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How do storm events and fair-weather conditions affect sedimentation patterns on salt marshes?

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Coastal salt marshes are extremely important ecosystems, occupying the transitional zone between submerged and emerged environments. Since salt marshes are based on a delicate balance between hydrodynamics and sedimentary processes, their future is heavily affected by relative sea-level rise (RSLR), caused by both subsidence and eustatism. If vertical accretion is sufficient, salt marshes can keep pace with RSLR; otherwise, lack of sediment input can eventually lead to plant death and marsh drowning, transforming these landforms into tidal flats and subtidal platforms. Resuspension driven by intense meteorological events can represent an important source of sediment for salt marsh accretion in tidal environments characterized by negligible fluvial sediment supply. However, it is not yet clear what is the mutual role and relative contribution of intense storm events and fair-weather conditions in terms of sedimentation patterns. To better understand sedimentation dynamics on salt marshes, we stared a field campaign in October 2018 to measure vertical accretion rate and sediment accumulation.

In the Venice lagoon (Italy), which is the largest lagoon in the Mediterranean sea and is characterized by a semi-diurnal, microtidal regime, we selected three study areas: the San Felice and Sant'Erasmo salt marshes in the northern lagoon and the Conche salt marsh in the southern lagoon. Subsidence at all these study sites ranges between 1.0 and 2.0 mm yr^{-1}, and the rate of sea-level rise is of about 2.0 mm yr^{-1}, for a total rate of RSLR of about 3.0-4.0 mm yr^{-1}. At each study area, we considered different transects, where we installed three measurement stations located respectively at 2.5 m, 7.5 m, and 27.5 m from the salt marsh margin. We equipped each station with an artificial marker horizon laid down on the marsh surface to measure the vertical accretion, and three sediment traps for measuring the short-term sedimentation. The material deposited in two sediment traps is collected monthly or after any single storm, whereas sediment deposited in the third trap is collected once a year, in order to compare sediment deposition dynamics at short (single storm event) and annual time scales. We measure accretion rate, grain size distribution, organic and inorganic content.

Short-term sedimentation displays a very high variability (0 – 320 g d^{-1} m^{-2}) highlighting the importance of particularly intense storm events in resuspending and transporting sediment from tidal flats to the salt-marsh surface. In particular, during the storm events occurred in October 2018 and November 2019, sedimentation increases significantly and displays values much higher

compared to fair-weather periods. According to our analysis, sedimentation grows exponentially with daily mean inundation time. Even if the inner part of the salt marsh is characterized by lower elevation and, hence, by greater inundation time, sedimentation shows smaller values compared to the salt marsh margin, since suspended material settles close to the margin and decreases towards the inner part of the marsh.