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Spatiotemporal high-resolution data provide new insights on primary production in Lake Geneva (Switzerland)

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In Lake Geneva, classic bi-monthly measurements at few discrete depths provide very limited information for disentangling the interplay between biotic and abiotic drivers of primary production. This lack in spatial and temporal resolution precludes a robust comprehension of why primary producers' biomass has only decreased by 10% despite an 80% decrease in the lake's total phosphorous concentration since the 1980s. To bridge this gap and enhance our understanding of primary production, we quantify lake metabolism (i.e. the balance between gross primary production and ecosystem respiration) as well as its physical drivers at the diel and weekly timescale from two recently acquired high-resolution data sets.
Since autumn 2018, a mooring with various sensors fixed at multiple water depths is deployed in Lake Geneva to monitor the lake's thermal structure, light regime, dissolved oxygen as well as carbon dioxide dynamics at sub-hourly time scales. Furthermore, an autonomous profiler system ("Thetis") equipped with various sensors is measuring at 10 cm vertical resolution providing additional data at three-hour time intervals. By combining and interpolating these data in a space-time matrix, we estimate lake metabolism using the free-water diel oxygen technique within the upper 30 meters of the water column. This approach allows for elucidating the importance of short-term variability in primary production and for gaining a more mechanistic understanding of its development observed over longer time scales.