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Impact of dense water formation events on deep marine sediments: spatial heterogeneity versus temporal variability.

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The western Gulf of Lions, in the Mediterranean Sea is a region occasionally impacted by strong hydrodynamical events (dense shelf water cascading and open-sea convection), which are known to transport large amounts of organic matter from the surface layer to the seabed, and are believed to alter the sedimentological and geochemical characteristics of deep surface sediments. A semestrial to yearly sediment survey at stations of the deep slope and basin was performed from October 2005 to October 2010 to characterize potential changes in organic matter composition of surface sediment after several intense events. However, the distance between the positions of successive core deployments for each station staggered between few meters to few hundred meters. Consequently, a complementary study was performed in April 2009 to apprehend the small scale (decimetric to hectometric) spatial heterogeneity of sediment parameters to properly assess their interannual variability. 27 samples merging 3 cores from 3 multicorer deployments at 3 different close sites were collected at a single station at 1900 m depth in the lower reach of the Cap de Creus Canyon. Organic matter parameters (total and organic carbon, total nitrogen and δ^{13}C) together with grain size distribution (clay, silt and sand fractions) were measured on surficial samples (0-0.5 cm). Their spatial patterns were examined by a variographic analysis that allowed comparing their variability at different scales. The results show that decimetric (within each multicorer deployment), decametric (within each site), and hectometric (between the different sites) variabilities of both organic matter and grain size parameters are similar. The most striking result is that small scale spatial variabilities of OC content (0.39 to 0.73%, Stdev: 0.07%) and δ^{13}C values (-22.11 to -23.16‰ , Stdev: 0.31‰) are larger than their respective interannual variability (OC content: 0.37 to 0.54%, Stdev: 0.06%; δ^{13}C values: -22.00 to -22.56‰ , Stdev: 0.21‰). Spatial and temporal variabilities of total carbon and nitrogen are similar. At this station, the small scale spatial variability conceals the interannual variability; therefore, it is not possible to detect significant changes in bulk organic parameters and carbon isotopic composition of surficial sediment linked to these extreme hydrodynamical events. In conclusion, knowledge of small scale spatial heterogeneity of the sediment is an essential prerequisite for suitable interpretation of temporal changes of surface sediment characteristics.