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Characterization of organic matter decomposition in the Venice Lagoon using the Tea Bag Index

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Salt-marsh evolution importantly depends on complex feedbacks between hydrodynamic, morphological, and biological processes. These crucial ecogeomorphic structures support a diverse range of ecosystem services, including coastal protection and biodiversity increase. In addition, they are among the most carbon�rich ecosystems on Earth, as their high primary production coupled with rapid surface accretion results into the ability to sequester atmospheric carbon at high rates. However, salt-marsh future is at risk today, due to the effects of climate changes and local anthropogenic disturbances, in particular sea-level rise and reduced fluvial sediment delivery to the coasts. The organic matter captured and stored by salt marshes results from the balance between inputs and outputs and may contribute to marsh surface accretion, which determines their ability to keep pace with sea-level rise. Therefore, a better understanding of the processes regulating organic matter dynamics on salt marshes is a critical step to elucidate their carbon sink potential and to address salt-marsh management and conservation issues. Toward this goal, we analysed organic matter decomposition processes within salt-marsh ecosystems by burying 712 commercially available tea bags within different marshes in the Venice Lagoon (Italy), following the Tea Bag Index protocol. The process provides the values of two key parameters: the decomposition rate (k) and litter stabilisation factor (S). Based on standardized litter bag experiments, the Tea Bag Index focuses on the effects of abiotic conditions, neglecting litter-quality influences. The mean values of the decomposition metrics from our analyses are in general consistent with previous results and indicate a quite fast decomposition of the organic matter with a remaining mass of about 34% of the initial labile mass after 90 days. We next explore the possible dependence of k and S on environmental drivers. Temperature showed the most significant relationship with decomposition processes, suggesting an organic-matter decay acceleration with warming temperature, in line with previous literature. Moreover, the statistical analysis indicated some significant trends of the decomposition rate also with surface elevation and distance from the marsh edge. This suggests that, at the marsh scale, higher and probably less frequently flooded sites are exposed to faster decomposition, likely due to greater oxygen availability enhancing microbial respiration. In conclusion, the organic matter decay we observed is rapid enough to consume all the labile material before it can be buried and stabilized, hence increased global temperatures may not have a significant effect in increasing organic matter

decomposition in coastal marshes. Therefore, we argue that, at least in the short term, the remaining mass of the organic matter contributing to carbon sequestration and marsh accretion, strongly depends on the initial litter quality, recalcitrant or labile, which may differ considerably between different species and plant parts and may be affected by climate change effects.