - Allow for computing a source area at each location on a route

Conclusion and Future Work

An interface for the exploration of mobile measurement data sets was developed;

We are currently investigating appropriate techniques for the interactive (real-time!) and accurate exploration of a sensor's field-of-view

Future Work:

- Include the three-dimensional geometry into source area modelling
- Validate results using more complex dispersion / flow models
- Use relationship between land cover fractions and microclimate for extrapolation of measurements / statistical modelling

Thank you.

Questions?

Acknowledgements:

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