Plate 1.2 Characteristics of Small Basins

Introduction

Knowledge of hydrological conditions is essential to the taking of measures in water resources management. For most catchments, considerable gaps in data exist in spite of hydrological and climatological measurement networks being comparatively dense. In catchments with no direct measurements, it has therefore been necessary to develop methods of regionalisation for estimating hydrological values. These methods are usually based on both the description of the catchment by means of basin characteristics and the modelling of the correlations between the characteristics and the hydrological values of concern. The present map compiles the most significant results of extensive data acquisition and analysis of hydrologically relevant basin characteristics.

Division of Switzerland into catchments of different surface

For the “Hydrological Atlas of Switzerland”, a spatial system of catchments comprising three levels was developed thus allowing a direct comparison of catchments within one level, and a linking one below the other of the catchments in all three levels by means of aggregation or disaggregation. Shown by the maps 5.4 and 6.1, each level permits different hydrological statements.

Large catchments (river basins) usually covering an area of multiple 1000 km^2 are the top level and are compiled in table 1. The water balance basins including catchments of 100 to 150 km^2, are a result of subdividing the river basins. The small catchments presently described (30 to 50 km^2) make up the lowest level of the spatial system.

Delimitation of small catchments

To derive spatially representative parameters, the division into small catchments aimed at the extraction of the most homogeneous catchments possible.

Catchment surface was the first criterion of division. An area ranging 30 to 50 km^2 was assumed as the standard, because the basin characteristics in relevant catchments are subject to rather small fluctuations on the one hand, and the number of catchments is easily comprehensible on the other.

Many characteristics – such as land use for example – being dependent on altitude, the elevation distribution was also taken into account for defining the boundaries of the small catchments.

For the deep alpine valleys of the Rhine and the Rhône, a deviation from a strict selection of hydrological catchments was necessary. Here, the valley sides were distinguished from the valley floor, thus avoiding two totally different hydrological units (such as valley floor and high mountain ridges) to be mixed in the same catchment. Open catchments with several outlets resulted. Around large lakes and in areas where the Rhine and the Doubs shape national boundaries, no hydrological catchments in the proper sense could be distinguished either. Yet, to allow hydrological statements for such instances, a most representative possible catchment was considered within such regions and relevant characteristics were transferred to the whole area.

A total of 1050 small catchments were considered. The average catchment surface is 37.1 km^2, one quarter of the catchments being larger than 47.8 km^2 and one quarter less than 27.8 km^2. The smallest catchment covers 7 km^2, the largest 195 km^2. Some of the small catchments are identical with the investigated basins of the Swiss National Hydrological and Geological Survey (SNHGS) (cf. list of characteristics).

The small catchments are numbered according to the hydrographic principle. As illustrated by the map legend, the superior water balance basin and river basin can be deduced from the catchment number.

Determination of basin characteristics

Besides climatic and meteorological factors, physiographic (invariate) basin characteristics play a dominant role in discharge modelling and regionalisation. The present map considers only invariate characteristics.

Within the scope of a preliminary study, an investigation was made as to the characteristics that are hydrologically relevant and can be determined using the existing data base. By means of the Geographic Information System (GIS) – an areal determination of parameters for all of Switzerland could hardly have been achieved without – approximately thirty hydrologically relevant parameters were then determined for each small catchment. For this purpose, the catchment divides were digitised and the available data – the RIMINI elevation model, the land use statistics of the Swiss Federal Office of Statistics, the Geotechnical Map of Switzerland and the river network at 1:200000 scale – were converted to digital form as required by the GIS. Basing on the overlay and statistics capabilities of the GIS, it was then possible to calculate the characteristics for every catchment, mainly as spatial mean values (e.g., mean slope) or percentile values (e.g., forested portion).

Cartographic representation of basin characteristics

The mean catchment altitude is the central focus of this cartographic representation. Being included in most procedures of regionalisation as a fundamental basin parameter and correlated with many basin characteristics, the importance of the elevation distribution with respect to hydrological questions is emphasised in figure 1, thus showing the hypsometric curves of those river basins the water balances were determined for in map 6.1.

To compile the list of catchment characteristics, it was necessary to make a selection of the roughly thirty parameters determined. They are split up as follows: values for morphometric characteristics (catchment area, perimeter), altitude values (mean area weighted catchment altitude, highest point, lowest point), slope values (mean slope, portion of areas with up to 3° slope, portion of areas exceeding 15° slope), values as to surface cover (portion of glaciated, sealed, forested, and soil-covered areas), as well as a value to soil characteristics (mean water storage capacity of the soil).

The water storage capacity of the soil (WSV) refers to the water in the root zone (pF values between 2 and 3) readily available to plants. This parameter serves as an indicator of the total water storage capacity of the soil.

Evaluation of the data base

The data base available for the determination of the basin parameters (cf. legend to the list of characteristics) have varying degrees of accuracy, depending on their scale, degree of generalisation and temporal origin.

The land use statistics of the Swiss Federal Office of Statistics for the year 1972 is the oldest basic information used. The land use data derived from it are available in high spatial resolution on a grid size of one hectare. With regard to actuality, it must be observed that land use has changed only on a small scale in the course of the last twenty years, and that the catchments have attained at least relative comparability owing to the use of the same data base. The land use categories selected for statistics, however, are not optimal in the hydrological sense, perennially green land and arable land being covered by the same category. The list of characteristics therefore reveals only the forested portion and the portion of sealed surfaces. The portion of surfaces with soil cover was determined by means of the 1:200000 soil suitability map.

To calculate the altitude values, a generalised version of the RIMINI elevation model (100 m intervals) was used thus explaining the rounded-off figures for minimum and maximum altitude in the list of characteristics. In some cases these values were taken directly from the 1:25000 map of Switzerland. Comparison with the basin characteristics [2] determined in the basins monitored by the SNHGS yield a maximum deviation of 135 m for both maximum and minimum catchment

altitudes, and 78 m for mean altitude. For the catchment area, the percentage deviations are usually below 2 % in comparison with the values given by the SNHGS. Some catchments in the Jura might show greater deviations due to a different delineation of catchment borders, as given in [1].

The data on slope conditions in Swiss catchments are scarce and of varying accuracy, which makes it difficult to classify the values calculated on the basis of the RIMINI elevation model.

The glaciation values are based on the glacier inventory assessed at a high spatial resolution (1:50000). Although these values represent the extent in 1973, they are valid for the early 1990s, as stated in map 3.1.

The water storage capacity (WSV) may be used only for relative comparisons of catchments due to the data acquisition method applied for the soil suitability map.

References

[1] **Magnin, O. (1990):** Délimination de bassins versants dans la chaîne du Jura et définition d'indices hydrogéologiques. Rapport interne du Centre d'hydrogéologie, Neuchâtel.

[2] **Spreafico, M., Bigler, R. (1980):** Verzeichnis der hydrologischen Untersuchungsgebiete der Schweiz. Mitteilung der Landeshydrologie und -geologie, Nr. 2, Bern.