E!8688 STAMFOR: Short term assessment and mitigation of flood risks at river basin level

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Introduction

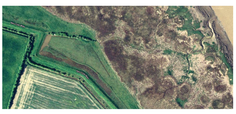
In STAMFOR, we focus our research on the development of an innovative safety monitoring system for earth embankments, namely flood levees and accumulation dams. The system will be based on the detection of temperature and water level fluctuations caused by seepages through or below the body of the embankment. Data will be collected by measuring profiles by optical fibres and discrete borehole sensors.

Breach of a flood levee

Definition of the system STAMFOR

The implementation of the system includes several steps, all of which are of crucial importance. In chronological sequence, these comprise:

Figure 1A: Surface preferential paths recognized on an aerial map



STEP 1 – Geophysical Monitoring System and modelling

1A Desk review and site reconnaissance

This is an often underestimated yet important activity that can bring a lot of useful information. Even a glance at existing aerial maps can become surprisingly rewarding.

1B Geophysical Monitoring System (GMS) and geotechnical survey

GMS provides quick and reliable information for assessing the vertical and horizontal structure of an embankment by using dipole electromagnetic profiling for quick testing measurement (QTM) and supplementary methods such as electric resistivity tomography and / or self-potential for a detailed measurement (DM). When combined with data from the borehole geotechnical investigation, we obtain a highly precise model of the real inner structure of the embankment.

Figure 1B_1: Measurement and evaluation of QTM

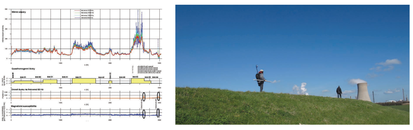
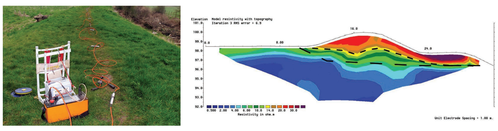


Figure 1B_2: Measurement and evaluation of DM



1C Modelling, failure assessment and definition of critical values

Knowing the inner structure of the levee and expected water load, a nonstationary flow model can be calculated. This model provides background for the assessment of possible failures and definition of the critical values to be implemented within the evaluation algorithm.

Figure 1C: Examples of models of water level and stability of the levee

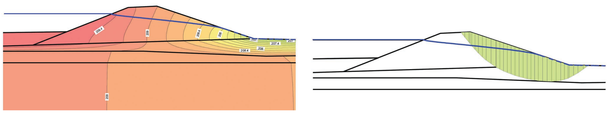
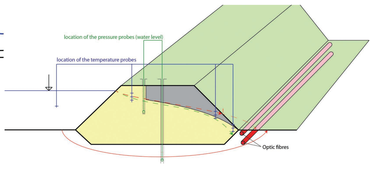


Figure 2A: General idea of the configuration of sensors in the body of the embankment



STEP 2 – Measuring profiles – Definition and Installation

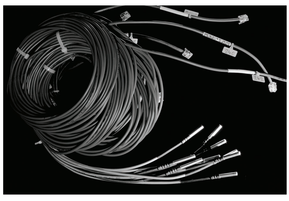
2A Definition of measuring profiles

The model gives us information necessary for proper positioning of the sensors.

2B Discrete borehole sensors

These sensors will collect data concerning water level and related temperature fluctuations in the body of the embankment.

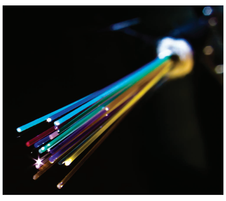
Figure 2B: Example of borehole thermometers

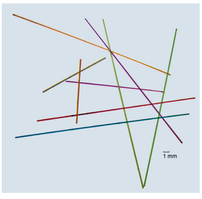


2C Distributed optical sensors

Measurement of the Raman scattering in optical fibres will bring us information on temperature changes in subsoil along an embankment section of significant length.

Figure 2C: Example of optical fibres





STEP 3 – Data gathering, evaluation and visualisation

3A Implementation of the data gathering system

The data gathering and administration system will be used to collect and transfer data to an online evaluation and visualisation platform and to remotely set up appropriate measuring modes. For the most part, communication will be wireless via radio and GPRS modules.

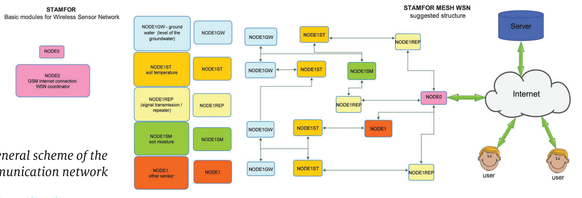


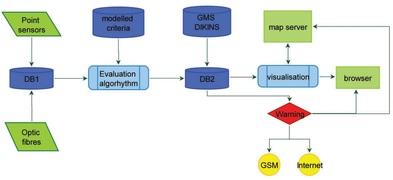
Figure 3A: General scheme of the wireless communication network

3B Calibration of the online platform for evaluation and visualisation

The platform will evaluate measured data by using an evaluation algorithm and visualize both archived (GMS) and real time (sensors) data as map layers displayed on aerial and DEM Basemaps. Moreover, once a risk scenario is confirmed, the warning system will text / mail a notice.

Figure 3B_1: Example of the visualisation of measured data

Figure 3B_2: Flow chart of data gathering, evaluation and visualisation



Literature

Boukalová Z. and Beneš V. (2007): *Dike breaks prevention as the process of flooding protection*. IAHR Congress, Venice, Italy, 1.- 6.7. 2007.

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