Review of diagnostic criteria of the volcanic alert levels at Izu-Oshima volcano by the Japan Meteorological Agency

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1. Introduction
After the Ontake-san eruptive accident in September 2014, the Japan Meteorological Agency (JMA) is reviewing the diagnostic criteria of the volcano alert levels at Ontakesan and other active volcanoes and has published them for some volcanoes (Yamasato et al., 2016). Also for Izu-Oshima, JMA has reexamined the criteria of the volcano alert levels with the Volcanic Disaster Mitigation Council.

2. Outline of the review
In the volcano alert level at Izu-Oshima, the levels 1-5 and each criteria are defined according to the countermeasures of the local governments referring the eruption scenario made by the Izu Subcommittee of the Coordinating Committee for Prediction of Volcanic Eruptions (2008). In the present review, we improved the criteria in the following three stages and clarified conditions as quantitatively as possible.
(1) Summit eruption of Miharayama
(2) Fissure eruption in the caldera and the flank of the island
(3) Plinian eruption or caldera forming eruption
In the scenario of the Izu Subcommittee, there are two categories; the summit eruption and the flank eruption. We classified them into three types as followings.
(a) Eruption at the summit of Miharayama and in the caldera
(b) Eruption at the outside of the caldera (far from the residential area)
(c) Eruption at the outside of the caldera (neighborhood of the residential area)

3. Criteria for summit eruption of Miharayama
We examined the upgrading criteria to level 2 with volcanic tremor activity reviewing the case of the 1986 eruption (e.g. Hashimoto et al., 1989). We set large amplitude tremor or continuous tremor that were observed 1-2 months before the 1986 eruption as new upgrading criteria. Besides them, we included fumarolic activity, volcanic glowing, seismic activity beneath the summit into the criteria.
In the previous criteria, Strombolian eruption at Miharayama had been classified into level 3, however, ballistic bombs from such eruption reached almost within 1 km from the summit crater, therefore, we redefined such eruption as level 2. If the lava flow exceeds 1 km from the crater or the eruption becomes more explosive and ballistic bombs frequently reach more than 1 km distant from the crater, the alert level must be upgraded to level 3.
As the criteria is made according to the 1986 activity, we examined the level simulation using them for the 1950-1974 eruption at Miharayama. Although the precursors of the start of the 1950 eruption could not detected because there was only one Wiechert seismograph at Oshima Weather Station, the high sensitive seismic observation after the start of the eruption detected volcanic tremors before some eruptions. We recognized that every eruptions took place in the alert level 2 or 3 in the level simulation using the modified criteria.

4. Criteria for fissure eruption
We examined the criteria for the activity in the 1986 fissure eruption. The activity in the eruption on 21

November 1986, was as followings.
a) 14:10 : Vigorous earthquake swarm and ground deformation
b) 16:15 : Start of fissure eruption on the caldera floor
c) 17:47 : Fissure eruption at the NW flank
New criteria are set as level 3, 4 and 5 at the stages a), b) and c), respectively. At the stage a), the alert area is enlarged to the outside of the caldera.

5. Alert level for large eruption
In the previous criteria, level 4-5 were defined only for lave flow and fissure eruption near the coast and did not include Plinian eruption or caldera forming eruption. In the new criteria, we included such eruption cases. For the example, when Plinian eruption occurs and volcanic plume reaches more than 10 km height, the alert level will be upgraded to level 4; when large amount of scoria or ash fall in the residential area, to level 5.

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