Royal Belgian Institute for Space Aeronomy – 3 Avenue Circulaire, 1180 Brussels, Belgium – sophie.vandenbussche@aeronomie.be

BIRA•IASB

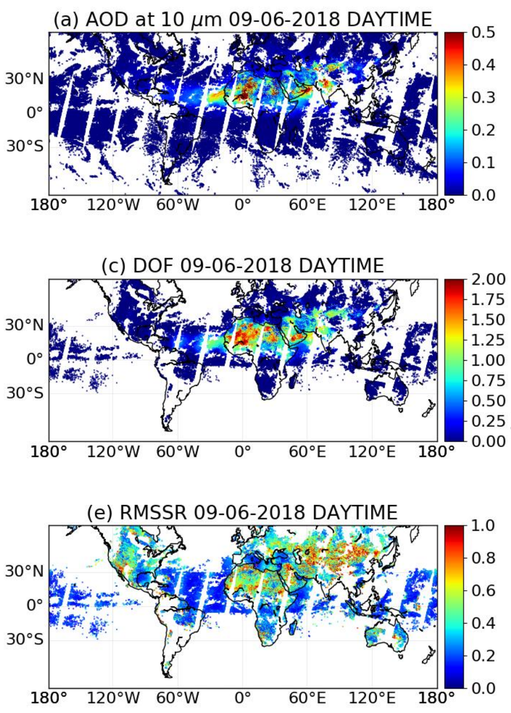
Mineral Aerosols Profiling from Infrared Radiances (MAPIR): Update of dust and ash vertical profile retrievals from IASI

S. Vandenbussche, N. Kumps, M. De Mazière

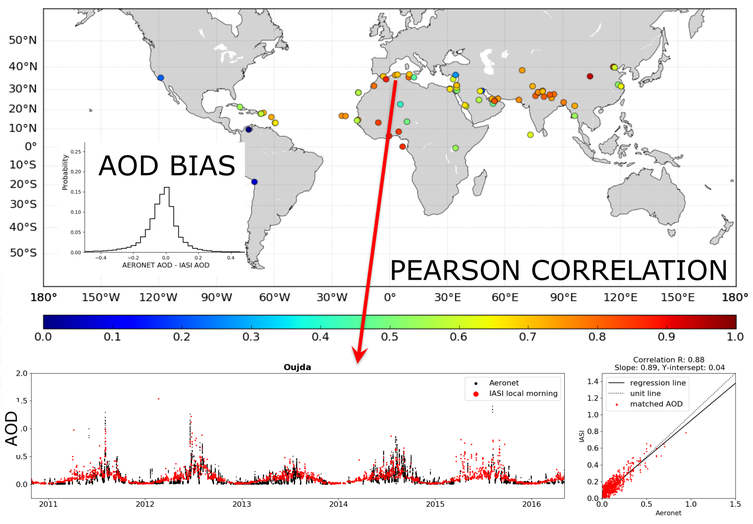
DUST (version 4.1)	MAPIR	ASH ("tailored")
RTTOV v12	RT code	RTTOV v12
OEM + Levenberg Marquardt on log	Retrieval	OEM + Levenberg Marquardt on log
905-927; 1098-1123; 1202-1204	Wavenumbers	830-838; 898-907; 1098-1123; 1140-1160; 1200-1209
7 layers centred at 0.5:1:6.5km + Ts	State vector	Aer prof. + SO_2 col. + Ts; alt. range depends on case
IASI operational level 2	T and H2O	ECMWF ERA-5
IASI level 2 cloud fraction <10% & cloud flag (v6) <=2	Cloud screening	None before; attempt after retrieval
Aerosol presence (based on BTD and surface emissivity)	Pre-filtering	None
RMSSR < 1K; AOD < 5; 200K < Ts < 350K	Quality filter	Depends on case… tweaked to remove clouds
Log normal, effective radius 2µm	Aerosol size	Mod. Gamma, size "manually" picked for each eruption
Dust, Volz +Shettle & Fenn	Aer. refr. index	"Manually" picked for each eruption
LIVAS monthly clim. (CALIOP), std dev 50%, v. corr. 1km	Aer. a priori	1part/cm³, std dev 100%, no vert. corr.
25/09/2007 - 31/12/2020 iasi.aeronomie.be	Data availability	Test cases: Puyehue, Grimsvotn, Calbucco, Raikoke
MAPIR v4.1: Callewaert et al, AMTD 2019	References	old version, Puyehue: Maes et al, Remote Sensing 2016

10 years of IASI dust profiles

Example day



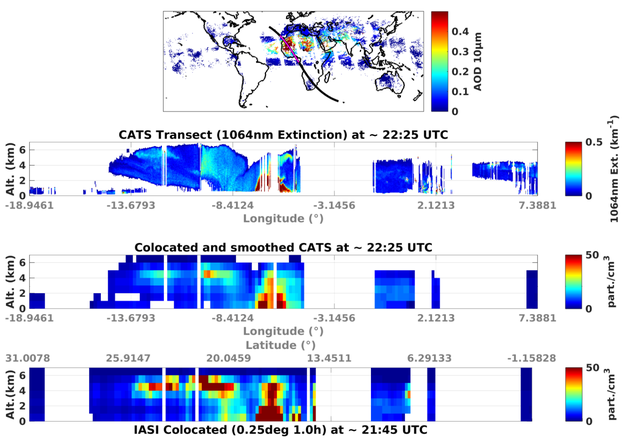
Aeronet comparison



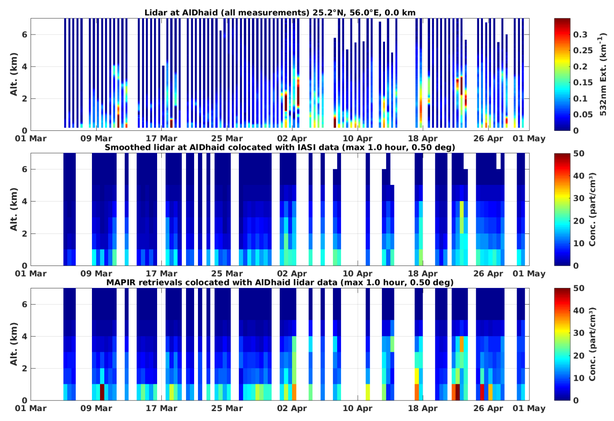
CALIOP mean alt. comp.

Cumulative Ext.	Day land	Night land	Day ocean	Night ocean
Bias ± RMS (km)	-0.45 ± 1.16	-0.23 ± 0.71	-0.18 ± 1.06	-0.25 ± 0.56
% in layer	69.1	72.8	85.5	99.5

CATS profile comparison



GB lidar UAE prof. comp.

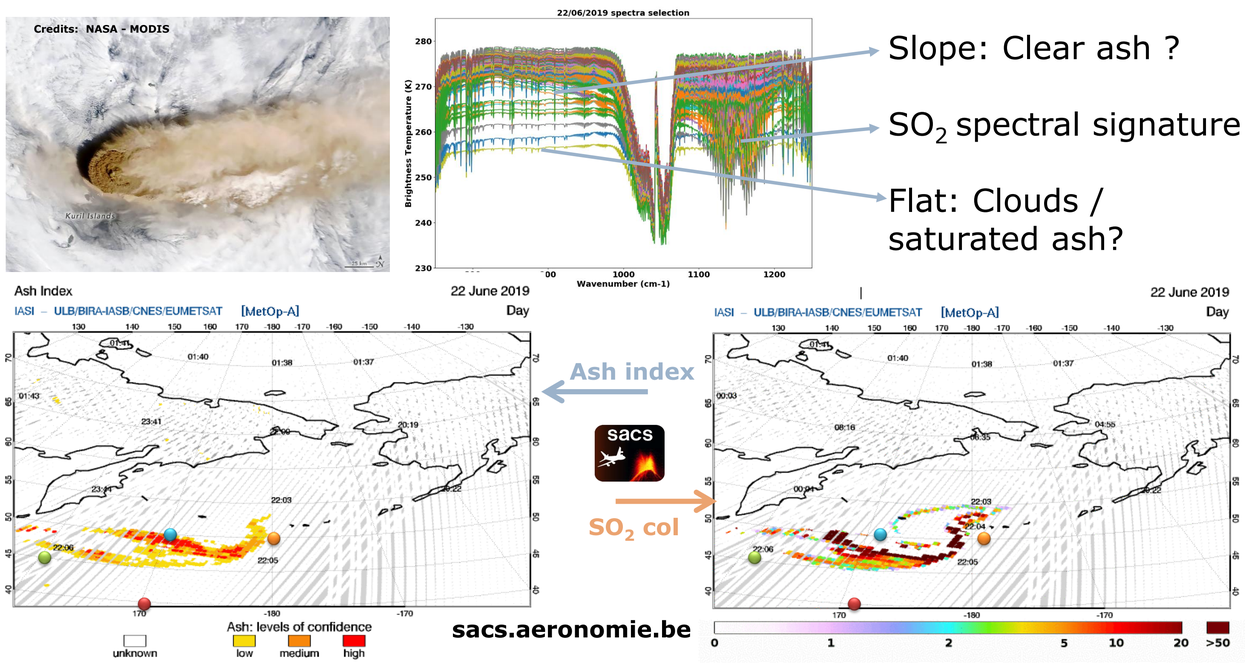


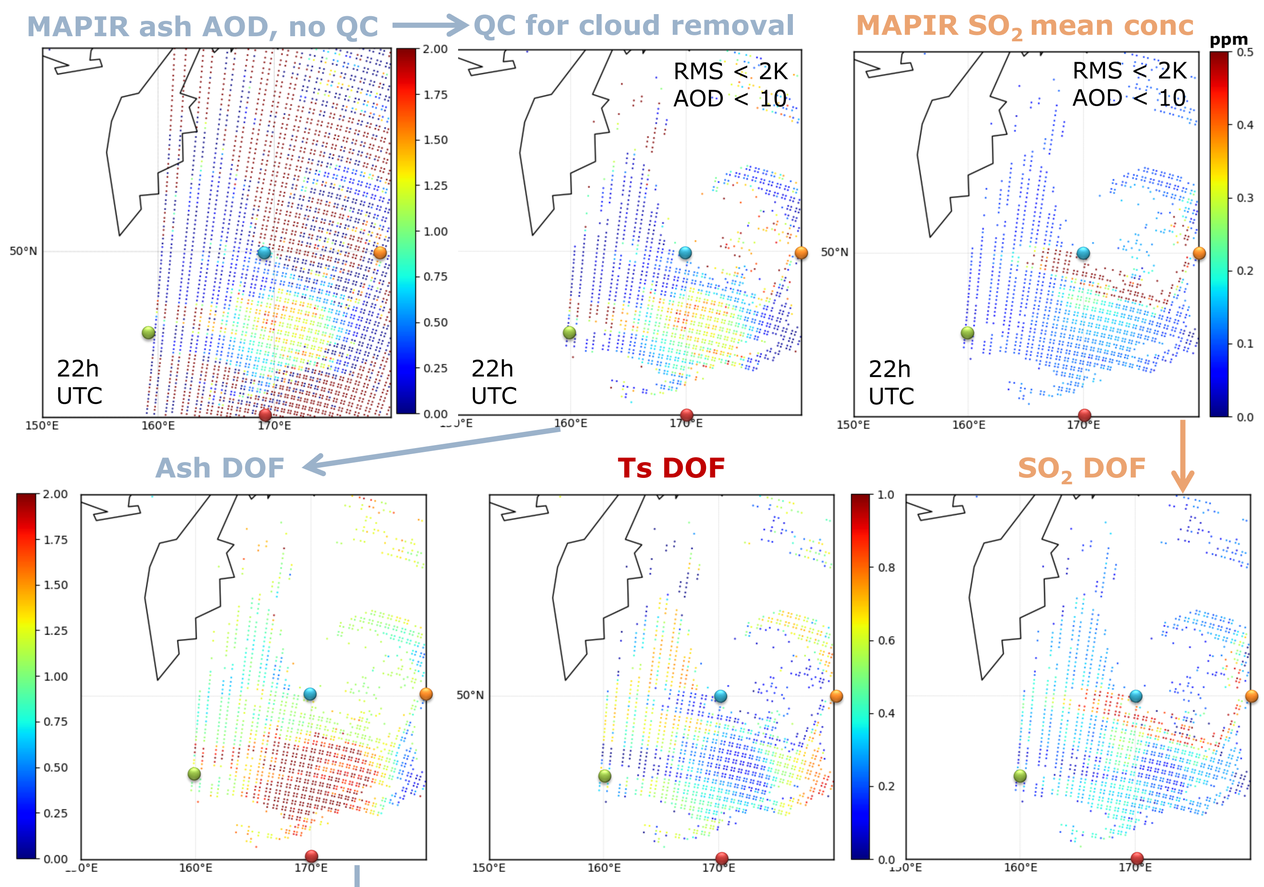
With respect to the previous versions, MAPIR v4.1 is largely improved, in terms of computation time and scientific quality:

- Improved AOD (no more overestimation)
- Much less retrieval failures over deserts
- Very low residuals (RMSSR median 0.32K, mean 0.39K)
- DOF ~2 in good situations, ability to detect 2 separate layers
- Good correlation with AERONET at most dusty stations
- Very low mean bias with respect to CALIOP mean altitude

Further improvements are needed for the "dust pre-filter" (or remove it) and for the long-range transport (underestimated).

22 June 2019 Raikoke eruption





MAPIR ash has been improved by the addition of SO_2 (very roughly) in the state vector, and using ECMWF ERA-5 atmospheric data.

Raikoke eruption:

- Ash DOF ~2; Ash AOD up to 2
- SO_2 DOF ~1; Conc. abs. value should not be used (approximate)!
- Ts DOF << 1: plume is thick!
- Ash altitude from ~3 to 8km; highest where there is also SO_2

Difficult to find validation data…
Difficult to automatize due to difficulties separating from clouds

@ EUMETSAT What would help?

1. For dust long-term: consistent high quality time series of T (and H_2O) profiles
2. Improved cloud flag – better specificity wrt large dust (/ash) clouds
3. Improved dust and ash (without cloud) flags to trigger MAPIR
4. Improved high-resolution surface emissivity

Belgian Science Policy Office belspo
aerosol cci
The research leading to these results has received funding from the European Union's Horizon 2020 Research and Innovation Programme, under Grant Agreement no 723986, from the Belgian Science Policy supplementary researcher's and PRODEX Programmes, and from ESA aerosols_CCI2 project.
EUNADICS-AV
HORIZON 2020
prodex
esa