Challenges and opportunities of using geodata in mobility and energy

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[Launch Event geodata4edu.ch – University of Berne]
Overview

- Challenges
- Opportunities
- Renewable Energy planning
- Sustainable mobility
- Conclusions
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Mobility & Energy – the challenges

- Mobile Information Society
  - Human mobility patterns (mass events)
  - Location-based decision support
- Complex mobility systems
  - Transport infrastructure
- Increased energy consumption
  - Integration of renewable energy sources
  - Reducing environmental impact
Opportunities - What’s new for GI researchers?

Data

- More and more data from different sources (federal, cantonal, business, etc.)
- Big **spatial** data (volume, velocity, variety, and veracity)
- Georeferenced (mobile phone) data
- Volunteered Geographic Information (VGI)

Methods

- Location-based …
- Spatio-temporal analysis
- Networks

Technology

- LBS, apps
- Information and Communication Technologies (ICTs)
- Geovisualization
Renewable Energy (RE) planning
- Swiss Energy Strategy 2050
- How to replace nuclear power plants?
- Energy target 2030: 10% of electricity supplied by RE
- What is the solar and wind potential that can be exploited?
- Transmission line grid ready to link exploitable sites to consumption centers?
- How to stabilize the Swiss electricity network with increased fluctuating renewable generation?
3D GIS for transparent and sustainable planning of electric power systems
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- GI engineered tool for
  - automated identification of suitable corridors for new transmission lines;
  - assessment of transmission line paths based on environmental, social, and financial aspects. [Grassi, Friedli, Grangier, Raubal 2014]

- GIS web-based platform
  - realistic 3D visualization of proposed transmission line project including surrounding environment;
  - allow understanding the effect of different paths of a transmission line in real time.
Approach

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Spatio-temporal optimization for locating biogas plants

- Method for finding optimal locations of biogas plants.
- Taking spatial and temporal variations of biomass availability and heat demand into account.
- Maximize profit of biogas plants => minimize biogas production costs & maximize energy utilization.

Approach:
- GIS => suitable biogas plant locations
- Mixed Integer Linear Programming (MILP) optimization => best locations by maximizing profit of the biogas plants
- Optimization model supports seasonal biomass availability and heat demand.
Model and Data

- BFS Data
- Heat Demand
- Road Network
- Possible Fermenter Location Selection
- Optimal Fermenter Placement
- CCHP Placement
- Biogas Production and Cost

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maximize: \( \text{gasRevenue} + \text{electricityRevenue} + \text{heatRevenue} \)

\[ - \text{transportationCosts} - \text{biomassCosts} - \text{plantCosts} \]
Estimation of PV potential

Resolution of existing DSM not sufficient to extract wall and roof areas of buildings (estimate PV potential on rooftops).
LIDAR point cloud and building footprints

Issues with LIDAR data:
- Low point density (~1 point / sqm)
- Low quality
- Quite old (2001-2008)

Building footprints:
- Unified dataset for CH:
  - 88.91% from cadastral survey
  - 6.86% from Openstreetmap
  - 4.22% from SwissTLM
- Use of error tolerant interpolation methods

[ Buffat 2016 ]
Improved Digital Surface Model (DSM)

Existing DSM  New DSM  Aerial photo
Modelling building heat demand

- Volume, wall and roof areas can be extracted from DSM and building footprints
- Governmental building register data:
  - Building age
  - Type of building (single / multi family house)
  - etc.
- Matching of datasets not trivial!

[Buffat, Froemelt, Heeren, Raubal, Hellweg under review]
PV potential and electricity production profiles

2012-08-01 00:00:00 UTC

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Sustainable mobility
How can we encourage people to engage in more sustainable mobility lifestyles, reducing use of the car?
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www.goeco-project.ch
Technology & system architecture

[Bucher, Cellina, Mangili, Raubal, Rudel, Rizzoli, Elabed 2016]
Big spatial data

Zurich
Conclusions

- Mobility and Energy: challenging problems
- Large opportunities and challenges of utilizing geodata
- Data challenges
  - Finding the right data
  - Cost
  - Quality
  - Data integration (interoperability)
  - Continuity of data
- Examples
  - Renewable Energy planning
  - Sustainable mobility
References


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Thank you!

For video demos of our research, search for gis@ethz
http://www.youtube.com/user/ETHzurichGIS