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Wordcrowd - A Location-Based Application to Explore the City based on Geo-Social Media and Semantics

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Outline

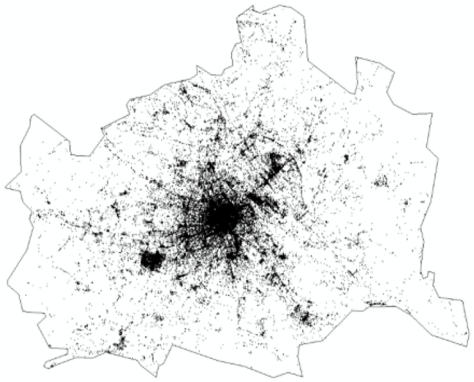
- Goals and context
- Data collection and preprocessing
- Tourism interest analysis
- Visualization and interface
- Coronavirus sentiment analysis
- Conclusion and future work

Goals and Context

- Wordcrowd focuses on social media data (Flickr)
- Huge amount of spatially-related data
- Automatically determine Areas of Interest (AOIs)
- Compare tourism interest for different nationalities
- Focus on both the location and the content of each post
- Visualize results in an intuitive LBS application

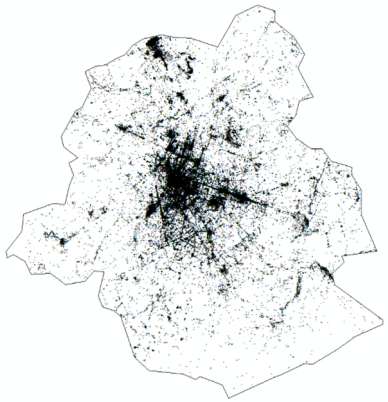
Data Collection

- Geolocated Flickr image tags from 2004-2018 for continental Europe
- Only 33% of total users specified country
- Home determination algorithm: precision of 0.87
- Limit scope to points in Austria (370.000) & Belgium (430.000)



Vienna

Ghent



Brussels

Data Preprocessing

- Multilingual data => translate to English
- Filter irrelevant words (brand names, stop words, etc.)
- Group similar words together with NLP techniques (stemming/lemmatization)
- Try to split joined hashtags (e.g. *viennaaustria*)
- Filter redundant multilingual city/country names via Wikipedia/Wikidata

Data Preprocessing

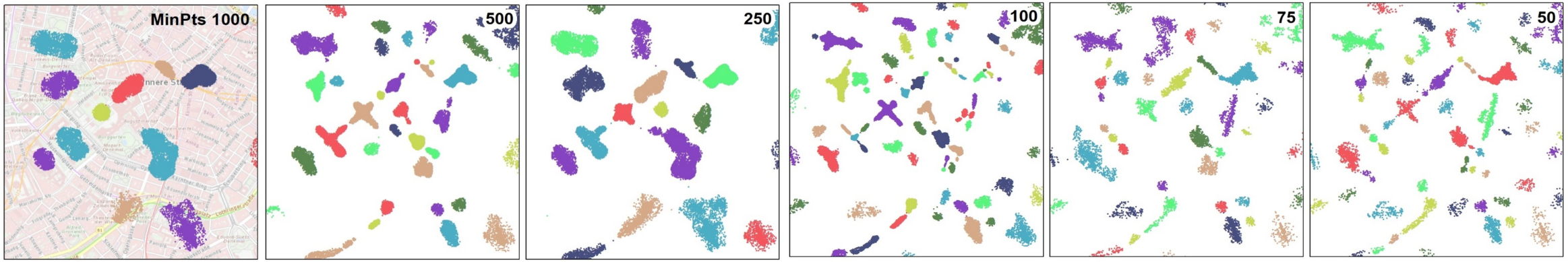
- Word cloud of original picture tags near Belvedere palace, Vienna
- In almost every cluster the city name and country name appears in multiple languages
- Many irrelevant tags (Nikon, iphoneography, iphone8plus,…)

Data Preprocessing

- Preprocessing improves the visualization
- Still some problems with joined hashtags, hard to automatically find a useful split

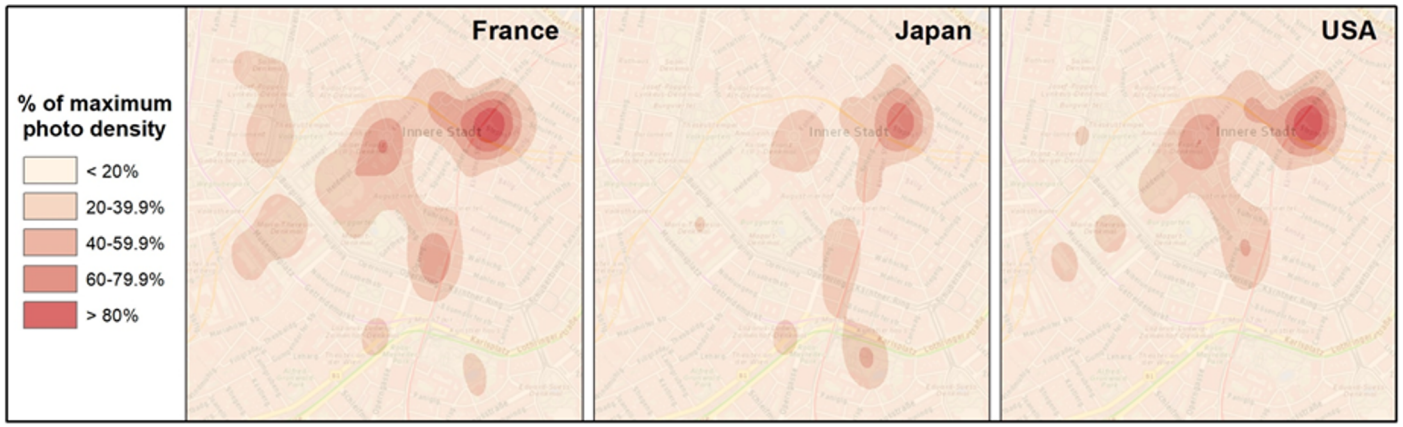
Clustering

- By spatially clustering the data (**HDBSCAN**), AOIs can be automatically extracted
- Multi-scale clustering to improve visualization & performance
- Visualize clusters as polygons in the app (convex hull)



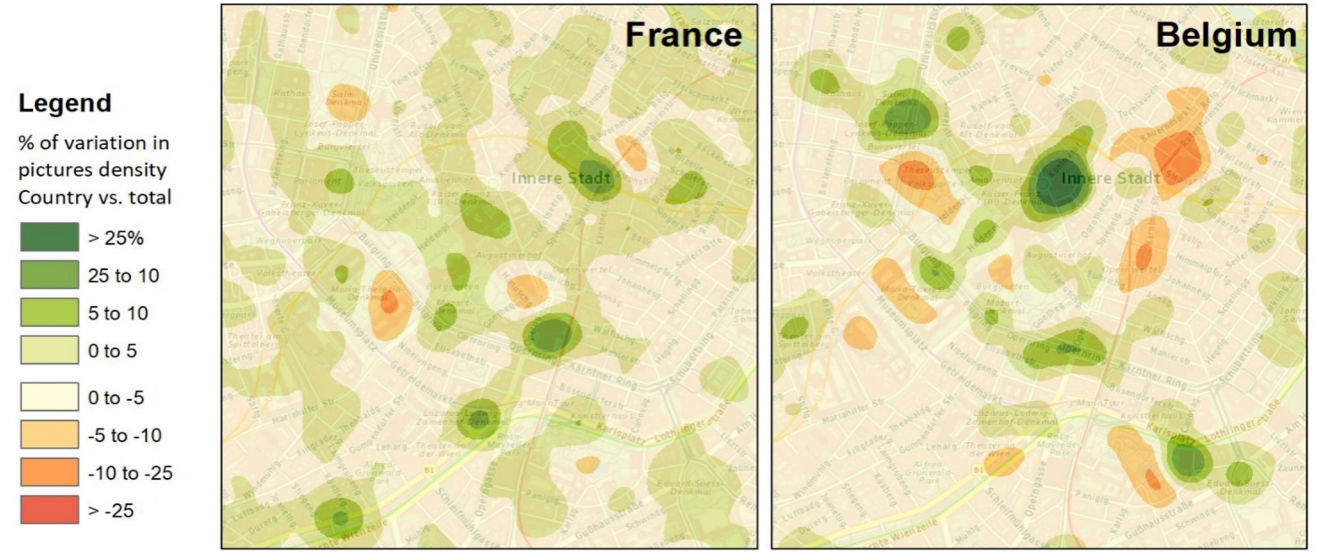
Tourism Interest Analysis

- Filter data on nationality
- Generate footprints for each via kernel density estimation (KDE)
- Most popular locations (hotspots) are often shared
- Differences in tourism interest patterns (Center of Vienna)



Tourism Interest Analysis

- Find relative interest by performing map algebra (Average vs country)
- Green areas indicate more interest than the average user
- Able to determine areas of interest that are specific to certain nationalities



Visualization & Interface

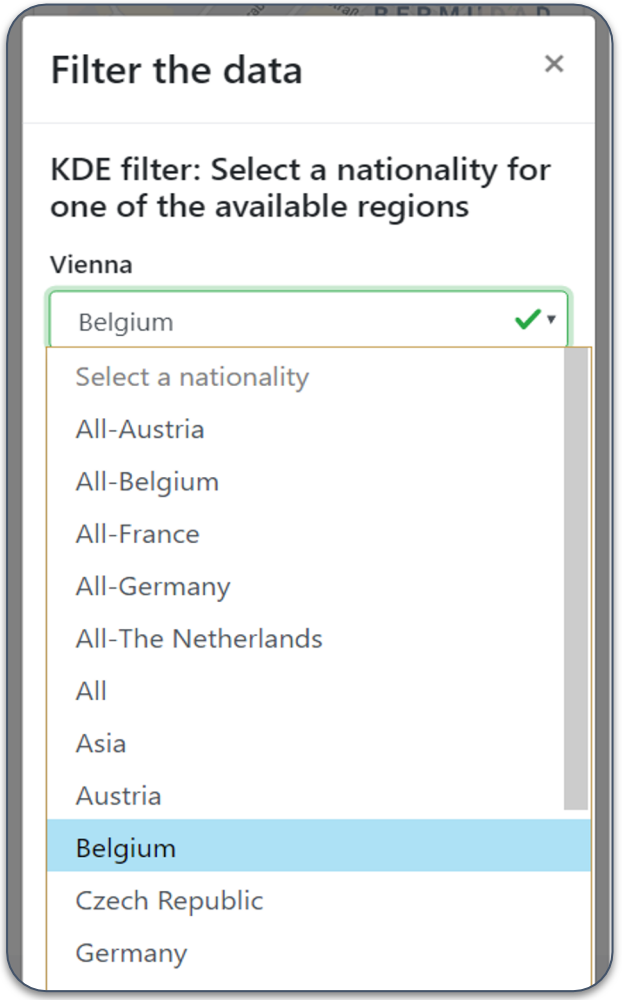
- Wordcrowd: Lightweight JavaScript LBS web application with PostGIS backend
- AOIs were extracted for three different scales
- Most frequently occurring tags saved in the database
- Geolocated AOIs and their descriptions generated from the Flickr picture tags
- Dynamically fetch data near the user at the right scale to reduce network overhead
- As the user explores the city, nearby areas of interest are discovered

Visualization & Interface

- Fetch and visualize nearby clusters in real time as polygons
- Word cloud of related tags is shown when an AOI is clicked
- Dynamic zoom is necessary to improve visibility & user experience
- http://bit.ly/wordcrowd

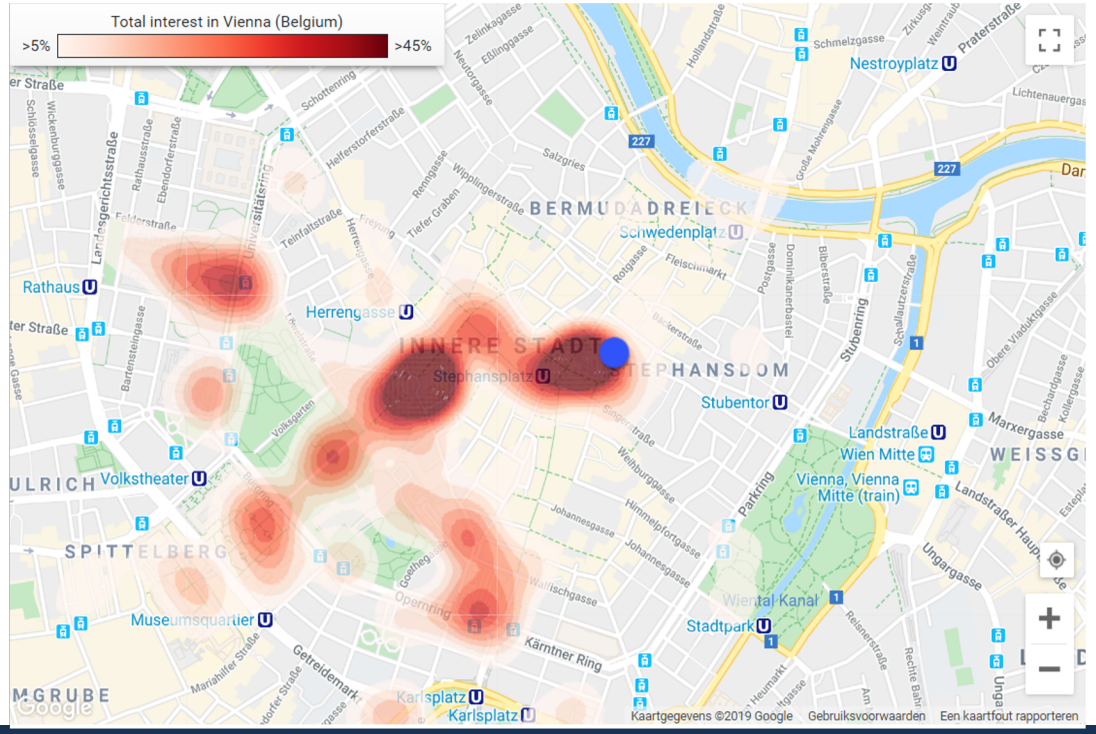
Visualization & Interface

- KDE rasters were calculated for several nationalities
- Vienna, Brussels, and Ghent
- Exported as GeoJSON to easily import into web application
- Scalable design => more regions/nationalities can always be added
- User can filter data on the fly

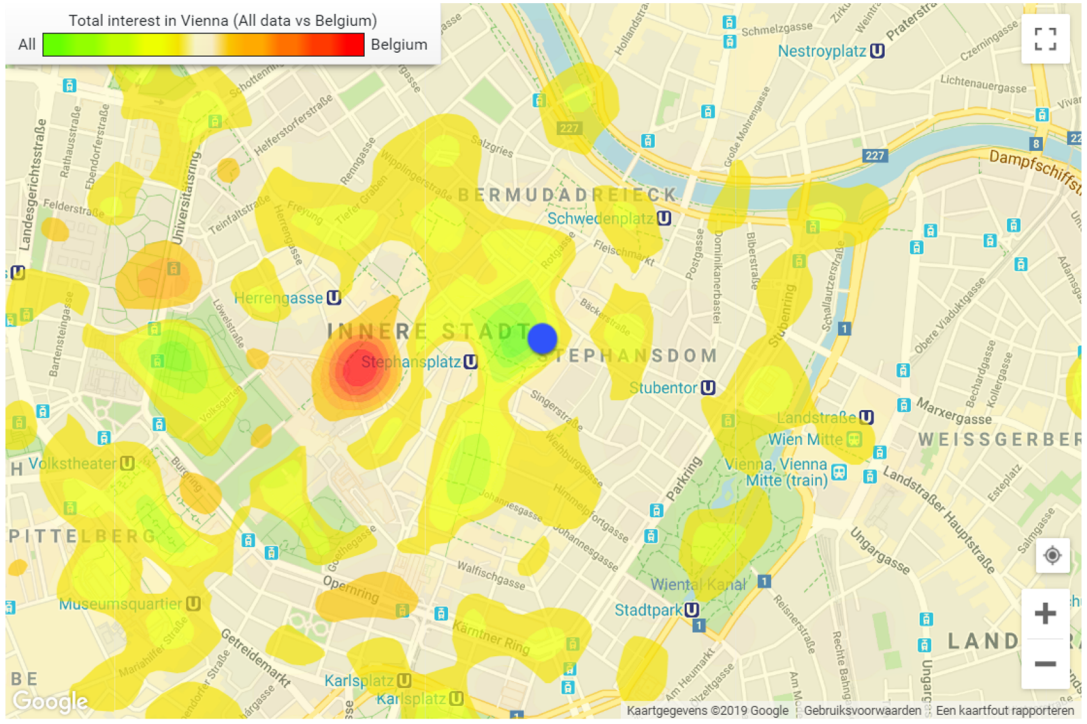


Visualization & Interface

- Total interest in the center of Vienna for Belgian tourists



- Relative interest in the center of Vienna for Belgian tourists

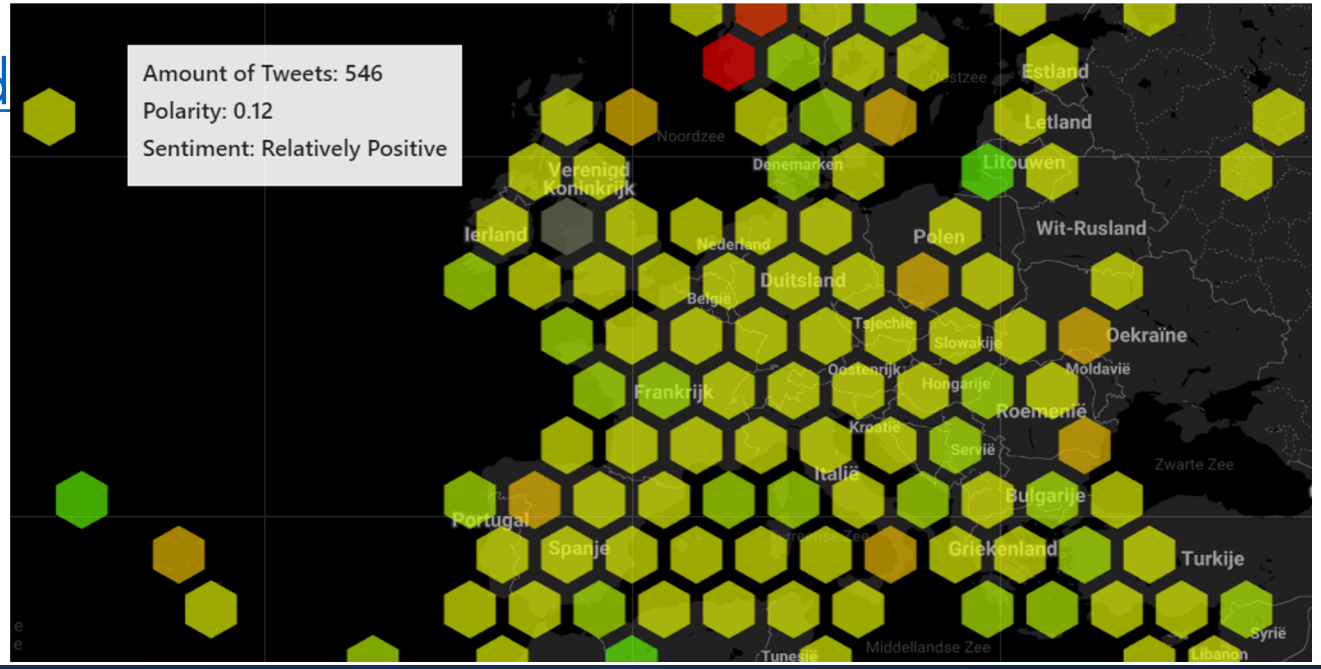


Visualization & Interface

- Specific tags show up for several countries of origin
- E.g. : tags about the Great War show up in data from English tourists in Belgi

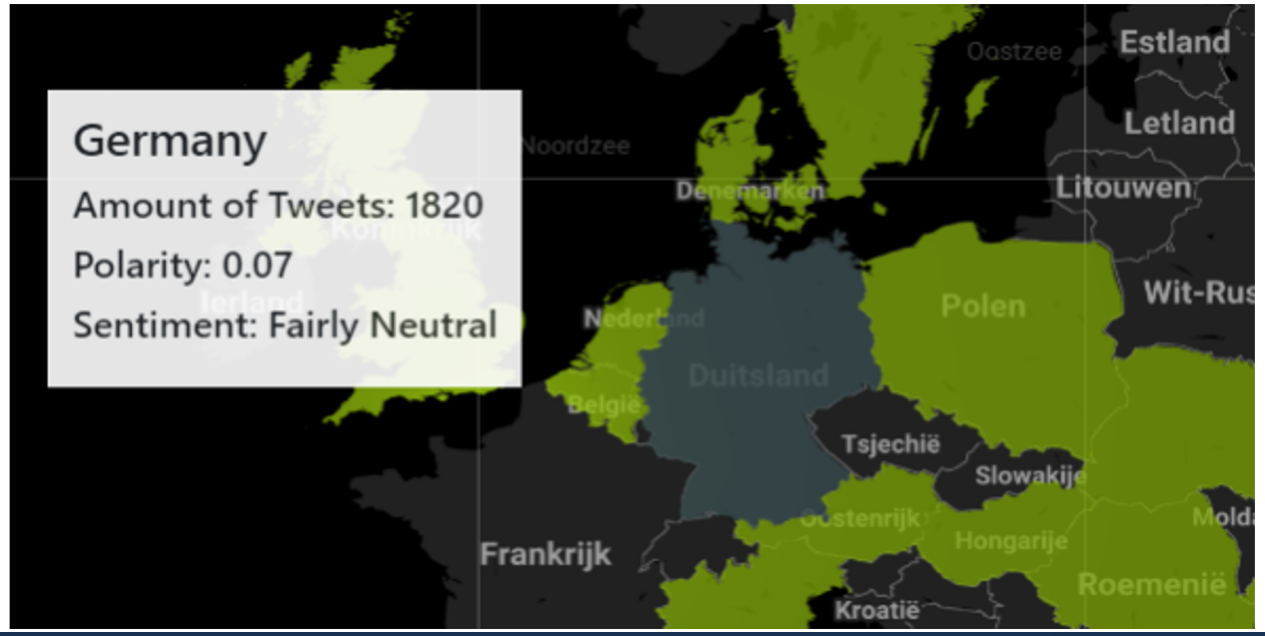
Coronavirus Sentiment Analysis

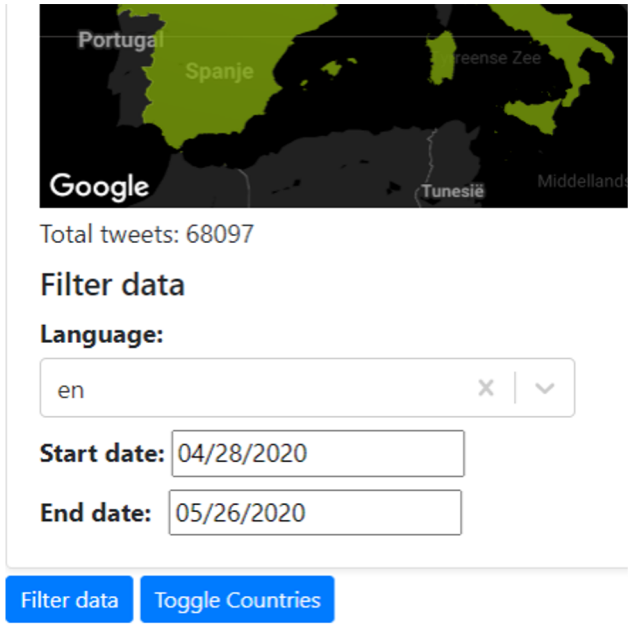
- Applied the Wordcrowd framework to tweets mentioning Coronavirus
- Tweets were preprocessed and dynamically clustered in hexagonal map visualization
- http://bit.ly/wordcrowd-covid



Coronavirus Sentiment Analysis

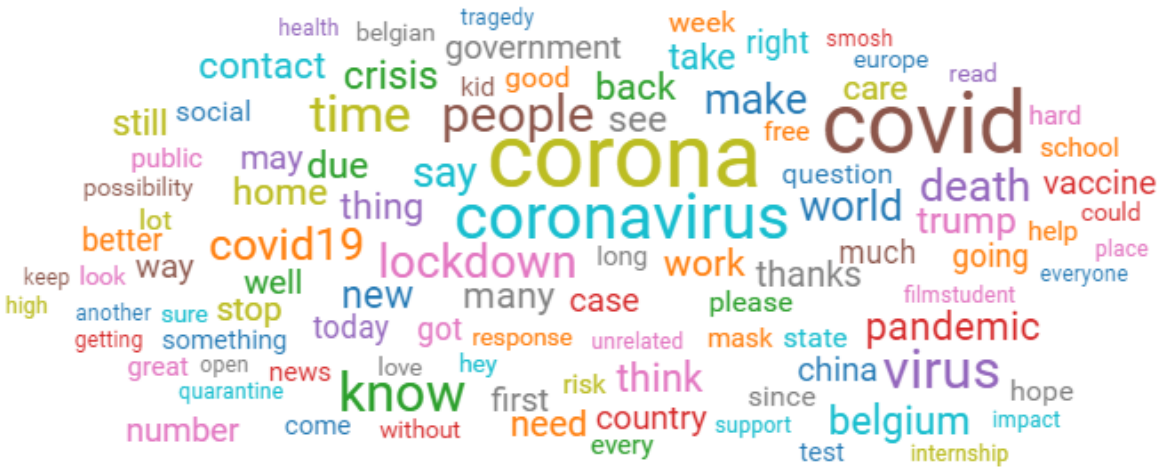
- Alternative visualization per country using GeoJSON
- Basic client-side temporal filtering





Coronavirus Sentiment Analysis

- Wordclouds are generated on the fly with filtered data
- Average sentiment for countries was not informative (always neutral)
- Wordclouds of different countries were very similar



Conclusions

- Social media data requires a large amount of preprocessing
- Developed framework to collect, analyze & visualize geolocated data
- Framework potentially applicable in main urban areas worldwide
- Tourism interest can differ greatly in both location and interest
- Can provide useful insights to various institutions (e.g. museums) about their social media reach and audience
- Can be used to tailor information based on a visitor's nationality

Future Work

- Improve grouping of related tags
- Analyze & integrate other data sources (e.g. full-te
- Add additional temporal filters (evolution over tim
- Automatically link with open data sources (Wikipedia,
- Recommending AOIs that correspond to user interest

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