On meteotsunami recorded in the harbors of Kochi prefecture in early January 2018

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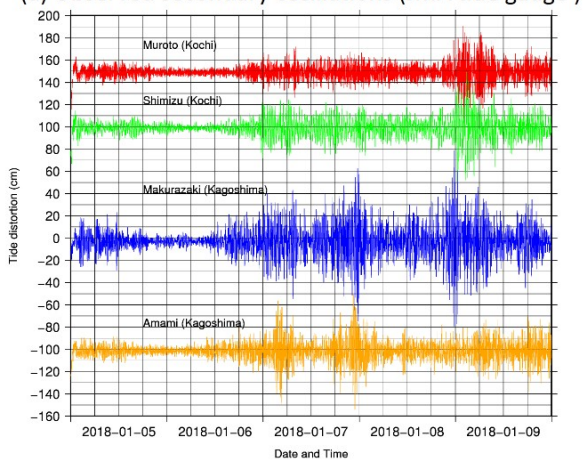
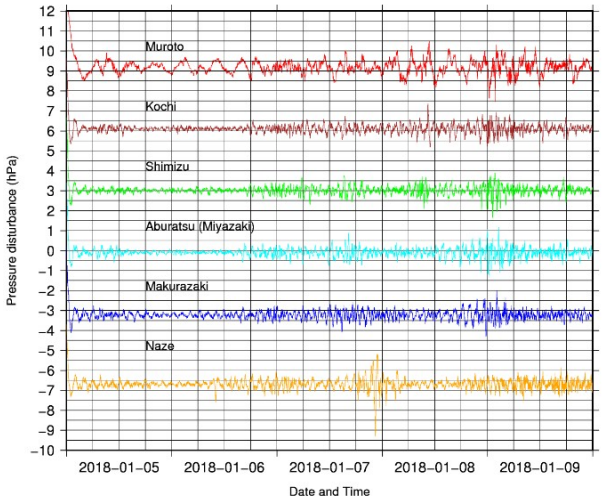
The secondary oscillations with the wave height as high as 1.0 m were recorded in the west Japan in early January 2018. The maximum wave height was recorded as high as 1.6 m at Makurazaki of south Kyushu in the midnight of 8 January, 2018. Such kind of the large amplified oscillation is called "Abiki" in Kyushu area, which is typically recoreded during winter and early April season. However, in this time, such large amplified oscillation was also recorded in the coast of Kochi Prefecture in Shikoku Island, which is the very rare case. Hence, we have an early report on the mechanism of the large amplified oscillation observed at Kochi area.
The maximum wave height of seconary oscillation was as high as 0.8 m observed at Cape Muroto (2:20 JST a.m. January 9) in the east Kochi Prefecture, and 1.0 m at Tosa Shimizu (3:00 JST a.m. January 9) in the west Kochi Prefecture (Figure (a)). The secondary oscillations itself became enlarged in the night of 6 January and continued with the wave height of 30-50 cm within a couple of days. A series of pressure disturbance with the small amplitude of 0.5-1.0 hPa was observed continuously as passing a couple of the extratropical low over the Japan. With in such pressure distribution, a kind of pressure depression with the rate of 1.5-2.0 hPa per 10 min was recorded at Muroto meteorological observatory (Figure (b)). The synoptic meteorological condition (Figure (c) showed that a belt of the unstable layer in the midtroposphere (400 - 700 hPa) extended to the south west coast of Japan, which is origined at southwest China, which is typical pattern to bring so-called meteotsunami in the west Kyushu area during winter season. The vertical wind profile at Kochi city by WINDAS (Japan Meteorological Society) showed that there was updraft layer between 3 km and 5 km above sea level (a.s.l.), while the downdraft below 3 km and above 5 km a.s.l. (Figure (d)) The horizontal wind speed of the updraft layer was 60-80 kt (30-40m/s) with the direction of southwest. According to the map of the phase speed of ocean long wave, a zone with the phase speed of 30-40 m/s was seen along with the shelf of Tosa bay (Figure (e)). This zone was oriented from southwest to northeast, corresponding to the wind direction of the updraft layer in the midtroposphere.
Hence, the large amplified oscillation in the Kochi area was brought by the internal gravity wave (IGW) in the mid-low troposphere. The sea level disturbance was resulted from the IGW and propageted along the edge of the coastal shelf, became enlarging by the Proudman resonance.

Keywords: Meteotsunami , Secondary oscillation, Tosa Bay, Resonance , continental shelf slope, atmospheric internal gravity wave

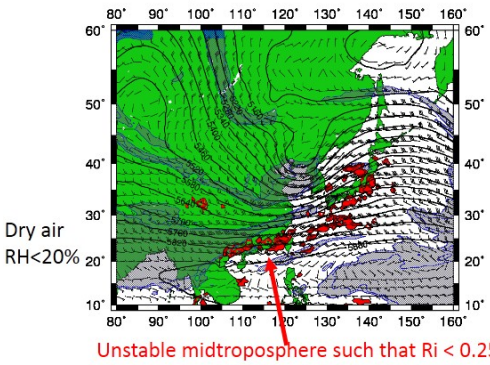
(a) Observed secondary oscillations (JMA tide gauge)



(b) Pressure disturbance (JMA tide gauge)

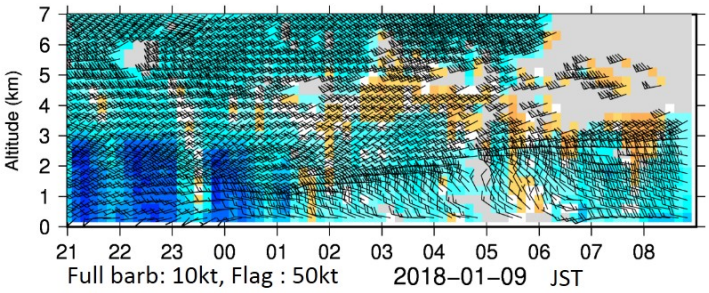


(c) Midtrposhere Chart 2018010812 Z



Unstable midtroposphere such that Ri < 0.25 (400-700hPa)

(d) Wind Profiler (Kochi)



(e) Scale of phase speed C=VgH