An updated sea surface pCO2 data-product for the global coastal ocean

ALIZÉE ROOBAERT[1], GOULVEN GILDAS LARUELLE[1], PETER LANDSCHÜTZER[2], PIERRE REGNIER[1]

[1] *Department of Geosciences, Environment & Society (DGES), Université Libre de Bruxelles, Brussels, CP160/02, Belgium*

[2] *Flanders Marine Institute (VLIZ), Ostend Belgium and Max Planck Institute for Meteorology, Hamburg, Germany*

In recent years, significant advances have been made regarding the development of robust interpolation methods based on machine learning techniques and their application to sea surface partial pressure of CO2 (pCO2) in order to produce high resolution maps, continuous in time and space. The resulting data-products, which are based on high-quality pCO2 measurements from uniform databases such as the Surface Ocean CO2 Atlas (SOCAT), now permit the spatially explicit quantification the oceanic air-sea CO2 exchange based on observations. However, most of these products do not explicitly include the coastal ocean, or their coarse spatial resolution is not appropriate to fully capture the highly heterogeneous spatiotemporal pCO2 dynamics that takes place in coastal zones. Moreover, until now, only one pCO2-product based on a 2-step neural network approach, was specifically developed for the coastal ocean but it is only applicable for climatological studies (Laruelle et al. 2017). Therefore, the study of the interannual variations of the coastal ocean air-sea CO2 exchange or the long-term trend of this exchange remains uncertain and limited to collections of local time-series.

Here, we update the coastal data-product of Laruelle et al. (2017) to reconstruct the temporal evolution of the global coastal CO2 sink over the past 4 decades. To do so, we update the coastal version of the 2-step Self Organizing Maps and Feed Forward Network method used by Laruelle et al. (2017) and, using more than 32 million observations from the latest release of the SOCAT database, we investigate the longest global timeseries available for the coastal ocean (1982-2020). Our results reveal, with good confidence due to our spatiotemporal evaluation of this new coastal data-product, that the coastal ocean acts as a CO2 sink since the first year of our study period (1982). The intensity of this CO2 sink has however increased over time from -0.25 Pg C yr-1 over a total surface area of 77 million km2 in the early 1980s to -0.6 Pg C yr-1 in more recent years. This updated coastal pCO2-product allows establishing regional carbon budgets requiring high resolution coastal flux estimates and provides new constraints for closing the global carbon cycle.