project description

Trans-boundary water quality management in the Danube Basin

assignment

The Danube River is 2857 km long and the basin covers 817,000 square km in 18 countries in the heart of central Europe. The basin is characterised by large socio-economical differences. It stretches out from rich Western-European states to some relatively poor former Soviet Union Republics. The river has a number of very large tributaries: the Sava (Slovenia, Croatia, Bosnia-Herzegovina, Yugoslavia), the Tisa (Ukraine, Slovakia, Hungary, Romania, Yugoslavia), the Drava (Austria, Slovenia, Croatia, Hungary) and the Inn (Germany, Austria). The Danube water is used intensively by the 85 million inhabitants of the basin. The basin features many important natural areas, including the Danube delta - the second largest wetland area in Europe.

In a series of recent projects Delft Hydraulics has been actively involved in the set-up and the realisation of a sustainable water quality management on a basin-wide scale.

client

The Danube River Protection Convention, created in the framework of the ECE-Convention for the protection of trans-boundary waters (Helsinki Convention 1992), became with its entry into force on 22 October 1998 the overall legal instrument for co-operation and trans-boundary water management in the Danube River Basin. The overall objective of the DRPC is to achieve and maintain the sustainable development and use of water resources in the Danube River Basin. The executing body of the convention is the International Commission for the Protection of the Danube River (ICPDR).

During the years 1994-2000 the institutional and technical infrastructure of the DRPC has been created, funded by the EU (Phare and TACIS) and the UNDP/GEF. Delft Hydraulics has carried out a number of projects, financed by the institutions mentioned above, in support to the DRPC infrastructure. On top of this, Delft Hydraulics is a partner in the EU 5th Framework Programme project ***daNUbs*** (2001-2004), which deals with the management of emissions of nitrogen and phosphorus on a basin-wide scale. ***daNUbs*** is being carried out with inputs from the ICPDR.

period

1995 - 2004

The "Blue" Danube in Budapest

keywords:

Q3460

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the accident early warning and prevention system

The Accident Emergency Warning and Prevention System (AEWPS) in the river Danube was implemented to safeguard the aquatic environment and the use of water in the riparian states. Catastrophic events like accidental spills, flooding and ice hazards may deteriorate the downstream ecosystem and jeopardise the supplies of water. In such cases, there is a clear need for the collection and dissemination of early information about these events.

The setting-up of the AEWPS was a priority activity under the DRPC. It was carried out by a so-called "Expert Group" of Danube experts, supported by a Consultants Team (including Delft Hydraulics) and the EU.

The principal aim of the AEWPS is to communicate information about sudden changes in the water characteristics, such as accidental spills or unpredictable changes in water level, with special attention to trans-boundary impacts.

The main instruments of the AEWPS are:

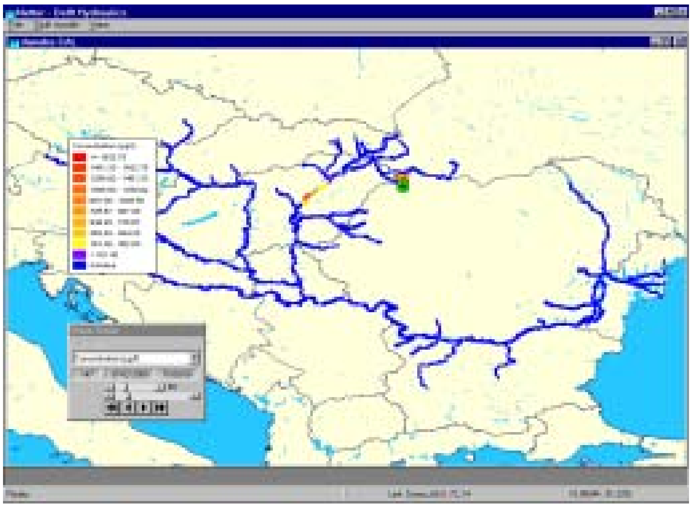
- joint procedures;
- joint communication and assessment tools (manuals, satellite communication equipment, hazardous substances database, accidental spill model).

The focal locations of the AEWPS are the Principal International Alert Centres (PIAC's).

The Principal International Alert Centres (PIAC's) of the Danube AEWPS

the danube basin alarm model

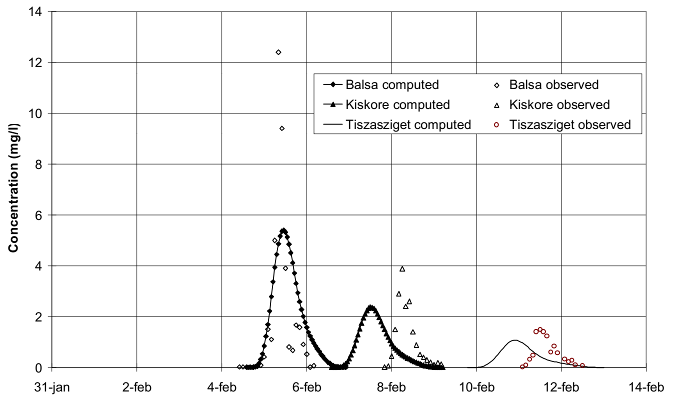
The Danube Basin Alarm Model (DBAM) was designed to support decision-making in relation to accidental spills with a probable trans-boundary impact. The January 2000 Baia Mare spill presents a dramatic example.



Application of the DBAM to the Baia Mare spill

The model provides forecasts of the travel time and the expected peak concentrations in the cloud of pollutants during its travel down the river. The DBAM was designed for use in operational conditions, to provide a fast and first order assessment of the effects of a spill. It uses limited and readily available input data. For reasons of computational speed and accuracy, the model uses an analytical technique to solve the governing mathematical advection-diffusion equation.

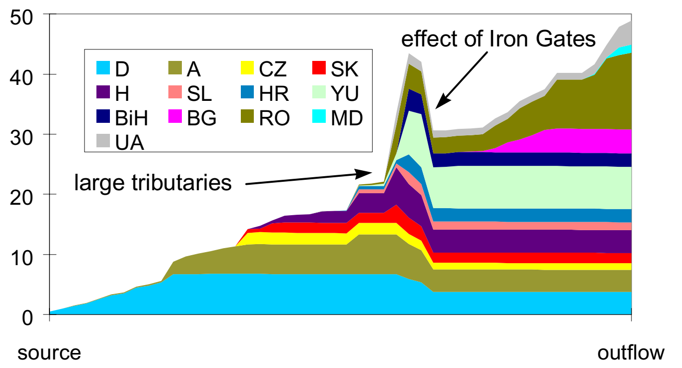
The DBAM model is operational in 11 Danube countries. An evaluation of its accuracy has been carried out on the basis of data collected during the Baia Mare Spill. At present, the ICPDR is planning the full-scale calibration of the model.



Pre-calibration assessment of the accuracy of the DBAM, based on data collected during the Baia Mare incident

Essential corner stones for its development were: (a) state-of-the-art nutrient emission data, (b) observed concentrations and loads in the river, (c) empirical relations describing the retention of nutrients in (parts of) the catchment as a function of the hydrology of the catchment, and (d) a panel of leading Danube experts. The model has been used to support a so-called Trans-boundary Diagnostic Analysis for the nutrients nitrogen and phosphorus, as well as to assess the effectiveness of the proposed pollution reduction programme.

Delft Hydraulics has been responsible for the definition of the model approach, and at a later stage has carried out a major upgrade of the software. Furthermore, Delft Hydraulics has trained experts in 10 Danube countries in the use of the model.



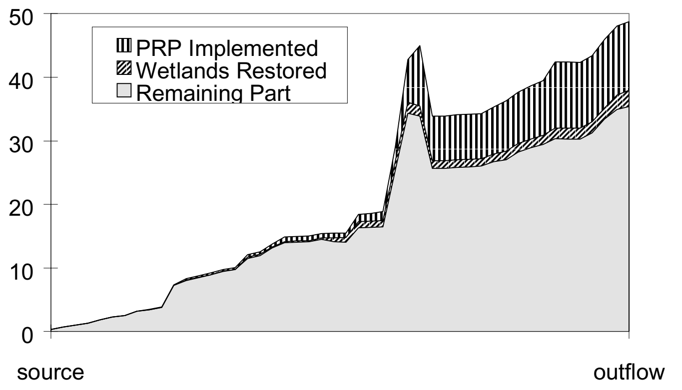
Trans-boundary diagnostic analysis: phosphorus in-stream load profile of the Danube river (reference situation) subdivided per country of origin of the emissions The annual pollutant load in kt/y is plotted against the river axis

the danube river basin pollution reduction programme

The Danube River Basin Pollution Reduction Programme is a project carried out by UNDP/GEF in 1997-1999. It studied among other things the current state of the Danube Basin and a concrete set of proposed measures aimed at reducing the trans-boundary transports of pollution.

The Pollution Reduction Programme comprises over 400 projects, responding generally to "hot spots" or point sources of emission, representing national priorities and taking equally into account the obligation to mitigate trans-boundary effects. Particular attention was given to the identification of sites for wetland restoration, which play an important role not only as natural habitats, but also as nutrient sinks. The total investment required to respond to the priority projects is estimated to be about 5,66 billion US$.

Delft Hydraulics' role during the project was to set up and run the Danube Water Quality Model (DWQM), a SOBEK-based model to simulate the actual in-stream loads of the nutrients nitrogen and phosphorus. The model was based on the advection-diffusion equation.



The effect of the proposed Pollution Reduction programme on the in-stream load profile of phosphorus.

The gaps in knowledge and data identified in this process are now being addressed in the ***daNUbs*** project, in the EU 5th Framework Programme.

daNUbs

Delft Hydraulics participates in the EU's 5th Framework Programme project ***daNUbs*** (Nutrient Management in the Danube Basin and its Impact on the Black Sea). The project has the following main objectives:

(a) Improvement of process understanding

The research, including literature and data review in combination with additional field work, addresses:
- the nutrient balance in the catchment with main emphasis on diffuse pollution (e.g. agriculture, air pollution) and the transport, retention and losses of nutrients in the catchment (nutrient balances in case study regions),
- the transport, retention and losses of nutrients and silica along the Danube River and
- the functioning of the Western Black Sea ecosystem concerning the direct influence of riverine nutrient and silica discharges.

(b) Mathematical modelling

Based on an improved process understanding, mathematical models are improved, combined, and applied to quantitatively assess nutrient fluxes from the Danube Basin along the Danube and the Delta to the Western Black Sea and to quantify the impact of these fluxes on the mixing zone of Danube River in the Western Black Sea. This part uses:
- the MONERIS-emission model based on a GIS data base,
- the Danube Water Quality Model (DWQM) for the description of the transport and transformation processes in the river system,
- the Danube Delta Model (DDM) for the quantification of nutrient transport in the Danube Delta and
- the Shelf Model for modelling the impact of the Danube load on the Western Black Sea.

Based on these models the whole system can be considered as a complex unit and scenarios can be developed as a basis for scenario evaluation.

(c) Strategic planning

Subsequently, the project elaborates scenarios for future strategic planning on the catchment scale. This part includes:

(1) a method to establish comparable, basin-wide, periodic nutrient balances considering the national data availability and

(2) the evaluation of different solutions for future nutrient management strategies considering socio-economic developments in the Danube Basin.

In ***daNUbs***, Delft Hydraulics is responsible for improving the Danube Water Quality Model. It is coupled to a basin-wide GIS based emission model (MONERIS), and it is further calibrated using newly collected field data. Furthermore, Delft Hydraulics co-ordinates all modelling activities in ***daNUbs***.

Basin-wide emission modelling in daNUbs is based on a GIS approach.

more information

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