

New method for simulating ebb, flood and tides to analyze soil respiration and priming effects at the interface of terrestrial and marine ecosystems

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Saltmarshes at the Wadden Sea are a highly dynamic system with fast changing abiotic conditions and a unique biodiversity. In order to quantify the mutual influence of environmental factors, such as salinity and inundation frequency, we determined the dependency of mineralization patterns from the tidal regime in a controlled laboratory experiment.

This study presents a novel experimental setup for the comparison of soils in which ebb, flood and tides can be simulated to measure CO₂ evolution and possible Priming Effects (PE). The mesocosms with the soils are framed by one or two air tight sets of pumps (depending on the treatment) in two closed circles. For all treatments, the first set constantly pushes air through the mesocosm into a NaOH-containing vial to trap the evolving CO₂. Afterwards, the CO₂-free air is transferred back to the pump. Set two is activated temporally by an automatic timer which is adapted to the natural tidal rhythm, regularly flooding the mesocosms with saltwater from a reservoir and draining them in 6-hour intervals. Two soil types from a Wadden Sea Saltmarsh (Pioneer Zone ("PZ") and Lower Saltmarsh ("LSM")) were analyzed with the following treatments: All-time-ebb ("Ebb"), all-time-flood ("Flood") and tides ("Tides") with changing water level. Half of the soils were amended with ¹⁴C labeled glucose.

Cumulative CO₂ productions showed that long term CO₂ evolution (Day 11 to 56) was mainly unlabeled. Moreover, a higher CO₂ production in soils from the LSM compared to soils from the PZ was linked to a nearly doubled amount of microbial biomass (0.369 mg*g⁻¹ for LSM to 0.195 mg*g⁻¹ for PZ) and a higher C (5.5% for LSM to 3.7% for PZ) and N (0.5% for LSM to 0.36% for PZ) content. Hence, a higher total respiration occurred in LSM-treatments. Ebb-treatments showed positive PE for PZ and LSM. In Tides-Treatment, only LSM had a positive PE. Negative PE was observed for LSM soils in Flood-treatments. The reasons are the existence of faunal grazing in Ebb-treatments, whereas there was a limitation of oxygen in Flood-treatments with Tides-treatment as intermediate. In conclusion, mineralization rates and PE were probably mainly driven by those two factors.