Ballistic Hazards Simulation at Merapi Volcano –Indonesia –using BALLISTA

*Christopher A Gomez[1,2], Kae Tsunematsu[3], Pak Djati[4], Angri Setiawan[2], Junun Sartohadi[5], Danang Sri Hadmoko[2]

1. Kobe University Faculty of Maritime Sciences Volcanic Risk at Sea Research Group, 2. Universitas Gadjah Mada, Faculty of Geography, Indonesia., 3. Yamagata University, 4. PSBA, Universitas Gadjah Mada, Indonesia, 5. Universitas Gadjah Mada, Faculty of Agriculture, Indonesia.

Introduction - Merapi Volcano is located in Central Java, Indonesia, and it is certainly one of the most active volcano in the world, with eruptions characterized with dome-collapse pyroclastic flows and lahars every five years. In 2010, the volcano produced its largest known eruption for the last 1,000 years, draping the summit and the South-East to South-West sector in pyroclasts and ash. Although it played a minor role in the eruption hazards, volcanic ballistics accompanying the eruption have blanketed the upper slopes, providing a good archive of the ballistic deposition zones during the eruption.

Returning to a more quiescent phase, the volcano is now, once again, a popular touristic destination, with an access to the Northern edge of the crater rim. Although the surface activity is now reduced to fumeroles, ballistic hazards should not be underestimated as the recent events at Mt. Ontake (2014) and in Kusatsu (2018), even in period of relative quiescence.

Methodology - Using Ballista model (programmed by K. Tsunematsu), a physical model with a stochastic approach to original ejection trajectory, the present contribution presents a hazard map of ballistics calibrated against the ballistic deposits of the 2010 eruption. This data was mapped using GIS from UAV-aerial photographs and then compared to different parametrization of the model.

Results –The main difficulty with the results is that a large proportion of the ballistics fly through the opening of the vent, but there aren't any field data to compare the results with, because it corresponds with the flank of the volcano battered by pyroclastic flows. Therefore, the matching between the ballistic deposits and the model was performed from the deposits that are most visible on the Western flank of the volcano, where no known pyroclastic flow occurred in 2010.

For an eruption similar to the one that occurred in 2010, ballistics can fly more than 4 kilometers from the vent carrying rocks with a density 2.5 to 2.8 g/cm^3 and of metric size. The pathways of the ballistics also cover the present day trail to the summit, putting tourists potentially at risks, even if a large proportion of the ballistics are trapped by the vertical walls of the crater.

Keywords: ballistics, hazards, Merapi