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Extreme variations of pCO_2 and pH in a macrophyte meadow of the Baltic Sea in summer: evidence of the effect of photosynthesis and local upwelling.

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Since the rise of ocean acidification as a major scientific question, state of the art knowledge on pCO_2 and pH in nearshore ecosystems are becoming crucial to drive the experimentalists. However, in temperate areas, such data are widely missing. In this study we investigated the variations of the carbonate system in the nearshore macrophyte meadows of the western Baltic Sea. These are key benthic ecosystems, providing spawning and nursery areas and food source to numerous commercially important species. In situ pCO_2, pH (total scale), salinity and PAR irradiance were measured with a continuous recording unit dropped in a shallow macrophyte meadow (Eckernförde bay, western Baltic) during three different weeks in July, August and September 2011. Means ($\pm$ SD) pCO_2 / pHtot observed were respectively 382 $\pm$ 114 μatm / 8.188 $\pm$ 0.131, 239 $\pm$ 62 μatm / 8.218 $\pm$ 0.101 and 931 $\pm$ 668 μatm / 7.826 $\pm$ 0.398 in July, August and September. Mean ($\pm$ SD) day / night pCO_2 variations due to photosynthesis and respiration were 227 $\pm$ 88 μatm, 195 $\pm$ 100 μatm and 1488 $\pm$ 732 μatm in July, August and September. The observed variations of pCO_2 were explained through a statistical model considering wind direction and speed together with PAR irradiance, proving the occurrence of local upwellings of hypercapnic water masses with late summer offshore winds. Those results are demonstrating the high variability of the carbonate system in nearshore macrophyte meadows depending on meteorology and biological activities. They highlight the need for future pCO_2 scenarios for nearshore habitats.