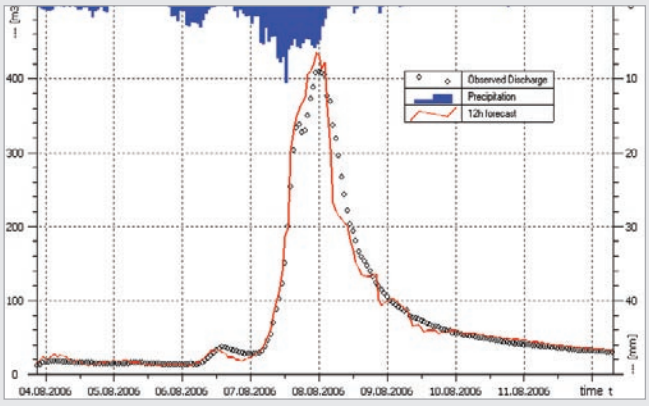
WISKI Modeling

WATER RESOURCES MANAGEMENT

Hydrological Modeling and Prediction

MODELING | WATER BALANCE | WATER MANAGEMENT | FLOOD MANAGEMENT

In WISKI, conceptual models for modeling, simulation and analysis of various water management issues, and for flood forecasting are used in low to medium high risk areas. The WISKI ModelBuilder provides powerful support in the generation of hydrological models. For higher requirements in regards to precision and speed for short term forecasts, e.g. in high risk flood areas with complex relations between the various influencing factors, WISKI offers an option for statistical forecasts as a useful supplement for conceptual modeling. Fast and precise statistical short term forecasts provide you with a decisive advantage in the critical field of flood forecast in fast reacting catchment areas. WISKI covers all requirements in the area of modeling and flood forecast with its two methods 'Conceptual Modeling' and 'Statistical Forecast'.



CONCEPTUAL MODELING - the all-rounder

Conceptual modeling allows accurate mapping of time-dependent behavior for a broad spectrum of water management systems. The WISKI ModelBuilder was designed as part of the WISKI product family to assist users in difficult tasks. As a universally deployable and highly flexible tool, the WISKI ModelBuilder provides indispensable support in routine operations of both water utilities and water power suppliers for the generation and comparison of management plans, storage plans, water management modeling, and flood forecasts.

Useful for many tasks

- Water management modeling
- Generation of water balance
- Hydropower plant simulations for the derivation of operational guidelines
- Simulations of storage tanks and pump systems
- Flood prediction (mid- and long-term) including alarming when threshold values are exceeded
- Modeling of options for pollution check controls

Flexible base concept

The highly flexible WISKI ModelBuilder provides optimized user support for the modeling of a hydrological network. The interactive modeling environment with its user-friendly GUI allows for

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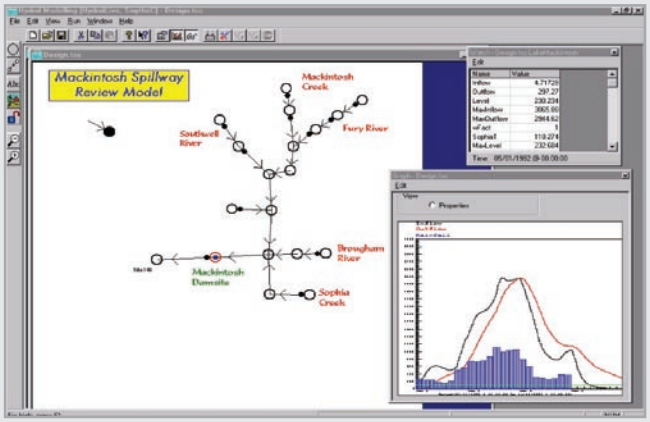


the construction of a WISKI model consisting of the two basic elements node and connection. These interact in the form of a regular tree structure, representing the modeled hydrological system. Each element (node or connection) is associated with a calculation method for mapping the corresponding sub-processes. The user can refer to the extensive WISKI library containing hydrological functions, or easily define new calculation routines for the individual system elements with KiScript script language. The WISKI model can therefore be customized for actual geographic conditions.

The WISKI model provides flexibility in regards to various input data, as it processes current real time data as well as forecast or fictitious data. Results are presented in clear graphs and tables to facilitate quick and easy interpretation.

Perfect integration

WISKI modeling is seamlessly integrated into the WISKI product family: That means that current data is available at any time via the WISKI database. Once the modeling and calibration phases have been concluded, modeling results and forecasts are generated directly in the operational dataflow. The user can view and edit the generated data just as easily, as any other data stored in the WISKI database. The interaction between statistical forecasts and the WISKI AlarmManager is particularly useful for flood forecasts.

Comprehensive application options

You can produce water balances, water management models, and management plans with the WISKI model for your customized hydrological network. The simulation of stores, pump systems, and entire hydrological power plants can be used to derive operational guidelines, or to assess the performance of the simulated unit. Furthermore, you can create flood forecasts and output alarms, when threshold values are exceeded. You also have the option to assess and evaluate infrastructure designs by simulating various scenarios. Various options for pollution checks can be modeled and compared. Furthermore, the conceptual modeling with WISKI provides an excellent basis for plausibility checks of your data, as well as safeguarding data quality, as data is replaced and gaps in time series are filled. Based on quality assured data, comparisons, regressions, analyses and more can be easily generated.

Conceptual modeling highlights with WISKI ModelBuilder

- Interactive modeling environment with user-friendly GUI
- Extensive library of hydrological calculation functions
- KISTERS script language KiScript for the creation of custom calculations and process descriptions
- Flexibility for various input data (current real time data, predicted or fictitious precipitation amounts)
- Clear mapping of resulting data in graphs and tables
- Perfect integration with WISKI, e.g. for access to current data, for simplified additional data processing, and for the interaction with WISKI AlarmManager in case of flood warning

STATISTICAL FORECASTS - the supplement for precise time and locality specific short term forecasts

When a danger of flood exists, timely and location specific action is essential. Due to the volatile situation in high risk flood areas, statistical processes utilizing artificial intelligence provide a distinct advantage and higher protection based on their speed and precision in short term forecasts. You gain valuable time for the implementation of effective flood protection measures where and when they are needed.

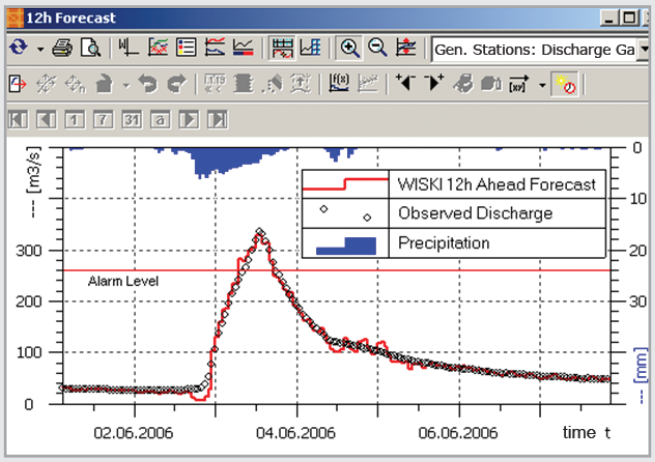
Statistical models are particularly helpful for short term forecasts (approx. 12 - 24 hours) and therefore offer protection for that critical area, for which conceptual modeling is often not enough. The precision of a forecast depends on local conditions of the

catchment area. Statistical models are however better suited for the mapping of complex, non-linear relations between influencing factors than conceptual models, which rely on a linear approach. The complexity of factors will not impact the precision of forecasts.

Innovative technology

An artificial neural net (ANN) makes up the core of a statistical forecast model - a programmable network of nodes, modeled after biological neural networks. The self-learning system is filled with historical data, generalizes these and independently determines cause and effect relations between the various influencing factors and the factors to be forecast (calibration phase). Based on historical data, statistical models are tested by comparing the actual events of a documented flood with output forecasts (validation phase).

In operational deployment, the ANN receives measured values for precipitation and flow of the last twelve hours, plus predicted precipitation values for the next twelve hours; with that data, and with the knowledge of the system-determined relations, it can now calculate a flow prognosis for the next twelve hours. The currently deployed ANN continuously learns from current data - which means constant and automatic optimization without any interference in operations. In an ANN the connections between inputs and receptors are prescribed by the user, and the network only adapts the weights. Adaptive Logic Networks (ALN) offer a supervised learning process where the network step by step adapts the relevant connections between input and receptive fields of the network.



The algorithm library for statistical forecasts is state-of-the-art and contains:

- Artificial Neural Networks (ANN)
- Adaptive Logic Networks (ALN)
- Fuzzy and Neuro-Fuzzy logic
- ARMA, ARIMA, ARIMAX Models
- Kalman filter
- and powerful modeling support for model generation, calibration, and validation

Fast and robust

Due to its flawless integration into WISKI, short response times and high reliability are guaranteed. Statistical forecasts have proven to be extremely robust in terms of fluctuations in precipitation predictions and incomplete data, which frequently occur in hydrological reality. That means that precise forecasts can be provided, even if there is no time for intensive data preparation. The adverse effects of forecast results due to faulty input data are reduced to a minimum - the best possible starting point for smooth operational flow.

Minimum effort - maximum benefit

Artificial neural networks require only a bare minimum of effort in regards to calibration and maintenance: Once configuration is complete, user actions will become largely unnecessary, as the ANN is self-optimizing - which is of course controlled by the user. There is no need for work intensive determinations and inputs of cause-effect relationships into the system, as the ANN carries out all these calculations automatically. All statistical processes are integrated perfectly into WISKI time series management and the WISKI database; superfluous and error-prone redundant data maintenance can therefore be eliminated. And since model configuration has never been easier, forecasts based on statistical models are now also feasible for small-scale institutions. It could be used as a supplement for the traditional hydrological model or, completely independently, for the specialist area of short-term forecasts.

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