United Nations Educational, Scientific and Cultural Organization

International Hydrological Programme

International Initiative on Water Quality

UNESCO-IHP International Initiative on Water Quality

UNESCO World Water Quality Portal

Monitoring water quality using satellite data

Sarantuyaa Zandaryaa, PhD

UNESCO Division of Water Sciences – International Hydrological Programme

United Nations Educational, Scientific and Cultural Organization · International Hydrological Programme

International Initiative on Water Quality

Improving world water quality is essential to achieve the SDGs

Ensure availability and sustainable management of water and sanitation for all

Ensure healthy lives and promote well-being for all at all ages

Ensure sustainable consumption and production patterns

Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss

SDG 6 – Water

Target 6.1 & 6.2

… access to safe water and sanitation

Target 6.3

… improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials…

SDG 3 - Health

Target 3.3 ***… combat water-borne diseases…***

Target 3.9 ***… reduce deaths and illnesses from hazardous chemicals … and air, water and soil pollution***

SDG 12 – Production & Consumption

Target 12.4

… significantly reduce release of chemicals to air, water and soil in order to minimize their adverse impacts on human health and environment

Water quality monitoring for the SDGs implementation and progress evaluation

Lack of global water quality data and information

Lack of human and technical capacity for water quality monitoring

Need to evaluate and monitor progress towards SDGs achievement

There is a need to enhancing global water quality data and information, supported by capacity building on water quality monitoring

UNESCO International Initiative on Water Quality

Activities on water quality monitoring

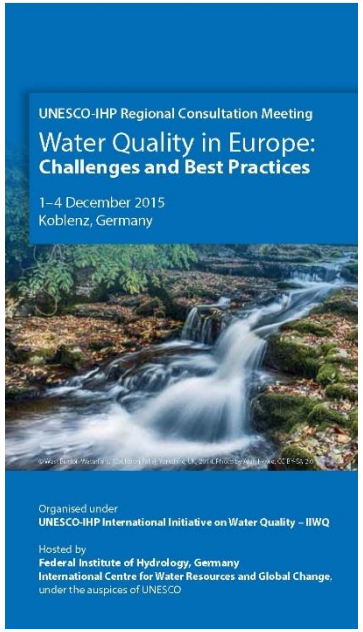
UNESCO IIWQ International Symposium on Water Quality Monitoring – Kyoto-Otsu, 2015

Focus on scientific, technological and policy innovations for improved water quality monitoring in the SDGs framework

A Session on Water Quality Monitoring using GIS and Remote Sensing *co-convened with JAXA*

- **The use of GIS and remote sensing technologies in water quality monitoring**
- The potential use of satellite and remote sensing data to:
  - monitor and assess inland water quality, especially in inaccessible areas
  - collect water quality data and information on systematic spatial and temporal scales.
- **The role of Earth Observation in monitoring SDG targets related to water quality and wastewater**

UNESCO IIWQ Regional Consultation on Water Quality in Europe – Koblenz, 2015



Focus on addressing water quality challenges and sharing and promoting best technical and policy practices

A Session on Water Quality Data and Monitoring

- Water quality assessment, data and monitoring at national and regional scales.
- Applications, capabilities and limitations of various water quality monitoring approaches, including
  - **Earth Observation tools for the interpretation and analysis of water resources**.

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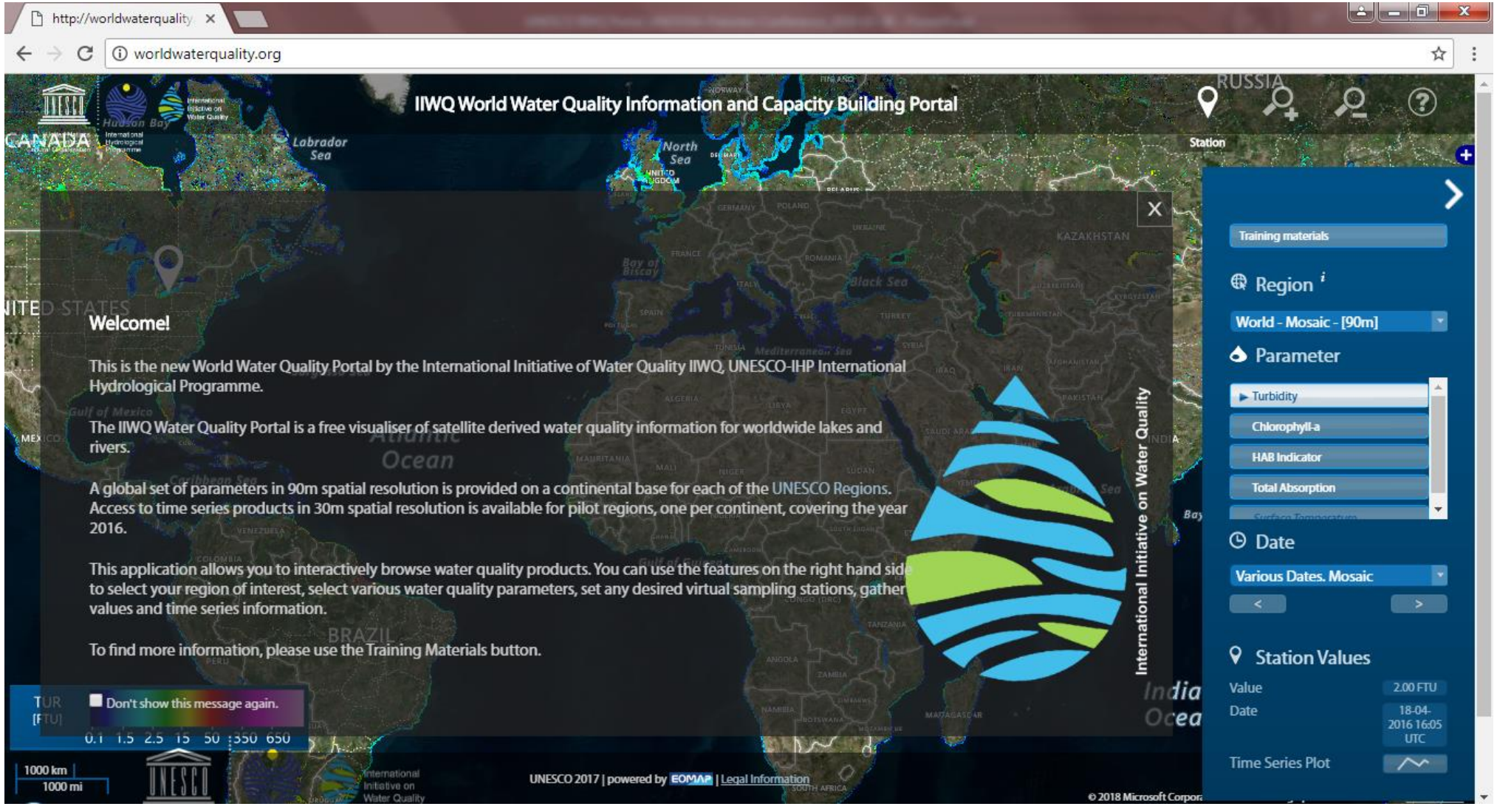

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World Water Quality Portal

- **A demonstration project on water quality monitoring, using Earth Observation** under the *International Initiative on Water Quality (IIWQ)* of UNESCO-IHP
- **Aims at improving global water quality information, focusing on inland freshwater**
  - A valuable tool to obtain water quality information, especially in remote areas and developing countries (Africa, Asia, Latin America, and SIDS) where water quality monitoring networks and laboratory capacity are lacking.
- **Promotes the use using innovative scientific approaches and technologies** for better water management
  - The use of Earth Observation (satellite-based data) for monitoring water quality in inland freshwaters

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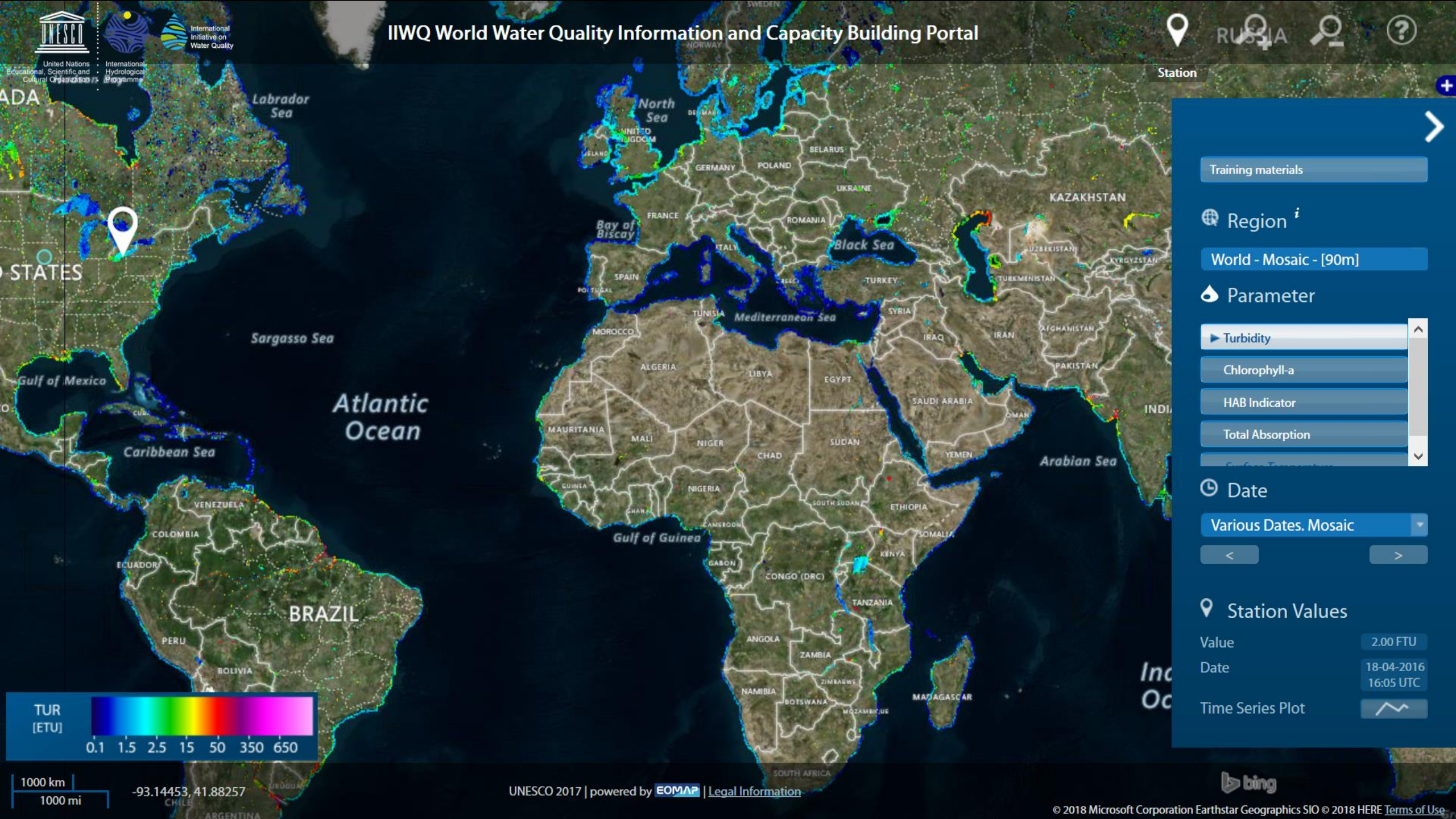
Water quality parameters

- Turbidity (sedimentation)
- *Chlorophyll-a*
- HAB indicator
- Total absorption
- Surface temperature

- **Global layer** (90-meter/mixed resolution)
- **Regional layers/demonstration basins** (30-meter resolution):
  - Lake Sevan in the Caucasus highlands - *Armenia, Azerbaijan*
  - Itaipu and Parana River Basins - *Argentina, Brazil, Paraguay*
  - The Mecklenburg Lake Plateau - *Germany*
  - River Nile and Aswan Reservoir - *Egypt, Sudan*
  - The Mekong Delta - *Vietnam*
  - Florida Lakes - *USA*
  - Zambezi River - *Zambia, Zimbabwe*

in partnership with EOMAP


IIWQ World Water Quality Information and Capacity Building Portal
United Nations Educational, Scientific and Cultural Organization
International Hydrological Programme
International Initiative on Water Quality
Station
Training materials
Region
World - Mosaic - [90m]
Parameter
Turbidity
Chlorophyll-a
HAB Indicator
Total Absorption
Date
Various Dates. Mosaic
Station Values
Value 2.00 FTU
Date 18-04-2016 16:05 UTC
Time Series Plot
TUR [ETU]
0.1 1.5 2.5 15 50 350 650
1000 km
1000 mi
-93.14453, 41.88257
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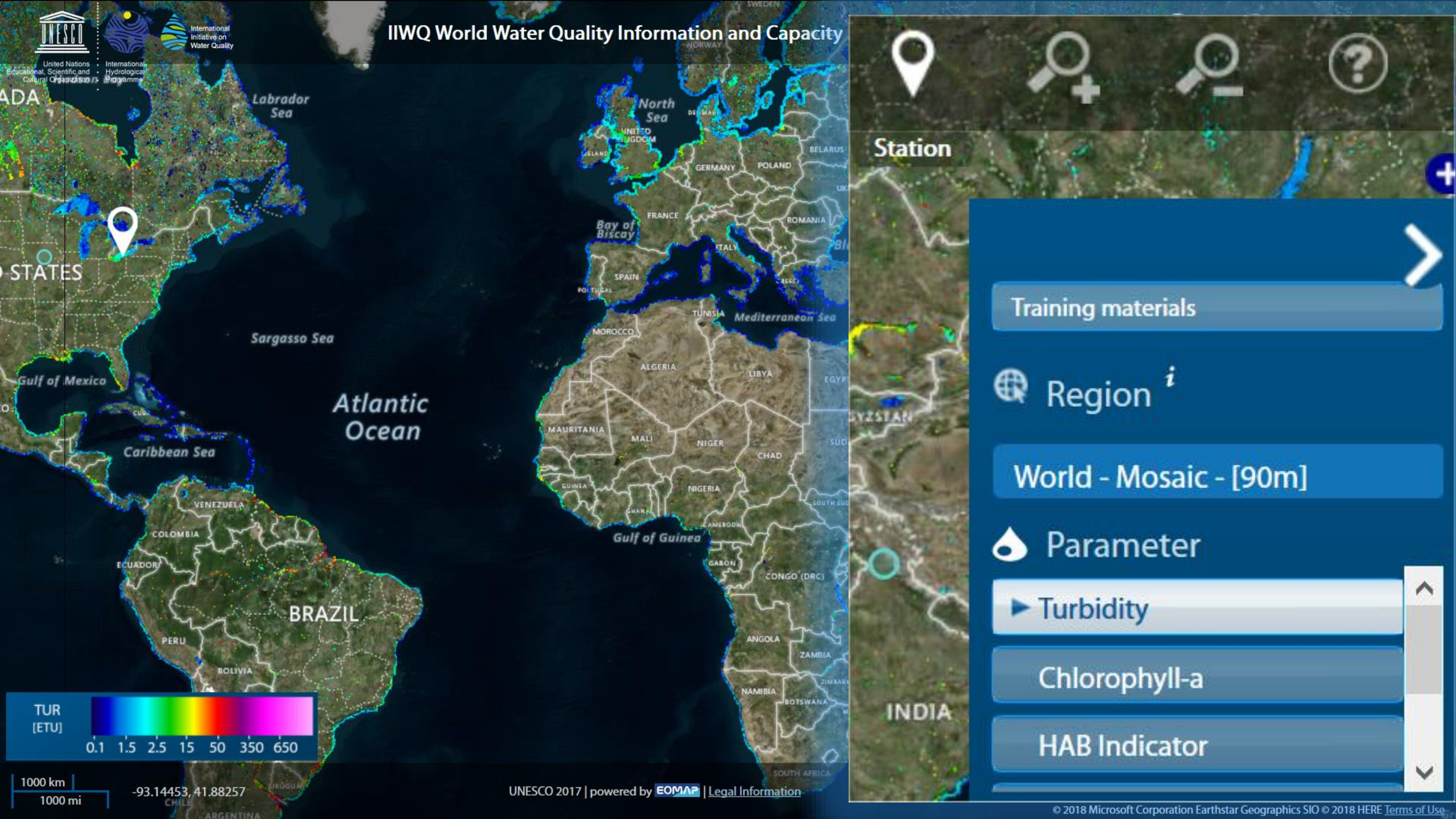
© 2018 Microsoft Corporation Earthstar Geographics SIO © 2018 HERE Terms of Use
Atlantic Ocean
Mediterranean Sea
Black Sea
Caribbean Sea
Gulf of Mexico
Gulf of Guinea
Sargasso Sea
Arabian Sea
Labrador Sea
North Sea
Bay of Biscay
BRAZIL
KAZAKHSTAN
RUSSIA


IIWQ World Water Quality Information and Capacity
United Nations Educational, Scientific and Cultural Organization
International Hydrological Programme
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Region
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Turbidity
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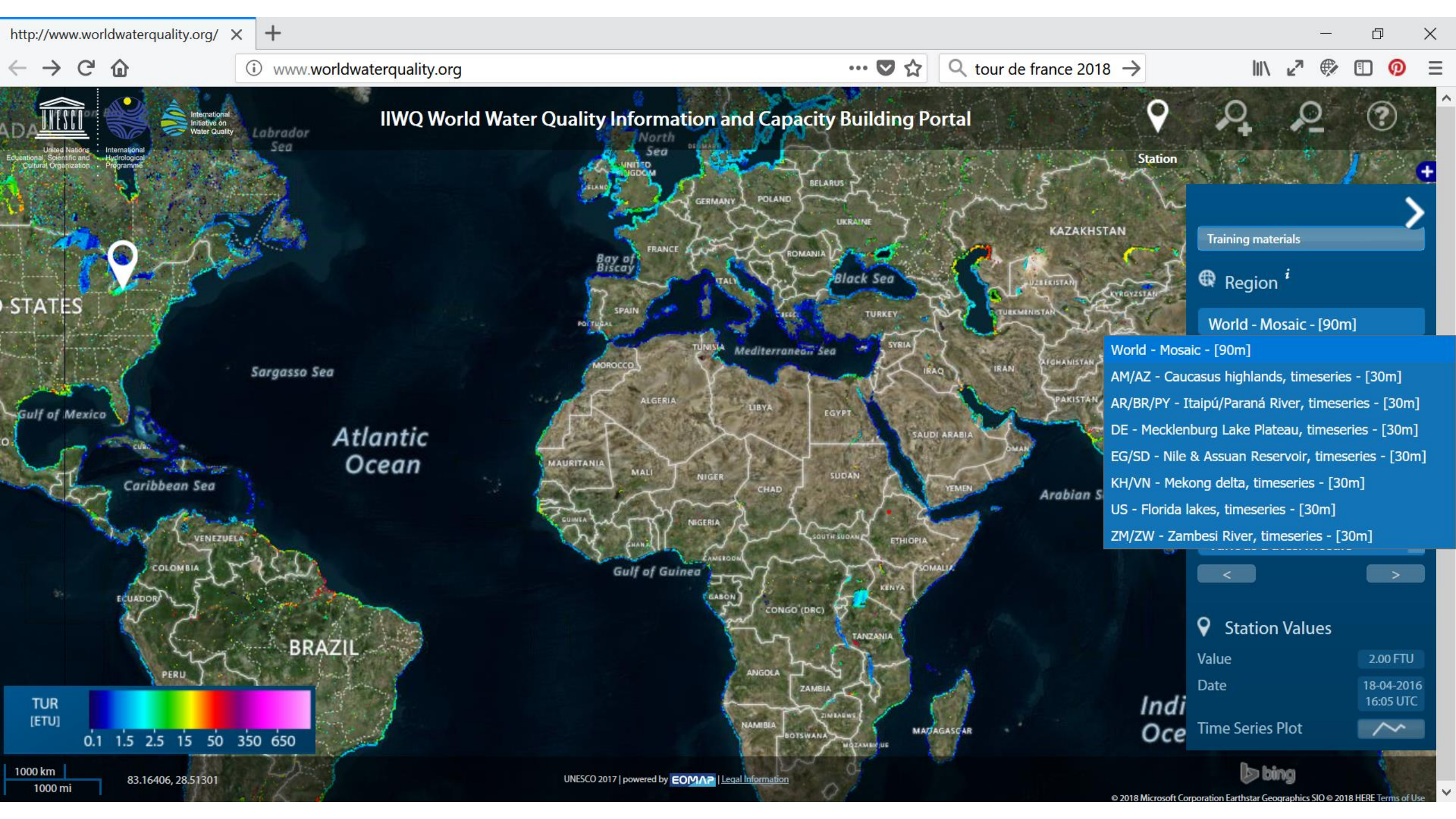
Labrador Sea
North Sea
Bay of Biscay
Sargasso Sea
Gulf of Mexico
Atlantic Ocean
Caribbean Sea
Mediterranean Sea
Gulf of Guinea
BRAZIL
INDIA
FRANCE
SPAIN
GERMANY
POLAND
ALGERIA
LIBYA
NIGERIA
CHAD
MALI
NIGER
MAURITANIA
MOROCCO
TUNISIA
ROMANIA
BELARUS
VENEZUELA
COLOMBIA
ECUADOR
PERU
BOLIVIA
ANGOLA
ZAMBIA
NAMIBIA
BOTSWANA
CONGO (DRC)
GABON
SOUTH AFRICA


http://www.worldwaterquality.org/
www.worldwaterquality.org
tour de france 2018
IIWQ World Water Quality Information and Capacity Building Portal
United Nations Educational, Scientific and Cultural Organization
International Hydrological Programme
International Initiative on Water Quality
Station
Training materials
Region
World - Mosaic - [90m]
World - Mosaic - [90m]
AM/AZ - Caucasus highlands, timeseries - [30m]
AR/BR/PY - Itaipú/Paraná River, timeseries - [30m]
DE - Mecklenburg Lake Plateau, timeseries - [30m]
EG/SD - Nile & Assuan Reservoir, timeseries - [30m]
KH/VN - Mekong delta, timeseries - [30m]
US - Florida lakes, timeseries - [30m]
ZM/ZW - Zambesi River, timeseries - [30m]
Station Values
Value
2.00 FTU
Date
18-04-2016 16:05 UTC
Time Series Plot
TUR [ETU]
0.1 1.5 2.5 15 50 350 650
1000 km
1000 mi
83.16406, 28.51301
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Atlantic Ocean
Sargasso Sea
Gulf of Mexico
Caribbean Sea
Mediterranean Sea
Black Sea
Bay of Biscay
North Sea
Labrador Sea
Gulf of Guinea
Arabian Sea
BRAZIL
KAZAKHSTAN
Indian Ocean

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World Water Quality Portal

www.worldwaterquality.org

- **A useful tool to assess the interlinkages between the human and natural (ecological) systems.**
- **Provides information on impacts and pressure on water quality from other sectors** such as urban areas, agriculture and energy sectors (dams and reservoir management), climate change, etc.

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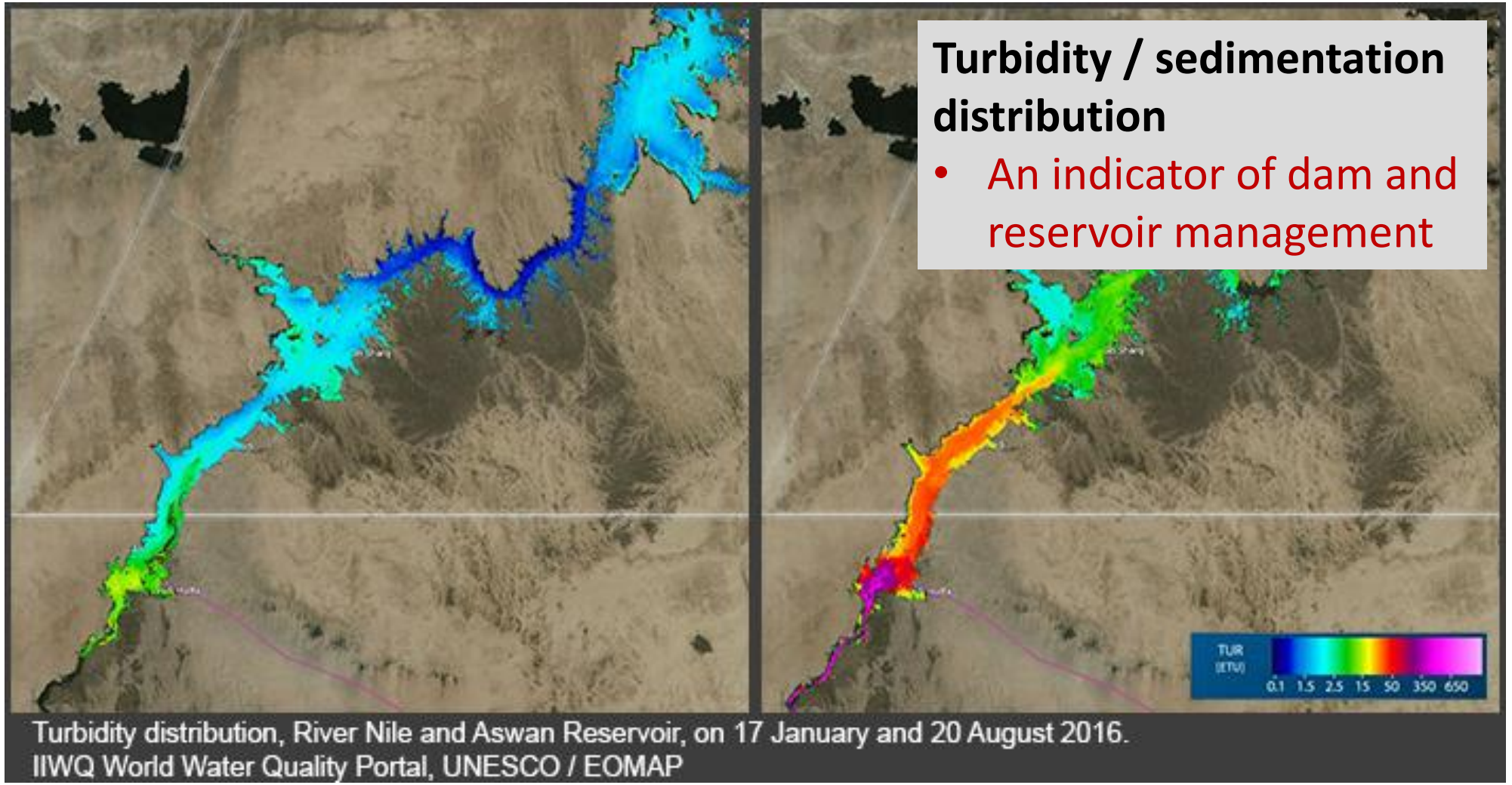

Turbidity distribution, River Nile and Aswan Reservoir, on 17 January and 20 August 2016.
IIWQ World Water Quality Portal, UNESCO / EOMAP

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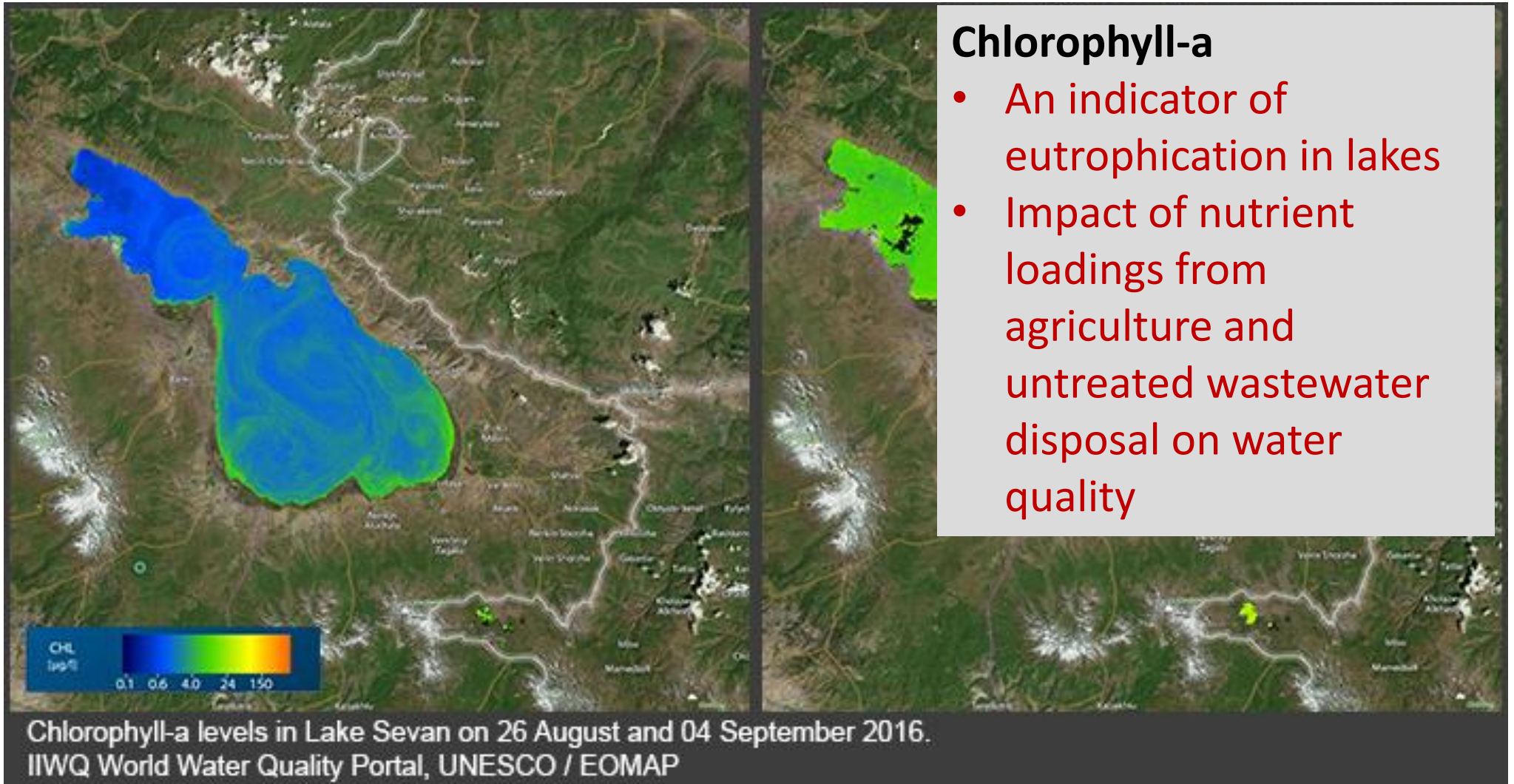

Chlorophyll-a levels in Lake Sevan on 26 August and 04 September 2016.
IIWQ World Water Quality Portal, UNESCO / EOMAP

Chlorophyll-a

- An indicator of eutrophication in lakes
- Impact of nutrient loadings from agriculture and untreated wastewater disposal on water quality

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Florida Lakes (USA)

Harmful Algae Bloom (HABs)

- An indicator of antropogenic nutrient enrichment / Eutrophication in surface waters
- Impact of agricultural activities and wastewater discharges on water quality

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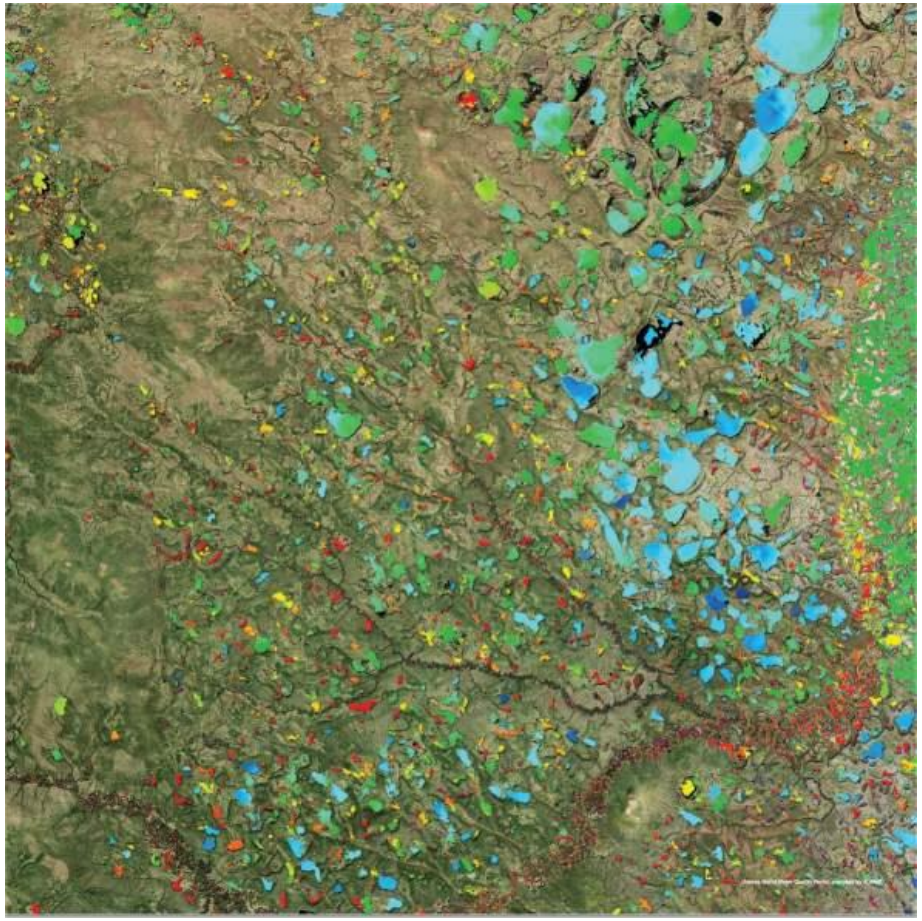


The Sakha Region (Russia)

Dissolved organic substances

- Permafrost melting
- Impact of climate change on water quality

The technology behind the UNESCO IIWQ portal

Satellite sensors: Landsat 8, Sentinel-2

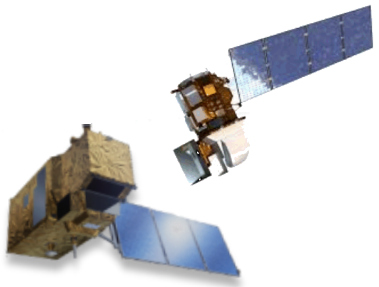
Combined approx. 2 records per week, 10m/20m & 30m resolution

Data processing: MIP - Modular Inversion and Processing System

Fully physics based, sensor generic, globally harmonized measures

Data portal: Online web application & Geoserver

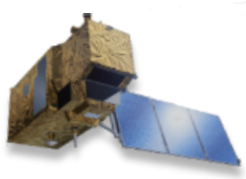
based on **EOMAP** eoApp web application technology



Satellite sensors used for the UNESCO IIWQ portal (Version 2017)

Landsat 8 (from USGS)

spatial resolution 30m, 2x/month



Sentinel-2 a/b (from ESA)

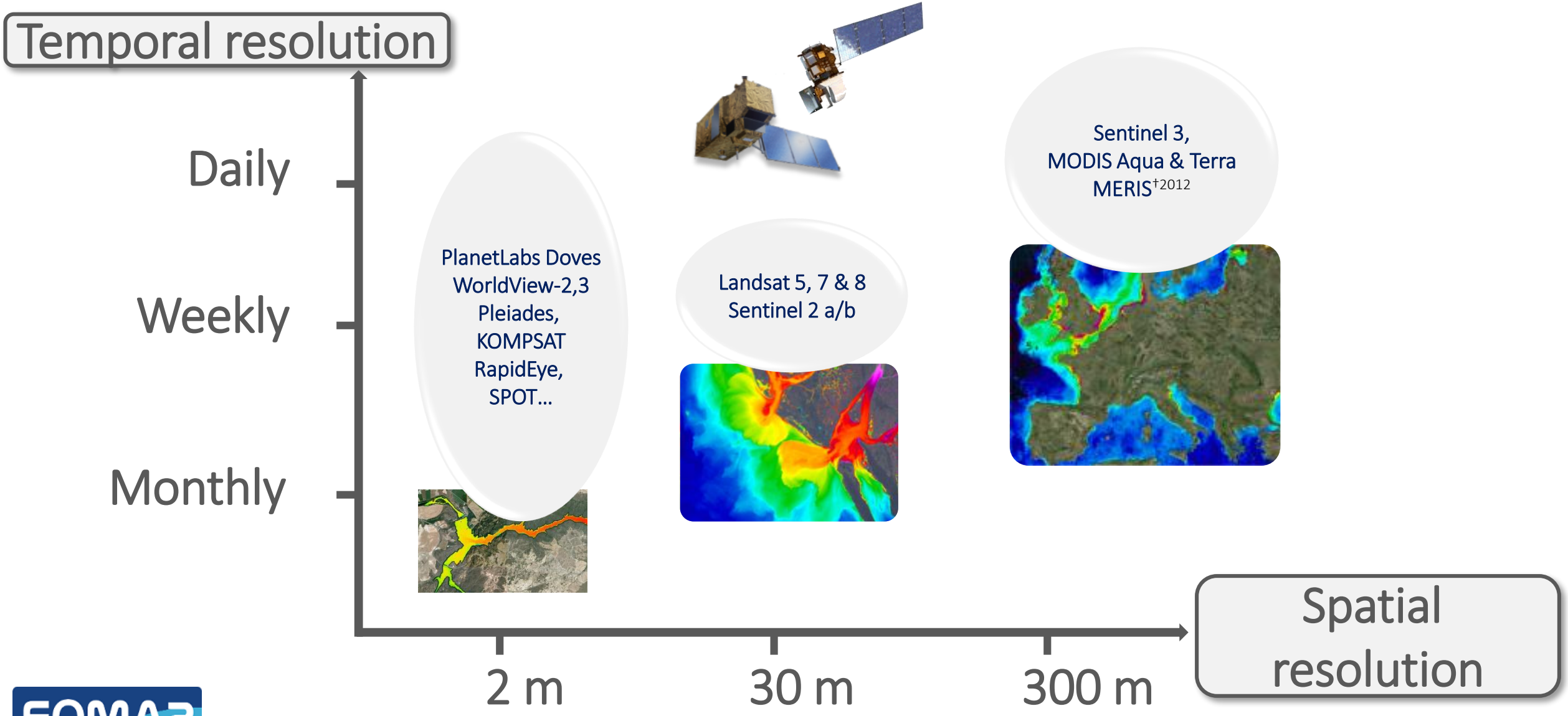
spatial resolution 10m&20m, 3x/month per sensor

Combined temporal resolution Landsat 7&8, Sentinel 2a&b:

10x/month

EOMAP

Sensors used for the IIWQ portal: Landsat 8, Sentinel-2



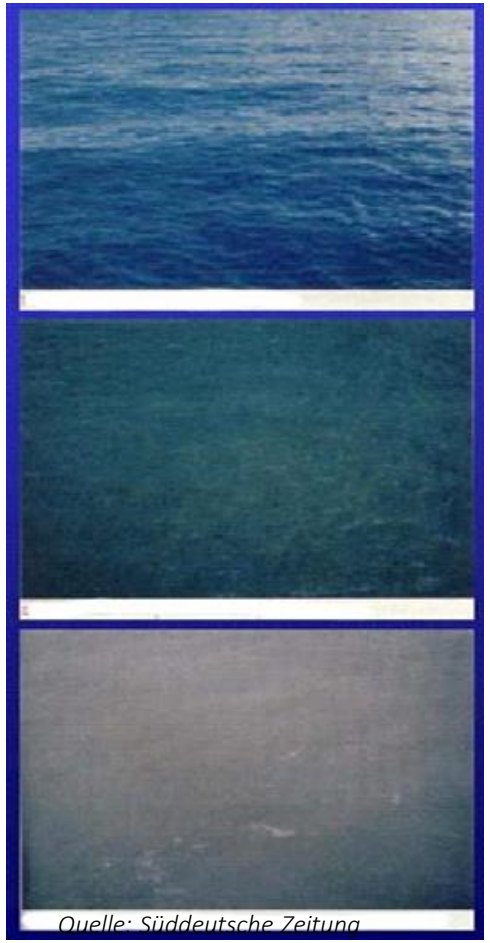
EOMAP

(© satellite images ESA, NASA, satimagingcorp, RapidEye © Blackbridge, Landsat 8 USGS, MODIS NASA)

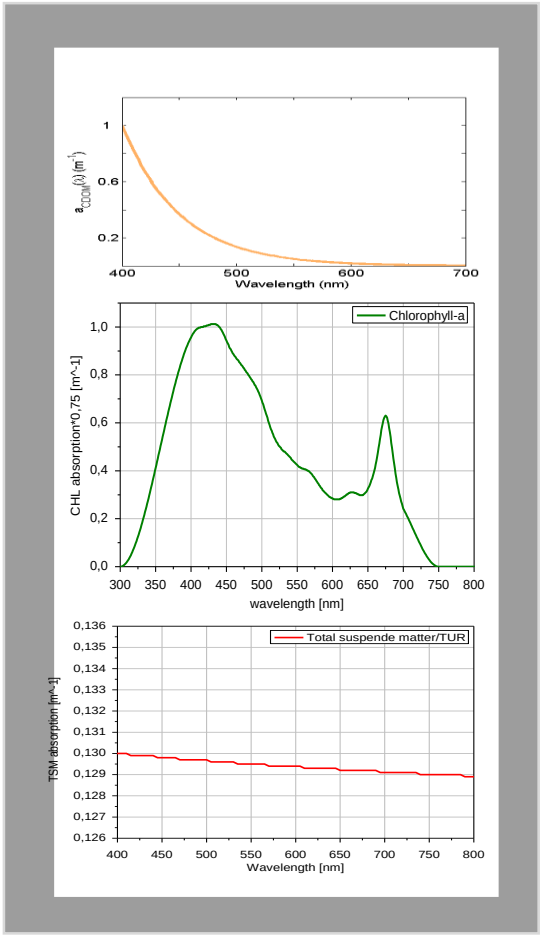
EO derived water quality properties

- *Reference properties: Spectral absorption and scattering coefficients*
- *Interface to establishe hydro-biological measurements*

water color « absorption and scattering « water constituents



Quelle: Süddeutsche Zeitung



turbidity

- TSM, Secchi depth, k …

organic-/anorg. absorption

- CDOM , organic/anorganic

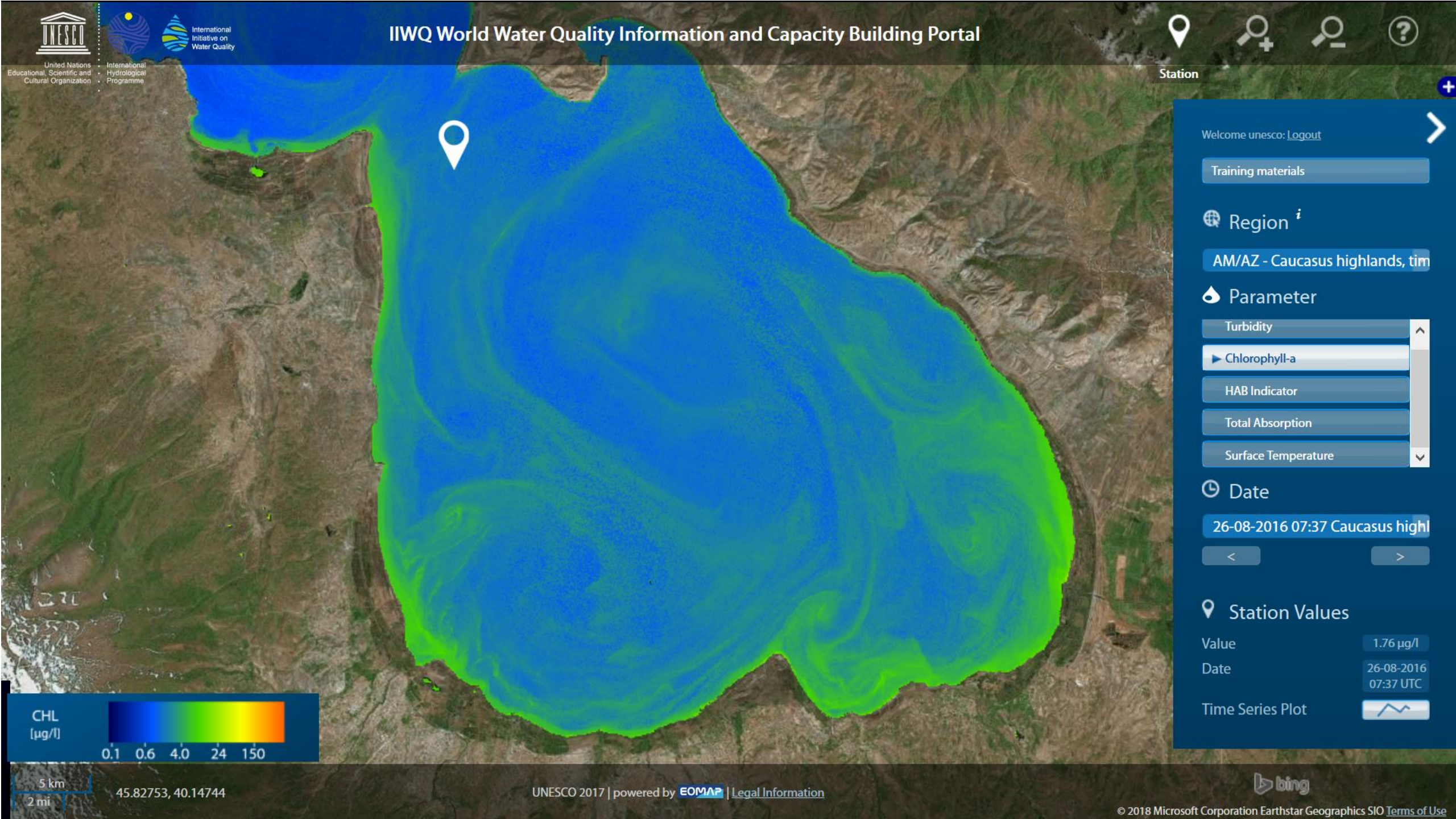
pigment absorption

- Chlorophyll a

specific pigment indicators

- Blue algae indicator

  harmfull algae bloom HAB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International Hydrological Programme
International Initiative on Water Quality
IIWQ World Water Quality Information and Capacity Building Portal
Station
Welcome unesco: Logout
Training materials
Region
AM/AZ - Caucasus highlands, tim
Parameter
Turbidity
Chlorophyll-a
HAB Indicator
Total Absorption
Surface Temperature
Date
26-08-2016 07:37 Caucasus highl
<
>
Station Values
Value
1.76 µg/l
Date
26-08-2016 07:37 UTC
Time Series Plot
CHL [µg/l]
0.1 0.6 4.0 24 150
5 km
2 mi
45.82753, 40.14744
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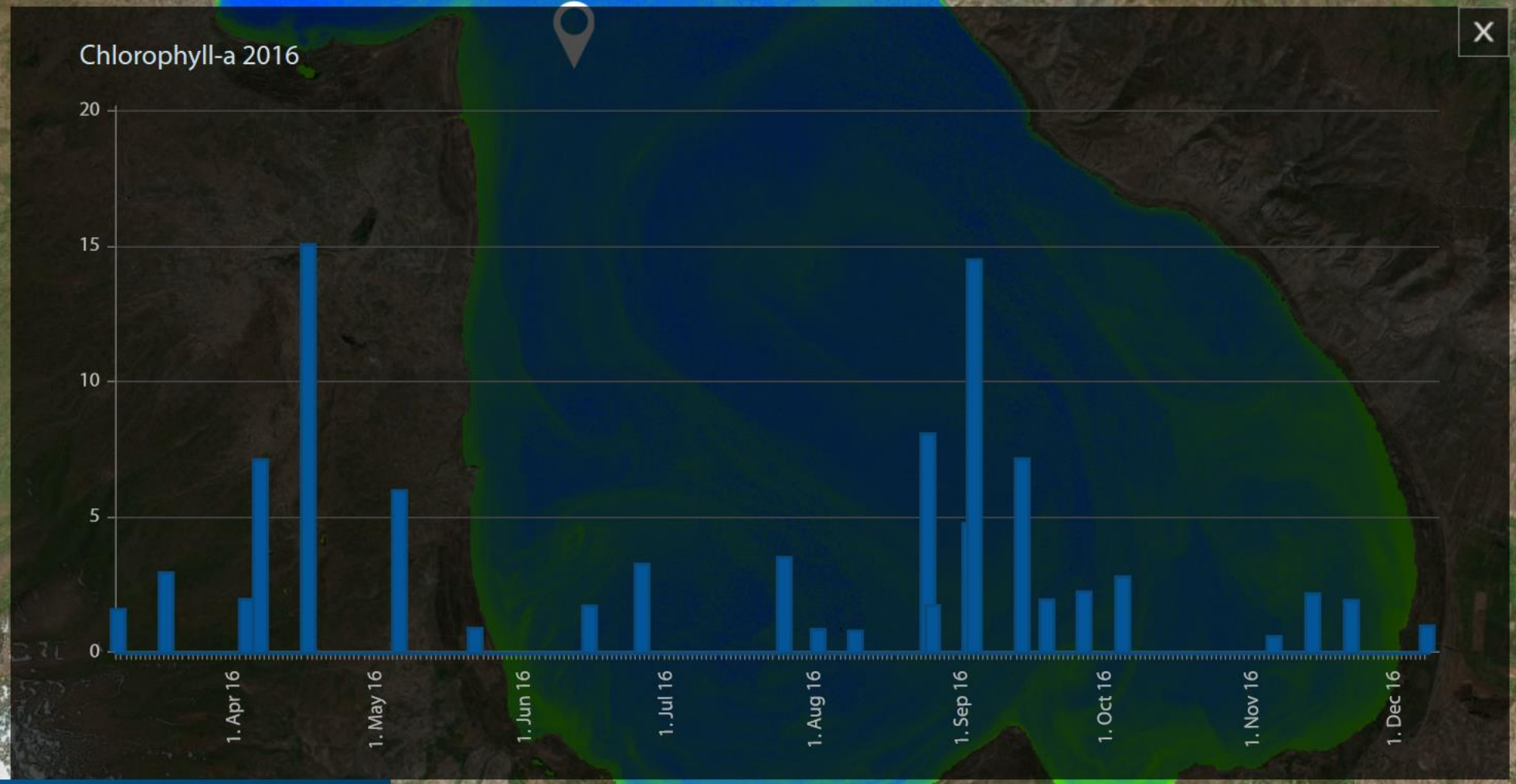

Welcome unesco: Logout
Training materials
Region
AM/AZ - Caucasus highlands, tim
Parameter
Turbidity
Chlorophyll-a
HAB Indicator
Total Absorption
Surface Temperature
Date
26-08-2016 07:37 Caucasus highl
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Station Values
Value 1.76 µg/l
Date 26-08-2016 07:37 UTC
Time Series Plot
Click here to generate a time series plot.
Report

CHL [µg/l]
0.1 0.6 4.0 24 150

5 km
2 mi
45.80624, 40.14691

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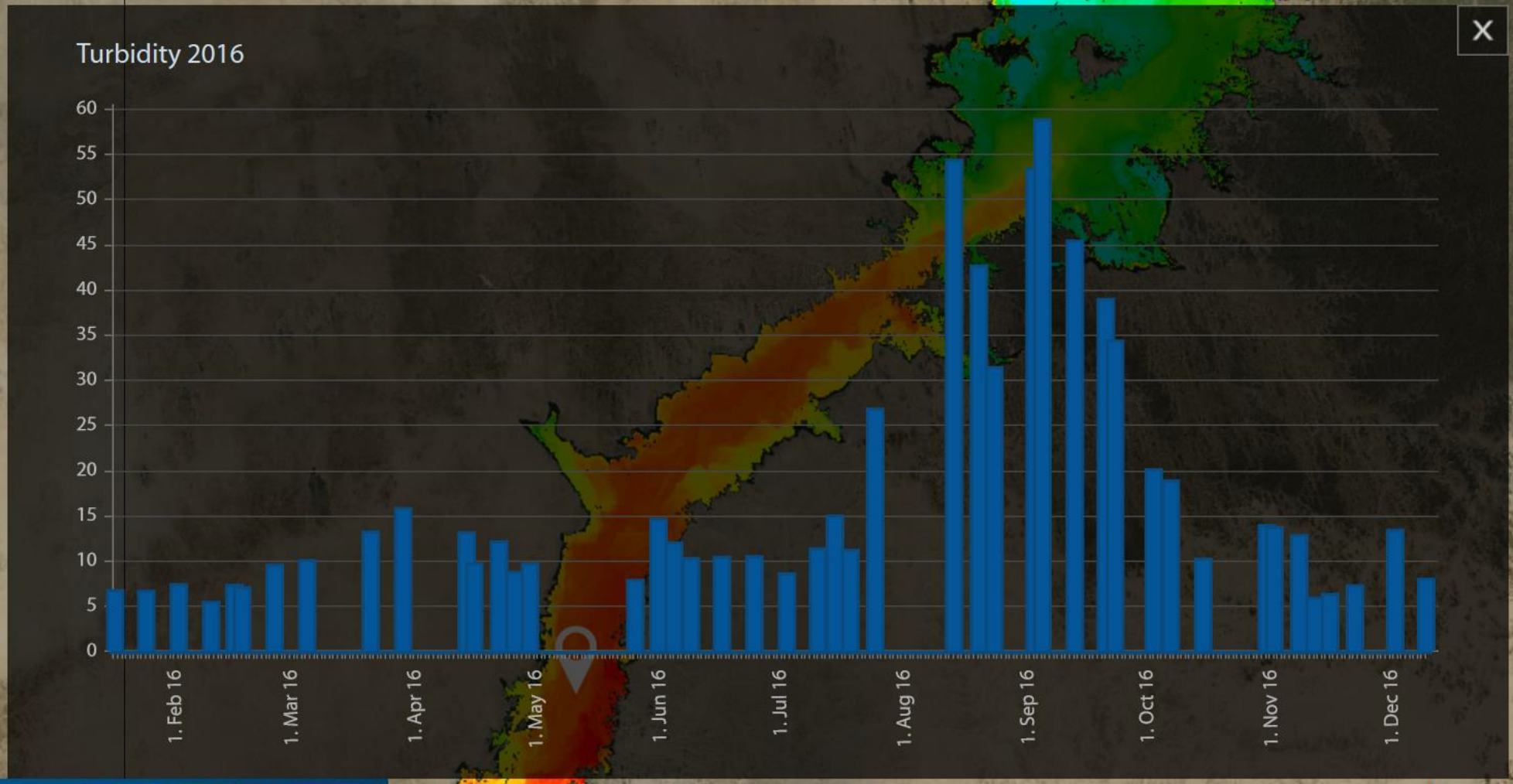

Welcome unesco: Logout

Training materials

Region

EG/SD - Nile & Assuan Reservoir

Parameter

- Turbidity
- Chlorophyll-a
- HAB Indicator
- Total Absorption
- Surface Temperature

Date

20-08-2016 08:19 Nile & Assuan R

< >

Station Values

Value 42.77 FTU

Date 20-08-2016 08:19 UTC

Time Series Plot

Report

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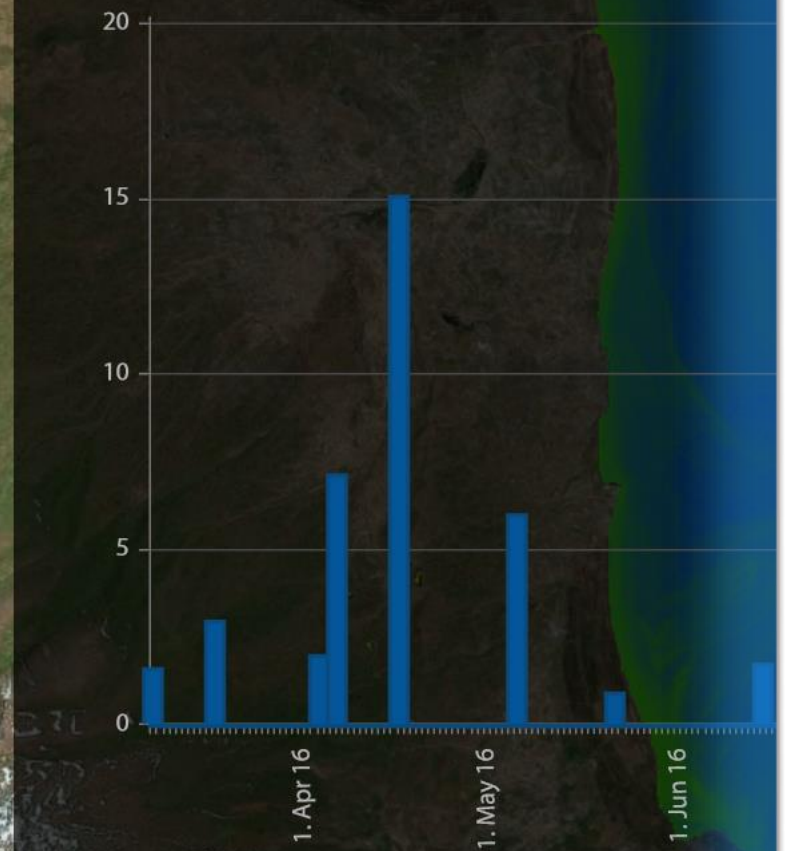

WATER QUALITY REPORT

Generated at: 2018-01-21 Time 17:41:40
Parameter: Chlorophyll-a
Unit: µg/l
Product: eoWater (satellite based)

Region: AM/AZ - Caucasus highlands, timeseries - [30m]
Station lat/lon: 40.41433 / 45.26688
Year: 2016
Median: 2.24
Mean: 3.97
Minimum value: 0.62
Bottom quintile: 1.38
Top quintile: 6.46
Maximum value: 15.09

Trophic State Index (according to Carlson 1977): Oligotrophic
Oligotrophic: 54.17%
Mesotrophic: 33.33%
Eutrophic: 12.50%

Report

CHL [µg/l]
0.1 0.6 4.0 24 150

5 km
2 mi
45.80624, 40.14691

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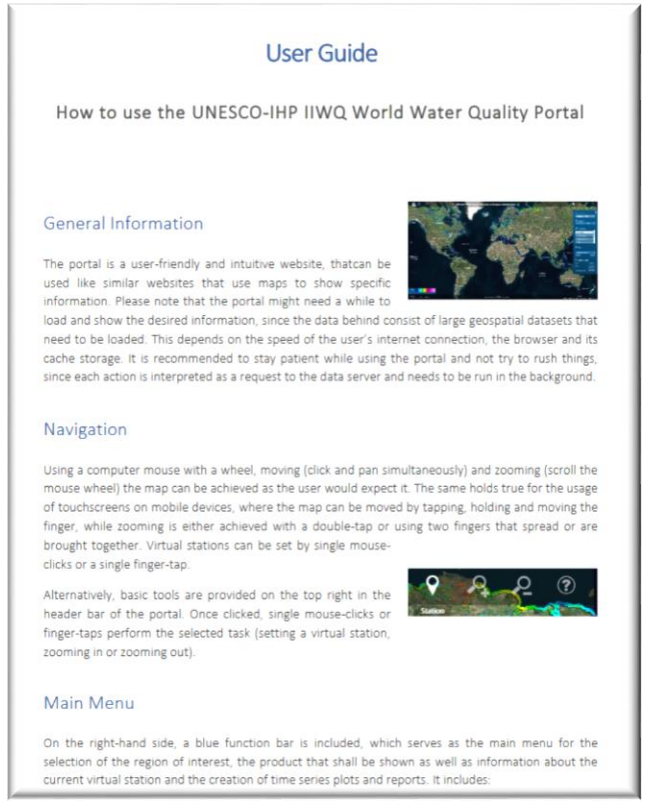
Capacity building and training on monitoring water quality using Earth Observation



User Guide

How to use the UNESCO-IHP IIWQ World Water Quality Portal

General Information

The portal is a user-friendly and intuitive website, thatcan be used like similar websites that use maps to show specific information. Please note that the portal might need a while to load and show the desired information, since the data behind consist of large geospatial datasets that need to be loaded. This depends on the speed of the user's internet connection, the browser and its cache storage. It is recommended to stay patient while using the portal and not try to rush things, since each action is interpreted as a request to the data server and needs to be run in the background.

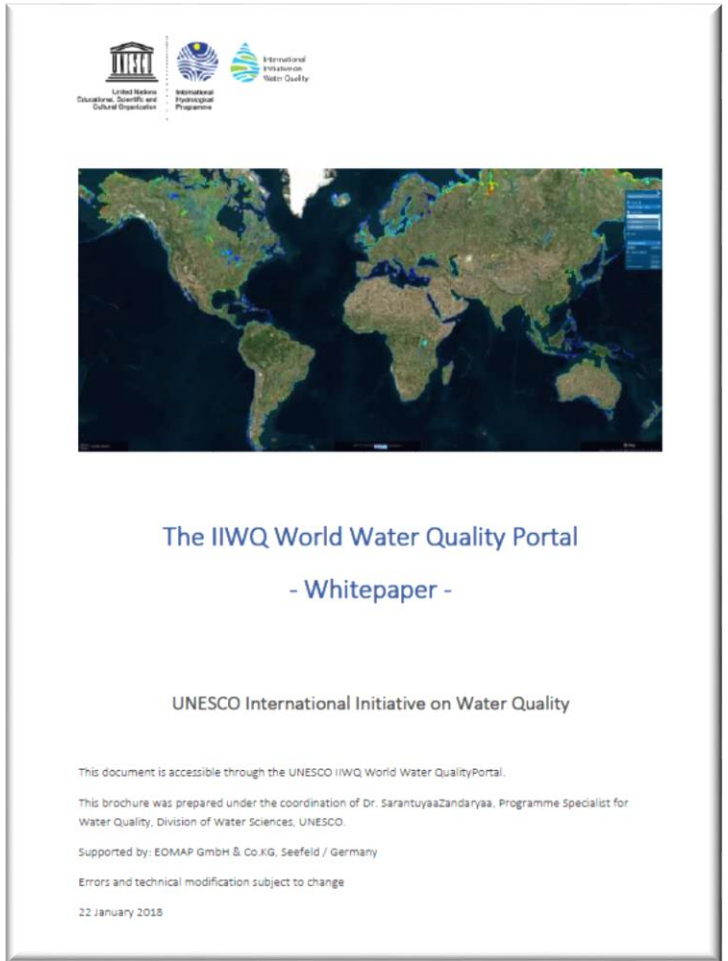
Navigation

Using a computer mouse with a wheel, moving (click and pan simultaneously) and zooming (scroll the mouse wheel) the map can be achieved as the user would expect it. The same holds true for the usage of touchscreens on mobile devices, where the map can be moved by tapping, holding and moving the finger, while zooming is either achieved with a double-tap or using two fingers that spread or are brought together. Virtual stations can be set by single mouse-clicks or a single finger-tap.

Alternatively, basic tools are provided on the top right in the header bar of the portal. Once clicked, single mouse-clicks or finger-taps perform the selected task (setting a virtual station, zooming in or zooming out).

Main Menu

On the right-hand side, a blue function bar is included, which serves as the main menu for the selection of the region of interest, the product that shall be shown as well as information about the current virtual station and the creation of time series plots and reports. It includes:



The IIWQ World Water Quality Portal

- Whitepaper -

UNESCO International Initiative on Water Quality

This document is accessible through the UNESCO IIWQ World Water QualityPortal.

This brochure was prepared under the coordination of Dr. SarantuyaaZandaryaa, Programme Specialist for Water Quality, Division of Water Sciences, UNESCO.

Supported by: EOMAP GmbH & Co.KG, Seefeld / Germany

Errors and technical modification subject to change

22 January 2018

Training handbook

"How to use

Satellite-based Water Quality Information

available at the UNESCO-IHP IIWQ World Water Quality Portal"

Comments from the UNESCO-IHP IIWQ Expert Advisory Group members and IHP Secretariat staff are gratefully acknowledged.

This brochure was prepared under the coordination of Dr. Sarantuyaa Zandaryaa, Programme Specialist for Water Quality, Division of Water Sciences, UNESCO

Supported by: EOMAP GmbH & Co.KG, Seefeld /Germany.

22 January 2018

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World Water Quality Portal

Supporting the SDG 6 (*6.3.2 Indicator*) implementation and monitoring

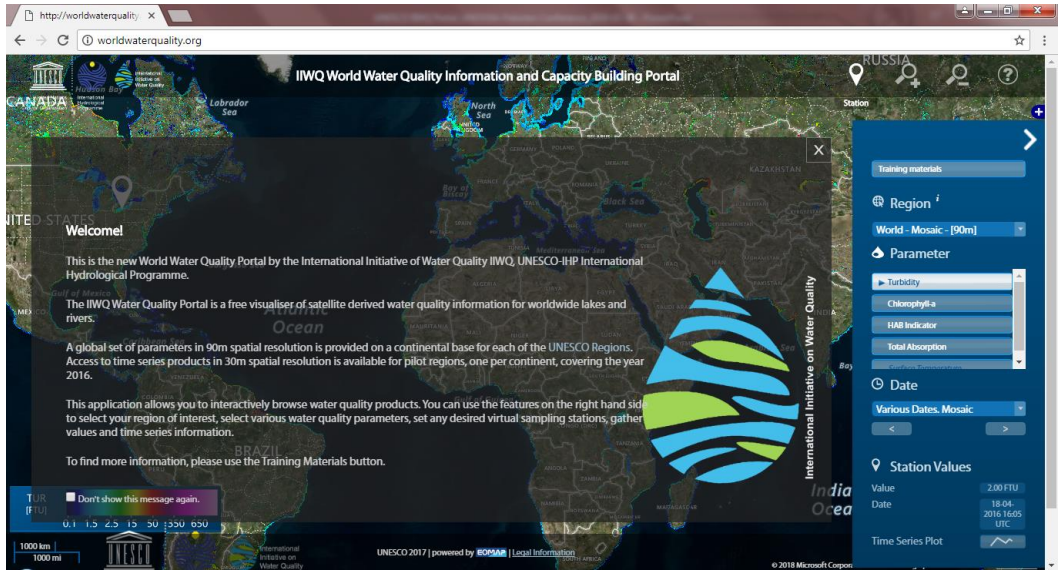
- **Promotes science-based, informed decision-making and policy development on water quality**, leading to sustainable water resources management **towards the SDGs achievement**.
  - A decision-support tool, helping countries identify the most pressing water quality problems such as pollution hotpots and consequently the action needed.
- **Supports national efforts for the implementation of water quality related SDG targets** as well as for monitoring progress towards their realization.

- **Directly supports the implementation and monitoring of SDG 6.3.2 Indicator *"Proportion of bodies of water with good ambient water quality"***

For more information

UNESCO World Water Quality Portal

www.worldwaterquality.org



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http://en.unesco.org/waterquality-IIWQ

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Thank you !

Sarantuyaa Zandaryaa (s.zandaryaa@unesco.org)

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International Initiative on Water Quality (IIWQ)

Division of Water Sciences – International Hydrological Programme