Simulation of volcanic and fire ashes spectra with σ-IASI/F2N

Lorenzo Cassini [1,2], Guido Masiello[2], Tiziano Maestri[3], Carmine Serio[2], Giuliano Liuzzi[2], Michele Martinazzo[3], Rocco Giosa[2], Federico Donat[2], Fabrizio Masin[3], Pamela Pasquariello[2], Giorgia Proietti Pelliccia[3]

[1] University "La Sapienza" Deepartment of Civil, Building and Environmental Engineering
Piazzale Aldo Moro 5, 00185, Roma, Italy
EMail: Lorezno.Cassini@uniroma1.it

[2] University of Basilicata, Department of Engineering
Viale Ateneo Lucano 10, 85100, Potenza, Italy

[2] University of Bologna, Physics and Astronomy Department "A. RIghi"
Viale Berti Pichat 6/2, 40127, Bologna, Italy

ABSTRACT

The number of events involving the development of spontaneous fires has increased in recent years. Monitoring and modelling these events, or identifying at-risk areas, is becoming increasingly important. Additionally, being able to track and quantify the amount of pollutants generated during fires or volcanic eruption is necessary to evaluate the air quality of the area in the days following the event.

It is within this context that we have developed new applications for the radiative transfer code σ-IASI/F2N, aiming to make it a useful tool for this type of studies. σ-IASI/F2N is an all-sky pseudo-monochromatic radiative transfer code used to calculate spectral radiance and analytical Jacobians across the Earth's atmospheric spectrum, from Far to Near Infrared. Currently, the simulation's spectral interval spans from 100 to 2760 cm^{-1} a range that suits our purpose for multiple reasons.

First, we can observe the wide atmospheric windows between 800-1000 cm^{-1} and 1100-1200 cm^{-1} which allows us to precisely characterize the impact of volcanic/fire plumes on the transmitted radiance. To achieve this, we have utilized a recently developed scaling method along with an additive term into the radiative transfer equations to correctly evaluating the impact of liquid and ice clouds in the radiation budget. This approximation allows us to retain the formalism for the clear sky scenario while correctly evaluating particle multiple scattering effects with a minimal computational coast. The parametrization of the optical properties for ice crystals and water droplets is computed in terms of their effective dimensions. In this work we have utilised the latest σ-IASI/F2N version exporting the same scaling methodology for the multiple scattering of aerosol layers to simulate layers of volcanic ashes or forest fires plumes. The results have been compared with some case of study from IASI measurements. While similar simulations have been performed over the years, they have not used the recently introduced scattering parametrization. This effort aims at developing an all-purpose radiative transfer code that can accurately simulate every sky condition.