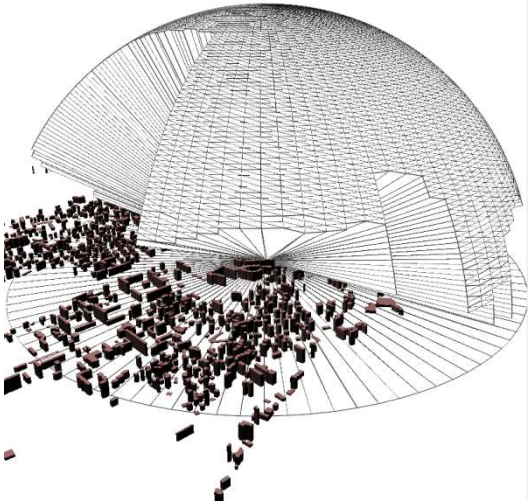
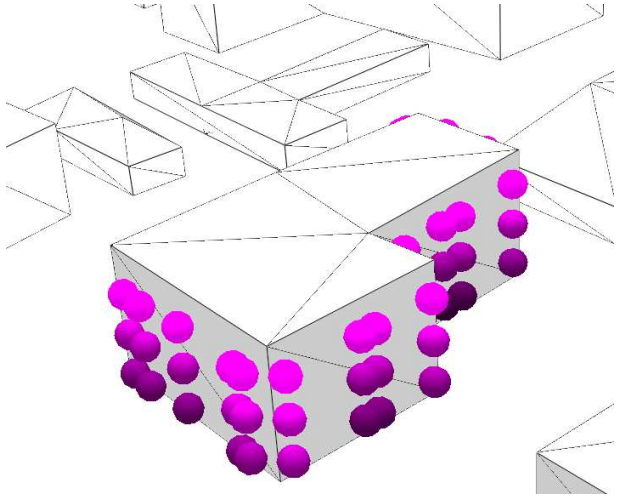
Measuring the impact of 3D data geometric modeling on spatial analysis

Illustration with Skyview factor

Mickael Brasebin – Julien Perret – Sébastien Mustière (COGIT)
Christiane Weber (LIVE)





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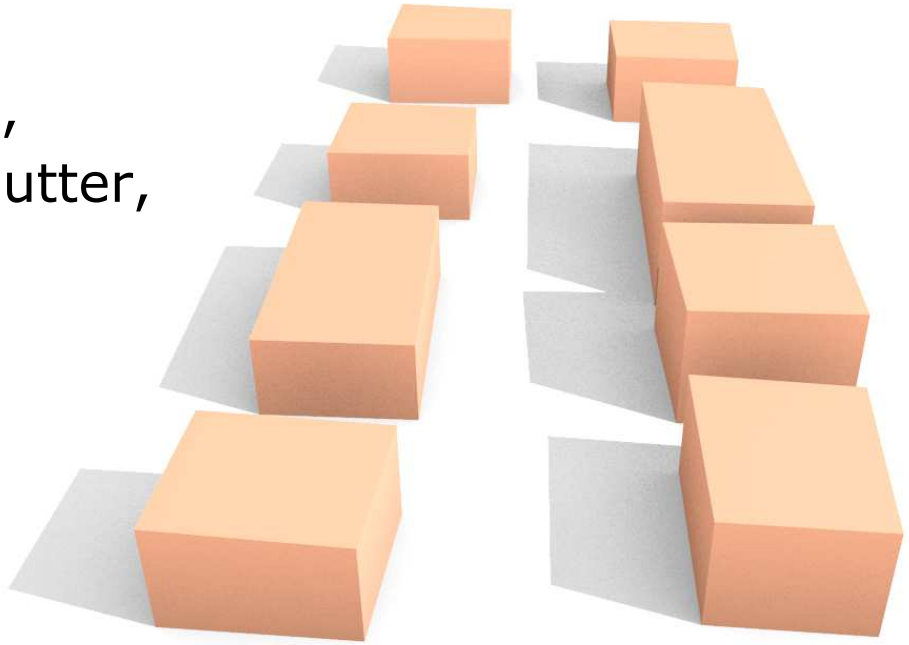
3u3d Conference – October 2012 - Nantes

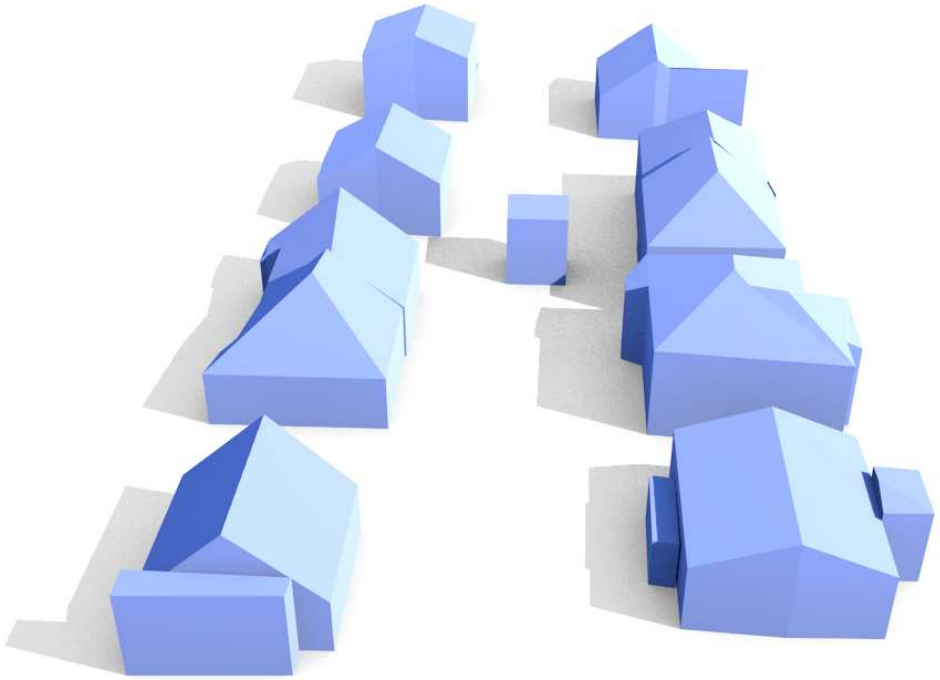
Context

- Increasing availability of 3D data
  - Heterogeneous production processes
  - Large variety of levels of detail or modeling choices
  - Different costs

Typical French 3D datasets

- IGN BDTOPO®
  - Coverage: French territory,
  - Building captured at roof gutter,
  - Free of charge for public services

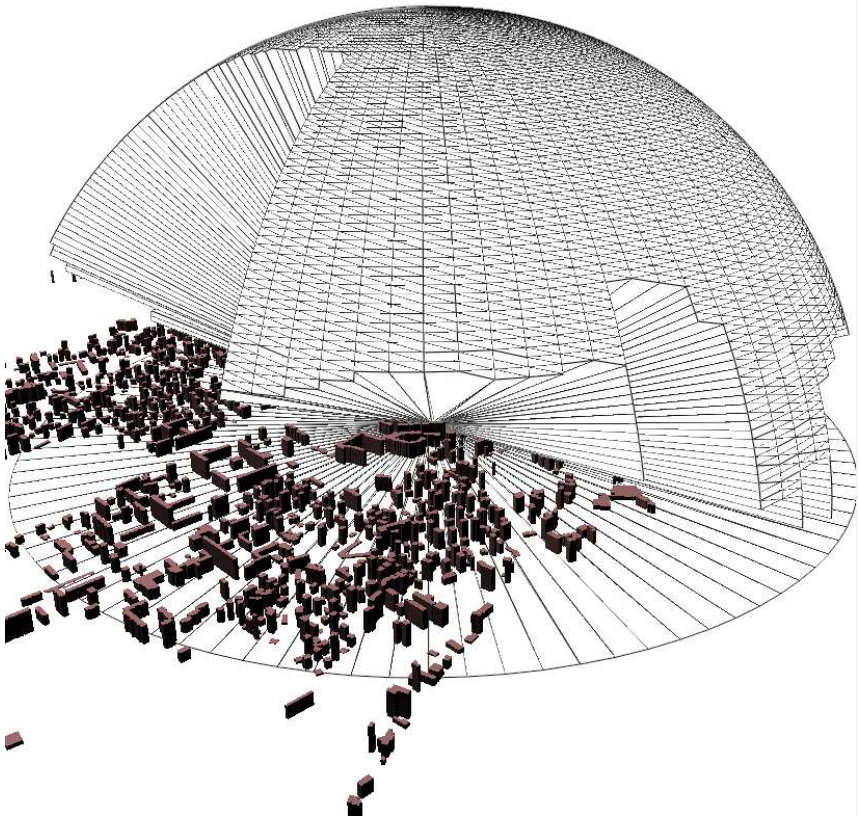




- 3DDB
  - Coverage: biggest agglomerations,
  - Building usually captured at footprint,
  - Produced on demand.

Sky View Factor

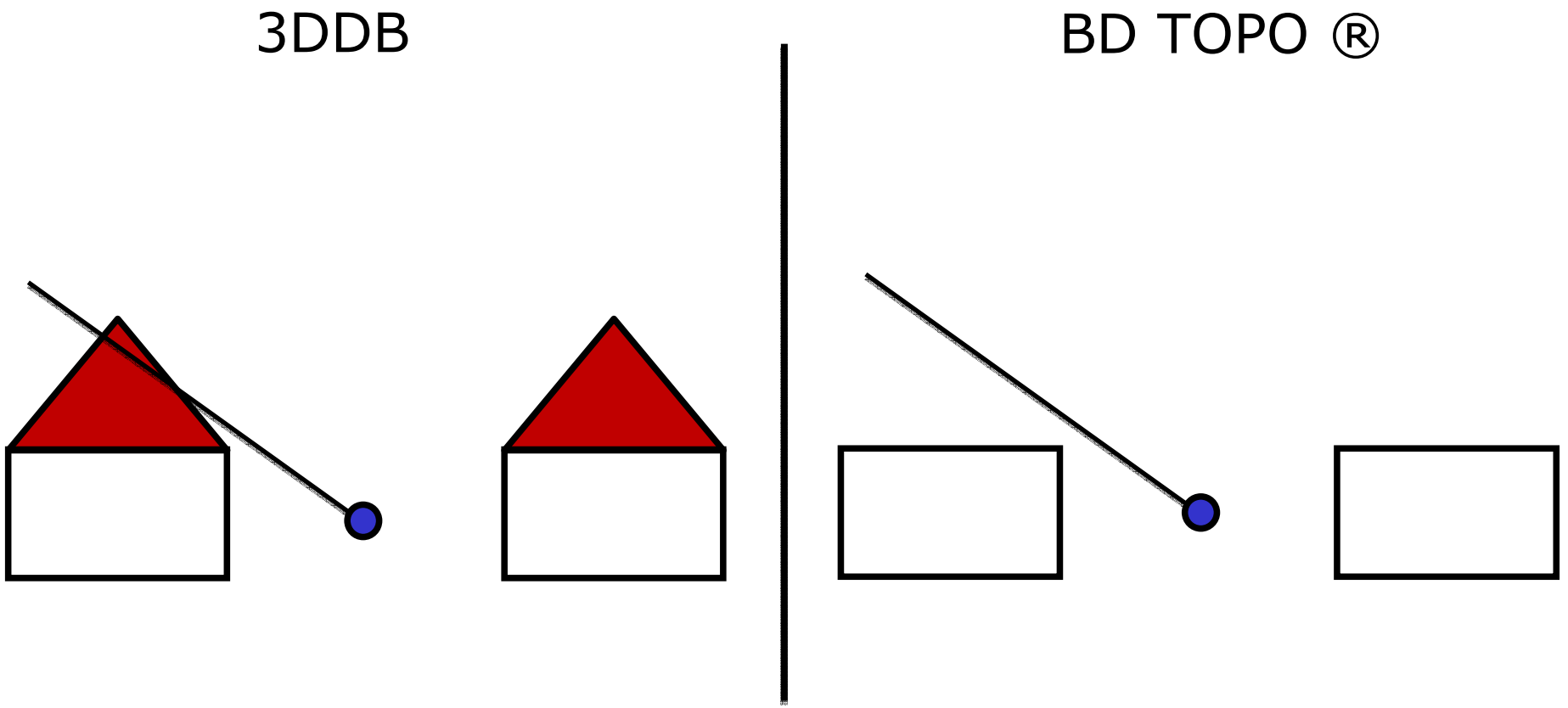
- Sky View Factor
  - % of visible sky in the upper hemisphere



- Uses:
  - Heat Island Effect
  - Interaction individual ⇔ air
  - Evaluation of urban fabric
- Pre-requisite:
  - 3D model,
  - Vertex,
  - Algorithm parameters (angle step and distance max)

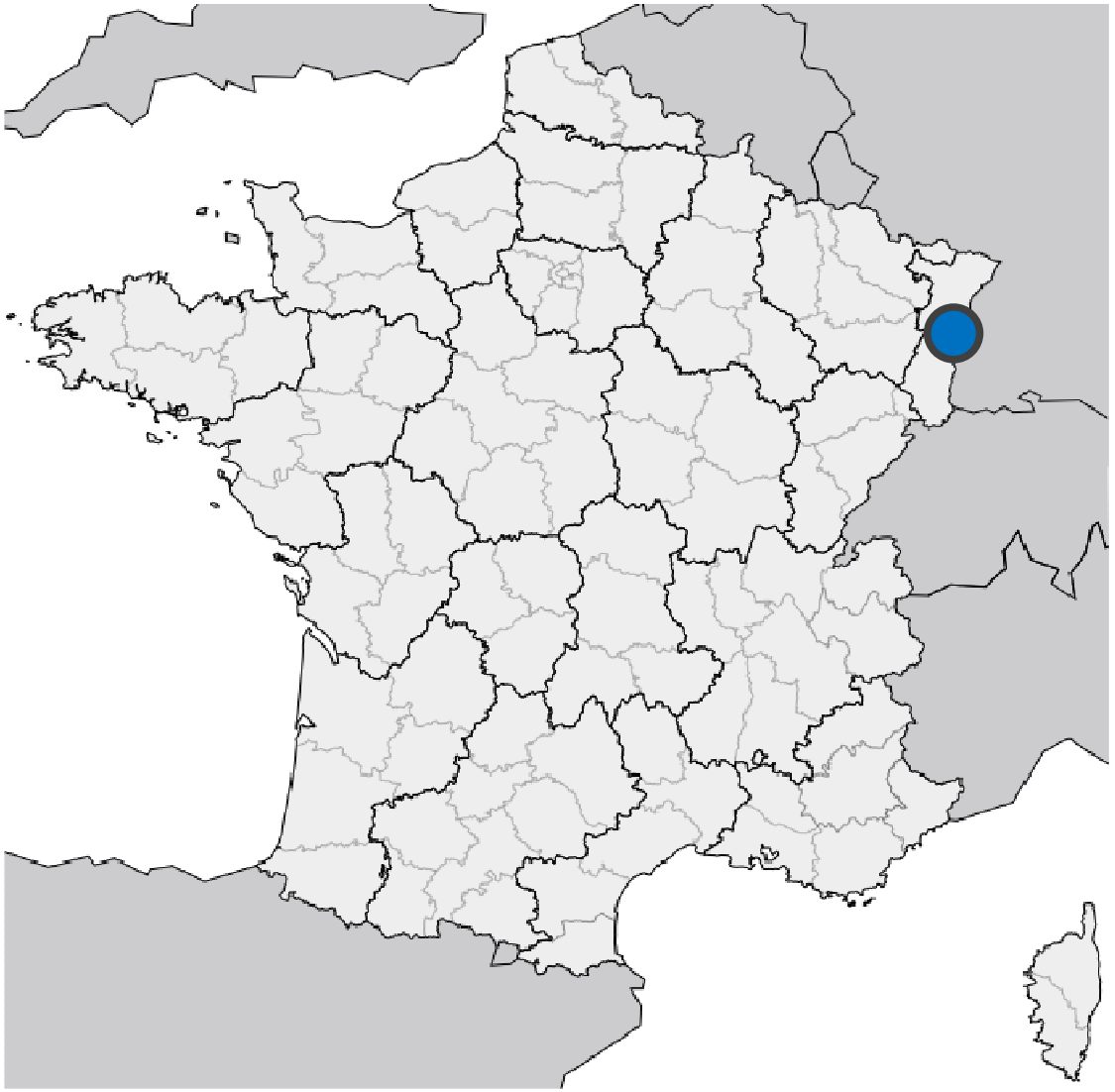
Expected results

- Intuitively higher SVF in BD TOPO ®



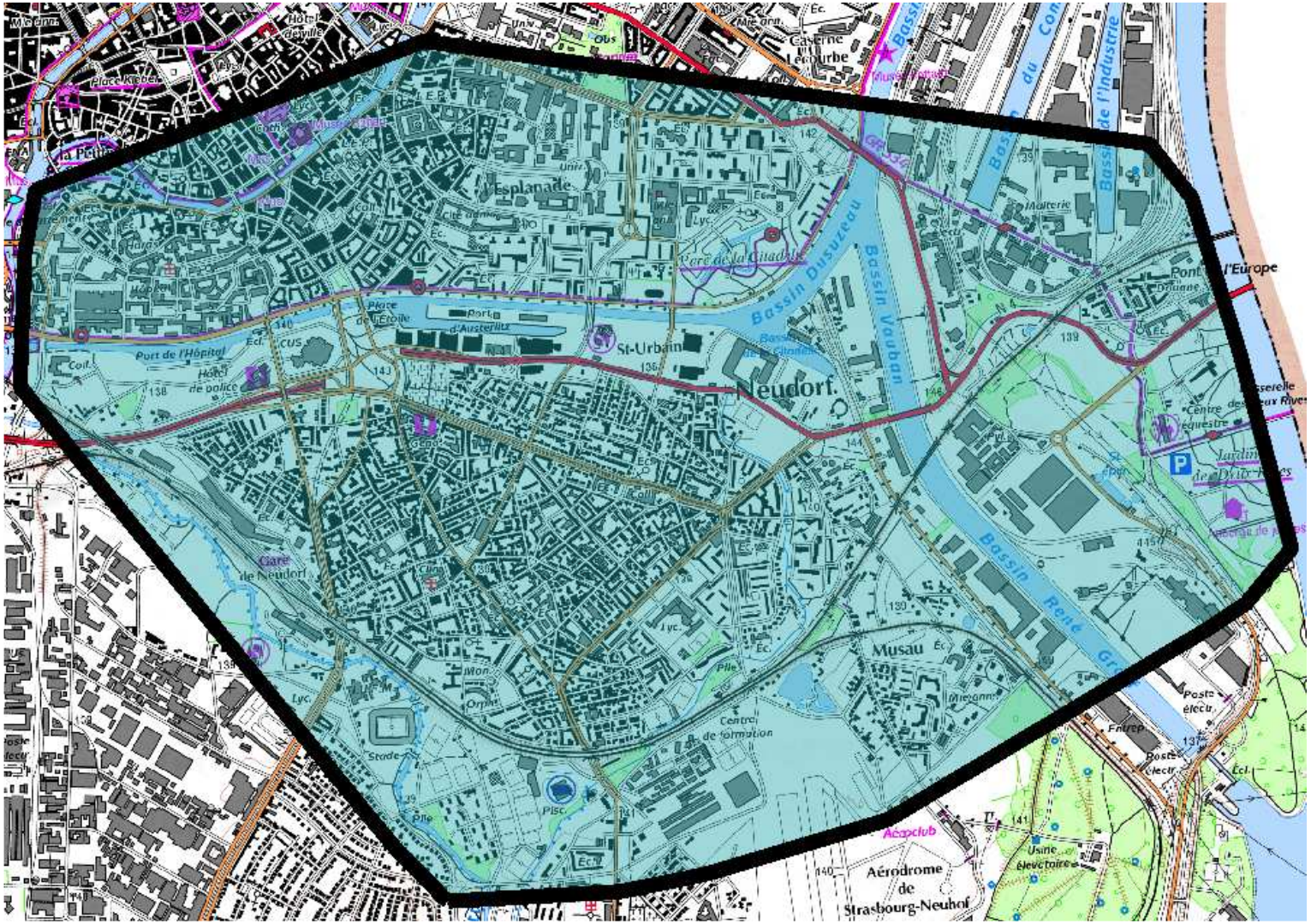
Work area

- City: Strasbourg



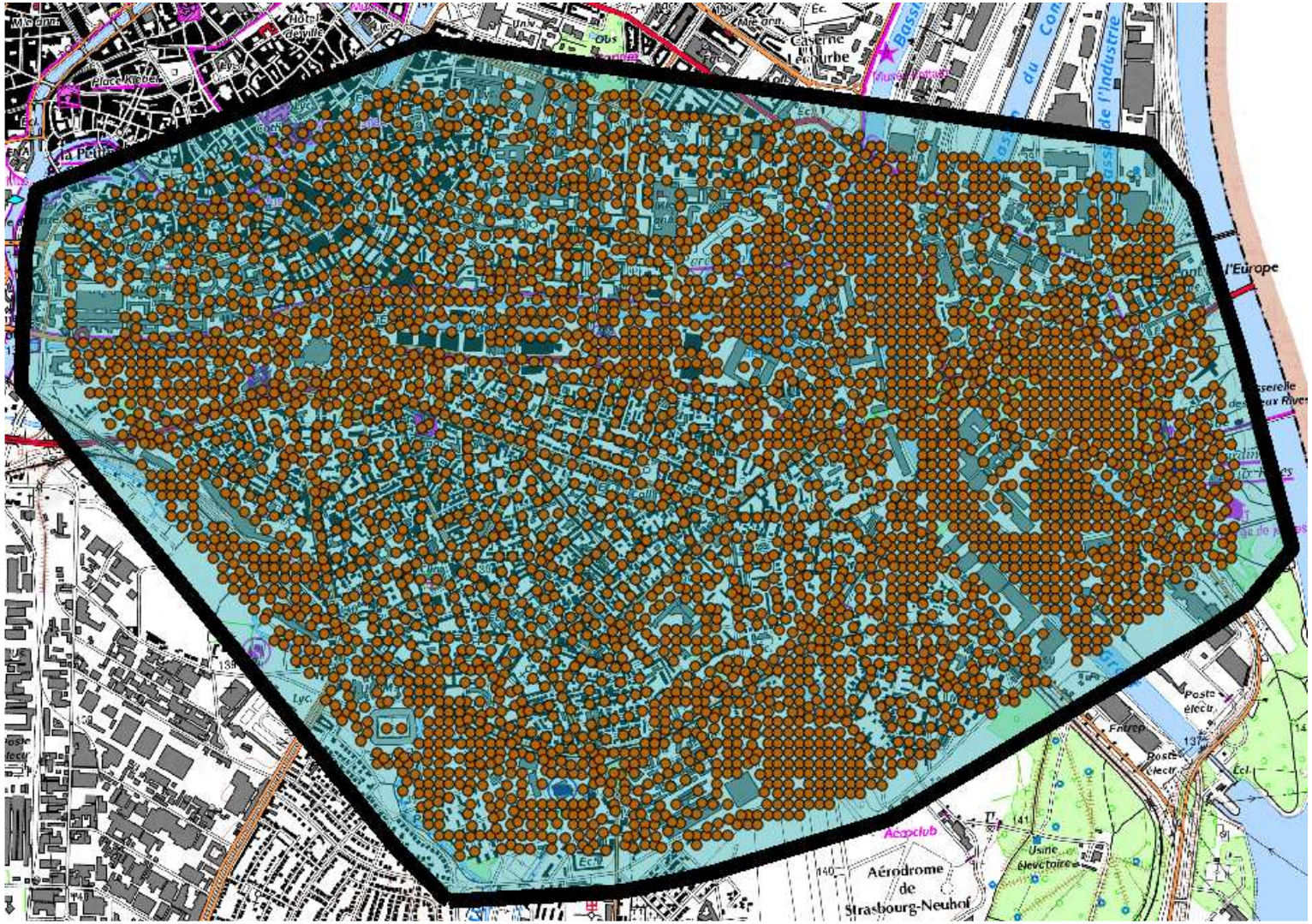
Studied area

- City: Strasbourg
  - 4.5 km * 3 km



Studied area

- City: Strasbourg
  - 4.5 km * 3 km
  - 4500 vertices



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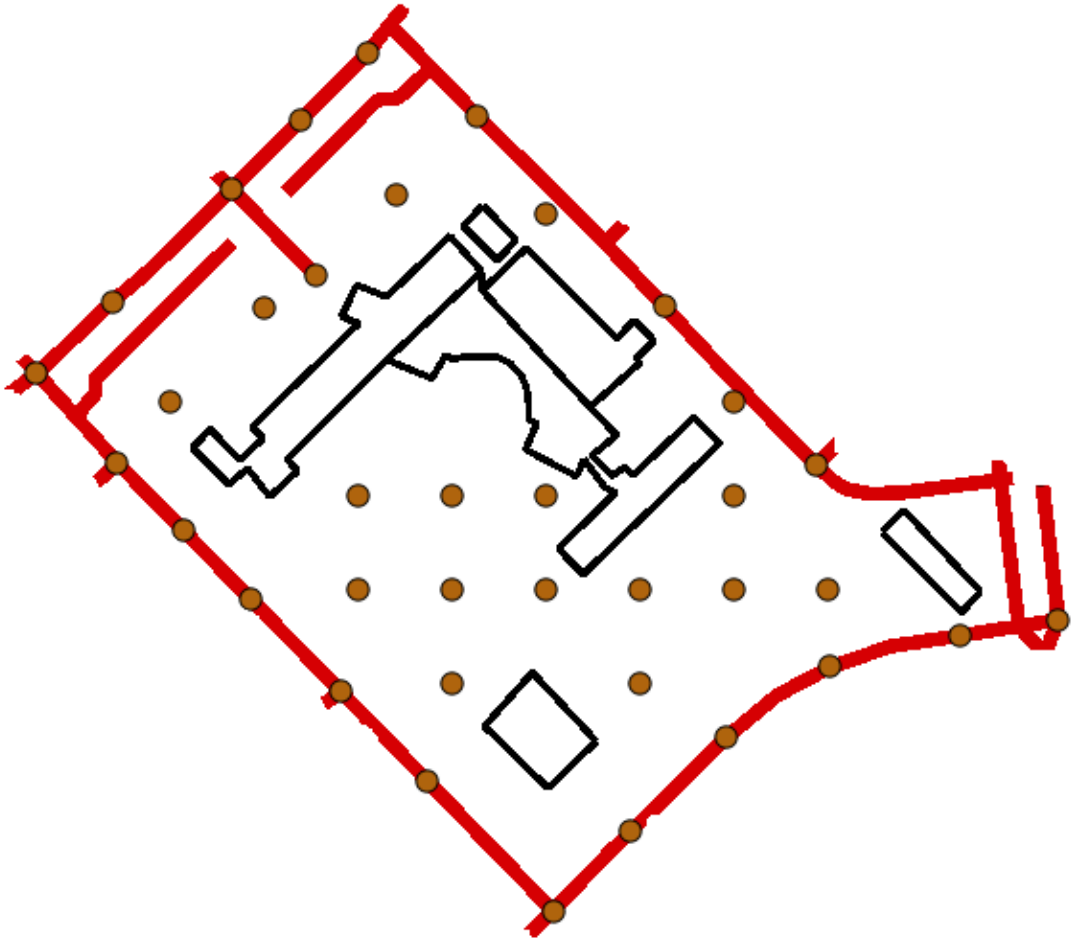
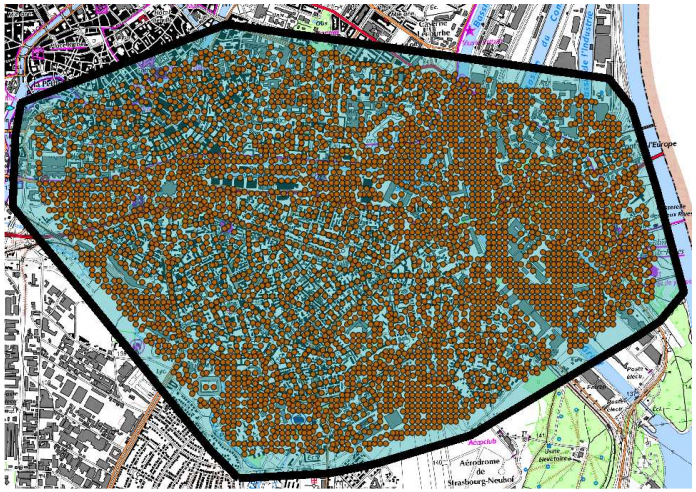
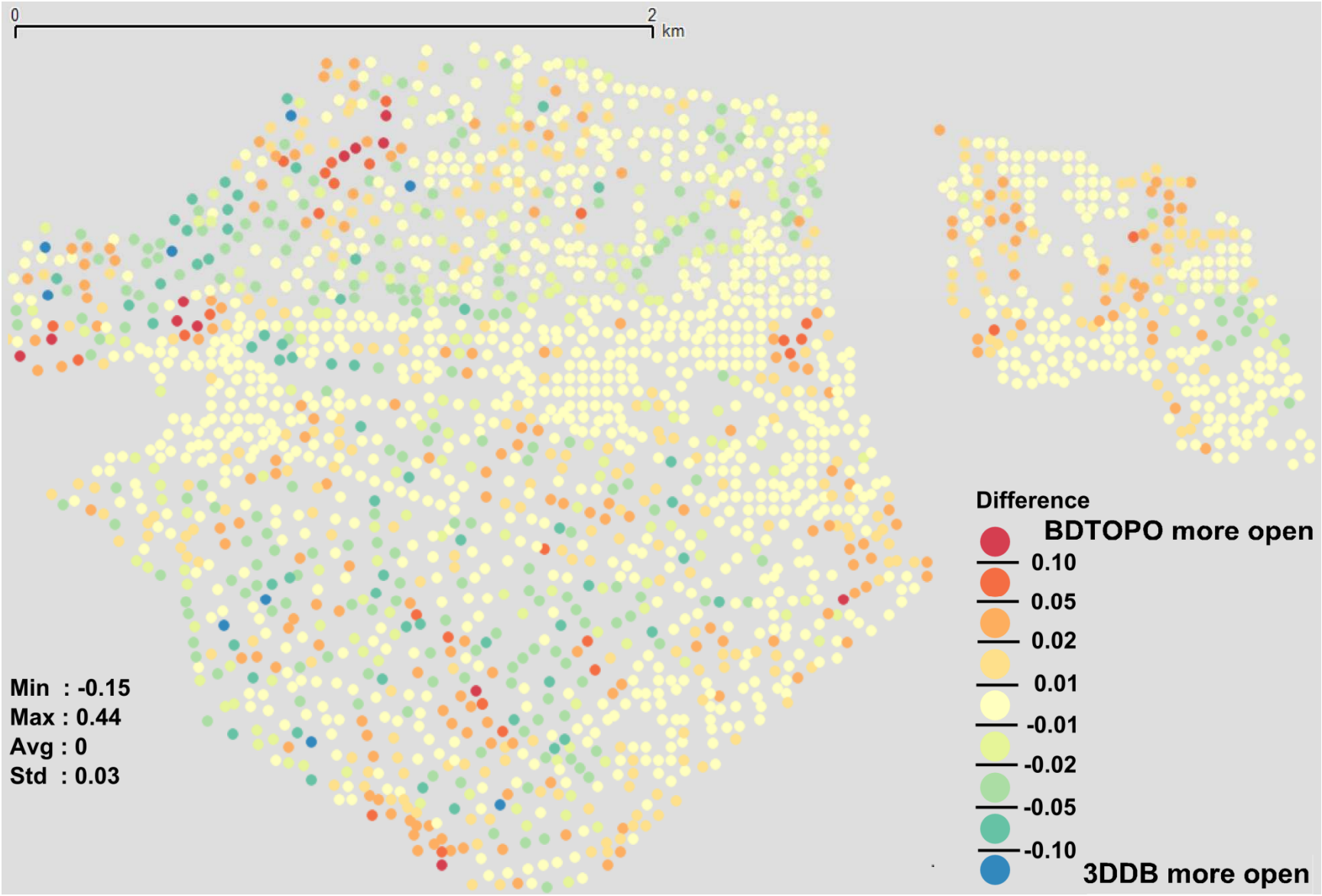




SVF difference between BDTOPO and 3DDB

- Average SVF difference < 10^{-3}



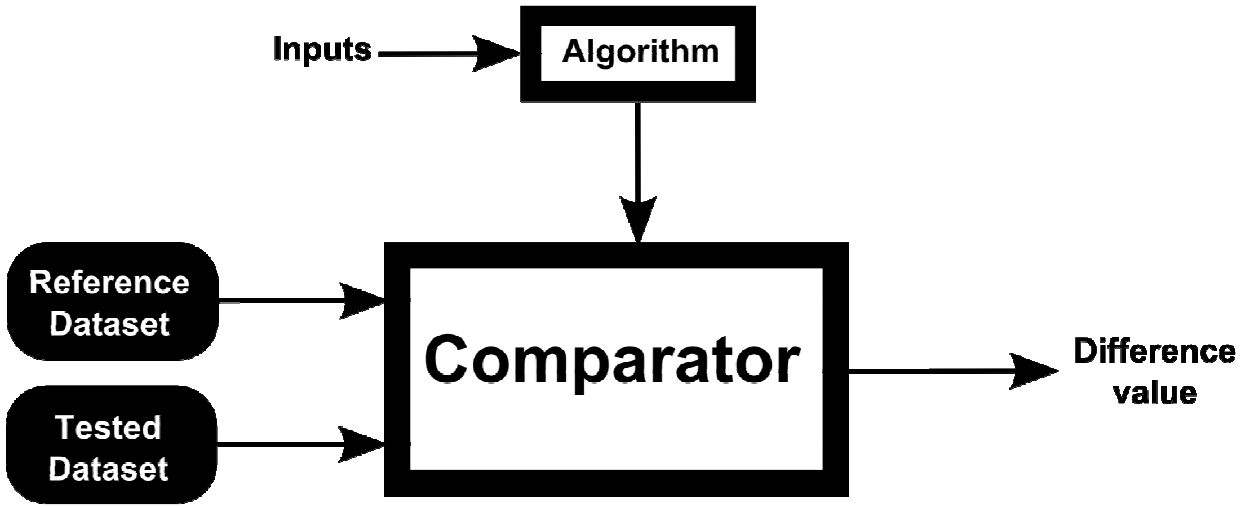
↳ How to explain this result ?

Plan

- A method to asses the influence of geometry modeling on indicator calculation
- Application case with the Sky View Factor
- Exploitation of the results
- Conclusion & discussion

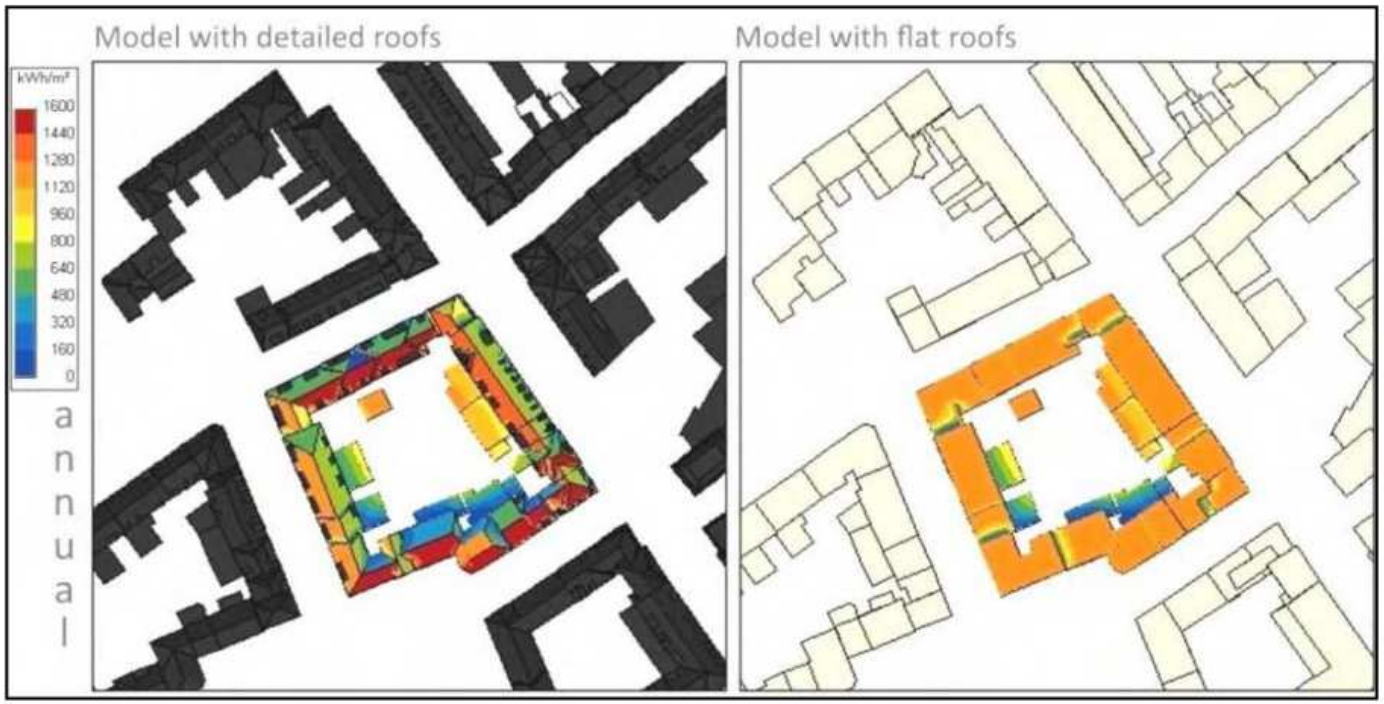
- Method focused on 3D indicator

- Common method:
  - Comparison between a reference and a test dataset,



Other work

- Some studies propose comparison between datasets
  - Sky View Factor [Gal, 2009]
  - Rock Falls [Tagliavini, 2009]
  - Solar simulation [Prevost, 2010]
  - …

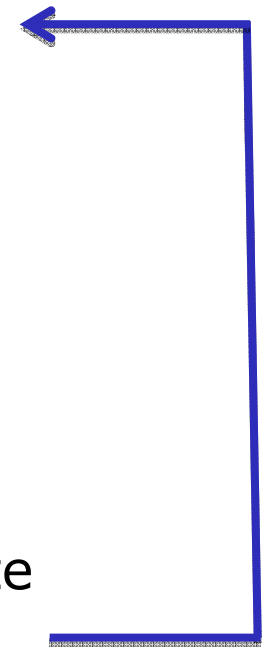


[Prevost, 2010]

Average difference of 1% on annual solar irradiation

Description of the steps of the method

1. Comparison of indicator values from the input datasets,
2. Determination of potential sources of difference,
3. Production of intermediate datasets isolating different sources of error,
4. Comparison of indicator values from intermediate datasets with the values from the reference dataset.



Plan

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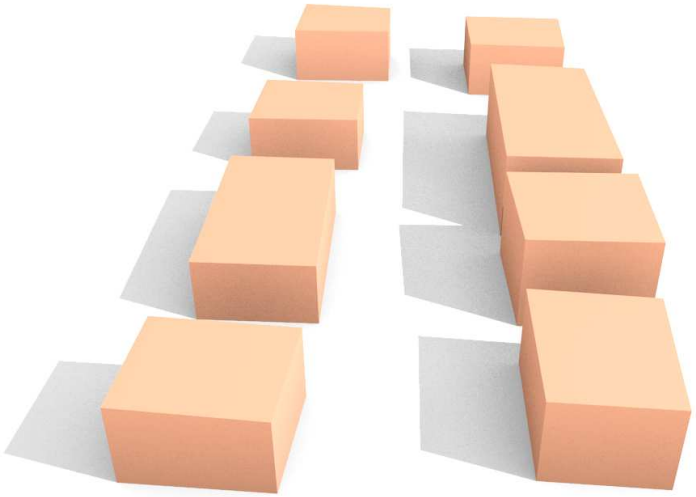
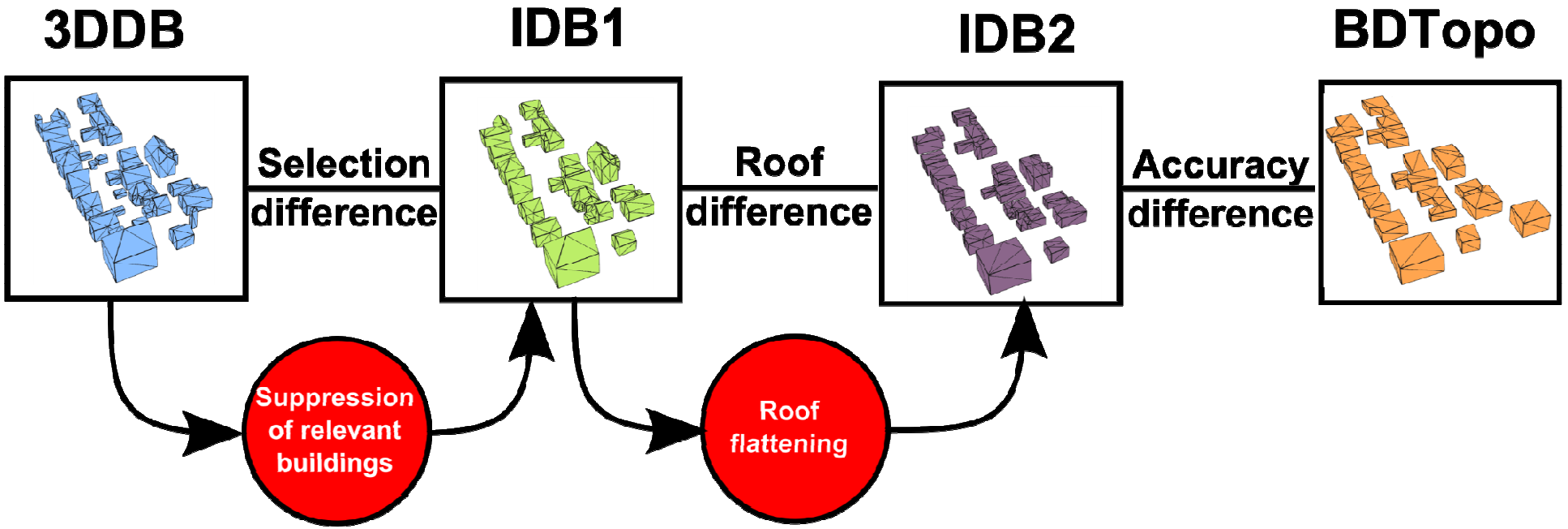
Uncertainty sources



- Building selection
- Roof modeling

- Geometric accuracy
  - Planimetric accuracy
  - Altimetric accuracy
  - Modeling choice

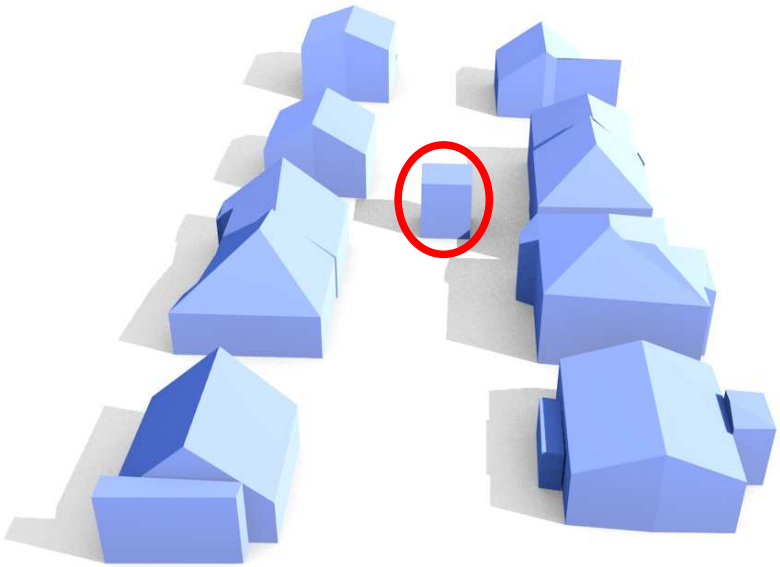
Production of intermediate datasets



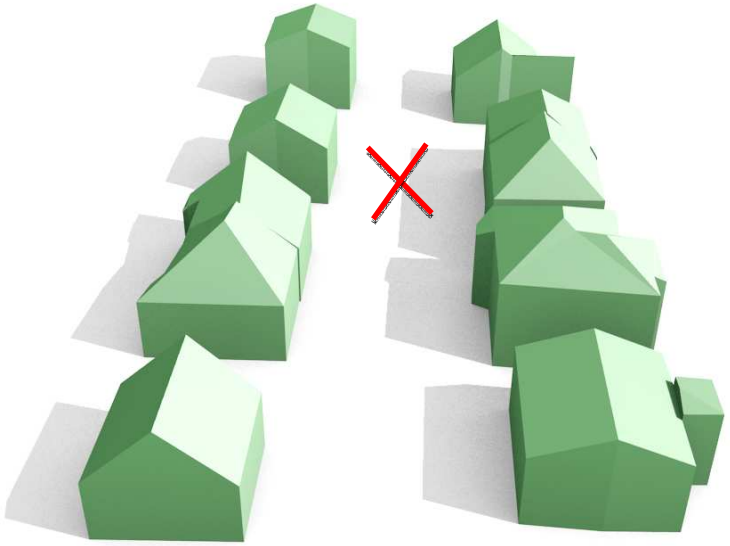
Production of IDB1

- Isolation of building selection error source
  - Selection of building with an area criterion considering data specifications

3DDB

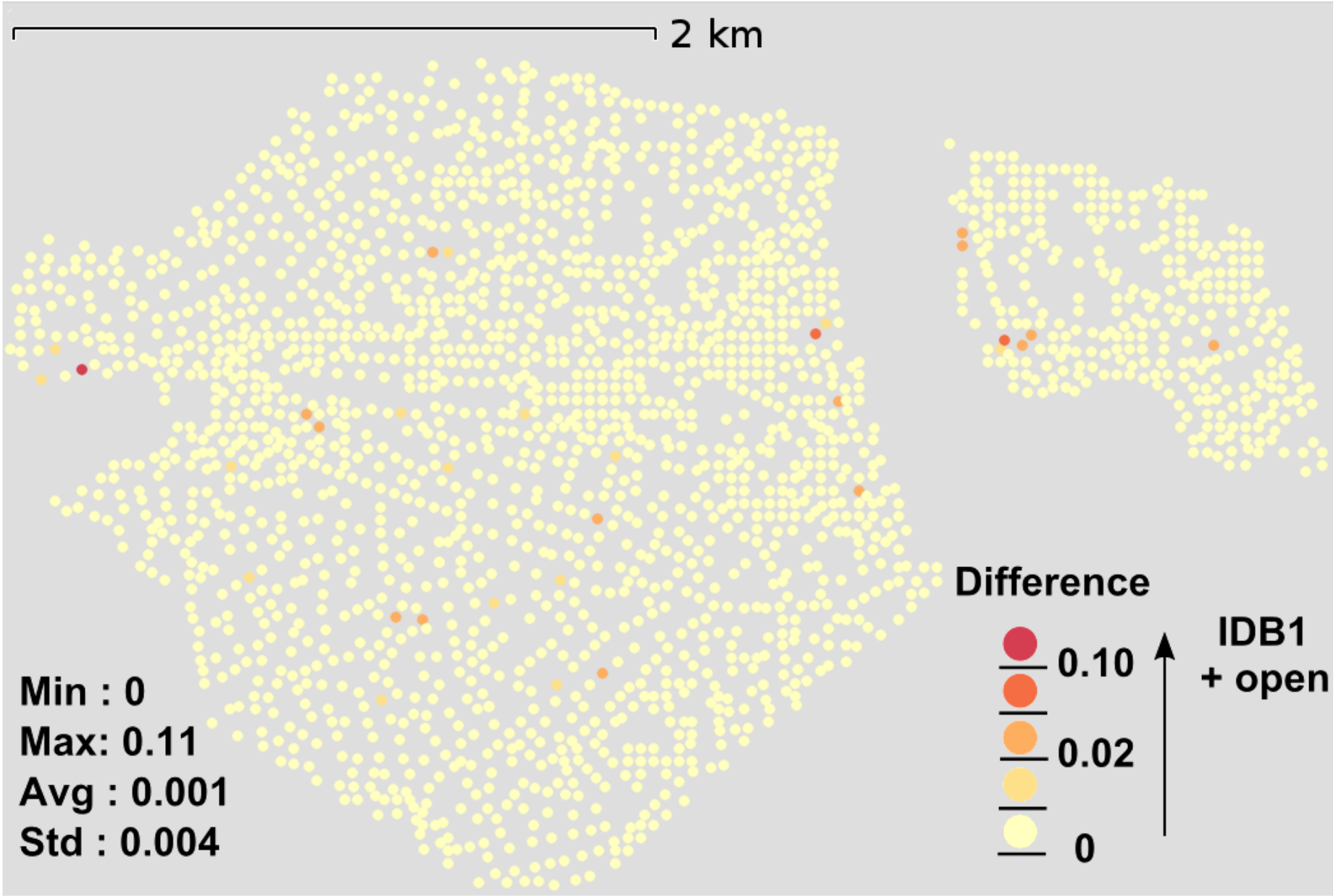


IDB1



Selection difference

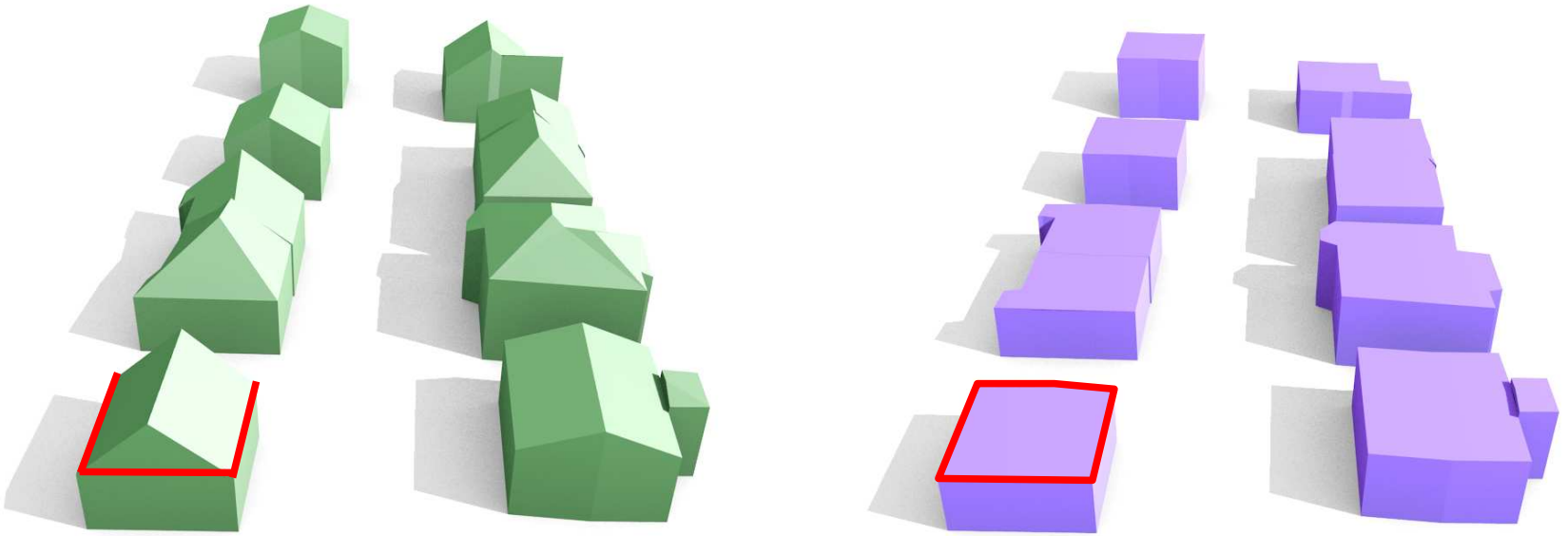
- Some hotspots explaining largest differences



- Isolation of roof modeling error source
  - Roof selection
  - Points moved in the approximated plane containing the gutters

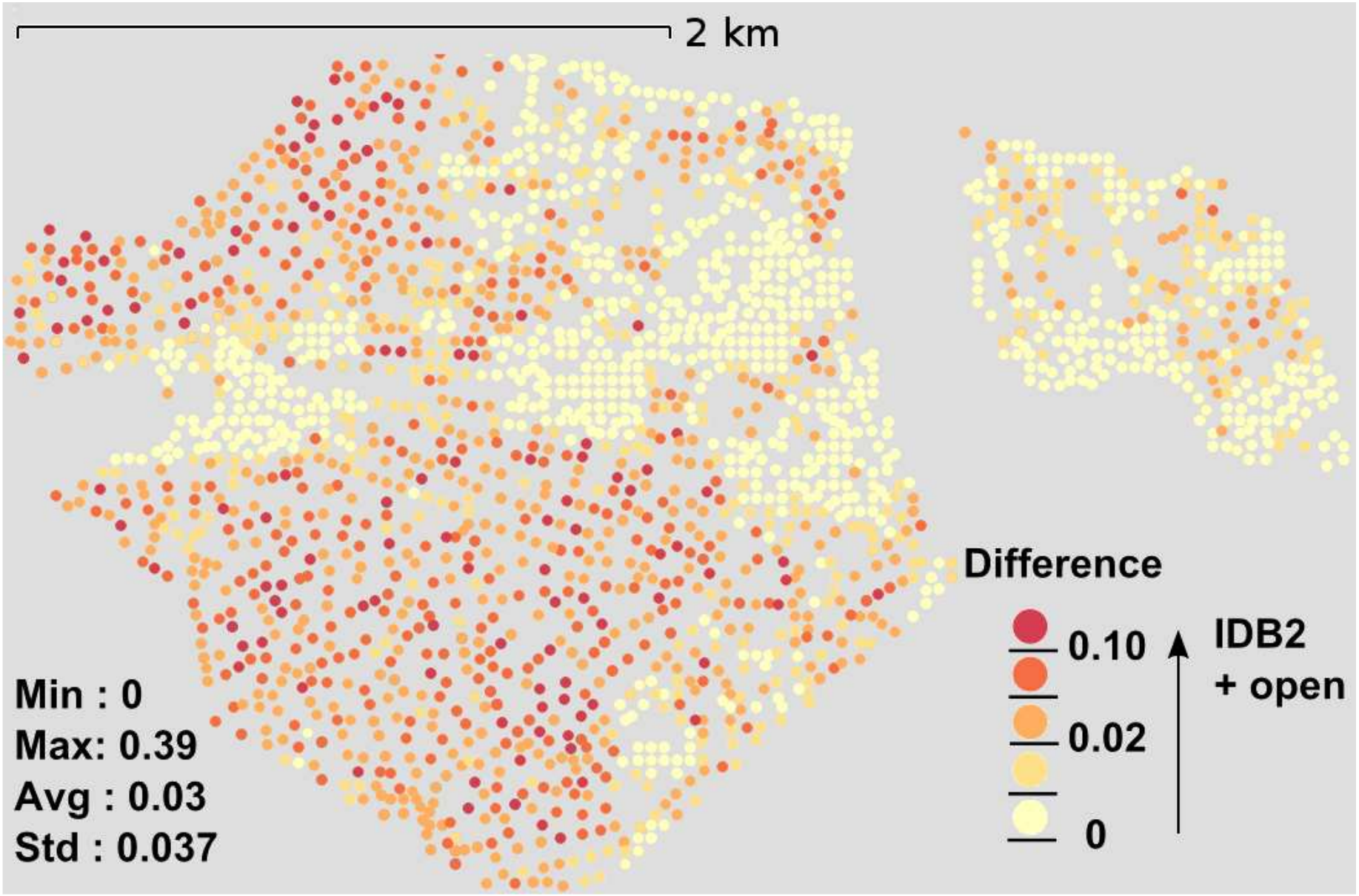
IDB1

IDB2



Roof difference

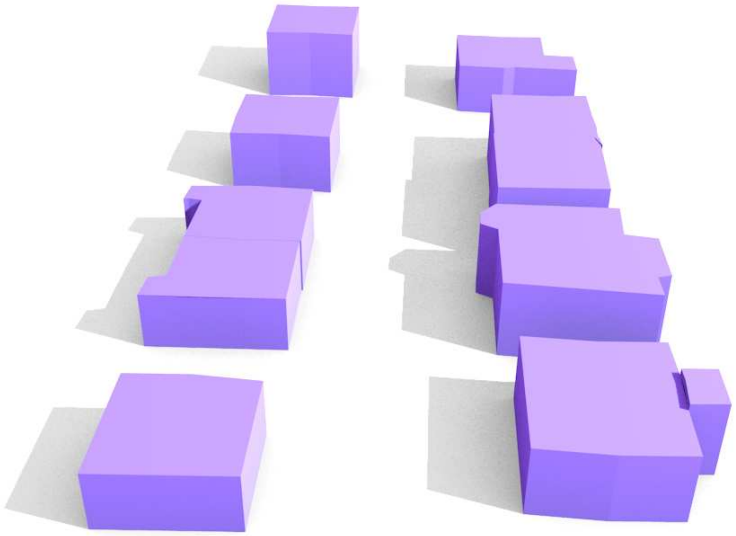
- Contribution in high density areas
  - Decreased openness



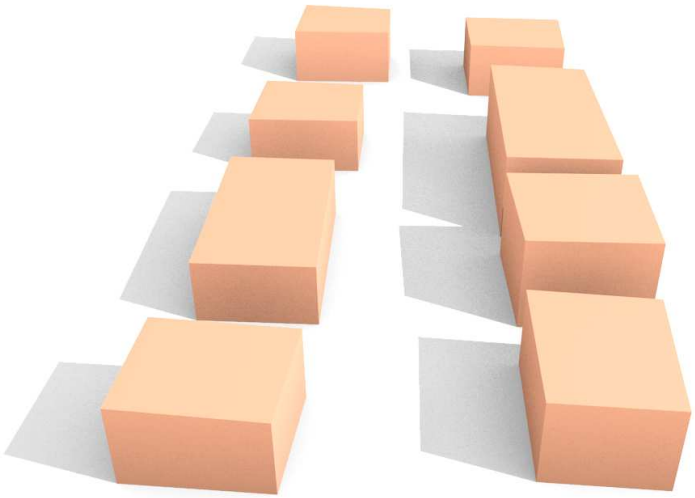
Comparison between IDB2 & BD TOPO ®

- Isolation of modeling choice error source

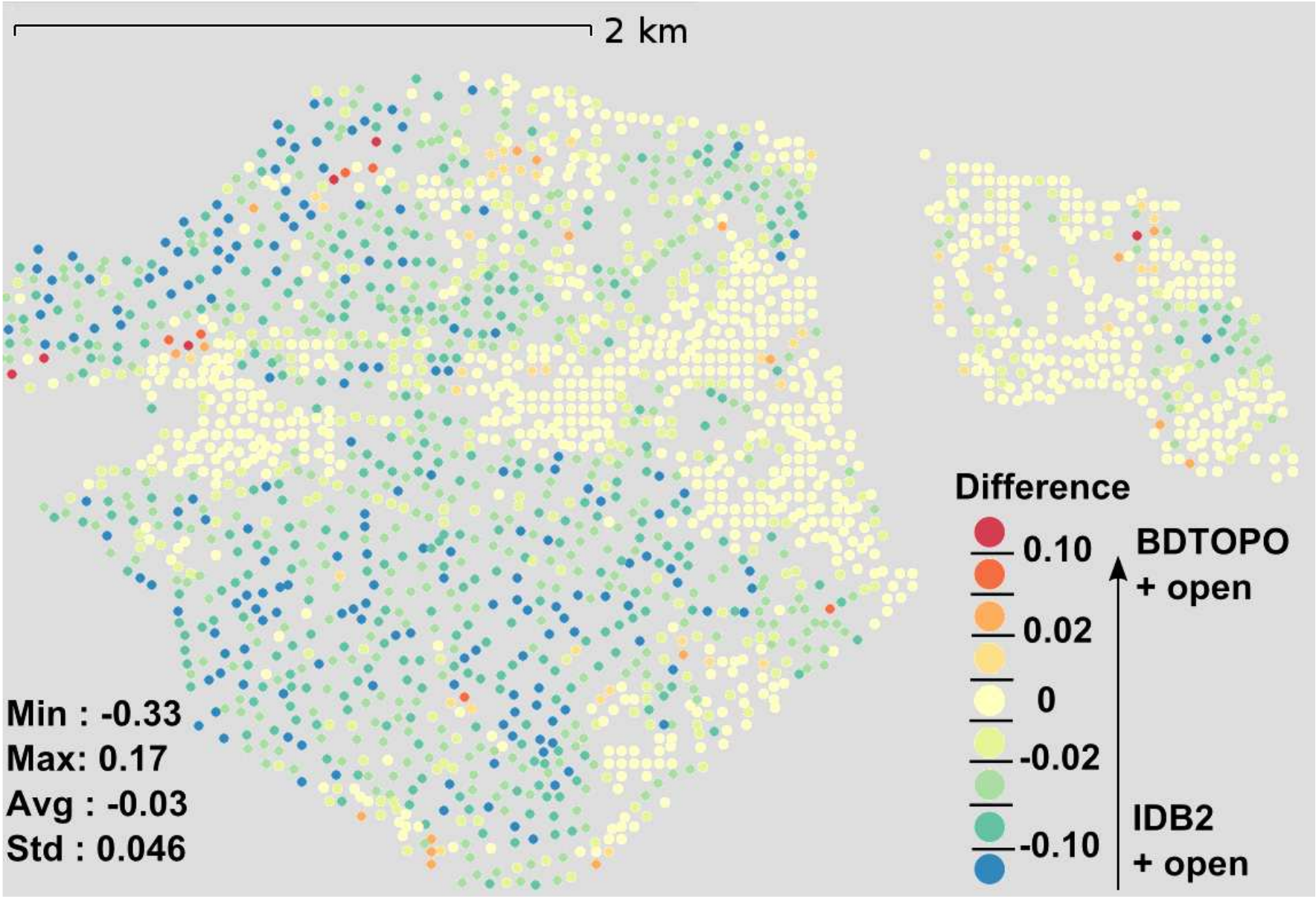
IDB2



BD TOPO ®



- Contribution in high density areas
  - Increased openness

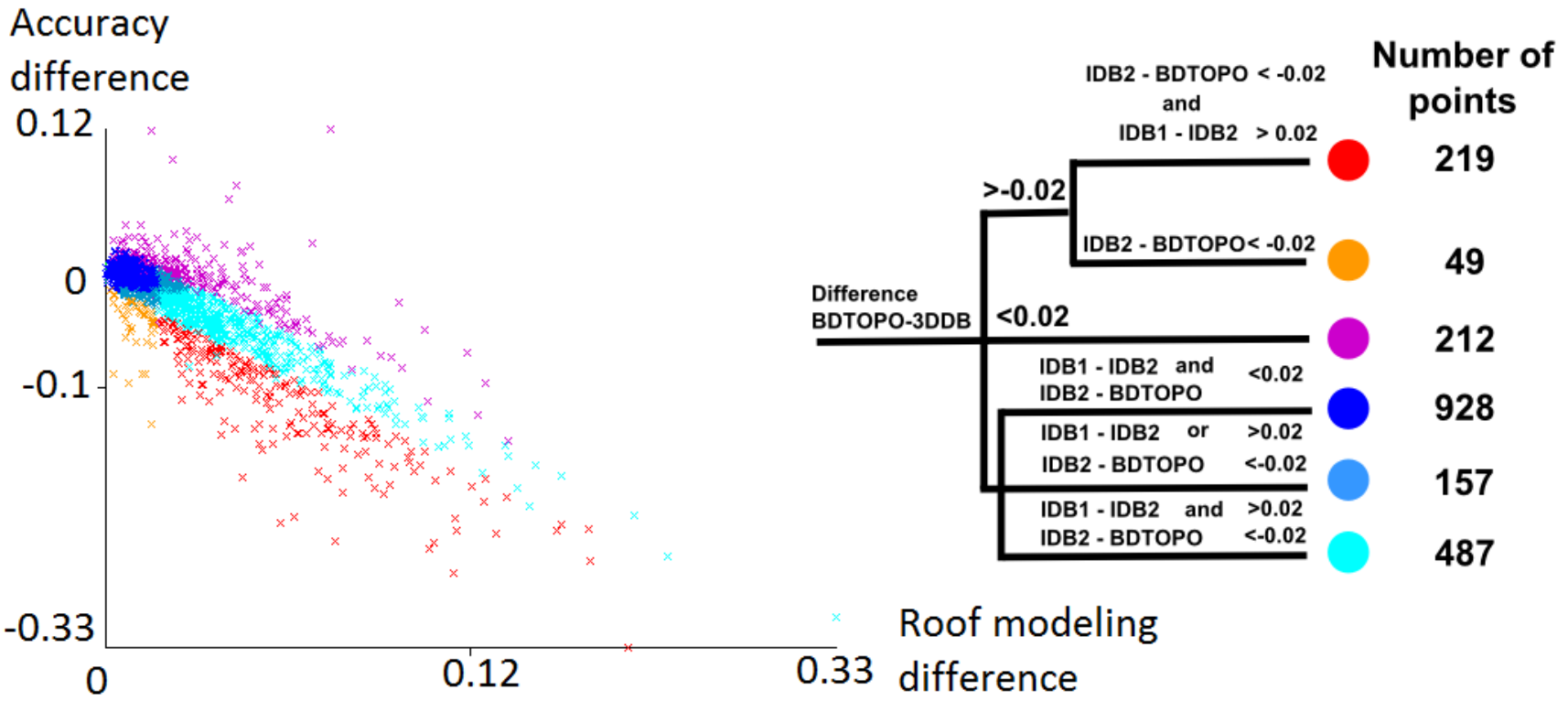


Plan

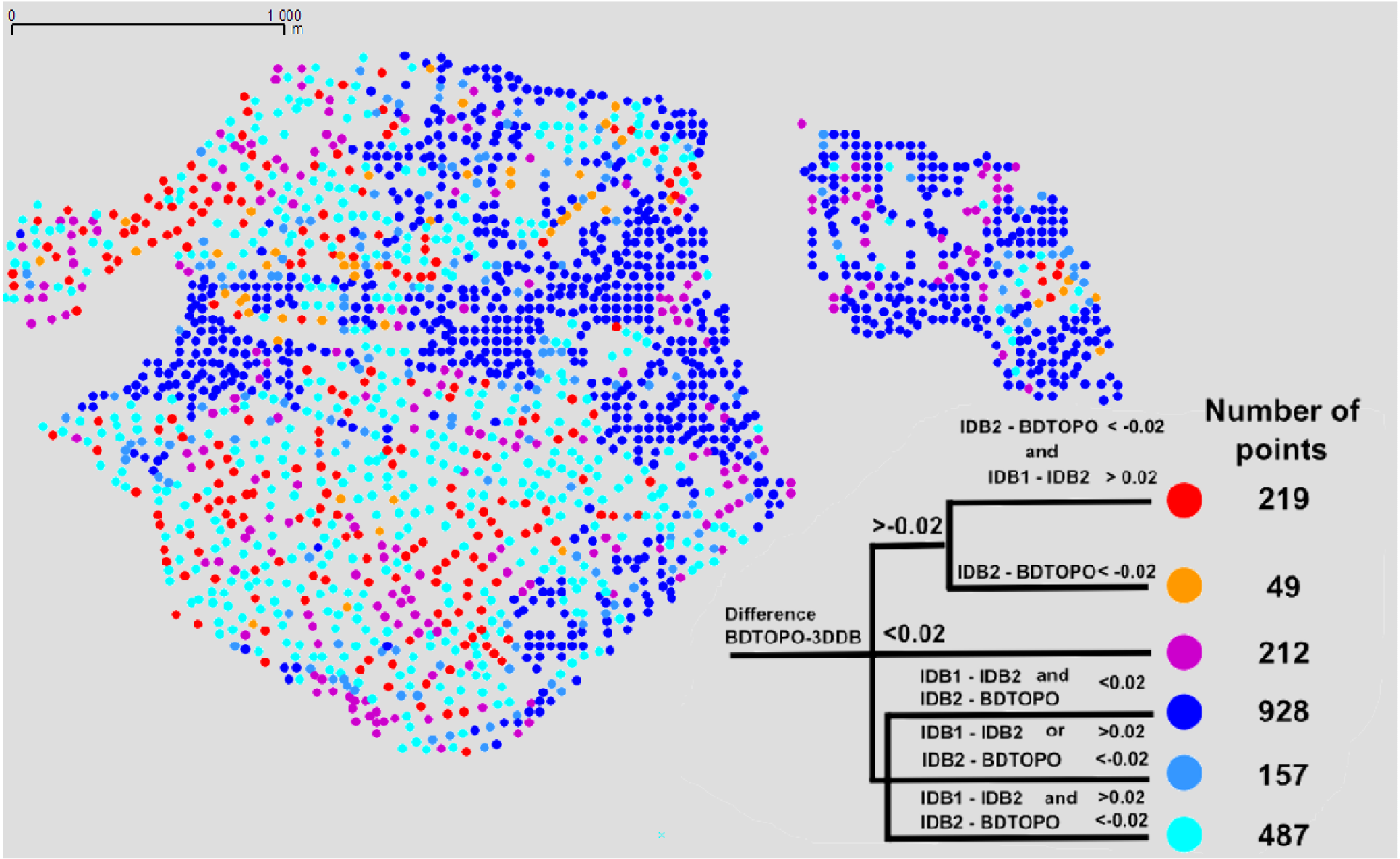
- A method to asses the influence of geometry modeling on indicator calculation
- Application case with Sky View Factor
- Exploitation of the results
- Conclusion & discussion

Classification of the points

- Determine major trends
  - Correlation & compensation between the 2 errors sources



Cartography of classification



Plan

- A method to asses the influence of geometry modeling on indicator calculation
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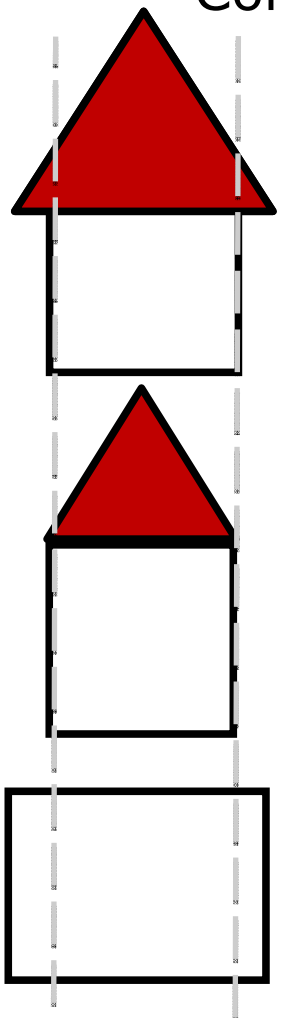
Conclusion

- A method to assess the impact of 3D geometric modeling
  - Based on isolation of accuracy sources
  - Relevant for other error sources and type of indicator

Conclusion

- Application to SVF with results
  - Error map according to modeling variation,
  - BD TOPO® suitable for aggregated calculation,
  - Compensation of modeling effects

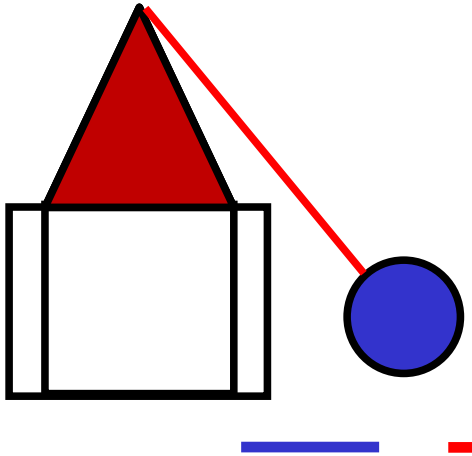


Real world

3DDB

BD TOPO ®

- Vertex with same SVF in both datasets



3DDB + open

BDTOPO + open

Thank you for your attention

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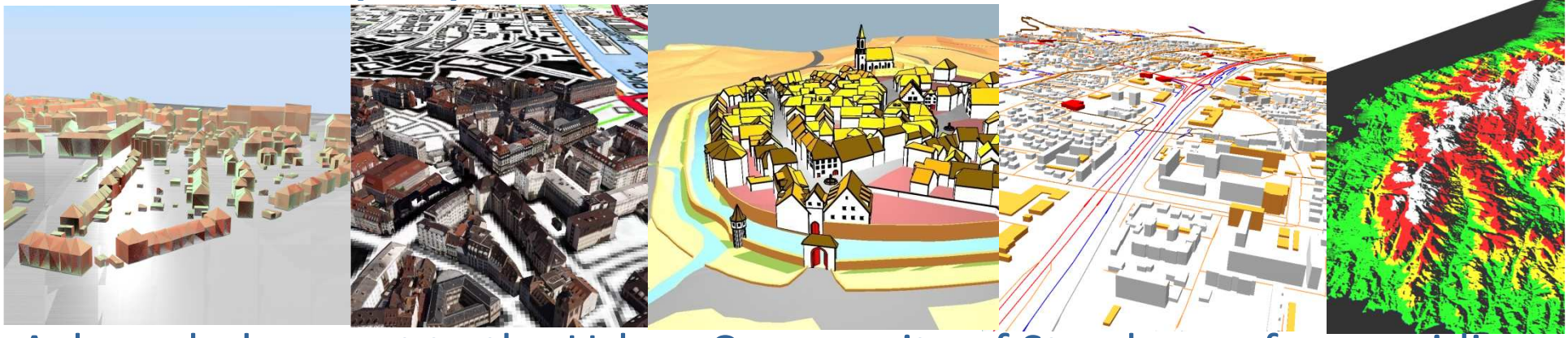
Christiane Weber (LIVE)



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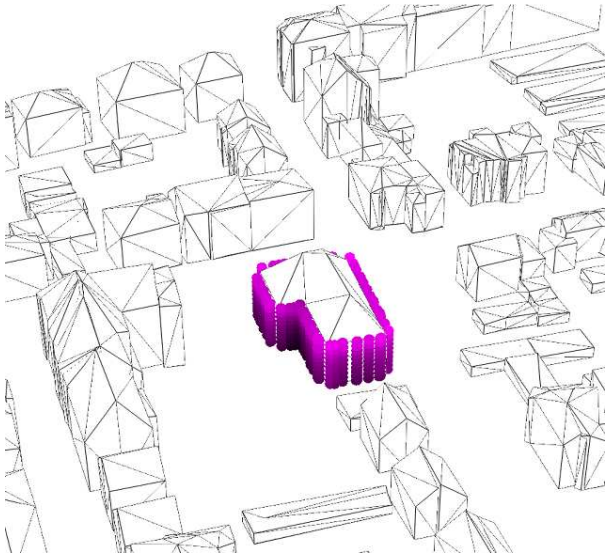
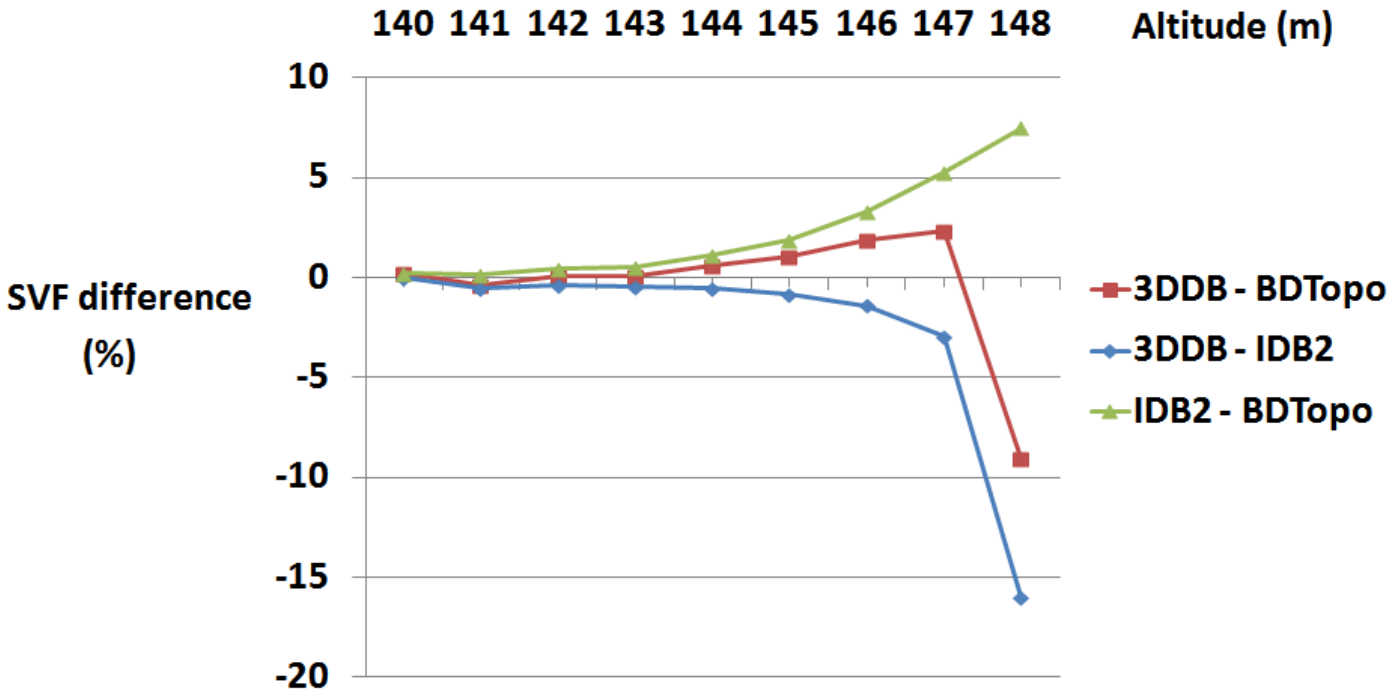
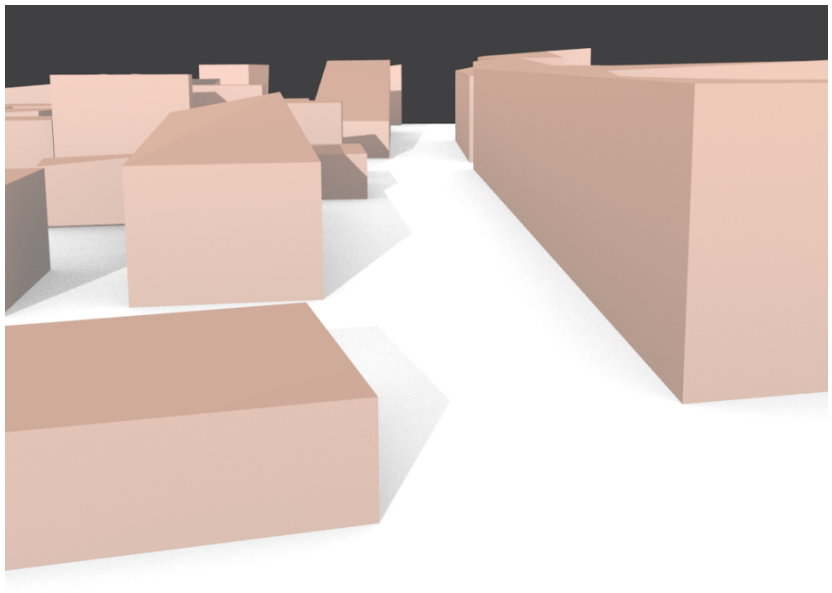
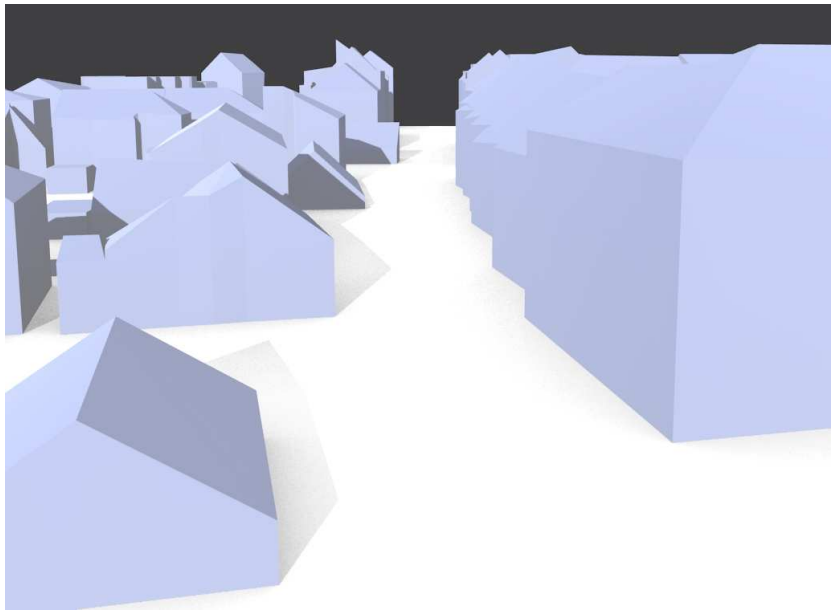
Discuss

- Points on building wall
- Influence of altitude

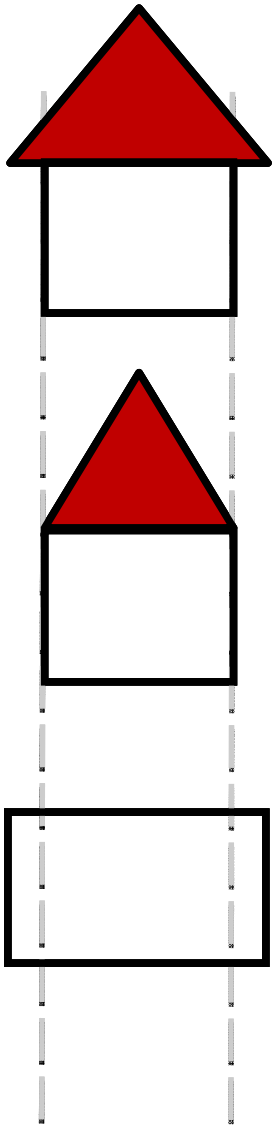








Differences between databases

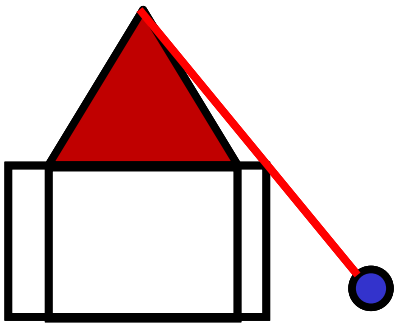


Real world

3DDB

BD TOPO ®

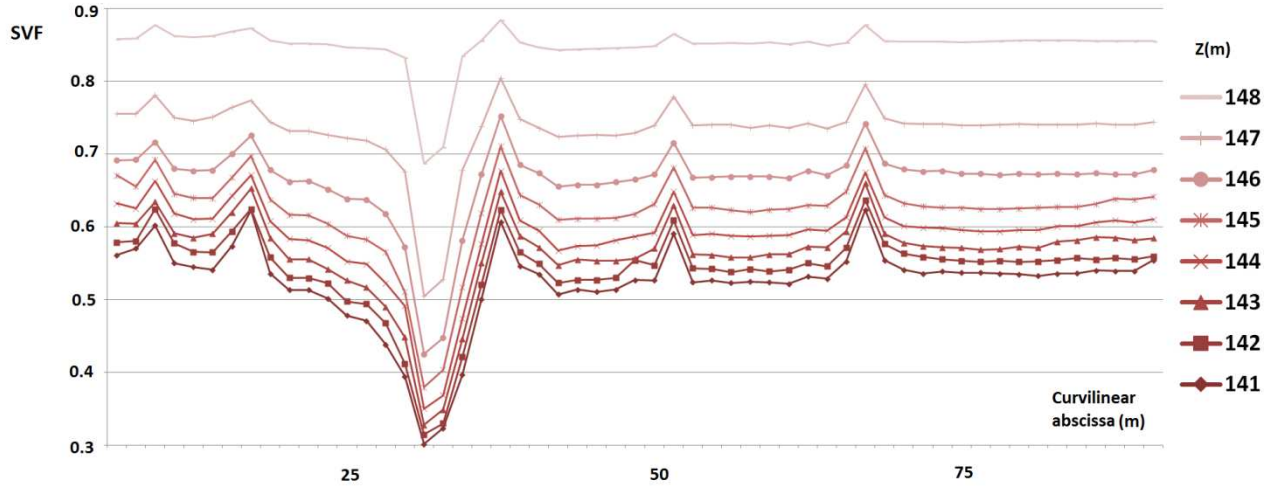
- Vertex with same SVF in both datasets

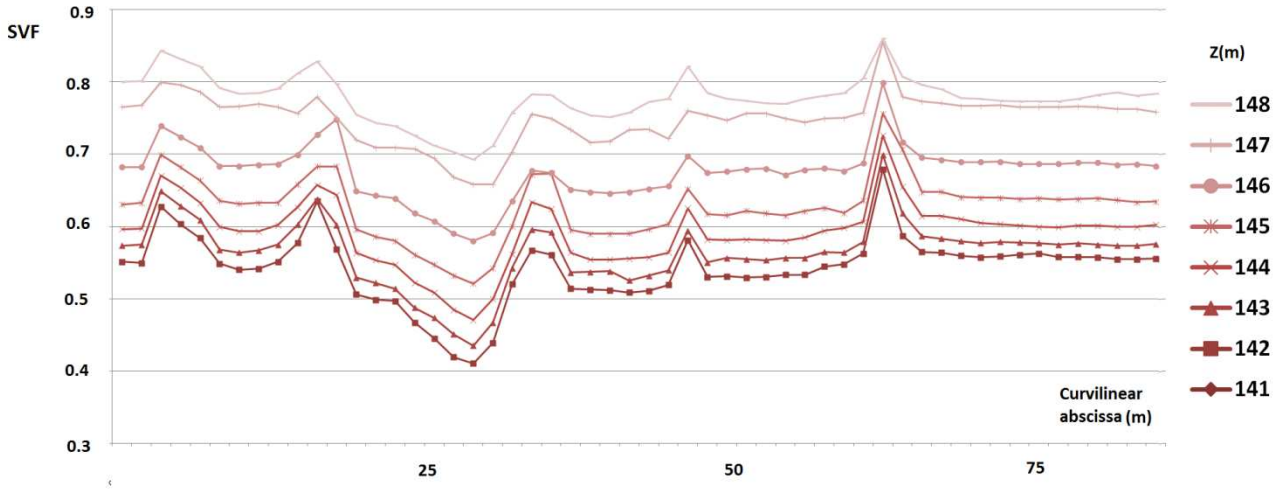


- How to assess the difference due to these differences on a large area ?

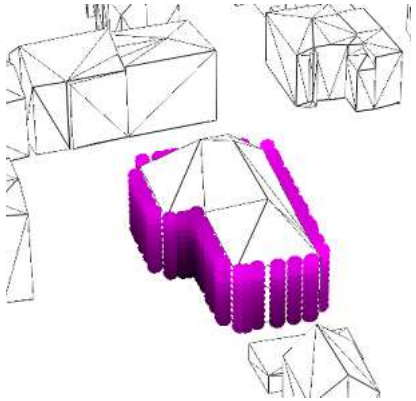
Discuss

- Variation around a building

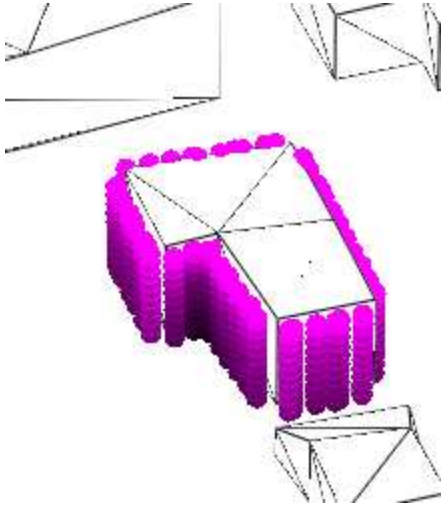




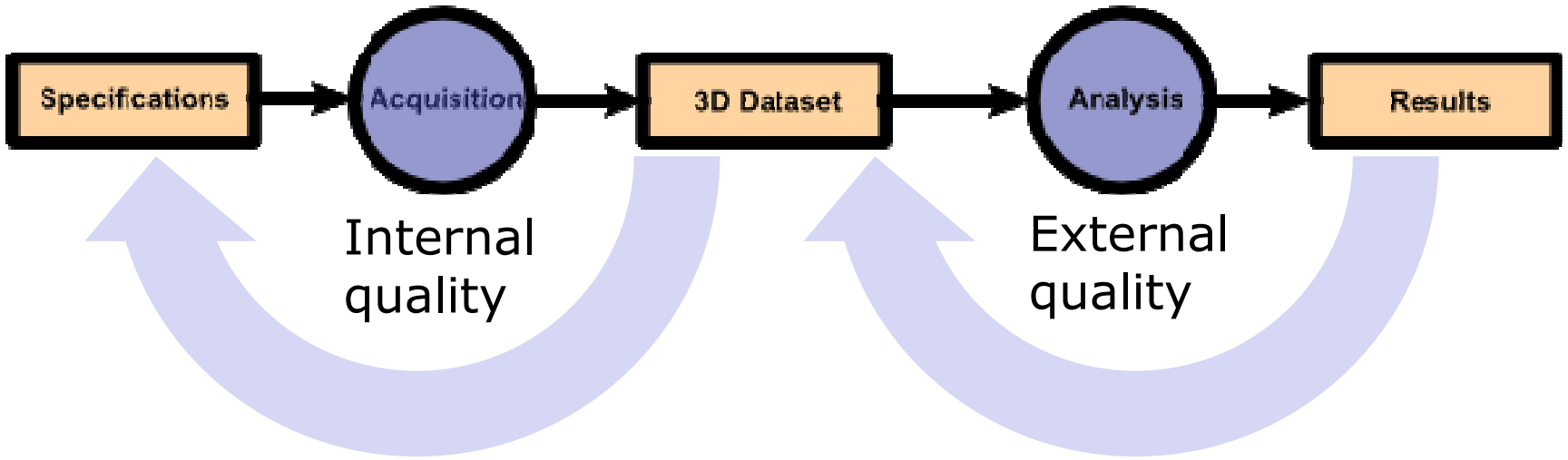
3DDB



BD Topo ®



Goal of the work



- How specification choices influence locally the quality of a result ?

- Topic of the presentation:
  - Generic method to assess the relevance of a dataset focused on indicator calculation,
  - Application case with Sky View Factor

- Isolation of uncertainty sources