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Fine structure of suspended matter and dissolved organic matter concentration fields in the Patos lagoon outflow

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We report results of a field survey conducted in the area adjacent to the entrance of the Patos Lagoon, the World's largest choked lagoon. The outflow from the lagoon carries large volumes of fine sediments, as well as dissolved and particulate organic matter. These discharges sometimes trigger negative consequences, such as massive depositions of mud on nearby beaches, deteriorating their recreational potential.
The concentrations of total suspended matter (TSM) and organic matter (as represented by total organic carbon, TOC) were mapped using an ultraviolet fluorescent LiDAR, which allowed for extensive data coverage (total of 79,387 simultaneous determinations of TSM and TOC) during 3 consecutive days. These observations were accompanied by hydrographic measurements from the ship and at a mooring station. We first describe synoptic variability of the plume, which responded energetically to wind forcing. We then analyze the TSM, TOC and hydrographic data jointly and develop a simple approach to estimate the rates of suspended matter removal from the upper layer due to gravitational settling and turbulent mixing based on relative changes in TSM and TOC concentrations.
The bulk TSM removal from the surface layer due to turbulent mixing generally exceeded that due to settling by a factor of 1.6, on average, except at about 2 km wide area immediately adjacent to the entrance, where the situation was the opposite. Four distinct regions were identified with respect to variability of TOC and TSM concentrations: the fully mixed "near-source" region (0-2 km from the lagoon entrance) where concentrations were maximum and TSM settling prevailed; the stratified "core" region of the plume (2-6 km) where TSM and TOC concentrations were subject to abrupt decrease mainly due to turbulent mixing with surrounding waters; the "inner" plume characterized by elevated spatial variability and patchiness of both TSM and TOC fields, significant increase of salinity and shallowing of the plume oceanward; and more uniform "outer" plume. The near-source region whose area was less than 2% of the total plume area contained 27% of TSM and 19% of TOC and accounted for about 14% of TSM removal from the surface layer, mainly because of gravitational settling. The "core" part of the plume at distances less than 1 km from the outlet was responsible for about 30% of both TSM and TOC contents and over 50% of TSM loss, mainly due to turbulent mixing. Another 25% of TSM withdrawal from the upper layer occurred in the "inner" part of the plume at the distances 6-11 km from the lagoon entrance, and only 10% of the loss took place beyond this distance.
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