climate change initiative

→ LAKES

Lakes CCI

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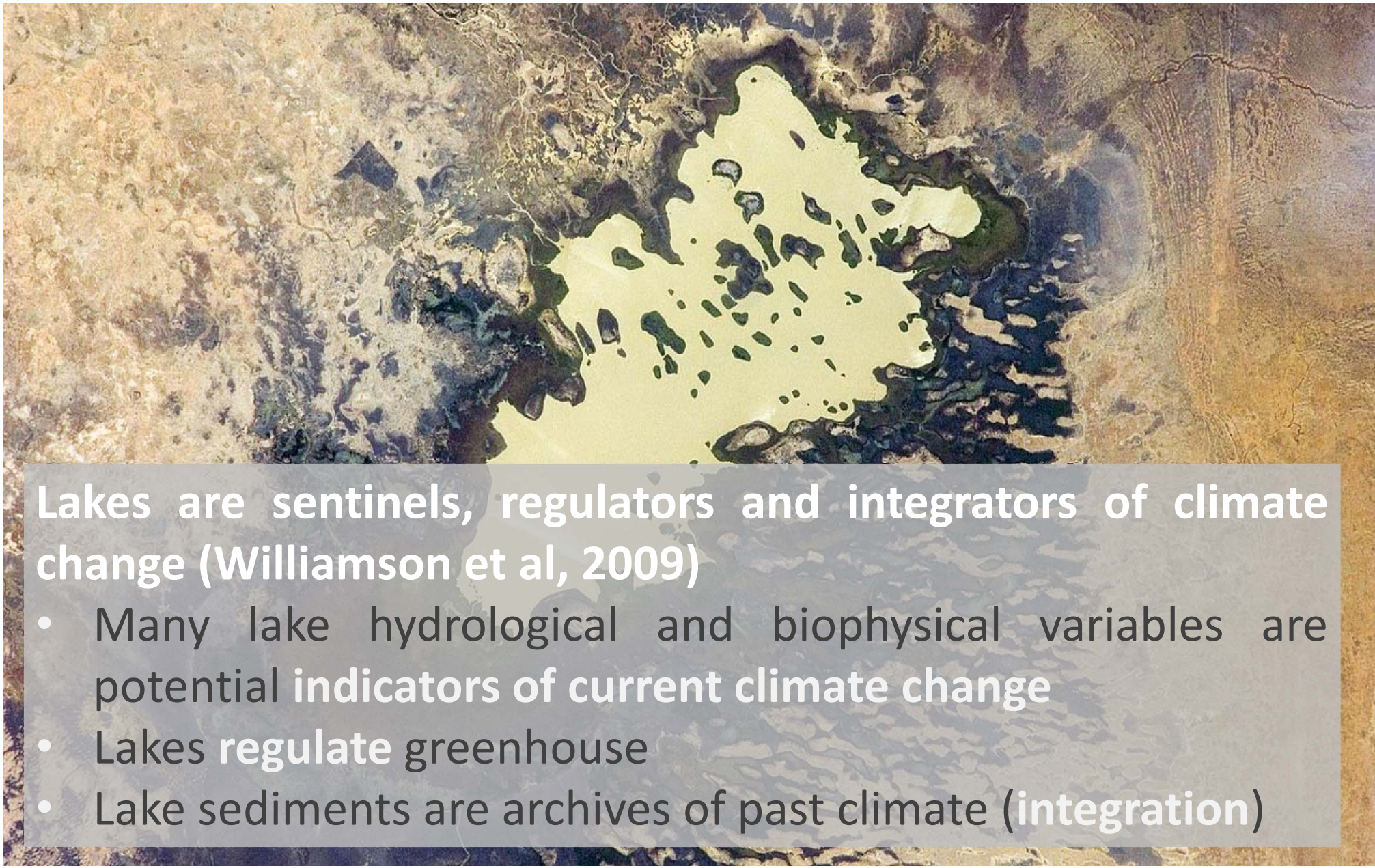

Lakes are sentinels, regulators and integrators of climate change (Williamson et al, 2009)

- Many lake hydrological and biophysical variables are potential **indicators of current climate change**
- Lakes **regulate** greenhouse
- Lake sediments are archives of past climate (**integration**)

Lakes Essential Climate Variables requirements (GCOS):

- Daily water **level** changes
- Daily water **extent** changes
- Weekly water **temperature**
- Weekly Water **colour**
- Freeze-up / break-up dates, monthly **ice** thickness

GCOS
GLOBAL CLIMATE OBSERVING SYSTEM

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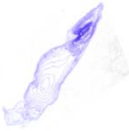
- Are these variables **measurable** from remote sensing **with sufficient confidence** to address climate questions?

- Need for **large and long observation dataset** to **disentangle natural and anthropogenic change**

→ Provide the first consistent, longest attainable time-series of the largest possible number of lakes covering all parameters under the Lakes ECV

ICE

LEVEL


EXTENT

COLOUR

TEMPERATURE

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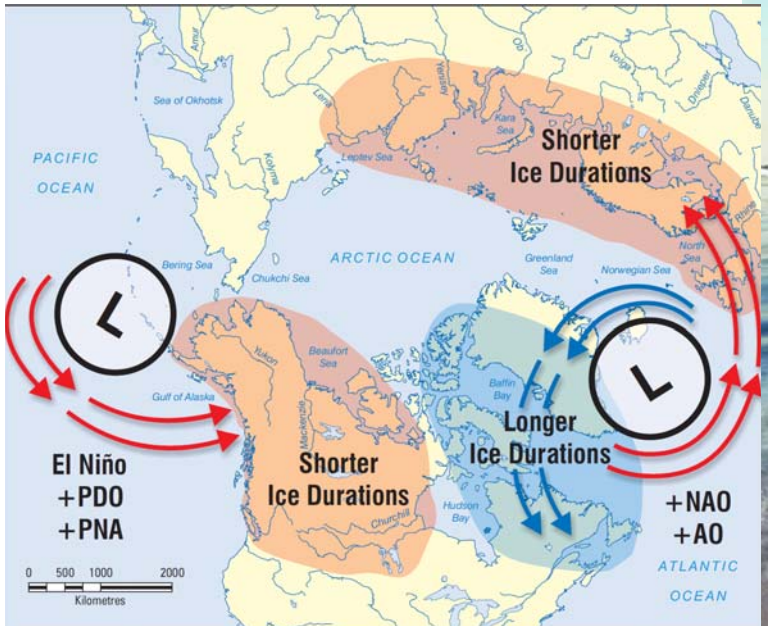
ICE

LEVEL

EXTENT

COLOUR

TEMPERATURE



Freeze-up/break-up, (ice duration) are robust indicators of climate variability and change

Ice cover extent/concentration has an important impact of lake-atmosphere interactions

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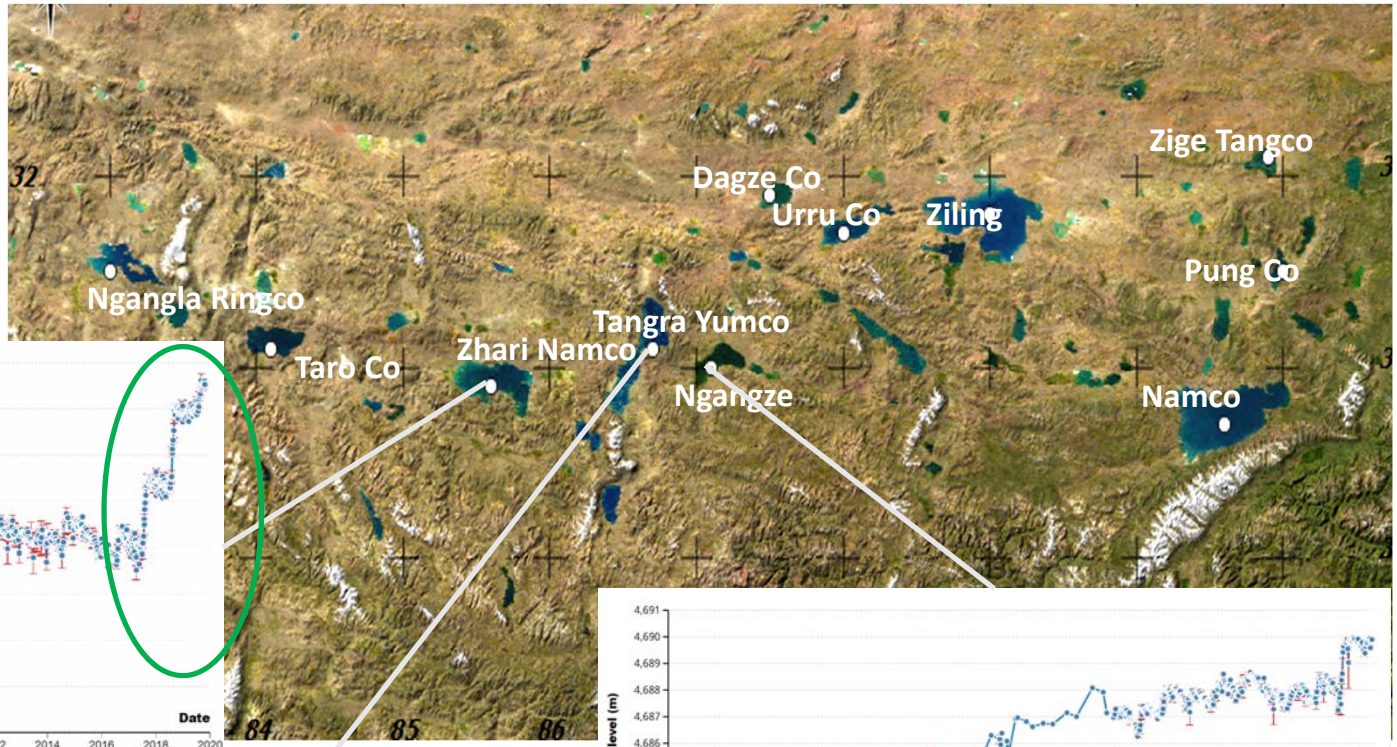

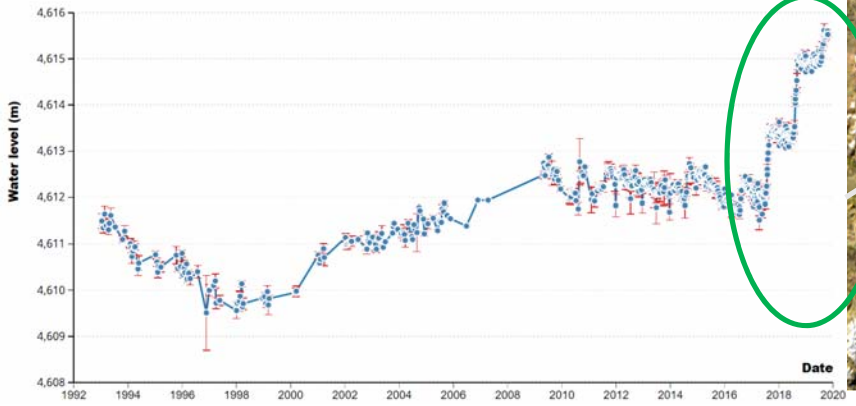

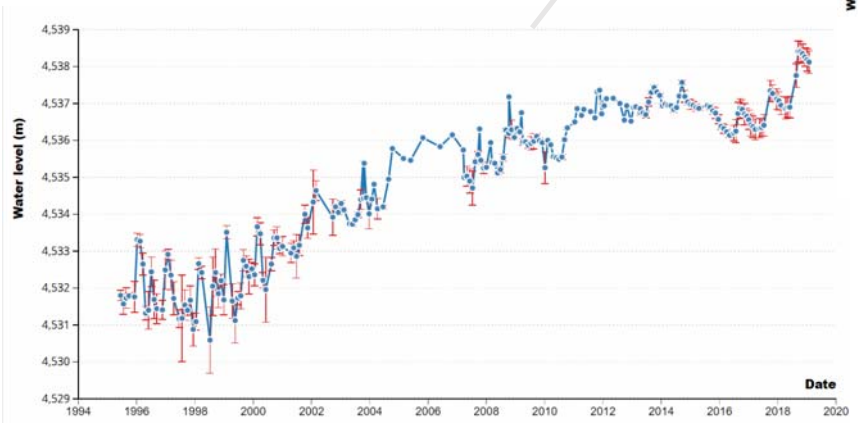

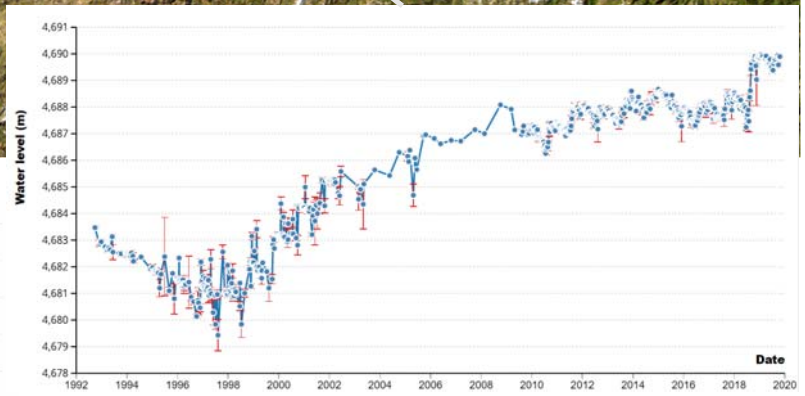

Changes in precipitations? Snow Melting? Glaciers

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ICE

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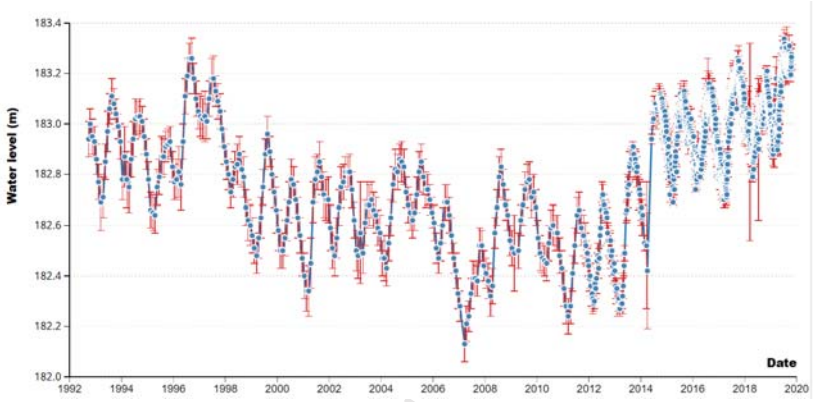

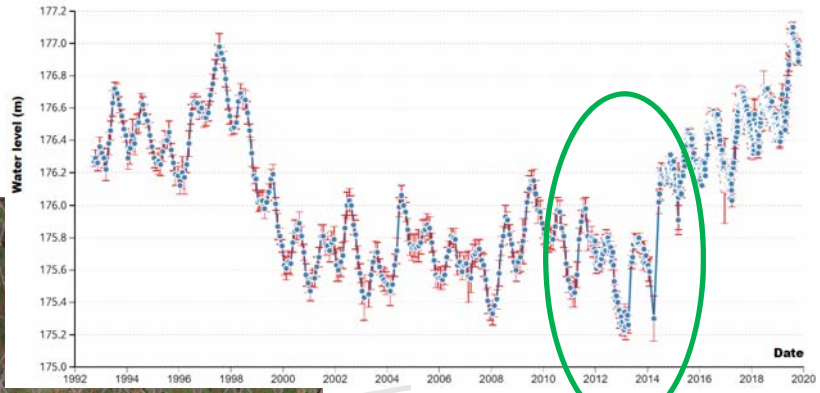

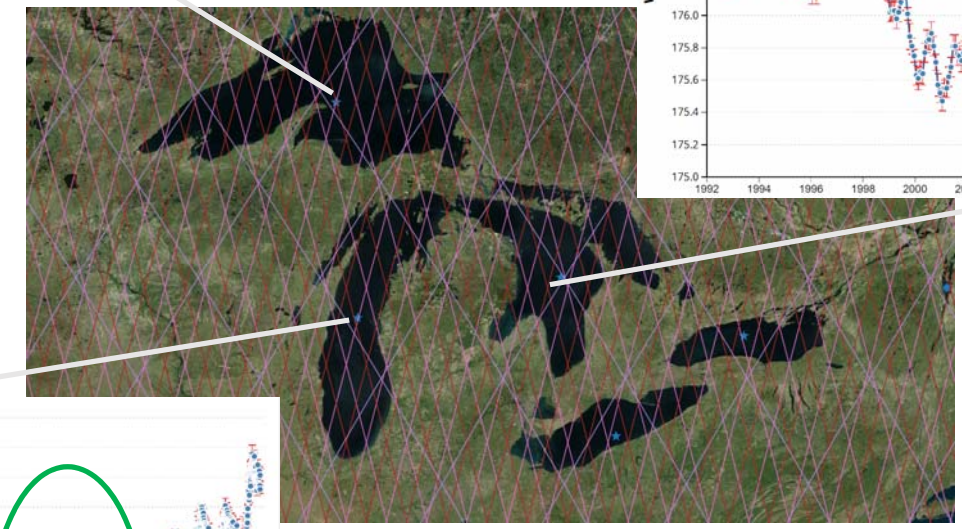

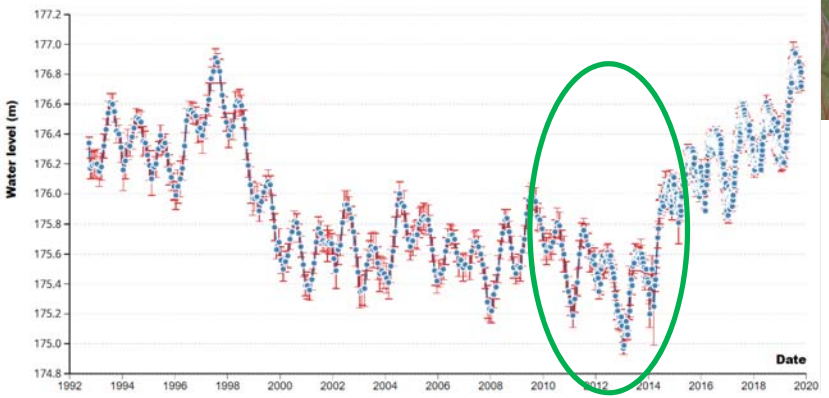

lack of a large snowpack in the winter coupled with very hot and dry conditions in the summer (source US Army Corps of Engineer)

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ICE

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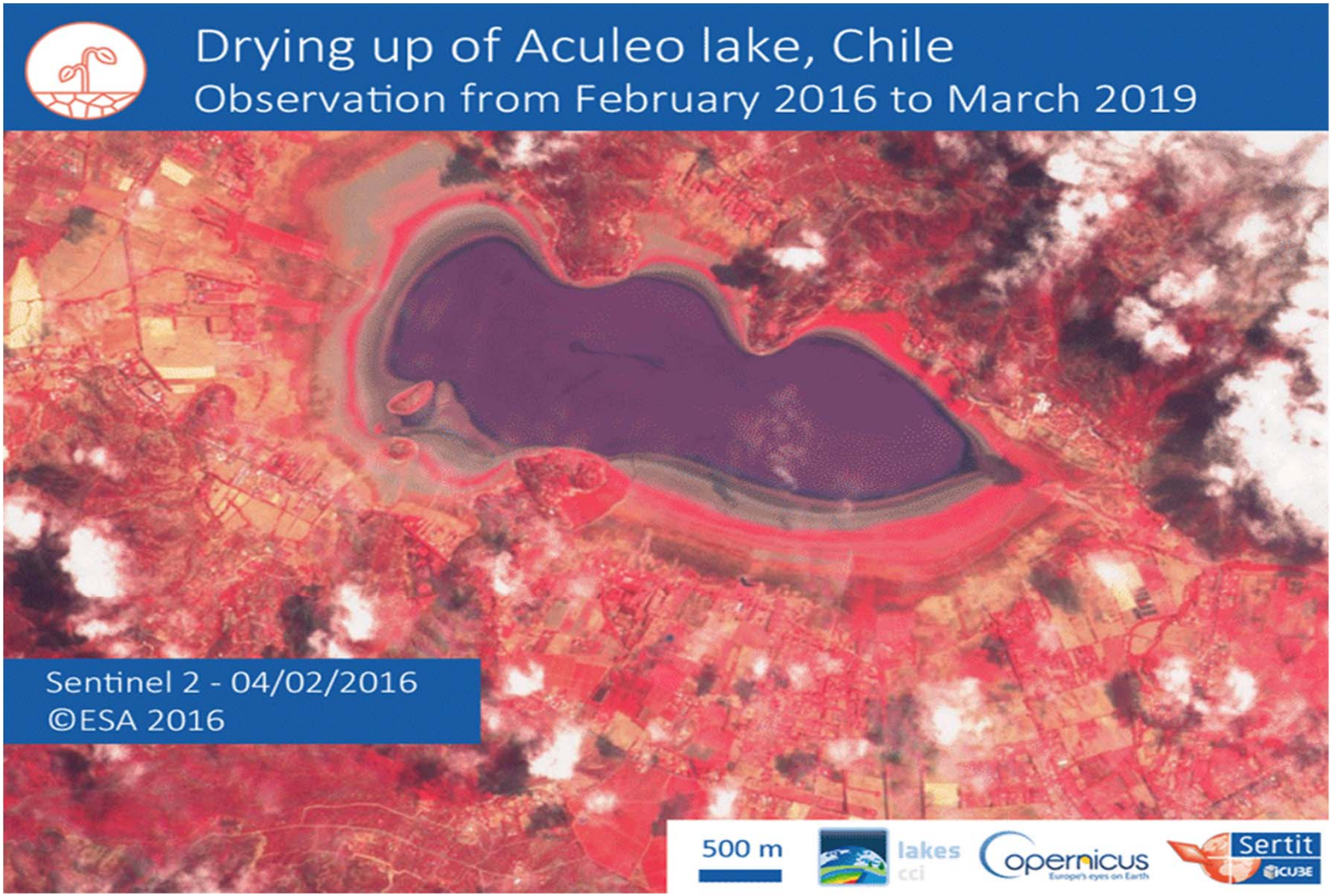

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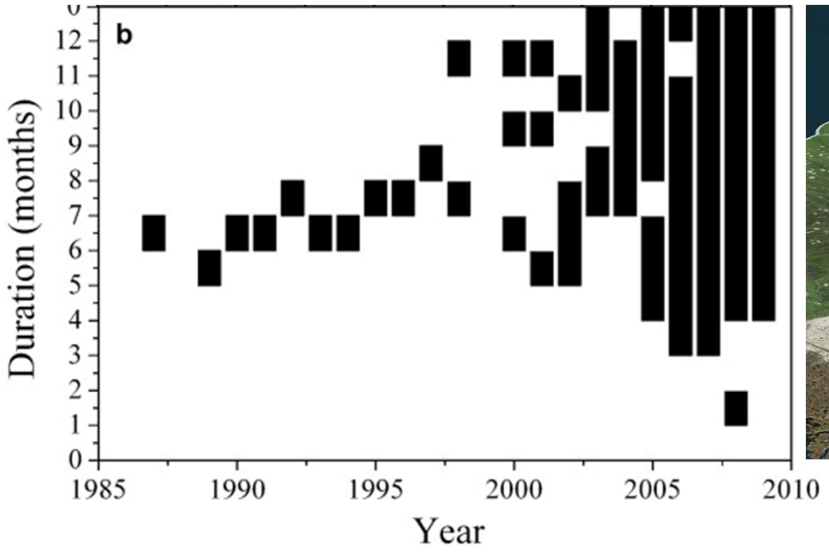
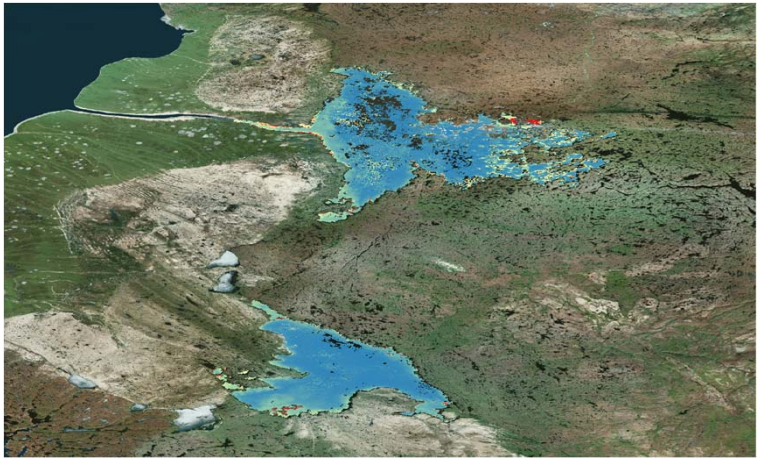
TEMPERATURE

Lake colour links the physical, chemical and biological processes

Seasonality and short-lived events (blooms) or long-term trends (eutrophication, brownification)**. Long time-series without gaps needed.**



Duration of cyanobacterial blooms in lake Taihu (RPC) from 1987 to 2009 (Zhang et al. 2012)



Lake Water Turbidity (Copernicus Global Land Product)

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ICE

LEVEL

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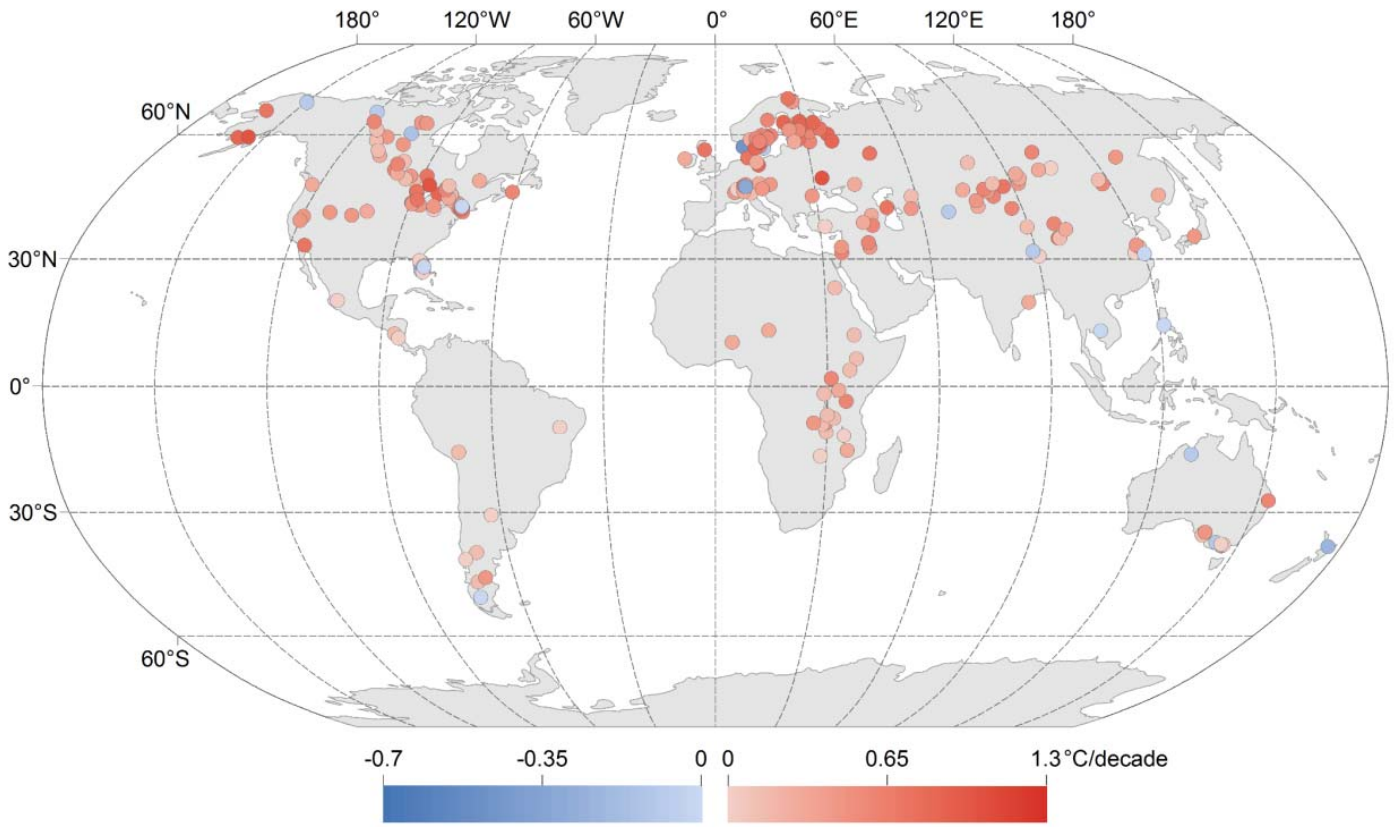
COLOUR

TEMPERATURE



Lake Surface Water Temperature trends, courtesy of O'Reilly

Lakes surface temperatures are increasing with a global average of 0.34 K/decade

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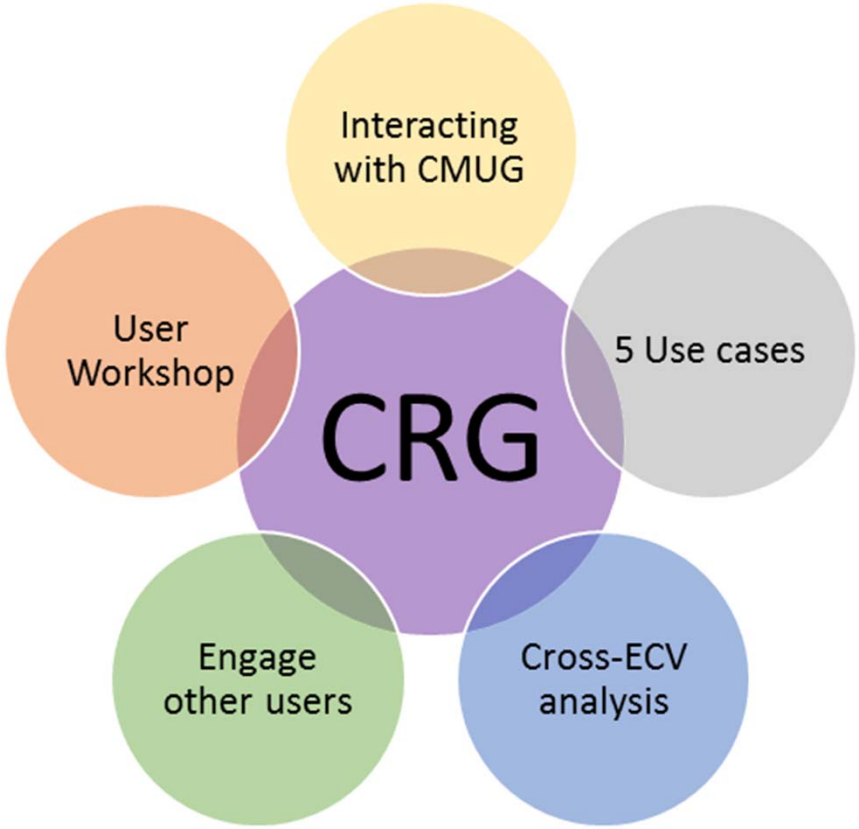

Target Users

- Climate modelers
- Lake scientists
- Catchment modelers
- Lake stakeholders

http://cci.esa.int/lakes

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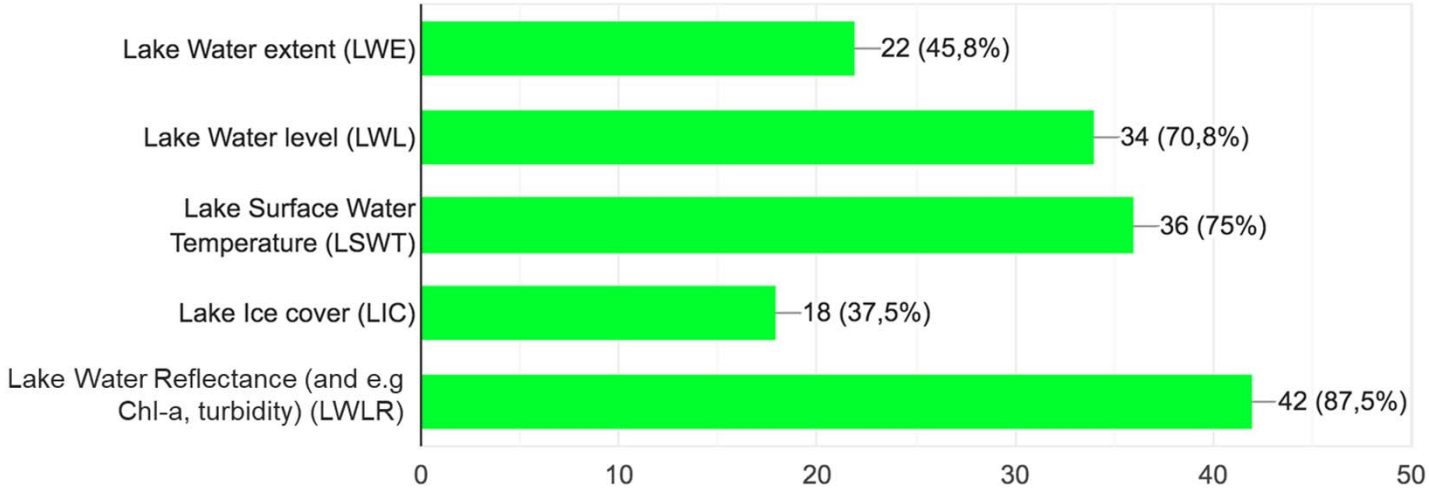
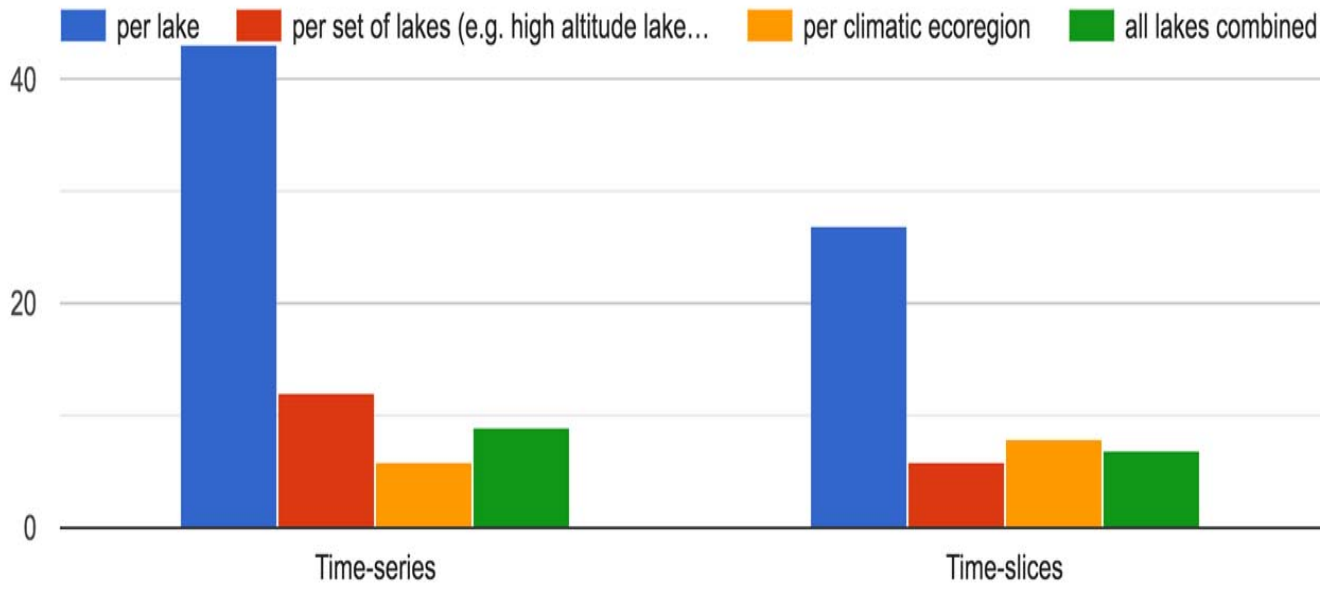
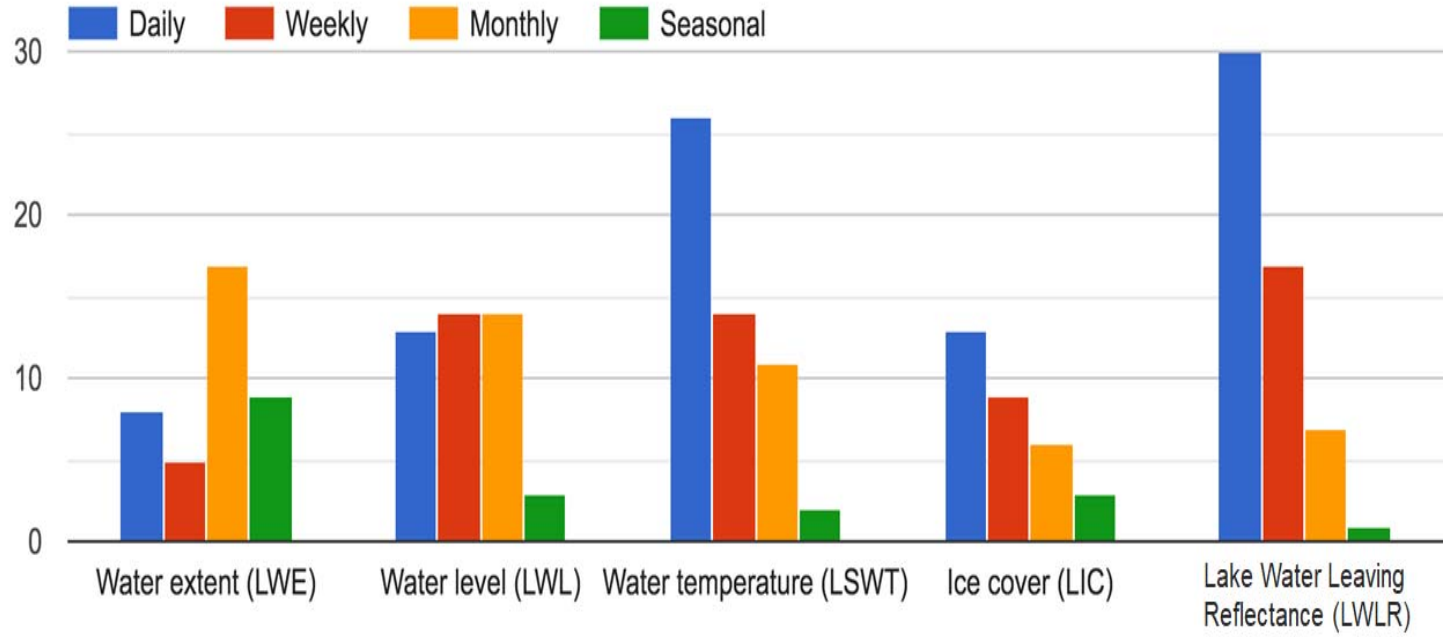
Users are interested in multiple lakes parameters



User Requirements on spatial aggregation



User requirements on temporal resolution



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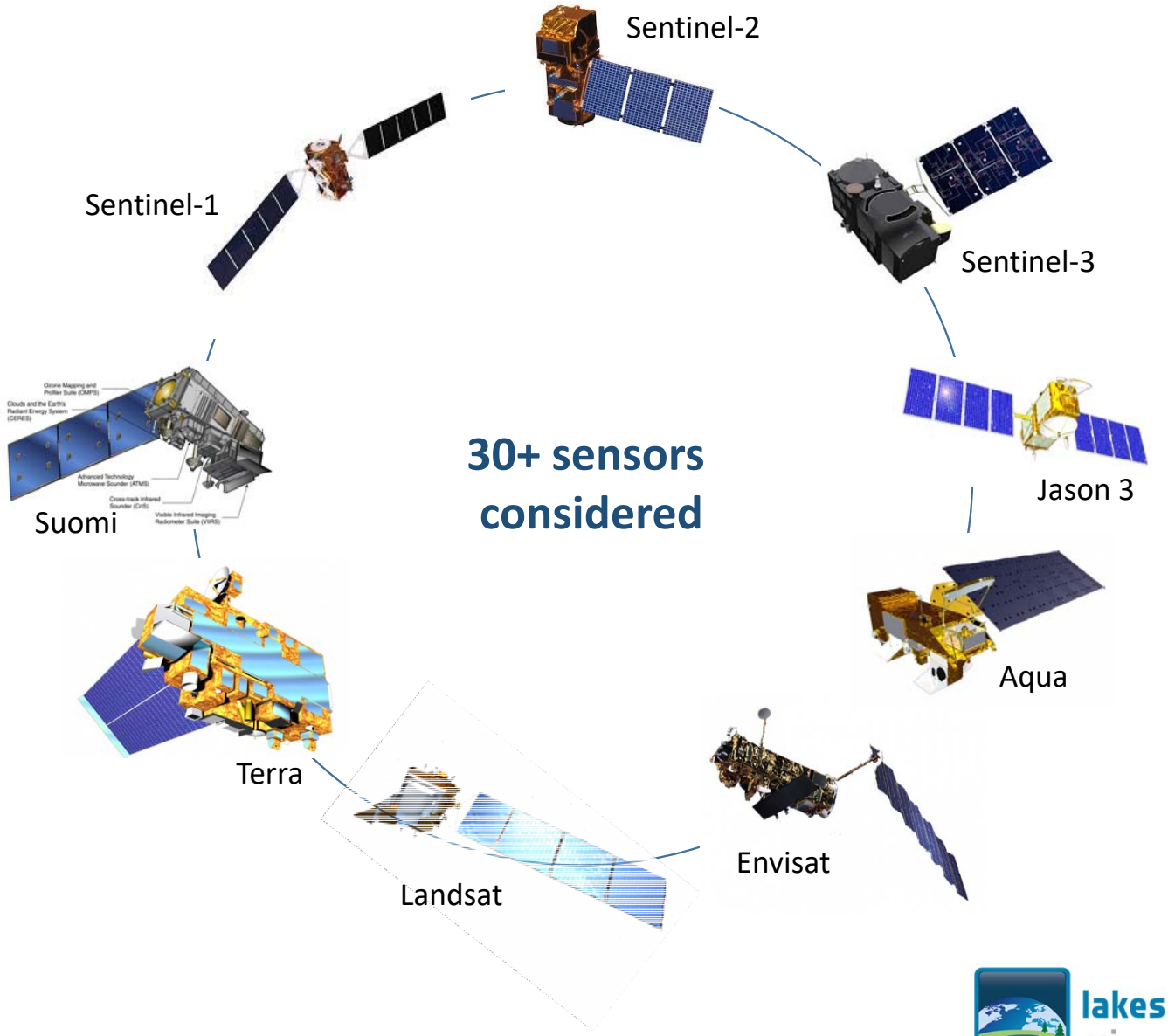
Project Dataset

Limitations:

- Observations are not synchronous,
- revisiting times differ,
- there are continuity issues (no-sensor gaps)
- There are standards discrepancies
- newer satellites offer more capabilities
- …



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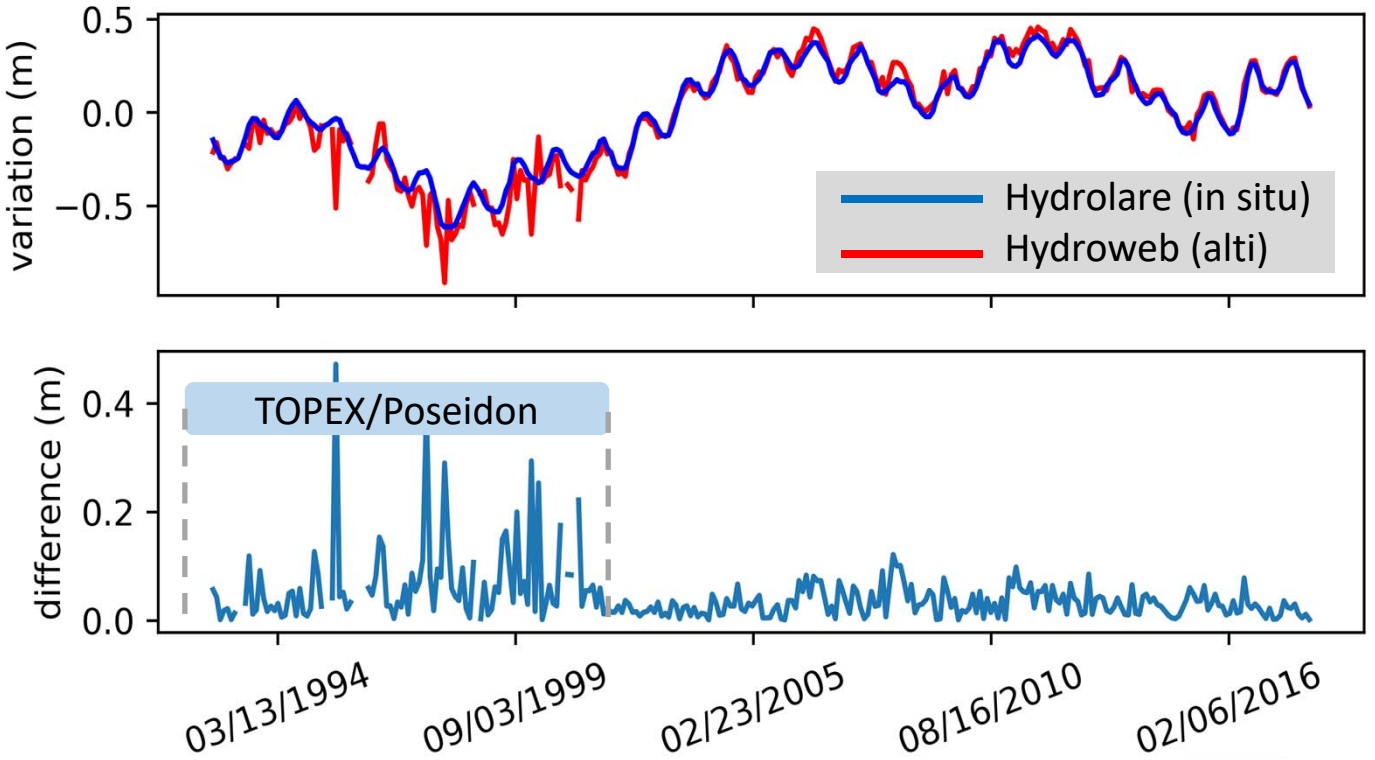
Example:

- Comparison between lake water level from altimetry (Hydroweb) and in situ (Hydrolare)
- → Uneven performance of altimetry dataset
- → Product should be improved thanks the TOPEX/Poseidon reprocessing

Lake Water Level – Issyk-Kul



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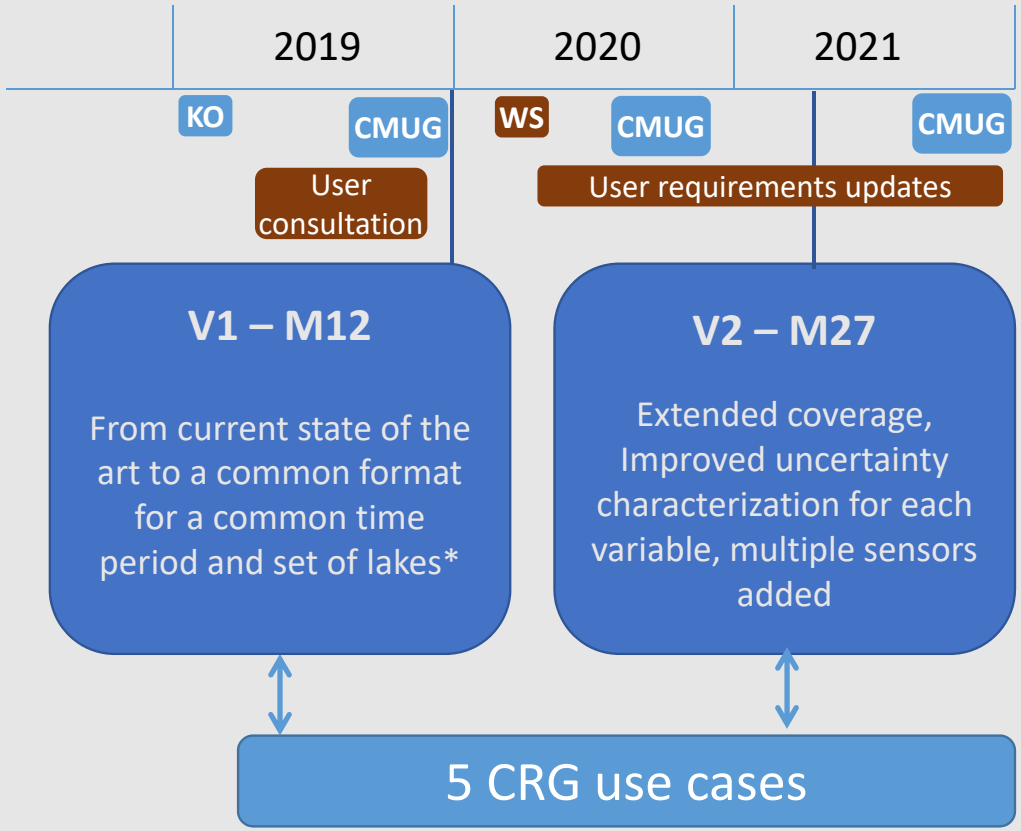

Innovations per production team:

- Adding satellite sensors into data set
- Improving **uncertainty characterization**
- Innovations for Lakes ECV consistency:
  - Optimizing **common output grids**
  - Identifying prominent data gaps
  - **Common and broad climatic coverage**
- Input (priorities) from CRG, CMUG and other user groups essential for v1 -> v2 evolution

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Climate Change Initiative - Lakes:
R&D activities for EO Lakes products

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cci.esa.int/lakes

esa

Copernicus Global Land Service - Lakes: Operational products

Land Monitoring

land.copernicus.eu

JRC

Copernicus Climate Change Service - Lakes: Operational Climate Data Records (NTC)

Climate Change Service

climate.copernicus.eu

ECMWF

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Outlook

- The variables needed to understand the role of the lakes in climate change are numerous: level, extent, temperatures, ice, water colour …etc
- A single consistent resource for Lake ECV data will be established thanks to remote sensing techniques: major challenge to align techniques and products
- Complementarity with in situ in terms of products and validation

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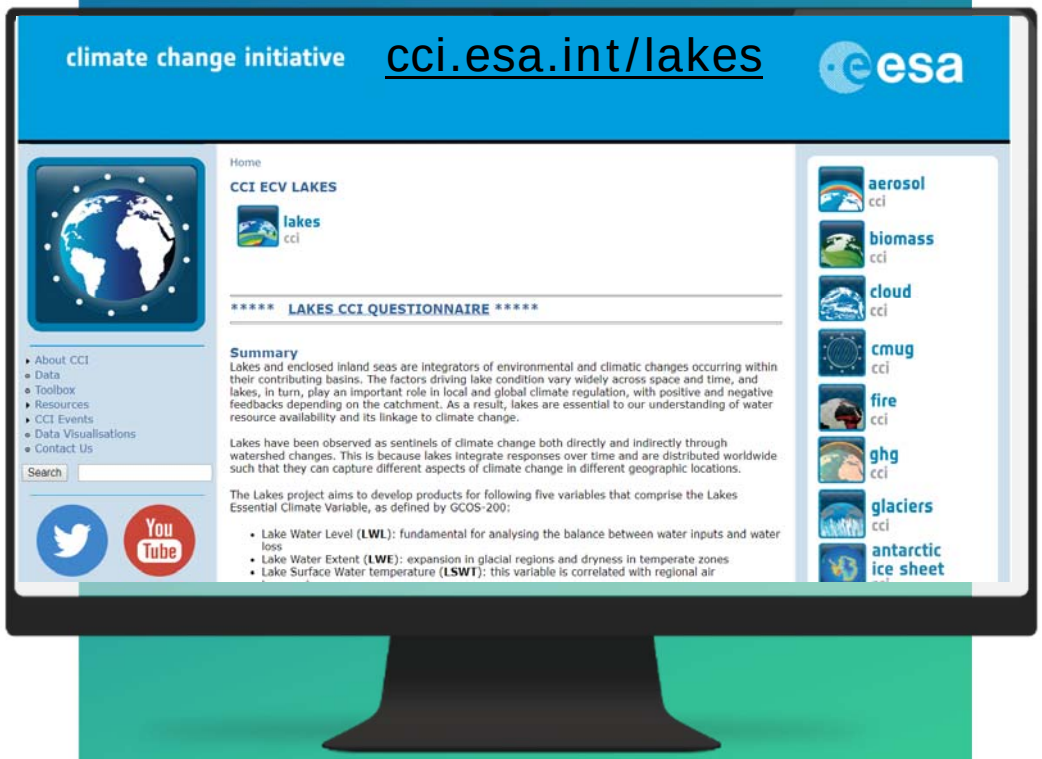

CLS COLLECTE LOCALISATION SATELLITES

LEGOS

PML Plymouth Marine Laboratory

Brockmann Consult

University of Stirling

University of Reading

GeoEcoMar

H2O Geomatics

Sertit

TRE Sensing the Planet

NORCE

National Research Council of Italy

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