Project: **970**

Project title: **TARANTO**

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In the past year, we continued working on the second paper, which is to constrain the sediment-based calibration for paleo SST estimation in the Mediterranean Sea by using a high-resolution regional physical-biogeochemical ocean model. The model explicitly simulates the full cycle of the temperature signal recorded in organic matters from its origin in the connection with phytoplankton production to its preservation along with the detritus depositing on the sediment. The simulation from 1901 to 2010 provides interannual to sub-decadal data to evaluate the relationship between the temporal variations of sediment temperature proxy and the upper ocean temperatures.

On the basin scale, the temperatures recorded in the sediment flux of detritus (wprotem) are less correlated with the local annual mean SSTs than with the monthly SSTs over the entire Mediterranean Sea except for some coastal regions like the northern part of the Adriatic Sea (Figs. 1a-b and c-d). This finding is contrary to the generally accepted view that the sediment temperature records (e.g. the alkenone-derived SST) reflect annual mean SST variations (e.g. Jalali et al, 2018; Müller et al., 1998). The months when the correlation reaches its maximum vary from January to March for most regions (Fig.2a). Those months are in accordance with the peak time of the primary production as shown in Fig.2b, implying that the seasonality of marine production and export of organic material are important aspects that need to be considered when interpreting sediment temperature records in the Mediterranean region.

The correlations are both significantly improved when the wprotem and SST are smoothed with a 5-year running mean (Figs.1a,c and Figs.1b,d), respectively), indicating that high-frequency (e.g. interannual) variability of the SST is not well preserved in the sediment.

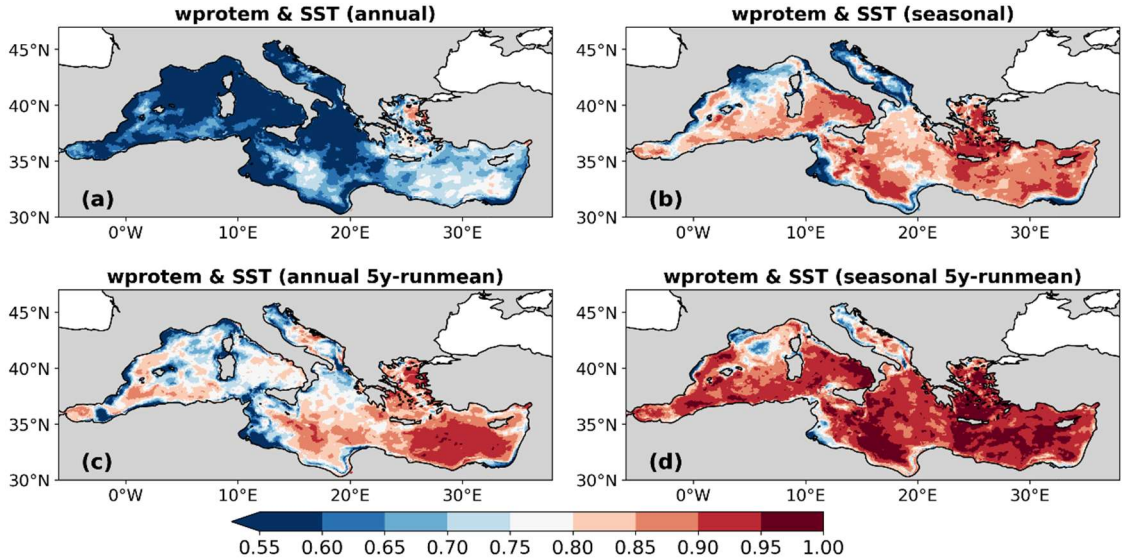

Fig.1 (a) Spatial distribution of the correlation coefficient between the yearly wprotem and the local annual mean SST. (b) Spatial distribution of the maximum correlation coefficient between the yearly wprotem and the local monthly mean SST. (c) Similar with (a) but the wprotem and the local annual mean SST are 5-year running means. (d) Similar with (b) but the wprotem and the local monthly mean SST are 5-year running means.

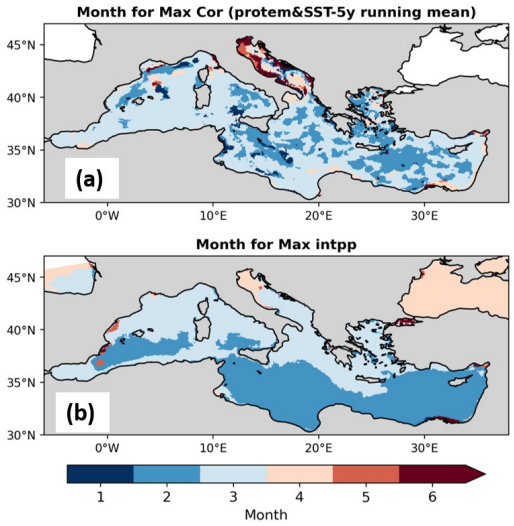

Fig.2 (a) Spatial distribution of the month in which the highest correlation shown in Figs.1 (d) occurs. (b) Spatial distribution of the month in which the highest primary production takes place

We also found that certain coastal areas (e.g. stations shown in Fig.3), which are popular sites for retrieving sediment cores because of their very high deposition rate, do not show a strong correlation between the sediment temperature records and the SST (Fig.1). The ratio between the coefficients of variation of the detritus sediment flux and the local annual mean vertically integrated primary production (Fig.3) provides additional insight into the factors that determine the correlation. A high ratio suggests that the sediment preservation of the temperature signal from the upper ocean is remarkably impaired by the non-sinking processes (e.g. resuspension). Thus, when using the high deposition records to reconstruct the past SST, one should bear in mind that these shelf sites might be particular sensible to disturbances and might not give a reliable reconstruction of the past climate variability.

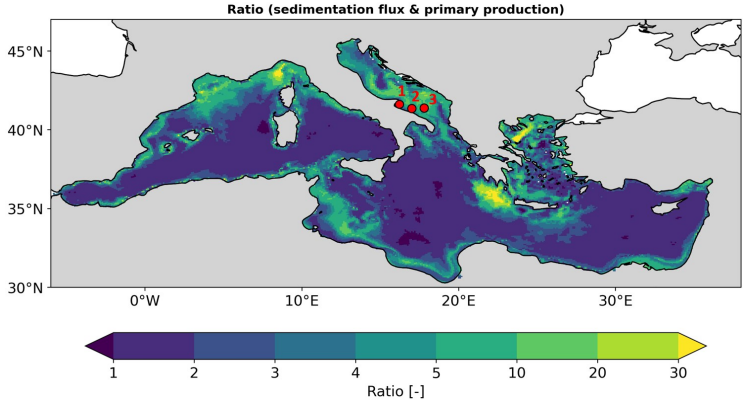

Fig.3 The ratio between the coefficient of variation of the detritus sediment flux and the local annual mean vertically integrated primary production for each model grid. Red dots are selected sediment cores, which are used in the paleo study. The name of the sediment cores are 1: INV12-15; 2: CSS00-07; 3: SW104-ND-14Q (Jalali et al. 2018)

The related manuscript is in preparation. This work will be continued in the next year to finally complete the paper for submission.

References:

Jalali, B., Sicre, M.A., Klein, V., Schmidt, S., Maselli, V., Lirer, F., Bassetti, M.A., Toucanne, S., Jorry, S.J., Insinga, D.D. and Petrosino, P., 2018. Deltaic and coastal sediments as recorders of Mediterranean regional climate and human impact over the past three millennia. *Paleoceanography and Paleoclimatology*, *33*(6), pp.579-593.

Müller, P.J., Kirst, G., Ruhland, G., Von Storch, I. and Rosell-Melé, A., 1998. Calibration of the alkenone paleotemperature index U37K′ based on core-tops from the eastern South Atlantic and the global ocean (60 N-60 S). *Geochimica et Cosmochimica Acta*, *62*(10), pp.1757-1772.