UNESCO International Initiative on Water Quality

World Water Quality Portal

Monitoring water quality using EO

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Can Earth Observation fill the global water quality data gap for the SDGs monitoring?
UNESCO International Initiative on Water Quality (IIWQ)
Activities on water quality monitoring
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 resources

- A valuable tool to obtain water quality data and 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

- Demonstrates the capabilities and use of Earth Observation (satellite-based data) for monitoring water quality in inland freshwaters

**Supports the implementation and monitoring of the SDGS** at the global, regional, national and local levels.
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
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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%
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• 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:
  • urban areas,
  • agriculture
  • energy sectors (dams and reservoir management)
  • climate change
Paraná River Basin: Sedimentation distribution in the Itaipu reservoir zone (08 June & 11 August 2016)
Brazil, Paraguay, and Argentina
Turbidity / sedimentation distribution
An indicator of dam and reservoir management
Chlorophyll-a
- An indicator of eutrophication in lakes
- Impact of nutrient loadings from agriculture and wastewater disposal
Harmful Algae Bloom (HABs)

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

Florida Lakes (USA)
Dissolved organic substances

- Permafrost melting
- Impact of climate change on water quality

The Sakha Region (Russia)
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
Sensors used for the IIWQ portal: Landsat 8, Sentinel-2

- **Temporal resolution**
  - Daily
  - Weekly
  - Monthly

- **Spatial resolution**
  - 2 m
  - 30 m
  - 300 m

- **Sensors used**:
  - PlanetLabs Doves
  - WorldView-2,3
  - Pleiades, KOMPSAT
  - RapidEye, SPOT...
  - Landsat 5, 7 & 8
  - Sentinel 2 a/b
  - Sentinel 3, MODIS Aqua & Terra
  - MERIS

(© 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 establish hydro-biological measurements

Water color ↔ absorption and scattering ↔ water constituents

- Turbidity
  - TSM, Secchi depth, k ...
- Organic-/anorg. absorption
- CDOM, organic/anorganic pigment absorption
- Chlorophyll a
- Specific pigment indicators
- Blue algae indicator
- Harmful algae bloom (HAB)
Capacity building and training on monitoring water quality using Earth Observation
<table>
<thead>
<tr>
<th>Targets</th>
<th>Indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>6.3:</strong> <strong>Improve water quality by reducing pollution</strong>, eliminating</td>
<td><strong>6.3.2:</strong> Proportion of bodies of water with good ambient water quality</td>
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<tr>
<td>dumping and minimizing release of hazardous chemicals and materials,</td>
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<tr>
<td>halving the proportion of untreated wastewater and substantially</td>
<td></td>
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<tr>
<td>increasing recycling and safe reuse globally</td>
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<tr>
<td><strong>6.6:</strong> <strong>Protect and restore water-related ecosystems</strong>, including</td>
<td><strong>6.6.1:</strong> Change in the extent of water-related ecosystems over time</td>
</tr>
<tr>
<td>mountains, forests, wetlands, rivers, aquifers and lakes</td>
<td>• spatial extent</td>
</tr>
<tr>
<td></td>
<td>• quantity of water</td>
</tr>
<tr>
<td></td>
<td>• state if ecosystem health (water quality)</td>
</tr>
<tr>
<td><strong>14.1:</strong> <strong>Prevent and significantly reduce marine pollution</strong> of all</td>
<td><strong>14.1.1:</strong> Index of <strong>coastal eutrophication</strong> and floating plastic debris</td>
</tr>
<tr>
<td>kinds, in particular from land-based activities, including marine</td>
<td>density</td>
</tr>
<tr>
<td>debris and <strong>nutrient pollution</strong></td>
<td></td>
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UNESCO World Water Quality Portal: Supporting science-based decision-making

- Promotes science-based, informed decision-making and policy development on water quality, leading to sustainable water resources management.
  - A decision-support tool, helping countries identify the most pressing water quality problems such as pollution hotspots 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.
International Initiative on Water Quality (IIWQ)

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International Hydrological Programme (IHP)

*Thank you!*