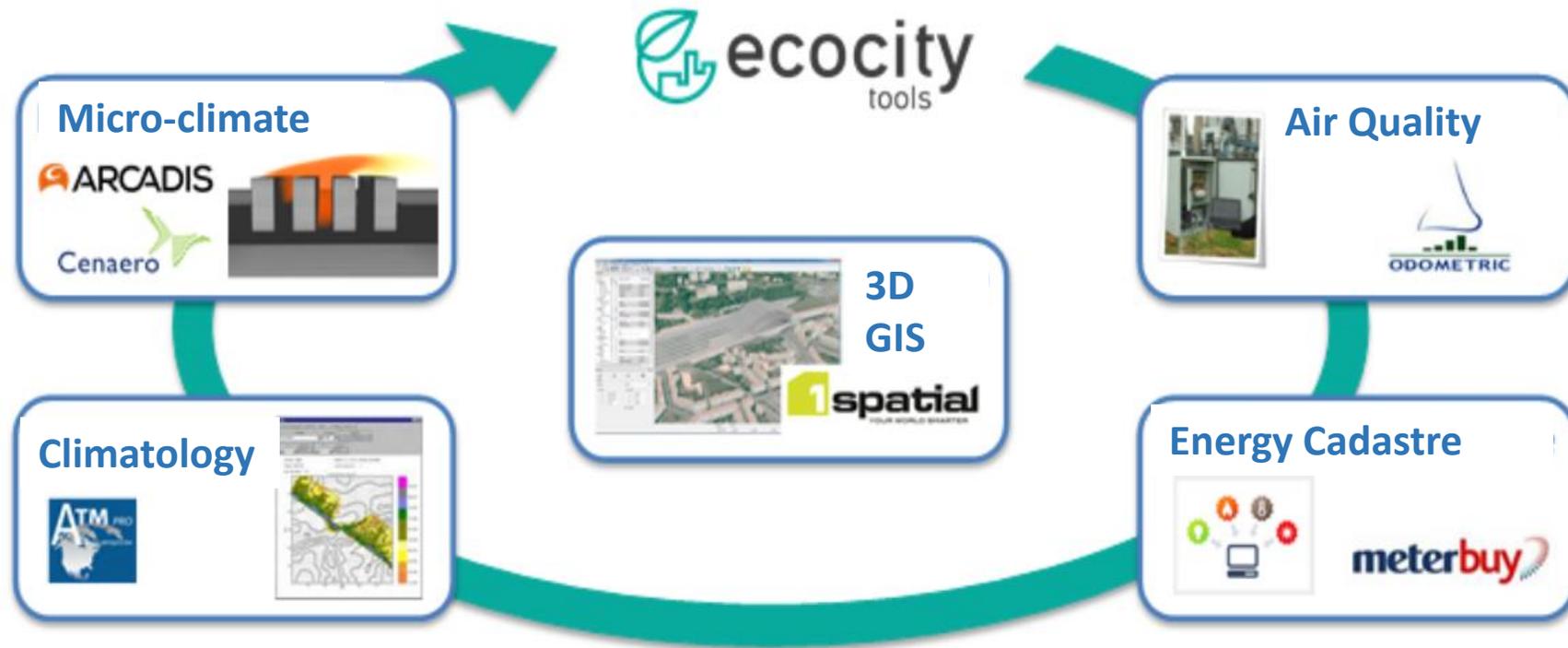


Integration of multiple sensor data into a 3D GIS for cities monitoring

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GHENT
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Introduction



Cities monitoring for better urban planning at a neighborhood scale

- Spatial Information must fit to the objectives of the « Smart City » project
 - **3D data** are essentials for analysis (ex: pollutant dispersions)
- **Sensor data** must be integrated into a GIS
 - Can be associated to **specific geometric parts** (ex: wall)

➔ Implementation of 3D GIS integrating sensor data

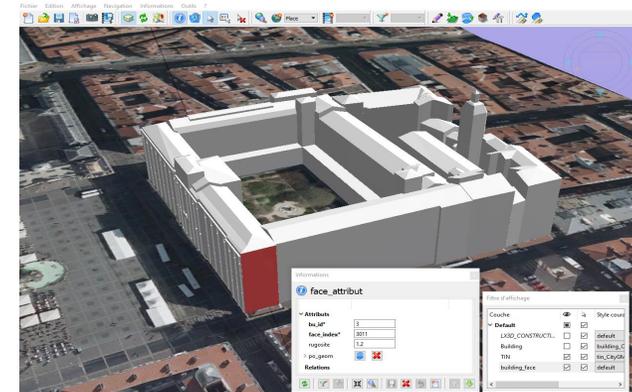
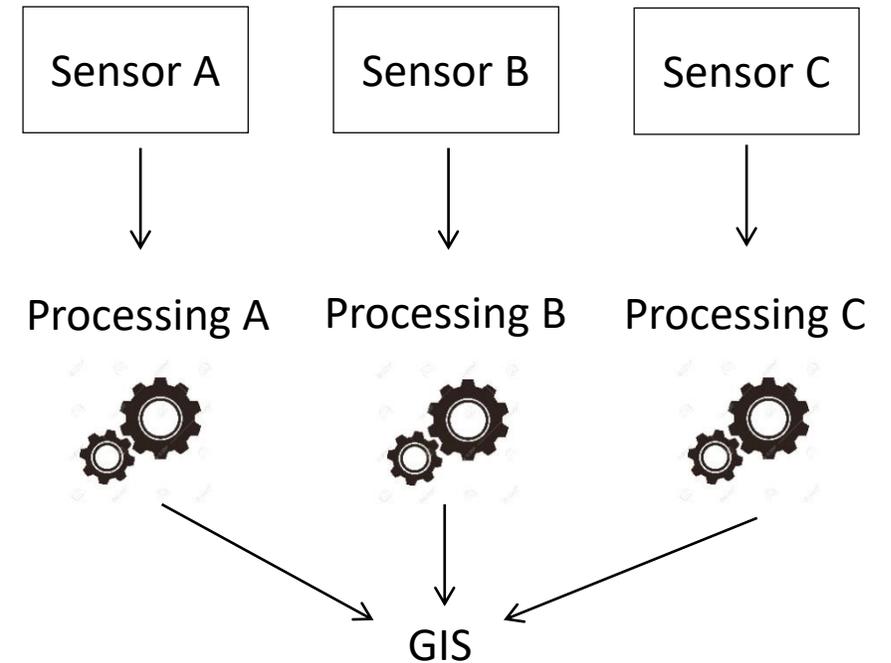
State of the art

- Conceptual model for 3D spatial information at different levels of details (LoD)
 - Data generally **available** at **LoD 1 or 2**

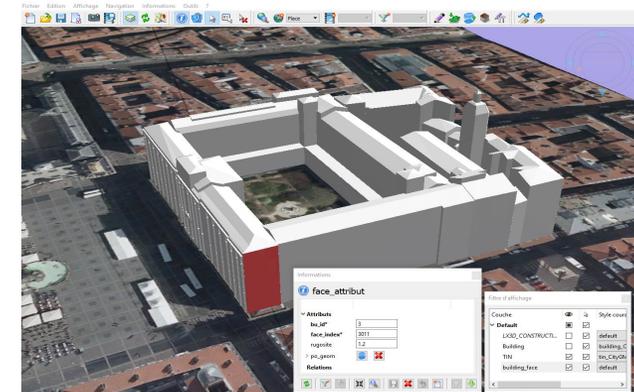
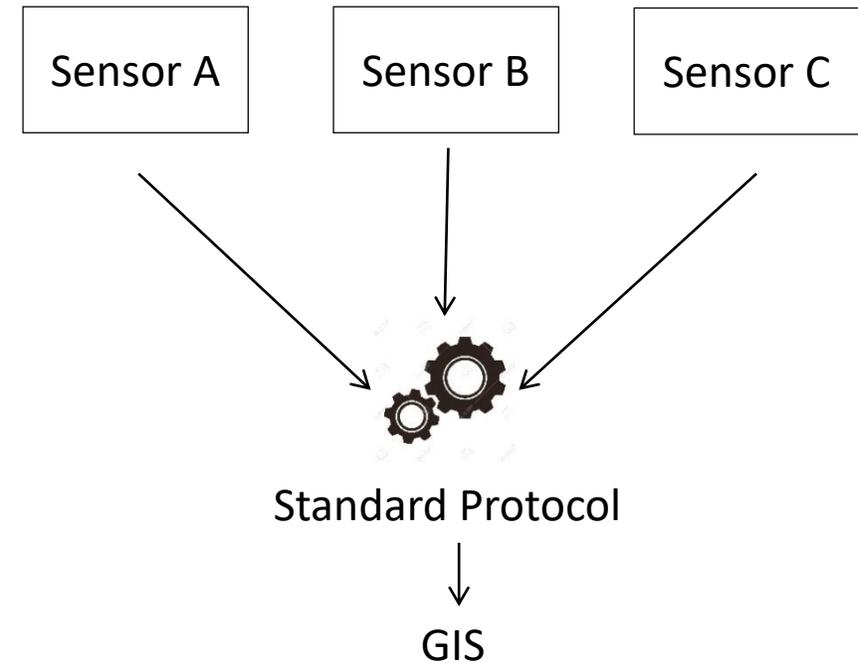


- 3D City DB
 - Implementation of CityGML in a **relational spatial database** (PostGIS)
 - **Semantic information** is associated to geometric primitives (point, curve, surface, solid) depending on LoD

- Geolocated temporal series
 - Large datasets frequently updated (ideally in real time)
- Heterogeneous data
 - Different sensors with different protocols for data exchange

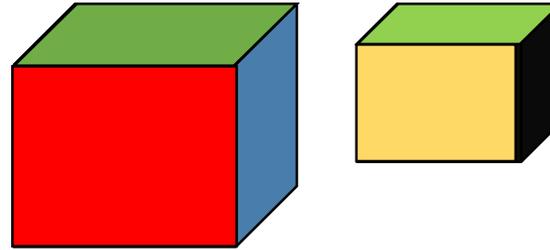


- OGC proposes standard protocols for sensor data exchanges in GIS
 - **Sensor Observation Service (SOS)**
 - Manage sensor data in a remote server (record/update/delete sensor information)
 - Consider very different types of sensors
 - Get observations filtered in space and time
 - **Sensor Things API (STA)**
 - Evolution of SOS



- Methodology for the **storage of building parts attributes** in a low LoD (1 or 2) 3D model
 - Relational PostGIS database
- Implementation of a standard **exchange protocols between sensors and GIS**
 - Sensor Observation Service

Methodology and implementation



Relational model for **high LoD**

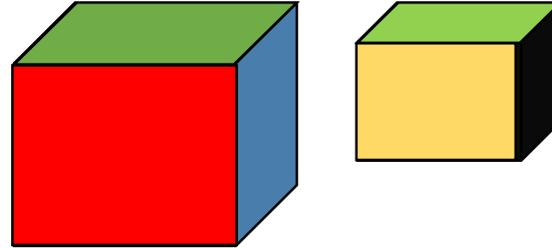
Object	Surface	Surface geometry	Colour
1	1	...	Red
1	2	...	Green
1	3	...	Blue
1	4	...	
1	5	...	
1	6	...	
2	1	...	Yellow
2	2	...	Green
2	3	...	Black
2	4	...	
2	5	...	
2	6	...	

Relational model for **low LoD**

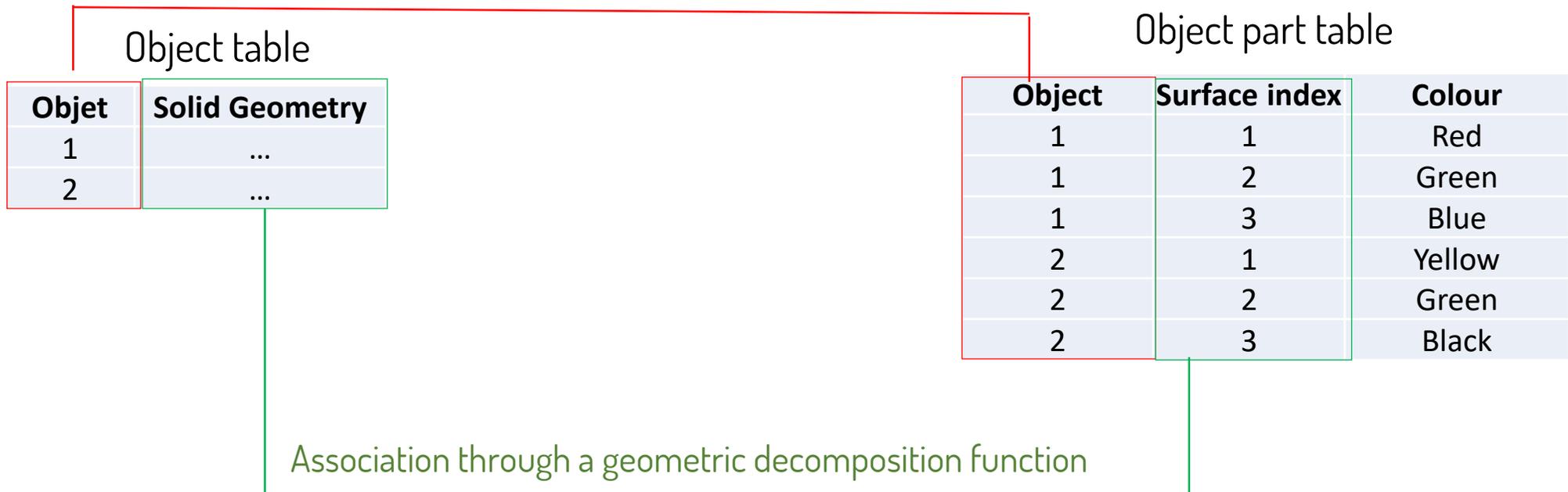
Objet	Solid Geometry
1	...
2	...



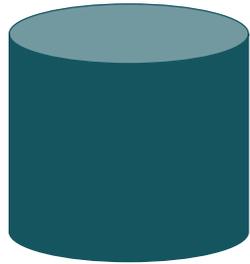
How do we store the semantic attributes when the LoD is low?



Direct association



PostGIS database with solid geometries

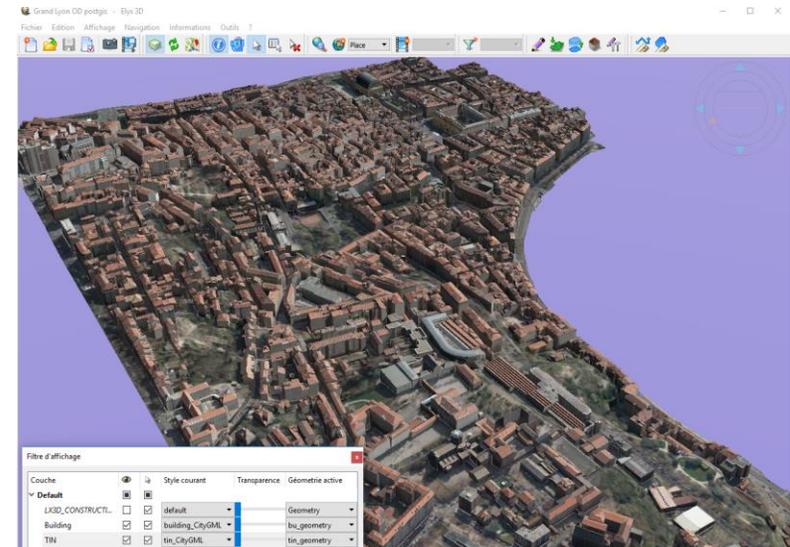


Script for the automatic creation of surface tables

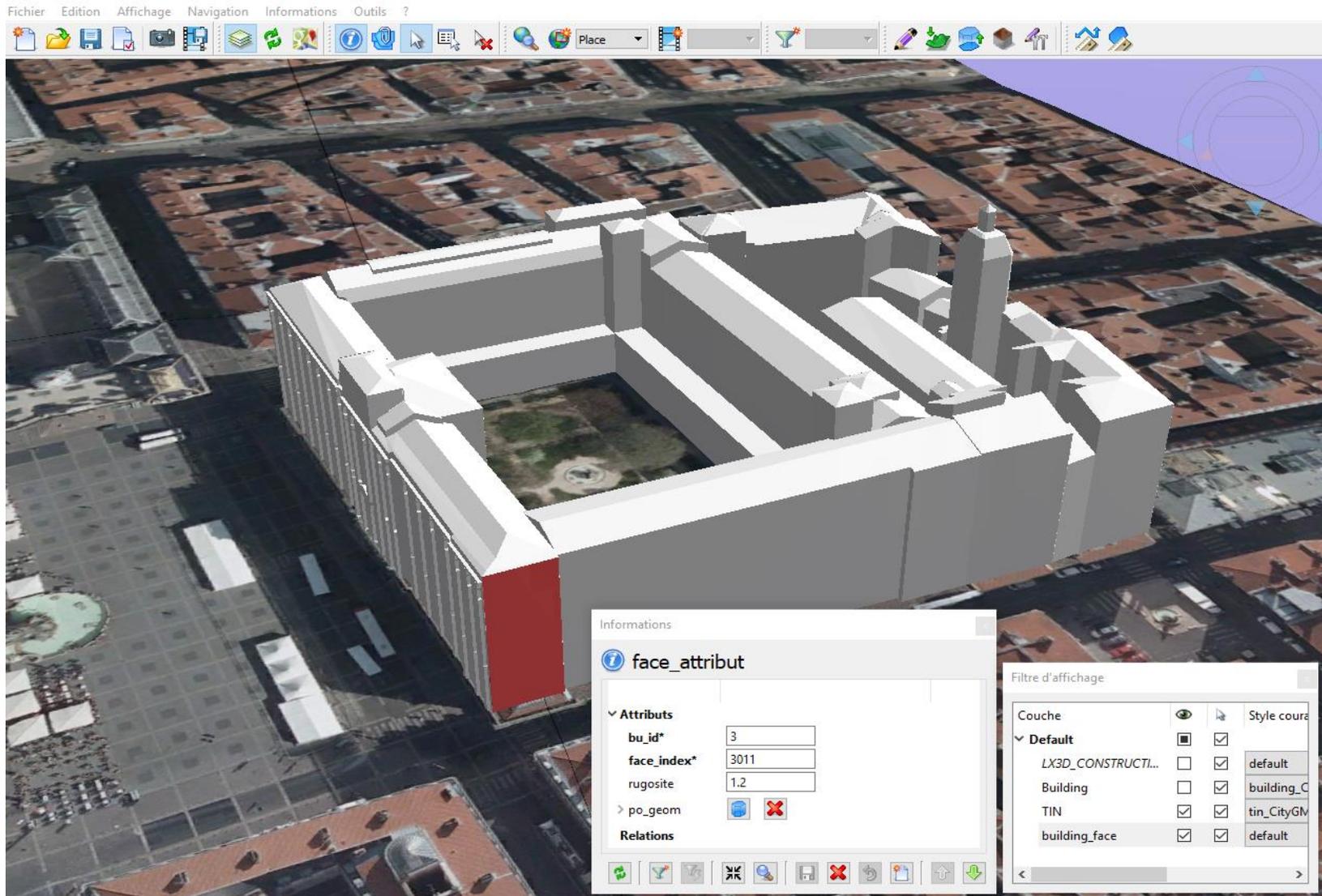


- Attributes
 - Visualization
 - Updates

Elyx 3D (ISpatial)

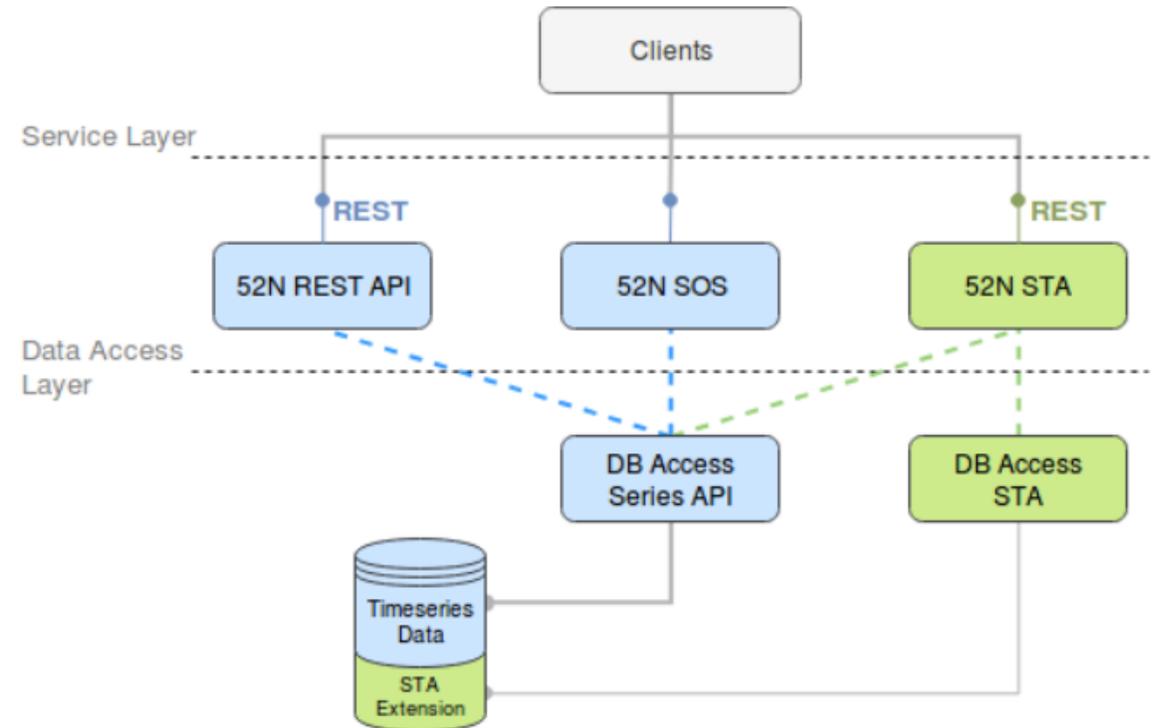


Semantic information in 3D GIS: validation



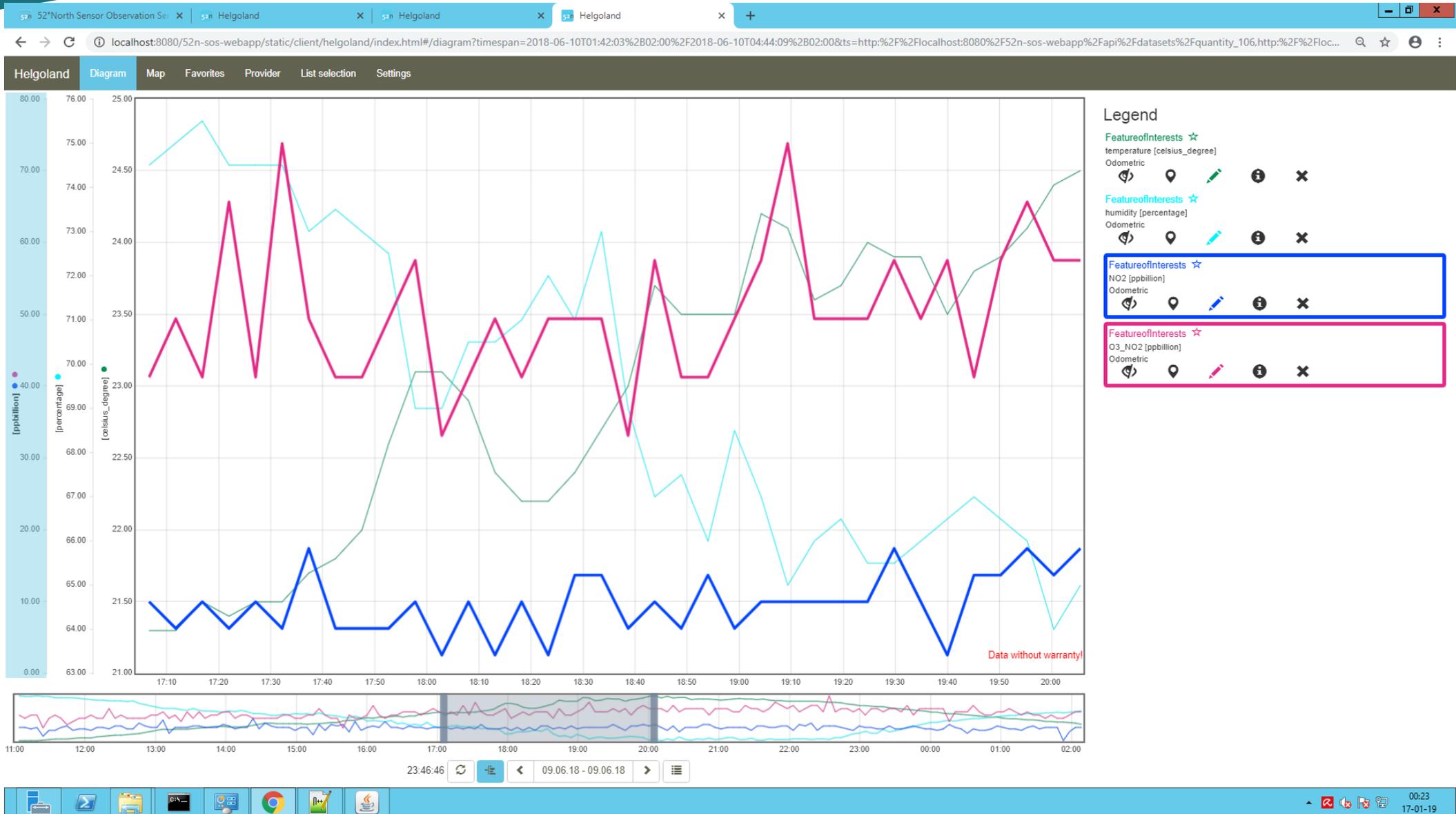
52° North

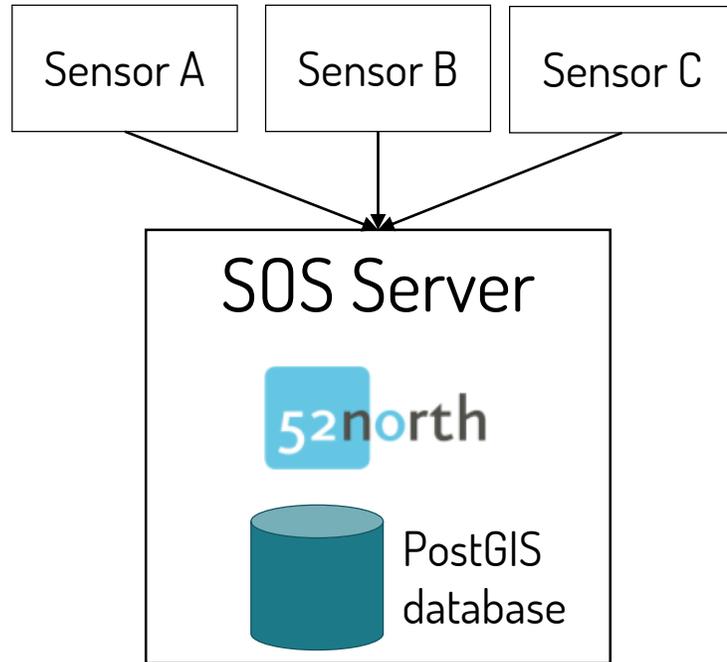
- **Open source** SOS server
- Future **STA** extension
- Provided with **Helgoland** client
- Uses a **PostGIS database** to store sensor data



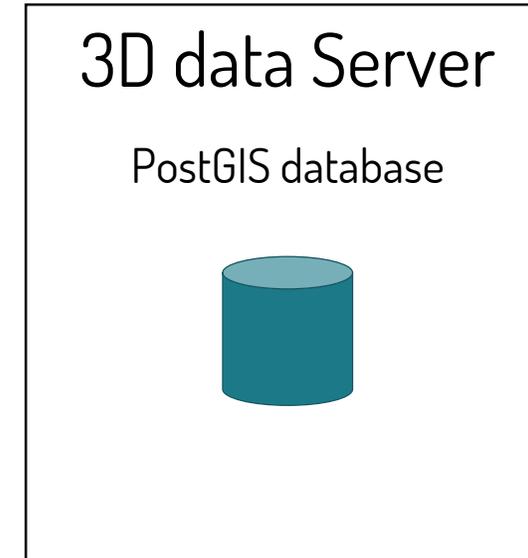
Integration of the STA into the 52°North Sensor Web Architecture

Helgoland interface: SOS Query

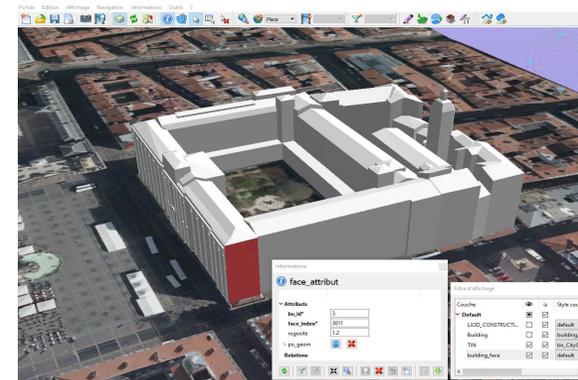


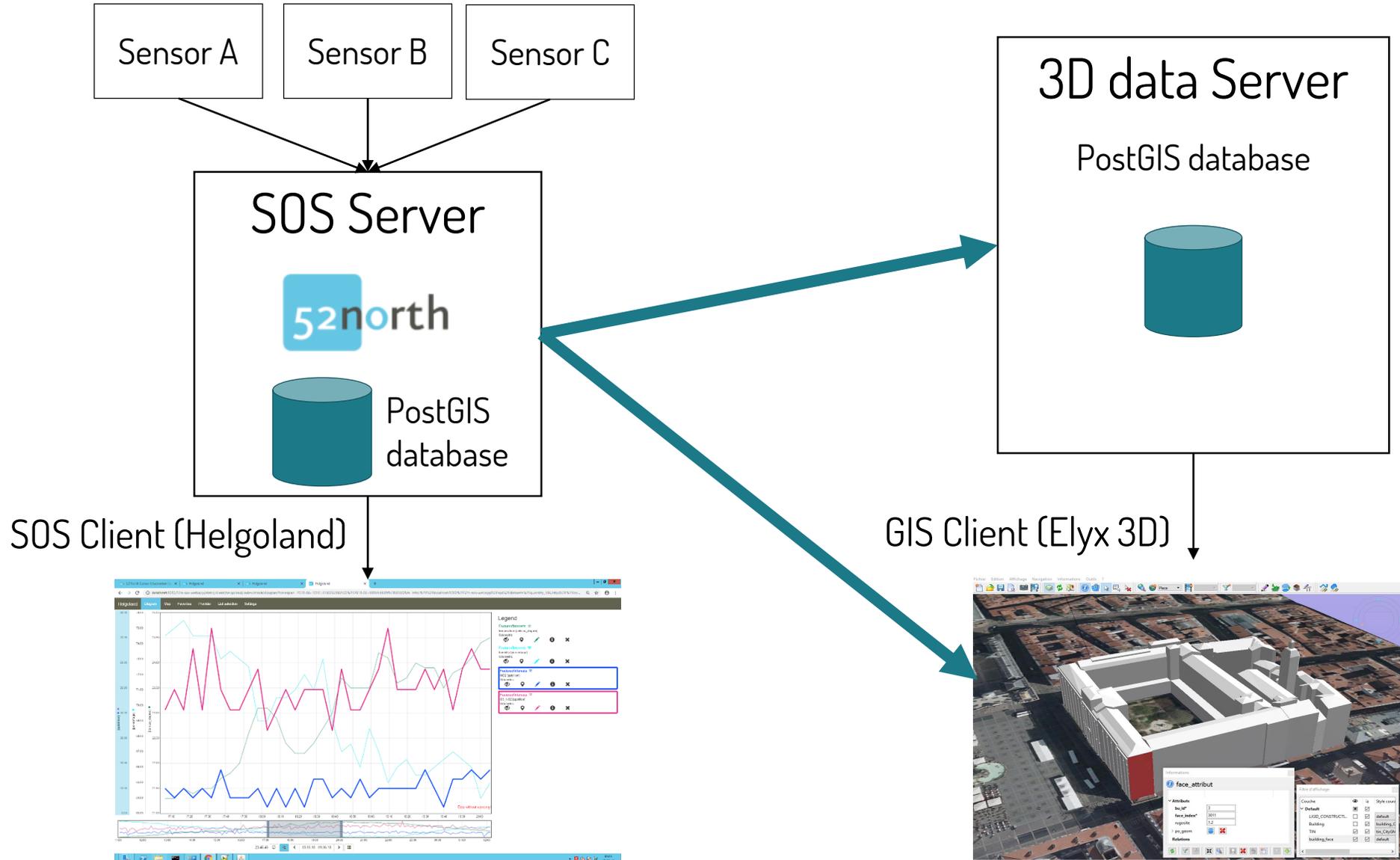


SOS Client (Helgoland)



GIS Client (Elyx 3D)





Conclusion

- Even with **low level of details**, available 3D open data can be used in a 3D GIS for **relevant analysis** (ex: pollutant dispersion) thanks to:
 - Spatial databases (PostGIS)
 - Geometric decomposition functions
 - Adapted 3D GIS clients
- 3D GIS also integrates real-time monitoring with **sensor data** thanks to:
 - OGC SOS and STA protocols
 - 52North server

But there is more to do:

- Extension of the SOS server to STA
- Implementation of SOS/STA protocol to the 3D GIS (client and/or server)

Thank you



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Main concept of SoS and STA

