Seasonal Variations in the Concentrations of Three Greenhouse Gases (CH₄, CO₂ and N₂O) in a Shallow Coastal Area Affected by Inputs of Organic Matter and Nutrients

FERRÓN S., T. ORTEGA, J.M. FORJA, A. GÓMEZ-PARRA

Departamento de Química Física, Facultad de Ciencias del Mar y Ambientales, Universidad de Cádiz, Spain.

The concentrations of three greenhouse gases, methane (CH₄), carbon dioxide (CO₂) and nitrous oxide (N₂O), were measured in the surface waters of Rio San Pedro (Bay of Cádiz, NW Spain), in order to characterised the dynamics of these biogases within the system. The study was carried out in a shallow inlet characterised by semidiurnal mesotides which is affected by inputs of large amounts of organic carbon and nutrients coming from the discharges of three aquaculture plants. The study covered all four seasons during 2004, and different tidal conditions.

The concentrations of these gases in samples were determined using a gas chromatograph (Varian 3600) equipped with a flame ionisation detector (FID) for CH₄ and CO₂, and an electron capture detector (ECD) for N₂O. Gases were extracted from the water sample using a head space method.

The concentrations of dissolved CH₄, CO₂ and N₂O varied between 11-88 nM, 36-108 mM and 14-50 nM, respectively, showing a great seasonal variability. Surface waters were in all cases oversaturated with respect to the atmosphere, reaching values above 4500% for CH₄, 1000% for CO₂, and 800% for N₂O. In general, maximum saturation values were found during the summer. Results also showed a variation with respect to tidal conditions, with higher values during low tide, which points out the importance of diagenetic processes in the production of these biogases. Quantification of air-sea fluxes showed mean values of around 50 mmol m⁻² d⁻¹ for CH₄, 85 mmol m⁻² d⁻¹ for CO₂ and 35 mmol m⁻² d⁻¹ for N₂O, indicating that this system is a net source of these gases to the atmosphere.