Visualizing Spatio-Temporal Data

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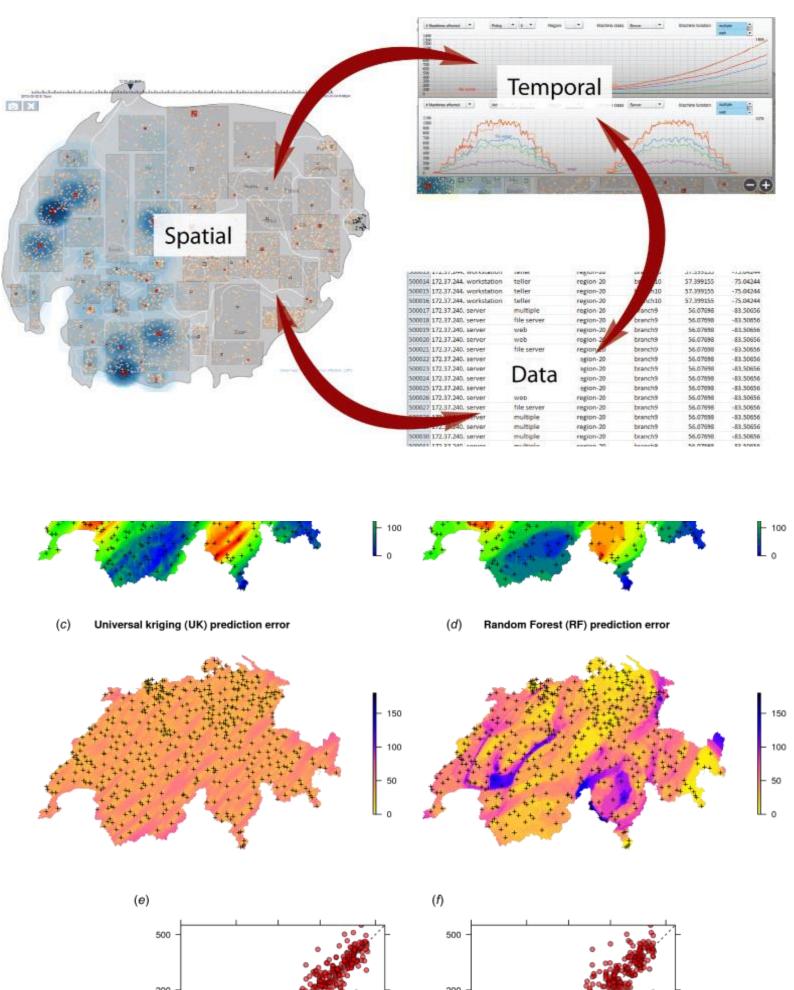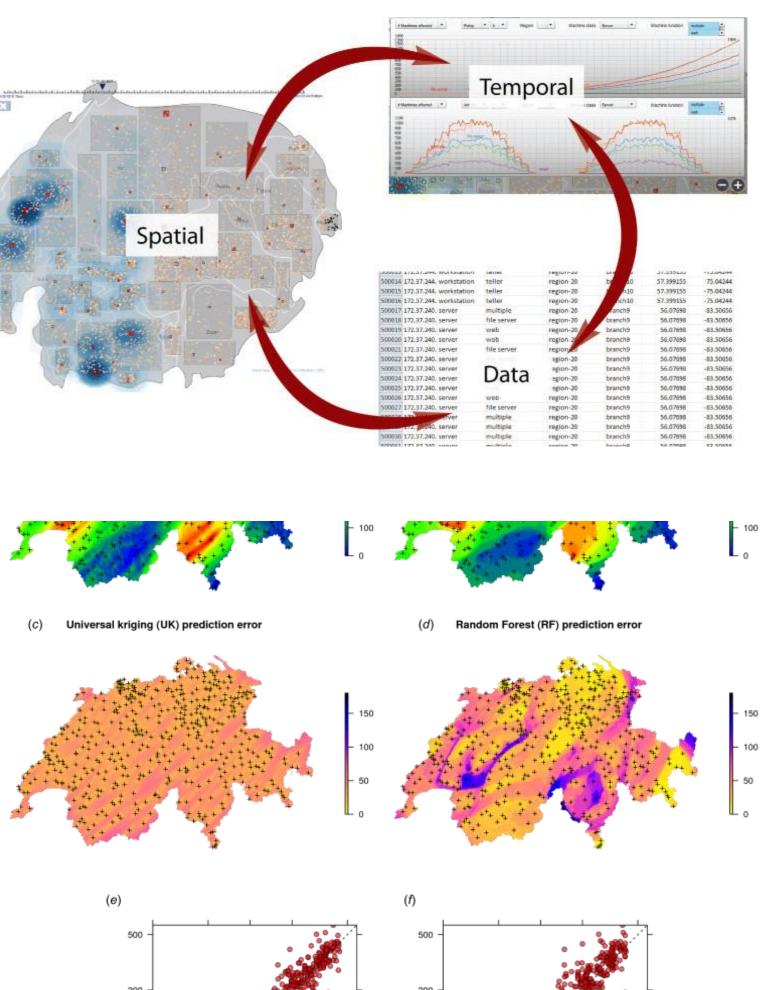
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Abstract: The research question is "How can Spatio-temporal data visualized on a graphical plot within the Lampy project of the DataSystems' Lab?" By using high-level Python libraries and data set software such as Matplotlib, time-series can be visualized. Likewise, spatial data can be visualized from the shapely library from GeoPanda, another similar software. However, if a particular dataset contains both spatial and temporal information, visualizing it is not supported by these libraries. The is the challenge the research team faces. Additionally, the project should account for users that may be interested in visualizing the results generated from it.

Introduction: High-level Python libraries are used in spatio-temporal data applications in order to receive a complex and detailed view of web maps. Spatio-Temporal data refers to any data that describes location or cartography, and web mapping uses this spatio-temporal data to implement within several applications that use location services. Unlike traditional map images that are found on most web maps, Python libraries such as Matplotlib contain a package of structured information about that certain sector of the map that include information about streets, bridges, and other architectural aspects of the area. Moreover, python libraries are much easier to use in data transfers between spatio-temporal applications, as they use significantly less processing power compared to traditional image tiles. Overall, python libraries are much more representative of real-life spatio-temporal data over simple and traditional image tiles.

Methods: The methods that I use in order to implement these python libraries, especially Matplotlib can be used to manipulate geospatial data within Lampy. The image tiles that were implemented in Lampy did use the Python library GeoPanda, so vector tiles that come as a package of more complex spatio-temporal data as a replacement should be able to be implemented but more complex way. After implementing the Python libraries throughout Lampy, the main goal is to find out its exact applications for companies or clients to use.

Results: The two major applications used for implementing vector tiles are Matplotlib and GeoPanda Implementations. In the table below, the two programs are compared, with its APIs and features. Overall, the implementation of vector tiles in Lampy can produce extremely useful characteristics in spatio-temporal management.

GeoPanda Implementation	Matplotlib Implementation
GeoPanda.VectorGrid – used to show gridded displays of the maps to signify specific areas	Matplotlib Studio – allows for Web design styling
ArcGIS API – API used to customize and draw vector tiles onto web maps using JavaScript	tilegrinder – helper library that is able to alter MBTiles , recompress, and encode in files
Fresco – open source editor to edit the details of vector tiles in individual web maps	Azure Maps Webs SDK – use vector tile layers using interactive web map control using JavaScript
orb – A geometry library that assists with vector tiles using Go and JSON	Mapbox MVT – Google Chrome extension that parses each vector tile and displays as GeoJSON
AliFlux VectorTileRenderer – allows to customize vector tile renderer using C# and other Gmap.Net components	Baremaps – A pipeline that uses Mapbox vector tiles from OpenStreetMap using Postgis and Java

Future Studies: Due to its packaged collection of complex spatio-temporal data, implementing it into applications and software. Past the literacy study of web mapping, so I look forward to actually implementing vector tiles onto Lampy using Matplotlib implementation.
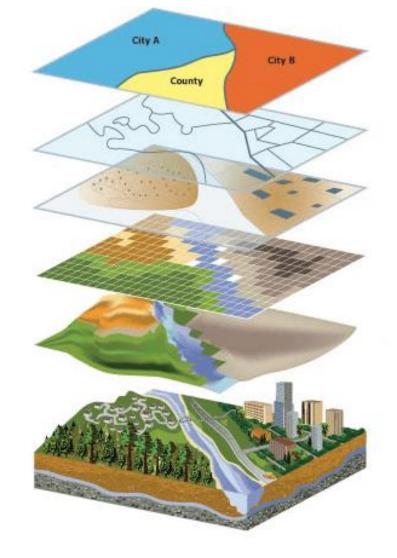
References:

·Visualization of Spatial and Spatiotemporal Data." *Visualization of Spatial and Spatiotemporal Data | OpenGeoHub Foundation*, opengeohub.org/visualization-spatial-and-spatiotemporal-data.

Team, Esri Press. "How to Perform Spatial Analysis." *ArcGIS Blog*, 9 May 2018, www.esri.com/arcgis-blog/products/product/analytics/how-to-perform-spatial-analysis/.

"Introduction." *Mapbox*, docs.mapbox.com/vector-tiles/reference/.

Janak, Dalibor. "What Are Vector Tiles and Why You Should Care – MapTiler News." – *MapTiler News*, MapTiler, 7 Feb. 2019, www.maptiler.com/blog/2019/02/what-are-vector-tiles-and-why-you-should-care.html.

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