

## **Report of the Czech National Committee for Hydrology (CNCH) on UNESCO IHP related activities (April/May 2020)**

### **1. ACTIVITIES UNDERTAKEN IN THE PERIOD JUNE 2018 – APRIL 2020**

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

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

Unfortunately, similar to the previous reporting period, no session was officially held. However, again, the CNCH members maintained their connections 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 regularly closely cooperate.

The meeting of the renewed CNCH that was announced in the previous report did not occur either. The reason was that the CNCH chairman and the director of the Czech Hydrometeorological Institute (CHMI), to whom the CNCH has been serving as an advisory body since June 2017, were very busy in the reporting period. Therefore, the renovation of the CNCH was postponed to the next period. Prof. Pavel Kovář, although having been not active for several months, thus still holds the position of a vice-chairman, which should be changed very soon.

Dr. Eva Soukalová, who was retired at the beginning of 2018, was *de facto* replaced by Dr. Petr Janál, the current director of the CHMI Brno Regional Office. He very intensively continues with the hydrological cooperation in the region of the Danube basin inherited from Dr. Soukalová. The membership of Dr. Janál is acknowledged especially by the CNCH scientific secretary who cooperates with him a lot regarding the European DAREFFORT project (see below). Dr. Janál's membership is beneficial also from the perspective of his long-term cooperation with the International Commission for the Protection of the Danube River (ICPDR).

As a couple of conferences should be organized in the near future by the renewed CNCH (see below), the plenary session involving new members is inevitable and it should take place by the end of 2020.

The CNCH further preserves its traditional connections to:

- Czech National Committee of Geodesy and Geophysics,
- Czech National Committee for Disaster Risk Reduction (CNC DRR),
- 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 the second vice-chairman and several national correspondents, remain the same as well. Despite not having occupied the position of the

correspondent for the Panta Rhei scientific decade, Czech hydrologists deal with the topic of socio-hydrology anyway.

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

#### 1.1.2 Status of IHP-VIII activities

The CNCH experts are still 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), International Flood Initiative (IFI), Regional Cooperation of the Danube Countries in the field of hydrology.

In February 2019, the scientific secretary visited Geneva, Switzerland where the extraordinary session of the WMO Commission for Hydrology (CHy) took place. As a follow-up, the new definition of operational hydrology and the new structure of hydrological bodies within the WMO was confirmed by the WMO Congress in June 2019, where the chairman of the CNCH was present together with other representatives of the CHMI. In addition, since the draft of the DAREFFORT project succeeded and was financially supported by the European Commission, the scientific secretary started visiting the planned meetings of the DAREFFORT experts focused on the forecasts of large-scale floods (droughts) and ice phenomena related to the rivers within the Danube basin. Right from the beginning of the project that was started by a kick-off meeting in Budapest, Hungary in September 2018, Dr. Janál helps the secretary with the negotiations. So far, the other DAREFFORT meetings have occurred in February 2019 (Vienna, Austria; the new Danube Forum was held there as well), May 2019 (Bucharest, Romania) and November 2019 (Bratislava, Slovakia). All these activities are in line with UNESCO IHP-VIII Theme 1, to which one could also add the expert meetings in Smolenice, Slovakia (November 2018) and Kyiv, Ukraine (November 2019; during the XXVIII Danube Conference) where Dr. Janál and others dealt with the finalization of the publication prepared by the group focused on the floods in the Danube basin (see Section 1.5 for the citation of the book).

At the expert meeting in Kyiv, it was decided that further hydrological activities should, among other aspects, aim at drought and low flows in the Danube basin. The new project should be led by Czech, Slovak, German and Austrian hydrologists, who are often at the same time the members of NCs. The selection of the topic was naturally triggered by the current situation in Europe, but it also reflects the needs highlighted in UNESCO IHP-VIII Theme 3. This theme was emphasized in Czechia also by reports evaluating the current long-term drought episode, some of which are already published online (but predominantly in Czech). During the preparation of the reports, Czech hydrologists closely cooperated with climatologists, which ensured strengthening knowledge on both sides.

The scientific secretary of the CNCH personally visited several conferences focused on strengthening the university students' knowledge and skills in Slovakia (November 2019) and Poland (April 2019). The students were given the advice there. In November 2018, the secretary could not visit

the conference in Slovakia personally, but he reviewed the students' manuscripts in order to help them reduce typical mistakes. In September 2018, the secretary contributed also to the announced 'Seminar of Applied Mathematics' (SAM) held in Poland, where a lot of statistical issues in environmental sciences were discussed with students, and not only with them. All this was in accordance with UNESCO IHP-VIII Theme 6.

### 1.1.3 Input on IHP-IX

In the reporting period, the Secretariat of the CNCH was several times asked for reviewing the draft of the UNESCO IHP-IX plan. The chairman of the CNCH, after several consultations with the scientific secretary, responded electronically to these requests. The main issue was the duplication of some of the planned activities with those which would be done anyway by other organizations within the UN system. Notably, operational hydrology should be the main domain of the hydrologists under the umbrella of the WMO. On the other hand, the CNCH really appreciates the inclusion of using modern technologies (either computer or field) in the plan.

## 1.2 Activities of the CNCH at national level

### 1.2.1 National scientific and technical meetings

As the drought episode continued in the reporting period, mainly the seminars focused on addressing this big issue were organized in Czechia. The previous report already informed about the seminar co-organized by the CNCH chairman in May 2018. The seminar ended up with the publication of the proceedings. Another seminar dealing with drought took place in Prague in September 2018, where the chairman informed about the history of drought occurrence in the territory of Czechia and elsewhere. The other speakers (CNCH correspondents inclusive) introduced the computer system 'HAMR' that, in brief, should be able to predict/forecast the onset of drought. The system combines several hydrological and other models (water balance, soil moisture, etc.). The 'HAMR' system was part of the programme also during the CNC DRR plenary session held in December 2018. On that occasion, the CNCH scientific secretary informed about the activities of the CNCH, as well as about the importance of the UNESCO IHP. One of the speakers at that session was Dr. Kodeš who has recently addressed the issue of pesticides not only in groundwaters. In June 2019, the successful seminar about drought in Czechia co-organized in May 2018 by the CNCH chairman continued. Again, a publication summarized the outcomes of the seminar, but this time only in the form of a book of abstracts that can be downloaded by the Czech readership from the CHMI websites (see also Section 1.5).

The CNC DRR plenary sessions took place also in May 2019 and in December 2019. The CNCH scientific secretary attended only the second one because in May 2019 he was abroad, due to the DAREFFORT project meeting in Bucharest, Romania.

Furthermore, the Czech Bioclimatological Society (CBCS), organizes more and more conferences regarding hydrology, water management and the importance of water for agriculture, particularly in the current dry times.

The conferences were international and, sometimes, a venue outside Czechia was selected. Dr. Janál often worked as a member of the scientific or local organizing committee, which emphasized the prominence of the CNCH.

Another 'Adolf Patera Workshop' took place on 1<sup>st</sup> October 2018 that was organized by a CNCH member. These workshops traditionally focus on extreme hydrological phenomena. The same member presented his results also at the 'CEBS19' (Central Europe towards Sustainable Building) conference held in Prague. The vice-chairman responsible for observing the IAHS activities originally planned to organize another 'Hydrology of a Small Basin' conference in April 2020, but finally it was cancelled because of the COVID-19 pandemic. This triennial international conference was held in April 2017 for the last time, although it was not mentioned in the previous report.

Members focusing on water management issues represented the CNCH at the biennial conference dealing with water reservoirs. The conference took place in Brno in October 2019 and one of its outcomes was the proceedings written in Czech with English abstracts. The CNCH chairman and another CNCH member were part of the scientific committee.

Last but not least, the CNCH scientific secretary attended the Czech national user fora and other events related to the European Copernicus Programme. This was not only due to his personal interest, but also due to the fact that he was involved in several projects exploiting satellite data for hydrological tasks. The secretary's skills related to the GIS systems were also the reason for attending INSPIRE events held in Czechia during the period of report.

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

As expected, in September 2019, another 'ERB Workshop and Steering Committee' meeting took place. The vice-chairman who traditionally visits these meetings again actively participated in negotiations. It had been known before that the next ERB conference should be organized close to Florence, Italy. At the meeting, however, it was specified that the '18<sup>th</sup> Biennial Conference ERB 2020' would be held in Portoferraio, Elba Island, Tuscany, Italy between 23<sup>rd</sup> and 25<sup>th</sup> September 2020. However, due to the COVID-19 pandemic, the event was postponed to 2021.

Dr. Janál actively participated in the working group focused on the flood regimes in the Danube basin which was led by the Slovak Committee for Hydrology (SCH) member Dr. Pavla Pekárová. Dr. Janál personally attended several meetings of that group (Smolenice, Slovakia in November 2018, and Kyiv, Ukraine in November 2019).

#### 1.2.3 Supported or sponsored projects

As far as the CNCH Secretariat knows, Czechia did not support or sponsor any projects related to the UNESCO IHP during the period of report.

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

In February 2019, the above-mentioned extraordinary session of the WMO (CHy) took place in Geneva, Switzerland. Other connections to WMO activities were mediated through the CNCH chairman. For instance, he was present at the 18<sup>th</sup> WMO Congress at the beginning of June 2019.

In the period of report, the scientific secretary did not have any chance to attend the traditional workshops of the IAHS International Commission on Statistical Hydrology (ICSH). The reason was that the venues of workshops were very distant (Adelaide, Australia in 2018, Nanjing, China in 2019). Nevertheless, the secretary attended another meeting where many of the attendees were interested in the applications of mathematics and statistics to hydrology. Namely, the secretary visited the SAM held in Boguszów-Gorce, Poland in September 2018, where he met also the statistical climatologists. The event was very beneficial; hence the organizers plan another one in the near future when the secretary should play a role of a member of the scientific committee. First, however, the COVID-19 pandemic must fade away.

The traditional cooperation with the SCH continued. Again, 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 November 2018 and 2019. He reviewed several papers for the conferences and gave his advice to the students. Nevertheless, the secretary could personally visit only the second event because of the concurrence of the first one with the '8<sup>th</sup> Global FRIEND-Water Conference' in Beijing, China (see later).

The CNCH scientific secretary together with the members of the Austrian NC (and other European NCs) carried on the research related to the floods in Europe. This time, the team was interested in the magnitudes of the flood peaks stored in the European Flood Database created earlier. Thanks to that cooperation, another prepared manuscript was successful and finally published in 'Nature' at the beginning of September 2019 (see Section 1.5).

As mentioned above, mainly Dr. Janál served as a member of various scientific or local organizing committees. Also, some of the activities of the CNCH chairman and the scientific secretary could be added to this aspect.

Mainly the CNCH scientific secretary visited the plenary sessions of the CNC DRR, while in December 2018, another member of the CNCH was present at their session, where the secretary introduced the CNCH activities.

#### 1.2.5 Other initiatives

The CNCH further successfully maintained its website (<http://cnvh.cz/>) in the reporting period. The CNCH Secretariat tried to 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. At the turn of June and July 2018, another update

of the datasets representing mean daily discharges from Czechia occurred at the website. In addition, an important new upload of annual maximum series (AMS) of discharge was performed. Roughly speaking, currently, scientists and researchers can download annual peak discharge data for 19 profiles. Note that these data represent the calendar years 1961–2010. In spring 2019, again, the time series of mean discharge were updated. They now represent the period from the beginning of the digitized material to the end of 2018.

Regarding the so-called opening of the hydrometeorological data representing the territory of Czechia, there are nowadays intense discussions between hydrologists and climatologists of the CHMI. It seems that the beginnings of the series will be limited by them. So, the further preservation of the time series presented at the website of the CNCH is meaningful.

In September 2018, the oldest recorded flood in Bohemia was commemorated. It occurred in 1118. The commemoration paradoxically fell inside probably the one of the historically driest periods, while Czech hydrologists were given a chance to scan the so-called hunger stones and other hydrological marks offering the idea where water levels were during both hydrological extremes in the distant past. The two obtained 3D computer models were published online in cooperation with the CNCH (for the hunger stone in Děčín kindly see <http://portal.chmi.cz/historicka-data/hydrologie/zaznamy-z-minulosti/hladovy-kamen>; for the Děčín water metre carved in the rock wall kindly see <http://portal.chmi.cz/historicka-data/hydrologie/zaznamy-z-minulosti/vodocet-na-skale>).

Last but not least, it still applies that the CNCH members help other hydrologists and climatologists combat against the current drought in the territory of Czechia. The correspondents very actively cooperate with experts from abroad as well.

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

#### 1.3.1 Contribution to IHP courses

The CNCH did not contribute to UNESCO 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 that would be accessible to anyone. However, the scientific secretary of the CNCH continued with the tradition established at the CHMI and, when asked by his colleagues from the institute, he contributed lectures given at the Brno Branch Office in May and December 2019. The lectures were devoted to the work in the environment of R statistical software and, specifically, to the connections to databases and working with the database tables in order to obtain desired aggregated values in the form of local tables.

### 1.3.3 Participation in IHP courses

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

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

Until his retirement from the Czech University of Life Sciences, the leader of the working group focusing on the education in hydrology in Czechia (and a vice-chairman of the CNCH) observed the activities of the UNESCO-IHE institute. After the renovation of the CNCH, a new observer needs to be assigned this position as quickly as possible.

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).

For instance, the reporting period was important regarding the updates of the Czech mean daily discharge series stored in the database of the Global Runoff Data Centre (GRDC, spring 2019). On the other hand, the selected Czech groundwater data were completely newly added to the database of the International Groundwater Resources Assessment Centre (IGRAC, spring 2018; see <https://ggmn.un-igrac.org/>).

The relationship with the Japanese ICHARM centre somewhat weakened. The following two reasons may be stressed: (1) the scientific secretary of the CNCH is extremely busy and he would need a new colleague in order to communicate better with the centre, and (2) there were established new projects within the Czech hydrology that to a large extent duplicated the planned activities.

Regarding the Regional Cooperation of the Danube Countries, there was a videoconference at the beginning of April 2020. Also, the interested workers of the UNESCO Venice Office took part (more details in Section 1.7.1).

## 1.5 Publications

The seminar about drought in Czechia reported previously led to the publication of the proceedings that referred to the period 2015–2017. In June 2019, however, another seminar took place that was co-organized by the CNCH chairman and that focused on this continuing prolonged drought episode. At the time of the seminar, the period 2014–2018 was considered (starting year was shifted due to synoptic causes) and the book of abstracts was published by the CHMI. Both books can be downloaded from the internet. Nevertheless, they are written only in Czech. The same applies to the continuing series about the international activities of CHMI hydrologists written by the CNCH scientific secretary and published every year in the journal 'Meteorological Bulletin'.

Drought in the territory of Czechia was reflected also in several papers co-authored by the chairman that dealt with the development of a software system devoted to drought forecasting and called 'HAMR'. Again, these

papers are only in Czech, although some of them contain an English abstract too. Moreover, chapters of the Hydrological Yearbook of the Czech Republic described the drought episode, and several evaluation reports were published online.

From the UNESCO IHP point of view, the most important contributions are the papers of the CNCH members included in the proceedings related to the 'XXVIII Conference of the Danubian Countries' held in Kyiv, Ukraine in November 2019, and the book resulting from the long-term efforts of hydrologists from the region of the Danube basin. The book benefits also from the knowledge of flood regimes in the region gained by the CNCH hydrologists. The book was edited by Slovak hydrologists and can be downloaded from the internet (<http://147.213.100.3:81/danubeflood/>) or obtained on various other media on request. Its citation is:

Pekárová, P., Miklánek, P. (Eds.), 2019. Flood Regime of Rivers in the Danube River Basin, The Danube and its Basin - Hydrological Monograph. Institute of Hydrology of the Slovak Academy of Sciences, Bratislava.

The following list of the contributions of the CNCH members (as well as the IAHS and the FRIEND-Water correspondents) to various journals, and conference proceedings highlights the peer-reviewed entries taken from the Scopus database (including the contributions to the Danube Conference) and corresponding to the period June 2018 – April 2020:

Beran, A., **Hanel, M.**, Nesládková, M., **Vizina, A.**, Vyskoč, P., Kožín, R., 2019. Climate change impacts on water balance in Western Bohemia and options for adaptation. *Water Supply* 19, 323–335. <https://doi.org/10.2166/ws.2018.080>

Beven, K.J., Almeida, S., Aspinall, W.P., Bates, P.D., **Blazkova, S.**, Borgomeo, E., Freer, J., Goda, K., Hall, J.W., Phillips, J.C., Simpson, M., Smith, P.J., Stephenson, D.B., Wagener, T., Watson, M., Wilkins, K.L., 2018. Epistemic uncertainties and natural hazard risk assessment – Part 1: A review of different natural hazard areas. *Nat. Hazards Earth Syst. Sci.* 18, 2741–2768. <https://doi.org/10.5194/nhess-18-2741-2018>

Bindzárová Gergel'ová, M., Kuzevi'ová, Ž., Labant, S., Gašinec, J., Kuzevi'č, Š., **Unucka, J.**, Liptai, P., 2020. Evaluation of selected sub-elements of spatial data quality on 3D flood event modeling: case study of Prešov city, Slovakia. *Applied Sciences* 10, 820. <https://doi.org/10.3390/app10030820>

Blöschl, G., Hall, J., Viglione, A., Perdigão, R.A.P., Parajka, J., Merz, B., Lun, D., Arheimer, B., Aronica, G.T., Bilibashi, A., Boháč, M., Bonacci, O., Borga, M., Čanjevac, I., Castellarin, A., Chirico, G.B., Claps, P., Frolova, N., Ganora, D., 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., Salinas, J.L., Sauquet, E., Šraj, M., Szolgay, J., Volpi, E., Wilson, D., Zaimi, K., Živković, N., 2019. Changing climate both increases and decreases European river floods. *Nature* 573, 108–111. <https://doi.org/10.1038/s41586-019-1495-6>

Burkina, V., Zamaratskaia, G., Sakalli, S., Giang, P.T., **Kodes, V.**, Grabic, R., Velisek, J., Turek, J., Kolarova, J., Zlabek, V., Randak, T., 2018. Complex effects of pollution on fish in major rivers in the Czech Republic.



Ecotoxicology and Environmental Safety 164, 92–99. <https://doi.org/10.1016/j.ecoenv.2018.07.109>

Chlumecky, M., **Tesar, M.**, Buchtele, J., 2018. Ascertaining evapotranspiration series by the optimized rainfall-runoff model. *BGM* 129, 487–497. <https://doi.org/10.21701/bolgeomin.129.3.001>

Dogan, T., **Hanel, M.**, Oguz, K., Demircan, M., 2019. Assessment of the urban heat island effect under current and climate change conditions in Istanbul, in: SGEM2019 Conference Proceedings. Presented at the 19th International Multidisciplinary Scientific Geoconference, International Multidisciplinary Scientific Geoconference, Albena, Bulgaria, pp. 891–898. <https://doi.org/10.5593/sgem2019/4.1/S19.113>

Dusek, J., Dohnal, M., **Vogel, T.**, Marx, A., Barth, J.A.C., 2019. Modelling multiseasonal preferential transport of dissolved organic carbon in a shallow forest soil: Equilibrium versus kinetic sorption. *Hydrological Processes* 33, 2898–2917. <https://doi.org/10.1002/hyp.13536>

Dusek, J., **Vogel, T.**, 2019. Modeling travel time distributions of preferential subsurface runoff, deep percolation and transpiration at a montane forest hillslope site. *Water* 11, 2396. <https://doi.org/10.3390/w11112396>

Dusek, J., **Vogel, T.**, 2018. Hillslope hydrograph separation: The effects of variable isotopic signatures and hydrodynamic mixing in macroporous soil. *Journal of Hydrology* 563, 446–459. <https://doi.org/10.1016/j.jhydrol.2018.05.054>

Elleder, L., Krejčí, J., Racko, S., **Daňhelka, J.**, Šírová, J., Kašpárek, L., 2020. Reliability check of flash-flood in Central Bohemia on May 25, 1872. *Global and Planetary Change* 187, 103094. <https://doi.org/10.1016/j.gloplacha.2019.103094>

**Fošumpaur, P.**, Kašpar, T., Králík, M., Zukal, M., 2019a. Study of boundary conditions for design of new types of fibre concrete energy dissipators in hydraulic structures. *IOP Conf. Ser.: Mater. Sci. Eng.* 596, 012031. <https://doi.org/10.1088/1757-899X/596/1/012031>

**Fošumpaur, P.**, Kašpar, T., Zukal, M., 2019b. Technical cultural heritage on the Elbe-Vltava waterway. *IOP Conf. Ser.: Earth Environ. Sci.* 290, 012152. <https://doi.org/10.1088/1755-1315/290/1/012152>

**Hanel, M.**, Rakovec, O., Markonis, Y., Máca, P., Samaniego, L., Kyselý, J., Kumar, R., 2018. Revisiting the recent European droughts from a long-term perspective. *Sci Rep* 8, 9499. <https://doi.org/10.1038/s41598-018-27464-4>

Hnilica, J., **Hanel, M.**, Puš, V., 2019. Technical note: Changes in cross- and auto-dependence structures in climate projections of daily precipitation and their sensitivity to outliers. *Hydrol. Earth Syst. Sci.* 23, 1741–1749. <https://doi.org/10.5194/hess-23-1741-2019>

**Hrkal, Z.**, Eckhardt, P., Hrabánková, A., Novotná, E., Rozman, D., 2018. PPCP monitoring in drinking water supply systems: the example of Káraný waterworks in Central Bohemia. *Water* 10, 1852. <https://doi.org/10.3390/w10121852>

**Hrkal, Z.**, Harstadt, K., Rozman, D., Těšitel, J., Kušová, D., Novotná, E., Váňa, M., 2019. Socio-economic impacts of the pharmaceuticals detection and activated carbon treatment technology in water management - an example from the Czech Republic. *Water and Environment Journal* 33, 67–76. <https://doi.org/10.1111/wej.12370>

Jackisch, C., Germer, K., Graeff, T., Andrä, I., Schulz, K., Schiedung, M., Haller-Jans, J., Schneider, J., Jaquemotte, J., Helmer, P., Lotz, L., Bauer, A., Hahn, I., **Šanda, M.**, Kumpan, M., Dorner, J., de Rooij, G., Wessel-Bothe, S., Kottmann, L., Schittenhelm, S., Durner, W., 2020. Soil moisture

and matric potential-an open field comparison of sensor systems. *Earth Syst. Sci. Data* 12, 683–697. <https://doi.org/10.5194/essd-12-683-2020>

**Janál, P.**, Kozel, T., 2019. Fuzzy logic based flash flood forecast, in: Gorbachova, L., Khrystiuk, B. (Eds.), *Electronic Book with Full Papers from XXVIII Conference of the Danubian Countries on Hydrological Forecasting and Hydrological Bases of Water Management*. Presented at the Danube Conference 2019, 6-8 November 2019, Kyiv, Ukraine, Ukrainian Hydrometeorological Institute, Kyiv, pp. 86–91.

Kertész, Á., **Křeček, J.**, 2019. Landscape degradation in the world and in Hungary. *HunGeoBull* 68.3.1, 201–221. <https://doi.org/10.15201/hungeobull.68.3.1>

Kohnová, S., Vasilaki, M., **Hanel, M.**, Szolgay, J., Hlavčová, K., Loukas, A., Földes, G., 2018. Detection of future changes in trends and scaling exponents in extreme short-term rainfall at selected stations in Slovakia. *Contributions to Geophysics and Geodesy* 48, 207–230. <https://doi.org/10.2478/congeo-2018-0009>

**Kovář, P.**, Fedorova, D., Bačinová, H., 2018. Implementation of the curve number method and the KINFIL model in the Smeda Catchment to mitigate overland flow with the use of terraces. *Soil & Water Res.* 13, 98–107. <https://doi.org/10.17221/163/2017-SWR>

Kozel, T., **Stary, M.**, 2019. Adaptive stochastic management of the storage function for a large open reservoir using an artificial intelligence method. *Journal of Hydrology and Hydromechanics* 67, 314–321. <https://doi.org/10.2478/johh-2019-0021>

**Křeček, J.**, Haigh, M., 2019. Land use policy in headwater catchments. *Land Use Policy* 80, 410–414. <https://doi.org/10.1016/j.landusepol.2018.03.043>

**Křeček, J.**, Palán, L., Pažourková, E., Stuchlík, E., 2019a. Water-quality genesis in a mountain catchment affected by acidification and forestry practices. *Freshwater Science* 38, 257–269. <https://doi.org/10.1086/698533>

**Křeček, J.**, Palán, L., Stuchlík, E., 2019b. Impacts of land use policy on the recovery of mountain catchments from acidification. *Land Use Policy* 80, 439–448. <https://doi.org/10.1016/j.landusepol.2017.10.018>

**Langhammer, J.**, 2019. UAV monitoring of stream restorations. *Hydrology* 6, 29. <https://doi.org/10.3390/hydrology6020029>

**Langhammer, J.**, Janský, B., Kocum, J., Minařík, R., 2018. 3-D reconstruction of an abandoned montane reservoir using UAV photogrammetry, aerial LiDAR and field survey. *Applied Geography* 98, 9–21. <https://doi.org/10.1016/j.apgeog.2018.07.001>

**Langhammer, J.**, Vacková, T., 2018. Detection and mapping of the geomorphic effects of flooding using UAV photogrammetry. *Pure Appl. Geophys.* 175, 3223–3245. <https://doi.org/10.1007/s00024-018-1874-1>

**Ledvinka, O.**, Coufal, P., 2019. Development of streamflow drought indices in the Morava River basin, in: Gorbachova, L., Khrystiuk, B. (Eds.), *Electronic Book with Full Papers from XXVIII Conference of the Danubian Countries on Hydrological Forecasting and Hydrological Bases of Water Management*. Presented at the Danube Conference 2019, 6-8 November 2019, Kyiv, Ukraine, Ukrainian Hydrometeorological Institute, Kyiv, pp. 119–132.

Lendziach, T., **Langhammer, J.**, Jenicek, M., 2019. Estimating snow depth and leaf area index based on UAV digital photogrammetry. *Sensors* 19, 1027. <https://doi.org/10.3390/s19051027>

Markonis, Y., **Hanel, M.**, Máca, P., Kyselý, J., Cook, E.R., 2018. Persistent multi-scale fluctuations shift European hydroclimate to its millennial

boundaries. *Nat Commun* 9, 1767. <https://doi.org/10.1038/s41467-018-04207-7>

Markonis, Y., Papalexiou, S.M., Martinkova, M., **Hanel, M.**, 2019. Assessment of water cycle intensification over land using a multisource global gridded precipitation dataset. *J. Geophys. Res. Atmos.* 124, 11175–11187. <https://doi.org/10.1029/2019JD030855>

Martínková, M., Hejduk, T., Fučík, P., Vymazal, J., **Hanel, M.**, 2018. Assessment of runoff nitrogen load reduction measures for agricultural catchments. *Open Geosciences* 10, 403–412. <https://doi.org/10.1515/geo-2018-0032>

Minařík, R., **Langhammer, J.**, 2019. Rapid radiometric calibration of multiple camera array using in-situ data for UAV multispectral photogrammetry. *Int. Arch. Photogramm. Remote Sens. Spatial Inf. Sci. XLII-2/W17*, 209–215. <https://doi.org/10.5194/isprs-archives-XLII-2-W17-209-2019>

Minařík, R., **Langhammer, J.**, Hanuš, J., 2019. Radiometric and atmospheric corrections of multispectral  $\mu$ MCA camera for UAV spectroscopy. *Remote Sensing* 11, 2428. <https://doi.org/10.3390/rs11202428>

Moravec, V., Markonis, Y., Rakovec, O., Kumar, R., **Hanel, M.**, 2019. A 250-year European drought inventory derived from ensemble hydrologic modeling. *Geophys. Res. Lett.* 46, 5909–5917. <https://doi.org/10.1029/2019GL082783>

Palán, L., **Křeček, J.**, 2018. Interception and fog drip estimates in fragmented mountain forests. *Environ. Process.* 5, 727–742. <https://doi.org/10.1007/s40710-018-0327-2>

Rahmati, M., Weihermüller, L., Vanderborght, J., Pachepsky, Y.A., Mao, L., Sadeghi, S.H., Moosavi, N., Kheirfam, H., Montzka, C., Van Looy, K., Toth, B., Hazbavi, Z., Al Yamani, W., Albalasmeh, A.A., Alghzawi, M.Z., Angulo-Jaramillo, R., Antonino, A.C.D., Arampatzis, G., Armindo, R.A., Asadi, H., Bamutaze, Y., Batlle-Aguilar, J., Béchet, B., Becker, F., Blöschl, G., Bohne, K., Braud, I., Castellano, C., Cerdà, A., Chalhoub, M., Cichota, R., Císlarová, M., Clothier, B., Coquet, Y., Cornelis, W., Corradini, C., Coutinho, A.P., de Oliveira, M.B., de Macedo, J.R., Durães, M.F., Emami, H., Eskandari, I., Farajnia, A., Flammini, A., Fodor, N., Gharaibeh, M., Ghavimippanah, M.H., Ghezzehei, T.A., Giertz, S., Hatzigiannakis, E.G., Horn, R., Jiménez, J.J., Jacques, D., Keesstra, S.D., Kelishadi, H., Kiani-Harchegani, M., Kouselou, M., Kumar Jha, M., Lassabatere, L., Li, X., Liebig, M.A., Lichner, L., López, M.V., Machiwal, D., Mallants, D., Mallmann, M.S., de Oliveira Marques, J.D., Marshall, M.R., Mertens, J., Meunier, F., Mohammadi, M.H., Mohanty, B.P., Pulido-Moncada, M., Montenegro, S., Morbidelli, R., Moret-Fernández, D., Moosavi, A.A., Mosaddeghi, M.R., Mousavi, S.B., Mozaffari, H., Nabiollahi, K., Neyshabouri, M.R., Ottoni, M.V., Ottoni Filho, T.B., Pahlavan-Rad, M.R., Panagopoulos, A., Peth, S., Peyneau, P.-E., Picciafuoco, T., Poesen, J., Pulido, M., Reinert, D.J., Reinsch, S., Rezaei, M., Roberts, F.P., Robinson, D., Rodrigo-Comino, J., Rotunno Filho, O.C., Saito, T., Suganuma, H., Saltalippi, C., Sándor, R., Schütt, B., Seeger, M., Sepehrnia, N., Sharifi Moghaddam, E., Shukla, M., Shutaro, S., Sorando, R., Stanley, A.A., Strauss, P., Su, Z., Taghizadeh-Mehrjardi, R., Taguas, E., Teixeira, W.G., Vaezi, A.R., Vafakhah, M., **Vogel, T.**, Vogeler, I., Votrubova, J., Werner, S., Winarski, T., Yilmaz, D., Young, M.H., Zacharias, S., Zeng, Y., Zhao, Y., Zhao, H., Vereecken, H., 2018. Development and analysis of the Soil Water Infiltration Global database. *Earth Syst. Sci. Data* 10, 1237–1263. <https://doi.org/10.5194/essd-10-1237-2018>

- Šanda, M.**, Vitvar, T., Jankovec, J., 2019. Seasonal subsurface water contributions to baseflow in the mountainous Uhlířská catchment (Czech Republic). *Journal of Hydrology and Hydromechanics* 67, 41–48. <https://doi.org/10.2478/johh-2018-0018>
- Šípek, V., Hnilica, J., Vlček, L., Hnilicová, S., **Tesař, M.**, 2020. Influence of vegetation type and soil properties on soil water dynamics in the Šumava Mountains (Southern Bohemia). *Journal of Hydrology* 582, 124285. <https://doi.org/10.1016/j.jhydrol.2019.124285>
- Skala, V., Dohnal, M., Votrubova, J., **Vogel, T.**, Dusek, J., Sacha, J., Jelinkova, V., 2020. Hydrological and thermal regime of a thin green roof system evaluated by physically-based model. *Urban Forestry & Urban Greening* 48, 126582. <https://doi.org/10.1016/j.ufug.2020.126582>
- Su, Y., Shao, W., Vlček, L., **Langhammer, J.**, 2019. Ecohydrological behaviour of mountain beech forest: quantification of stomatal conductance using sap flow measurements. *Geosciences* 9, 243. <https://doi.org/10.3390/geosciences9050243>
- Sun, Q., Miao, C., **Hanel, M.**, Borthwick, A.G.L., Duan, Q., Ji, D., Li, H., 2019. Global heat stress on health, wildfires, and agricultural crops under different levels of climate warming. *Environment International* 128, 125–136. <https://doi.org/10.1016/j.envint.2019.04.025>
- Trnka, M., Hayes, M., Jurečka, F., Bartošová, L., Anderson, M., Brázdil, R., Brown, J., Camarero, J., Cudlín, P., Dobrovolný, P., Eitzinger, J., Feng, S., Finnessey, T., Gregorič, G., Havlik, P., Hain, C., Holman, I., Johnson, D., Kersebaum, K., Ljungqvist, F., Luterbacher, J., Micale, F., Hartl-Meier, C., Možný, M., Nejedlik, P., Olesen, J., Ruiz-Ramos, M., Rötter, R., Senay, G., Vicente-Serrano, S., Svoboda, M., Susnik, A., Tadesse, T., **Vizina, A.**, Wardlaw, B., Žalud, Z., Büntgen, U., 2018. Priority questions in multidisciplinary drought research. *Clim. Res.* 75, 241–260. <https://doi.org/10.3354/cr01509>
- Vogel, T.**, Dohnal, M., Votrubova, J., Dusek, J., 2019. Soil water freezing model with non-iterative energy balance accounting. *Journal of Hydrology* 578, 124071. <https://doi.org/10.1016/j.jhydrol.2019.124071>
- Vogel, T.**, Dusek, J., Dohnal, M., Snehota, M., 2020. Moisture regime of historical sandstone masonry — A numerical study. *Journal of Cultural Heritage* 42, 99–107. <https://doi.org/10.1016/j.culher.2019.09.005>
- Vokoun, M., **Hanel, M.**, 2018. Comparing ALADIN-CZ and ALADIN-LAEF precipitation forecasts for hydrological modelling in the Czech Republic. *Advances in Meteorology* 2018, 1–14. <https://doi.org/10.1155/2018/5368438>
- Vrtiška, J., **Křeček, J.**, Tognetti, R., 2018. Indication of environmental changes in mountain catchments by dendroclimatology. *Soil & Water Res.* 13, 208–217. <https://doi.org/10.17221/199/2017-SWR>
- Wdowikowski, M., Kaźmierczak, B., **Ledvinka, O.**, Jedlička, M., 2019. Attempts to establish a regional probabilistic model of intense rainfall for the Upper and Middle Oder River basin. *E3S Web Conferences* 100, 00084. <https://doi.org/10.1051/e3sconf/201910000084>
- Wild, J., Kopecký, M., Macek, M., **Šanda, M.**, Jankovec, J., Haase, T., 2019. Climate at ecologically relevant scales: A new temperature and soil moisture logger for long-term microclimate measurement. *Agricultural and Forest Meteorology* 268, 40–47. <https://doi.org/10.1016/j.agrformet.2018.12.018>
- Zappa, M., Holko, L., **Šanda, M.**, Vitvar, T., Parajka, J., 2019. Thematic issue on snow resources and hydrological cycle. *Journal of Hydrology and Hydromechanics* 67, 1–3. <https://doi.org/10.2478/johh-2018-0027>

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

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

In short, it can be said that only small international conferences or meetings were hosted by Czechia in the period of report. When seeking larger ones, the events such as the mentioned 'CEBS19' conference should be repeated here.

The term 'smaller conferences' also means that maximally participants from neighboring countries visited them. For example, Slovak hydrologists attended the seminars about drought in 2018 and 2019. As well, the conferences organized by the CBCS attracted some Slovak guests.

The above-mentioned biennial conference devoted to water reservoirs, where the members of the CNCH were present, was also attended by Slovak water managers.

When it comes to the meetings at the edges of hydrology, Czechia traditionally hosted fora dedicated to the exploitation of satellite products offered by the European Copernicus Programme services. In March 2019, the scientific secretary attended the event called 'Brno Space Days' where the representatives of Copernicus and the European Centre for Medium-Range Weather Forecasts (ECMWF) introduced their mutual visions. A lot of speakers there were from abroad.

On the other hand, again, predominantly the Slovak experts were present at various meetings related to the European initiative INSPIRE.

At the end of the reporting period, the COVID-19 pandemic prevented those who were interested in the activities of the Czech hydrology from travelling to Czechia. It unfortunately affected, for example, the planned triennial 'Hydrology of a Small Basin' conference that was scheduled in April 2020.

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

In September 2018, a vice-chairman of the CNCH took part in the '17<sup>th</sup> Biennial Conference of the Euromediterranean Network of Experimental and Representative Basins (ERB)' held in Darmstadt, Germany. The vice-chairman also served as a member of the international scientific committee there.

Again, the scientific secretary of the CNCH very often focused on the conferences devoted 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 co-author of manuscripts) at conferences held in Poland ('EKO-DOK 2019') and Slovakia (young experts). Moreover, he actively participated in the SAM 2018 in Poland where he discussed with students a lot and, as well, collected many contact details of Polish applied mathematicians for further potential cooperation. Additionally, at the SAM 2018 event, the secretary met a famous statistical climatologist from Germany, to whom he promised to write a contribution to an encyclopedia.

The year 2018 was very important because another 'Global FRIEND-Water Conference' took place. It was in Beijing, China and the scientific secretary, as announced in the previous report, presented there the results of the Czech-German project 'ElbeRegime2100'. The manuscript was prepared for publication in 2018, but the Chinese organizers somewhat delayed the process. However, according to the last information the secretary has, the proceedings should be published very soon.

The year 2019 was probably even more important. Namely, the '27<sup>th</sup> IUGG General Assembly' (IUGG2019) and the 'XXVIII Conference of the Danubian Countries' were hosted in Montreal, Canada in July, and in Kyiv, Ukraine, respectively. The scientific secretary of the CNCH joined his forces with Canadian hydrologists who then presented the mutual results related to hydrological regime changes at selected Canadian water-gauging stations during the IUGG2019. The secretary presented his results related to the trends in hydrological drought indices within the Morava River basin at the Danube Conference. Dr. Janál and others from the CHMI Brno Branch Office presented there as well.

Although the scientific secretary was not present at the EGU general assemblies in 2018 and 2019, his contributions were presented there by his colleagues from universities. The contributions were, in brief, devoted to the study of changing snow conditions and their effects on runoff seasonality in selected mountain catchments in Czechia. One of the presentations was exhibited also in Innsbruck, Austria in October 2018 during the 'International Snow Science Workshop'.

Unfortunately, nobody from the CNCH could visit the extraordinary session of the UNESCO IHP Intergovernmental Council that took place in Paris in November 2019. At that time, the CNCH Secretariat was regularly informed by the Permanent Delegation of the Czech Republic to UNESCO, or the CNCH members searched for the necessary information on the internet.

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

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

Several personal meetings occurred in the region of the Danube basin regarding the cooperation of the Danube countries and the working groups. Dr. Janál was present in Smolenice, Slovakia in November 2018, as well as at the meeting in Kyiv, Ukraine in November 2019, where he also helped the absent CNCH secretary. The main outcomes of the meetings are: (1) the book (and its appendices) about floods in the Danube basin, as already mentioned in Section 1.5, and (2) the decision on new topics that should be in focus of hydrologists in the Danube basin in the future. One of the projects should deal with drought and low flows in the region. It should be led by Czech hydrologists to whom Slovak, German and Austrian hydrologists should assist. Any other hydrologists from the region are welcome to join.

At the beginning of April 2020, a videoconference took place between the experts from the Danube countries. The representatives from the UNESCO Headquarters and the UNESCO Venice Office took part in that meeting. Among other things, the issue of missing websites was addressed. Also, an

initiative regarding archiving and digitizing various material, such as the proceedings from the past Danube conferences, was supported. Last but not least, the drafts of new regional projects were discussed. The hydrologists wishing to join the teams or to edit the drafts were offered some additional time for deciding whether or not they would join. The draft of the Czech project (drought and low flows) together with the Slovak sub-project (water temperature) received a lot of support, while many experts want to cooperate. Another videoconference regarding the Danube region is scheduled at the end of May 2020.

During the period of report, the DAREFFORT project officially started and continued in which the composition of experts substantially overlapped with the Regional Cooperation of the Danube Countries. Even their interests overlapped and visiting the periodical meetings was very beneficial. The CNCH members, at the same time data providers, actively supported the project where the data and forecasts exchanges are one of the main goals. In February 2019, besides the periodical meeting, the new Danube Forecasting Forum took place in Vienna, Austria where the attendees could see what up-to-date forecasting systems were used in the region at that time. Prof. Szölösi-Nagy had a great presentation there, drawing attention to his and his colleague's book about hydrological forecasting using a state space approach.

#### 1.7.2 Completed and ongoing scientific projects

At the end of 2019, the Czech-German project 'ElbeRegime2100' was finished. The CNCH members substantially contributed to it. Especially, the patterns of long-term persistence and their influences on trend detection in discharge series were studied. Naturally, the time series of derived hydrological indices related to drought were in focus as well. Some of the results were presented at the '8<sup>th</sup> Global FRIEND-Water Conference' and at the 'XXVIII Conference of the Danubian Countries'. The final report was prepared by the colleagues from the T. G. Masaryk Water Research Institute.

The scientific secretary of the CNCH further closely cooperated with other hydrologists from the CHMI. They developed a new software devoted to the estimation of design values of flood discharges. At the end of 2019, the team prepared a certified methodology that should be used throughout hydrological departments of the CHMI.

Besides the above-mentioned project aimed at drought and low flows in the Danube basin, another big project is prepared by the members of the CNCH together with the hydrologists of the CHMI that should focus on various aspects of drought, specifically in the territory of Czechia. The project should be in short called 'PERUN' and, if financially supported, it should take some 6.5 years. Not only hydrologist should work on it, but also climatologists and other experts are expected to cooperate.

The CNCH scientific secretary and his colleagues from other institutes in Czechia were successful in a competition of project drafts. This means that a new, financially supported, four-year project devoted to the exploitation of remote sensing products will run as of June 2020. Among other aspects, intense rainfall, soil moisture and erosion in small Czech catchments will

be studied. Four institutes will be incorporated, while the CNCH secretary will be responsible for the activities done by the CMHI.

Some of the CNCH members are also part of the team addressing the topics related to the changes in extremes of the water cycle in the territory of Czechia. This project started in 2019 and is financed by the Ministry of Interior of the Czech Republic. Besides hydrologist involved in the project, also meteorologists and climatologists from the CHMI focus on the extremes and, additionally, on the society's exposure to them. The project should end in 2021.

## **2. FUTURE ACTIVITIES**

### **2.1 Activities planned until December 2020**

During the dates between 24<sup>th</sup> and 25<sup>th</sup> September 2020, another ICSH workshop is planned. The venue is located in Valencia, Spain and the CNCH scientific secretary is preparing his abstract for this event.

Additionally, still in September 2020, the '6<sup>th</sup> IAHR Europe Congress' should take place in Warsaw, Poland. The scientific secretary of the CNCH already sent the organizers his extended abstract that was accepted. The abstract may be extended further to a regular manuscript for a special issue of the Swiss journal 'Water'.

Another personal meeting of the representatives of the Regional Cooperation of the Danube Countries that should take place in Slovenia is scheduled in October 2020. The chairman of the Slovene NC is responsible for announcing the specific days of the meeting.

By the end of 2020, the CNCH must be urgently renewed in order to ensure that the CNCH is able to organize the conferences scheduled in September 2021. In general, the number of members should be lowered and younger members should be involved so as to ensure better flexibility of the CNCH. Right after the renovation of the CNCH, the plenary session must occur.

The scientific secretary is again prepared to review the manuscripts submitted to the next 'Conference of Young Experts', and specifically its part devoted to hydrology (Bratislava, Slovakia, November 2020). It is believed that this activity generally contributes to a certain improvement in the quality of the next papers by starting scientists.

Another plan for 2021 should be prepared by the scientific secretary by the end of 2020 regarding the internal research at the CHMI. All the future activities must be carefully considered, especially with regard to the fact that many other similar projects will run, while the duplications will be undesirable.

The dataset containing the mean discharge series on the CNCH website will be updated in order to offer also the calendar year 2019 to the students and other researchers. Moreover, other hydrological series will be published online in cooperation with the colleagues from the CHMI (see also Section 1.2.5).



## 2.2 Activities foreseen for 2021–2022

Further systematic archiving and rescuing historical hydrological data should occur. This applies also to rescuing older publications, such as conference proceedings, which is in line with the activities highlighted by the Danube countries. Cataloging of the material obtained as a legacy from Dr. Josef Hladný should definitely continue. Incidentally, it was found that younger generations of hydrologist do not know who Dr. Hladný was and how important his work was for Czech hydrology. Not only for this purpose, a Zotero reference manager database was established in order to catalogue digitized Dr. Hladný's contributions and other publications collected by him.

In September 2021, Czechia should host the next 'XXIX Conference of the Danubian Countries'. The CNCH decided that this conference will be organized jointly with the traditional Czech-Slovak conference called 'Hydrology Days' that should be a follow-up to the last Hydrology Days held in Bratislava, Slovakia in 2015. The combined conference in 2021 will take place in South Moravia in the basin of the River Morava, a left-hand tributary of the Danube, and the Czech and Slovak presentations will be interpreted for English-speaking attendees.

As already mentioned, the '18<sup>th</sup> Biennial Conference ERB' should be organized in Portoferraio, Elba Island, Tuscany, Italy in September 2021. At least a vice-chairman who has traditionally served as a member of the scientific committee should represent the CNCH there again. The scientific secretary of the CNCH already prepared a contribution to this conference, together with his colleague from the Faculty of Science, Charles University. More interestingly, the '19<sup>th</sup> Biennial Conference ERB' should be hosted by Czechia. The vice-chairman thinks that some place in the Bohemian Forest could be ideal as a venue.

The next Polish 'Seminar of Applied Mathematics' was postponed from September 2020 to September 2021 due to the current COVID-19 pandemic. The scientific secretary of the CNCH and a colleague of his from the CHMI are preparing the contribution to this event.

When mentioning the postponed conferences, also the 'International Conference on the Status and Future of the World's Large Rivers' must be emphasized here. Originally, it was scheduled in August 2020 in Moscow, Russia, but now, it is known that Moscow will host the conference in August 2021. The CNCH secretary and one of his colleagues from the CHMI Brno Regional Office are preparing the contribution to the conference, dealing with hydrological droughts in the Morava River basin.

Some of the CNCH experts may visit the next EGU general assemblies in 2021 and 2022 where hydrological sections and related short courses are very frequent (including the following Vienna catchment science symposia).

At the turn of June and July 2021, another IAHS Scientific Assembly should take place in Montpellier, France. At least the scientific secretary of the CNCH is extremely interested in this event.

Further cooperation with the CNC DRR regarding the organization of their seminars or plenary sessions is welcome.

The CNCH members and their colleagues are prepared to contribute to the DARREFORT project until its successful end in spring 2021.

Last but not least, due to the current hydrometeorological situation in Czechia, the CNCH members will certainly help other hydrologists and climatologists with the preparation of next reports on drought. For instance, one such report should be compiled for the whole Elbe basin in cooperation with German hydrologists.

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

The CNCH is prepared to fully support the new IHP-IX activities, especially through the experts mentioned in Section 1.1.2.

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

In July 2023, the CNCH members will certainly visit the '28<sup>th</sup> IUGG General Assembly' that should be held in Berlin, Germany.

Further maintenance of the CNCH website is envisaged, including the translation of its content.