

climate change initiative

→ LAKES



7th LAKES 2024 Workshop




# CCI\_lakes project: exploring satellite dataset



**lakes**  
cci



ESA UNCLASSIFIED – For ESA Official Use Only



→ THE EUROPEAN SPACE AGENCY



- Where and how to download the dataset?
  - CEDA Archive
  
- How to download the dataset for a lake and a variable?
  - Jupiter notebook (Github) & Binder
  
- How to visualize and query the dataset?
  - WebGIS Portal
  - Global Climate Dashboard



# Data overview





## Key facts about CRDP v2.1

- 1992-2022, 1km (1/120 degrees), 2024 lakes in a single global netCDF
- > 11k files, 768 GB (with data compression)
- The list those of lakes, including their location and thematic ECV data availability for version 2.1.0 can be downloaded in csv format (lakescci\_v2.1\_metadata) or shp format (lakescci\_v2.1\_shp)

The official source for the latest version of the lakes\_cci dataset (V2.1.0) is at the Centre for Environmental Data Analysis (CEDA): <https://catalogue.ceda.ac.uk/uuid/7fc9df8070d34cacab8092e45ef276f1>.

CEDA offers multiple download mechanisms and ways to extract a set of variables, or data for a specific Access:

 Dataset

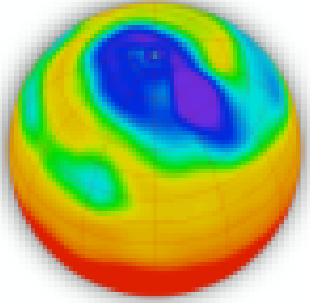
 **ESA** Lakes Climate Change Initiative  
(Lakes\_cci): Lake products, Version 2.1

[View XML](#)

Open Access  Download

Update Frequency:	Not Planned
Status:	Completed
Online Status:	ONLINE
Publication State:	Citable
Publication Date:	2024-04-03
DOI Publication Date:	2024-04-04
Download Stats:	last 12 months
Dataset Size:	11.06K Files   768GB





## CEDA Archive

The **Lakes Climate Change Initiative (Lakes\_cci)** by ESA, hosted by CEDA, uses satellite data from 1992–2022 to study over 2000 lakes globally.

It examines six essential climate variables:

- Water level
- Extent
- Surface temperature
- Ice cover
- Reflectance
- Ice thickness.

These datasets help analyze regional and global climate impacts and are freely available for scientific research.



# Filezilla FTP - Connection



FileZilla interface showing a connection to an FTP server. The status bar at the bottom indicates "Coda: vuota" (Queue empty). A green arrow points to the "Connessione rapida" button.

Host: on-ftp.ceda.ac.uk Nome utente: Password: Porta: Connessione rapida

Stato: Recupero elenco cartella di "/neodc"...

Stato: Elenco cartella di "/neodc" completato

Stato: Recupero elenco cartella di "/neodc/esacci"...

Stato: Elenco cartella di "/neodc/esacci" completato

Sito locale: C:\Users\ \

Sito remoto: /neodc/esacci

Nome file	Dimensi...	Tipo file	Ultima modifica
..			
.config		Cartella di file	28/10/2018 09:...
.fontconfig		Cartella di file	16/11/2020 16:...
.gsutil		Cartella di file	19/04/2022 14:...
.idl		Cartella di file	12/01/2023 16:...
.matplotlib		Cartella di file	18/02/2023 16:...
.ms-ad		Cartella di file	23/06/2022 11:...
.prefs		Cartella di file	11/08/2019 22:...
.snap		Cartella di file	14/10/2024 15:...
.unidata		Cartella di file	13/03/2022 11:...
.vscode		Cartella di file	01/09/2018 16:...

11 file e 43 cartelle. Dimensione totale: 39.681.779 byte

Nome file	Dimensi...	Tipo file	Ultima mod...
..			
aerosol		Cartella ...	13/02/2019...
biomass		Cartella ...	25/07/2024...
cloud		Cartella ...	13/02/2019...
fire		Cartella ...	04/11/2019...
ghg		Cartella ...	26/11/2019...
glaciers		Cartella ...	06/08/2019...
high_resolution_land_cover		Cartella ...	19/01/2024...
ice_sheets_antarctica		Cartella ...	28/11/2019...
ice_sheets_greenland		Cartella ...	13/02/2019...

3 file e 27 cartelle. Dimensione totale: 2.037 byte

File server/locale Direzi... File remoto Dimensi... Priorità Stato

File in coda Trasferimenti non completati Trasferimenti completati

Coda: vuota





# Filezilla FTP - Sharing Data



Sito remoto: /neodc/esacci/lakes/data/lake\_products/L3S/v2.1/merged\_product/2022/03

Sito locale: D:\ \CNR\

2021  
2022  
01  
02  
03  
04

Nome file	Dimensi...	Tipo file	Ultima modifica	Dimensi...	Tipo file	Ultima mod...	Permessi	Propriete
..								
ESACCI-LAKES-L3S-...	122.510....	File NC	19/11/2024 16:...	S-L3S-LK_PRODUCTS-MERGED-20220301-f...	122.510....	File NC	05/03/2024...	adfrw (0... ftp ftp
ESACCI-LAKES-L3S-...	126.962....	File NC	19/11/2024 16:...	S-L3S-LK_PRODUCTS-MERGED-20220302-f...	126.962....	File NC	05/03/2024...	adfrw (0... ftp ftp
ESACCI-LAKES-L3S-...	144.141....	File NC	19/11/2024 16:...	S-L3S-LK_PRODUCTS-MERGED-20220303-f...	144.141....	File NC	05/03/2024...	adfrw (0... ftp ftp
ESACCI-LAKES-L3S-...	150.252....	File NC	19/11/2024 16:...	S-L3S-LK_PRODUCTS-MERGED-20220304-f...	150.252....	File NC	05/03/2024...	adfrw (0... ftp ftp
ESACCI-LAKES-L3S-...	114.164....	File NC	19/11/2024 16:...	S-L3S-LK_PRODUCTS-MERGED-20220305-f...	114.164....	File NC	05/03/2024...	adfrw (0... ftp ftp
ESACCI-LAKES-L3S-...	128.039....	File NC	19/11/2024 16:...	S-L3S-LK_PRODUCTS-MERGED-20220306-f...	128.039....	File NC	05/03/2024...	adfrw (0... ftp ftp
ESACCI-LAKES-L3S-...	127.167....	File NC	19/11/2024 16:...	S-L3S-LK_PRODUCTS-MERGED-20220307-f...	127.167....	File NC	05/03/2024...	adfrw (0... ftp ftp
ESACCI-LAKES-L3S-...	155.909....	File NC	19/11/2024 16:...	S-L3S-LK_PRODUCTS-MERGED-20220308-f...	155.909....	File NC	05/03/2024...	adfrw (0... ftp ftp
ESACCI-LAKES-L3S-...	127.167....	File NC	19/11/2024 16:...	S-L3S-LK_PRODUCTS-MERGED-20220309-f...	118.984....	File NC	05/03/2024...	adfrw (0... ftp ftp
ESACCI-LAKES-L3S-...	155.909....	File NC	19/11/2024 16:...	S-L3S-LK_PRODUCTS-MERGED-20220310-f...	119.298....	File NC	05/03/2024...	adfrw (0... ftp ftp
				S-L3S-LK_PRODUCTS-MERGED-20220311-f...	136.503....	File NC	05/03/2024...	adfrw (0... ftp ftp

8 file - dimensione totale: 1.069.147.759 byte



File server/locale	Direzi...	File remoto	Dimensi...	Priorità	Stato
anon-ftp.ceda.ac.uk					
D:\	\...	<<-- /neodc/esacci/lakes/da...	126.962....	Norm...	Trasferimento in co...
	Trascorsi 00:00:08	Rimanenti 00:00:06	65.6%		83.361.792 byte (8,7 MiB/s)
D:\	\...	<<-- /neodc/esacci/lakes/da...	144.141....	Norm...	Trasferimento in co...
	Trascorsi 00:00:08	Rimanenti 00:00:16	26.9%		53.215.232 byte (5,9 MiB/s)





# Jupyter notebook examples

To explore some of the ways in which you can extract data for a specific lake or region, we offer a series of python scripts and a jupyter notebook.

These are intended to help new users familiarise themselves with data extraction for further analysis: **project code repository**.



[https://github.com/ccilakes/lakes\\_cci\\_tools](https://github.com/ccilakes/lakes_cci_tools)



# Github tools



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cci-lakes / lakes\_cci\_tools Public

Notifications Fork 5 Star 2

Code Issues 2 Pull requests 1 Actions Projects Security Insights

main 1 Branch 0 Tags

Go to file Code

File Name	Action	Time
cci-lakes	Add files via upload	4dd3b01 · 2 weeks ago 41 Commits
ESA_CCI_static_lake_mask_v2.1.nc	Add files via upload	last month
README.md	Update README.md	5 months ago
lakes_cci_binder.ipynb	Add files via upload	2 weeks ago
lakes_cci_data_availability.ipynb	Add files via upload	5 months ago
lakes_cci_download.ipynb	Update lakes_cci_download.ipynb	last year
lakes_cci_download1lake_by_id.ipynb	Update lakes_cci_download1lake_by_id.ipynb	last year
lakes_cci_download1variable1lake_by_id.ipynb	Add files via upload	7 months ago
lakes_cci_mean_timeseries.ipynb	Update lakes_cci_mean_timeseries.ipynb	5 months ago
lakes_cci_mean_timeseries_nc.ipynb	Add files via upload	last month

**About**  
No description, website, or topics provided.

- Readme
- Activity
- 2 stars
- 1 watching
- 5 forks

Report repository

**Releases**  
No releases published

**Packages**  
No packages published







# binder

Turn a Git repo into a collection of interactive notebooks

Have a repository full of Jupyter notebooks? With Binder, open those notebooks in an executable environment, making your code immediately reproducible by anyone, anywhere.

New to Binder? Get started with a [Zero-to-Binder tutorial](#) in Julia, Python, or R.

## Build and launch a repository

GitHub repository name or URL


GitHub ▾

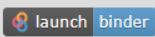

Git ref (branch, tag, or commit)

Path to a notebook file (optional)

File ▾

Copy the URL below and share your Binder with others:



Expand to see the text below, paste it into your README to show a binder badge:  



# Jupyter - Scripts



File Edit View Run Kernel Tabs Settings Help

Filter files by name

Name

- ESA\_CCI\_static\_lake\_mask\_v2.1.nc
- lakes\_cci\_binder.ipynb
- lakes\_cci\_data\_availability.ipynb
- lakes\_cci\_download.ipynb
- lakes\_cci\_download1lake\_by\_id.ipynb
- lakes\_cci\_download1variable1lake\_by\_id.ipynb
- lakes\_cci\_mean\_timeseries\_nc.ipynb**
- lakes\_cci\_mean\_timeseries.ipynb
- README.md
- requirements.txt

Launcher

Description

This script allows to generate a timeseries of the mean value of a variable for a lake\_id for lakes\_cci version 2.1.0

INPUT:

- The identifier of the lake. The id of the lake is indicated in the csv file containing lake metadata. This file is available at the project website: [https://dap.ceda.ac.uk/neodc/esacci/lakes/data/lake\\_products/L3S/v2.0.1/ESA\\_CCI\\_static\\_lake\\_mask\\_v2.1.0\\_metadata.csv](https://dap.ceda.ac.uk/neodc/esacci/lakes/data/lake_products/L3S/v2.0.1/ESA_CCI_static_lake_mask_v2.1.0_metadata.csv)

This also produces a .netcdf file. (Beta feature under testing)

Reference: Carrea, L.; Crétaux, J.-F.; Liu, X.; Wu, Y.; Bergé-Nguyen, M.; Calmettes, B.; Duguay, C.; Jiang, D.; Merchant, C.J.; Mueller, D.; Selmes, N.; Simis, S.; Spyarakos, E.; Stelzer, K.; Warren, M.; Yesou, H.; Zhang, D. (2022): ESA Lakes Climate Change Initiative (Lakes\_cci): Lake products, Version 2.1.0. NERC EDS Centre

Simple 0 4 Python 3 (ipykernel) | Idle Mem: 275.63 / 2048.00 MB Mode: Command Ln 1, Col 1 lakes\_cci\_mean\_timeseries\_nc.ipynb 1





# Jupyter - Outputs



The screenshot shows a Jupyter Notebook window titled 'lakes\_cci\_binder.ipynb'. The left sidebar displays a file explorer with a search bar and a list of files, including 'lakes\_cci\_binder.ipynb' which is selected. The main area shows a code cell with the following code:

```
[21]: #####  
# Two metrics can also be visualised in a single plot  
#####  
  
varname = "lake_surface_water_temperature"  
ds_data[varname].max(("lon", "lat")).plot(marker='o', label = 'max')  
ds_data[varname].min(("lon", "lat")).plot(marker='o', label = 'min')  
plt.legend()
```

The output of the code cell is a legend object: `[21]: <matplotlib.legend.Legend at 0x7a40bca8bbe0>`. Below the code is a line plot showing 'lake\_surface\_water temperature' on the y-axis (ranging from 285 to 315) against 'time' on the x-axis (ranging from 0 to 30). The plot features two data series: 'max' (blue line with circular markers) and 'min' (orange line with circular markers). The 'max' series fluctuates between approximately 300 and 315, while the 'min' series fluctuates between approximately 285 and 300. A legend in the bottom right corner of the plot identifies the two series.

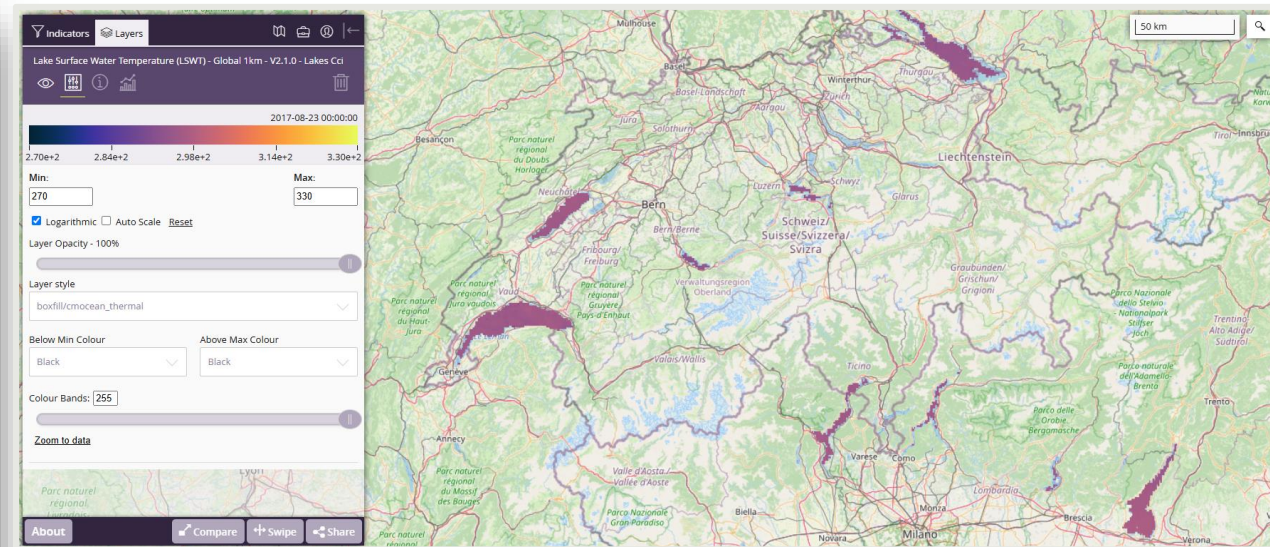
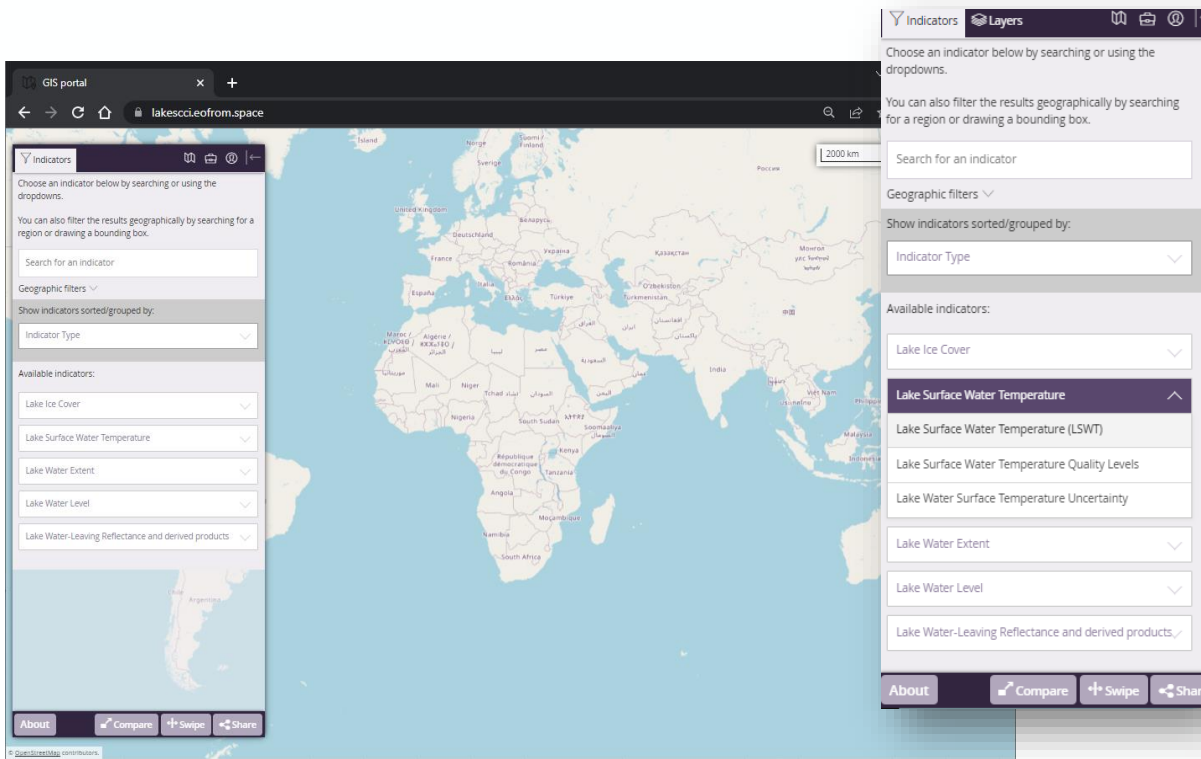
A yellow callout box on the right side of the plot contains the text: "Plotting one or more metrics for the time frame."

At the bottom of the Jupyter interface, the status bar shows: "Simple", "0 \$ 0", "No Kernel | Unknown", "Mem: 101.25 / 2048.00 MB", "Mode: Command", "Ln 11, Col 1", "lakes\_cci\_binder.ipynb", and "1".





- For **intuitive data visualisation** and browsing versions 2.0.2 and v2.1.0
- Analysis and download functionality are limited by the large data volume hosted



<https://lakescci.eofrom.space>





## Analysis:

- Generate time series plots and animations in a lightweight GIS
- This calls the WCS server, completion time is indicated when generating a new plot – unless data are cached this takes time!
- Plots are stored with your session if logged in (good for demos)
- Note: this shows all data regardless of quality level / uncertainty

**Indicators Layers**

Lake Surface Water Temperature (LSWT) - 1km - Lakes Cci

Scale - Kelvin 2018-07-25 00:00:00

ANALYSIS  
You can use this panel to produce a range of different plot types or to export data in netCDF format. To refine the data before analysis you can use the controls below, or just jump to 'Make new plot' for the entire spatial extent

**DRAW AN AREA**  
Draw a box or any other shape using your mouse

**ENTER COORDINATES**  
Coordinates (in metres) for a bounding box (left,bottom,right,top) or a [WKT POLYGON](#)

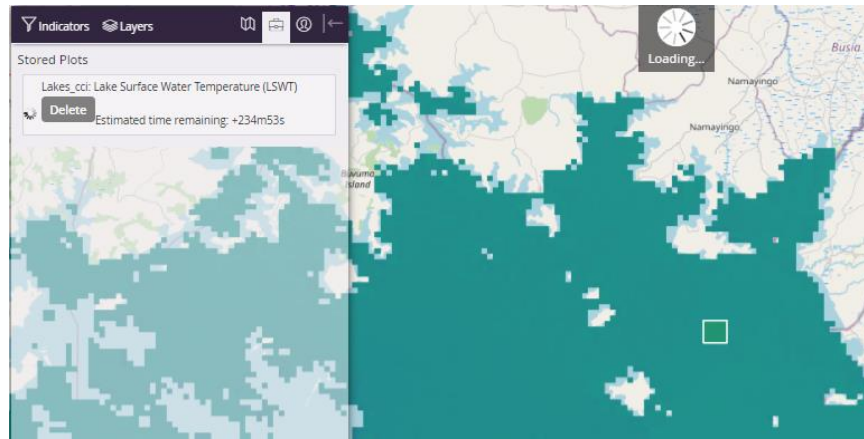
**DRAG & DROP**  
Drag a KML, GeoJSON, IGC, GPX, or TopoJSON file and drop it directly onto the map

**UPLOAD**  
[Login](#) to upload a shapefile or to save your analysis areas for a later visit

Download netCDF Make new plot

Clear Selection

About Compare Swipe Share

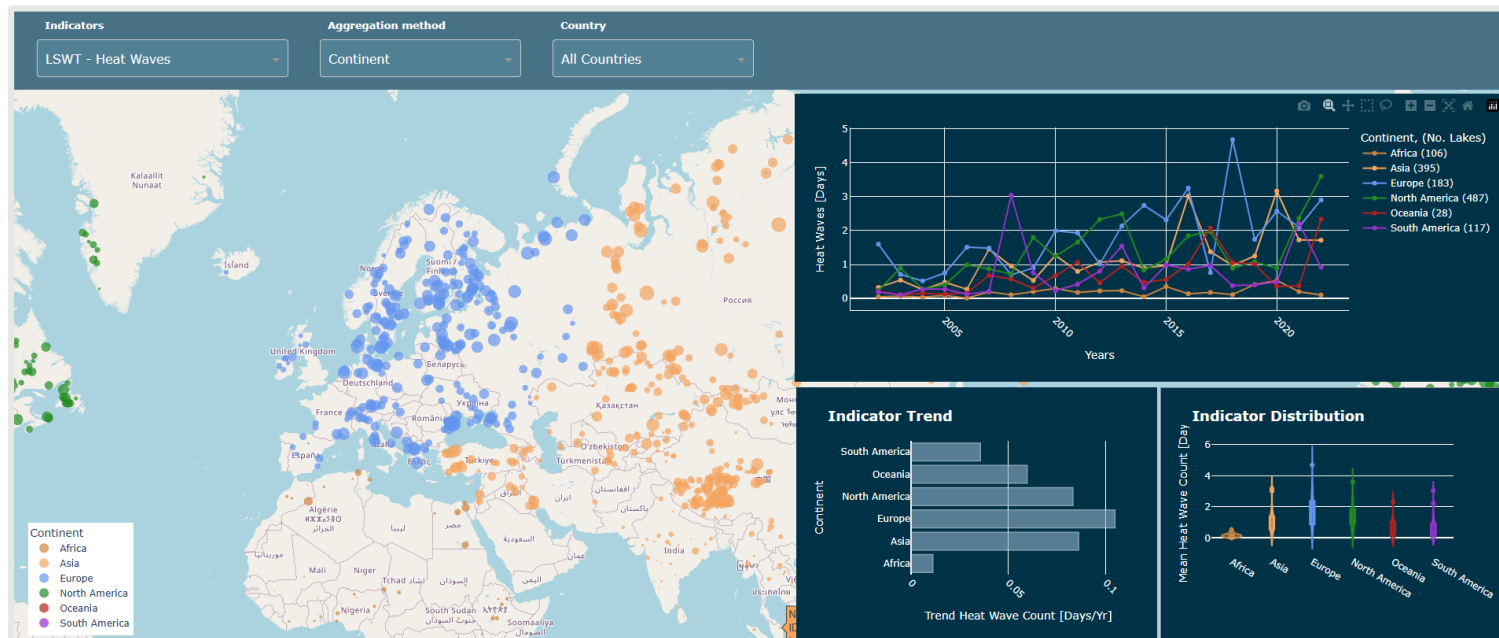


- Share an instance of your session with others



## Management and educational support

The Global Climate Indicators Dashboard provides intuitive visualization of change in lakes using a range of aggregation methods. Current indicators include the **LSWT anomaly**, **lake heat wave occurrences** and change in **ice-covered area**



<https://lakescci.climate-indicators.brockmann-consult.de>



# Further reading



The Climate Change Initiative provides a full set of documentation for each Essential Climate Variable:

All Lakes ECV documents are hosted on <https://climate.esa.int/en/projects/lakes/>

## **Product Specification**

User Requirements

System Description

## **Algorithm Theoretical Basis**

End-to-End ECV Uncertainty

Product Validation and Algorithm Selection

## **Product User Guide**

Product Validation Plan

Product Validation and Intercomparison Report

Climate Assessment Report





# State-of-the-art limitations



The Lakes\_cci dataset is state-of-the-art, but it is not perfect!

- Wide range of satellite instruments required – over 30 sensors, each discipline improved over time.
- Always use quality flags and masks provided – we do not know your application so we give you as much choice as possible.
- We uniquely look at product consistency across disciplines to improve quality flagging, e.g. water colour and non-freezing temperatures should not co-occur with ice.





# lakes cci

<http://climate.esa.int/projects/lakes>





Product	Spatial Resolution	Temporal Resolution	Temporal Coverage
LWL	N/A	1 to 10 days	1992 – 2022
LWE	10-30 m	1 to 10 days	1992 – 2022
LIC	250 m	Daily	2000 – 2022
LIT	10 km	1 to 10 days	2000 – 2022
LSWT	1 km	Up to daily	1995 – 2022
LWLR	300m – 1100 m	1-3 days	2002 - 2022

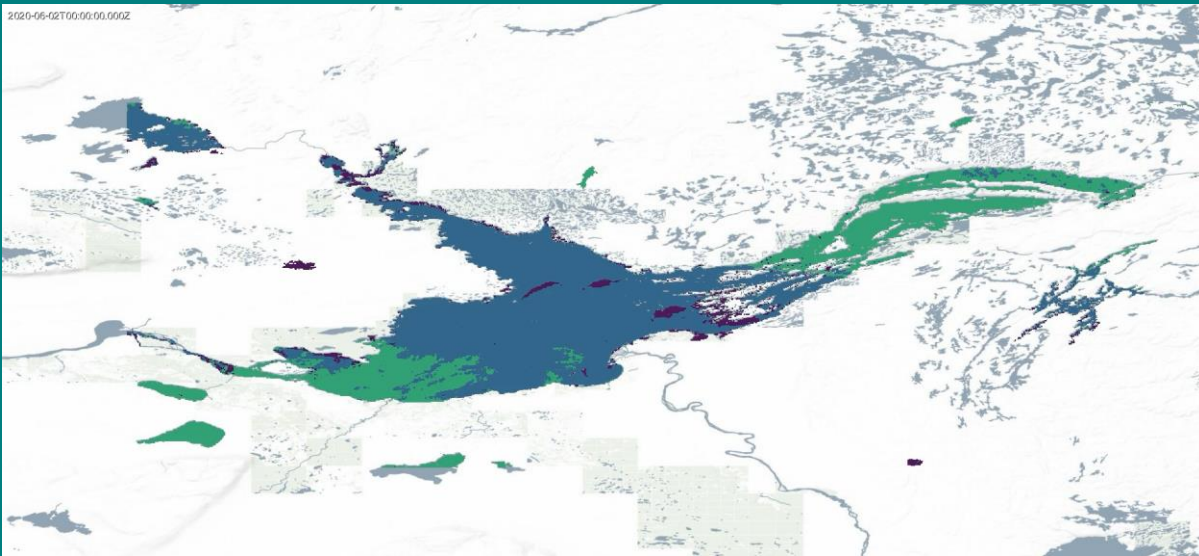


# Demo: LIC and LSWT at Great Slave Lake

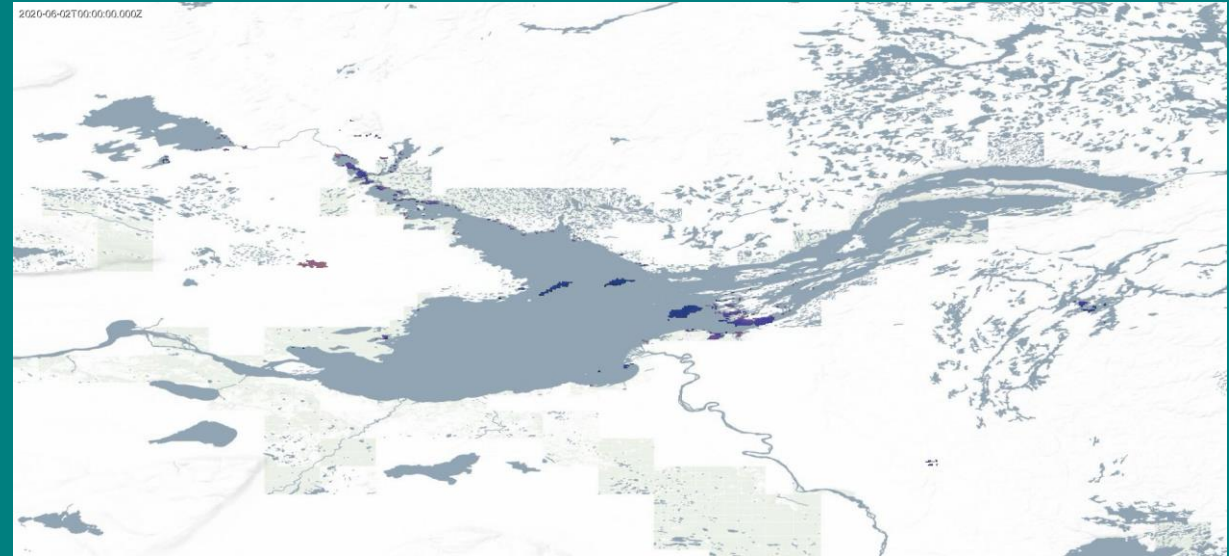


Animation: 2 June – 1 August 2020

Lake Ice Cover



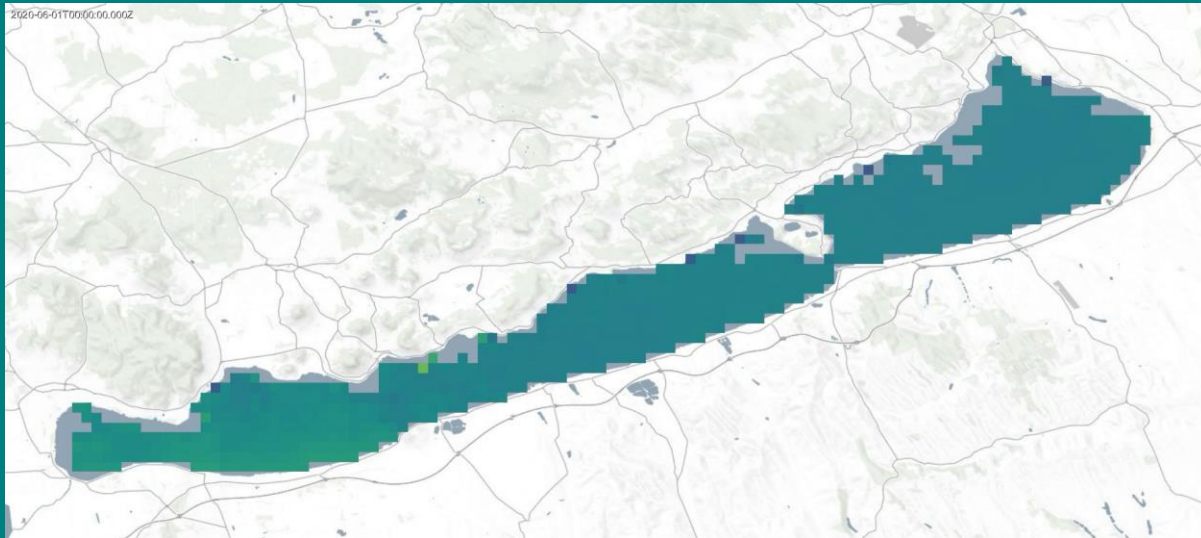
Lake Surface Water Temperature



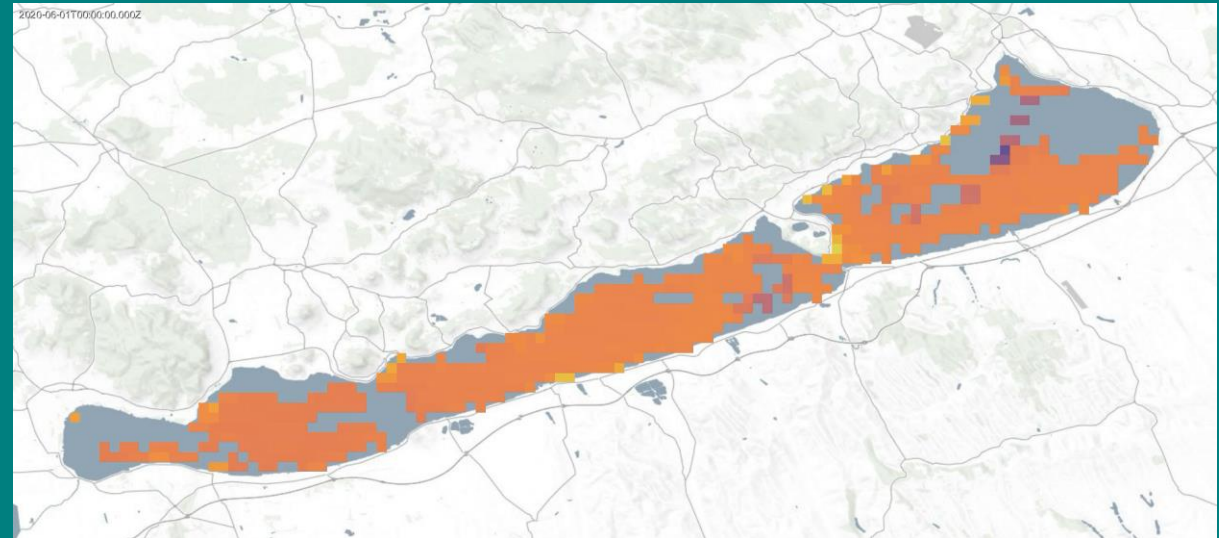


## Animation: 1 June – 1 August 2020

### Chlorophyll-a



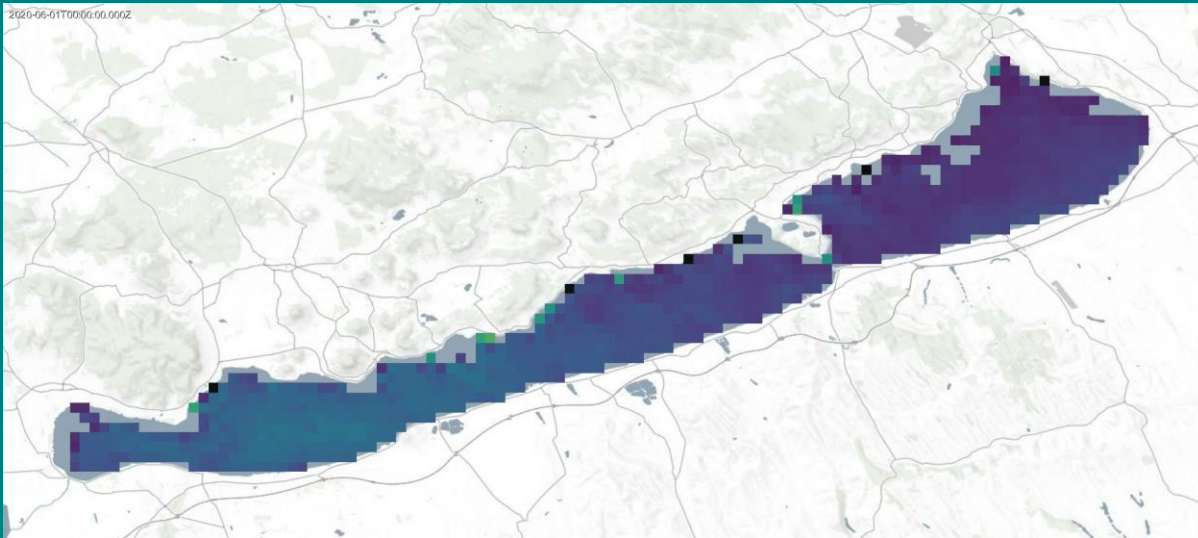
### Lake Surface Water Temperature





## Animation: 1 June – 1 August 2020

### Turbidity



### Lake Surface Water Temperature

