МЕЖДУНАРОДНЫЙ ЦЕНТР ДАННЫХ
ПО ГИДРОЛОГИИ ОЗЁР И ВОДОХРАНИЛИЩ

INTERNATIONAL DATA CENTRE
ON HYDROLOGY OF LAKES AND RESERVOIRS

ANNUAL NEWSLETTER

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Dear reader! You hold in your hands another, tenth issue of the bulletin, which this year, due to the problems associated with the coronavirus pandemic, came out at the end of the year. Traditionally, this release provides information on the Centre's database replenishment and its technological development aimed at improving the service for informing users about the data that can be provided by the Centre.

The article of J.-F. Cretaux, representing the Laboratory for Ocean Geophysical Research (LEGOS) of the French National Space Agency (CNES), contains information on the development of the project for the exploration of lakes using satellites – Lakes_cci project, which is carried out within the framework of the international program Climate Change Initiative (CCI). The aim of the project is to develop a methodology for defining five variables in the climate change indicator ECV-Lakes: water level, lake area, water surface temperature, ice cover, lake water reflectivity. The first phase of the project has been completed.

In 2020, the Centre's database was enriched with satellite-based water-level observations from 73 water bodies on the planet, courtesy of the LEGOS Laboratory.

An important event in 2021 will be the next HYDROLARE Steering Committee meeting, to be held in Saint Petersburg in October.

In conclusion, as always, I would like to express my sincere appreciation to the representatives of the countries cooperating with the Centre.

Prof. Valery Vuglinsky
Director of HYDROLARE

Lake Maloe Markinskoye (Russia)

DEVELOPMENT OF THE CENTRE'S IT COMPLEX

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

In 2019 and 2020, the development of the Centre's database and information technology complex continued.

The main direction of development was to improve the service for informing users about the data that can be provided by the Centre.

For this purpose, on the Center's website hydrolare.net an interactive map-catalog of water bodies presented in the HYDROLARE database was posted (fig. 1). The blue markers on the map indicate the water bodies for which ground observations are available, purple - satellite observations, red - both types of observations.

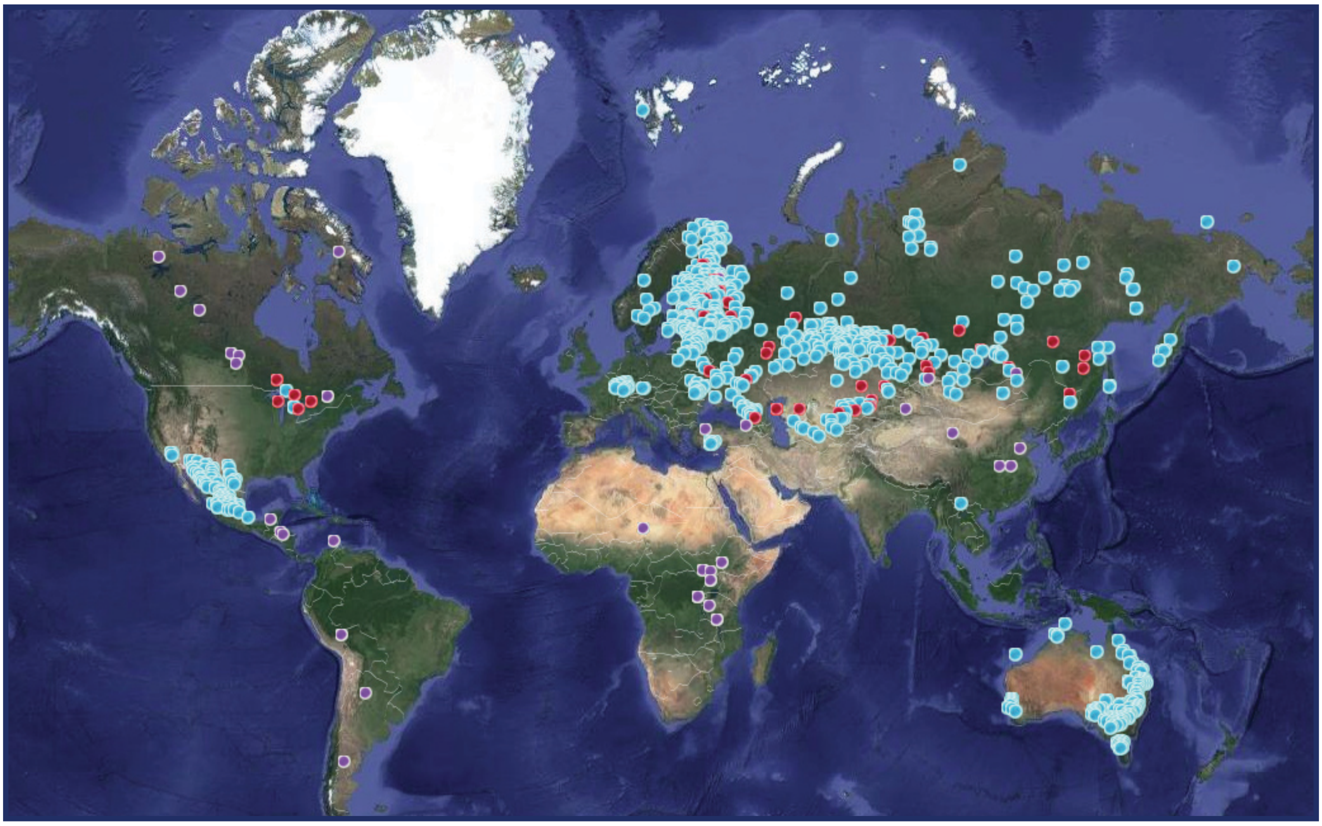

Fig. 1. Interactive map - catalogue of water bodies represented in the HYDROLARE database

To get information on the water body, it is sufficient to press the corresponding marker. A window will appear showing the location of the water body, the types of data available and the observation periods for each species (fig. 2).

Information about all water bodies in the HYDROLARE data base can be obtained immediately, as before, using the Excel file catalogue on the hydrolare.net/Data/Catalogue of lakes and reservoirs page. The interactive map is available on the same page. With the help of the search engine on the hydrolare.net/Data/Availability site page in the HYDROLARE database, it is possible to get more detailed information, not only about the water bodies, but also about the posts on them.

The Centre continued to collect, analyse and prepare the data and to convert them into a single type, required for uploading to the HYDROLARE database. As in previous years, in 2019 and 2020, data on the water levels and temperatures of the water bodies presented on the websites of the relevant services of Canada, USA, Sweden and Slovenia were searched, recognized and selected. In addition to the earlier data, data for different elements of hydrological regime for lakes of Belarus and Switzerland for 2017 were received.

The database was supplemented with information on water levels at posts in Belarus (10), Switzerland (33), Slovenia (2), Sweden (6), Canada (23), USA (43), Russia (210). Data on the average water levels of the lakes of Russia (13) and the Great Lakes (5) were also prepared and downloaded.

In addition, data on average monthly and higher water temperatures for posts of Belarus (29), Kazakhstan (76), Kyrgyzstan (8), Slovenia (2) and Russia (100) were loaded.

In the framework of international cooperation with the LEGOS Laboratory represented by J.-F. Cretaux, the Centre was provided with satellite water-level observations of 73 water bodies on the planet. For 20 of them, data were received for the first time (table 1). For 49 water bodies, including the Caspian Sea, data were replenished up to 2020.

This brings the total number of water bodies with satellite observations to 78.

Data contained in the Centre's database continued to be made available to users upon request.

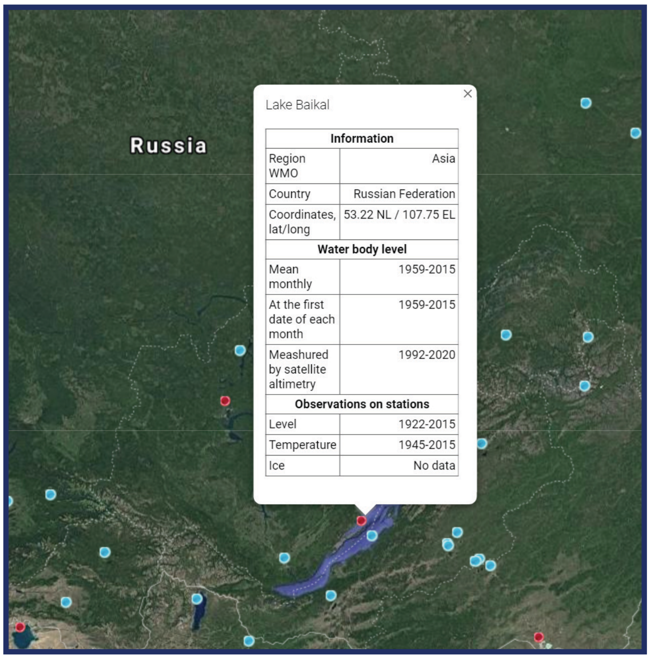

Fig. 2. Fragment of interactive map with information on data availability for Lake Baikal.

Table 1. NEW WATER BODIES WITH SATELLITE OBSERVATIONS INCLUDED IN THE HYDROLARE DATABASE

№	Water body	Country	Period	№	Water body	Country	Period
1	Beloe	Russian Federation	2016-2020	11	Khanka	Russian Federation	2000-2020
2	Segozerskoe		2008-2020	12	Udyl		2013-2020
3	Vagatozero		2008-2019	13	Kulundinskoe		2016-2020
4	Verkhnee Kujto		2008-2020	14	Chukochye		2016-2020
5	Vygozero		2008-2020	15	Karasor	Kazakhstan	2016-2020
6	Yanisyarvi		2008-2019	16	Kapchagajskoe		1992-2020
7	Kamskoe		2008-2020	17	Toktogul	Kyrgyzstan	1995-2020
8	Barun-Torej		2016-2020	18	Sarykamyshskoe	Turkmenistan	1992-2020
9	Bolon'		2008-2020	19	Sevan	Armenia	1995-2020
10	Chukchagirskoe		2008-2019	20	Kremenchugskoe	Ukraina	1992-2020

RESEARCH OF LAKES BY SATELLITE WITHIN THE FRAMEWORK OF THE PROGRAMME «CLIMATE CHANGE INITIATIVE»

J.-F. Crétaux, (LEGOS/CNES, France)

Until recently, most of the hydrological study of lakes was based on ground observations. Over the past 20 to 25 years, Earth satellites have been used extensively to study natural objects, including lakes, and the processes occurring on them. However, satellite observations on lakes need to be calibrated and validated from ground measurements.

In 2017, a major international program of the European Space Agency Climate Change Initiative (CCI) was launched. Under this program, the Lakes_cci project is being implemented to explore lakes using satellites, which was launched in February 2019 and is designed for three years. The LEGOS laboratory and SHI are involved in this project, which aims to develop a satellite methodology for determining the following variables constituting the essential climate variable ECV-Lakes (under the Global Climate Observing System (GCOS) international programme):

- Lake Water Level (LWL): determines the balance between inflow and outflow of the lake;
- Lake Water Extent (LWE): a proxy for change in glacial regions (lake expansion) and drought in many arid environments;
- Lake Surface Water temperature (LSWT): correlated with regional air temperatures;
- Lake Ice Cover (LIC): changing freezing times in autumn and melting in spring is an indicator of climate change;
- Lake Water-Leaving Reflectance (LWLR): indicator of biogeochemical processes (for example, seasonal fluctuations in phytoplankton biomass) and frequency of extreme events.

The overall goal of the Lakes_cci project is to prepare and perform the correction and validation of the above variables. The project is aimed at a sufficiently long period of combined satellite observations, including the acquisition and rapid processing of satellite data, with the ultimate aim of establishing a single technological complex for processing satellite information.

The main goal of the **first phase** of the project was to provide consumers with a set of homogeneous variables of the indicator ECV-Lakes in terms of content, format and time period. This stage was completed: https://catalogue.ceda.ac.uk/uuid/3c324bb4ee394d0d876fe2e1db217378. Given the number of parameters, the work was based on the experience of previous similar projects, without taking full account of user requirements and developing new algorithms.

In the **second phase** of the project, the database will be upgraded to take account of consumer requirements, the application of new data processing algorithms and the expansion of the composition of lakes (currently 250 lakes are in the project database). Quality control of satellite data is an important part of the work. The LEGOS laboratory and HYDROLARE work with the sets of ground and satellite data for monitoring the water level of Russian lakes. The main focus is on the water bodies of the North-West of Russia: large (Ladoga, Onega, Ilmen) and medium-sized (Segozerskoe, Kumskoe, Verkhnee Kujto, Vygozero, etc.). The first results of the comparison of these data showed good consistency and, in most cases, sufficient accuracy of satellite data, especially when considering large lakes (fig. 3, 4).

The same result applies to smaller lakes when using modern altimeters installed on the Sentinel 3A and Sentinel 3B satellites. In addition, the sharing of ground-based and satellite-based measurements provides long and continuous multi-year data series on lake water levels, as available satellite measurements fill gaps in the absence of ground-based measurements. This allows continuous monitoring of lake levels, including recent years.

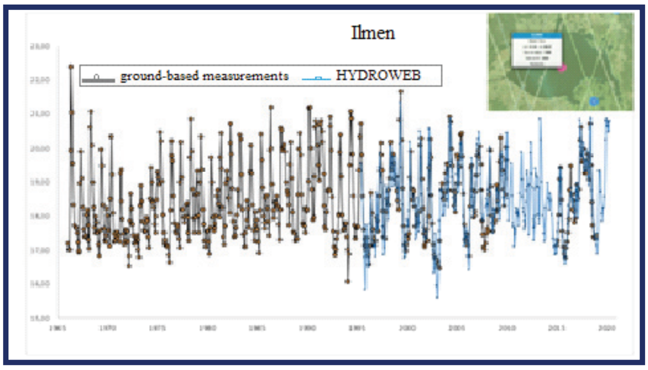

Fig. 3. Lake Ilmen water level by ground and satellite altimetry

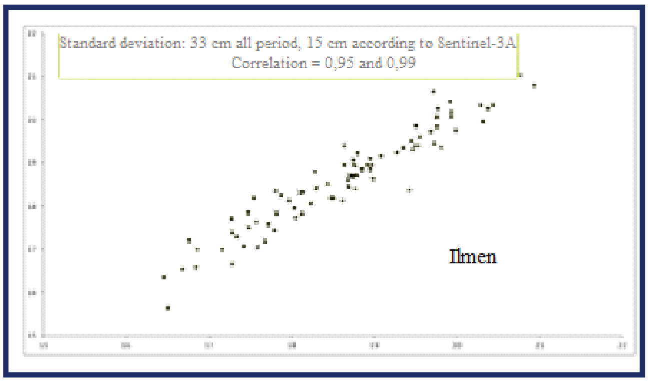

Fig. 4. Water level comparison for ground measurements (X-axis) and altimetry (Y-axis) for Lake Ilmen

CHRONICLE

The seventh meeting of the HYDROLARE Steering Committee was not held in 2020 due to the coronavirus pandemic.
It is planned to be held in Saint Petersburg in October 2021.