Sunlight's power: Predicting global lake pollution reduction through photochemistry

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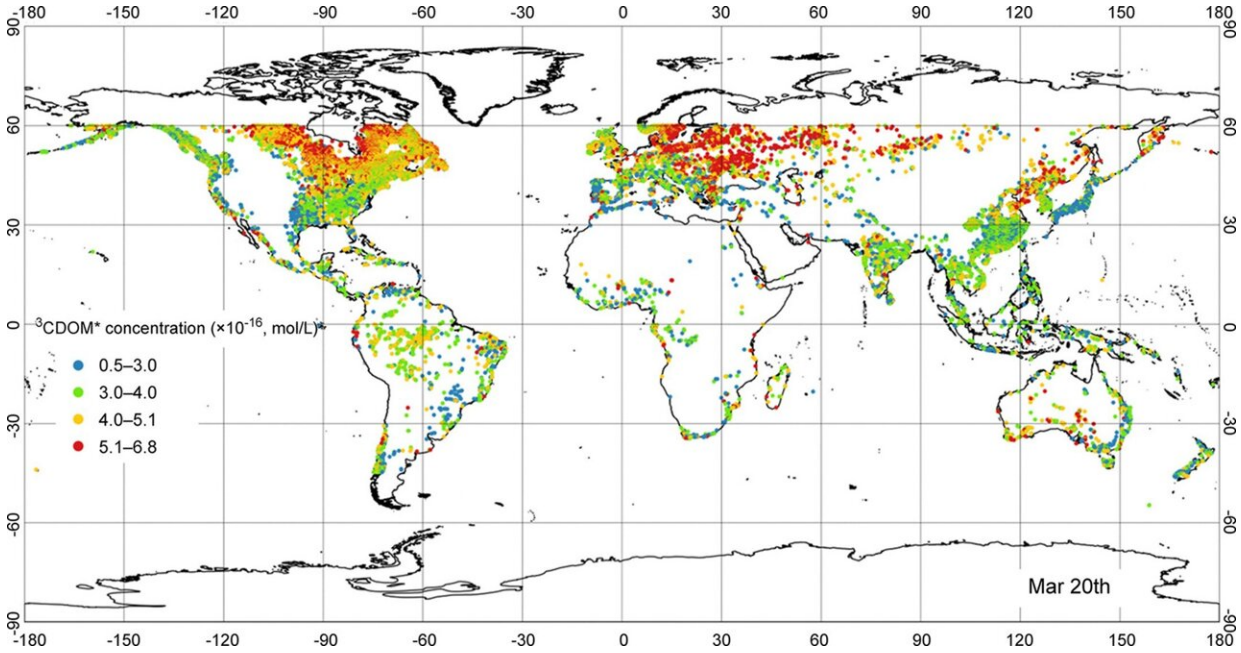

Global Distribution of ^{3}CDOM* Concentrations in Lakes. Credit: Eco-Environment & Health

A study explores how natural photochemical reactions can help degrade emerging contaminants in freshwater systems, specifically focusing on clofibric acid and diclofenac. The research highlights the contrasting effects of triplet sensitization and direct photolysis, providing new insights into how these processes can mitigate pollutant levels in lakes. The findings underscore the potential of photochemical reactions in

supporting global efforts for water management and pollution control.

The rising levels of contaminants in freshwater systems, particularly pharmaceuticals and personal care products, represent a growing environmental threat. These substances, which often evade conventional water treatment methods, persist in aquatic ecosystems and pose risks to both environmental health and human well-being. As these emerging contaminants challenge traditional remediation techniques, understanding the role of sunlight-driven photochemical reactions offers a promising natural solution for mitigating pollution in lakes.

In a study published on September 19, 2024, in *Eco-Environment & Health*, researchers from the University of Torino, Repsol Technology Lab, and Universidad Rey Juan Carlos employed global modeling to analyze the photochemical behavior of clofibric acid and diclofenac. By comparing triplet sensitization and direct photolysis, the research presents a comprehensive assessment of how these processes influence contaminant degradation in lakes across diverse global regions.

The study uses the equivalent monochromatic wavelength (EMW) approximation to predict the photodegradation of clofibric acid and diclofenac in lakes worldwide. By integrating an extensive range of photochemical parameters, such as water depth and dissolved organic carbon (DOC) levels, the research reveals key regional variations in pollutant degradation.

For instance, clofibric acid undergoes rapid degradation mediated by DOC in Nordic environments, while diclofenac degrades most efficiently in tropical regions through direct photolysis. These findings not only enhance our understanding of global contaminant dynamics but also offer practical insights for optimizing water treatment strategies that leverage natural photochemical processes.

Dr. Davide Vione, the study's senior author, commented, "Our findings emphasize the critical role of photochemical processes in the natural attenuation of emerging contaminants. This understanding is essential for developing strategies that protect water quality and safeguard aquatic ecosystems from pollutants."

This research has far-reaching implications for environmental management, particularly in optimizing wastewater treatment methods. By identifying the global patterns of pollutant degradation, the study suggests that photodegradation could serve as a powerful complement to traditional water treatment practices. This approach has the potential to significantly reduce contaminant levels, providing a cost-effective and sustainable solution to enhance water quality and protect aquatic ecosystems worldwide.

More information: Luca Carena et al, Global modeling of photochemical reactions in lake water: A comparison between triplet sensitization and direct photolysis, *Eco-Environment & Health* (2024). DOI: 10.1016/j.eehl.2024.09.001

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