Geophysical Research Abstracts
Vol. 20, EGU2018-19770, 2018
EGU General Assembly 2018

Designing a web-based software application for risk management of drinking-water supply in support of the Water Safety Plan approach

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The Water Safety Plan (WSP) approach (WHO et al., 2014) is a comprehensive and proactive risk management approach for drinking-water supply systems. WSPs consider the whole water-supply system (catchment, treatment, distribution, consumer).
In practice, the implementation of the WSP approach is cumbersome and costly. In particular, the risk management of catchment areas can be very expensive due to the high number of potential hazardous events.
Hence, the implementation of risk management should be facilitated by software support. Since there is no adequate software solution on the market, we designed and prototypically implemented a software tool supporting the user in risk management of drinking-water catchments. A first version of this tool has been realized and usability testing has been done with domain experts.
To build this WSP risk management tool, we first modeled the relevant WSP processes with the main activities hazard identification, initial risk assessment, determination and validation of control measures, residual risk management, development of an improvement plan, and documentation. For all activities, the relevant input and output documents and data have been identified. Then an entity-relationship model was defined for the affected objects in order to store all collected and processed data centrally in a PostgreSQL geodatabase. The application logic for the web-based application was implemented using the Grails framework. Basically, the software helps people to apply the WSP risk management processes in a guided manner, with user-friendly means to document their working steps, access background information and collect all relevant data easily. For cartographic visualization of risks, the Disy Cadenza WebGIS was employed.
At the core of the system, there is a practice-oriented workflow for drinking-water risk management with catchment-specific aspects, based on prior work by Sturm et al. (2016a, 2016b). It combines semi-quantitative risk assessment methods and quantitative approaches. A central design decision lies in the trade-off between qualitative / semi-quantitative methods and strictly quantitative approaches. Here one has to decide between more or less informative and (un)certain methods at the price of complexity and data-intensity of methods. There is certainly no single „right“ solution. But a modular software tool can offer and combine different methods and lead to country- or region-specific solutions. In our project, local conditions in Germany and in Peru have been examined.
We report on work-in-progress. The current implementation of the tool contains (i) a GIS component for visualizing risks and vulnerability and for assigning hazardous events and control measures to hazard carriers, (ii) input forms for hazardous events and control measures, (iii) formulas for risk analysis, (iv) customizable semi-quantitative scales for specifying likelihood of occurrence, severity of consequences, vulnerability and classification of risk, as well as (v) reporting features and overview tables for visualizing input data like hazardous events. Future work comprises practical improvements regarding usability and usefulness of the tool for practitioners. From a scientific point of view, the trade-off between more or less complex methods, the full or partial automation of process steps by geoinformatics algorithms and the adaptation to local conditions, are interesting directions.