Geophysical Research Abstracts
Vol. 12, EGU2010-12990, 2010
EGU General Assembly 2010

Bedforms and sediment distribution in the Minho estuary (Northern Portugal)

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Here are presented preliminary results of the MINHO09 cruise, carried out within the scope of the paleoclimatic research task of the MINHO project (PROYECTO 0234_NATURA_MIÑO_MINHO). Bed features and sediment distribution were mapped in the Minho estuary (Northern Portugal) using a dual frequency sidescan sonar mosaic (EdgeTech 4200-MP), and bottom sediment texture data from 71 sites sampled with a winch operated sediment grab (Van Veen type). The survey was done within 5 days, in low flow energy conditions of summer dry weather and neap tides, close to optimal conditions for correlating the acoustic imagery with the bottom sediment data. A DGPS (Omnistar 8200HP) was used to determine the horizontal position of the acoustic imagery and the sediment sample sites with sub-meter accuracy. Uncorrected water depths were determined with a depth echo-sounder (Odom HYDROTRAC echo sounder), and the water depths referred to the local datum was later determined using data from a tidal gauge (Valeport model 740) deployed specifically for this survey.
Overall the sampled sediments were mostly poorly calibrated, with grain sizes ranging from gravel to mud coexisting in the same sample, probably reflecting the great seasonal contrast in flow conditions in the Minho River. The predominantly muddy sediments were observed along the river margins (frequently charged with gas) and, locally, along relatively deeper portions of the channel bed.
The bedforms observed in the sidescan sonar data are dominated by 2D and 3D dunes and ripples. There are several locations were the bedforms suddenly change from larger dunes (wave lengths greater than 5m) to smaller ripples (wave lengths smaller than 1m). These changes may be related to the occurrence of supercritical flow conditions (Froude number > 1): hydraulic jumps in places were there is a sudden change in depth without any change in channel width, or chutes and pools in places were there is a sudden change in channel width; future work is planed to answer this question by doing a detailed comparison of the bedforms, sediment texture and bathymetric data (data that was not yet available at the time of writing of this abstract). Fan shaped echoes and associated sediment landslide scars are frequently observed near steeper channel margins and at the foot of ship docking ramps, evidence of sediment input directly from the river margins. The muddy river margins frequently exhibited a stair case pattern of low reflectivity in the horizontal segments, and strong linear echoes in the steeper portions of the “stair case” margin. This same pattern was also observed in the muddy margins of a regularly dredged channel that crosses a large area of sand bars in the middle of the estuary. The preliminary interpretation of this pattern is that it is caused by the deposition and slumping of muddy sediments along the margins in the low energy conditions that were predominant during the spring and summer season prior to the survey. Sea grass is clearly recognizable in the form of densely packed irregular lines of strong echoes, and is abundant upriver towards Tuy, probably outside the tidal influence. Some of the acoustic “speckle” found in the sonar imagery may be evidence of the bivalve Fluminea corbiola present in most samples. This bivalve is an invasive species in the area, originally from Asia.