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Geo-spatial analysis of bicycle usage open data in Zurich

Motivation and Main Goal

The motivation for this Master Thesis has been identified due to the big amount of available data on the usage of bicycles in Zurich. Open Data on the network and usage of bicycles in Zurich are published on the Internet and Volunteered Geographic Information (VGI) is available from personal devices and fitness applications. In addition, a huge number of environmental measurements is available from the OpenSense project run by ETH.

The main goal of this Master thesis was the design and implementation of an online interactive tool for the assessment and visualization of the exposure of riders or pedestrians in air pollution, using Web-GIS tools and technologies. In a nutshell, this work is all about the development of an online interactive Web-GIS tool to mantain a database of environmental measurements available as Open Data, to visualize selected measurements using user-defined criteria, to calculate the spatial distribution of pollutants and to calculate exposure indices for user-provided tracks (VGI) and bicycle networks (Open Data).

Figure 1: The schematic workflow

Implementation

• Maintain database of measurements (import from CSV)
• Simplify imported measurements by pollutant, date and hour using orthogonal grids
• Display raw and simplified input measurements on a map
• Filter simplified measurements interactively by date and time ranges and display filtered data
• Select interpolation method, calculate and display the concentration of the selected pollutant on a map

Figure 2: The infrastructure - three tier system architecture

• Create contours using the calculated pollutant concentrations
• Save calculated contours
• Select and upload KML activity track
• Maintain bicycle mobile network
• Select calculation parameters for indices of exposure to pollutant
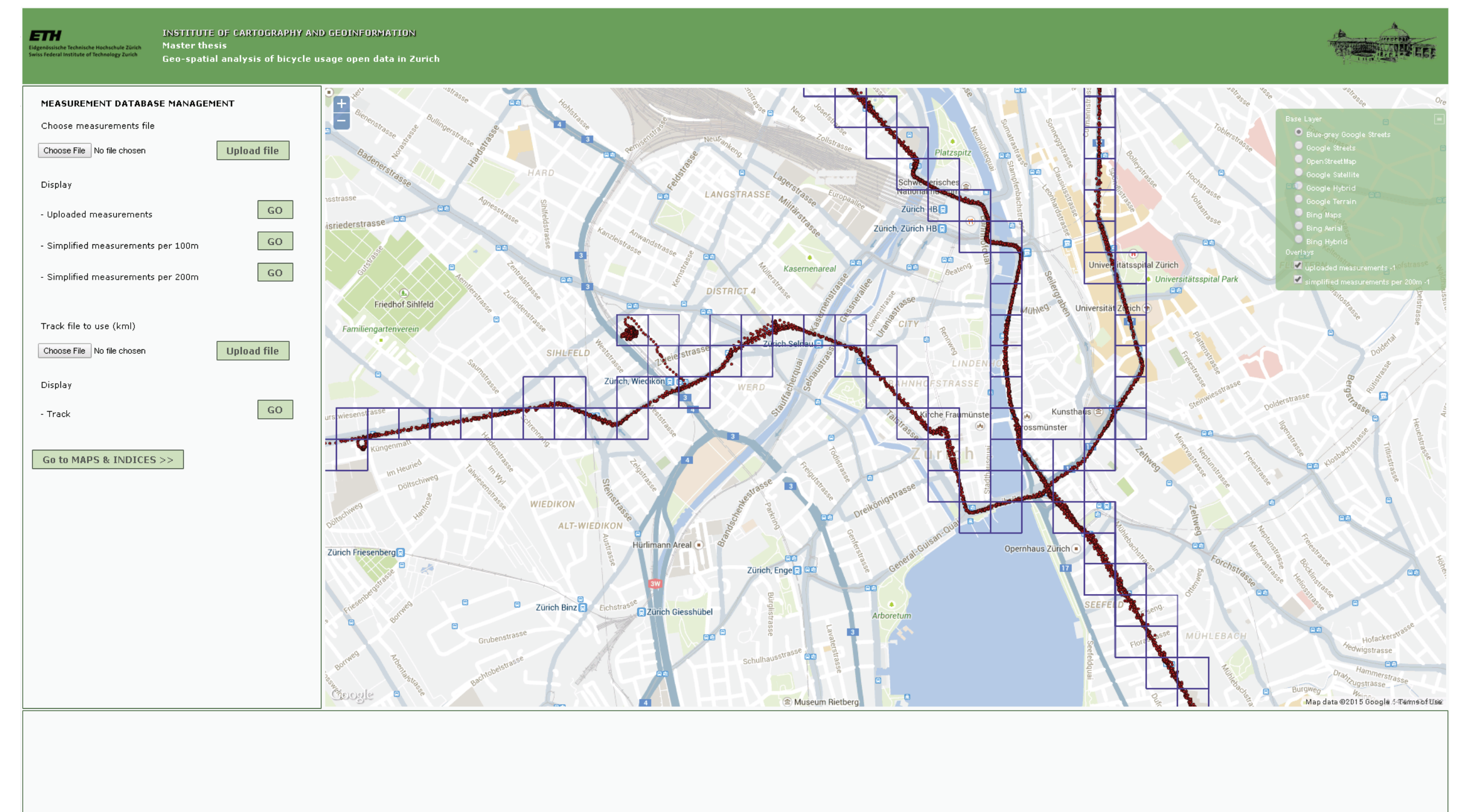• Calculate and display pollutant exposure index

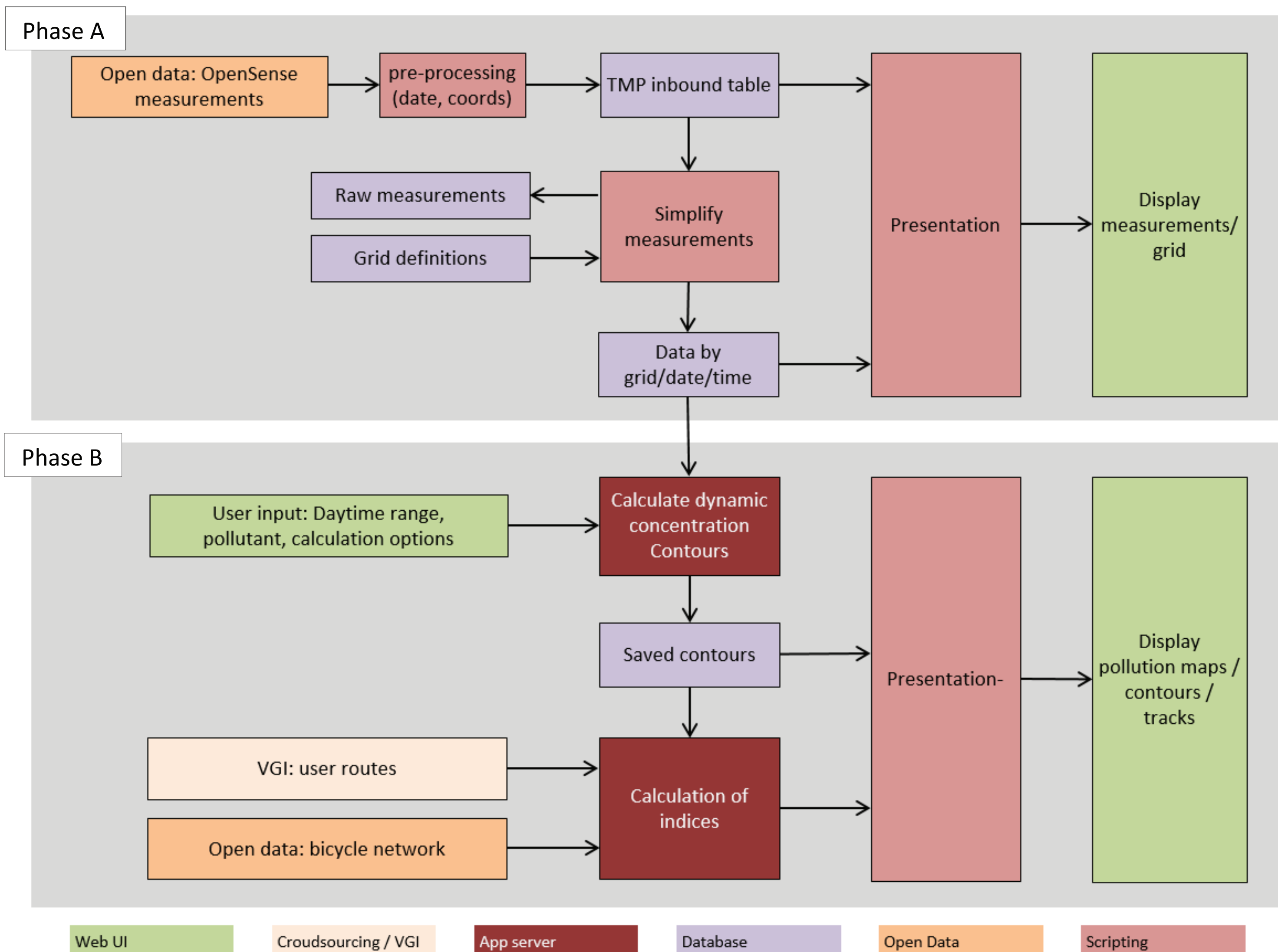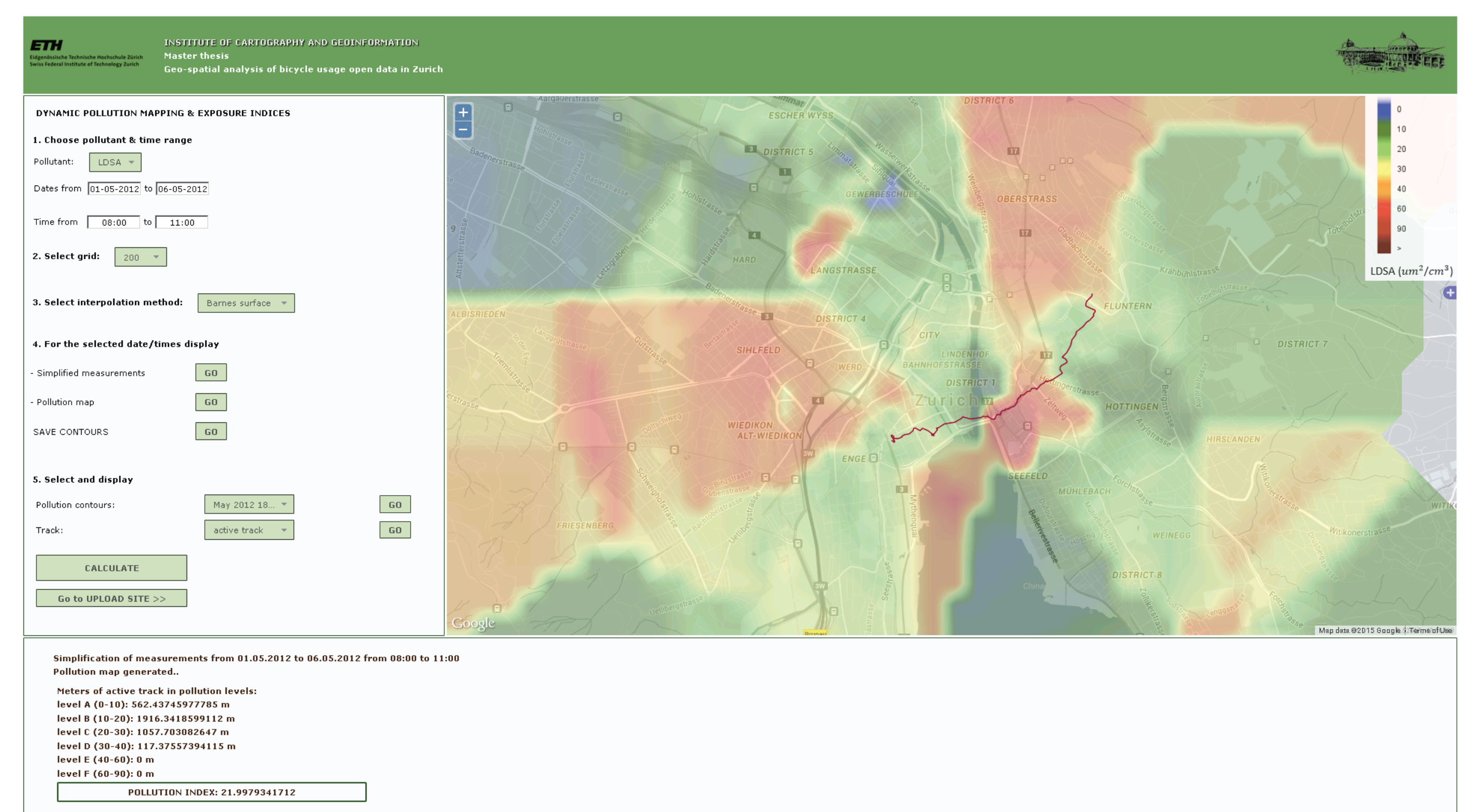Figure 3: The web-user interface A - upload & simplify measurements

Figure 4: The web-user interface B - exposure of pollution indices

Conclusions

Value
• Use as a measurements' aggregator and interactive mapping tool for environmental applications
• Calculate routes for walking, cycling, etc., by minimizing exposure to atmospheric pollution
• Use in multi-criteria decision support for bicycle network planning and assessment

Limitations
• Performance (current development environment)
• Availability of measurements (outside Zurich...)
• Non-CFD dispersion calculation

Future improvements

• Integrate parts of this work with the OpenSense website for measurements visualization, filtering, sharing
• Integrate with environmental measurement acquisition platforms (Zurich and elsewhere)
• Implement CFD models for dispersion calculations of different pollutants
• Export visualizations + data for use in third-party DSS
• Open questions for further research: calculations uncetrainty

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Master Thesis

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