Vertical profiles of volcanic ash aerosols: a case study with the Puyehue Cordón Caulle eruption in June 2011

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Volcanic ash is a threat to humans and animals when present in ambient air, and to aviation when present in the planes track. Characterization of the ash clouds (geolocation and altitude) is therefore very important. Current satellite-based measurements provide mostly AOD, with no or very limited altitude information. Altitude is most often derived from transportation models, from the geolocation of the plume and the volcano, and wind fields. Here, we propose a method to obtain ash vertical profiles from TIR IASI data (MAPIR algorithm). The method is applied to study the Puyehue Cordón Caulle eruption of 4 June 2011, which was followed by a second less intense eruption on June 11-12.

Plume’s first days: 2D comparisons ...

Night 4-5 June
Day 5 June
Night 5-6 June
Day 6 June
Night 6-7 June
Day 7 June

... some vertical slices ...

Very high OD’s observed!
Geolocation of the plume by MAPIR and IMARS match very well.

... and a 3D view!

A little bit later... when CALIOP is back
(16 June 2011)

Conclusion

For the first time, IASI measurements have been used to derive vertical profiles of volcanic ash in the atmosphere. The Puyehue plume detection and general spatio(2D)-temporal evolution is consistent with previously reported results (Klüser et al, AMT 2013). Vertical profiling is, to the extent of possible comparisons, highly reasonable while not really validated yet because of the lack of comparable data. This method is therefore very promising for improving ash « crisis management » and the general knowledge of ash 3D distribution.

The main issues to be solved for further improvement and application of this method are: the issue of ash mixed with ice particles, the generalisation to any eruption (ash refractive index and size, altitude range), unforeseen difficulties above cold surfaces.