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SO_2 Layer Height retrieval from Sentinel-5 Precursor/TROPOMI using FP-ILM

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Precise knowledge of the location and height of the volcanic SO_2 plume is essential for accurate determination of SO_2 emitted by volcanic eruptions for aviation control applications, but so far very time-consuming to retrieve from UV satellite data. We have developed an extremely fast yet accurate SO_2 layer height retrieval algorithm using the Full-Physics Inverse Learning Machine (FP-ILM) algorithm, which, for the first time, is applied to TROPOMI aboard Sentinel-5 Precursor.

Conceptually, the FP-ILM consists of a training phase, in which the inversion operator is obtained using synthetic data generated using a radiative transfer (RT) model, and an operational phase, in which the inversion operator is applied to satellite measurements. The main advantage of the FP-ILM over classical direct fitting approaches is that the time-consuming training phase involving complex RT modeling is performed offline; the inverse operator itself is robust and computationally simple and therefore extremely fast.

In this presentation we demonstrate the ability of the FP-ILM algorithm to retrieve layer heights in near-real time applications with an accuracy of better than 2 km and show SO_2 layer height results for selected volcanic eruptions measured by Sentinel-5 Precursor/TROPOMI, including the Krakatau and Etna eruption end of 2018.