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Exploring the influence of soil erosion on lake eutrophication through remote sensing across Europe

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Soil erosion by water is a critical factor contributing to eutrophication in water bodies, acting as a significant nitrogen and phosphorus input from land. While many models predict soil erosion and sediment transport into lakes and rivers, and the connection between soil erosion triggering eutrophication is considered textbook knowledge, there is, indeed, limited scientific data-based evidence of a direct link between eutrophication and soil erosion. We assessed the impact of soil erosion on eutrophication, considering other covariates such as slope, elevation, phosphorus, nitrogen, and water temperature, by analysing buffer zones of varying sizes around lakes in six different regions of Europe: Austria (82 lakes), France (313), Germany (294), Hungary (79), Poland (478), and the UK (320). We utilized multispectral Sentinel-2 satellite remote sensing data at 20m spatial resolution for 2021 and 2022 to estimate the Floating Algae Index (FAI) of lakes. Bloom occurrence (BO) – the frequency of detected algal blooms – and maximum bloom extent (MBE) – the total area affected by blooms during the study period were correlated with the aforementioned covariates within contributing terrestrial zones of 100m, 200m, 500m, and 1km using machine learning algorithms. Initial results indicate that soil erosion itself is a the most important driver of eutrophication for many of the selected European regions, with water temperature and elevation also playing important roles. Moreover, the significance of soil erosion varies depending on contributing terrestrial zone across different regions. This study underscores the utility of remote sensing in assessing the impact of soil erosion on eutrophication providing a data based scientific link between the two processes.