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A Vulcano Expert System: Automatic Alert Level Estimation and GIS Visualization on top of a multi-parameter Data Base

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The success of volcano fast response systems including early warning of an imminent eruption lives through its connection capability to already installed monitoring systems. Also new temporary, possible wireless networks as well as combination of different raw and model data needs to be covered. In practice this means a high-dimensional, complicated (raw or already parameterised) data stream with different sampling rates and time histories that have to be stored and analysed.

In the framework of the Exupery project (GEOTECHNOLOGIEN, German Ministry for Education and Research - BMBF) the SeisHub Database handles multi-parameter data resulting from modern volcano monitoring networks simultaneously. This is a quite common situation today in order to assess volcanic activity.

The warning system, here a GIS and an automatic alert level estimation, connects to the data base to retrieve the relevant information. The GIS provides access to the data as well as analysis results. By overlaying various parameters in the GIS systems the expert can analyse the situation and base his/her decision easily on multi-parameter data. In addition to data interactive visualization via the GIS the alert level of the volcano is automatically estimated using a Bayesian Belief Network (BBN) approach. This allows the expert to verify his own assessment versus the automatic system. In case there are major differences, the expert can identify the origin of the difference in the graphical representation of the BBN and if necessary adapt the BBN. BBNs are chosen because of their transparency (graphical representation), flexibility, probabilistic architecture and their possibility to incorporate expert knowledge. The probabilistic architecture allows to compute a confidence measure for the given alert level. A high, automatically estimated alert level with either high or low confidence can certainly lead to different decisions by the human interpreter.