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The lower ionosphere effects caused by the tsunami-driven internal gravity waves

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Measurements from the VLF/LF station in Petropavlovsk-Kamchatsky (Russia) were used to observe the response of the lower ionosphere to the tsunami triggered by the 2010 Chili earthquake. This earthquake produced the trans-ocean tsunami, which severely affected the coastal communities of Chile and presented a serious threat for all Pacific Ocean coasts including the far eastern coast of Russia. Disturbances in the phase and amplitude of the VLF signal propagating from the transmitter in Hawaiian Islands were observed during the tsunami wave passage recorded by the Deep-ocean Assessments and Reporting of Tsunamis (DART) bottom pressure stations. The tsunami propagation time from the source to Hawaii Islands was about 14 h and to the coast of Russia about 21 h. The new point discussed here is that we observed a second tsunami and its ionospheric effects which have been missed in the previous observations in the upper ionosphere. Nevertheless, the presence of the second tsunami is confirmed by both the VLF and DART's measurements. The tsunamigenic effects in the ionosphere were compared to the in-situ sea-level DART measurements near Hawaii Islands and not far from Kamchatka. The frequency of the maximum spectral amplitude both for the VLF and DART data was found to be in the range of periods of 8-60 min which corresponds to the period of the internal gravity waves generated by tsunami.