Geophysical Research Abstracts
Vol. 12, EGU2010-4203, 2010
EGU General Assembly 2010
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Dense shelf water cascades in two northwestern Mediterranean submarine canyon heads during winters 2007 and 2008

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Submarine canyons incised in continental margins are considered to be preferential pathways for the exchange of water and particles between the coastal area and the open sea. Hydrodynamics and sediment transport processes in submarine canyons depend upon several forcing conditions in the region such as general circulation, seafloor morphology and atmospheric regime. The off-shelf sediment transport trough submarine canyons, due to storms and river floods, can be significant and recently dense shelf-water cascading (DSWC) has been also identified as an important transport mechanism able to generate high sediment fluxes in submarine canyons. DSWC is seasonal, resulting from the formation of dense water by cooling and/or evaporation over the shelf, and occurs on both high- and low latitude continental margins. The Palamós and the Cap de Creus submarine canyon heads were instrumented during two consecutive winters to study their respective role in the dynamics of the sediment transport on the northwestern Mediterranean Sea. The Cap de Creus submarine canyon has been intensively studied during the past years as it acts as a major transport conduit during storms and DSWC events. On the contrary, little information exists about the sediment transport processes operating within the Palamós submarine canyon during winter conditions. Observational work during this study consisted of a series of field measurements carried out with instrument moorings during winters 2007 and 2008 at the heads of both submarine canyons, at around 300 m depth. These moorings were equipped with a current meter with temperature, conductivity, pressure and turbidity sensors, placed at 5 m above the seafloor. Multibeam bathymetry from both canyon heads was also acquired and used to determine the canyon axis morphology, which was considered to compute down-canyon fluxes. Forcing conditions were obtained from oceanographic buoys and gaps in the wave height and peak period time series were filled with models outputs. Daily river discharges from nearby rivers were also analyzed. Sediment transport events during winters 2007 and 2008 were quite similar, and several DSWC events were identified and compared among them. Down-canyon current velocities of > 60 cm/s were detected in the Cap de Creus Canyon, and velocities of > 40 cm/s in the Palamós Canyon. Increases in current speed were associated with subtle drops in temperature ($\sim$ 1 ºC) related to DSWC, and peaks of suspended sediment concentration. Values up to 170 mg/l were recorded during both studied winters at the Cap de Creus canyon head coinciding with the first DSWC event concurrent with an eastern storm. During both study periods no relation was found between sediment transport events and nearby river discharges. The amount of sediment transported during DSWC events at the Cap de Creus Canyon was one order of magnitude greater than the one observed at the Palamós Canyon. This corroborates the fact that most of the off-shelf sediment transport in the northwestern Mediterranean during DSWC events occurs at the southwestern end of the Gulf of Lions, through the Cap de Creus submarine canyon.