Position Paper

Dynamic and Observational Spatial Data

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Digital maps have become a ubiquitous tool for interaction with our surroundings. These developments may seem very dynamic in nature, but they remain relatively static, continuing to mimic the nature of paper maps; dynamics are usually reduced to allowing the user to toggle additional layers, or to view simple attributes pertaining to objects on these layers.

At the same time, the amount of dynamic data available about our world is rising exponentially, with real-time data on our world being made available by a multitude of sources, e.g. sensors of diverse types ranging from stationary or mobile air quality sensors measuring particulate matter or nitrogen oxide, gauges of groundwater or surface water levels up to earth observation images from satellites [7]. Additionally, novel usages of SensorThings technology have recently been emerging ranging in domain from real-time data on the number of Covid-19 cases to background data such as demography. While there is at least basic tooling available for the integration of static features into mapping environments, these tools rarely offer support for dynamic sources. Providing such data to users in an interactive manner requires additional development efforts and expertise of the underlying data models and services.

For many years, the Open Geospatial Consortium (OGC) has specified open system architectures together with observation and measurement (O&M) information models (now formalized as ISO 19156) and sensor observation and management services under their Sensor Web Enablement initiative, based upon web services technology. With the emergence of the Internet of Things (IoT) and related technologies, OGC started the Sensor Things initiative that migrates Sensor Web specifications towards a lightweight REST (REpresentational State Transfer) architectural style and corresponding APIs. As these models for dynamic data have long been standardized via the OGC data models, Web Services and now APIs, it would be most valuable to integrate these sources for dynamic data into the wider mapping community.

Based on our experience, the following functionality would be essential for the true integration of dynamic and observational data into a mapping environment:

- Correct and timely representation regardless of zoom level - while this can also be an issue with non-dynamic data, it becomes even more pressing with dynamic data. The visual representation and loaded data subset may have to change depending on zoom level
- Support for access to and visualization of observational data, particularly time series
- Support for update modalities pertaining to real time data
- Hooks to allow custom scripts to add geospatial (map bound) and modal (window bound) elements to the map, and react to user interactions with the map

The authors have all long been involved in diverse activities pertaining to the structuring, provision and utilization of observational and IoT-related data, both within the framework of the OGC as well as via other international initiatives. They have been involved in defining the core conceptual models for environmental risk management architectures (European research project ORCHESTRA [1]), further-on tailored for and extended to the provision and management of environmental sensor data (European research project SANY [2]) and utilized in Europe for air quality monitoring [3]. Furthermore, the authors are working on the sensor web of the future via their activities as leading members and co-chairs of the O&M and SensorThings API standardisation working groups within OGC. In addition, they have participated in multiple research and implementation projects as well as large-scale spatial data infrastructure initiatives such as INSPIRE [4] (Infrastructure for Spatial Information in Europe), bringing the flexibility of newly emerging APIs to this administrative framework [5].

As a summary, when discussing maps for the Web, the inclusion of dynamic and observational spatial data cannot be neglected without losing decisive and essential information sources for decision support. In early warning systems such information has to be made available in maps in near real-time [6], e.g. when having to decide if tsunamis will result from observed earthquakes in the sea. The long-standing and practically proven OGC technologies in the context of the Sensor Web Enablement shall be considered for modern mapping technologies for the Web when considering dynamic and observational data.

References

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