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Rapid flood loss estimation driven by social media based inundation maps

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Motivation

- During and shortly after floods information about affected areas and consequences are scarce and not readily available.
- Rapid inundation maps and loss estimates provide important information for disaster response, recovery and reconstruction planning.
- Photos shared via social media with geo-location tags provide promising information which can be used to derive inundation depth maps as an input to flood loss estimation models.

Objectives

- Investigate the quality of social media based inundation maps.
- Test and evaluate their suitability for the estimation of flood loss in near real-time.

Approach

- Collect, filter and analyse photos from twitter and flickr using the Postdistiller framework (Fohringer et al., 2015).
- Infer inundation depths from photo context information and derive water levels in combination with DEM based ground elevation data.
- Derive flood maps by spatial extrapolation of individual inundation depth estimates.
- Estimate flood loss to residential buildings using the 3d-city flood damage (3dcfd) module (Schröter et al., 2017)
- Application to the June flood 2013 of the Elbe River in Dresden (Germany).

Discussion

- Social media provide useful complementary information for flood mapping and situation awareness in near real-time. Inundation depths tend to be overestimated for the case study in Dresden.

  The efficient filtering of social media images is key to purposeful usage in a timely manner.
- Algorithms for the automatic selection of relevant images using visual analytics are currently under development.
- The accurate delineation of inundation areas is of high relevance for the loss estimation on the micro-scale, i.e. for individual buildings. The combination with ancillary information, e.g. from remote sensing, shows clear improvements.
- Refined spatial interpolation of point values will be explored.

References

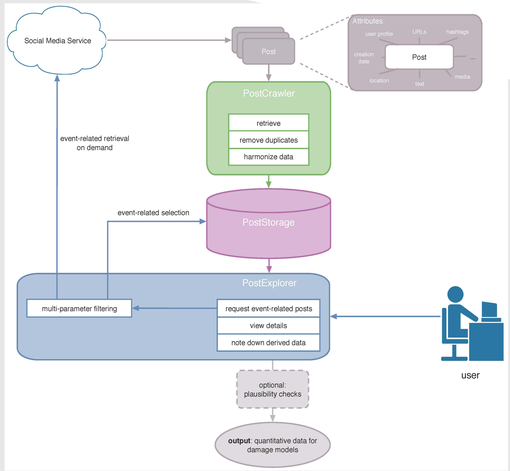
Fohringer, J., Dransch, D., Kreibich, H. and Schröter, K.: Social media as an information source for rapid flood inundation mapping, Nat. Hazards Earth Syst. Sci., 15(12), 2725–2738, doi:10.5194/nhess-15-2725-2015, 2015.
Schröter, K., Redweik, R., Lüdtke, S., Meier, J., Bochow, M., Kreibich, H., Ross, L. and Nagel, C.: 3D-ctiy Flood Damage Module prototype implementation, , doi:10.5880/GFZ.5.4.2017.001, 2017.

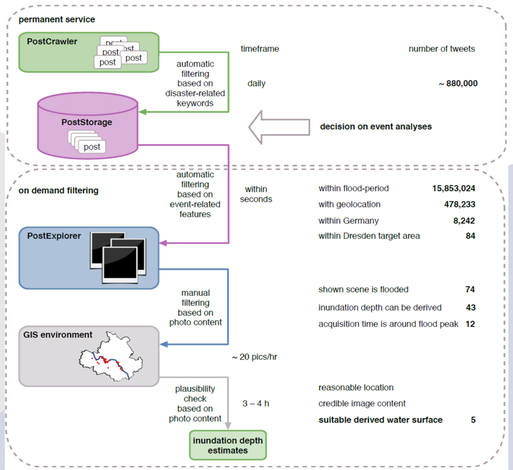
Acknowledgements

This research has received and receives funding from the CEDIM research project 'Rapid flood event analysis in near real-time' (2012 - 2015, www.cedim.de), the EIT Climate-KIC Pathfinder project '3d-City flood damage module' (2015 – 2016), and the DFG project 'ENAP – Enhancing scientific environmental data by using volunteered images in social media' (2016-2019). The virtual 3d-citymodel has been kindly provided by the city of Dresden. The reference inundation map for the June 2013 flood has been provided by the German Federal Institute of Hydrology (BfG).

Postdistiller - Collecting, filtering and analysing social-media posts

Postdistiller architecture (left) and flow-chart of the analyses of the June flood 2013 (right), Fohringer et al., (2015)

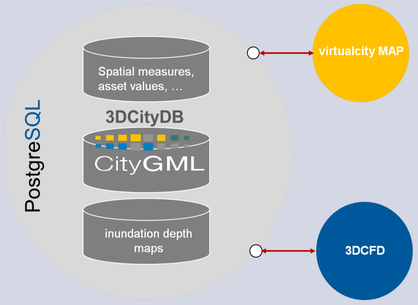




3d-City flood damage module

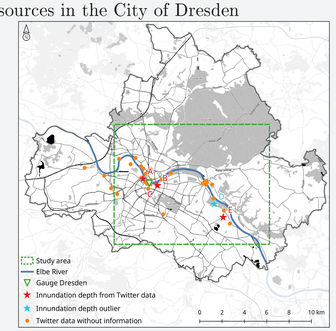
Components of the 3dcfd-Prototype, Schröter et al., (2017)

- Random Forest predictive model on the level of individual buildings based on virtual 3d-city-model data and inundation depths.
- Derived and validated with empirical data of relative flood loss.
- Implemented as a functional extension to the 3D city DataBase.

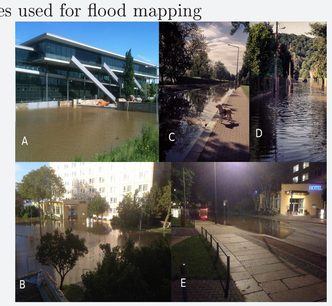


Case-study area Dresden (Germany)

Information sources in the City of Dresden

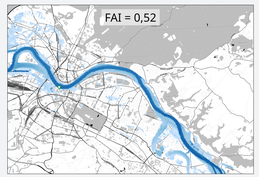


Sample images used for flood mapping

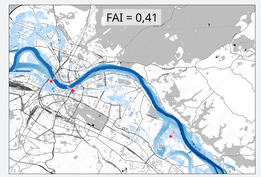


Results

Rapid flood maps; evaluation in comparison to BfG reference map; FAI = Flood Area Index



Gauge: Extrapolation of water level from gauge Dresden, 4,227 affected buildings, pBias=4.8%, RMSE=0.31.

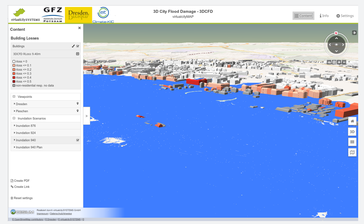


Twitter: Interpolation of social media based depth values, 11,421 affected buildings, pBias=23.5%, RMSE=0.7.

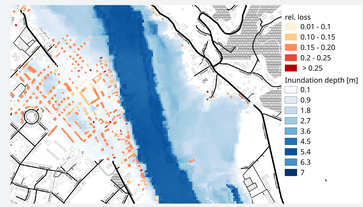
Twitter+Perils: Twitter combined with Pléiades HR1A flood footprint, 949 affected buildings.

BfG: Reference flood map based on aerial images and terrestrial surveying, 1,444 affected buildings.

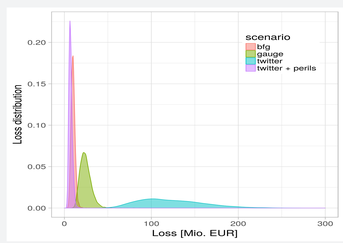
Rapid flood loss estimation using 3dcfd-module



Visualisation of flooding and loss ratios within 3dcfd-Prototype using virtualCityMap web mapping technology (www.virtualcitysystems.de).



Map detail of inundation depths and loss ratios for affected buildings.



Flood loss distribution estimated by Random Forest 3dcfd-module for different flood maps.