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Primary production varying with water column depth and turbidity and chlorophyll a concentration, related to sediment resuspension, in a highly turbid estuary

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Abstract

The Guadalquivir estuary in the SW of Spain is a highly anthropogenically impacted estuary, with high nutrient inputs from waste water and agricultural run-off. Freshwater inflow is mainly controlled by a dam situated at 110 km from the estuary mouth and the estuary is partially canalized and largely isolated from the bordering tidal marshes and potential foodplains. As a result, the estuary is highly turbid and therefore considered net heterotrophic.

However, the estuary is vital for the recruitment of fisheries stocks in the Gulf of Cádiz (Atlantic), being the nursery area for important species like anchovy and sardine, which depend on primary productivity and secondary productivity of the lower levels of the food web in the estuary.

Microscopic observation and fatty acid analyses of suspended particulate matter in the estuary revealed a high diversity of phytoplankton, consisting of 50% diatoms along the whole salinity gradient, with increasing nutritional value towards the more saline zone.

As part of a long-term monitoring and ecological study, monthly measurements were performed at two sites in the Guadalquivir estuary. With a multiparametric sonde temperature, salinity, oxygen, turbidity and chl *a* were registered at 5-min intervals during 2 tidal cycles. Light penetration was evaluated by measurements with a quantum sensor and primary productivity was measured by O₂ bottle incubations.

We found that turbidity and chl *a* strongly and similarly fluctuated over the tidal cycle, indicating the resuspension of sediments and associated chl *a*, consisting of phytoplankton and microphytobenthos, by tidal currents. We present results of depth- and time-integrated primary production (PPd) and show how this variation of turbidity (light penetration) and chl *a* influences calculated PPd for water columns of different depth. We suggest that the spatial heterogeneity of primary productivity and the resuspension of microphytobenthos explain the relatively high chl *a* concentrations observed.

Keywords

estuary, turbidity, phytoplankton, primary production