Geophysical Research Abstracts, Vol. 8, 06730, 2006
SRef-ID: 1607-7962/gra/EGU06-A-06730

The image of the submarine geomorphological structures by water waves in satellite photographs

R. Beigelbeck (1), F. Paschke (2), A. Preisinger (2), and S. Aslanian (2)

(1) Austrian Academy of Science, Austria, 2700 Wiener Neustadt, Viktor Kaplanstr. 2

(2) Technical University of Vienna, Austria, 1080 Vienna, Lerchengasse 23/2/9

e-mail: apreisin@mail.zserv.tuwien.ac.at

In our study, we used satellite photography to investigate the topology of the sea bottom near the coast of the Bulgarian Black Sea close to Sozopol. Two satellite photographs were taken there at the same site at different times, one when there was no wind, the other with a strong North-East wind. The photographs show the central bay of Sozopol and the bay of Harmanite south of Sozopol. The measurements of the geomorphological structure by means of a Sediment Echo Sounder SES 96, a parametric sub-bottom profiler (Preisinger et al., 2004), and of a GPS-Garmin 168-sounder (Gergov et al., 2005) were done in the central bay of Sozopol down to a water depth of 20 m and in the bay of Harmanite down to a water depth of 10 m, both performed perpendicular to the coast, as well as some measurements parallel to the beaches. From the measurements, submarine geomorphological maps have been designed. The land around Sozopol was formed about 70 million years ago by mesozoic submarine volcanic rocks. Our measurements showed that lava streams from the volcanoes reach some hundred metres down into the sea. The contours and the ends of these lava streams were detected. We were able to show that some of the volcanic rocks and lava flows are covered by Danube sand that was carried in during the continuous increase of the water level of the Black Sea over the last 8000 years. These geomorphologic investigations of the sea bottom revealed that the artifacts on the satellite pictures are correlated with the topological properties of the sea bottom and are strictly coupled with the direction and strength of the wind. However, the water is too deep for a direct visibility to the sea bottom, so an important question is: “Why is the bottom mapped into the wave structure at the water surface?” In this contribution, we present a sci-

entific explanation of this bottom-to-surface mapping (BTSM) process employing a two-dimensional mathematical model of a rectangular step placed at a finite depth in the sea bottom. The step geometry is chosen as perhaps simplest of its types to analyze the interaction of water waves and barriers. Although the propagation of water waves over a submerged obstacle has been studied theoretically by many investigators within the framework of the linearized potential theory, an investigation of the BTSM is still lacking (Kanoria et al., 1999). While these former studies are mainly concerned with determining the reflection and transmission on properties for a given incident wave (Miles, 1967), we extend these methods to describe the influence of an underwater obstacle on the propagation of an oblique incident, monochromatic, progressive wave of small amplitude in lateral direction over water on the surface wave distribution. Assuming the validity of the linear water theory, the governing partial differential equations for sea waves, which travel as flexural gravity waves, are solved using a multiterm Galerkin approach. This yields the general amplitude distribution of the water waves at the sea surface and reveals that the BTSM is strictly related to the appearance of evanescent waves in lateral (to the sea surface) direction above the scattering obstacle because they also cause propagating waves perpendicular to the surface. Under special circumstances, e.g., high wind strengths and wind directions near the so-called critical angle of the scattering process, the reflection coefficient and the evanescent wave amplitudes can be huge resulting in a good BTSM even for larger water depths.

References

Preisinger, A., S. Aslanian and W.-D. Heinitz - Geomorphologic development of the Bay of Sozopol, Bulgaria (Black Sea) during the last 7500 years. Bulletin du Musée National de Varna, Vol. **51-52**, p.7-16, 2004.

Gergov, G., A. Preisinger and S. Aslanian - The coast lines of the Harmanite Bay south of Sozopol, Bulgarian Black Sea, during the last 3000 years. Geophysical Research Abstracts, Vol. 7, 07076, 2005, Poster X334, 2005.

Kanoria M. et al., Water-wave scattering by thick vertical barriers. J. of Eng. Mathematics, **35**, 361-384, 1999.

Miles J., Surface-wave scattering matrix for a shelf. Journal of Fluid Mechanics, **28**, 775-767, 1967.