Validation of Absorbing Aerosol Height product from GOME-2 using CALIOP data

De Bock, V., Pardo Cantos, I., Laffineur, Q., Mangold, A., Tilstra, G., Tuinder, O., and Delcloo, A.

1 Introduction

The Absorbing Aerosol Height (AAH) is a new GOME-2 product for aerosol detection developed within the Atmospheric Composition Satellite Application Facility (ACS AF). It uses the Absorbing Aerosol Index (AAI) and derives the actual height of the absorbing aerosol layer in the O2-A band using the Fast Retrieval Scheme for Cloud Observables (FRESCO) algorithm (Tilstra et al. 2010). This AAH product could be used to monitor volcanic eruptions globally and to provide the height of the ash layers (e.g. within the framework of aviation safety).

To determine the quality of the AAH, a new quantitative validation exercise has been done, using the extracted height of the different aerosol layers from CALIOP and comparing this to the AAH from GOME-2. The results from different case studies will be presented.

2 Method

- Download CALIOP Vertical Feature Mask data (version 4.20) from NASA Langley Research Center Atmospheric Science Data Center
- Retrieve aerosol type(s) and layer height from CALIOP
- Retrieve AAH from GOME-2 for AAI > 4 cases
- Compare CALIOP layer height with AAH for points located within 100 km distance

3 Some validation results

3.1 Case 1: Calbuco eruption

- On 23/04/2015, the ash plume rose higher than 15 km and drifted N, NE, and E.
- Fig. 1 shows the aerosol layers detected by CALIOP and GOME-2 for 23/04/2015 (left) and 24/04/2015 (right).

On 24/04/2015, CALIOP detected several aerosol species: dust and polluted dust between 0.2-5.5 km; volcanic ash between 13-17.5 km; sulfate and stratospheric elevated smoke between 14.5-15 km. The AAH of GOME-2 was between 1.8-4.8 km.

3.2 Case 2: Puyehue eruption

- On 05/06/2011, the ash plume rose to 10.7-12.2 km and drifted ESE over the coast of Argentina and into the Atlantic Ocean.

On 05/06/2011, CALIOP detected volcanic ash between 11-14 km, stratospheric elevated smoke between 13.5-14 km, dust between 5.5-9.5 km and polluted dust between 4-9.5 km. GOME-2 AAH was between 4-11 km.

3.3 Case 3: Grimsvotn eruption

- On 03/05/2011, the ash plume rose to 5-10 km and drifted S at lower altitudes and W at altitudes over 8 km.

When only taking the AAI > 4 GOME points into consideration, there are only CALIOP observations of dust, polluted dust and sulfate located within 100 km. The height of the sulfate layer is between 8.8-9.3 km and the corresponding AAH is 1.2-1.3 km. However, when we would also look at AAH > 2, there are much more points in the comparison: CALIOP data now also include observations of volcanic ash (at 8.2-12.1 km), sulfate (at 8.8-16.3 km) and elevated smoke (8.4-10.9 km). The corresponding AAH is lower than 3.4 km.

3.4 Case 4: Mount Kelud eruption

- On 13/02/2014, ash plumes rose to an altitude of 17 km and caused ashfall in areas NE, NW and W of the volcano.

On 13/02/2014, CALIOP detected volcanic ash between 17-20 km, stratospheric elevated smoke between 16-17 km, dust between 5.5-11 km and polluted dust between 8-9.5 km. GOME-2 AAH was between 3-7 km.

It can be seen that the AAH does not agree with the height of the volcanic layer observed by CALIOP.

4 Conclusions/Outlook

The amount of data for comparison is often highly limited when only using AAH calculated under conditions with AAI > 4.

Finding perfect collocations both in space and time between GOME-2 and CALIOP overpasses is challenging.

For the volcanic case studies, the AAH clearly underestimated the height of the volcanic aerosol layers detected by CALIOP. The fact that GOME-2 AAH is limited at 15 km plays a role.

Dispersion modelling will be used in the future to study the bin size of the aerosol layer and to determine the representative type.

5 References and acknowledgements

- Information on the studied volcanos was found at: https://volcano.si.edu/
- The CALIOP data were obtained from the NASA Langley Research Center Atmospheric Science Data Center.