



## Development and implication of a human-volcano system model

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In an attempt to understand the complexity of human-environment systems, models help to define, quantify, describe, or simulate complex interactions. With regards to the human-volcano system, we develop a conceptual model in order to assist analysis of its two basic elements, the physical and the social environment. A field survey of the human environment interaction of two of the most active volcanic areas in Indonesia (Mt. Merapi and Mt. Bromo) and a corresponding literature review from other case studies was carried out. A differentiated understanding of human interaction with hazard potential elements within the human-volcano system is the main focus of the model development. We classified volcanic processes and effects as three pairs of dichotomies: positive or negative impacts, on society or environment in an indirect or direct way. Each volcanically induced process or effect characterized accordingly leads to eight distinct process/effect classes. They are positive direct effects on society (PDS); positive direct effects on natural resources (PDN); positive indirect effects on society (PIS); positive indirect effects on natural resources (PIN); negative direct effects on society (NDS); negative direct effects on natural resources (NDN); negative indirect effects on society (NIS) and lastly negative indirect effects on natural resources (NIN). Such differentiated view of volcanic process/effects bears several advantages. First, whereas volcanic processes have hitherto been viewed as hazards only, it becomes possible now to describe a particular process/effect in a particular context as negative or positive. Secondly, such a categorization makes it possible to account for processes of the human-volcano system that do not have a direct physical expression but are of socio-cultural relevance. Thirdly, the greater degree of differentiation that is made possible when evaluating volcanic processes has significant repercussions on the way volcanic risk must be perceived. The capturing, differentiation and categorization of volcanic processes/effects as described above provides the basis for a) an open conception of risk and b) has significant consequences for practical disaster risk management decisions.

Keyword: Model, human-volcano system, volcanic process/effects, open volcanic risk concept