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Features of internal solitary waves revealed by seismic oceanography data

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In this paper, we used the seismic oceanography method to study the structural characteristics of internal solitary waves (ISWs) near the Strait of Gibraltar in the Mediterranean Sea, South China Sea and offshore Central America.

The ISWs near the Strait of Gibraltar are the first mode depressional type, mostly medium amplitude and large amplitude internal solitary waves. The maximum vertical amplitude is up to 74.5m, and the amplitude increases with depth—the propagation velocity increases with amplitude. It can be determined that the "true" maximum amplitude position is near the pycnocline. After correction, the maximum half-height-width can reach 1721.8m, but there is somewhat different from the theoretical result—which may be related to the development stability of ISWs. As the solitary wave packet continuously moves eastward, the overall wave width becomes larger, and the vertical velocity becomes smaller. In this paper, seismic oceanography is applied to the analysis of ISWs in the Mediterranean Sea, which further proves the feasibility of using seismic oceanography to study the movement of sea water.

We reprocess some multi-channel seismic (MCS) data which is acquired recently in the Dongsha region of the northeastern South China Sea and we obtain new seismic oceanography data. The research suggest that there are the mode-2 internal solitary wave (ISWs) not just the mode-1 ISWs and a special reflection pattern (hair-like reflection configuration) usually above sand dunes in the seismic images. In new seismic oceanography data, there are some mode-1 ISWs with amplitudes less than 50m and wavelength of 1~5 km and the biggest mode-1 ISWs have the amplitude about 45m. The internal solitary waves packets are not prototypical rank-ordered ISW packets, their soliton amplitudes are smaller than 40. The mode-2 ISWs is well-shaped and its' amplitude is approximate 30m, the vertical structure height is about 200m. The reflection configuration of water column above sand dunes usually include weak reflection layer—maybe called turbulent bottom boundary layer, and there is hair reflection configuration that must not appear. Whether there will be hair reflection configuration or not may depend on the angle between the seismic line and the sand dunes.

In the region offshore Central America, there are lots of mode-2 ISWs revealed from seismic oceanography data. We combine seismic data with hydrographic data to study the features of

ISWs in these different regions. The preliminary results show the phase velocity in SCS is the largest, that in the Strait of Gibraltar is the second and that offshore Central America is the last. The phase velocity depends on the amplitude of ISW. Usually the mode-1 depressional ISW has the largest phase velocity, while the mode-1 elevation ISW is the second, and the mode-2 ISW is the last. The location of the maximum amplitude from the characteristic function is consistent with the pycnocline as shown from floating frequency curve. The polarity of ISW is consistent with nonlinear parameter of alpha. Seismic data in global continental margins will provide more and more key evidence to increase our understanding of ISW evolution in the ocean.

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