

Coastal flooding protection will change salt-marsh sedimentation dynamics

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COASTAL FLOODING PROTECTION

Storm-surge barriers designed to protect coastal urban areas are increasingly common worldwide

- Barriers active: the river Scheldt Estuary (The Netherlands), the river Thames (UK), New Orleans (USA), St. Petersburg (Russia), Venice (Italy),...
- Barriers planned: Shanghai (China), Galveston Bay (USA), New York (USA), ...

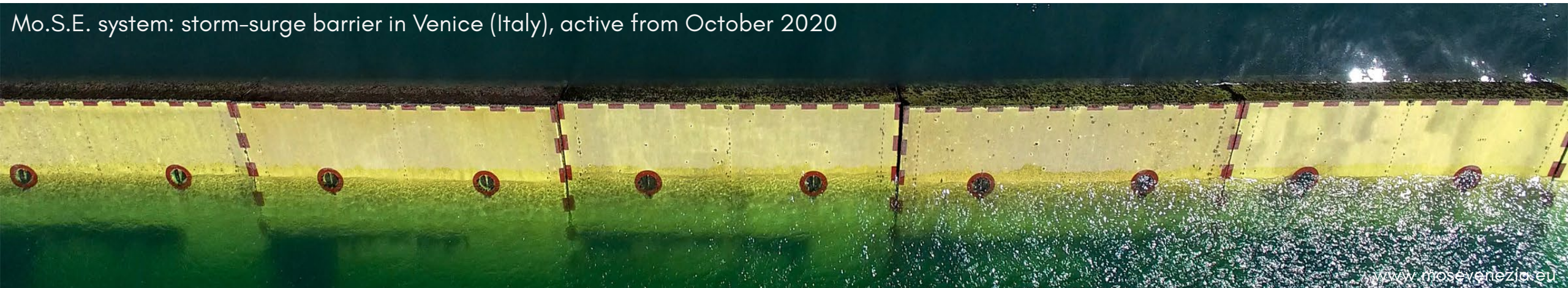


How will storm-surge barriers affect salt-marsh sedimentation?



We analysed salt-marsh sedimentation in the **Venice lagoon** (Italy), which is flood regulated since October 2020

Mo.S.E. system: storm-surge barrier in Venice (Italy), active from October 2020



MEASUREMENTS IN THE VENICE LAGOON



3

study areas: SF, SE and CO

27

stations equipped with two cylindrical sediment traps (Temmerman et al., 2003; Nolte et al., 2013)

1230

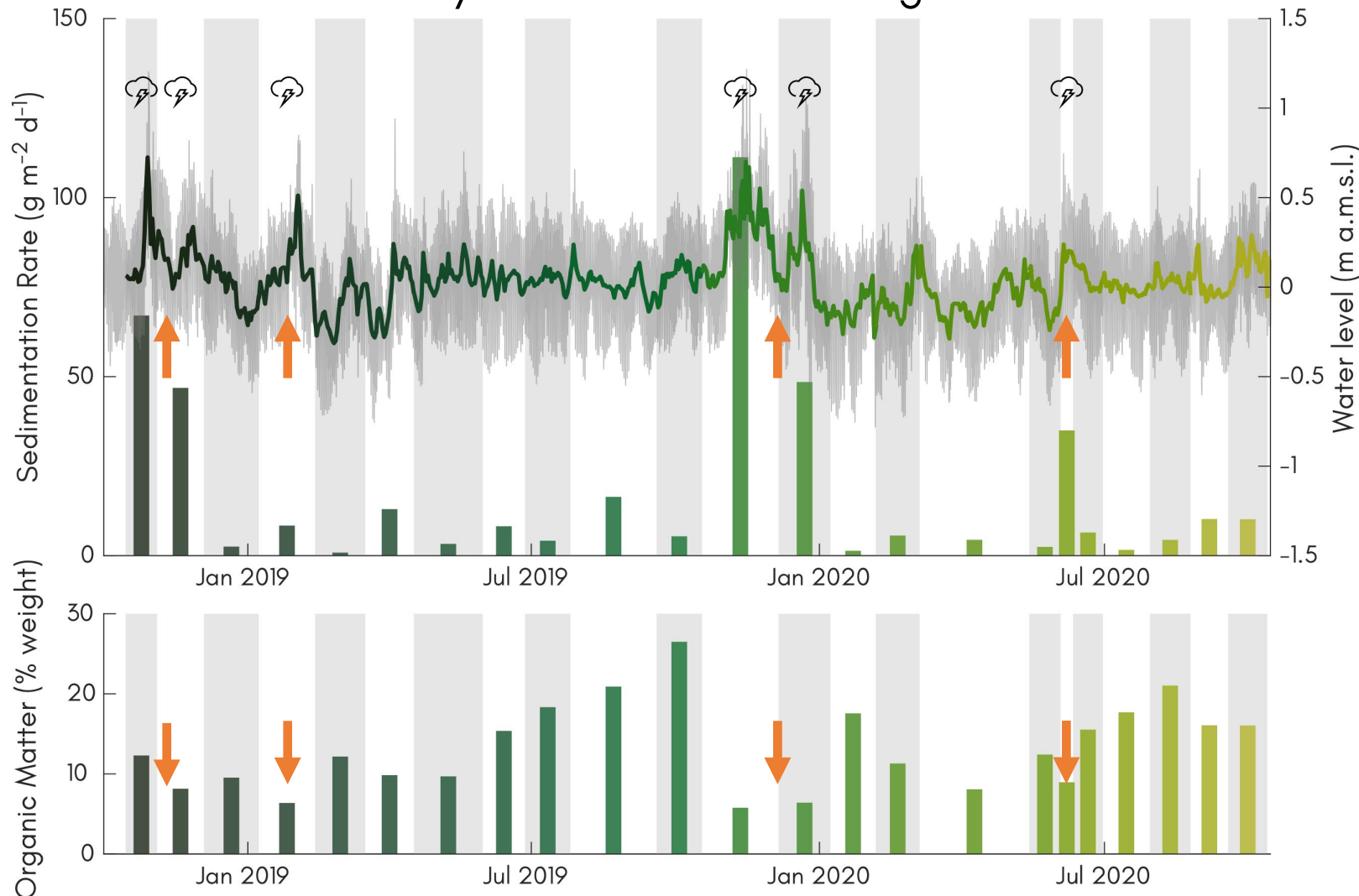
samples collected monthly or after storm surges from October 2018 to October 2020

Sediment accumulation: sediment dried at 40°C for 48 hours then weighed

Organic fraction: estimated with Loss On Ignition. 2 g of sediment crumbled and combusted at 375° C for 16 h (Ball, 1964; Roner et al., 2016)

SEDIMENTATION VARIES OVER TIME

Study area: SF – Northern lagoon



Sedimentation

- increases during severe storm surges
- is low during fair-weather conditions

Organic matter

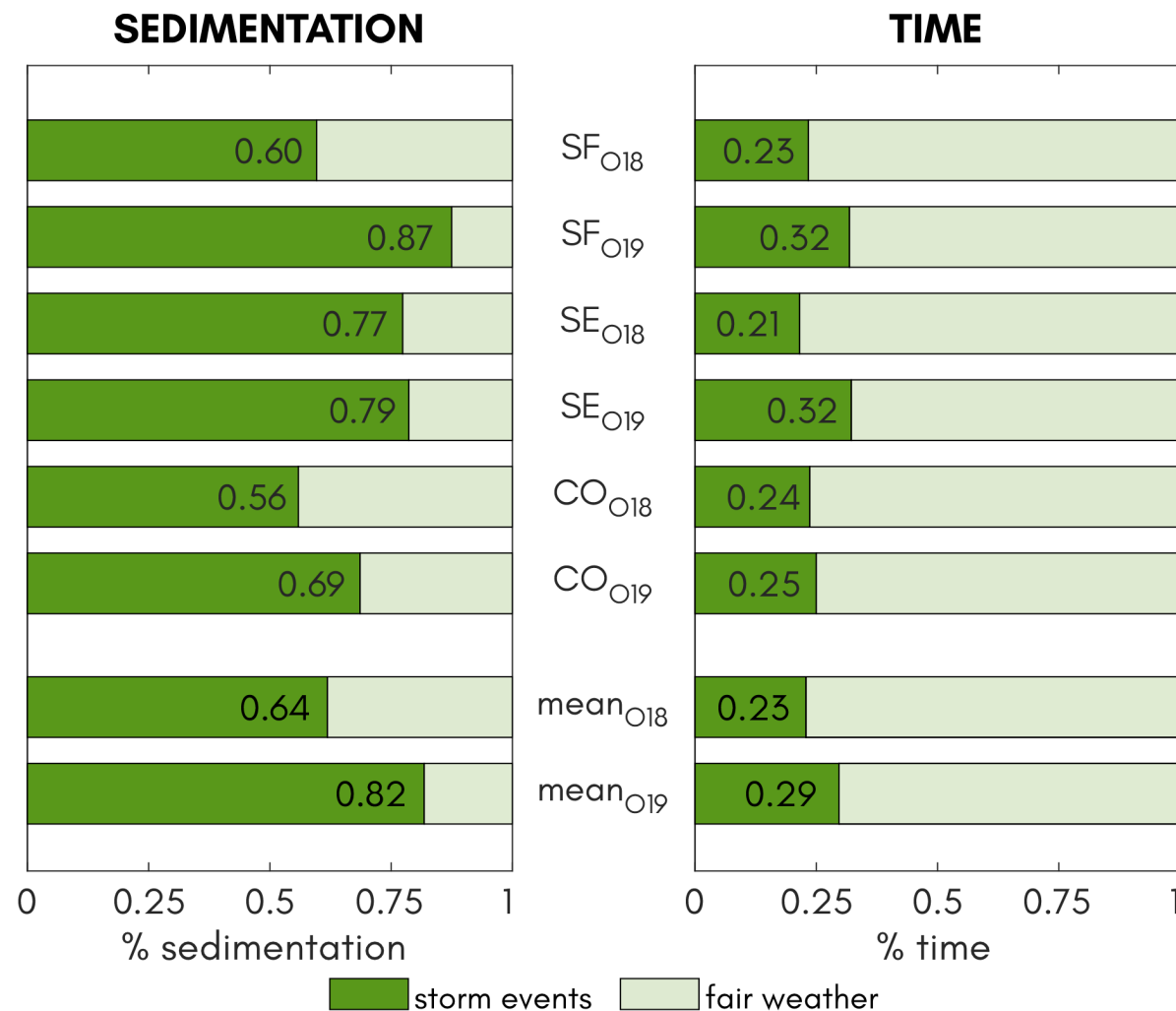
- increases during summer and early autumn
- is relatively low during storm surges

IS SEDIMENTATION STORM-DRIVEN?

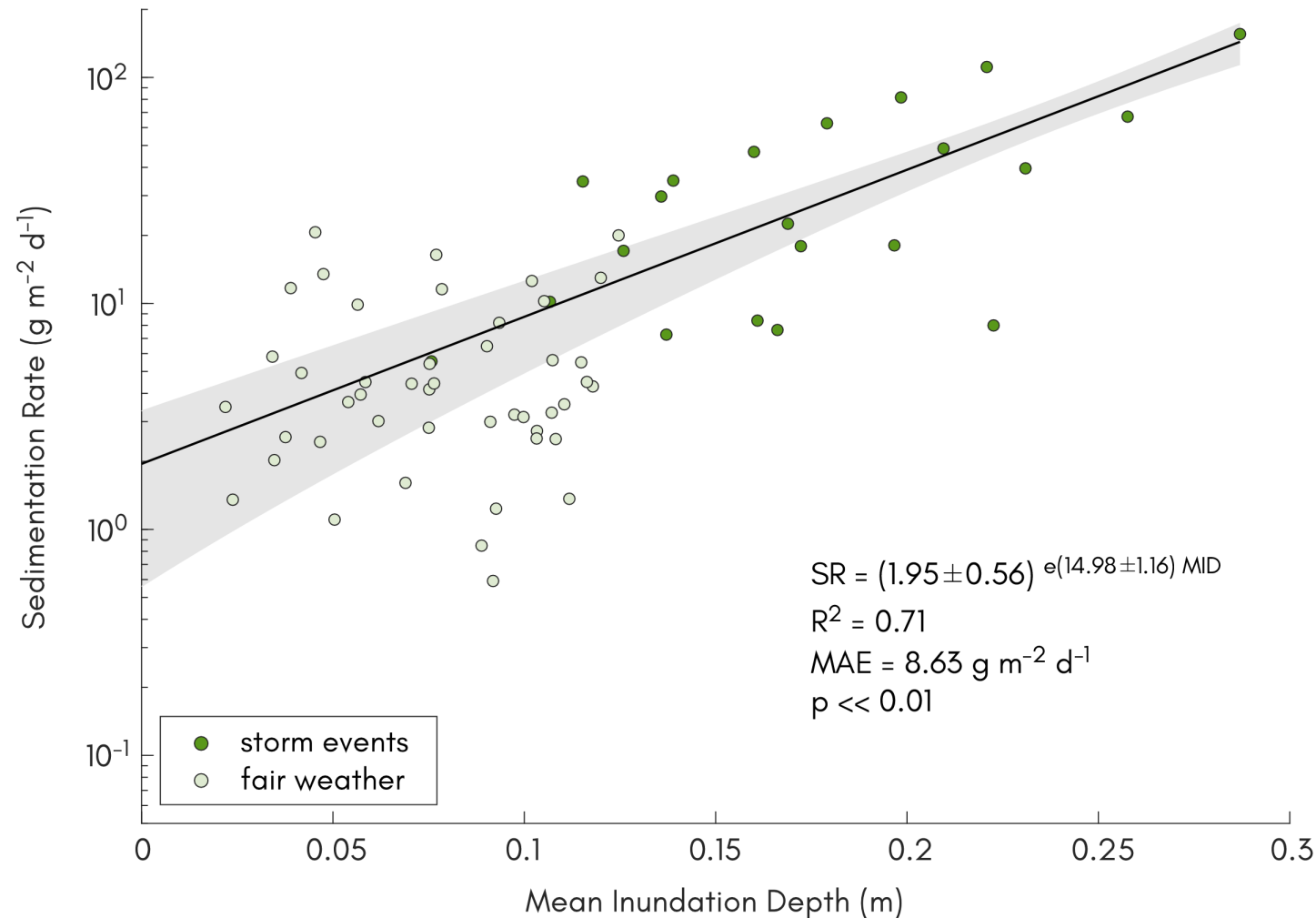
70%

of yearly sedimentation
occurs during storms

Storm vs non-storm contribution is normalized over yearly periods (O18: October 2018–October 2019, O19: October 2019–October 2020) for each study area (SF, SE and CO) and the overall mean



ARE SEDIMENTATION AND TIDE RELATED?



Sedimentation rate increases exponentially with Mean Inundation Depth (MID)

MID = mean water depth over the marsh

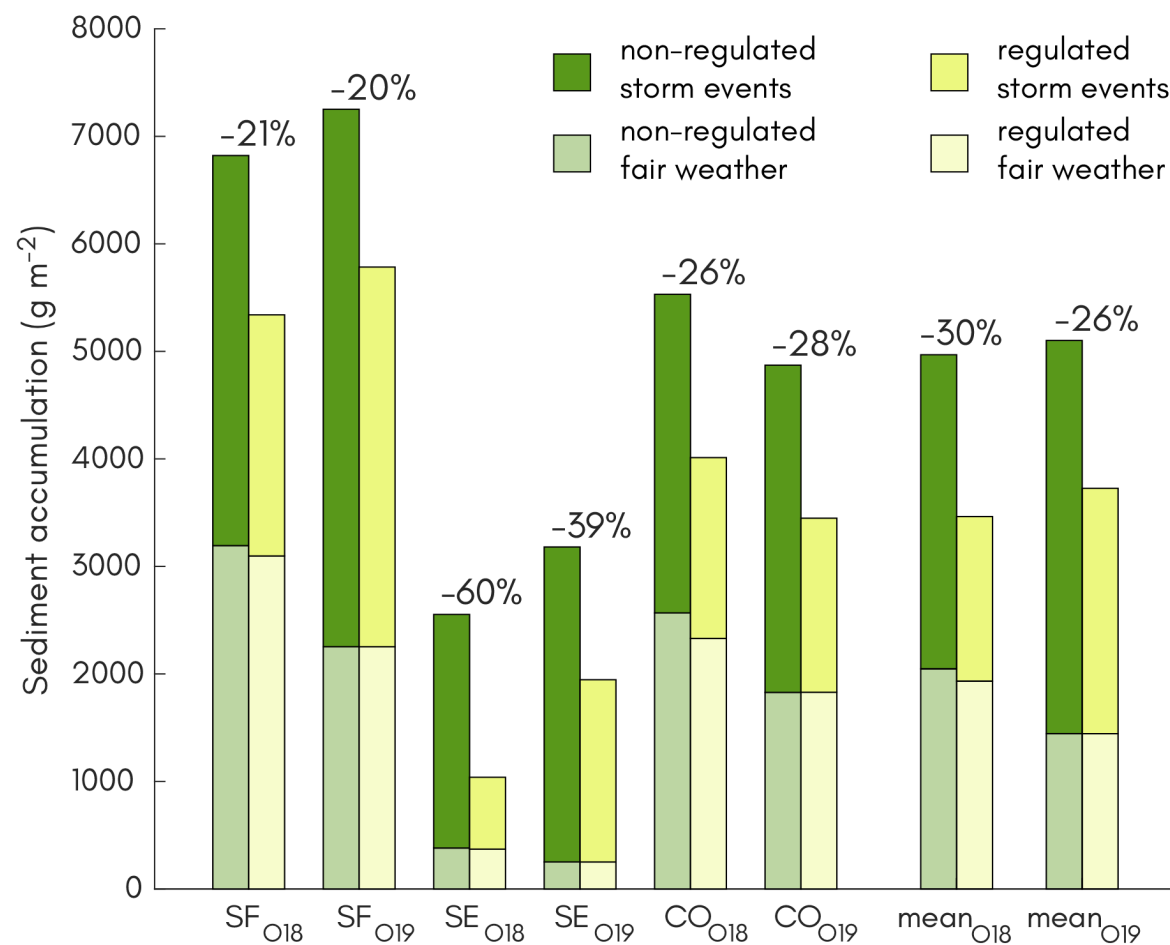
The exponential model captures sedimentation dependence on MID both under fair-weather and storm-surge conditions

Flood regulation will reduce MID

Flood-barriers cap water levels, reducing MID

The empirical exponential model can be used to estimate sedimentation changes due to flood regulation

FLOOD REGULATION AFFECTS SEDIMENTATION



Flood regulation
will reduce the
yearly sedimentation
more than

25%

Sedimentation is computed applying the exponential model with water levels (i.e. MID) in non-regulated and flood-regulated conditions for yearly periods (O18: October 2018–October 2019, O19: October 2019–October 2020) for each study area (SF, SE and CO)