Near real-time assimilation of volcanic sulfur dioxide from IASI and other sensors in the MOCAGE model: various case studies

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ABSTRACT

Sulfur dioxide emissions during volcanic eruptions can have a significant impact on air traffic. Indeed, sulfur dioxide is a precursor of sulfuric acid which is highly corrosive and can damage aircraft engines when they pass through a plume of sulfur dioxide.

Currently, to predict the concentration of sulfur dioxide of volcanic origin in the French chemistry-model MOCAGE, SO_2 total columns providing from TROPOMI satellite are assimilated in MOCAGE. Nevertheless, we assume that the SO_2 plume is between 3 and 10 km of altitude, which is not the case for all volcanic eruptions. Our analyses and forecasts can be improved by using information about the height of the plume and more instruments.

Different instruments using infrared or ultra violet wavelengths exist to measure SO_2 total columns. In our study, we decided to assimilate TROPOMI and IASI instruments. With the use of ultra-violet wavelength, TROPOMI measures SO_2 only during daytime but with high horizontal resolution from the surface to the top of the atmosphere. Moreover, it allows to know the altitude of plume for SO_2 total columns stronger than 20 DU. The infrared instruments IASI measure SO_2 both during day and nightime. Moreover, the altitude of the plume is known even for weak SO_2 total columns. Nevertheless, because of the sensitivity of this wavelength range to water vapor, the measure of SO_2 in the lowest layers of the atmosphere is difficult. Height is used to constrain the altitude of plume in the model. This presentation will give a comparison between the assimilation with and without height information on different eruptive events. Following the study of these various case studies, the assimilation volcanic SO_2 from IASI will be transferred to operational use.