Extreme sea level oscillations in the Sea of Japan caused by the most powerful typhoons for the period 2012-2020

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Typhoons are an annual phenomenon in the Sea of Japan. They vary in size, tracks, and atmospheric pressure drop. Unfortunately, atmospheric forecasts do not allow us to avoid damage to coastal infrastructure. We need to know the local topographical features of gauges in different parts of the sea to plan protective measures and reduce risks. Extreme sea levels have several components: tides, storm surges, seiches, infragravity waves, and wind waves. The influence of six the most powerful cyclones for the period 2012-2020 was analyzed for 21 stations in the northern, central, and southern parts of the sea. The data were obtained from open access sources: IOC, NOAA, KITAMOTO Asanobu's Web, and ERA5 reanalysis. These six typhoons passed over the Korea Strait and then moved north or north-east towards the Pacific Ocean. Cyclones Sanba (2012) and Chaba (2016) were single atmospheric eddies. For these events, storm surges dominate among other sea level components. The amplitude didn't exceed 50 cm. Chaba affected sea level only at Hamada (Japan), as its track passed through southern part of the sea. The other cyclones represent two interesting cases of "coupled typhoons". This means that atmospheric eddies pass one by one on the closed tracks. These cases are rare enough for the Sea of Japan. Typhoon Trami (2018) moved to the east of the Japanese Islands and didn't cross the sea but caused more significant storm surges and high-frequency oscillations in the northern part of the sea. Negative surge to -22 cm relative to mean sea level was observed at all stations between Trami and Kong-Rey (2018) few days later. The largest sea level oscillations were caused by typhoons Maysak and Haishen in 2020, although they belong to the category 4 on the Saffir–Simpson hurricane wind scale, in contrast to other analyzed cyclones of category 5. Except for Preobrazheniye and Rudnaya Pristan on the Russian coast, the contribution of storm surges dominates among other components of sea level oscillations. The height of high-frequency sea level oscillations was about 2 m. All stations were grouped according to the features of storm surges and short-period sea level oscillations. This classification agrees well with the geographical location of the gauges.