INTERNATIONALES
HOCHSCHULINSTITUT
ZITTAU

„Testing the transferability of the expert system WBS-FLAB for the use in Czech republic and comparative assessment of designation of flood-forming areas in Saxony and the Czech Republic"

Final report

This study was conducted within the project LABEL in the CENTRAL EUROPE program and is funded by the European Regional Development Fund.

Initiator:	Saxon State Office for Agriculture, Environment and Geology Zur Wetterwarte 11 01109 Dresden
Contractor:	International Graduate School Zittau Markt 23 02763 Zittau
Members of staff:	Dr. rer. nat. C. Seidler (IHI Zittau) Dipl.-Ing. Matthias Kändler (IHI Zittau)

Zittau, 30.03.2012

Dr. Christina Seidler

Contents

1. Motivation and goal

Areas with fast runoff conditions and a high probability for heavy rain events play an important role for flood formation/generation. In accordance with the Saxony Water Law (SächsWG) these areas are indicated as „runoff generation areas“. In Saxony such areas were designated using the knowledge based system “areas of similar runoff generation conditions” (WBS FLAB). It is also possible to use other methods as shown in the Czech pilot regions. Particularly for cross-border basins it would be helpful to use a uniform methodology to achieve comparable results. Therefore the transferability of the WBS-FLAB to the Czech Republic within the framework of the EU project LABEL should be tested, and the methods used in the Czech pilot regions were to be compared with the Saxon approach. Consequential recommendations for further actions should be derived.

2. Testing the transferability of the expert system WBS-FLAB for use in the Czech Republic

On the basis of available information about land use, soil types and a digital elevation model, provided as grid data, the WBS-FLAB assesses each grid concerning runoff generation conditions. Areas with similar runoff components are identified. To ensure the application of the expert system with a variable range of input information, a classification of the input data was necessary. It allows the user to create the maps required by WBS-FLAB correctly. All classes of input data are tied to a specific encoding (dictionary) that is used to create the raster maps (Seidler & Merta, 2005). Only the information encoded in the dictionary is used. New categories have to be assigned to either the existing classes in the dictionary, because they have similar properties with respect to runoff generation, or a new category with a new code must be inserted. Then it is necessary to derive corresponding rules for the new category. This is equally true for to land use, soil and slope.

For Central Europe the standardized CORINE land use data are available. These were updated in 37 European countries for the reference year 2006, making them equally available for Germany and the Czech Republic with a grid size of 100 m x 100 m.
Concerning the soil no such consistent cross-border classification system is available. Discrepancies exist between the soil classification systems of the countries.
The WBS-FLAB can be used, if all respective input-information is available in the same spatial solution. The modelling results depend on the quality of the input data. To check the usability for Czech regions, the cross-border basin of the river Mandau was chosen. It is a sub-basin of the Neiße river with an area of 295 km^2 of which one third is Czech and two thirds are German.
The Czech soil types (Taxonomické klasifikační systém půd ČR) were assigned to the respective German ones and the information was integrated in the WBS-FLAB. An exact assignment of the single soil types to each other is impossible. Soil types with similar hydrological properties were grouped.
Figure 1 shows the resulting map of the Mandau catchment with dominating runoff components.

For final designation/identification of runoff generation areas information about precipitation has to be combined with the results of WBS-FLAB. Those were not available in the same quality for the whole basin.

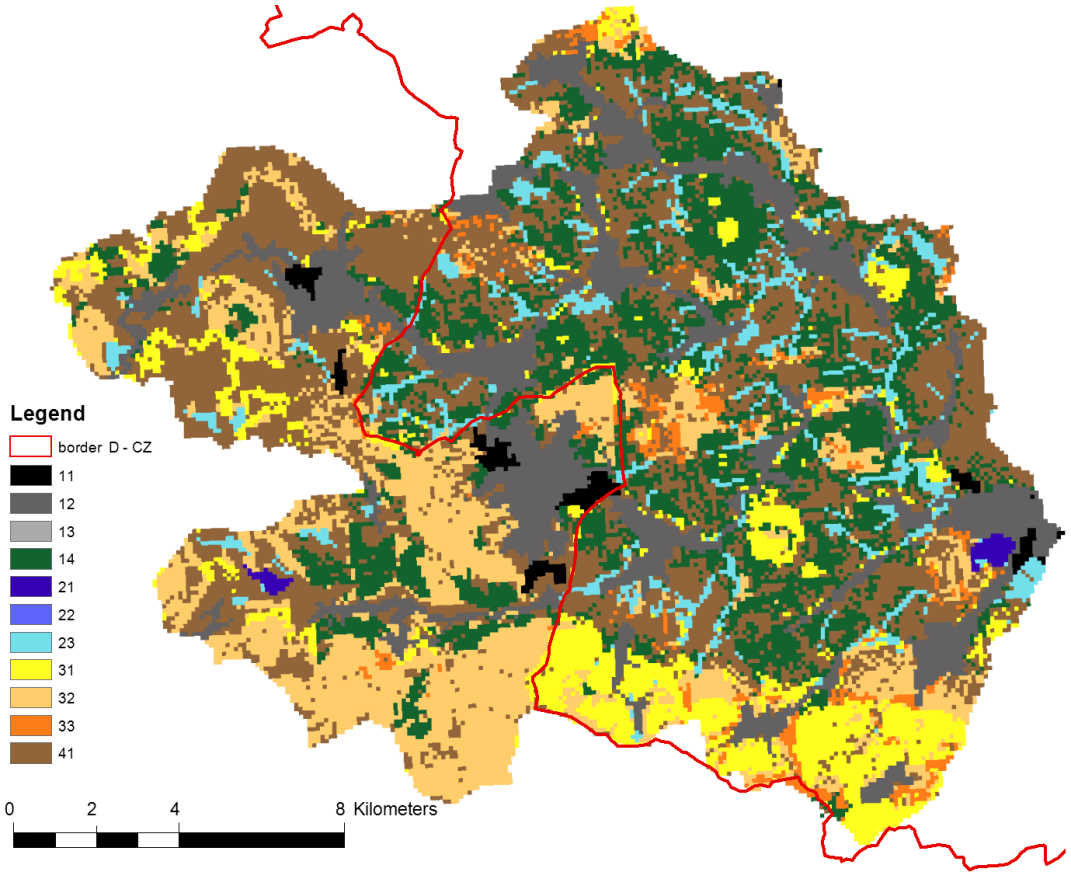

Figure 1: Dominating runoff components in the Mandau-basin determined with the expert system WBS-FLAB (100 m x 100 m grid). The meaning of the codes is declared in Table 1.

Table 1: Meaning of colours and codes (runoff components) in Figure 1

Runoff components according to WBS-FLAB / Odtokovásložkapodle WBS-FLAB			
Symbol	Code/Kód	Runoff component	Označení
	11	Surface runoff from sealed areas	Povrchovýodtokzezpevněnýchploch
	12	Surface runoff from partly sealed areas	Povrchovýodtok z částečnězpevněnýchploch
	13	Surface runoff from rocks	Povrchovýodtokzeskalníchploch
	14	Surface runoff from areas with low infiltration capacity	Povrchovýodtok z ploch s malouinfiltračníschopností
	21	Water bodies	Otevřenévodníplochy
	22	Saturated overland flow from permanent saturated areas	Povrchovýodtok z permanentnězamokřenýchploch
	23	Saturated overland flow from fast saturating areas	Povrchovýodtok z rychle se nasycujícíchploch
	31	Fast interflow	Zrychlenýpodpovrchovýodtokponepropustnévrstvě
	32	Delayed interflow	Zpomalenýpodpovrchovýodtokponepropustnévrstvě
	33	Strongly delayed interflow	Silnězpomalenýpodpovrchovýodtokponepropustnévrstvě
	41	Deep percolation	Hlubokáinfiltrace

3. Comparative assessment of the designation of flood-forming areas in Saxony and the Czech Republic

To identify runoff generation areas it is necessary to assess the storage capacity, the runoff processes and the precipitation characteristics of a certain area.

In Saxony the expert system WBS-FLAB and statistics for heavy rain events as annual frequencies of daily amounts ≥ 50 mm were used. Overlapping the results of the WBS-FLAB runs, with the precipitation information, lead to combinations of areas with fast runoff components and a high probability of intense rain events. These areas are designated as “runoff generation areas”. The grid size was 25 m x 25 m for two pilot regions and 100 m x 100 m for whole Saxony.

For the Czech pilot region Kruszne Hory several models were applied to determine sub-basins and their runoff directions, to calculate „drainage characteristics“ of each sub-basin and to identify inundation areas for certain water levels. Each sub-basin is given a CN-value (SCS-method, Kent 1972) to describe the risk of surface runoff. This method does not consider lateral subsurface flow processes. Precipitation information was included as daily and hourly maximum values of a 100-yr period. The relation of these values says something about areas with probable high precipitation intensities. Overlapping the digital information about CN-values with precipitation information would show the areas with high runoff risk and high rain intensities which could be identified as “runoff generation” areas.

In the Pilsen region it was the aim of the study to assess the retention capacity. For die GIS-analysis, the whole area was separated into hexagons. The retention capacity of each hexagon was estimated considering the following parameters: slope, mean area precipitation amount, soil type, portion of forest and ecological stability. Each parameter got scores 1 to 10. The worst case concerning retention got 10 and the best 1. The scores were weighted depending on their importance. Slope and precipitation got the factor 1, soil and portion of forest area 0.5, ecological stability 0.1. The sum of the weighted products describes the retention capacity in each hexagon and thus, the runoff risk. The average of annual precipitation (1961-90) is used as precipitation data. Hexagons with mean precipitation smaller than 450 mm/a got a 1 score, precipitation amounts higher than 1200 mm/a a 10 score. Thus, hexagons with big sums show the low retention capacity and can be called "runoff generation areas".

All methods are suitable to map the runoff conditions of areas. The used data bases in the Czech Republic and Saxony are similar. GIS-tools are used to combine information about vegetation cover, land use, soil type and built-up areas. There are big differences in the available precipitation information. The use of long-term annual mean values does not really seem to be evident for this goal; different precipitation intensities are not reflected. In contrary the use of 100-yr maximum daily and hourly values is the other extreme. It is questionable, whether long-term area coverage data sets are available to derive these parameters. The procedure in Pilsen resembles the Saxony method. Table 3 shows the data base and the basic procedure in the different regions.

Table 3: Data base and procedure concerning the determination of runoff generation areas in Saxony and two pilot areas in Czech Republic.

	D - Saxony	**Cz - KruszneHory**	**Cz – Region Pilsen**
Precipitation	frequency of occurrence ≥ 50 mm/d	relation hourly to daily maximum rainfall amounts for a centennial time series	Mean annual sum 1961 -90
Runoff-formation disposition	expert system WBS-FLAB parameter: - slope, - soil properties, - vegetation	CN-values depending on soil characteristics and land use categories	scoring-system of parameters as slope, forest cover percentage, soil types and ecological stability; combined as the coefficient for the retentionpotential
Area	Grid 25 x 25 m² resp. 100 x 100 m²	small sub-basins, dimension unknown	hexagons dimension unknown
Basic data	Soil concept map, map of land use (CIR-data, digital elevation model	Maps of soil categories and land use, digital elevation model	maps of soil types and land use, digital elevation model

4. Conclusions

It is absolutely necessary to use the same data to designate cross-border runoff generation areas. Regarding land use, this is given by the CORINE-data. Soil information systems differ between the countries. For use of the WBS-FLAB the attributes in the digital soil map are very important to assess the hydrological effectiveness of soils. Within the soil concept map (Saxony; BKkonz Sachsen) all necessary properties can be found. In the Czech soil map these attributes are not totally equivalent.

Regarding precipitation information big differences exist between the used data sets. Within the countries different data bases are available. A standardized procedure is very important to reach comparable results for the identification of runoff generation areas.

It seems to be difficult to obtain a mutual basis of precipitation data. A standardized area coverage basis could be created by analysing daily precipitation for different intensity classes. It is necessary that enough long-term data series are available for a certain area.

5. References

Kent, K.M. (1972): National Engineering Handbook, Section 4, Hydrology.http://www.info.usda.gov/opennonwebcontent.aspx?content=18389.wba

Tschechisches Bodenklassifikationssystem/ Taxonomickýklasifikačnísystémpůd ČR
http://klasifikace.pedologie.czu.cz/index.php?action=showHomePage