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.

Project duration: Three years (01.08.2024 – 31.07.2027)

Contractors: The Federal Environment Agency (UBA), the Federal Institute of Hydrology (BfG), and the Helmholtz Centre for Environmental Research (UFZ).

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 central 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.

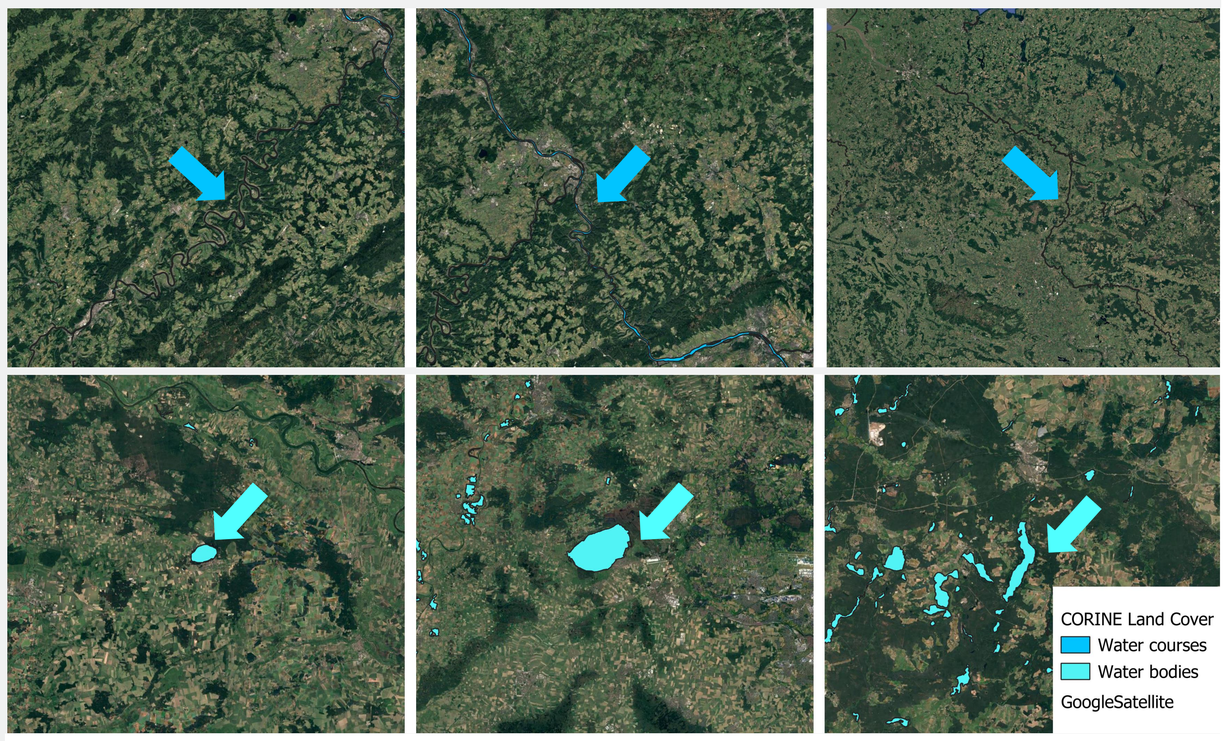


Figure 1: Exemplary water bodies from Germany. Top: Mosel, Mittelrhein, Elbe; bottom: Arendsee, Steinhuder Meer, Scharmützelsee (from left to right). Source: CORINE Land Cover; GoogleSatellite.

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).

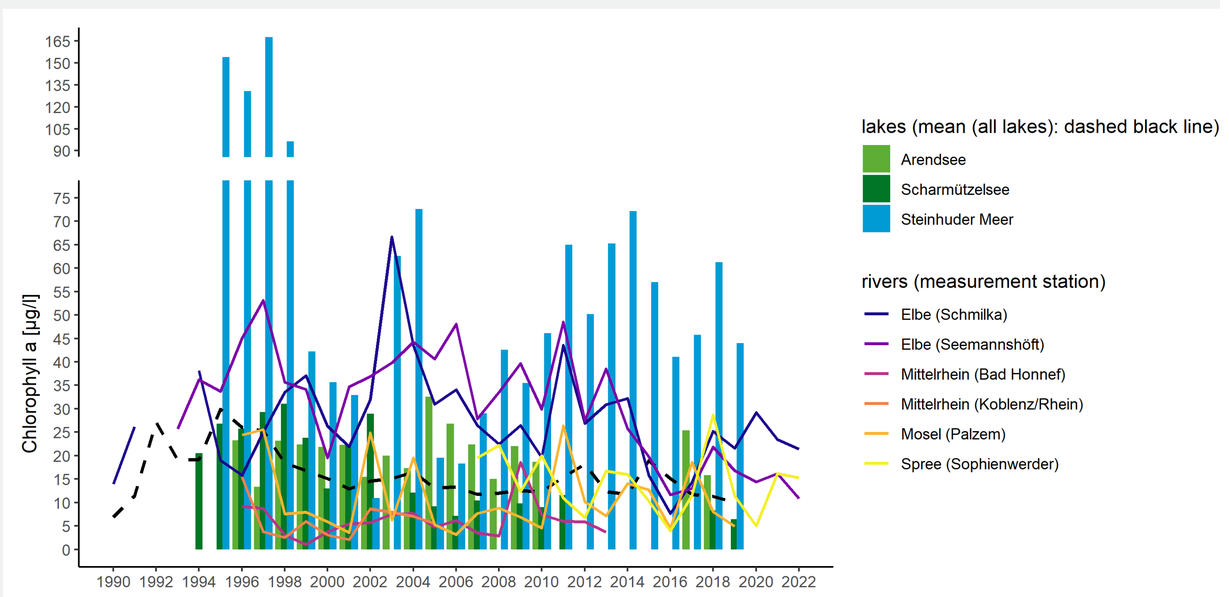
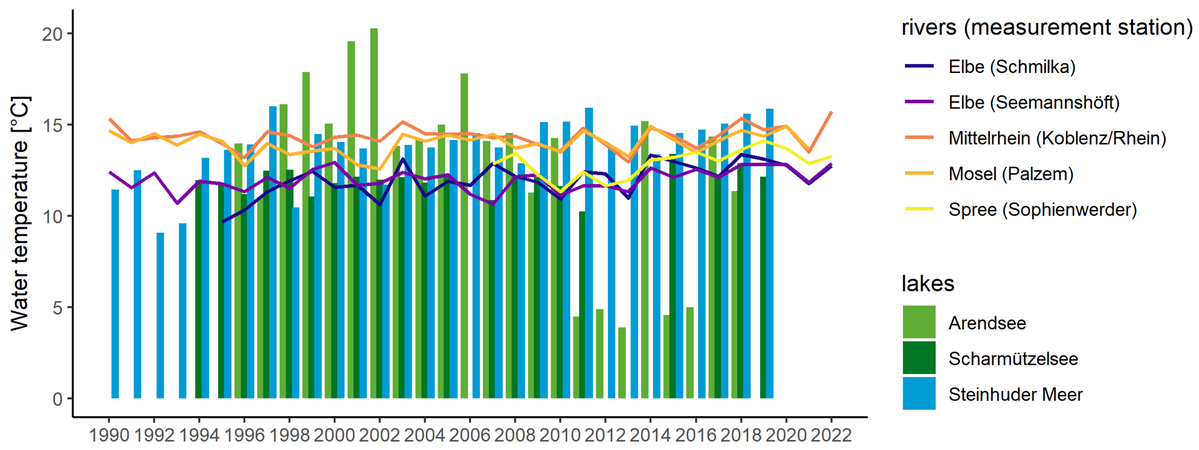


Figure 2: Chlorophyll-A concentration of selected water bodies (bars: lakes; lines: rivers) over the years 1990 – 2023. Source: Seendatenbank (Umweltbundesamt, 2023); FGG Elbe (2025); FGG Rhein (n.d.).

Potential of Remote Sensing in Water Monitoring

Although various data collection methods already exist, they often lack the **temporal or spatial resolution** or the **practical applicability** required by 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**.



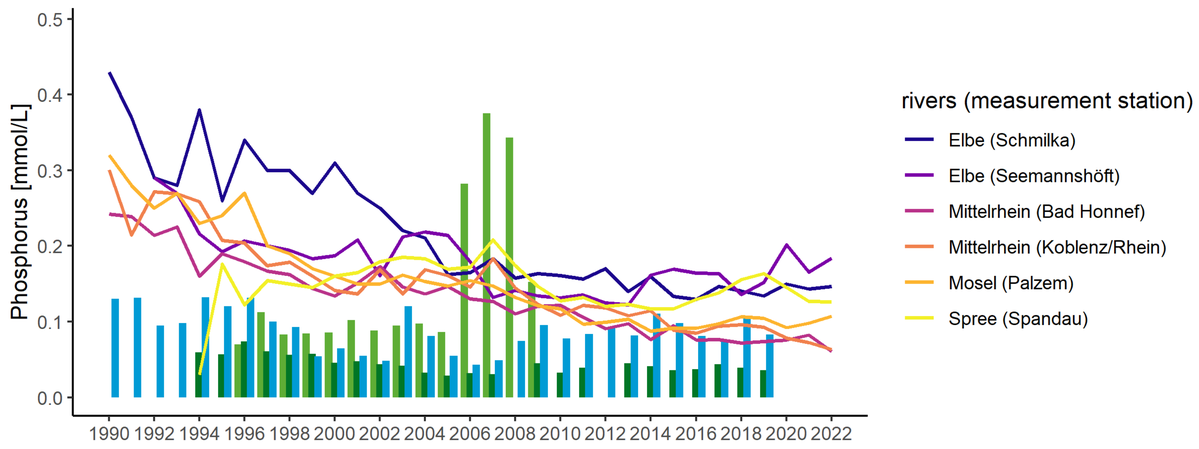


Figure 3: Water temperature and phosphorus concentration of selected water bodies (bars: lakes; lines: rivers) over the years 1990 – 2023. Source: Umweltbundesamt (2023); FGG Elbe (2025); FGG Rhein (n.d.).

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**.

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BfG Bundesanstalt für Gewässerkunde

Umwelt Bundesamt