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Statistical analysis of long term (2006-2016) TIR imagery based on Generalized Extreme Value estimator: an application at Pisciarelli volcanic area (Campi Flegrei, Italy).

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Quantifying and monitoring energy budgets at calderas, released in terms of heat output during unrest periods, is crucial to understand the state of activity, the system evolution and to draw a possible future eruptive scenario. Campi Flegrei, a restless caldera in Southern Italy, during the last years is experiencing clear signs of potential reawakening. Indeed, is now more important then ever to consider, analyse and monitor all the potential precursors, contributing to the caldera volcanic hazard assessment.
We analysed the continuous long term (2006-2016) TIR images night-time collected at Pisciarelli site. This volcanic area, is located above a critical volume which recently showed an increase and clustering of earthquakes distribution and which shows the most impressive gas discharge (mainly H_2O and CO_2) at Campi Flegrei caldera. We treated in a statistical way the TIR images, defining an anomaly zone, which we compared to a background area. The pixel distributions, as function of the temperature, showed a generalized extreme value structure. The anomaly area, with a long tail toward high temperature values, showed a positive factor form ($f > 0$, Frechet distribution). This value was constantly above zero and kept stable along the whole 2006-2016 period, while the scale factor was estimated with a decreasing trend (variance reduction). Pixels of the background TIR images, in contrast, showed a factor form between zero and a weakly negative value ($f = 0$ or $f < 0$) Gumbel or Weibull distribution). We used the location parameter as representative of the temperature distribution (which is very near the average temperature) and analysed its trend as function of time, removing the annual variation using a 365.25 days mobile average.