

Suboscillations in the period from 4 to 5 hours excited in Hiuchi-nada, the Seto Inland Sea

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The sea level changes observed in Hiuchi-nada, the Seto Island Sea have significant signals with the periods around 4 and 5 hours, and their amplitudes are larger on the southeast region. Hiuchi-nada is a semi-enclosed sea bounded by Honshu and Shikoku to the north and south, as well as many islands to the east and west. These signals are presumed to be suboscillations excited in Hiuchi-nada. In this study, I showed the spatial distribution of amplitudes and phases of the sea level changes around the periods of 4 and 5 hours observed along the Hiuchi-nada in 2025, and confirmed that they were suboscillations using numerical calculations.

The sea level changes with a period about 5 hours are excited in Osaka Bay at the eastern part of the Seto Inland Sea. Since the amplitudes of these sea level changes depend strongly on the atmospheric and oceanic conditions, Sato et al. (2016) concluded that these variations were suboscillations excited by tides and ocean currents, with its node at the Kii Channel mouth. On the other hand, Mukai (2025) calculated numerically the suboscillations in Osaka Bay and showed that they could have a node at the Akashi Strait. This suggests that the oceanic variations with that period could be propagating from the western part of the Seto Inland Sea.

In fact, the observational data of sea level in the Seto Inland Sea have significant signals with a period about 5 hours. Hiroshima and Ehime prefectures perform the continuous observations of sea level at the coastlines in Hiuchi-nada, the Seto Island Sea. The observational data are available through the Hiroshima Prefecture River Disaster Prevention Information System and the Ehime Prefecture Sea Level Information Provision System. Frequency analysis using FFT was applied to the sea level changes observed in 2025 at Fukuyama, Yokota and Habu Ports in Hiroshima Prefecture, and at Mishima Kawanoe and Toyo Ports in Ehime Prefecture. The results showed significant signals around a period of 5 hours, which had smaller amplitude in the western part of Hiuchi-nada and larger to the eastern part. This suggests that a suboscillations are excited in the period about 5 hours and have a node at the narrow channel around the western border of Hiuchi-nada. This is supported by the analytical solutions of suboscillation period which is about 5 hours in the semi-enclosed oceanic region with a length of 60 km corresponding to the east-west size of Hiuchi-nada and a depth of 20 m corresponding to the average sea depth. Significant sea level changes also appeared at a period about 4 hours. Their amplitudes are smaller to the northwestern part of Hiuchi-nada and larger to the southeastern part. Since the period of the analytical solution of the suboscillations was estimated to be about 4 hours under the condition of the length of 50 km corresponding to the northwest-southeast size of Hiuchi-nada, the sea level changes could be also presumed to be a suboscillations.

In this study, I showed the characteristics of sea level changes observed in Hiuchi-nada, the Seto Inland Sea, and confirmed that the suboscillations were excited with periods about 4 and 5 hours using numerical calculations. I also investigated meteorological and oceanic conditions that caused the excitation of the suboscillations.

Keywords: suboscillation, Hiuchi-nada, the Seto Island Sea