5.11 **Optimization of a macroscale hydrological model for flood forecasting in the Odra watershed**

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1. Introduction

The hydrological model SEROS is a combination of the land surface scheme SEWAB (Mengelkamp et al., 1999, 2000) and the large-scale routing scheme (Lohmann et al.. 1996). It is intended to be coupled directly to an atmospheric mesoscale model. Therefore SEWAB solves the coupled system of the surface energy and water balance. The routing scheme describes the concentration time for runoff reaching the outlet of a grid box as well as the transport of water in the channel system. Both parts of the routing scheme (within grid cell and river routing) are built as simple linear transfer function models. The within grid cell transport is described by a unit hydrograph, the river routing is calculated by means of a solution of the cinematic wave equation and diffusion.

SEROS is applied to the Odra watershed covering 120,000 km² with a horizontal grid size of 7x7 km^2. The routing network and sub-catchments of each gauging station are determined from a digital elevation model (fig. 1). Land use is taken from the CORINE data set of the European Environment Agency which is available with a spatial resolution of 250 m, soil information from the FAO soil characteristics. Forcing data from 50 synoptic stations and about 1250 precipitation stations are used to force the model. Daily discharges of 29 gauging stations and of 13 reservoirs in the mountainous region are used to calibrate and verify the model.

The calibration period covers 3 years from 1992 to 1994. The verification period from 1995 to 1999 includes the extreme flooding event in 1997 during which hundreds of cities and villages were inundated, more than 100 casualties occurred and vast areas of land were flooded for weeks.

2. Calibration and validation

SEROS is optimized/calibrated by use of the Shuffled Complex Evolution Approach (SCE-UA) which was developed at the University of Arizona (Duan et al, 1993). The calibration parameters

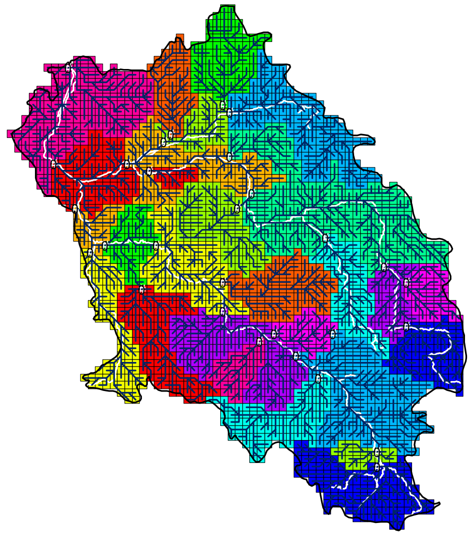

Figure 1: Routing network of the Odra basin on a 7 km grid, location of gauging stations and sub-catchments

which include parameters for surface and subsurface runoff generation, for the control of evapotranspiration and for the horizontal water transport are allowed to vary in prescribed boundaries. As a measure of the efficiency the Nash-Sutcliffe coefficient is used.

The coincidence of measured and simulated hydrograph is not necessarily a criterion for the adequate description of physical processes. Therefore the parameter sensitivity is investigated relative to the characteristics (orography, landuse, soil type) of each of a total of 38 sub-catchments. Results indicate the relevance of different physical processes for different catchments.

During the calibration period over 70 % of the catchments show an efficiency of more than 65 % (Fig. 2) which is reached for the verification period by about 50 % of the catchments. There are two main reasons for low efficiencies which occur mainly in the eastern part of the watershed (Fig. 3). This area is characterized by a low density of rainfall stations. Additionally, convective rain over small areas occurs more often than in the southern part. In the upper lowlands also many parts of the river system

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were canalized which makes a successful calibration of a conceptual model impossible.

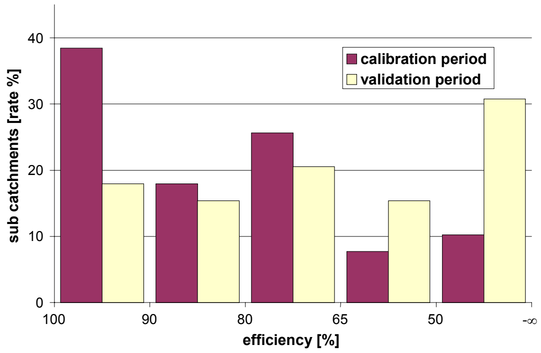
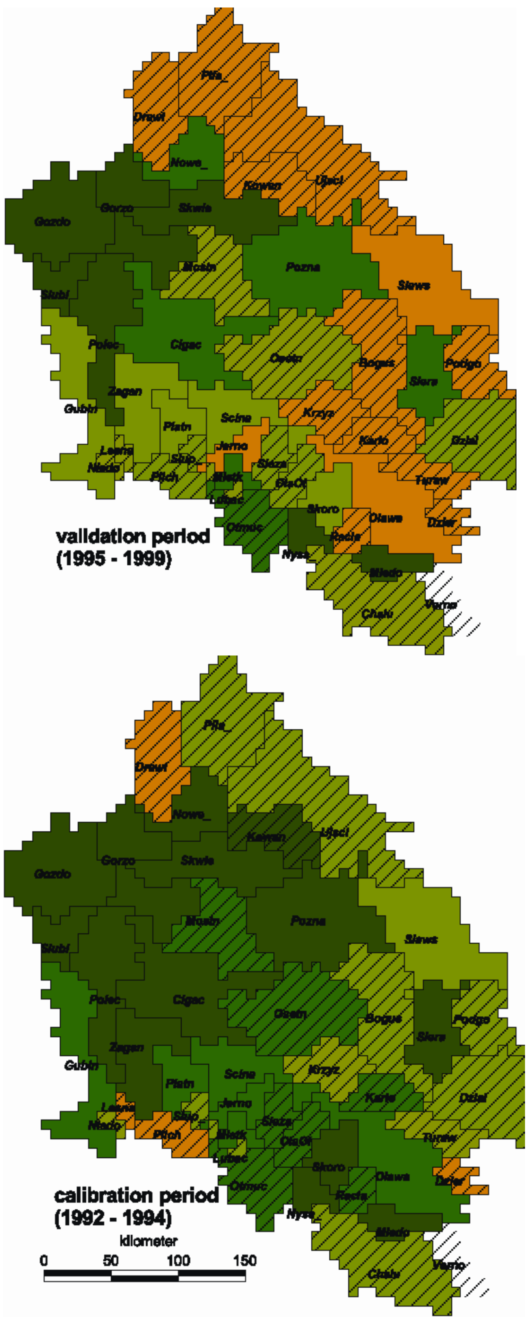


Fig. 2: Statistics of efficiency and percent of sub-catchments for the calibration period and the verification period.



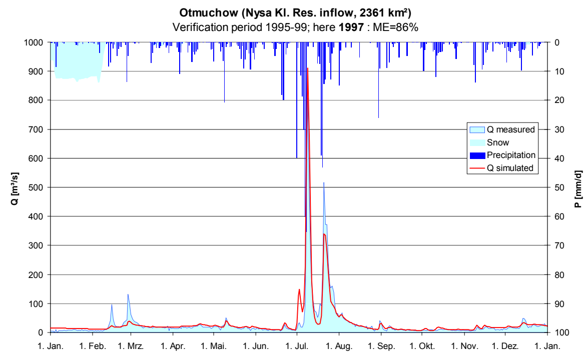


Fig. 4: Simulated (red) and observed (blue) hydrograph of the gauging station Otmuchow.

The hydrograph of the station Otmuchow is shown for the year 1997 out of the validation period. A major flooding event occurred during July 1997. The efficiency for this year is 86 %.

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Fig. 3: Areal distribution of efficiency for the calibration (above) and validation period.