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Drone high resolution infrared imaging of the Lusi mud eruption

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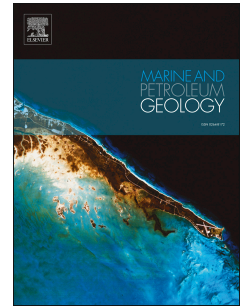
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7

8 **Abstract**

9 The use of low-cost hand-held infrared (IR) thermal cameras based on uncooled micro-bolometer
10 detector arrays became more widespread during the recent years. Thermal cameras have the ability
11 to estimate temperature values without contact and therefore can be used in conditions where targets
12 are difficult or dangerous to reach such as volcanic eruptions. Since May 2006 the Indonesian Lusi
13 mud eruption continues to spew boiling mud, water, aqueous vapour, CO₂, CH₄ and covers a
14 surface of nearly 7 km². Here we performed surveys above and around the erupting crater using a
15 specifically equipped remote-controlled aerial vehicle (drone). Despite the harsh logistics and the
16 continuously varying gas concentrations, we managed to collect IR images composing mosaics to
17 estimate the crater zone spatial and temporal thermal variations as well as that in the surrounding
18 regions. In this manuscript we provide a) a description of the main processes that affect and control
19 the acquisition of IR images; b) an overview of still non disclosed physical model used by the
20 thermal camera employed during our survey (i.e. Flir I7 IR); c) a method for capturing high
21 resolution infrared images over an erupting clastic system; d) analysis and interpretation of the
22 acquired data and scientific results. The results show that it is possible to obtain good quality
23 mosaics also in inaccessible areas such as erupting craters where fixed reference points are not
24 constant, and where the presence of IR attenuation factors introduce errors in terms of temperature
25 estimates. However the IR camera radiative transfer model (based on Lowtran model) allows the

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