

## МЕЖДУНАРОДНЫЙ ЦЕНТР ДАННЫХ ПО ГИДРОЛОГИИ ОЗЁР И ВОДОХРАНИЛИЩ

INTERNATIONAL DATA CENTRE ON HYDROLOGY OF LAKES AND RESERVOIRS

# ANNUAL NEWSLETTER

**D**ear reader of the next, ninth issue of the newsletter!

D Traditionally, it provides information on the collection of new data on the hydrology of lakes and reservoirs and technological development of the Center, the main focus of which is currently the improvement of services for informing users about the composition and content of the information provided.

An article by J.-F. Crétaux (CNES) provides a summary of the new European Space Agency (ESA) international project "Climate Change Initiative" (CCI). The project's goal is to use satellite observations and modern calibration methodologies to create as long and continuous data series as possible for various Essential Climate Variables (ECV), including for the ECV - Lakes. The verification and calibration of satellite data will be carried out based on the results of ground-based observations presented in the database of the Center.

The results of my research are also offered to your attention. It is about assessing changes in water level of largest lakes of Eurasia based on Centers data.

I can not fail to mention the important hydrological event of 2019, the centenary of the State Hydrological Institute, under which the Center operates. Anniversary information can be found on the website of the Institute: www.hydrology.ru.

In conclusion, as always, I want to express my sincere gratitude to the representatives of the countries cooperating with the Center.

Prof. Valery Vuglinsky Director of HYDROLARE



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Lake Bohinj (Slovenia)

### FURTHER DEVELOPMENT OF THE HYDROLARE IT INFRASTRUCTURE

L. Barinova, G. Barinova, E. Kuprienok (HYDROLARE, Russia)

uring the 10-year period of existence of the WMO International Data Center Hydrology of Lakes and Reservoirs on (HYDROLARE), its technological development was aimed at expanding the species composition of the information provided and improving the service of informing users about data that can be provided by the Center. In 2016, all types of data provided in the Center's database appeared - water levels, water temperature and maximum ice thickness. Information about the current content of the database can be obtained on the Center's website either using a step-by-step search system with a map interface, or directly through the catalog presented on the site. Currently, the improvement of user information services has become the main focus of the technological development of the Center.

In the framework of the Center's cooperation with the Laboratory of Ocean Geophysical Research (LEGOS) of the National Space Agency of France (CNES), in 2018 the technological capability was provided to display points ("virtual stations") on the maps presented on the HYDROLARE website that made satellite measurements of water level on rivers associated with lakes (Fig. 1).

The corresponding technology has been implemented for the Volga river basin.



Fig. 1. Presentation on the website of the center information about virtual stations on the rivers flowing into the lake and flowing from it

The active list of such items available on the HYDROLARE website allows you to click on the link to the Hydroweb website owned by LEGOS, which shows graphs of the river water level measured from the satellite (Fig. 2).



Fig. 2. The graph of the water level of the Volga River, measured at the virtual station, on the Hydroweb website

Another link provides information on which rivers and lakes of the world and for what period satellite observations of the water level were made (Fig. 3).



Fig. 3. Information about satellite observations of the water level on the site Hydroweb

Work continued on collecting, analyzing and preparing data on the hydrology of lakes and reservoirs of WMO member countries, as well as on their conversion to a single species required for loading into the database. Work was carried out on the search, recognition and selection of data on the water levels and water temperature of lakes, presented on the websites of the corresponding services of Canada, USA, Sweden and Slovenia. In 2018, the Center received data on the regimes of lakes and reservoirs of Belarus (2010–2016), Kyrgyzstan (2013–2017), Kazakhstan (average water levels over Lake Balkhash for 2009–2016), Switzerland (2016), which added data received from these countries in past years. As a result, the database was supplemented with information on water levels at the stations of Kyrgyzstan (6 stations), Belarus (19), Switzerland (33), Slovenia (2), Sweden (6), Canada (23), USA (43), Russia (207). For the largest lakes of Russia (18), Great Lakes of Canada and the USA, Lake Issyk-Kul (Kyrgyzstan) and Lake Balkhash (Kazakhstan), water levels averaged over the water bodies were prepared and loaded into the database. The data on the average monthly and maximum water temperature at the stations of Belarus (29), Slovenia (3), Russia (167) were replenished.

All data contained in the database of the Center, as before, is provided to users upon their requests.

#### **CLIMATE CHANGE INITIATIVE PROJECT ON LAKES**

J.-F. Crétaux, (LEGOS/CNES, France)

**T**n the beginning of 2019, the kickoff of a new L project has been held in Reading in England. This project aims to produce and validate a consistent data set of the variables grouped under the Lakes Essential Climate Variables (ECV). It includes multiple variables: lake water level, extent, temperature, surface reflectance, and ice cover. The framework project is the Climate Change initiative (CCI) of the European Space Agency (ESA), and it has been signed for 3 years. The main ambition associated with this objective is to establish wide uptake by a varied and fragmented landscape of potential users. This requires significant alignment of current practises for producing the individual lake variables, cross-variable validation, and demonstration in the form of use cases. Thus, the challenge of producing a single data set for the Lakes ECV becomes an opportunity to move the science community towards wider uptake of Earth Observation data in limnological studies.

The objective of this project is to exploit satellite data to create the largest and longest possible consistent and global data records on the ECVs, relying on the state of the arts of methodologies to achieve such purpose. The first released of the lake ECV data set is expected in January 2020, including more than 200 lakes.

The consortium is constituted by several research laboratories from European countries, and also Canada. The science leaders are J.-F. Crétaux from LEGOS/CNES and Stefan Simis from Plymouth Marine Laboratory (PML). The State Hydrological Institute (SHI) of St Petersburg is associated to the project as external partner. It is indeed crucial before we can release ECVs that the satellite data sets of ECVs products could be validated using the maximum possible of *in-situ* measurements. Exchange of such data and satellite products between the CCI project and the SHI has already started and will help to achieve the validation purpose. A set of lake surface temperature and of water height in-situ measurements over the Russian territory have already been released from SHI to the CCI project's members. Therefore, the SHI as an essential partner of the project will participate in the future to the workshop which will be held in October 2019 in Toulouse and which is jointly organised by Meteo France and the CCI project. It will aim to gather modellers and providers of ECVs and to generate new interest in the EO climate datasets produced for inland water bodies within the community of limnologists, operating at local to global spatial scales and likely to use varying subsets of the Lakes ECV products.

The current linkage between LEGOS and SHI, which has started in 2011 by the signature of an official agreement and the participation of LEGOS to the HYDROLARE project, opens opportunity to enhance new cooperation between our both groups, but also between SHI and the other members of the consortium of the CCI project. SHI, through the responsibility on the HYDROLARE data center, is a natural partner of the CCI project on lakes in such context.

#### CHANGES IN THE WATER LEVEL OF LARGE EURASIA LAKES

Prof. V. Vuglinsky, (HYDROLARE, Russia)

The character of long-term fluctuations in the water level in natural water bodies is important for the surrounding areas, because it determines the degree of their flooding, which, in turn, affects the flora and fauna of the coastal zone, as well as its economic use.

Below are the results of the analysis and assessment of changes in the water level of five large lakes of Eurasia in a warming climate. The baseline data used are the long-term observation series for the average annual water level of lakes for the period from 1960 to 2016, obtained from the database of the HYDROLARE. accordance with In the existing ideas, the beginning of the period of climate change (climate warming) was adopted in 1980. As objects of research five large lakes of Eurasia (Baikal, Balkhash, Issyk-Kul, Ladoga, Onega) were chosen. The perennial series of average annual water levels for these lakes were divided into two periods: from 1960 to 1979 (the period of the stationary climatic situation) and from 1980 to 2016 (period of non-stationary climatic situation). The research methodology consisted analyzing the homogeneity in and significance of trends in the long-term series, identifying linear trends in the time series during the unsteady climate situation (1980-2016), and quantifying changes in water levels from 1960-1979 compared to their natural fluctuations.

For the two lakes (Baikal, Ladoga), the samples were homogeneous. For the remaining three

lakes (Balkhash, Issyk-Kul, Onega), the samples were heterogeneous, indicating a violation of the natural course of water levels over the period under consideration. A possible reason for this may be changed climatic conditions.

The table shows the changes in the water levels of the lakes considered for the period 1980-2016 compared with the previous period (1960-1979).

Table – Changes in the average annual water levels of lakes for the period 1980-2016 compared with the previous period

Lake	Average level change, cm
Baikal	+13
Balkhash	+6
Issyk-Kul	-79
Ladoga	+2
Onega	+11

As can be seen from the table, a significant decrease in the water level occurred in Issyk-Kul Lake (a drop of 79 cm). On the other lakes there was an increase in water levels, although not as significant.



Lake Issyk-Kul

In 2019, the 100<sup>th</sup> anniversary of the establishment of the State Hydrological Institute, the leading research institution of the Russian Federation in the field of land hydrology, is celebrated. Festive events dedicated to this significant event will be held in St. Petersburg in October this year. Relevant information can be found on the website of the Institute: www.hydrology.ru



The historical building of the State Hydrological Institute