Geophysical Research Abstracts
Vol. 17, EGU2015-701-1, 2015
EGU General Assembly 2015

Innovative Methodologies for thermal Energy Release Measurement: case of La Solfatara volcano (Italy)

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This work is devoted to improve the knowledge on the parameters that control the heat flux anomalies associated with the diffuse degassing processes of volcanic and hydrothermal areas. The methodologies currently used to measure heat flux (i.e. CO_2 flux or temperature gradient) are either poorly efficient or effective, and are unable to detect short to medium time (days to months) variation trends in the heat flux. A new method, based on the use of thermal imaging cameras, has been applied to estimate the heat flux and its time variations. This approach will allow faster heat flux measurement than already accredited methods, improving in this way the definition of the activity state of a volcano and allowing a better assessment of the related hazard and risk mitigation. The idea is to extrapolate the heat flux from the ground surface temperature that, in a purely conductive regime, is directly correlated to the shallow temperature gradient. We use thermal imaging cameras, at short distances (meters to hundreds of meters), to quickly obtain a mapping of areas with thermal anomalies and a measure of their temperature.

Preliminary studies have been carried out throughout the whole of the La Solfatara crater in order to investigate a possible correlation between the surface temperature and the shallow thermal gradient. We have used a FLIR SC640 thermal camera and K type thermocouples to assess the two measurements at the same time. Results suggest a good correlation between the shallow temperature gradient ΔTs and the surface temperature Ts depurated from background, and despite the campaigns took place during a period of time of a few years, this correlation seems to be stable over the time. This is an extremely motivating result for a further development of a measurement method based only on the use of small range thermal imaging camera.

Surveys with thermal cameras may be manually done using a tripod to take thermal images of small contiguous areas and then joining them together in a bigger map of the whole area. However this kind of scanning does not fully solve the low speed problem of traditional techniques: a future development of this technique will be the use of drone-born IR cameras.