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Spectra classification methodology for hyperspectral InfraRed imaging of Mt Etna volcanic plume with a radiative transfer retrieval model

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Quantification of sulfur dioxide (SO_2) emission flux is a fundamental task in volcanology to have insights of the composition and the spatial evolution of volcanic plumes. The ground based InfraRed hyperspectral imager HyperCam, from Telops Company, was deployed during IMAGETNA campaign in 2015 and provided high spatial and spectral resolution images of Mt Etna plume. The spectral range of the hyperspectral imager is [7.7 - 11.8 μm] and the measured images contained 320 x 64 pixels with a spectral resolution of 2 cm-1. To process hyperspectral images in quasi real-time, a fast and reliable radiative transfer retrieval model is required. The LATMOS Atmospheric Retrieval Algorithm (LARA), used to retrieve the slant column densities of SO_2, includes an accurate line-by-line radiative transfer model and an efficient minimization algorithm of the Levenberg-Marquardt type. But the calculation time remains too high to infer near real time (NRT) estimation of SO_2 fluxes. As first, to reach NRT target, a classification methodology of the brightness temperature spectra was developed and then applied on each measured sequence to significantly decrease the processing time. One image previously took a week of calculation to be retrieved. The classification of the spectra allows the retrieval of a complete measurement sequence of the field campaign ($\sim$400 images) in only a couple of hours. The accuracy of the methodology was confirmed, by comparing the SO_2 slant column density images obtained after classification with the one obtained by the accurate and time expensive pixel by pixel retrieval processing. The LARA model, the spectra classification methodology and a comparison of the results will be presented.