Visualizing urban microclimate transect measurements

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Introduction: Transect data sets and why they are difficult to analyze

- Transects are used to investigate the spatial variation of atmospheric measurements
- A vehicle equipped with sensors is moved through heterogeneous environment
- Impact of different urban forms and neighborhood designs on the surrounding microclimate can be investigated
- The resulting data set is complex, since it is
  - *multivariate*
  - *time-varying*
  - *spatially dependent*
  - *afflicted with uncertainties*

TraVis: A visualization system that is tailored to the analysis of transect data

Key Features (under development):

- Representation of the data set within its spatial context
- Data correction procedures, such as
  - *sensor lag correction*
  - *time detrending*
- Spatial and temporal statistical analysis

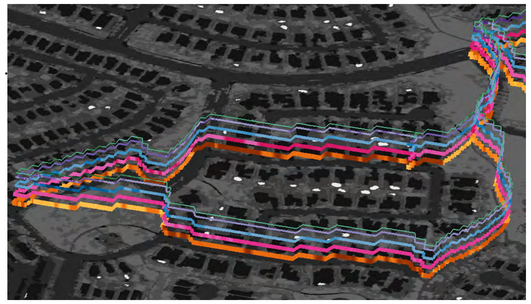
The transect data set

GOLF CART EQUIPPED WITH A GPS, SENSORS AND A DATA LOGGER

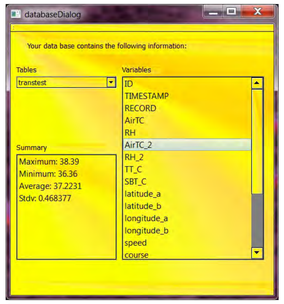
- A golf cart equipped with sensors was used for continuous atmospheric measurements in the Power Ranch Community (Gilbert, Arizona) over the course of one year
- Recorded variables:
  - *Air temperature in 1m and 2m height*
  - *Relative humidity in 1m and 2m height*
  - *Surface temperature*
  - *Latitude and longitude of the current measurement location*
- Temporal resolution: 1 second

Current state of TraVis

- Integration of the transect data set into a high-resolution land use image (Central Arizona NAIP data set [1]) for display purposes
- Representation of each variable as a wall that winds through the area (similar to [2])
- Walls are stacked based on the respective measurement height
- Each variable is uniquely color coded to facilitate comparison (based on ColorBrewer, [3])
- Zooming, panning and rotating the display shows the data from different perspectives
- A statistical summary window informs the user about the variables in the database



CLOSE UP OF THE DATA WALLS



THE STATISTICAL SUMMARY WINDOW

THE GRAPHICAL USER INTERFACE

TOP VIEW OF THE DATA SET

Implementation

- Connection to a local mySQL server to ease data management and specific queries
- A GUI, implemented using Qt 4.8, includes the visualization display and provides access to the database
- Walls are rendered by connecting the individual data points with 3-D lines, decreasing in thickness from bottom to top

Future Work

- Elimination of visual artifacts caused by lines with increased thickness by means of an improved rendering routine
- Visualization of a microscale source area for each measurement point
- Glyph-based visualization of pairwise correlations between the recorded variables (inspired by [4])
- Clustering based on these glyphs to highlight areas of similar multivariate relationships
- Spatial extrapolation of the transect data using a sophisticated regression model that takes the surrounding land use into account

References

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