CARBORHONE: Spatio-temporal dynamics of air-sea CO_2 fluxes in Gulf of Lion (Mediterranean Sea)

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Over the past decade, the coastal oceans have been the focus of several studies highlighting the key role of these ecosystems in the global budget of air-sea CO_2 fluxes. The spatial variability in air-sea CO_2 fluxes is large from one coastal ecosystem to the other and it was recently proposed to classify continental shelves as sinks and near-shore ecosystems as sources of atmospheric CO_2. However, the latest estimates of air-sea CO_2 fluxes in coastal ecosystems are subject to large uncertainty. At present, the lack of sufficient data is the major limitation in the quantification of the spatial and temporal variability of these CO_2 fluxes in coastal environments. This lack of data is even more relevant in coastal ecosystems impacted by estuarine plumes. While there is an emerging agreement on the role of inner estuaries as source of CO_2 to the atmosphere, estuarine plumes (e.g. outer estuaries) can either act as sources or as sinks for atmospheric CO_2. To accurately constrain the present impact of estuarine plumes in global air-sea CO_2 fluxes, additional investigations must be carried out in a greater diversity of ecosystems.

The air-sea CO_2 fluxes in Mediterranean coastal ecosystems impacted by estuarine inputs have been particularly poorly investigated. The Gulf of Lions is a coastal ecosystem considerably impacted by freshwaters inputs from the largest estuary surrounding the Mediterranean Sea namely the Rhône. In the framework of the MERMEX-CARBORHONE project, we investigated the processes controlling the air-sea CO_2 fluxes from the inner estuary to the estuarine plume located within the 1500 m isobath of the Gulf of Lions. Our approach relied on 4 seasonal cruises carried out in 2011 and 2012. In the present paper, we provide a first assessment of the processes controlling the carbon dioxide system in the very heterogeneous coastal ecosystem “Rhône estuary/Inner Gulf of Lions”. This first assessment will constitute a basis for a future understanding of the carbon dioxide system alteration under global change.