

## **Report of the Czech National Committee for Hydrology (CNCH) on UNESCO IHP related activities (May 2018)**

### **1. ACTIVITIES UNDERTAKEN IN THE PERIOD JUNE 2016 – MAY 2018**

#### **1.1 Meetings of the CNCH**

##### 1.1.1 Decisions regarding the composition of the CNCH

Although no session was officially held in the period of report, the CNCH members preserved their connection during various other (e.g. university) sessions, conferences (workshops), or electronic communication. Furthermore, several groups of members worked together under the umbrella of the same institute or the institutes that closely cooperate.

On 1<sup>st</sup> June 2017, a substantial change occurred regarding the Statute of the CNCH. Namely, the CNCH reflected the request of the Ministry of Environment stated in the letter sent to the CNCH Secretariat in March 2016. After some negotiations with vice-chairmen and other representatives, the CNCH became an advisory body of the director of the Czech Hydrometeorological Institute (CHMI), which was in accordance with the current situation in the Czech Republic.

In February 2018, Dr. Eva Soukalová was retired from the CHMI, but she still cooperates with the CNCH. Also, in autumn 2017 Prof. Pavel Kovář, a vice-chairman of the CHNC, announced his will to be retired from the Czech University of Life Sciences in Prague, and recommended As. Prof. Martin Hanel to take his place. In December 2016, Dr. Josef Hladný passed away and the CNCH unfortunately lost a very important long-term coworker and friend.

From the abovementioned facts, it is clear that some changes and further negotiation are needed in the near future regarding the composition of the CNCH.

However, it still applies that the CNCH has its traditional connections to:

- Czech National Committee of Geodesy and Geophysics,
- Czech National Committee for Disaster Reduction (CNC DR),
- Czech Committee of the International Commission on Irrigation and Drainage,
- Czech National Committee for the UNESCO Programme on Man and the Biosphere,
- Czech National Committee for IGCP (International Geoscience Programme),
- Czech National Committee for Cooperation with IOC.

The relationships with the IAHS scientific committees, mediated through a vice-chairman and several national correspondents, remain the same as well. Despite no success concerning the post of the correspondent for the Panta Rhei scientific decade, the Czech hydrologists deal with the topic of socio-hydrology anyway.

Additionally, each of the members of the CNCH maintains his/her own relationships closely linked to his/her professional specialization.

#### 1.1.2 Status of IHP-VIII activities

It still applies that there are experts prepared to participate in focal areas 1.1, 1.4, 1.5, 6.3 (Dr. Jan Daňhelka), 1.3 (Dr. Ondřej Ledvinka), 2.4 (Dr. Vít Kodeš), 5.1, 5.2 (Mr. Šimon Bercha) and 6.2 (Mr. Libor Ducháček). They are also highly interested in activities related to the following associated programmes: FRIEND-Water, International Drought Initiative (IDI) and International Flood Initiative (IFI).

In December 2016, the chairman and the scientific secretary of the CNCH visited Rome, Italy where the 15<sup>th</sup> session of the WMO Commission for Hydrology (CHy) took place. The CNCH representatives, where the chairman is at the same time a member of the CHy Advisory Working Group, pointed out the need for seasonal forecasting. Then in May 2017, the chairman visited Cancún, Mexico where he dealt with the Multi-Hazard Early Warning Systems under the Global Platform for Disaster Risk Reduction. These two WMO meetings were perfectly in line with IHP Theme 1.

In April 2017, the scientific secretary visited Budapest, Hungary due to the initiation of the project called 'DAREFFORT'. Although this meeting was not directly related to the Regional Cooperation of the Danube Countries, its several representatives were present there, while they dealt with the possible improvement in the international cooperation in the regional flood and river ice forecasting and warning systems. Also, the sharing of data and warnings among various Danube countries were addressed. The hydrologists from the Brno Regional Office of the CHMI are ready to cooperate as an associated partner in the case of the success of the project proposal.

During the XXVII Conference of the Danubian Countries held in Golden Sands near Varna, Bulgaria at the end of September 2017, there was a side meeting of the representatives of IHP Electoral Group II (and other, invited representatives of national committees focusing on the Danube River basin) held in order to come up with the topics that should be addressed within the region in the future. The scientific secretary of the CNCH highlighted the importance of the historical records in hydrological science. Certainly, they should be saved (and carefully stored in databases) so as to allow a better understanding of the processes in hydrology. The practices of saving the data should be shared throughout the region. Yet, another side meeting aiming to improve the flood forecasting systems within the region occurred in Golden Sands where a closely related worker from the CHMI represented the Czech hydrology. These activities were undoubtedly associated with IHP Themes 1 and 6.

The scientific secretary of the CNCH visited several conferences focused on university students in Slovakia (Novembers 2016 and 2017) and Poland (Aprils 2017 and 2018) where the students were given his advice. This was in accordance with IHP Theme 6.

Last but not least, there were several meetings in the reporting period where the scientific secretary of the CNCH and the chairman of the Slovak

Committee for Hydrology (SCH) could discuss several issues, including the evaluation of the large-scale hydrological drought that hit not only their countries. In fact, IPH Theme 3 underpins this need, but it would have been done anyway due to the current situation in Europe as such.

## **1.2 Activities of the CNCH at national level**

### **1.2.1 National scientific and technical meetings**

Due to the situation in the Czech Republic and elsewhere in Europe, notably the long-term drought occurrence, the hydrologists from the CNCH organized or co-organized several seminars devoted to addressing the water scarcity and other related risks. Especially, there were several seminars co-organized with the CNC DR (e.g. December 2016, May 2017 and April 2018) in Prague. Also, there were other societies organizing this type of seminars (e.g. in October 2016 which aimed at water quality as well). At the end of the reporting period (i.e. May 2018), the chairman of the CNCH organized, as an expert, a seminar dedicated to the evaluation of the dry period 2015–2017 in the Czech Republic.

A CNCH member organizes the conferences called 'Adolf Patera Workshop'. This time, only one of them took place in Prague (i.e. at the end of 2016). The next one is expected to be held by the end of 2018.

In late summers 2016 and 2017, international conferences focusing on modelling in environmental sciences called 'World Multidisciplinary Earth Sciences Symposia (WMESS)' took place in Prague. A member of the CNCH and his student presented there the use of artificial intelligence in relation to the management of water reservoirs.

Generally, after the 15<sup>th</sup> session of the WHO CHy, where also a special meeting with experts showing the potential of satellite imagery exploitation in hydrology took place, some of the CNCH members focus further on this topic. For instance, the scientific secretary of the CNCH usually visits the so-called user fora that are supported by the European Space Agency (ESA) and Czech ministries. There are also members of the CNCH who have dealt with this topic before. For example, in July 2016, the International Society for Photogrammetry and Remote Sensing organized a conference in Prague where the CNCH members and their students had their presentations.

### **1.2.2 Participation in IHP Steering Committees/Working Groups**

Between 31<sup>st</sup> August and 1<sup>st</sup> September 2017, there was another 'ERB Workshop and Steering Committee' held in Sopron, Hungary. Although the vice-chairman who traditionally visits these meetings cannot be present there, he participated at least in the communication preceding and following the meeting.

### **1.2.3 Supported or sponsored projects**

The Czech Republic did not support or sponsored projects during the period of report.

#### 1.2.4 Collaboration with other national and international organizations, programmes and committees

In December 2016, the abovementioned 15<sup>th</sup> session of the WMO CHy took place in Rome, Italy. Other connections to WMO activities were mediated through the CNCH chairman.

Due to his expertise, there is a very close relationship between the CNCH scientific secretary and the IAHS International Commission on Statistical Hydrology (ICSH). The secretary also attended two workshops of this scientific committee in the reporting period (in September 2016 in Quebec City, Canada, and in September 2017 in Warsaw, Poland).

The cooperation with the SCH is traditional. The scientific secretary of the CNCH served as a co-organizer for the Czech side regarding the 'Conference of Young Experts', and also was a member of the evaluation committee at the section dedicated to young hydrologists in Novembers 2016 and 2017. He reviewed several papers for the conference and gave his advice to the students as well as to the organizers. In November 2017, the secretary visited a meeting (called 'International Poster Day') of hydrologist dealing with the interaction 'soil-plant-atmosphere', which was beneficial because this meeting traditionally takes place in Bratislava at the Slovak Academy of Sciences. The secretary discussed several topics with the SCH chairman there.

The CNCH together with the members of the Austrian NC (and other European NCs) intensively cooperated in the preparation of the manuscript of the influential (and well-cited) paper about changing climate and its impacts on the timing of floods throughout Europe. The final version of the paper was published in 'Science' in August 2017 (see Section 1.5).

Some of the national correspondents served as members of scientific committees as regards other local conferences or seminars (e.g. 'Snow Meetings' in the Czech Republic and Slovakia). The CHMI published valuable proceedings related to the 'Snow Meeting' held in the Czech Republic in March 2018.

Some of the members of the CNCH were parts of scientific committees as regards the conferences organized by the Czech Bioclimatological Society. In 2016, a member of the CNCH was a guest editor of the special issue of the journal 'European Countryside' where topics related to the role of water in agriculture and rural areas were preferred.

As announced in the previous report, closer relationship was established with the CNC DR. The scientific secretary of the CNCH became a member of that committee and, moreover, many members of the CNCH participated in the programme of the seminars organized by the CNC DR.

#### 1.2.5 Other initiatives

The CNCH still successfully maintains its website (<http://cnvh.cz/>). Although a number of meetings, seminars/workshops, conferences, etc., are organized in the Czech Republic and abroad, the CHCH tries to carefully select the substantial information and upload it to the website in order to have the Czech hydrological community informed about the

UNESCO, IAHS and WMO water-related activities. In spring 2017, also the set of freely available time series of mean daily discharge at ten water-gauging stations were updated in order to have the year 2016 included as well. Now, the scientists, researchers and students who need these data can also cite two papers authored and coauthored by the scientific secretary of the CNCH (see Section 1.5). Not only the features of hydrological series but also the features of climatological series are addressed in the papers.

Dr. Eva Soukalová was awarded the A. R. Harlacher Prize in February 2018 on the occasion of her retirement during a seminar at the CHMI Brno Regional Office.

Two regional floods (1997 in Moravia and 2002 in Bohemia) were commemorated in 2017 and, therefore, corresponding seminars were held in Prague and Brno. Furthermore, the chairman of the CNCH coauthored a paper considering these two important floods in the Czech Republic.

The dry period that started in 2015 (and has continued further) called for the establishment of several online portals devoted to the monitoring (and forecasting) of drought in the Czech Republic. The chairman of the CNCH founded the website called the 'State of Drought' ('Stav sucha'; <http://stavsucha.cz/>). Furthermore, the members and correspondents of the CNCH are actively interested in combating the drought gradually implemented in national strategies.

### **1.3 Educational and training courses**

#### **1.3.1 Contribution to IHP courses**

The CNCH did not contribute to IHP courses during the reporting period.

#### **1.3.2 Organization of specific courses**

The CNCH was not involved in the organization of specific courses during the reporting period.

#### **1.3.3 Participation in IHP courses**

The CNCH did not receive any reports that Czech experts participated in international IHP courses in the past two years.

### **1.4 Cooperation with international/regional water centres under the auspices of UNESCO**

The leader of the working group focusing on the education in hydrology in the Czech Republic (and a vice-chairman of the CNCH) still observes the activities of the UNESCO-IHE institute. He plans to be retired from the Czech University of Life Sciences and, in the near future, his successor needs to be found. With high probability, As. Prof. Martin Hanel from the same university will take the place.

It still applies that the CNCH expresses its interest in the activities of UNESCO category-2 water-related centres (e.g. ecohydrology in Poland,

natural disasters reduction in Japan, groundwater and drought in the Netherlands, and climate change in Serbia).

Especially, the relationship with the Japanese ICHARM centre is very intense now. During July 2016, several personal meetings occurred in Prague with one of their representatives. Then, several online meetings (via Skype) occurred as well. The researchers from ICHARM have a strong interest in dealing with the extremes in hydrological cycle in the Czech Republic, which was confirmed at the 15<sup>th</sup> session of the WMO CHy, where also other representatives of ICHARM were present. So far, the cooperation resulted in a poster presentation informing about the initiation of the research that was presented during the European Geosciences Union General Assembly 2017 in Vienna, Austria.

## 1.5 Publications

Mainly, the prolonged occurrence of drought in the territory of the Czech Republic steered the attention of the CNCH hydrologists towards addressing drought phenomena in the basins of mean European rivers such as the Elbe and the Danube in the publications. Also, the issue of groundwater shortage was in the focus. A key publication stemming from the international cooperation (i.e. International Commission for the Protection of the Elbe River) in this area came into being where also the scientific secretary of the CNCH contributed with his statistical expertise. However, this publication was written only in Czech and German.

In 2017, the 70<sup>th</sup> anniversary of the Czech hydrometeorological journal called 'Meteorological Bulletin' ('Meteorologické Zprávy') and the time taken from the occurrence of the two most important recent regional floods in the Czech Republic called for the contribution of the chairman of the CNCH to this journal. He commemorated the floods in Moravia (1997) and Bohemia (2002) and, as well, aimed at the history of the study of hydrological cycle (similarly as in the case of another Czech journal dealing with mountainous areas). Also, in 2017, the scientific secretary of the CNCH started contributing to this journal with his short informative papers about the international cooperation involving the CHMI hydrologists, summarizing their activities in every previous year. These papers are, however, written only in Czech.

Probably the most relevant contributions (from the UNESCO IHP point of view) are the contributions of Czech hydrologists to the proceedings related to the XXVII Conference of the Danubian Countries held in Golden Sands, Bulgaria in September 2017. One of them was coauthored by the CNCH scientific secretary. This paper, although not peer-reviewed, was added to the following list of the contributions of the CNCH members, as well as the correspondents, to various journals, books and conference proceedings. The list predominantly includes the entries taken from the Scopus database corresponding to the period June 2016 – May 2018:

Augustinková, L., Fárek, V., Klepek, J., Krakovská, A., Neruda, M., Ponížilová, I., Strachota, M., Šrejber, J., **Unucka, J.**, Voženílek, V., Winkler, I., Židek, D., 2017. Utilization of the geoinformatics and mathematical modelling tools for the analyses of importance and risks of the historic water works, in: Ivan, I., Singleton, A., Horák, J., Inspektor,

T. (Eds.), *The Rise of Big Spatial Data*. Springer International Publishing, Cham, pp. 289–306. [https://doi.org/10.1007/978-3-319-45123-7\\_21](https://doi.org/10.1007/978-3-319-45123-7_21)

Bačínová, H., **Kovář, P.**, 2017. Impact of overland flow on soil characteristics in Třebsín experimental plots. *Soil and Water Research* 12, 187–193. <https://doi.org/10.17221/133/2016-SWR>

Beran, A., **Hanel, M.**, Nesládková, M., **Vizina, A.**, 2016. Increasing water resources availability under climate change. *Procedia Engineering* 162, 448–454. <https://doi.org/10.1016/j.proeng.2016.11.087>

Beranová, R., Kyselý, J., **Hanel, M.**, 2018. Characteristics of sub-daily precipitation extremes in observed data and regional climate model simulations. *Theoretical and Applied Climatology* 132, 515–527. <https://doi.org/10.1007/s00704-017-2102-0>

**Blazkova, S.D.**, Blazek, V.D., Jansky, B., 2017. Continuous simulation for computing design hydrographs for water structures. *Hydrological Processes* 31, 2320–2329. <https://doi.org/10.1002/hyp.11204>

Blöschl, G., Hall, J., Parajka, J., Perdigão, R.A.P., Merz, B., Arheimer, B., Aronica, G.T., Bilbashi, A., Bonacci, O., Borga, M., Čanjevac, I., Castellarin, A., Chirico, G.B., Claps, P., Fiala, K., Frolova, N., Gorbachova, L., Gül, A., Hannaford, J., Harrigan, S., Kireeva, M., Kiss, A., Kjeldsen, T.R., Kohnová, S., Koskela, J.J., **Ledvinka, O.**, Macdonald, N., Mavrova-Guirguinova, M., Mediero, L., Merz, R., Molnar, P., Montanari, A., Murphy, C., Osuch, M., Ovcharuk, V., Radevski, I., Rogger, M., Salinas, J.L., Sauguet, E., Šraj, M., Szolgay, J., Viglione, A., Volpi, E., Wilson, D., Zaimi, K., Živković, N., 2017. Changing climate shifts timing of European floods. *Science* 357, 588–590. <https://doi.org/10.1126/science.aan2506>

Broucek, M., **Fosumpaur, P.**, Kralik, M., Zupal, M., 2016. Methodology of historical dam safety improving, in: Sojkova, K., Tywoniak, J., Lupisek, A., Hajek, P. (Eds.), *CESB 2016 - Central Europe Towards Sustainable Building 2016: Innovations for Sustainable Future 2016*. Grada Publishing, Praha, pp. 72–77.

Dohnal, M., **Vogel, T.**, Dusek, J., Votrubova, J., **Tesar, M.**, 2016. Interpretation of ponded infiltration data using numerical experiments. *Journal of Hydrology and Hydromechanics* 64. <https://doi.org/10.1515/johh-2016-0020>

Dusek, J., **Vogel, T.**, Dohnal, M., Barth, J.A.C., **Sanda, M.**, Marx, A., Jankovec, J., 2017. Dynamics of dissolved organic carbon in hillslope discharge: modeling and challenges. *Journal of Hydrology* 546, 309–325. <https://doi.org/10.1016/j.jhydrol.2016.12.054>

Fedorová, D., Bačínová, H., **Kovář, P.**, 2017. Use of terraces to reduce overland flow and soil erosion, comparison of the HEC-HMS model and the KINFIL model application. *Soil and Water Research* 12, 195–201. <https://doi.org/10.17221/160/2016-SWR>

Fick, J., Brodin, T., Heynen, M., Klaminder, J., Jonsson, M., Grabicova, K., Randak, T., Grabic, R., **Kodes, V.**, Slobodnik, J., Sweetman, A., Earnshaw, M., Barra Caracciolo, A., Lettieri, T., Loos, R., 2017. Screening of benzodiazepines in thirty European rivers. *Chemosphere* 176, 324–332. <https://doi.org/10.1016/j.chemosphere.2017.02.126>

Gregar, J., **Kovář, P.**, Bačínová, H., Bažatová, T., 2017. Comparison of water regimes of two dump catchments in the Krušné hory Mts. (Czech Republic) in dry years using a hydrological balance. *Soil and Water Research* 12, 137–143. <https://doi.org/10.17221/97/2016-SWR>

**Hanel, M.**, Kožín, R., Heřmanovský, M., Roub, R., 2017. An R package for assessment of statistical downscaling methods for hydrological climate change impact studies. *Environmental Modelling & Software* 95, 22–28. <https://doi.org/10.1016/j.envsoft.2017.03.036>

**Hanel, M.**, Máca, P., Bašta, P., Vlnas, R., Pech, P., 2016. The rainfall erosivity factor in the Czech Republic and its uncertainty. *Hydrology and Earth System Sciences* 20, 4307–4322. <https://doi.org/10.5194/hess-20-4307-2016>

Heřmanovský, M., Havlíček, V., **Hanel, M.**, Pech, P., 2017. Regionalization of runoff models derived by genetic programming. *Journal of Hydrology* 547, 544–556. <https://doi.org/10.1016/j.jhydrol.2017.02.018>

Hnilica, J., **Hanel, M.**, Puš, V., 2017. Multisite bias correction of precipitation data from regional climate models. *International Journal of Climatology* 37, 2934–2946. <https://doi.org/10.1002/joc.4890>

Hvězdová, M., Kosubová, P., Košíková, M., Scherr, K.E., Šimek, Z., **Brodský, L.**, Šudoma, M., Škulcová, L., Sáňka, M., Svobodová, M., Krkošková, L., Vašíčková, J., Neuwirthová, N., Bielská, L., Hofman, J., 2018. Currently and recently used pesticides in Central European arable soils. *Science of The Total Environment* 613–614, 361–370. <https://doi.org/10.1016/j.scitotenv.2017.09.049>

Jankovec, J., Vitvar, T., **Šanda, M.**, Matsumoto, T., Han, L.-F., 2017. Groundwater recharge and residence times evaluated by isotopes of hydrogen and oxygen, noble gases and CFCs in a mountain catchment in the Jizera Mts., northern Czech Republic. *Geochemical Journal* 51, 423–437. <https://doi.org/10.2343/geochemj.2.0469>

Juras, R., Pavlásek, J., Vitvar, T., **Šanda, M.**, Holub, J., Jankovec, J., Linda, M., 2016. Isotopic tracing of the outflow during artificial rain-on-snow event. *Journal of Hydrology* 541, 1145–1154. <https://doi.org/10.1016/j.jhydrol.2016.08.018>

Kändler, M., Blechinger, K., Seidler, C., Pavlů, V., **Šanda, M.**, Dostál, T., Krása, J., Vitvar, T., Štich, M., 2017. Impact of land use on water quality in the upper Nisa catchment in the Czech Republic and in Germany. *Science of The Total Environment* 586, 1316–1325. <https://doi.org/10.1016/j.scitotenv.2016.10.221>

Kořínek, J., Nekardová, O., **Kovář, P.**, 2016. The influence of woven geotextiles on ponding time and overland flow. *Soil and Water Research* 11, 244–249. <https://doi.org/10.17221/4/2016-SWR>

**Kovář, P.**, Bačinová, H., Loula, J., Fedorova, D., 2016. Use of terraces to mitigate the impacts of overland flow and erosion on a catchment. *Plant, Soil and Environment* 62, 171–177. <https://doi.org/10.17221/786/2015-PSE>

**Kovar, P.**, Peskova, J., Dolezal, F., Bacinova, H., Krovak, F., Mihalikova, M., 2017. Evapotranspiration impact on diurnal discharges in a small catchment. *Journal of Hydrologic Engineering* 22, 05017015. [https://doi.org/10.1061/\(ASCE\)HE.1943-5584.0001545](https://doi.org/10.1061/(ASCE)HE.1943-5584.0001545)

Kozel, T., **Stary, M.**, 2017. Hybrid stochastic forecasting model for management of large open water reservoir with storage function. *IOP Conference Series: Earth and Environmental Science* 95, 022003. <https://doi.org/10.1088/1755-1315/95/2/022003>

Kozel, T., **Stary, M.**, 2016. Stochastic management of the open large water reservoir with storage function with using a genetic algorithm. *IOP Conference Series: Earth and Environmental Science* 44, 022024. <https://doi.org/10.1088/1755-1315/44/2/022024>

Krakovská, A., Nováková, J., **Unucka, J.**, Melčáková, I., Lapčík, V., Andráš, P., Klimša, L., 2017. Proposal of potential flood control. *Carpathian Journal of Earth and Environmental Sciences* 12, 283–292.

Královec, V., **Kliment, Z.**, Matoušková, M., 2016a. Evaluation of runoff response on the basis of a comparative paired research in mountain



catchments with the different land use: Case study of the Blanice River, Czechia. *Geografie* 121, 209–234.

Královec, V., **Kliment, Z.**, Vlček, L., 2016b. Evaluation of soil water retention in forest and non-forest environment. *Zpravy Lesnického Vyzkumu* 61, 181–189.

**Krecek, J.**, Palán, L., Stuchlík, E., 2017. Acid atmospheric deposition in a forested mountain catchment. *iForest - Biogeosciences and Forestry* 10, 680–686. <https://doi.org/10.3832/ifor2319-010>

Kubin, E., **Křeček, J.**, Palán, L., 2017. Effects of forest practices on water resources recharge in the boreal climate. *Environmental Processes* 4, 509–522. <https://doi.org/10.1007/s40710-017-0249-4>

**Langhammer, J.**, Bernsteinová, J., Miřijovský, J., 2017a. Building a high-precision 2D hydrodynamic flood model using UAV photogrammetry and sensor network monitoring. *Water* 9, 861. <https://doi.org/10.3390/w9110861>

**Langhammer, J.**, Česák, J., 2016. Applicability of a nu-support vector regression model for the completion of missing data in hydrological time series. *Water* 8, 560. <https://doi.org/10.3390/w8120560>

**Langhammer, J.**, Lendzioch, T., Miřijovský, J., Hartvich, F., 2017b. UAV-based optical granulometry as tool for detecting changes in structure of flood depositions. *Remote Sensing* 9, 240. <https://doi.org/10.3390/rs9030240>

**Ledvinka, O.**, 2017a. Batch orographic interpolation of monthly precipitation based on free-of-charge geostatistical tools. *E3S Web of Conferences* 22, 00101. <https://doi.org/10.1051/e3sconf/20172200101>

**Ledvinka, O.**, 2017b. Freely available mean daily discharge series from Czechia: what can be inferred from them? *E3S Web of Conferences* 17, 00051. <https://doi.org/10.1051/e3sconf/20171700051>

Lendzioch, T., **Langhammer, J.**, Jenicek, M., 2016. Tracking forest and open area effects on snow accumulation by unmanned aerial vehicle photogrammetry. *ISPRS - International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences XLI-B1*, 917–923. <https://doi.org/10.5194/isprsarchives-XLI-B1-917-2016>

Maly, A., **Ledvinka, O.**, 2017. Changes in water temperature in selected streams of the Morava River basin, in: Ninov, P., Božilova, E. (Eds.), *Electronic Book with Full Papers from XXVII Conference of the Danubian Countries on Hydrological Forecasting and Hydrological Bases of Water Management. Presented at the Danube Conference 2017, 26-28 September 2017, Golden Sands, Bulgaria, Company for International Meetings, Sofia, Bulgaria*, pp. 174–181.

Markonis, Y., Moustakis, Y., Nasika, C., Sychova, P., Dimitriadis, P., **Hanel, M.**, Máca, P., Papalexiou, S.M., 2018. Global estimation of long-term persistence in annual river runoff. *Advances in Water Resources* 113, 1–12. <https://doi.org/10.1016/j.advwatres.2018.01.003>

Martinkova, M., **Hanel, M.**, 2016. Evaluation of relations between extreme precipitation and temperature in observational time series from the Czech Republic. *Advances in Meteorology* 2016, 1–9. <https://doi.org/10.1155/2016/2975380>

Marx, A., Dusek, J., Jankovec, J., **Sanda, M.**, **Vogel, T.**, van Geldern, R., Hartmann, J., Barth, J.A.C., 2017a. A review of CO<sub>2</sub> and associated carbon dynamics in headwater streams: a global perspective. *Reviews of Geophysics* 55, 560–585. <https://doi.org/10.1002/2016RG000547>

Marx, A., Hintze, S., **Sanda, M.**, Jankovec, J., Oulehle, F., Dusek, J., Vitvar, T., **Vogel, T.**, van Geldern, R., Barth, J.A.C., 2017b. Acid rain footprint three decades after peak deposition: long-term recovery from

pollutant sulphate in the Uhlirská catchment (Czech Republic). *Science of The Total Environment* 598, 1037–1049. <https://doi.org/10.1016/j.scitotenv.2017.04.109>

Melišová, E., **Hanel, M., Vizina, A.**, 2017. Evaluation of hydrological balance using soil moisture, in: SGEM2017 Conference Proceedings. Presented at the 17th International Multidisciplinary Scientific GeoConference SGEM 2017, International Multidisciplinary Scientific Geoconference, Albena, Bulgaria, pp. 261–268. <https://doi.org/10.5593/sgem2017/31/S12.033>

Minařík, R., **Langhammer, J.**, 2016. Use of a multispectral uav photogrammetry for detection and tracking of forest disturbance dynamics. *ISPRS - International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences XLI-B8*, 711–718. <https://doi.org/10.5194/isprsarchives-XLI-B8-711-2016>

Oulehle, F., Chuman, T., Hruška, J., Krám, P., McDowell, W.H., Myška, O., Navrátil, T., **Tesař, M.**, 2017. Recovery from acidification alters concentrations and fluxes of solutes from Czech catchments. *Biogeochemistry* 132, 251–272. <https://doi.org/10.1007/s10533-017-0298-9>

Oulehle, F., Kopáček, J., Chuman, T., Černohous, V., Hůnová, I., Hruška, J., Krám, P., Lachmanová, Z., Navrátil, T., Štěpánek, P., **Tesař, M.**, Evans, C.D., 2016. Predicting sulphur and nitrogen deposition using a simple statistical method. *Atmospheric Environment* 140, 456–468. <https://doi.org/10.1016/j.atmosenv.2016.06.028>

Palán, L., **Křeček, J.**, Sato, Y., 2018. Leaf area index in a forested mountain catchment. *Hungarian Geographical Bulletin* 67, 3–11. <https://doi.org/10.15201/hungeobull.67.1.1>

Rozman, D., **Hrkal, Z.**, Váňa, M., Vymazal, J., Boukalová, Z., 2017. Occurrence of pharmaceuticals in wastewater and their interaction with shallow aquifers: a case study of Horní Beřkovice, Czech Republic. *Water* 9, 218. <https://doi.org/10.3390/w9030218>

**Šanda, M.**, Sedlmaierová, P., Vitvar, T., Seidler, C., Kändler, M., Jankovec, J., Kulasová, A., Paška, F., 2017. Pre-event water contributions and streamwater residence times in different land use settings of the transboundary mesoscale Lužická Nisa catchment. *Journal of Hydrology and Hydromechanics* 65. <https://doi.org/10.1515/johh-2017-0003>

Šatala, T., **Tesař, M.**, Hanzelová, M., Bartík, M., Šípek, V., Škvarenina, J., Mindáš, J., Dagsson Waldhauserová, P., 2017. Influence of beech and spruce sub-montane forests on snow cover in Poľana Biosphere Reserve. *Biologia* 72. <https://doi.org/10.1515/biolog-2017-0097>

Shao, W., Su, Y., **Langhammer, J.**, 2017. Simulations of coupled non-isothermal soil moisture transport and evaporation fluxes in a forest area. *Journal of Hydrology and Hydromechanics* 65. <https://doi.org/10.1515/johh-2017-0038>

Šípek, V., **Tesar, M.**, 2017. Year-round estimation of soil moisture content using temporally variable soil hydraulic parameters. *Hydrological Processes* 31, 1438–1452. <https://doi.org/10.1002/hyp.11121>

Sobotková, M., Sněhota, M., Budínová, E., **Tesař, M.**, 2017. Isothermal and non-isothermal infiltration and deuterium transport: a case study in a soil column from a headwater catchment. *Journal of Hydrology and Hydromechanics* 65. <https://doi.org/10.1515/johh-2017-0029>

Su, Y., **Langhammer, J.**, Jarsjö, J., 2017. Geochemical responses of forested catchments to bark beetle infestation: Evidence from high frequency in-stream electrical conductivity monitoring. *Journal of Hydrology* 550, 635–649. <https://doi.org/10.1016/j.jhydrol.2017.05.035>

Svoboda, V., **Hanel, M.**, Máca, P., Kyselý, J., 2017. Characteristics of rainfall events in regional climate model simulations for the Czech Republic. *Hydrology and Earth System Sciences* 21, 963–980. <https://doi.org/10.5194/hess-21-963-2017>

Svoboda, V., **Hanel, M.**, Máca, P., Kyselý, J., 2016. Projected changes of rainfall event characteristics for the Czech Republic. *Journal of Hydrology and Hydromechanics* 64. <https://doi.org/10.1515/johh-2016-0036>

Trnka, M., Semerádová, D., Novotný, I., Dumbrovský, M., Drbal, K., Pavlík, F., Vopravil, J., Štěpánková, P., **Vizina, A.**, Balek, J., Hlavinka, P., Bartošová, L., Žalud, Z., 2016. Assessing the combined hazards of drought, soil erosion and local flooding on agricultural land: a Czech case study. *Climate Research* 70, 231–249. <https://doi.org/10.3354/cr01421>

Tumova, J., Grabicova, K., Golovko, O., Koba, O., **Kodes, V.**, Fedorova, G., Grabic, R., Kroupova, H.K., 2017. Comparison of passive sampling and biota for monitoring of tonalide in aquatic environment. *Environmental Science and Pollution Research* 24, 22251–22257. <https://doi.org/10.1007/s11356-017-9850-3>

Van Lanen, H.A.J., Laaha, G., Kingston, D.G., Gauster, T., Ionita, M., Vidal, J.-P., Vlnas, R., Tallaksen, L.M., Stahl, K., Hannaford, J., Delus, C., Fendekova, M., Mediero, L., Prudhomme, C., Rets, E., Romanowicz, R.J., Gailliez, S., Wong, W.K., Adler, M.-J., Blauhut, V., Caillouet, L., Chelcea, S., Frolova, N., Gudmundsson, L., **Hanel, M.**, Haslinger, K., Kireeva, M., Osuch, M., Sauquet, E., Stagge, J.H., Van Loon, A.F., 2016. Hydrology needed to manage droughts: the 2015 European case. *Hydrological Processes* 30, 3097–3104. <https://doi.org/10.1002/hyp.10838>

Vašát, R., Kodešová, R., Borůvka, L., Jakšík, O., Klement, A., **Brodský, L.**, 2017. Combining reflectance spectroscopy and the digital elevation model for soil oxidizable carbon estimation. *Geoderma* 303, 133–142. <https://doi.org/10.1016/j.geoderma.2017.05.018>

Vasilaki, M., Kohnová, S., **Hanel, M.**, Szolgay, J., Hlavčová, K., Loukas, A., Rončák, P., 2017. Detection of future changes in seasonality in extreme short-term rainfall in selected stations of Slovakia. *Contributions to Geophysics and Geodesy* 47. <https://doi.org/10.1515/congeo-2017-0009>

Vlček, L., Kocum, J., Janský, B., Šefrna, L., **Blažková, Š.**, 2016. Influence of peat soils on runoff process: Case study of Vydra River headwaters, Czechia. *Geografie* 121, 235–253.

**Vogel, T.**, Votrubova, J., Dohnal, M., Dusek, J., 2017. A simple representation of plant water storage effects in coupled soil water flow and transpiration stream modeling. *Vadose Zone Journal* 16. <https://doi.org/10.2136/vzj2016.12.0128>

Votrubova, J., Dohnal, M., **Vogel, T.**, **Sanda, M.**, **Tesar, M.**, 2017a. Episodic runoff generation at Central European headwater catchments studied using water isotope concentration signals. *Journal of Hydrology and Hydromechanics* 65. <https://doi.org/10.1515/johh-2017-0002>

Votrubova, J., Dohnal, M., **Vogel, T.**, **Tesar, M.**, Jelinkova, V., Cislerova, M., 2017b. Ponded infiltration in a grid of permanent single-ring infiltrimeters: Spatial versus temporal variability. *Journal of Hydrology and Hydromechanics* 65. <https://doi.org/10.1515/johh-2017-0015>

Wdowikowski, M., Kaźmierczak, B., **Ledvinka, O.**, 2016. Maximum daily rainfall analysis at selected meteorological stations in the upper Lusatian Neisse River basin. *Meteorology Hydrology and Water Management* 4, 53–63.

## **1.6 Participation in international scientific meetings**

### **1.6.1 Meetings hosted by the country**

As mentioned above, the CNCH members helped organize or participated (either with oral or written contributions) in several interdisciplinary meetings hosted by the Czech Republic. Recall, for instance, that in summer 2016 there was another international conference focusing on remote sensing (and hydrology or fluvial geomorphology as well) hosted by the Czech Republic. In Septembers 2016 and 2017, Prague hosted multidisciplinary symposia devoted to earth sciences where the role of the CNCH members could be emphasized.

The meetings needed not be purely scientific, as illustrated especially by the seminars of the CNC DR that have a very variable audience consisting also of the people working for the government and municipalities. The purpose of such seminars is rather to spread the valuable information about the disaster risk reduction (including floods and droughts) across the public.

The territory of the Czech Republic has been hit by the large-scale drought, which triggered many seminars devoted to it. Also, in 2017 the occurrences of important regional floods were commemorated (see above).

As the scientific secretary of the CNCH mostly aims at the applications of statistics and GIS in hydrology, which includes also the European INSPIRE initiative, he visited many seminars and workshops pointing out the news regarding the initiative and the exploitation of its data products (e.g. seminars related to the 'Attractive Danube' project).

In January 2017, a short meeting involving the hydrologists from the CHMI (including the CNCH), the T. G. Masaryk Water Research Institute, p.r.i. (TGM WRI), and the hydrologists from the German institute BfG took place in Prague in order to initialize the project called 'ElbeRegime2100'. The project aims at the identification of changes in hydrological time series coming from the Elbe River basin and the determination of their causes.

### **1.6.2 Participation in meetings abroad**

The chairman of the CNCH visited several scientific meetings abroad. More or less, they related to the activities of the WMO CHy, as was the case of the already mentioned conferences in Cancún, Mexico or in Rome, Italy. With his colleagues from the CHy and CHMI, the chairman contributed to the 'Seventh International Conference on Flood Management (ICMF7)' that took place at the University of Leeds, UK in September 2017. The abstracts can be found on the internet.

In September 2016, a vice-chairman of the CNCH took part in the '16th Biennial Conference of the Euromediterranean Network of Experimental and Representative Basins (ERB)' held in Bucharest, Romania. The vice-chairman also served as a member of the international scientific committee there.

The scientific secretary of the CNCH very often focused on the conferences dedicated to the students in the field of hydrology and other earth/environmental sciences. He served as a member of scientific committees (and a reviewer or author of manuscripts) at conferences held in Poland (EKO-DOK 2017 and 2018) and Slovakia (young experts).

As mentioned, the secretary further attended the workshops of the IAHS ICSH in Canada (2016) and Poland (2017). In April 2018, he also visited a specialized seminar in Magdeburg, Germany in order to complement his knowledge of the cooperation among Czech and German hydrologists in the basin of the Elbe River.

Poland was probably the most visited country by the secretary in 2017 as in July he attended also the first 'International Conference on Advances in Energy Systems and Environmental Engineering' in Wroclaw, dealing with climatology, hydrology and water treatment as well. He submitted and successfully published a paper about the orographic interpolation of monthly precipitation with the help of freely available geostatistical tools (see Section 1.5).

Regarding the cooperation with the Japanese ICHARM UNESCO category-2 centre, the contribution to the EGU General Assembly 2017 (prepared mainly by the secretary and Dr. Youngjoo Kwak) must be stressed (see above). The secretary was present also at the following 'Vienna Catchment Science Symposium'.

At the end of 2017, another meeting among Czech (the scientific secretary and his colleagues from the TGM WRI) and German hydrologists took place in Nürnberg, Germany in order to summarize existing results (and to determine further objectives) of the 'ElbeRegime2100' project.

## **1.7 Other activities at regional level**

### **1.7.1 Institutional relations and cooperation**

Only one bigger personal meeting of the IHP Electoral Group II (or better the representatives of the Regional Cooperation of the Danube Countries) took place during the reporting period where the CNCH (i.e. the secretary) was present. In particular, it was one of the side meetings that occurred in Golden Sands, Bulgaria in September 2017 (see above).

Several other personal meetings occurred between the secretary of the CNCH and the chairman of the SCH during a few events abroad.

If necessary, the Secretariat of the CNCH responded electronically to the questions and questionnaires sent by the UNESCO Headquarters via e-mail. Among these activities, the CNCH substantially contributed to the regional opinion on the changes/updates of the IHP Statutes and other related documents (such as Rules of Procedure) in the second half of 2016.

### **1.7.2 Completed and ongoing scientific projects**

In November 2016, works on the project devoted to the estimation of flood quantiles in small ungauged basins (i.e. TB050MZP018) ended. The

CNCH scientific secretary then contributed to the draft of a certified methodology which was successfully defended and, currently, the CHMI, as the national hydrological service, continues using this methodology when issuing the values of such flood quantiles.

Currently, the project 'ElbeRegime2100' (more details above) is still in progress. Results such as publications in the IAHS proceedings (PIAHS) and elsewhere are expected relative to this project. For instance, an abstract about possible long-term persistence in regime hydrological series from the Czech and German parts of the Elbe River basin was submitted to the ongoing 'Global FRIEND-Water Conference' (Beijing, China, November 2018).

As the CHMI (including the CNCH) became, among other aspects, a research institute, there is more space for studying the possibilities of the application of remote sensing data in Czech hydrology, which is desirable and more than beneficial relative to the continuing cooperation between the CHCH and the ICHARM centre.

## **2. FUTURE ACTIVITIES**

### **2.1 Activities planned until December 2018**

The next (in fact 17<sup>th</sup>) part of the biennial ERB conferences will take place in Darmstadt, Germany approximately in the middle of September 2018. Some Czech hydrologists including a vice-chairman of the CNCH (who is a traditional member of the scientific committee) are going there.

The scientific secretary of the CNCH plans to take part in the next 'Global FRIEND-Water Conference' that should be held in Beijing, China at the beginning of November 2018. Also, a full contribution to the proceedings is planned. However, this depends on the acceptance/rejection of the abstract submitted at the end of March 2018.

The scientific secretary, as a member of scientific committee(s), further plans to review manuscripts submitted to the 'Seminar of Applied Mathematics (SAM)' that should firstly take place in Boguszów-Gorce, Poland in September 2018. Namely, hydrological and climatological topics are expected there. As well, a review of the manuscripts related to the next 'Conference of Young Experts' (Bratislava, Slovakia, November 2018) should again be reviewed by the secretary. It is believed that this activity will contribute to a certain improvement in the quality of the next papers by starting scientists.

At the end of 2017, the CHMI (together with the CNCH) became a research institute. That meant that its scientific workers had to prepare a 5-year strategy (2018–2022) and a detailed plan for 2018 in order to achieve financial support from government. The chairman and the scientific secretary of the CNCH therefore prepared their works so that they would be in line with the UNESCO IHP activities. Especially, some foundations of a better flood and drought forecasting (including the exploitation of satellite data in Czech hydrology) should be laid in 2018. For this purpose, another personal meeting between the CNCH scientific secretary and Dr. Youngjoo Kwak from the ICHARM centre was scheduled for the beginning of August 2018. Relative to the more intense scientific works at the CHMI in the future, an education strategy (either for specific fields or as regards

the English language) should be prepared in the rest of 2018 in cooperation with the CNCH Secretariat.

The CNCH websites devoted to offering selected time series will be updated and complemented by the flood peaks data (i.e. annual maximum series, but representing calendar years instead of hydrological years) in order to meet several international requirements (relative e.g. to the cooperation with Austrian and German hydrologists).

The next plenary session of the renewed CNCH (with the Statute and some members changed) should finally take place in late summer/autumn 2018.

Another meeting of the representatives of the Regional Cooperation of the Danube Countries that should take place in Bratislava, Slovakia is scheduled for the turn of September and October 2018. The chairman of the SCH is responsible for announcing the particular term of the meeting.

## **2.2 Activities foreseen for 2019-2020**

Although some parts of the CNCH websites are already in English (especially regarding the freely available hydrological time series), the works on the translation will continue.

Further archiving and saving historical hydrological data should occur. This fact was also emphasized at the side meeting of IHP representatives in Golden Sands, Bulgaria (see above). In line with this, the archive of Dr. Josef Hladný that contains a lot of valuable (not only UNESCO IHP) materials should undoubtedly be saved and cataloged.

Some of the CNCH experts may visit the next EGU general assemblies in 2019 and 2020 where hydrological sections are very frequent (including the following Vienna catchment science symposia).

Further cooperation with the CNC DR regarding the organization of their seminars is welcome.

## **2.3 Activities envisaged in the long term**

The CNCH is prepared to support the IHP-VIII and the next IHP-IX activities, especially through the experts mentioned above.

The CNCH will further support the SCH and the Slovak Hydrometeorological Institute (SHMI) activities, namely co-organizing the valuable conferences of young experts (hydrologists, water managers and climatologists).

Further maintenance of the CNCH website is envisaged.