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How to evaluate the surface heat loss and closely follow the evolution of solphataric activity by integrating satellite data and ground measurements to the thermal monitoring of a closed conduit: The case of the active crater at La Fossa (Island of Vulcano, Italy)

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The aim of volcanic surveillance is to interpret the observational data in order to highlight changes of activity and possibly to define the risks for human health and activities. Current satellite missions, providing imagery in the TIR region at high spatial resolution, offer to volcanic surveillance the possibility to estimate the surface temperature and highlight surface changes, related to the buried energy sources. Actually the remote sensing allows repeating the acquisitions in time, with a more convenient cost to benefit ratio, than the direct surveys could do. Moreover, thanks to the widest areal coverage provided by satellite images, remote sensing dataare able to identify the areal changes of thermal anomalies all over the volcanic system.. As regards the Island of Vulcano, the acquisition from LANDSAT and from ASTER (NASA-TERRA), provide thermal data by IR channels, to monitor the evolution of the surface temperatures on the cone.
The La Fossa cone of Vulcano (Aeolian Arc) has been monitored by the INGV observational network, since the eighties. The geochemical network, includes, beside many other monitored parameters, also the output temperature of high temperature fumaroles located on the summit crater. The historical thermal monitoring has been based on contact sensor, either in the fumaroles (maximum measured temperature $\sim$670 °C) and in the steam heated areas (maximum measured temperature $\sim$100 °C). Within the steam heated ground, the INGV monitoring system consists in a data-logger storing the ground temperature at fixed time interval (1 h) on 4 points, lying along the main direction of diffuse heat flux on a shallow vertical profile of soil.
In this work analysis and the comparison of about twenty years of nighttime satellite data and twenty-five years of ground measurements are presented. The choice to process only nighttime satellite data is due to not presence of the solar contamination and the obtained temperature has acceptable values in the normal ground surface heated only by the sun radiation. This long term monitoring of high temperature fumaroles holds a good potential to improve the interpretation of many surface phenomena occurring in any active volcanic area.
To improve the systematic use of satellite data in the monitor procedures of Volcanic Observatories a suitable integration and validation strategy is needed, also considering that current satellite missions do not provide TIR data with optimal characteristics to observe small thermal anomalies that may indicate changes in the volcanic activity.
For example, to observe small thermal anomalies and also to detect the effect of different moisture contents on a short optical path (about 1m), proximal IR thermo-camera images of the fumarole fiels have been taken at different times (during daytime and nighttime), and the results have been compared. The analysis of data by proximal IR thermo-camera images could supply either an intermediate observational scale. Moreover they would provide also an intermediate instrumental resolution between the ground measurements by contact sensors and indirect remote sensing data by satellite monitoring, to get comparison of results and validation strategies, more easy.