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Quantifying SO_2 emissions from the Bárðarbunga rifting event with semi-permanent infrared imaging cameras

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SO_2 emissions from Icelandic fissure eruptions have historically had significant climatic effects. For example, the 1783-1784 eruption of Laki emitted an estimated 120 MT of SO_2 over a period of eight months and caused dramatic meteorological and environmental effects throughout Europe. The ongoing activity at Bárðarbunga has persistently been emitting plume since its initiation in August 2014. Emission rates have been estimated as averaging around 20,000 tonnes/day from ground based and satellite sources. However, the high gas concentrations and low ambient light levels during the Icelandic winter have limited the ability to accurately determine emission rates using ground-based UV spectroscopy. Satellite retrievals have also been limited by limited sunlight hours, poor weather and the low plume altitude.

As a part of the FUTUREVOLC project, the Icelandic Meteorological Office received three infrared imaging cameras (NicAIR II), specifically designed to withstand the conditions in Iceland. Since the eruption began, the instruments have been deployed intermittently for periods ranging from a few hours up to a number of weeks at the fissure site. A calibration procedure for these instruments has now been developed and SO_2 concentrations can be derived from the image sequences. In this work we present the time series of emission rates derived from the IR cameras and compare these with other estimates including those from UV cameras and satellites. We also demonstrate the features of the instrument and the logistical adaptations that have been developed to enable near-continuous monitoring throughout the Icelandic winter.