Semantic-driven Geospatial Data Visualization Approach to Agriculture

Use case: Apple-growing in South Tyrol, Italy

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The achievement of SDG 2 – Zero hunger requires the widespread promotion of sustainable agriculture. Semantic Technologies provide scientists and decision-makers with the opportunity for data integration and automatic information extraction and unlock insights into Big Geospatial Data [1]. Cartographic techniques, in turn, allow decision-makers to discover the hidden content visually and therefore enhance information exploration and knowledge construction. Furthermore, being an interdisciplinary domain, cartography has the potential to satisfy the demand for visualization of Big Geospatial Data by providing an interface between data and target audience and, thus, can support sustainable agriculture.

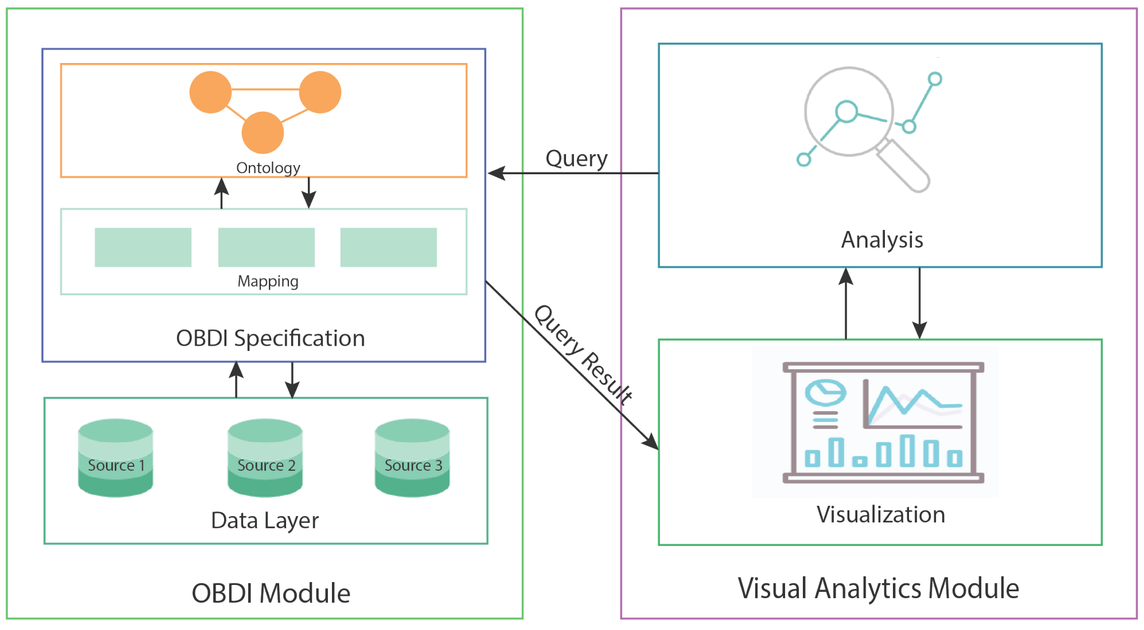

Fig. 1 The ontology-driven geospatial data integration and visualization framework

Background

The advancement in Smart Agriculture enabled farmers and scientists to collect agricultural data using various platforms and equipment. Hence agricultural datasets are spatial, temporal, complex, heterogeneous, non-standardized, and very large. As a result, it is complicated to identify agricultural data needed for a specific task, and if it is done so, it might be challenging to combine and analyze the data collected [2,3].

Objective

This study intends to develop a novel framework in the agricultural domain that unites specific-ontology-based data integration and visualization. This research aims to enhance the domain of cartography with a semantic-based geospatial data visualization approach as well as to apply this approach to agriculture to improve processes and decision support systems.

Methodology

This section presents a comprehensive framework for ontology-driven geospatial data integration and visualization for the needs of agriculture. There are two primary modules in the framework:

1. the OBDI module

2. the visual analytics module.

The OBDI module provides an ontological view of the data sources from the data layer. A declarative mapping describes the relationships between data sources and ontology. As a result, the data layer is exposed as a virtual knowledge graph via the ontology and mapping combined, known as OBDI specification [4]. The vocabulary from the ontology is used to create SPARQL queries for the analytical tasks.

An interactive dashboard is used as interface for visual analytics performance. Dashboard provides users with filtering, guided navigation, interactive analytics, and visualization. Thus, it is an effective way to monitor spatial and temporalchanges, look for specific answers, and see all important metrics at a glance.

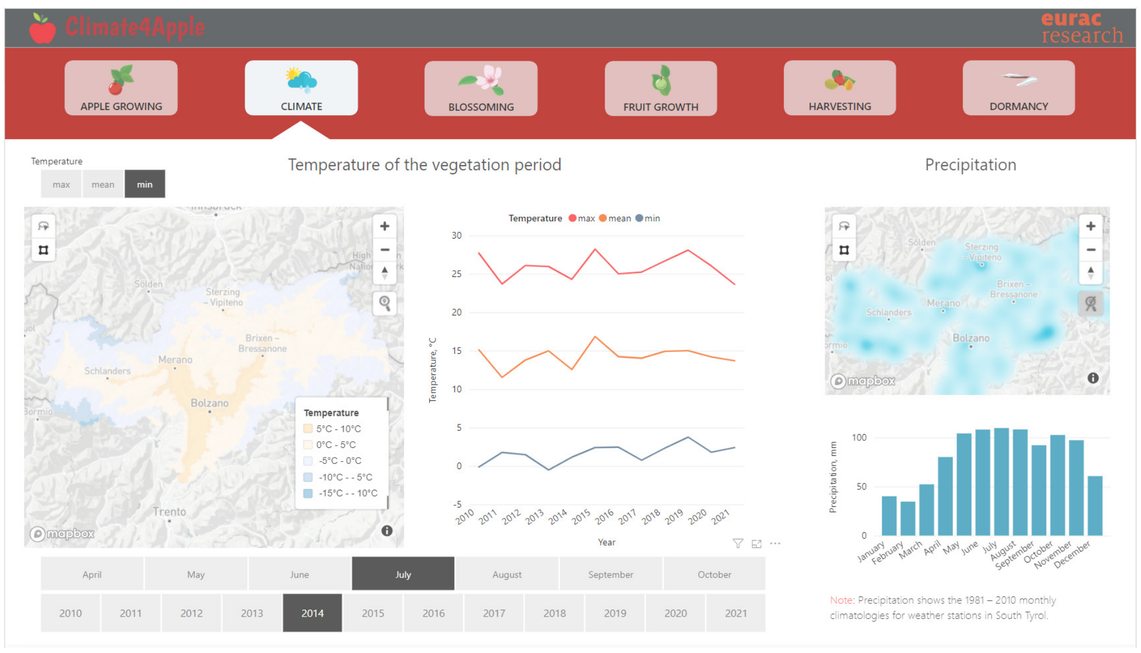

Fig. 2 Climate4Apple: Climate

Results

This research contributes to three interconnected levels:

- At the level of Cartography, this study opens up new perspectives for data access and visualization. Semantic-driven approach to data integration adds value to the data and allows easy information retrieval.

- From the point of view of Agriculture, domain experts can easily access integrated data sources. In addition, they benefit from utilizing visual analytics in their research which gives new opportunities for knowledge construction

- Data Integration specialists can find in this research practical application of their theories and methods.

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