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Quantification of the meteorological impact on fumarole temperature data from Merapi volcano

G. Richter (1), J. Wassermann (2), M. Zimmer (3)

(1) Institute of Geosciences, University of Potsdam, Postfach 601553, D-14415 Potsdam, Germany (richter@geo.uni-potsdam.de), (2) Geophysical Observatory, Department of Earth and Environmental Sciences, Munich University, Ludwigshöhe 8, D-82256 Fürstenfeldbruck, Germany, (3) GeoForschungsZentrum Potsdam, Section 4.2, Telegrafenberg B326, 14473 Potsdam, Germany

Introduction

Fumarole temperature measurements can provide further insides in volcanic processes like degassing events if sampled with high frequency (Zimmer & Erzinger, 2003, Byrdina et al., 2003, Richter et al., 2004). However, large perturbations can completely cover the relevant variations related to degassing events. This is caused by a mixing of the magmatic gases with air and meteoric water near the surface (Friedel et al., 2004, Richter et al., 2004). The data set from multi-parameter stations (Rebscher et al., 2000) at Merapi volcano provides an excellent starting point for quantitative analysis of the meteorological impact on fumarole temperature. The monitoring network consists of several stations installed on the flanks of the volcano recording the meteorological parameters as well as one station in close distance to the fumarole temperature measurement sites. The results of this quantitative analysis result in a deconvolution procedure using an empirical transfer functions in order to minimise the meteorological perturbations in the temperature data. The resulting time series are capable to provide new information about the shallow magmatic system.

Quantitative Analysis

According to the different sources of meteorological parameters, two types of analysis techniques are applied. Episodical rain or wind events have been first identified in the continuous time series. Thereafter, the changes in fumarole temperature from two observation sites are investigated in more detail. A systematic correlation between

rain/wind event parameters (intensity, duration etc.) and differences in temperature changes (increase/decrease) are extracted. The results show a clear decrease of fumarole temperature after rain fall at one site (Woro -fumarolic field: WTMP) whereas no significant changes can be observed at the other site (Gendol fumarolic field: GTMP). A linear relationship between rain intensity and temperature decrease could not be found. The analysis of periodic changes in fumarole temperature caused by barometric pressure or air temperature changes are analysed by correlation analysis. This analysis reveals a stronger correlation at site GTMP.

Conclusions

The meteorological data set from several stations at Merapi Volcano enables us to quantify variations in fumarole temperature related to changes in meteorological parameters. The resulting time series of two fumaroles are promising parameter for characterising the state of volcanic activity.

References

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