

USER-CENTRIC GEOSPATIAL ANALYTICS AND VISUALIZATION OF A CATASTROPHE RISK PORTFOLIO USING THE EXAMPLE OF THE INSURANCE INDUSTRY

Thesis Defence

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Cartography M.Sc.



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Problem:



1. Multiple user groups have multiple information appetites
2. Users have different knowledge backgrounds



1. Large quantity of point dataset
2. With multiple variates need to be visualized



Most of them are less flexible and dedicated to specific purposes with fixed scales and topics (Lobo et al., 2017; Wood & Dykes, 2008)



Proposing a visualization strategy considering users' information appetites for exploring large point dataset



How to integrate the idea of User Centred Design (UCD) into work ?

1. What is the structure of UCD ?
2. Which methods used for assessing user requirements?
3. Which methods used for conducting user test ?



What is the visualization demand from intended user groups?

1. What are the characteristics and use cases of different user groups?
2. At which point in the decision-making process will users need visualization support?



Proposing a visualization strategy considering users' information appetites for exploring large point dataset



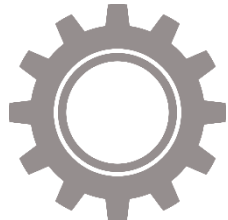
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How is the visualization strategy structured?

1. Which factors need to be considered for creating the visualization strategy?
2. Which visualization technique is suitable for the large point dataset ?



Proposing a visualization strategy considering users' information appetites for exploring large point dataset



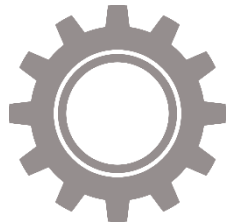
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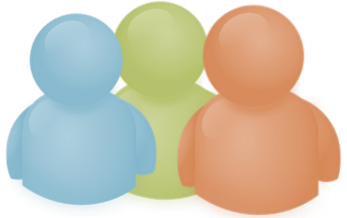
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How is the effectiveness of the proposed visual strategy?

1. How is the usability of the Geo-visualization application based on proposed visual strategies?
2. What functions can be implemented based on the strategy?



Targeted Users

There are different end-user groups, i.e. portfolio managers, underwriters,



Catastrophe Risk Portfolio Dataset

consists of certain locations and multiple risk metrics has great affection on the dispersion and degree of potential risk



Expected Results

Have a web-based application which integrates the studied dataset, visualization results and customized functions together and conduct the user test in the end

Aim:

Implementing the proposed visualization strategy into the insurance industry using the catastrophe (CAT) portfolio dataset provided by Allianz Global Corporate & Specialty (AGCS) to verify the effectiveness of proposed visualization strategy

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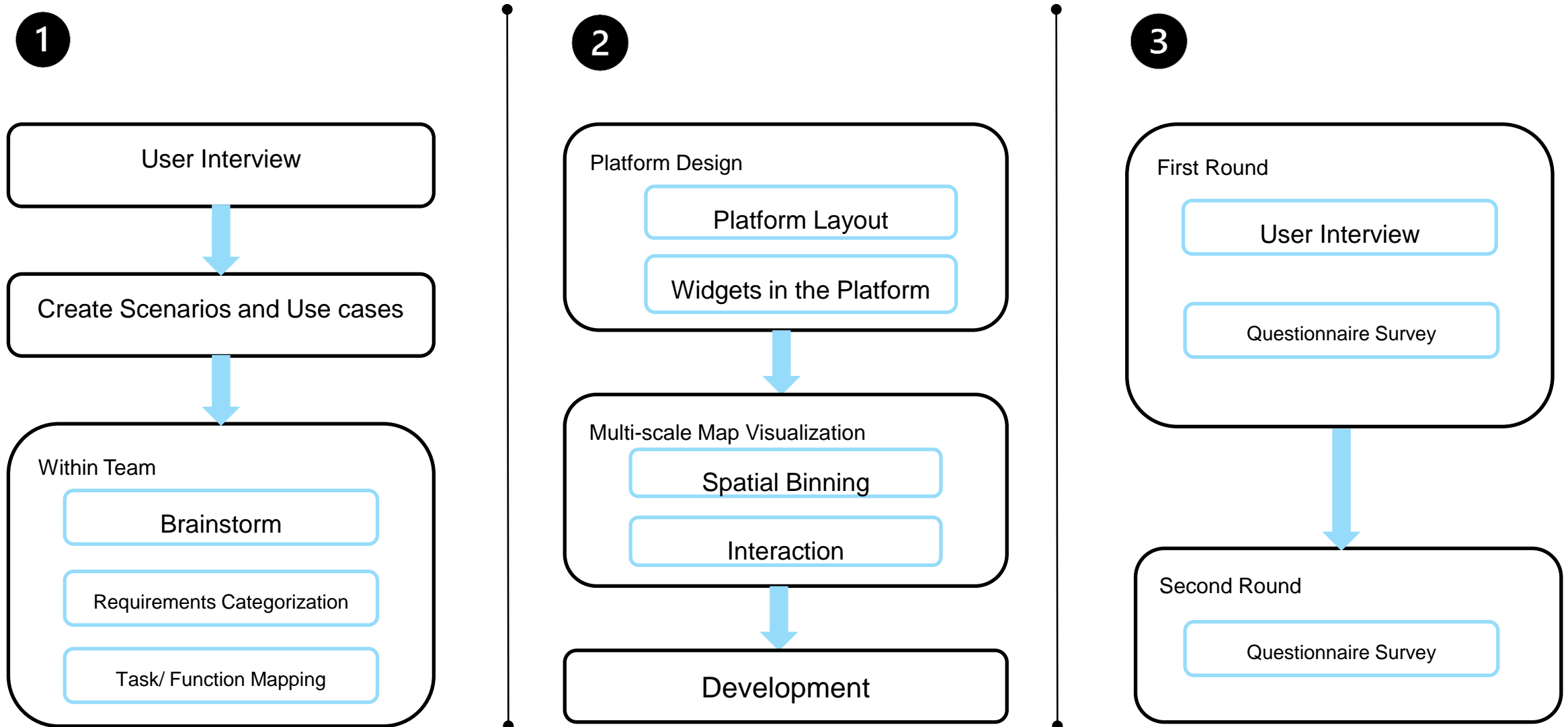
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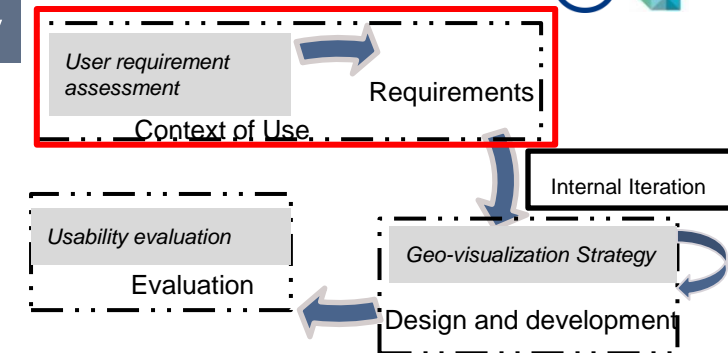


1. Overview on Portfolio development (growth/diversity)
2. Detect changes in key metrics (user defined)
3. Help to understand changes
4. Visualize/Communicate findings

1. Refine question from Scenario 1 capacity steering
2. Monitor business individually and dynamically in exposure hotspots

1. Persistent and precise evaluation of insurance related values at any given time
2. Establishing workflows/guidelines for e.g. Portfolio Management

1. Capacity steering
2. Monitoring new & renewal business in exposure hot spots
3. Impact estimation of new & renewal business on exposure hot spots

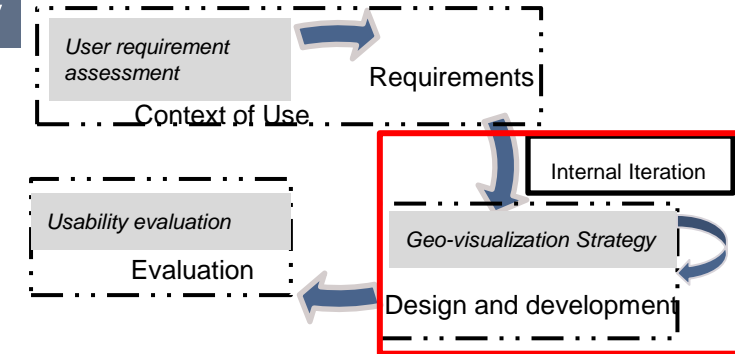
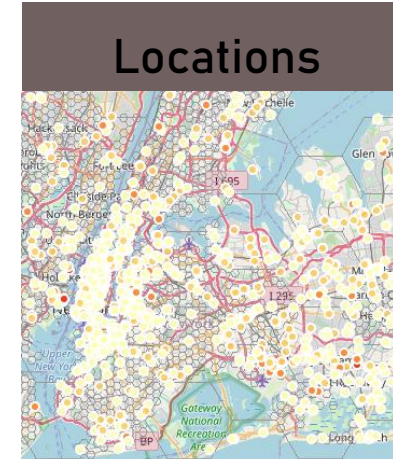
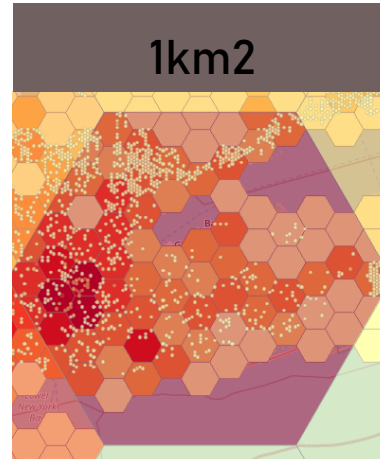
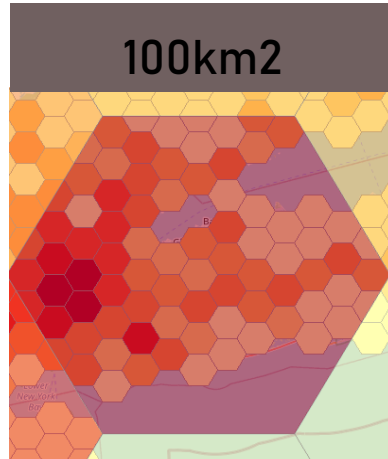
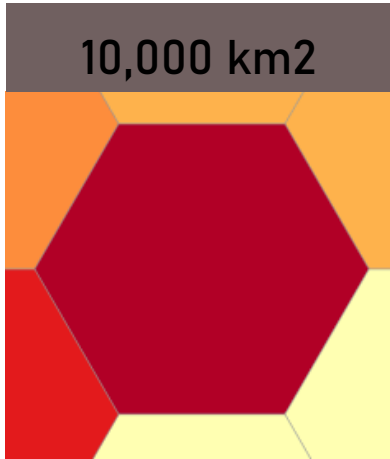


User Requirements

Every user was invited to a **user requirement interview** separately for gathering their requirements.

Even though targeted users are from different departments, there are still several **overlapping scenarios** which are mentioned by all of them

Blue = optional



Hexagon System

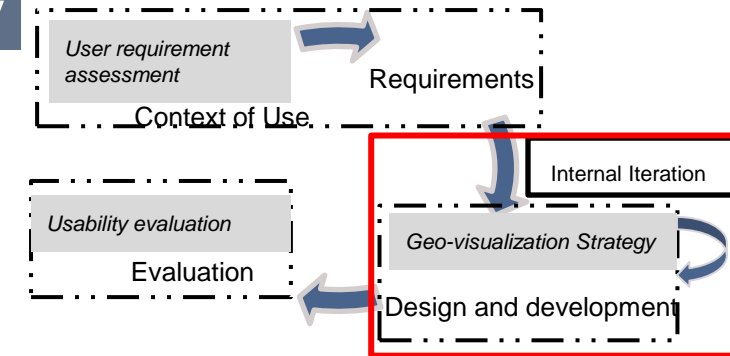
1. A consistent **multi-resolution hexagon layers** works on carrying aggregated points' values in different resolutions.
2. Hexagon layers in different **resolution level** also correspond to different **visible scale ranges**.

Why Hexagon ?

1. Hexagonal grids suffer less distortion compared to rectangular grids especially in the large research region
2. there is less bias caused by grid's edges from hexagonal tessellation

Requirements

1. The hexagon layers reference the same projection coordinate system (Web Mercator).
2. They are required to be consistent in the geometry and covered the world seamlessly.

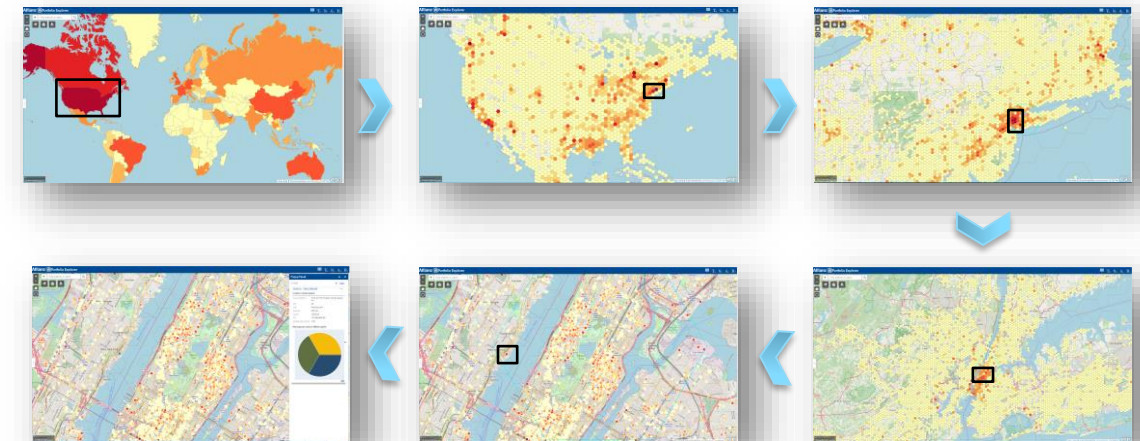
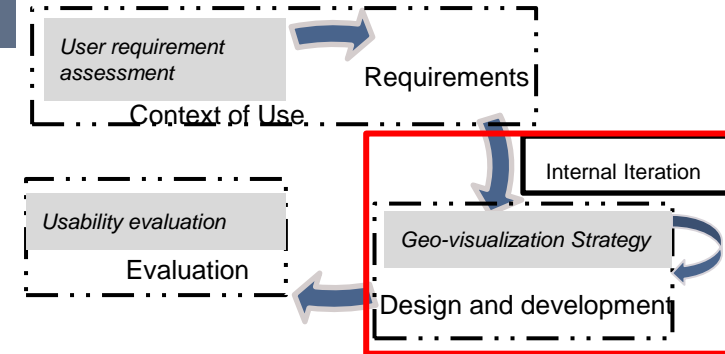


Layout

1. Header: container of widget buttons
2. Left panel: foldable panel for map legend
3. Map: interactive web map presents main information
4. Right panel: foldable panel for statistic charts.

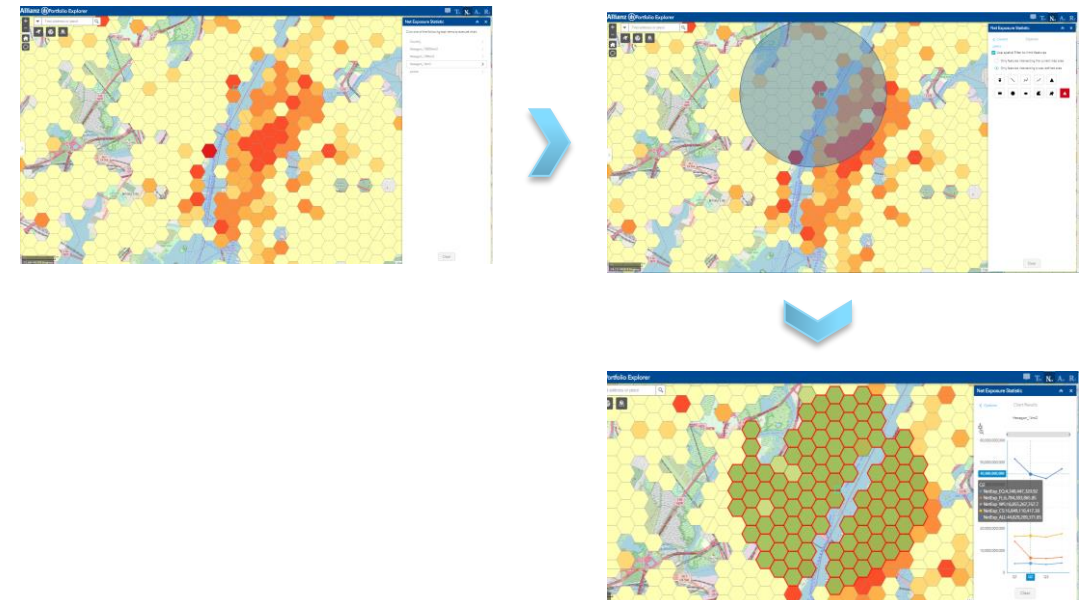
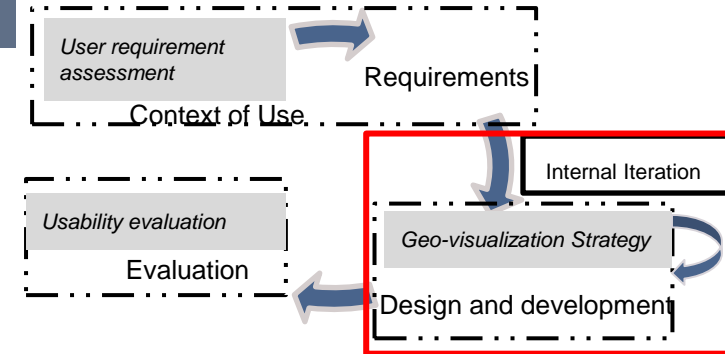
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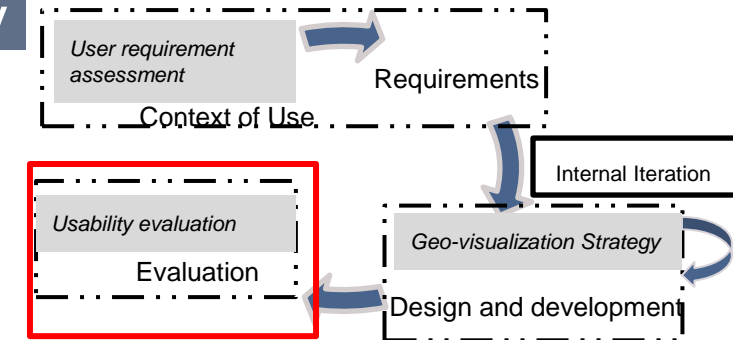
Negative



A word cloud of terms related to user experience and performance. The words are arranged in a circular pattern, with 'widgets' at the top, 'latency' on the left, 'personalized' on the right, and 'focused' at the bottom. Other words include 'colours', 'optimized', 'breakdown', 'metrics', 'LOB', 'information', 'symbol', 'non-modelled', 'regions', 'speed', 'lag', 'estimates', 'rendering', and 'experience'.

Need **more available attributes** to be presented in the map

Provide more **filter** choices for map layers



1. summarize out the qualitative result from answered questionnaires and comments.
2. they are supportive materials for us to analyse user experience and assess our final application in return.

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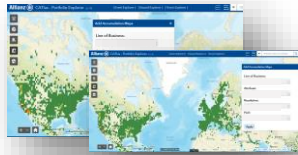
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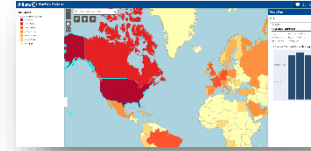
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Foldable Theme



Jewelry Box Theme

Application Layout

Map Presentation

Functionalities

Two static resolution rectangular grids

1. Layer Selection
2. Manual calculation for one quarter
3. Other default widgets from ArcGIS Web App builder



Dynamic Multi-resolution hexagon layers

1. Layer Selection
2. Automatic attribute panel
3. Manual calculation for four quarters

Comparison

In the **map presentation**, new application replaces the rectangular grids **by multi-resolution hexagon layers** to support the dynamic exploration process. Such presentation takes the advantage of switching the details of map consistently in the exploration process

more available **functions** does not mean the better usability. For some functions, users may do not know which scenarios are suitable to be applied in. It can also overwhelm users to understand the application

*Foldable theme: the default app theme in ArcGIS Web App builder which enables all kinds of widgets can be added in the app.

Jewelry Box theme: another app theme in ArcGIS Web App builder which is inherited from foldable theme. It places main widgets on the left of the app.

User-centred

1. set up the working plan and conducted the **user requirement assessment**
2. concrete visualization solution were discussed and explored **in the process**



Visualization large point dataset

Select the grid-based spatial binning technique to compose **multi-resolution hexagon layers** for achieving the multi-scale map visualization

Application

1. ArcMap and python were used for **pre-processing** procedure and the final application is hosted in the ArcGIS server
2. Final **user test** was conducted to reflect the final usability



User-centred

1. Specify a detailed development plan at the beginning is impractical
2. it's also valuable to **search opinions** and set up discussions with different parties



Visualizing large point dataset

Multi-resolution hexagon layers has certain **flexibility** and can be served as a visual prototype for other point datasets

Application

Combing with **dedicated functions** designed according to different users' requirements, it can finally promoted into a comprehensive visualization solution for complexed cases



User-centred

1. Apply other evaluation methods with **more** users
2. **Optimize** the work based on users' feedback



Visualizing large point dataset

Implement **more visual variables** to extend the visible information in the single layer

Application

1. Extend **available attributes** in the hexagon layer
2. **Optimize** the functionality of the application



Lobo, M.-J., Appert, C., & Pietriga, E. (2017). MapMosaic: dynamic layer compositing for interactive geovisualization. *International Journal of Geographical Information Science*, 31(9), 1818–1845.

<https://doi.org/10.1080/13658816.2017.1325488>

Wood, J., & Dykes, J [Jason] (2008). Spatially ordered treemaps. *IEEE Transactions on Visualization and Computer Graphics*, 14(6), 1348–1355. <https://doi.org/10.1109/TVCG.2008.165>

THANKS QUESTIONS?

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