




Ministry of the Environment  
of the Czech Republic


# Experience of the Czech Republic in the Field of Water Management and Natural Hazards





The topic of Water Management, mainly the necessity of a sudden reversal from **flood prevention to drought prevention**, has gained importance during the last years in the Czech Republic. As it has been observed that the problem of drought and water supply is closely linked to Climate Change and Adaptation measures, there was an intersectoral/interdepartmental working group on drought established in the Czech Republic, in order to search for common solutions, preventing landscape from soil erosion, land degradation, and other irreversible changes. Water and soil protection is a very complex global phenomenon and it is also one of current priorities of the Ministry of the Environment.

The Ministry of the Environment and its Specialized Institutions play a crucial role in environmental protection in the Czech Republic and represent a significant source of national and international experience and know-how in the field of Water. We are convinced that only the countries which understand the importance of Water Management may succeed in the future.



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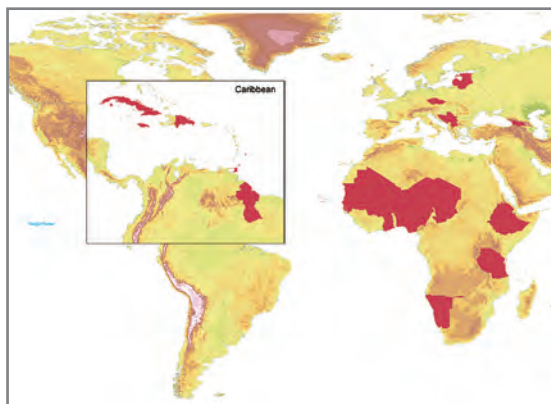


## What Czech institutions offer?

### Czech Hydrometeorological Institute



The Czech Hydrometeorological Institute (CHMI) is a state institution in the field of **air quality, hydrology, water quality, climatology and meteorology** providing services to the state administration, private sector and general public. The CHMI establishes and operates national monitoring and observation networks for monitoring of qualitative and quantitative conditions of the atmosphere, including the ozone layer and the hydrosphere. As such, CHMI **monitors all aspects of water cycle**. Monitoring is done to the extent of the approved monitoring programmes and includes all the basic activities in the operation of the national monitoring networks, data collection and primary processing, database management, and provision of **forecasts and warnings** as well as **operational and regime information** in relation to, for example, **assessment of flood and drought risks and hazards**. In respect to **water quality**, the CHMI is responsible for the situational and operating monitoring of the chemical pollution of surface water and groundwater. Similarly, information about air pollution levels for governmental and municipal institutions and also for public is provided by the CHMI through its air quality information system. The CHMI can provide **expertise for the operation and maintenance of the national monitoring networks** in its fields of responsibility.



Locations of CLIDATA installation



CLIDATA training in Tanzania



Accumulation of the large woody debris in a natural stream

Climatological database (**CLIDATA**) developed by the CHMI is currently being used **in 36 countries on 4 continents**, and the regular trainings are taking place in the Czech Republic and abroad. See: <http://www.clidata.cz/en/introduction>.

CHMI has long tradition in monitoring of the ozone layer (since 1961). Solar and Ozone Observatory of CHMI serves as a secondary European calibration centre for Dobson spectrophotometers (cooperation with observatory at Hohenpeissenberg, Germany) and as sub regional calibration centre for Brewer spectrophotometers (cooperation with International Ozone Services, Canada). CHMI experts take regularly part in Brewer and Dobson calibration campaigns worldwide and also have **developed software for the processing of ozone measurements**.

Considering the ongoing climate change CHMI is also very active in the field of agricultural meteorology. The drought monitoring system based on the operational data was developed **to evaluate the water balance and soil water conditions** and is widely used by government and other state and research institutions. CHMI experts have also participated in scientific projects focused on research on soil water balance, water and wind erosion and soil degradation.

CHMI experts have developed an original approach of the data quality control, homogenization and gridding. Using its own software is CHMI able to produce high quality long-term time series of meteorological elements without errors, inhomogeneity and missing values for meteorological and climatological stations or arbitrary location and interpolate these data in daily or sub daily step. See: <http://www.climahom.eu/>.



## Czech Geological Survey (CGS)



The Czech Geological Survey (CGS) is a state organization that compiles, stores, interprets and provides expert geological information for the state administration, the private sector and the public both in the Czech Republic and overseas.

The CGS is responsible for providing the state geological survey in the Czech Republic and it is the only institution with the mission to systematically investigate geoscientific characteristics of the whole territory of the Czech Republic. CGS also participates in a number of interdisciplinary research projects and within the Czech Development Assistance Program CGS has carried out a number of projects in Africa, Asia and Central America.

The main fields of expertise include:

- Geological research and mapping
- Groundwater resources
- Applied geology and natural hazards
- Mineral resources and mining impact assessment
- Geochemistry and environmental studies

Detachment zone of a landslide from the Erzgebirge Mts.  
into the CSA lignite open pit mine



CGS is one of the Czech leading institutions in the field of **hydrogeological research and natural hazards**.

CGS has recently realised a major project focused on re-assessment of groundwater resources over approximately one third of the territory of the Czech Republic (2010–2015). The project included a study of human activities impact on groundwater resources and sustainability study. Using the advanced geological, conceptual hydrogeological and transient groundwater flow mathematical models, the optimum conditions for exploitation and protection of groundwater resources were defined. The methodology for future periodical evaluation of groundwater resources was also developed as one of the project outputs.

In the period from 2007 to 2010, the Czech Geological Survey, in cooperation with Aquatest Ltd, undertook a project in Northern Peru that was designed to assess the vulnerability of the central and low catchments of the Piura and Chira rivers drainages to natural hazards. This project followed the assessment of natural hazards in the central and upper catchments of these rivers that was undertaken



Sample collection from a tailing pond at Zlaté Hory



In 2013 a massive landslide destroyed D8 motorway under construction



by Czech geologists during 2003–2006. The occurrence of natural disasters in the Piura Region is mainly connected with the El Niño phenomenon and involves in particular floods, sediment accumulation, soil erosion and salinization. A further task was to evaluate the hydrogeological situation of the region, propose procedures leading to more efficient usage of existing groundwater resources and to find new resources. A geo-morphological map, a map of natural hazards and a map of engineering-geological zones were compiled on the basis of an analysis of satellite images. The hydrogeological part of the project was based on the studies of archive data, field documentation and mathematical modelling. The main outputs are a hydrogeological scheme of the area, a map of surface water and groundwater quality and an evaluation of groundwater reserves. The results of this project enabled improved land-use planning, use of natural resources and protection of an area from natural hazards.

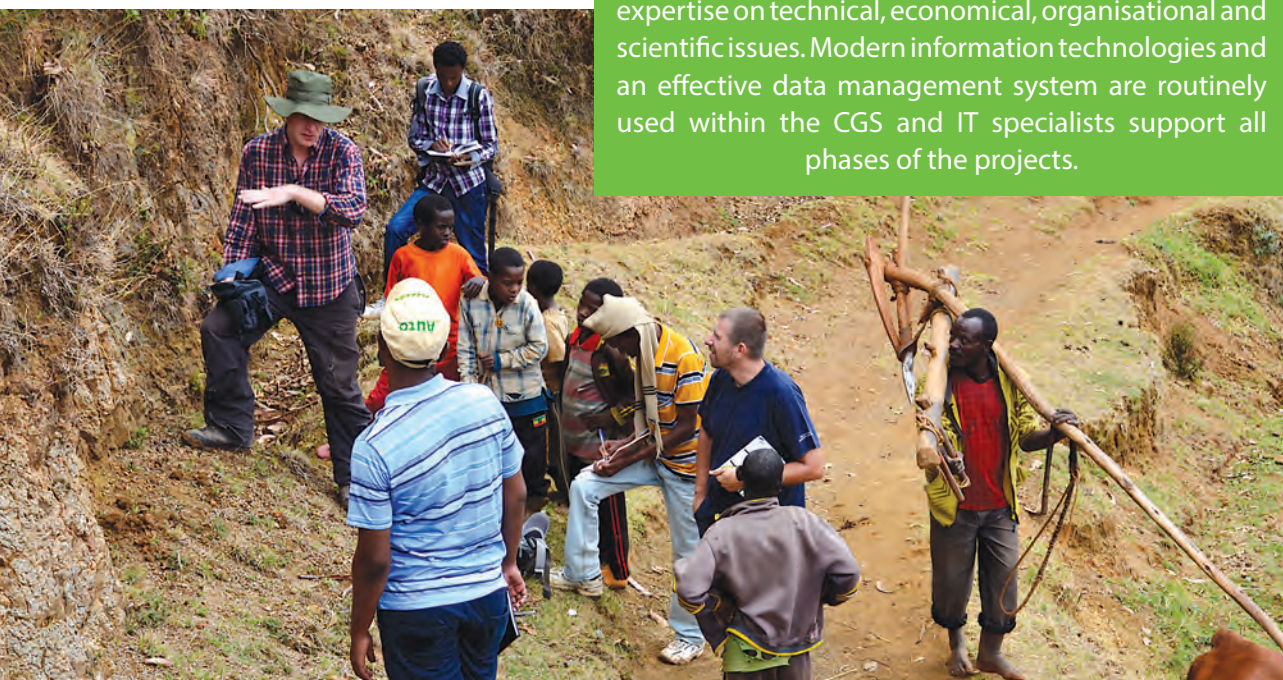
CGS participated in the project “Capacity Building in the Field of Engineering Geology and Hydrogeology in Ethiopia”. The mapped area covered 184,752 km<sup>2</sup>, with 9,150,932 inhabitants and is part of the Wabe Shebelle and Genale-Dawa river basins (Eastern Ethiopia). Surface water resources were assessed as being 37,310 Mm<sup>3</sup>/year and renewable groundwater resources 7,247 Mm<sup>3</sup>/year. A Water Management Plan for water resource development was defined together with 104 sites selected for drilling of new wells.



CGS also participated in the project entitled “Capacity Building in the Field of the Environmental Geology and Hydrogeology in Ethiopia – Georisk mapping including mapping of hydrogeological conditions on the Dila and Hossaina sheets, Ethiopia” covering an area of approximately 80,000 km<sup>2</sup> of the central part of the Ethiopian Rift Valley and its surroundings. The principal objective of the project was special training of local experts and creation of conditions for the transfer of Czech experience and knowledge in the fields of engineering geology, geohazards and compilation of hydrogeological maps. The transfer of know-how was applied in practice to the compilation of 4 sheets of the hydrogeological and hydrochemical maps (Asela, Dolo, Dila and Hosaina) in the scale of 1:250 000.

In the years 1997–2009, the Czech Geological Survey implemented several projects of Development Cooperation in Central America (Nicaragua, El Salvador, Costa Rica). Several subsequent projects were focused on research of natural hazards resulting from supra-subduction geological settings as well as landslides triggered by catastrophic climatic events such as heavy rains during hurricanes or tropical storms. The outcomes of this cooperation including methodologies and a large number of new data were provided for the local partner organisation and state authorities for practical application.

CGS provides comprehensive, impartial and up-to-date expertise on technical, economical, organisational and scientific issues. Modern information technologies and an effective data management system are routinely used within the CGS and IT specialists support all phases of the projects.



Practical training in field logging of volcanic rocks in Ethiopia



## T. G. Masaryk Water Research Institute



The main objectives of the Institute include complex research topics of all aspects of water management of surface and rain waters, groundwater, waste waters, aquatic ecosystems and their relations to landscape and to environmental risks, and also waste and packaging management, technical support of water protection, prevention of flood risks and adaptation measures for drought seasons. The Institute has modern facilities of chemical and microbiological reference laboratories; the radiology lab is

at the forefront of the Czech Republic, it ensures operation of the radiation monitoring network in the whole Czech Republic.

Examples of problem issues solved currently:

### Flood management

One of the main topics on which the Institute is focused, are **flood risks, analyses of flood consequences, and proposals of protective measures**. In particular, the activities of the Institute in the field of flood



Constructed wetland



Stabilization pond



management include systematic preparation of conceptual and strategic documents, development of methodological tools for identification and evaluation of flood hazard and flood risk, and participation on real flood events assessment. Special attention is paid to flood protection measures in urban areas, international cooperation.

#### **Waste management, waste water treatment**

In the field of waste management the Institute is focused on research on prevention and **minimization of waste quantity** and its assessment, research focused on sewage treatment plants, evaluation of existing technologies and development of new methods in order to increase the efficiency of substance removal from waste water, and **research focused on comprehensive technologies for waste water treatment** (stabilization ponds, bio-filters, irrigation by wastewater, removing of specific organic matters etc.).

#### **Sustainable use of water resources under conditions of climate change**

The project aims at evaluating future groundwater and surface water resources and likely development



Hydraulic model

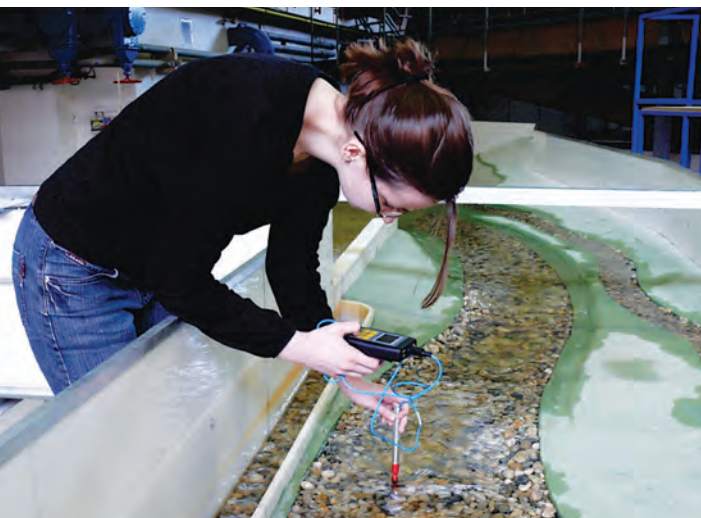


of the **water balance conditions affected by the ongoing climate change**. The approaches currently recommended for assessments of future water balance conditions do not match current conditions, which are already affected by climate change, both drought and floods. New software tools are therefore being developed, particularly for addressing the links between hydrological water balance components and water management components of surface water and groundwater, and for simulation of future water resources.

### **Strategy for managing emergency situations induced by drought and water scarcity**

The objective is to develop methods for managing emergency situations that can occur consequently to the occurrence of drought. It should include also a proposal for relevant legal framework, similarly to that, which has already been adopted for protection against floods. This includes **setting up degrees of drought** (equivalent to degrees of flood protection activities) by using knowledge on drought indicators and knowledge of water management authorities, state institutions and enterprises involved in problems concerning water resources and water demands, particularly during dry periods. In addition





Speed of river  
flow measuring



Evaluation of water quality

to defining the degrees of drought, the output should propose necessary powers of the state and regional authorities in water management and priorities for the use of water during dry periods. Necessary **measures for eliminating risks from the effects of extreme dry conditions** in sectors of water management, agriculture and forestry, including impacts on water quality are proposed. Specific attention is paid to the study of minimum residual flows in rivers and streams, and also to water balance assessment in water bodies and water resources (based on numerical hydrological models)

#### **Assessment of hydraulic structures on rivers**

Hydraulic research is concentrated on assessment of new hydraulic structures (weirs, dams, waterways, fish ways, water power stations etc.).

**Physical models are built in suitable scale** and the research is conducted in large hydraulic laboratories. Hydraulic research is highly efficient and significantly reduces the financial cost of the planned construction. Part of the hydraulic research is also represented by **mathematical modeling** which is focused on determination of flood plain area, flood risk mapping, water quality in open channels, and evaluation of potential flood damages in urban areas using 1, 2 or even 3D modeling tools.

#### **Groundwater and surface water use and protection, artificial recharge**

The Institute focuses its activities also on the **quantity and quality of groundwater and surface water** and their protection, on



Monitoring quantity and quality of groundwater and surface water

Noble crayfish (*Asterastacus astacus*) in an unaffected river

contaminated sites and their survey, monitoring and evaluation, on the risk assessment process. It is deeply interested in diffuse **pollution sources from agriculture** and the designation of nitrate vulnerable zones. A new intensive research deals with **specific organic compounds in natural and drinking waters** (PPCP, pesticides etc.). It has great experience with enrichment of groundwater resources for drinking water purposes, through **artificial groundwater recharge** methods.

### Monitoring of water and environment

The Institute is engaged in special targeted monitoring of surface waters, groundwater and wastewater, both in terms of quantity and quality. It monitors impacts of nuclear power plants in the Czech Republic on the surrounding environment and waters, anthropogenic impacts on drinking water resources (e.g. for Prague) etc. The institute also participates in the data interpretation from



Fish sampling (electrofishing) in the Berounka River





national monitoring network of surface water and groundwater, operated by CHMI; the extent of the monitoring network throughout the Czech Republic is large, e.g. one monitoring object of groundwater covers an area 30–50 km<sup>2</sup>.

### **Collaboration with China Atomic Energy Authority (CAEA)**

In the past three years a significant cooperation with China Atomic Energy Authority has taken place. Knowledge and technology transfer focused on monitoring for environmental impacts of activities related to mining and processing of uranium. Methodological approaches and technical implementation of monitoring systems around the tailing ponds of uranium industry were widely presented and discussed with Chinese experts, also at professional meetings and workshops in China. All necessary aspects of monitoring network were dealt with, starting with stability of slopes and embankments, through quantity and quality of leachate and surrounding surface water and groundwater, and finished by radiological monitoring of the atmosphere, soil and crops, drinking water and the population in the area. The project also included methodical approaches for removing environmental accidents and environmental contamination caused by radionuclides and other harmful chemical pollutants.

### **Research in applied ecology**

Research works focus on relationships among different levels of biological structures of aquatic ecosystems (in terms of individuals, populations and communities). Observations include substances contained in water affecting on water organisms, analyses of conflicts between natural ecosystems and anthropogenic impacts (water use, water contamination and other impacts). The project to rescue crayfish belongs to most interesting topics.





LC Agilent 1200 device with an auto-sampler Gilson and a MSD AB SCIEX 4000 Q Trap detector



Testing Laboratory for Water Management Installations



## What Czech business sector offers?

Not only Czech State Institutions, but also number of private companies are experienced in research activities and development in the area of floods, drought and sewage treatment technologies and sewage treatment plant construction. Lots of international projects in these fields were carried out even with the support of Ministry of the Environment.

As an example we can mention projects in central Asia focusing on **strengthening readiness for extremely variations of weather and flood prevention measures**. This project helped to enlarge and update meteorological and hydrological monitoring networks of National Environmental Agency of Georgia. The transfer of know-how of Czech Hydrometeorological Institute was much appreciated, especially the collected data processing. The project led to improvement of meteorological and hydrological threats in the country and helped to reduce negative impacts of floods.

Another example is **monitoring of alpine glacial lakes and protection of the population against disastrous consequences of floods caused by breaks of moraine dams**. In connection with global warming of the atmosphere of Earth there occur significant changes in the glacial cover of alpine areas. In consequence of glacier wastage, numerous lakes are formed, that are dammed by not very resistant moraine dams. In a certain phase of development of the lake there may occur a landslides or a dam break with the disastrous consequences for the population in the valley below the lake. The project helped to introduce modern methods of investigation, the process of long-term monitoring and effective warning system.

Successful projects dedicated to **risk disasters and prevention of landslides** were implemented in Latin America e.g. in specific regions in Peru which are most endangered by natural disasters. The high vulnerability of this area is caused not only by its geological, geographical and climatic conditions, but also by the limited ability to predict natural hazards and to face their consequences. This project included methodology of geomorphological, geological and hydrogeological research and was focused on evaluation and prediction of geological risks and water-supply planning.

The Czech Republic is open to future cooperation and ready to share its experience from national and international activities in these fields.





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T. G. Masaryk  
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