HYDROLOGIE

ALBERT-LUDWIGS-UNIVERSITÄT FREIBURG i.Br.

Tritium based water balance modelling in the Weser catchment, Germany

Project description

The Institute of Hydrology of the Freiburg university (IHF) in conjunction with the German Federal Institute of Hydrology (BfG) are to integrating tritium data for a water balance model. Tritium observations in precipitation and river water covering a period of 30 years are used to establish a tritium aided water balance for a 46.300 km² area in Germany (Weser catchment). The whole study area is separated into 8 sub areas ranging from 930 km² to 15.770 km². The altidues of the sub areas reach from 0 to more than 800 m a.s.l. The considered time period is 1950 to 2000.

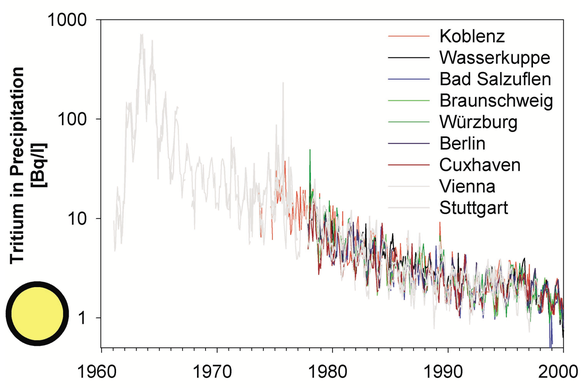

Fig. 1
Environmental tritium in precipitation at five locations close to or within the Weser catchment and additionally at the locations Stuttgart and Vienna. These two locations cover a longer period of tritium investigations and will serve to extrapolate the data series of the investigation area. Tritium in precipitation was mainly introduced into the water cycle by nuclear weapon testing in the 60s (note logarithmic scale).

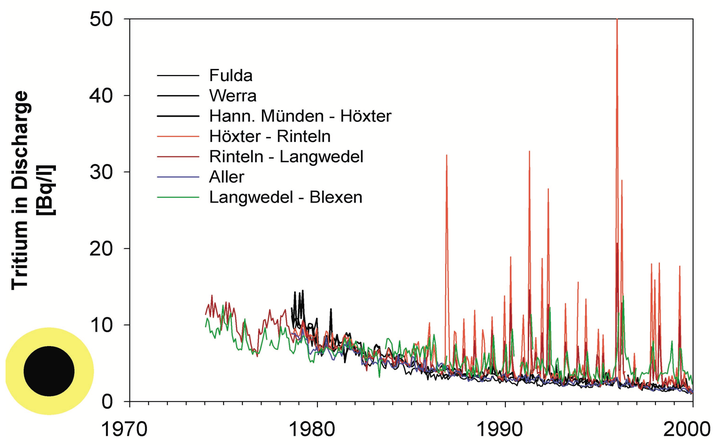

Fig. 2
Tritium in discharge at seven locations in the Weser catchment. The black lines indicate observations only influenced by precipitation. Stations with colored lines are influenced by nuclear power plants that are located within the catchment.

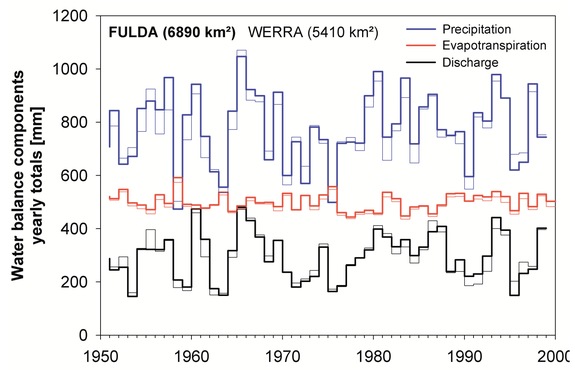

Fig. 3
Water balance components for the sub areas Fulda and Werra in yearly time resolution from 1950 to 2000. Precipitation (DWD - German Weather Service), evapotranspiration (using the grass reference method based on the Penman-Monteith formula DWD) and discharge at the outlet of the catchments are plotted.

Tritium balance model

A tritium balance model is used for semi distributed water and tritium balance calculations (Fig 4). The modelling is performed on monthly time steps and consider evapotranspiration from land surface and evaporation of water bodies (rivers, lakes). Snow cover distribution and different runoff components (direct runoff, fast and slow groundwater discharge) are considered as temporal storage. The model accounts for tritium input from precipitation (T_I), nuclear power plants (T_{NPP}) and channels (T_{IK}) that introduce water from surrounding catchments. Outputs for tritium are evapotranspiration from land (T_{EL}) and evaporation from water surface (T_{EW}), outflow through channels (T_{OK}) and discharge (T_O).

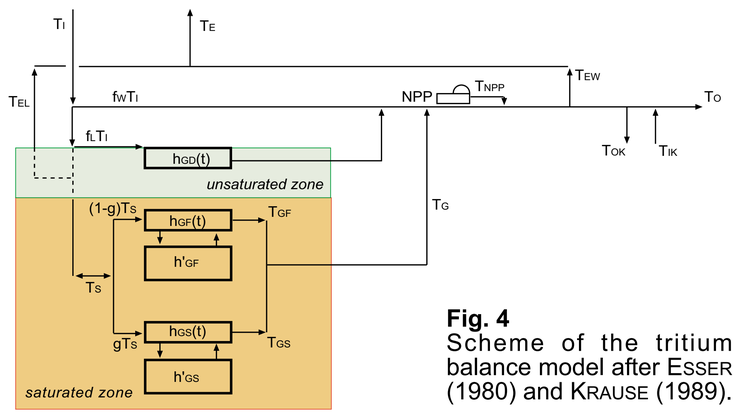

Fig. 4
Scheme of the tritium balance model after ESSER (1980) and KRAUSE (1989).

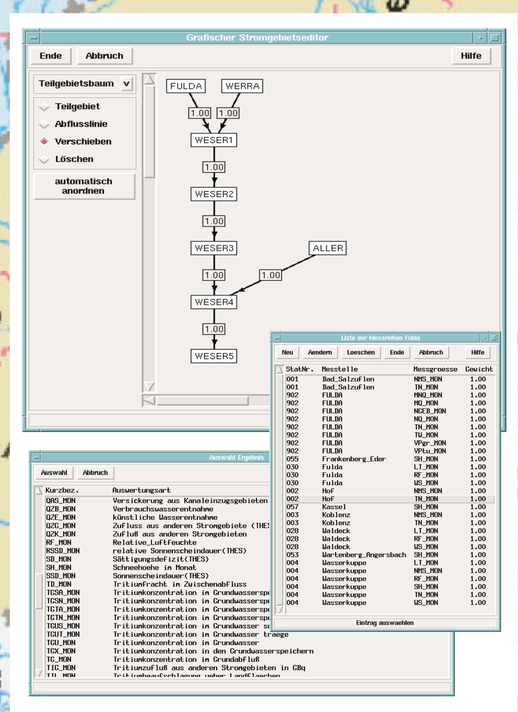

Fig. 5
The model calculations are conducted using a LINUX based software (TRIBIL) that allows to handle a huge number of different data files.

Preliminary results

Including the conservative tracer tritium into large scale modelling is a rather new approach. Balancing of solutes in catchment studies can be improved and this approach can serve as an additional validation tool for water balance models.

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