Sediment deposition patterns on salt marshes: the role of standard conditions and storm events

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1. Introduction

Salt marshes are worldwide 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 marsh drowning and plant death, transforming these landforms into tidal flats and subtidal platforms.

However, it is not yet clear what is the mutual role and relative contribution of intense storm events and standard hydrodynamic conditions in terms of sedimentation. Indeed, in tidal environments with no fluvial sediment input, resuspension due to intense meteorological events can represent the major source of sediment for salt marsh accretion (Day et al., 1998). Here we present field observations and related analyses aiming at describing sediment deposition dynamics and vertical accretion rates of salt marshes, revealing the role of intense storm events.

2. Methods

We selected three different sites in the Venice Lagoon, Italy: San Felice (SF), Sant'Erasmo (SE), and Conche (CO) salt marshes (Figure 1a). 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} (Carbognin et al., 2004; Strozzi et al., 2013). For similar salt marshes in the Venice Lagoon, the accretion rate between 1993 and 1995 was estimated to be about 3.0 mm yr^{-1} by Day et al. (1998).

The SF study site is a sandy-rich soil salt marsh in the northern part of the lagoon, close to the Lido inlet. The SE and CO salt marshes, located in the northern and southern part of the lagoon, respectively, are more rich in silt and organic matter and they are both exposed to the action of wind-waves generated by the Bora wind, the most intense and morphologically significant wind in the Venice lagoon, blowing from North-East.

At each study site, we considered different transects (Figures 1b, c, and d) and for each of them 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 two sediment traps for measuring the short-term sedimentation (Figure 1e). The material deposited in the first sediment trap is collected monthly or after any single storm, meanwhile sediments deposited in the second one are collected once a year, in order to compare sediment deposition dynamics at short (single storm event) and annual time scales. Following the approach proposed by Roner et al. (2016), we measure accretion rate, grain size distribution, organic and inorganic content.

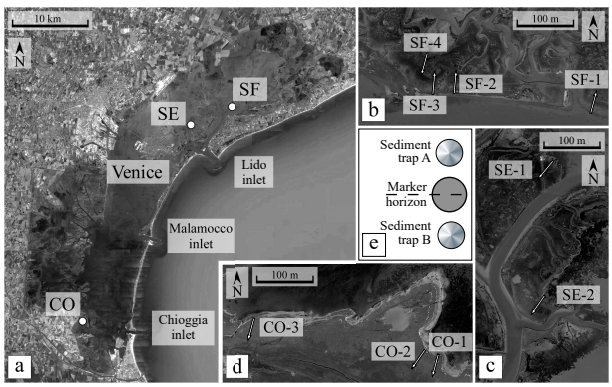

Figure 1. (a) Location of the study sites in the Venice lagoon, Italy. Position of the transects in (b) San Felice (SF), (c) Sant'Erasmo (SE), and (d) Conche (CO) study areas. (e) Sketch of a measurement station.

3. Results and Conclusions

The field campaign is still ongoing, and, since the beginning in October 2018, already two intense storm events occurred at the end of October 2018 and in December 2018. A preliminary analysis of our field data suggests that during intense storm events sediment deposition over the marsh surface can exceed the deposition occurring in several months characterized by standard hydrodynamic conditions. Furthermore, sedimentation seems to increase in the inner part of the marsh during storm events otherwise it mainly concentrates close to the margin. The analysis of sediments deposited on the traps will help us to relate sedimentation patterns to the eco-morphological salt-marsh characteristics and to further understand the relative contribution of severe storms.

References

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