FACTSHEET

Development of framework for the influence and impact of uncertainty

FLOODsite Task 20 has produced:

- A conceptual framework for the process of conducting uncertainty analysis and communicating to stakeholders;
- Reframe – a software framework for flood risk calculation and computational decision support;
- UNEEC – an innovative methodology for modelling errors in forecasting situations;
- Info-gap analysis – new methods for robust decision-making under severe uncertainty.

These tools are intended to be used by:

- Managers required to make robust risk-based decisions in both policy and emergency situations;
- Flood risk modellers requiring guidance on choice of model components and how they should be brought together to analyse uncertainty.

Where to find reports and models:

- Access to reports, examples and animations is via Task 20 area of the project website www.floodsite.net.

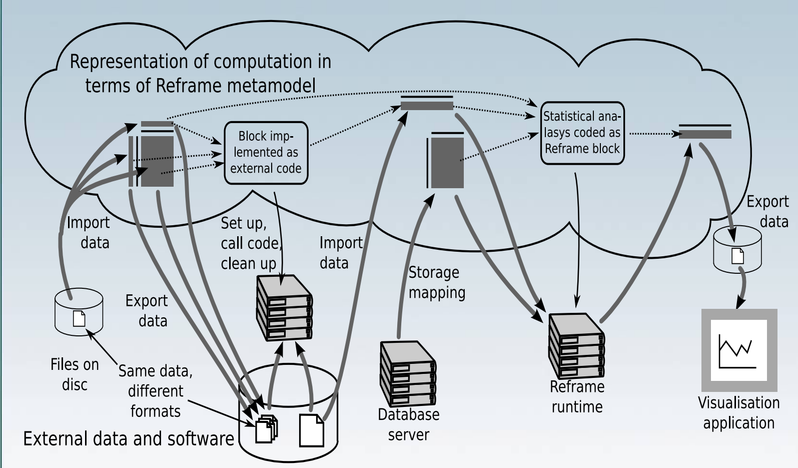

Fig. 1. Reframe metamodel

In Brief

Flood risk managers are required to make evidence-based decisions, but the data available to them are usually uncertain. It is important to quantify and consider the potential impacts of this uncertainty on the rational decisions made.

While methods for estimating uncertainty may differ, the logical structure of the conceptual framework developed through Task 20 of the FLOODsite project is intended to be applicable to risk-based planning, strategy and design decisions. Uncertainties are propagated through to key decision outputs in order to demonstrate the implications of uncertainty for decision-makers. Sensitivity analysis is used to understand the contribution that different factors make to the total uncertainty.

The conceptual framework is supported by the Reframe software framework, which enables:

- Coupling of software components,
- Propagation of uncertainty through coupled models, and
- Collaboration, including remotely and across organisational boundaries.

The UNEEC (Uncertainty Estimation based on local Errors and Clustering) methodology uses advanced machine learning techniques to propagate uncertainty through complex models.

SIXTH FRAMEWORK PROGRAMME

FACTSHEET

Conceptual Framework

A flow chart is available in FLOODsite report T20-08-04 that can be used as a guide through the process of uncertainty analysis. The process should be tiered and scalable, in much the same way as risk-based decision making. In this way, it can be an iterative process progressively refining uncertainty estimates with regard to the most significant factors.

Reframe

Reframe is built around a new metamodel (Fig. 1). It is designed to help people conceptualise and structure the complex multi-dimensional analyses which increasingly form the basis of support for flood risk management decision making; it facilitates communication about these kinds of analyses and encoding of them for manipulation by computer.

This work under FLOODsite took the conceptual developments made in earlier projects and built a prototype software system. However, considerable additional work will be needed to convert this into a robust tool ready for use by end users.

UNEEC

The UNEEC (Uncertainty Estimation based on local Errors and Clustering) methodology uses information regarding uncertainty extracted from residual errors between model predictions and observations. Patterns are identified in these errors, which can be applied to flood forecasting problems to predict uncertainties.

The methodology consists of three main parts:

- Clustering - partitioning the data into several natural groups that can be interpreted (Fig. 2).
- Estimation of the error probability distribution for the clusters.
- Building the overall model of the error probability distribution - in order to predict the uncertainty in flood forecasts. A machine-learning model is used with predictive power after being trained using the calibration data.

Info-gap Analysis

Information-gap theory, or info-gap for short, has been developed to enable robust decision-making under uncertainty. We have shown that even in situations of severe uncertainty it is possible to make well-justified decisions by exploring the implications of a wide range of future possibilities.

Info-gap theory has been applied to an example of strategic investment decision-making in the Thames Estuary. The FLOODsite analysis went on to demonstrate the possibility of exploring the value of waiting until improved knowledge becomes available by constructing options that explicitly model this possibility.

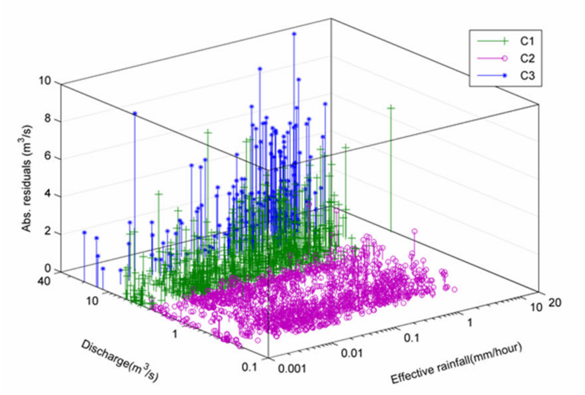

Fig. 2. Visualisation of UNEEC clustering of input data

The FLOODsite project

FLOODsite is an interdisciplinary project integrating expertise from physical, environmental and social sciences, as well as spatial planning and management. The project has over 30 research tasks across seven themes, including pilot applications in Belgium, the Czech Republic, France, Germany, Hungary, Italy, the Netherlands, Spain and the UK. The EC has identified FLOODsite as one of its contributions to the European Flood Action Programme.

Email. floodsite@hrwallingford.co.uk
Website www.floodsite.net

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