

NE FRIEND PROJECT 5  
Catchment hydrological and biogeochemical processes in changing environment

**RESEARCH PROGRAM FOR 2002-2006**

**INTRODUCTION**

Scientists with strong background in field research in small catchment traditionally participated in Project 5. It is regarded important to maintain and further develop close links between the field workers, physical hydrologists and mathematical modellers. Increasing knowledge on hydrological processes in research catchments and specific role of various parts of the catchment should be reflected in improved mathematical rainfall-runoff models, e.g. either physically based models with reasonable amount of parameters or conceptual models with new routines describing hydrological processes. Determination of proper parameterisation schemes of mathematical models for different scales is an important part of mathematical modelling and should be addressed as well. The same holds also for transfer of hydrological knowledge over different scales.

A lot of knowledge on runoff generation has already been gained in research, but increasing attempts to synthesise the knowledge, incorporate it into the models and identify the directions of further research will be needed in future. Organization of workshops during group meetings and joint ERB-FRIEND conferences would enhance these attempts.

**RESEARCH ACTIVITIES PROPOSED FOR YEARS 2002-2006**

Proposed research activities listed below include the activities contributed by several participants and individual projects of group members.

Contributing organizations

Czech Hydrometeorological Institute Prague – CHMI,  
Institute of Hydrodynamics, Czech Academy of Sciences Prague - IHCAS  
Research Institute of Soil and Water Conservation Prague - RISWC  
Finnish Environment Institute Helsinki  
Technical University Braunschweig - TUB  
Albert-Ludwigs University Freiburg - ALU  
Wageningen University - WU  
University of Warsaw  
Institute of Hydrology, Slovak Academy of Sciences Liptovsky Mikulas – IHSAS  
Swedish Meteorological and Hydrological Institute - SMHI

Multilateral activities

1. Incorporation of runoff generation knowledge into rainfall-runoff models

This research will revolve around two approaches – the rainfall-runoff modelling based on delineation of areas with dominating runoff generation processes developed within TAC-D model and concept of retention-evapotranspiration units used to characterise the soil moisture regime in vegetated areas.

Contributors: ALU, IH CAS, IH SAS, SMHI

## 2. Improved estimation of snow water equivalent

Improved modelling of snow water equivalent is requested to improve river discharge forecasts during the snowmelt periods. This research will focus on spatial distribution of SWE with regard to vegetation cover and snow redistribution in mountainous catchments.

Contributors: IH SAS, CHMI, SMHI

## 3. Identification of discharge-recharge areas

This research will focus at practical application of knowledge on the role of catchment features in generating catchment runoff and field measurements to identify potential recharge and discharge areas in a small catchment.

Contributors: RISWC, IH SAS, ALU, TUB

### Individual research programs of group participants

#### **Institute of Hydrodynamics of the Academy of Sciences of the Czech Republic, Prague**

Dr. M. Tesar, Dr. J. Buchtele

The main attention will be paid to the soil water regime in the head water regions in the Czech Republic and its observation, assessment and modelling. The head water regions represent important source of drinking water for more than 50 % of inhabitants and cover about 20 % of the area of the Czech Republic. We suppose to use a new approach to runoff models – the concept of the retention-evapotranspiration unit (RETU) for areas continuously covered by vegetation during the warm season. The next research activities will focus on the use of the RETU concept in the framework of the watershed based on the experimental data obtained from the mountainous catchments situated in the Šumava Mts., Jizerské hory Mts. and Krkonoše (Giant) Mts. Further attempts will be made to connect the RETU concept and experimental results on the recharge and discharge areas determination in the catchment scale in order to involve the influence of basin topography and of vegetative and soil diversity in the model (TOPMODEL in our case).

Analysis of the long-term series of rainfall-runoff data combined with rainfall-runoff modelling should address problem of identification of possible changes in runoff regime.

#### **Research Institute for Soil and Water Conservation, Prague , Czech Republic**

Dr. F. Dolezal, Dr. T. Kvittek

The existing and newly made measurements of runoff and water quality in small surface streams and in tile drainage systems will be investigated from the viewpoint of runoff and water quality generation mechanisms. In particular, various existing and newly developed methods of runoff component separation, based either exclusively on the variability of the runoff itself or on supplementary information (groundwater table levels, precipitation, water quality), either empirical or based on rainfall-runoff modelling, will be applied. The investigated catchments lie in the foothill zone of highlands of Central and East Bohemia. This analysis is assumed to provide, together with the results of other NE Friend Project 5 teams, a clue to the problem of water quality management in agriculturally intensive foothill landscapes of Central Europe.

**Finnish Environmental Institute**, Helsinki, Finland  
Dr. P. Seuna, Dr. A. Lepistö,

Analysis of the long-term data collected in small catchments should receive further attention. New evaluation of such data would help in climate change and landuse change impacts studies. The analyses of data series should be concentrated on changes in the frequency of extreme rainfall/runoff events, and possible changes in frequency of mild winters with a number of snow accumulation/melting periods.

Upscaling of process information is another important issue. The research should look at the importance of particular processes in small catchments and large river basins.

**Institute of Geoecology, Technical University of Braunschweig**, Germany  
Prof. Dr. A. Herrmann

Future activities will continue to focus on runoff formation process in different environments with different land use: alpine-highland-lowland, dominant porous-fractured rock aquifer, agricultural (with/without irrigation)-forestry, humid mid-latitude – monsoon climate basins located in Europe and South Asia.

As a major technique to discriminate individual basin water bodies with in respect to origin, age and flow paths environmental and artificial tracers will be applied. In this context, preferential flow will be attributed a major concern in the next years.

Another activity concerns the organisation of the International Conference on Hydrology of Mountain Environments in Berchtesgaden, Germany 27 September-1 October 2004 which is a contribution of Germany to IHP VI. In this context a regional Workshop on mountain hydrology is planned for 2003 as a preparatory step.

**University of Freiburg, Institute of Hydrology, Freiburg, Germany**  
Contact person: Dr. S. Uhlenbrook

The research interests concentrate on the interactions of surface water, soil water and groundwater at the plot and catchment scale. The experimental investigation of runoff generation processes at hillslopes and floodplains using various tracer methods and further hydrometric techniques is a focal point. It aims on the estimation of residence times and the mixing of different water compartments. Therefore, the physical properties as well as the hydrochemical and isotopic composition of the water are used, that are defined by different biogeochemical processes and atmospheric forces.

In addition to field base experimental work, the process-oriented catchment modelling and extensive model validations based on different experimental data are main interests. Therefore the TAC-D model (tracer aided catchment model, distributed) is used. In the latest model version, it is a completely distributed, raster-based model and is integrated into a GIS environment. Thus, it is dedicated to utilize remote sensing data. The next step will be to integrate solute transport.

**University of Warsaw, Faculty of Geography and Regional Studies, Division of Hydrology**  
Contact person Prof. M.Gutry-Korycka

The following themes will contribute to NE Friend 5:

U. Somorowska – surface wetness conditions in the lowland catchment evaluated from soil moisture measurements by TDR (Time Domain Reflectometry) method.

M. Lenartowicz – groundwater dynamics and chemistry in forested wetland catchment.

D. Woronko – water circulation of mountain peatland catchment.

A. Afelt – mathematical model of suffosion process (quantity and quality approach).

**Alterra, Department of Water and Environment**, Wageningen, The Netherlands,  
Dr. E. Querner

Future activities will focus in general on the relation between water management and spatial planning. Some concrete activities within this framework are:

- application of SIMGRO model under ArcView shell on river catchments where flood protection measures or water conservation measures are required
- water management in relation to ecosystem restoration

**The Swedish Meteorological and Hydrological Institute**, Norrköping, Sweden  
Ass. Prof. L. Andersson, Lic. G. Lindström, Dr. B. Johansson.

The Swedish team will focus their contribution on the incorporation of  $^{18}\text{O}$  analyses of transit times and flow paths and other internal variables with hydrological models. This work will be combined with assessments of phosphorus flow from an agricultural fields and small agricultural catchments; with nitrogen flow from a small forested catchment; and with silica flow from alpine catchments. In addition to available data from Swedish catchments, we would like to cooperate with European groups with the aim to get a better understanding of links between flow paths and water quality from various landscape elements within different European regions. In addition, we are involved in and would like to cooperate within the fields of combining remote-sensing techniques with hydrological models for snow water equivalent estimates.

## **OUTPUTS**

Participation in organization of ERB conferences where project participants will present their research results will continue (ERB2002, Slovakia, ERB2004, Italy, ...). Since elevated areas are frequently in the centre of our research the results are also expected to be presented at the conference on mountainous hydrology organised at Berchtesgaden, Germany, 2004.

At Krakow meeting, an idea of preparation a runoff generation textbook was born. ALU, TUB, WU and IH SAS took first steps in this activity and the publication should be prepared during the Vth phase of FRIEND.

## **MEETINGS**

The group will meet annually. Workshops regarding specific questions would be organised during the meetings upon interest.