

Algenmonitor

“Development and demonstration of current remote sensing data on chlorophyll-a in rivers and lakes, for use in water body management.”

Focus: Optimising the use of Copernicus data and services in Germany for public tasks.

Contractors: German Environment Agency (UBA), the Federal Institute of Hydrology (BfG), and the Helmholtz Centre for Environmental Research (UFZ). Funded by German Aerospace Centre and BMV

Objective of the Algenmonitor

The **Algenmonitor** aims to develop, implement, and demonstrate an operational system for the processing, visualization, and validation of current remote sensing data on **chlorophyll-a concentrations** in rivers and lakes. Its future objective is to establish a **nationwide satellite-based monitoring system** that enables water authorities to **rapidly detect ecologically significant phenomena** such as algal blooms and respond immediately with appropriate measures – for example, issuing bathing bans or suspending water withdrawals during critical algae events.

Challenge: Eutrophication and Algal Blooms

Eutrophication of many inland waters, driven by excessive nutrient inputs from agriculture and urban areas, represents a fundamental ecological problem and often leads to **increased algal growth** (Umweltbundesamt, 2022). One of the most visible consequences is the occurrence of **algal blooms**, which not only disrupt the ecological balance of aquatic systems but also pose **significant economic, health, and societal risks** (Rinke et al., 2019). These blooms serve as indicators of multiple stressors affecting inland waters, including **nutrient overloads, climate change, and physical or biological structural alterations**.

A striking example is the **mass fish die-off in the Oder River in 2022**, where toxic algal blooms caused extensive damage. Such events illustrate how rapidly and extensively harmful processes can unfold – often beyond the detection capabilities of conventional monitoring approaches (Nikolaidis et al., 2022).

Potential of Remote Sensing in Water Monitoring

Although a range of data collection methods is already available, many fall short in terms of **temporal or spatial resolution**, or fail to meet the **practical needs** of administrative bodies. Here, remote sensing offers new potential: **satellite-based monitoring**, especially through the **EU's Copernicus programme**, allows for **large-scale and near real-time detection of chlorophyll a** as a proxy for algal blooms. This enables the development of **early warning systems** for short-term mass occurrences and provides valuable decision support for the **management of drinking water reservoirs and recreational waters**.

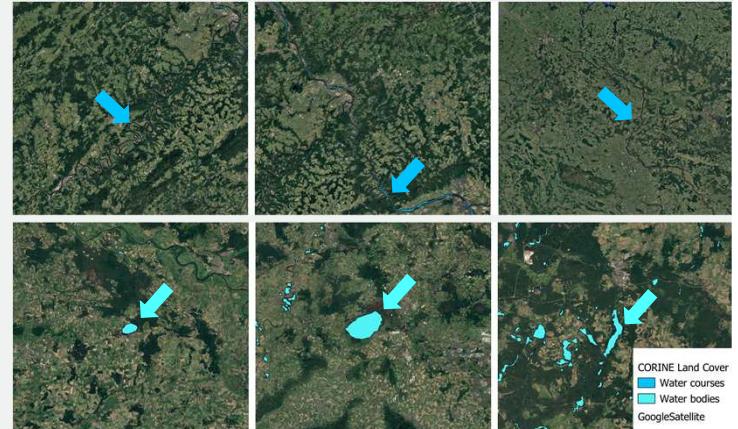


Figure 1: Exemplary water bodies from Germany. Top: Mosel, Mittelrhein, Elbe; bottom: Arendsee, Steinhuder Meer, Scharmützelsee (from left to right). Source: CORINE Land Cover; GoogleSatellite.

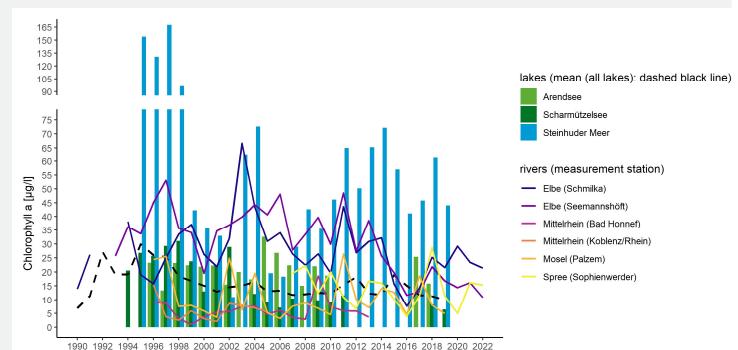


Figure 2: Chlorophyll-a concentration of selected water bodies (bars: lakes; lines: rivers) over the years 1990 – 2023. Source: Seendatenbank (Umweltbundesamt, 2023); FGG Elbe (2025); FGG Rhein (n.d.).

Contribution of the Algenmonitor Project

Algenmonitor addresses this gap by providing a **free, open-source solution** based on validated Copernicus data. The generated datasets are **scientifically validated, quality-assured, and tested at selected pilot sites**. The project aims to demonstrate a **scientifically robust application** that **delivers temporally high-resolution remote sensing data** from representative water bodies for use by public authorities.

Due to its open-source architecture, the system offers a **scalable foundation for nationwide implementation**. The resulting services are optimized for **public sector applications** in the fields of **water quality monitoring, environmental protection, nature conservation, and environmental information services**.

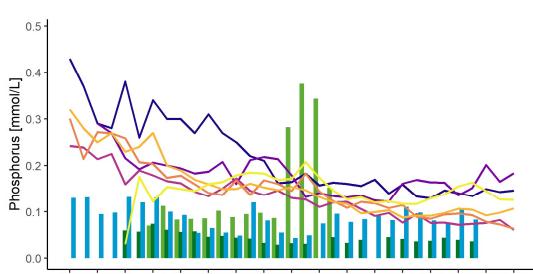
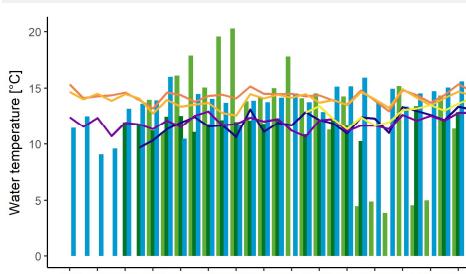


Figure 3: Water temperature and phosphorus concentration of selected water bodies (bars: lakes; lines: rivers) over the years 1990 – 2023. Source: Umweltbundesamt (2023); FGG Elbe (2025); FGG Rhein (n.d.).

CORINE Land Cover (CLC) 2018, Version 2020_20u1. European Union's Copernicus Land Monitoring Service (https://land.copernicus.eu/pan-european/corine-land-cover/clc2018) (Accessed on 10.06.2025). DOI: 10.29097/71c95a07-e296-44f3-b22b-a15f23ac10f0

FGG Elbe. (2025). Biologische Qualitätskomponenten Phytoplankton. Retrieved on June 10, 2025, from https://www.elbe-datenportal.de/FisForElbe/conten/auswertung/Untersuchungsreihen/phytoplankton_filter_parameter

FGG Elbe. (2025). Physikalisch-chemische Qualitätskomponenten. Retrieved on June 10, 2025, from https://www.elbe-datenportal.de/FisForElbe/conten/auswertung/Untersuchungsreihen/physchem/filter_parameter

FGG Elbe. (2025). Wasserqualitative Parameter. Retrieved on June 10, 2025, from https://www.elbe-datenportal.de/FisForElbe/conten/auswertung/Untersuchungsreihen/wasserqualitativeParameter/filter_parameter

Nikolaidis, N. P.; Phillips, G.; Pukanszky, S.; Vlahogi, G.; Bourani, F.; Malaga, A. & Lili, M. A. (2022). River and lake nutrient targets that support ecological status: European scale gap analysis and strategies for the implementation of the Water Framework Directive. *Science of the Total Environment*, 2022, 813, 151988.

Rinke, K.; Glosevnik, L.; Sübel, G.; Snoj, L. (2022). Satellite-based monitoring of cyanobacteria in bathing waters. *ETC/ICM Technical Report* 07/2022: European Topic Centre Inland, Coastal and Marine Waters, 35 pp.

Umweltbundesamt (2022). Die Umweltbemühungen – Gewässer in Deutschland 2021. *Fortschritte und Herausforderungen*. Bonn, Dessau.

Umweltbundesamt (2023). Datenbank der Gewässermonitoringdaten bis 2019. *Metadaten* (n.d.). Umweltbundesamt (2023). https://www.umweltbundesamt.de/sites/default/files/medien/3894/dokumente/dok_lahnsinselwerte_seen.xlsx

Umweltbundesamt (2025). Fließgewässer – Nährstoffe und Salinität. Retrieved on June 10, 2025, from <https://metadaten.uba.de/smartfinder-client/?lang=de/datasets/iso/50083274-c127-4481-bbf2-8c8ddde438b8>

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