

# HYDROGEOCHEMICAL EXTREMES IN SMALL FOREST TRIBUTARY (RESULTS OF ICP-IM STATION CZ 01 – KOŠETICE)

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## Introduction

The Košetice Observatory of the Czech Hydrometeorological Institute was established as a station specialized in the problems of regional environmental quality monitoring in the year 1988. The Observatory is situated at 49°35' N latitude and 15°05' E longitude. Elevation above sea level is 534 m. The observatory is involved in:

- ICP-IM (International Co-operative Programme on Integrated Monitoring)
- GAW/WMO (Global Atmosphere Watch)
- EMEP/ECE (Co-operative Programme for Monitoring and Evaluation of Long-range Transmission of Air Pollutants in Europe).

The monitoring programme of Košetice Observatory includes meteorology (synoptic measurements according to WMO, climatological observations), solar radiation (total, diffuse and UV-B radiation), air chemistry (sulphur and nitrogen compounds, surface ozone, carbon monoxide, heavy metals, PM<sub>10</sub>, PM<sub>2,5</sub>, methane, VOCs), precipitation chemistry (bulk, wet-only, throughfall), hydrology and surface water chemistry, soil analysis, biological monitoring and POPs monitoring in all compartments of the environment. More detailed information (geographic conditions, monitoring programme, results) is available in (Váňa, Holoubek 2007) or at [www.chmi.cz/uoco/struct/odd/indexe](http://www.chmi.cz/uoco/struct/odd/indexe).

## ICP-IM programme

Hydrological monitoring have been implementing according to the guidelines of International Co-operative Programme on Integrated Monitoring (ICP-IM). The overall aim of ICP-IM was originally to determine and predict the state and change of terrestrial and freshwater ecosystems in a long-term perspective with respect to the impact of air pollutants, especially nitrogen and sulphur. This was to provide one basis for decisions on emission controls and assessment of the ecological impact of such controls within CLRTAP. However the full implementation of the ICP-IM will allow the ecological effects of tropospheric ozone, heavy metals and persistent organic substances to be determined. Implementation of the Programme will provide a major contribution to the international data requirements for examining the ecosystem impacts of climatic change, changes in biodiversity and depletion of stratospheric ozone. A primary concern is the provision of scientific and statistically reliable data that can be used in modelling and decision making. The main emphasis is to establish consistent time series for environmental variables rather than establishing representative surveys across the UNECE region.

The aims are fulfilled by:

- monitoring both biogeochemical trends and biological responses in small (10– 1000 ha) clearly defined areas
  - seeking to separate the noise of natural variation, including succession, from the signal of anthropogenic disturbance by monitoring natural or semi-natural ecosystems
  - developing and applying tools, e.g. models, for regional assessment and prediction of long-term effects.
- Košetice Observatory is involved in ICP-IM programme since 1989.

## Description of the catchment area

Precipitation quality measurements (wet-only and bulk) have been carried out in the monitoring area of the Observatory. Throughfall as well as hydrological and hydrogeochemical measurements are located in small nameless forest monitoring catchment. The small forest brook is 250 m long; the catchment covers 0.285 km<sup>2</sup>; average annual discharge is 0.5 dm<sup>3</sup>·s<sup>-1</sup> and specific runoff 1.75 dm<sup>3</sup>·s<sup>-1</sup>·km<sup>-2</sup>. The bedrock is represented by biotitic and sillimanitic-biotitic paragneiss; acid brown forest soils are from 30 to 100 cm thick. More than 90% of the catchment is forested, largely by spruce (*Picea abies* /L./Karst.).

## Methods

- WET-ONLY – sampling is realized only during precipitation. An open-close collector is automatically opened in the beginning of rain or snow and close after precipitation event. Frequency of sampling is one day. Implemented under EMEP and GAW since 2004.
- BULK – one week continuous sampling to plastic bottles accordance with EMEP and ICP-IM instructions since 1996.
- THROUGHFALL – The same measurement as BULK located under tree crowns. Precipitation samples are taken monthly according ICP-IM methodological guidelines since 1989.
- Hydrological characteristic (discharge, water temperature) are measured by automatic hydrological station. Water level in the channel is measured by ultrasonic battery operated equipment in 5 minutes interval. Checking of the station is done three times a week by manual measurements.

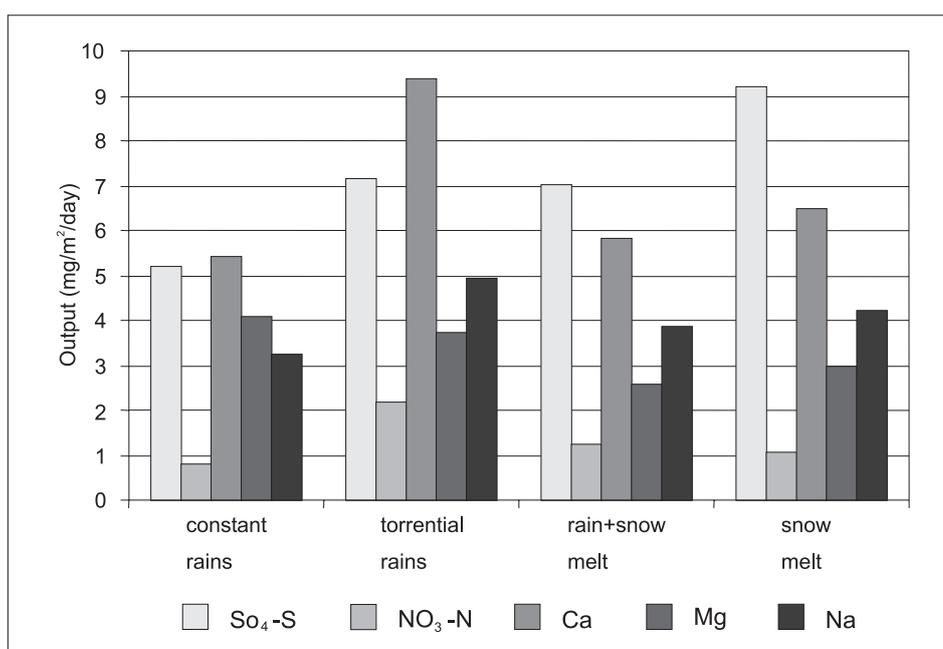


Figure 1. Average runoff during high water episodes (1993-2006)

- Chemical analysis of surface water have been carried out since 1985 in authorised laboratory of Water Research Institute in following scope: pH, conductivity,  $\text{SO}_4^{2-}$ ,  $\text{NO}_3^-$ ,  $\text{NH}_4^+$ ,  $\text{NO}_2^-$ ,  $\text{Ca}^{2+}$ ,  $\text{Na}^+$ ,  $\text{K}^+$ ,  $\text{Mg}^{2+}$ ,  $\text{Fe}^{2+3+}$ ,  $\text{Mn}^{2+}$ ,  $\text{Al}^{3+}$ ,  $\text{Pb}^{2+}$ ,  $\text{Cd}^{2+}$ ,  $\text{Cl}^-$ ,  $\text{SiO}_2$ ,  $\text{PO}_4^{3-}$ ,  $\text{C}_{\text{org}}$  (total and soluble), acidity, alkalinity, hardness (total, transient and permanent). Samples have been taken monthly according to the ICP-IM guidelines.

Hydrological measurement station is enlarged in upper part and enables measurements during extreme flow rates. Besides regularly taken samples also episodes during high water were studied. Events with extreme episodes occurred usually during heavy rains or snow melting. The criterion for episode sampling is not total discharge but relative increase of discharge compared to original state. More than 56 samples in such an extreme situations were taken in the period 1993–2006 (in average 4 samples per year). In general, four basic types of high water situations were found:

- Quit snow melting caused dominantly by rapid air temperature increase (without significant precipitation amounts)
- Quit snow melting caused by significant precipitation amounts
- Constant rains
- Torrential rains

Runoff of substances from the catchment in high water episodes, weighted by discharge values, is presented in Figure 1.

## Conclusions

The results show that:

- the highest runoff of sulphur is observed during snow melt episodes in winter and spring months
- generally, the output of monitored substances by torrential heavy rains is higher than by continuous long-term rainfalls,
- output of sulphur and cation compounds by snow melting episodes is more significant during snow melting events without rain,
- high runoff caused by torrential rains is rich in calcium and natrium,
- differences found in runoff among selected categories were not as significant as expected.

## Reference

Váňa, M., Holoubek, I. *et al.*, 2007: *Košetice Observatory – 20 years*. ČHMÚ, Praha.

