EGU General Assembly 2020

EGU2020-978

Natural vs. trawling-derived transport of sediment and particulate organic matter in a submarine canyon

Sarah Paradis[1,2], Marta Arjona-Camas[2,3], Miguel Goñi[4], Pere Masqué[1,5,6], Pere Puig[2]

[1]Institut de Ciència i Tecnologia Ambientals, Universitat Autònoma de Barcelona, Barcelona, Spain
[2]Institut de Ciències del Mar (CSIC), Barcelona, Spain
[3]Department of Earth and Ocean Dynamics, University of Barcelona, Barcelona, Spain
[4]College of Earth, Ocean, and Atmospheric Sciences, Oregon State University, OR, USA
[5]Edith Cowan University, Western Australia, Australia
[6]International Atomic Energy, Principality of Monaco, Monaco

Deep bottom trawling in the Mediterranean Sea

Deep bottom trawling (200-1000 m) occurs in most of the Mediterranean continental slope.

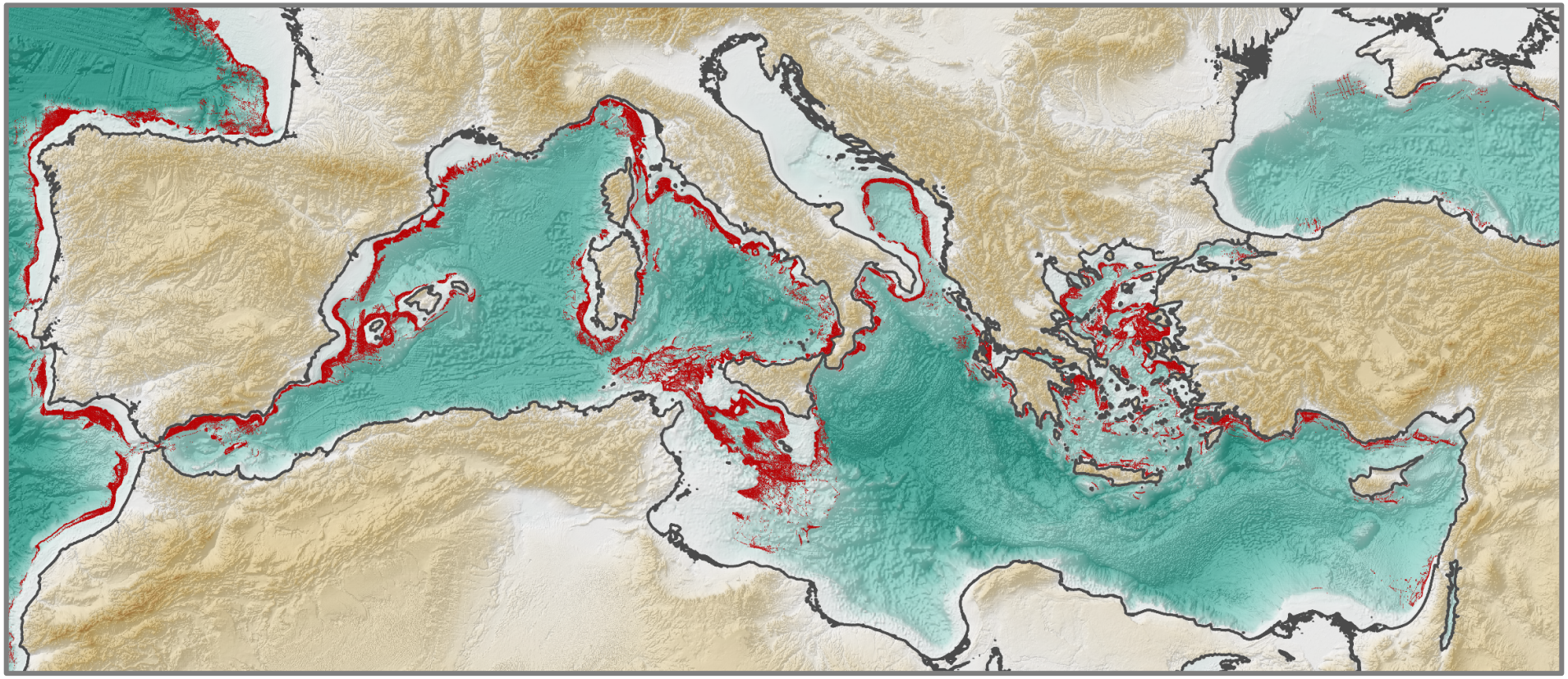

Fig. 1. Deep bottom trawling grounds in the Mediterranean continental slope.

Palamós Canyon

- Palamós Canyon supports bottom trawling grounds along its flanks (400-800 m), and trawling activities occur from March-December, with a seasonal trawling closure from Janurary-February.
- Bottom trawling activities alters natural sedimentary dynamics in the canyon by triggering sediment gravity flows towards the canyon's axis.
- The composition of this trawling-derived sediment hasn't been assessed yet

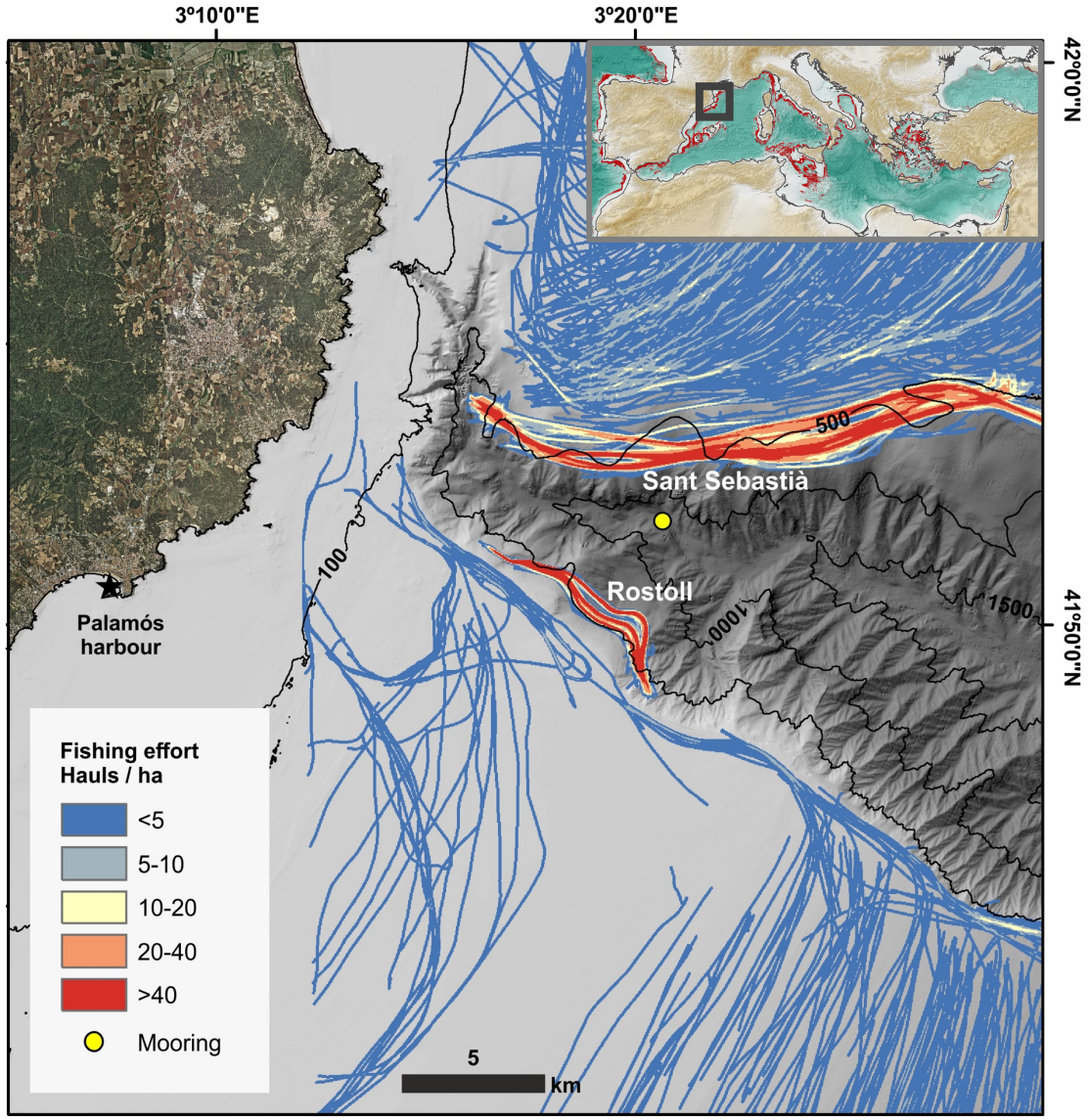

Fig. 2. Palamós Canyon and cumulative trawling fishing effort (hauls/ha) in the area, as well as the location of the mooring.

AIM

Assess the **contribution** and **composition** of **downward particle fluxes** in Palamós Canyon linked to **natural** and **bottom trawling** sediment transport events.

Methodology

- A near-bottom mooring line equipped with a 24-cup **sediment trap**, a **current meter** and a **turbidimetre** was deployed during 2017 in the axis (1200 m) of Palamós Canyon (**Fig. 2**).
- Temporal variations in the quantity and composition of trapped particulate organic matter were assessed through the analysis of organic carbon (OC), total nitrogen (TN) and several biomarkers.
- Daily hauls in the area were extracted from the northern flank (yellow square in Fig. 3)

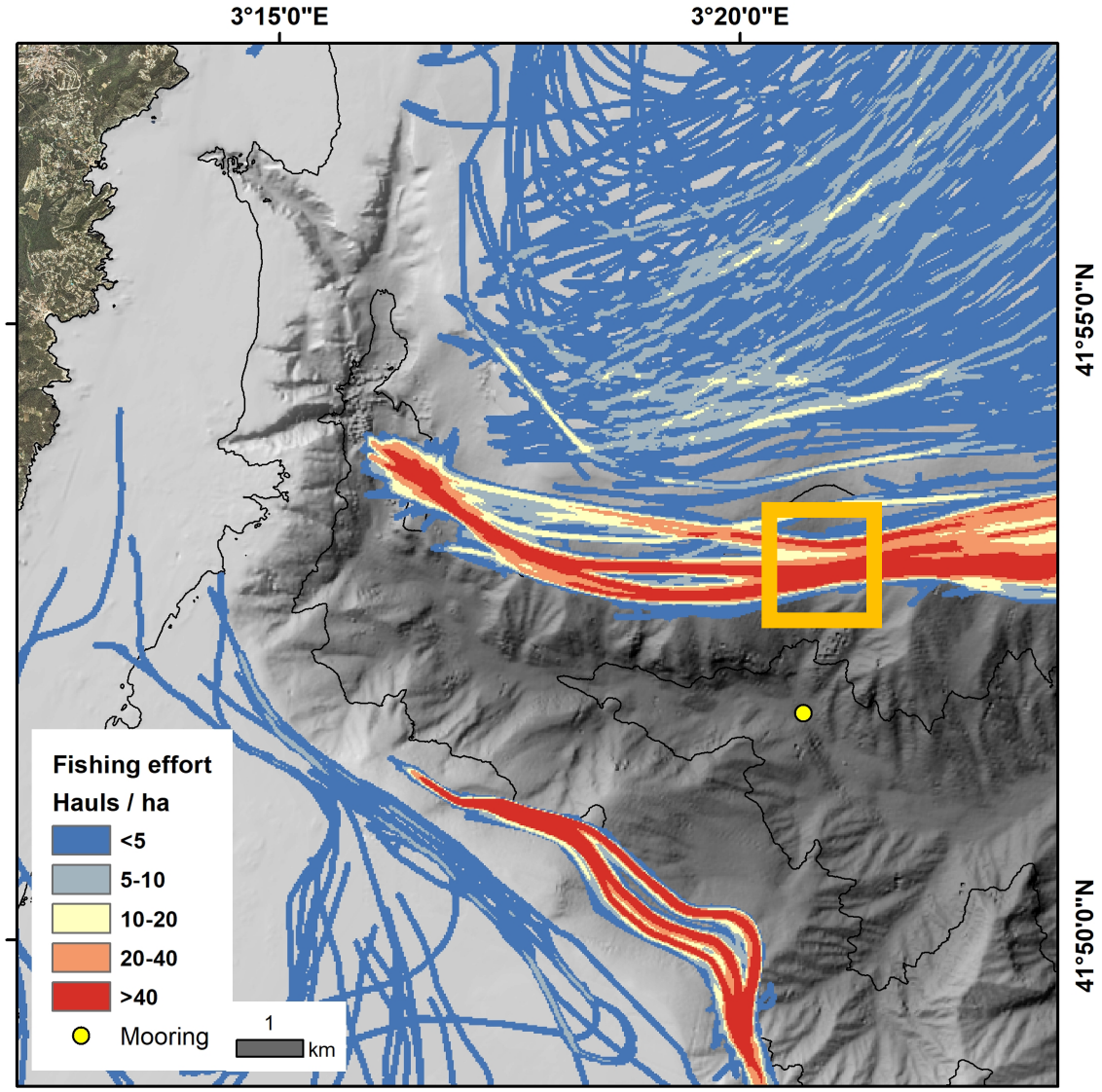

Fig. 3. Mooring location in Palamós Canyon. The yellow square limits the area where daily hauls were extracted.

Forcing conditions

- Strong Eastern storms in January-February
  - High significant wave height and river discharge
- Almost daily trawling frequency in the northern flank during weekdays since beginning of March

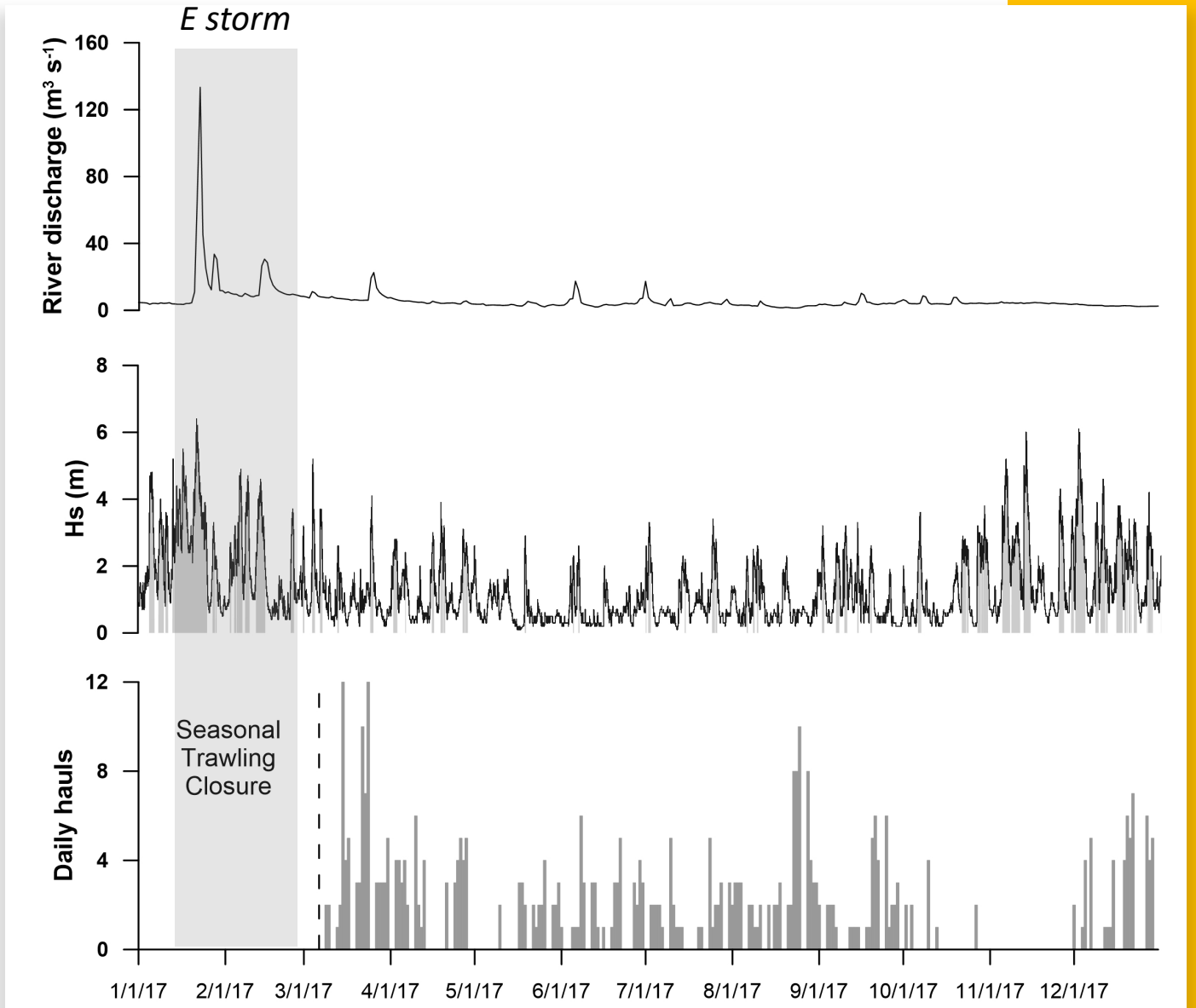

Fig. 4. Palamós Canyon and cumulative trawling fishing effort (hauls/ha) in the area, as well as the location of the mooring.

Sediment transport

- Dominating **down-canyon** sediment transport, but an equally-important **accross-canyon** sediment transport, coming from the northern flank
- With the available data, we observed a cumulative down-canyon sediment transport of 850 kg·m^{-2} and a cumulative down-flank transport of 490 kg·m^{-2}

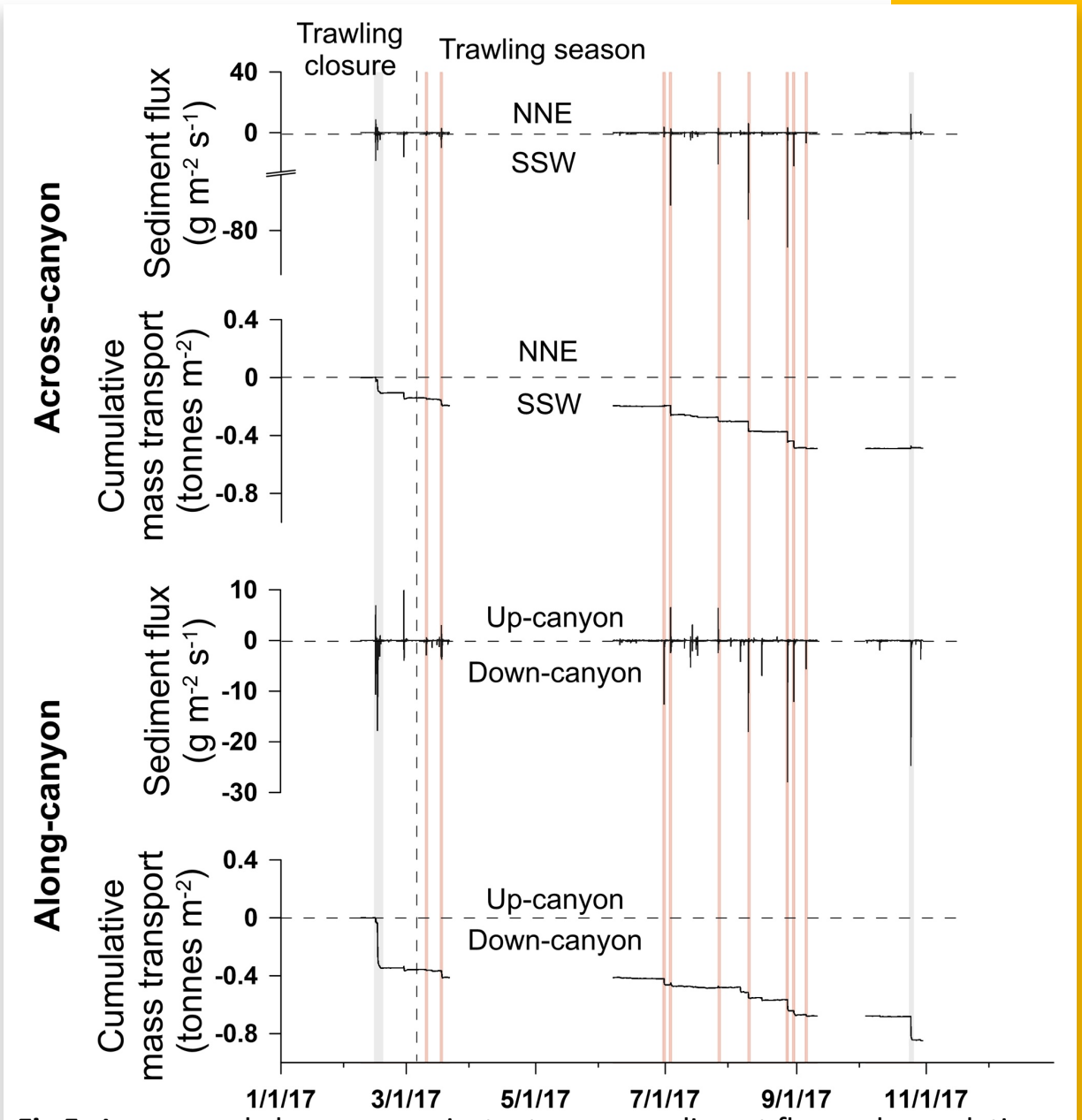

Fig 5. Across- and along-canyon instantaneous sediment flux and cumulative mass transport at the mooring site during the monitoring period.

Trawling closure

- **Winter storm** generated strong down-canyon (~400 kg·m^{-2}) and down-flank (~100 kg·m^{-2}) sediment transport.

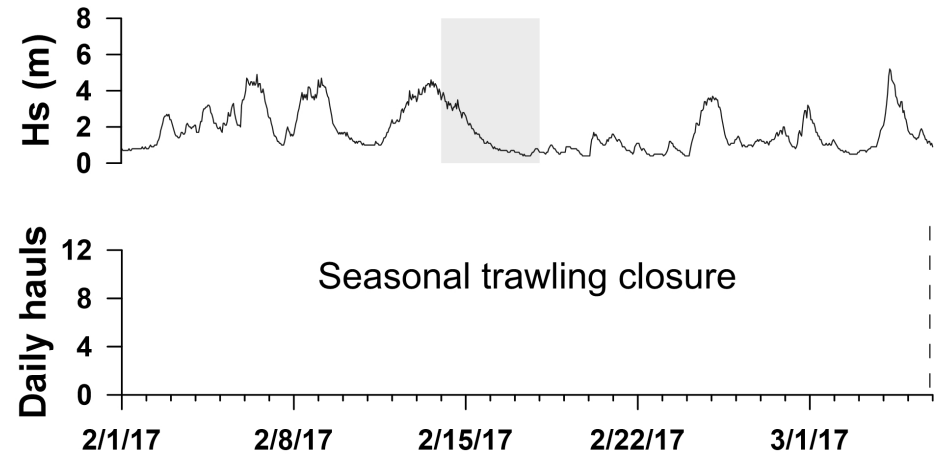

Fig. 6. Forcing conditions during the trawling closure. The grey bar indicates the storm-derived sediment transport event.

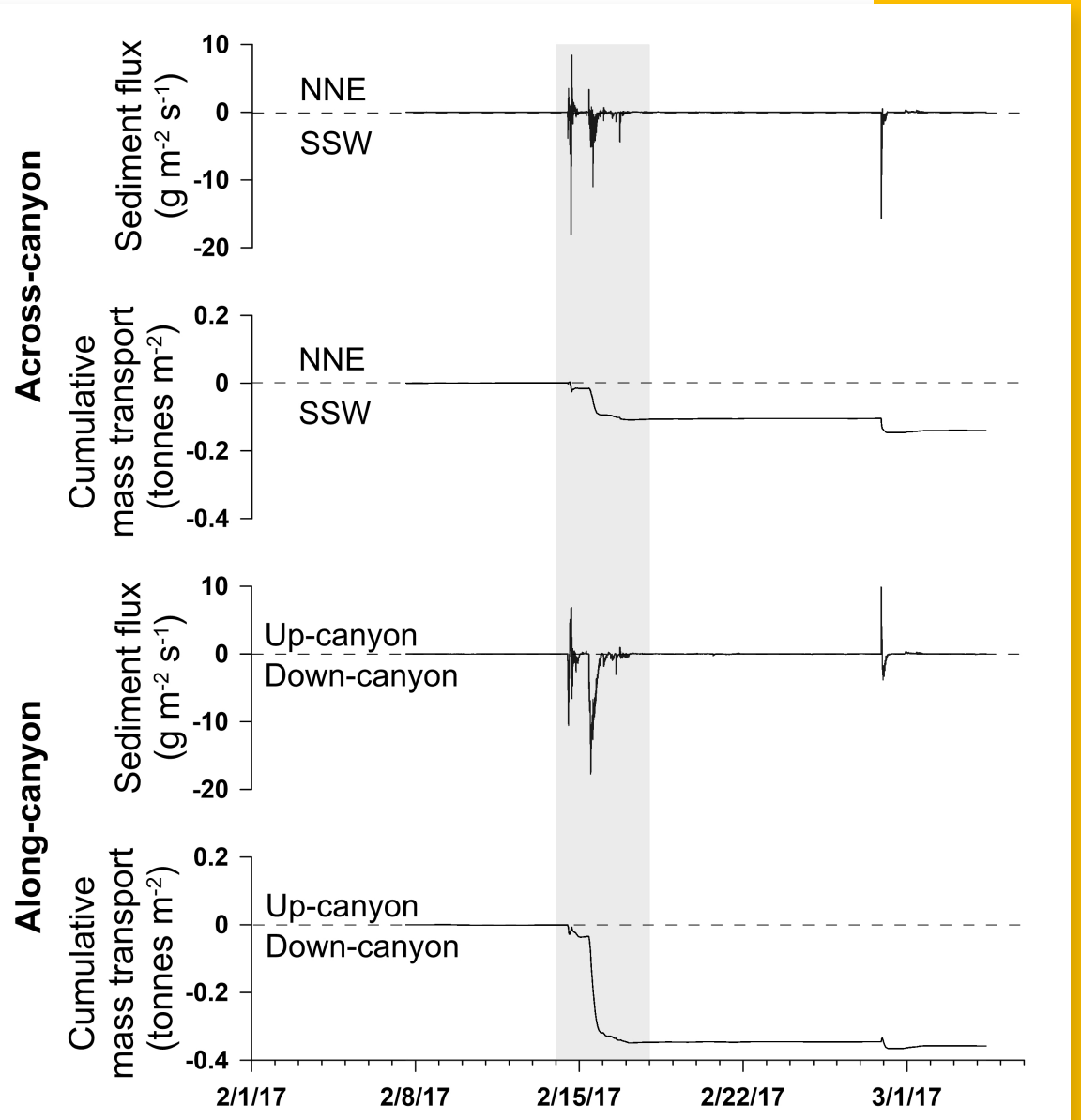

Fig. 7. Detail of across- and along-canyon sediment transport during the trawling closure.

Trawling season

- Certain bottom trawling hauls on the northern flank triggered **sediment gravity flows** towards the canyon's axis.
- Trawling activities transported ~300 kg·m^{-2} of sediment across-canyon during these months.

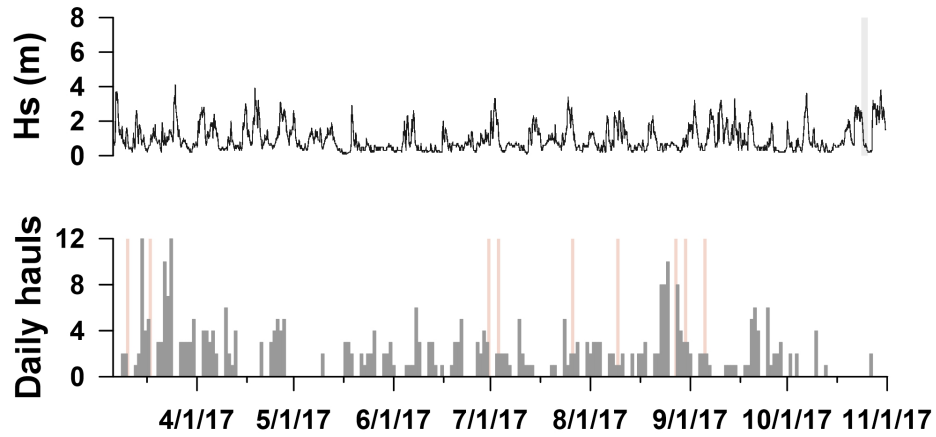

Fig. 8. Forcing conditions during the trawling closure. The red bars indicate trawling-derived sediment transport events.

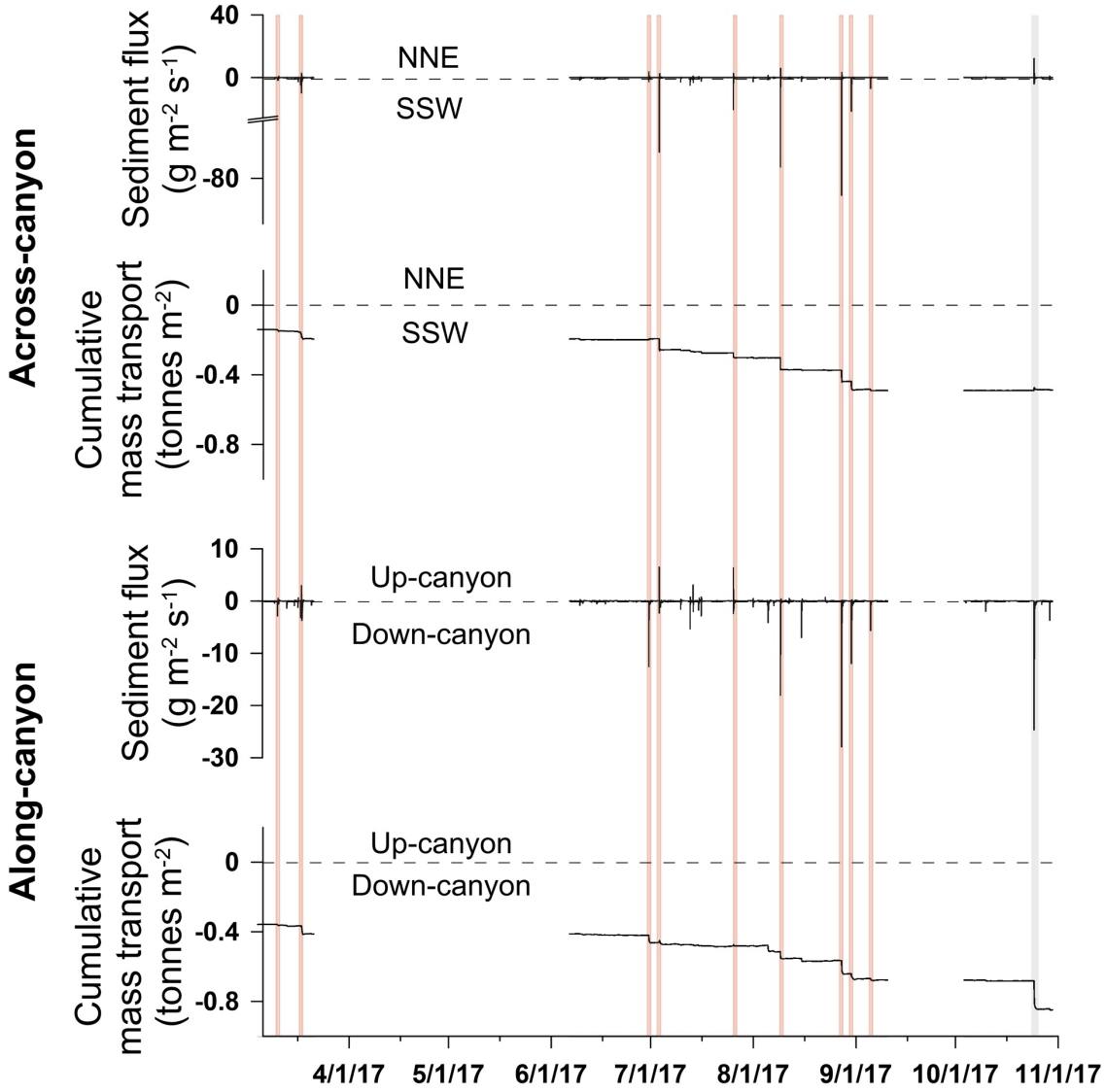

Fig. 9. Detail of across- and along-canyon sediment transport during the trawling season.

Total sediment transport

- **Winter storms** sediment transport events (grey bars) accounted for **60 %** of the **downcanyon sediment transport.**
- **Bottom trawling** sediment transport events (red bars) accounted for **70 %** of **across-canyon** sediment transport.

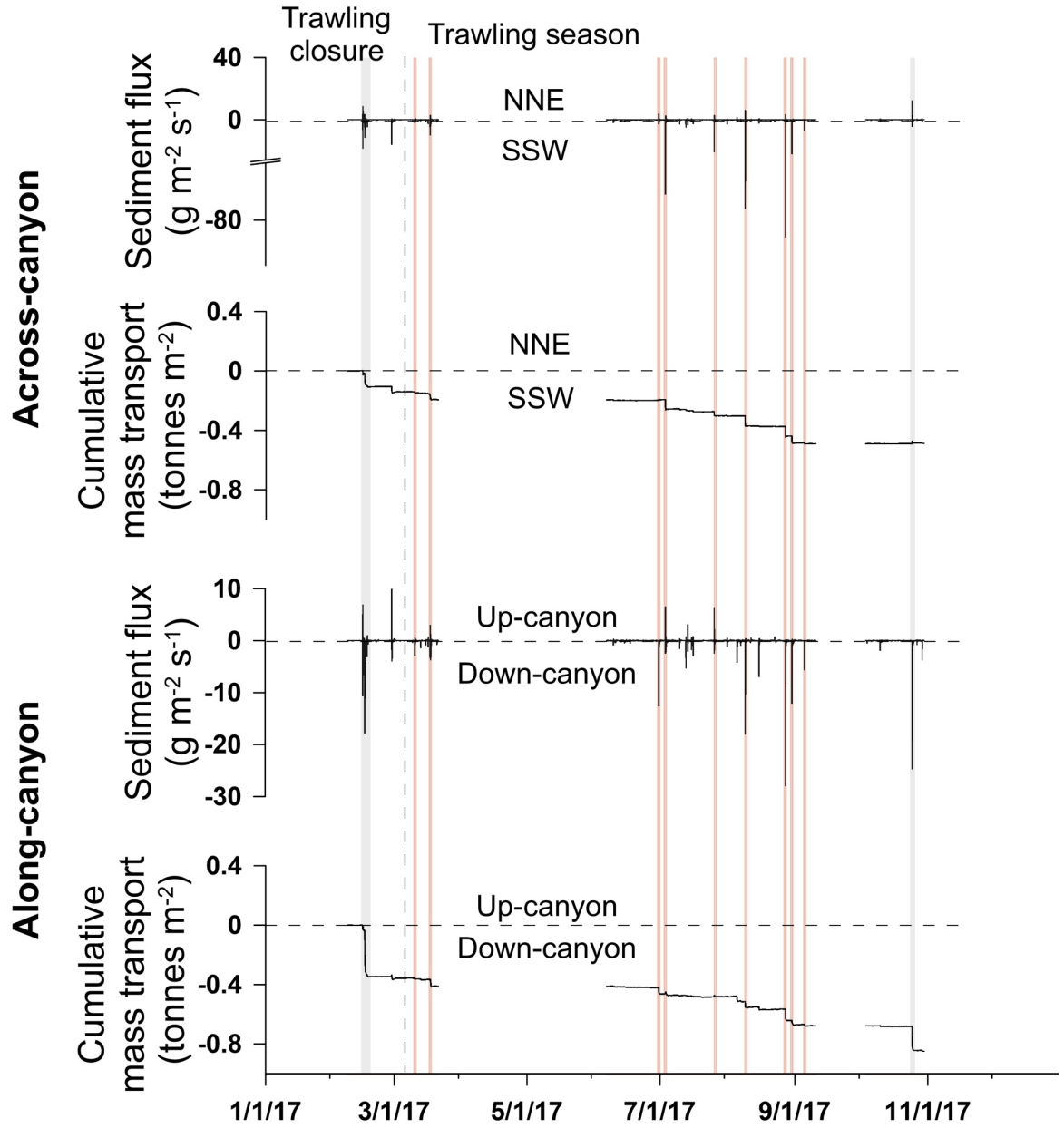

Fig 10. Across- and along-canyon instantaneous sediment flux and cumulative mass transport at the mooring site during the monitoring period.

Sediment trap

- **Winter storm** transported sediment consisting of high $CaCO_3$, TOC, TN contents.
- Sediment trap **collapsed** in the onset of **bottom trawling** in March 2017, with coarse sediment enriched in TOC and TN
- High downward particle flux during **trawling-induced** sediment gravity flows consisted of **coarser sediment**
- Sediment transported by trawlers had **higher $CaCO_3$ and lower OC and TN** concentrations.

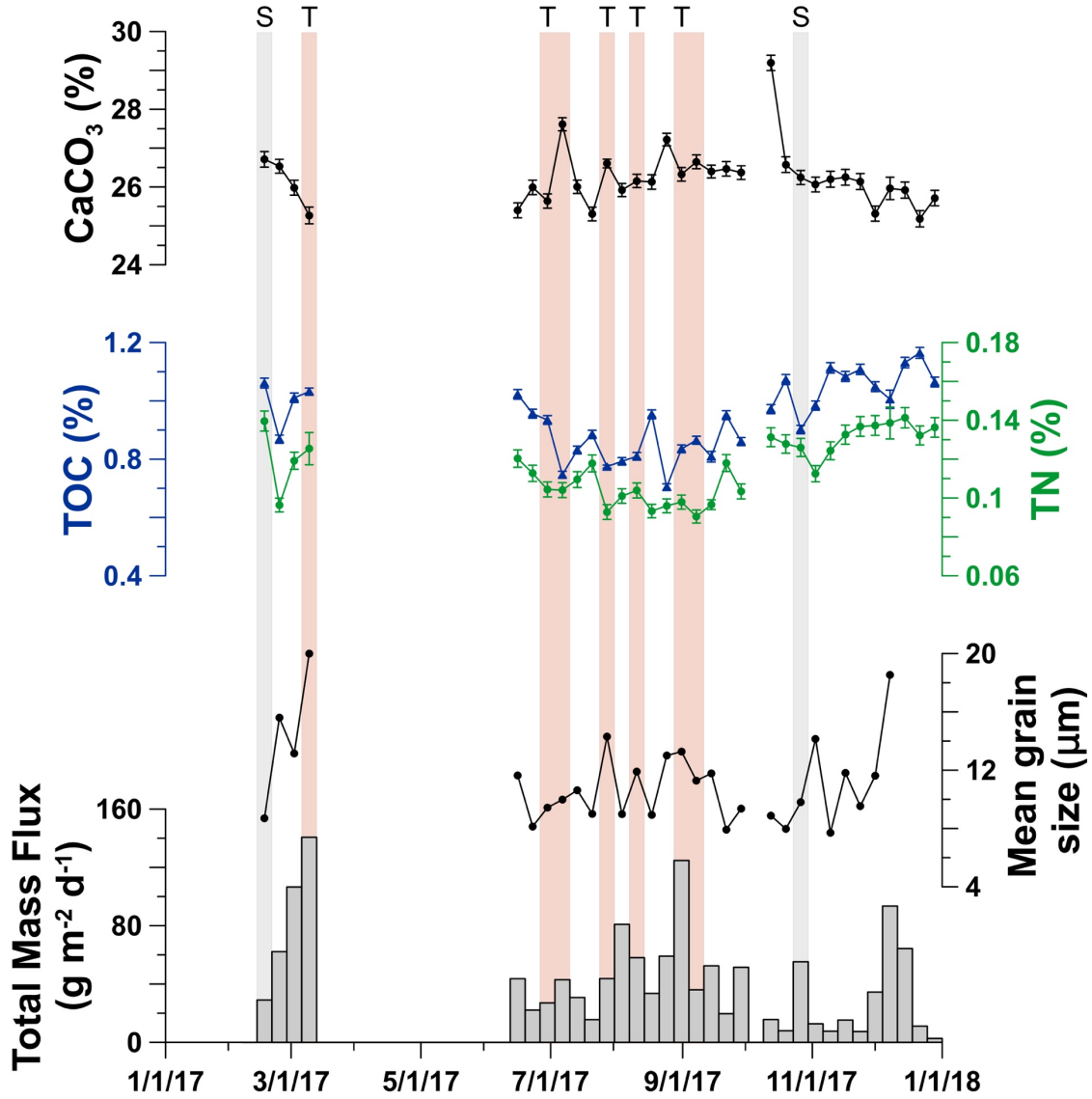

Fig. 11. Total mass flux, mean grain size, total organic carbon (TOC), total nitrogen (TN) and $CaCO_3$ in the sediment trap, indicating the storm (S) and trawling (T) induced sediment transport event

Sediment trap

- **Winter storm** transported sediment with **high organic matter content**.
- The first trawling-derived sediment trap sample had **similar composition** as the winter storm, possibly due to the transport of storm-related sediment that had deposited on the trawling flank during the previous month.
- Trawling-derived sediment had lower organic matter contents.

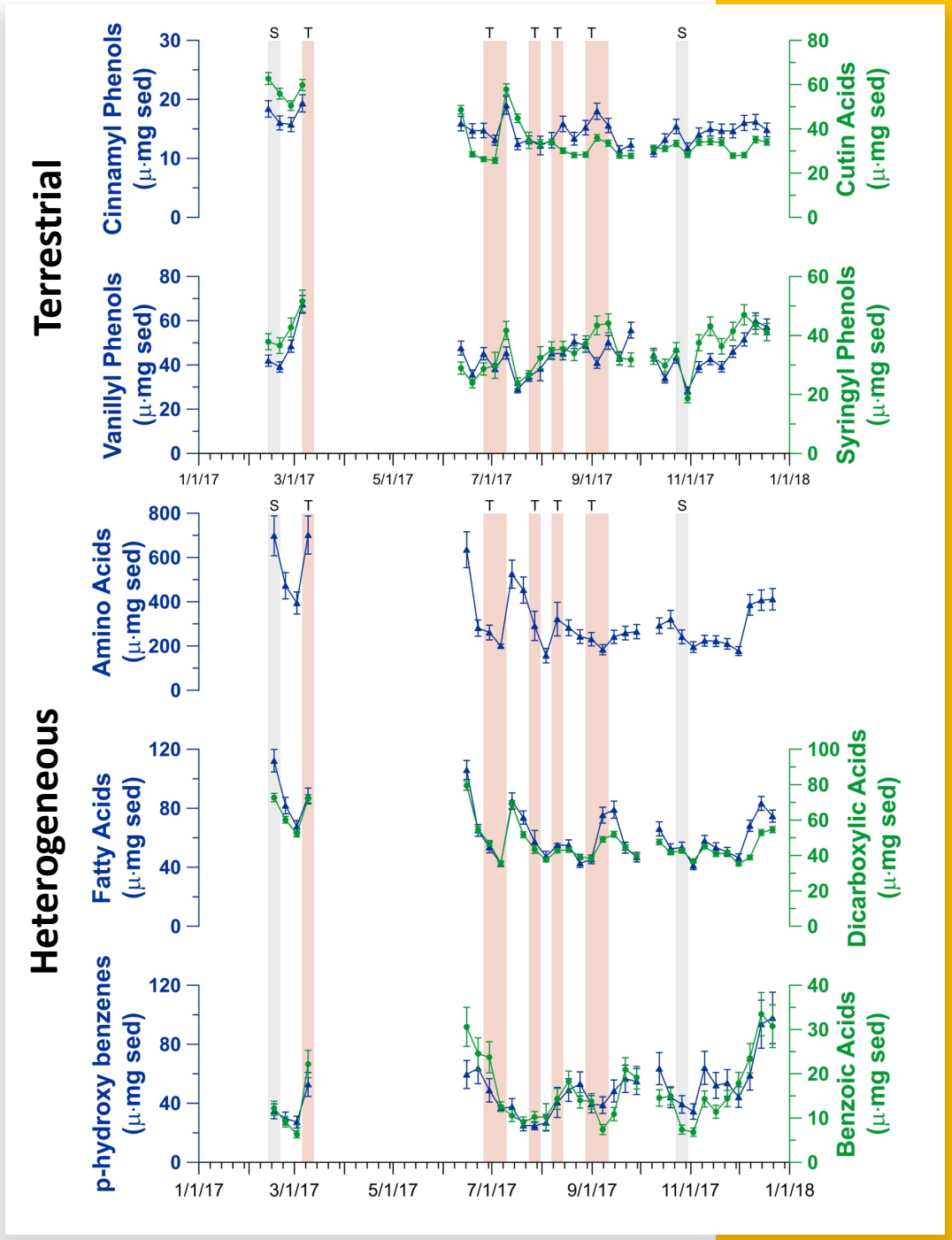

Fig. 12. Yields of CuO products, indicating the storm (S) and trawling (T) induced sediment transport event.

Sediment trap

- **Composition** of **trawling-derived sediment** is similar to the organic matter composition of **surface sediment** of the trawled northern flank, confirming that this material is the result of the **erosion and sediment transport from bottom trawling grounds**

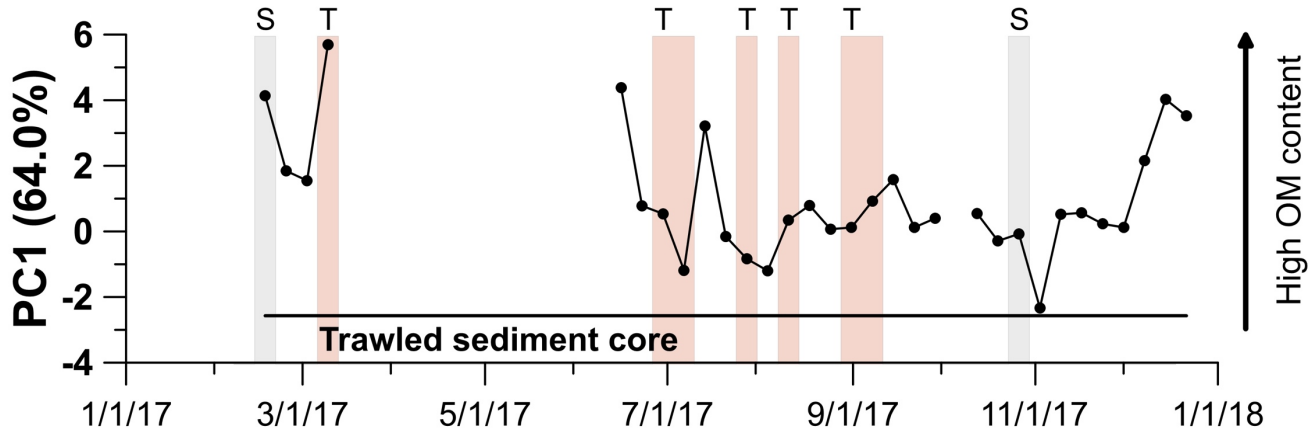

Fig. 13. First component of PCA carried out on CuO products in sediment trap samples and in surface sediment from the trawled site. Positive loadings indicate high CuO yields, implying high organic matter content.

CONCLUSION

Natural

Winter storms transport large volumes of **sediment downcanyon**, enriched in **organic matter**.

Bottom trawling

Bottom trawling triggers **sediment gravity flows** during calm **summer** months, transporting **coarse sediment** with **low organic matter content** resuspended from the northern trawling flank

EGU General Assembly 2020

EGU2020-978

Natural vs. trawling-derived transport of sediment and particulate organic matter in a submarine canyon

Sarah Paradis[1,2], Marta Arjona-Camas[2,3], Miguel Goñi[4], Pere Masqué[1,5,6], Pere Puig[2]

[1]Institut de Ciència i Tecnologia Ambientals, Universitat Autònoma de Barcelona, Barcelona, Spain
[2]Institut de Ciències del Mar (CSIC), Barcelona, Spain
[3]Department of Earth and Ocean Dynamics, University of Barcelona, Barcelona, Spain
[4]College of Earth, Ocean, and Atmospheric Sciences, Oregon State University, OR, USA
[5]Edith Cowan University, Western Australia, Australia
[6]International Atomic Energy, Principality of Monaco, Monaco