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Exploring seasonal to interannual variability of the carbonate system in the southern Adriatic

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Since the beginning of the industrial revolution, about 30% of total anthropogenic CO_2 emissions have been absorbed by the world's oceans, resulting in a global reduction in ocean pH. This process, commonly referred to as ocean acidification, is considered one of the greatest threats to marine ecosystems. Recently, it has been recognised that the regulation of oceanic CO_2 uptake is controlled by the oceanic overturning circulation. Accordingly, the site of dense water formation in the Southern Adriatic (SAd), where the Eastern Mediterranean deep thermohaline circulation originates, could play an important role in CO_2 sequestration and acidification of the Mediterranean Sea. The Southern Adriatic is characterised by a quasi-permanent cyclonic circulation and it is known that deep water forms in the centre of the gyre through winter open-ocean convection. In this contribution, we used data from several oceanographic cruises between 2008 and 2023 to investigate the spatial and temporal variability of the carbonate system properties in the Southern Adriatic. The vertical distributions of total alkalinity (A_T), pH, inorganic nutrients, dissolved inorganic carbon (DIC) as well as CO_2 partial pressure (pCO_2), calculated with the CO2Sys software, are analysed. Time series of high-frequency pCO_2 data from an automatic sampling system set up on the surface buoy of the E2M3A facility, operated by the Italian National Institute of Oceanography and Applied Geophysics (OGS), are also presented. E2M3A is moored in the centre of the southern Adriatic Pit (SAP) and has been collecting pCO_2 data since 2015. We discuss the seasonal and interannual variations of the carbonate system variables and the influence of physical and biological processes on this variability. These results contribute to the understanding of the role of the Southern Adriatic in transporting and storing CO_2 to the deeper layers and in inducing ocean pH changes. Furthermore, we emphasise the importance of an integrated oceanographic approach that combines fixed-point observations with hydrographic surveys to comprehensively investigate the response of the Adriatic Sea to climate change.