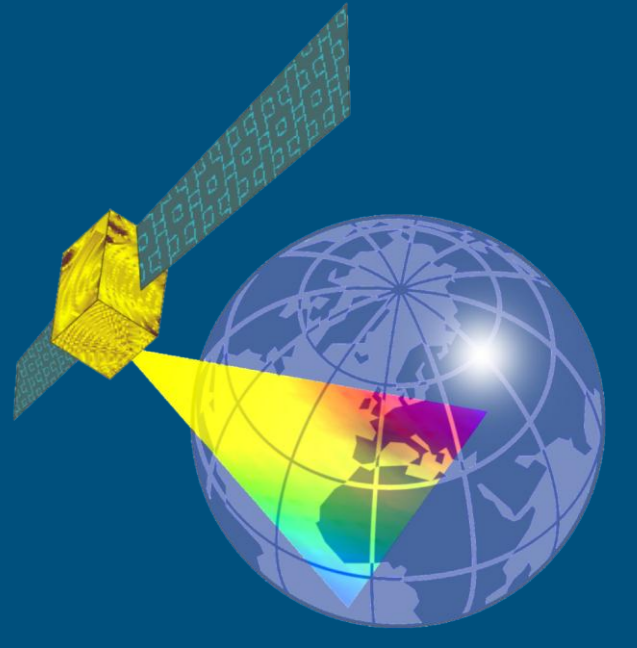


Evaluation of the effect of strong aerosol loads on satellite retrievals of tropospheric NO₂, SO₂ and HCHO using MAX-DOAS observations in Wuxi, China

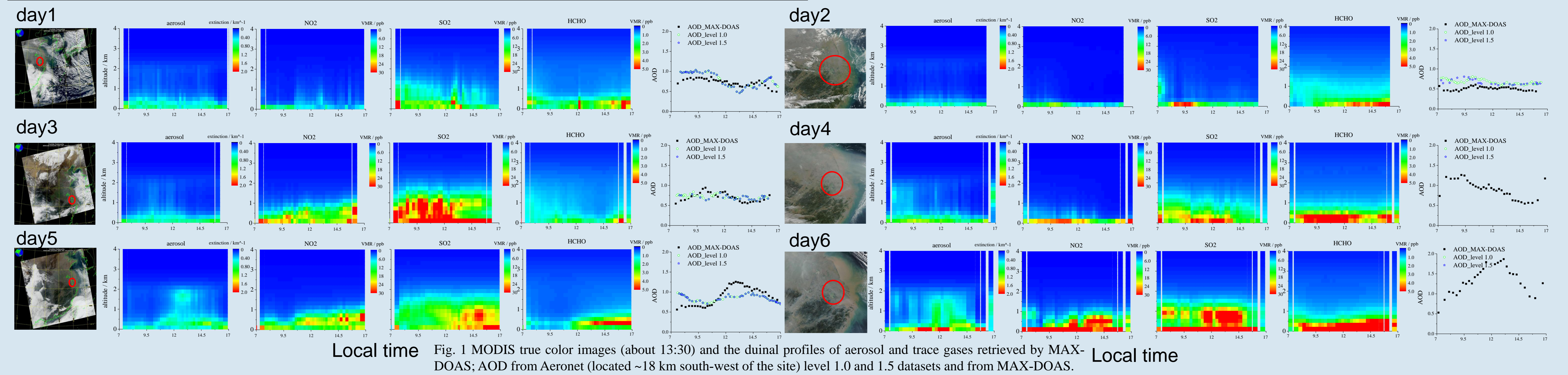


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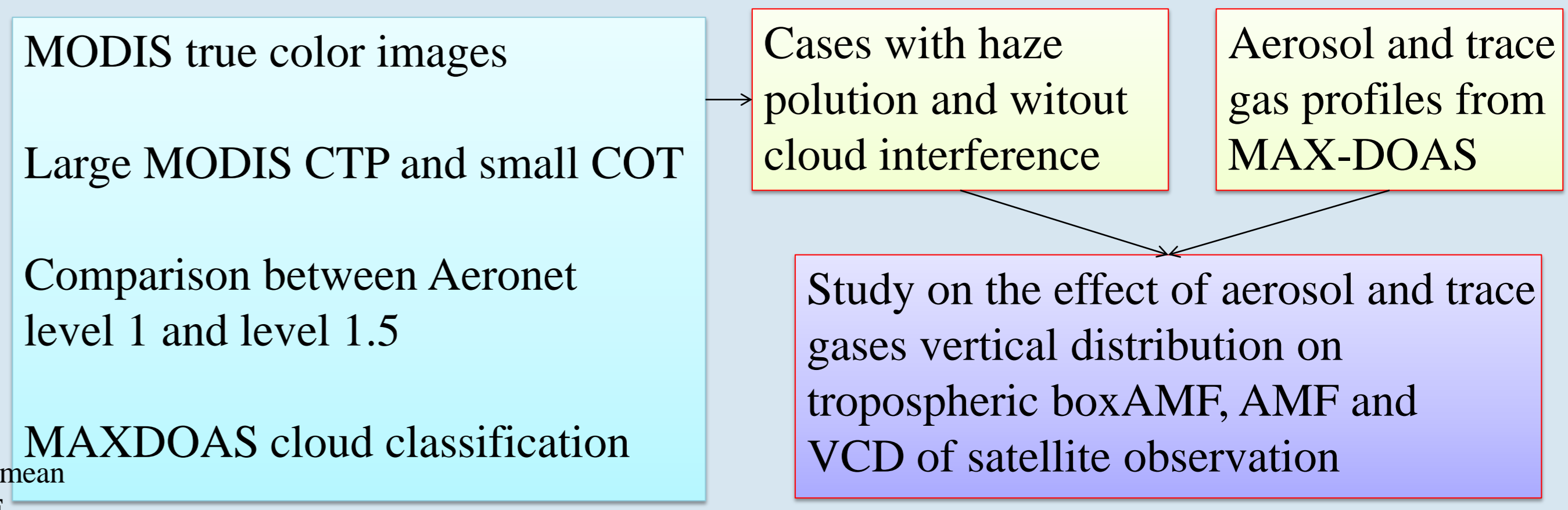
ATMOS 2015, ESA
University of Crete, Greece
8-12 June 2015
DOI:10.13140/RG.2.1.4950.2881

Extraction of six days with haze pollution and without clouds



| daynumber | Date | AOD | MODIS CF [%] | MODIS AOD | MODIS CTP [hPa] | MODIS COT | OMI UV_aerosol index | Aeronet SSA | Visibility [km] |
|-----------|--------------|------|--------------|-----------|-----------------|-----------|----------------------|-------------|-----------------|
| 1 | Jan 26, 2012 | 0.56 | 65 | Nan | 1040 | 0.85 | 0.94 | 0.905 | 9 |
| 2 | Oct 28, 2013 | 0.61 | 34 | 0.65 | 1040 | 0.81 | Nan | 0.65 | 16 |
| 3 | Dec 10, 2011 | 0.69 | 27 | Nan | 1040 | Nan | 0.58 | 0.895 | 12 |
| 4 | Nov 20, 2013 | 0.75 | 68 | Nan | 1040 | Nan | 1.23 | Nan | Nan |
| 5 | Apr 22, 2012 | 0.85 | 0.5 | 1.09 | Nan | Nan | 1.4 | 0.935 | Nan |
| 6 | Nov 19, 2013 | 1.66 | 46 | 0.79 | 1040 | Nan | 0.832 | Nan | 11 |
| 7 | Feb 19, 2012 | 0.91 | 50 | 0.8 | 1040 | Nan | 0.09 | 0.885 | 14 |

Table 1 geometry cloud fraction, cloud top pressure, cloud optical thickness and AOD from MODIS and OMI UV_aerosol index (at about 13:30) as well as the mean AOD, single scattering albedo and visibility values from 12:30 to 14:30 on the seven days. The day 7 is specially used for Fig. 4 because of its small OMI CRF.



Comparison of the boxAMFs, AMFs and VCDs from different procedures for OMI pixels

Aerosol: including MAX-DOAS aerosol profile; **Clear and Cloudy:** box-AMF for clear and cloudy part of the OMI pixel (no aerosols); **Total:** boxAMF using independent pixel approximation; **STD:** boxAMF provided DOMINO and BIRA datasets.

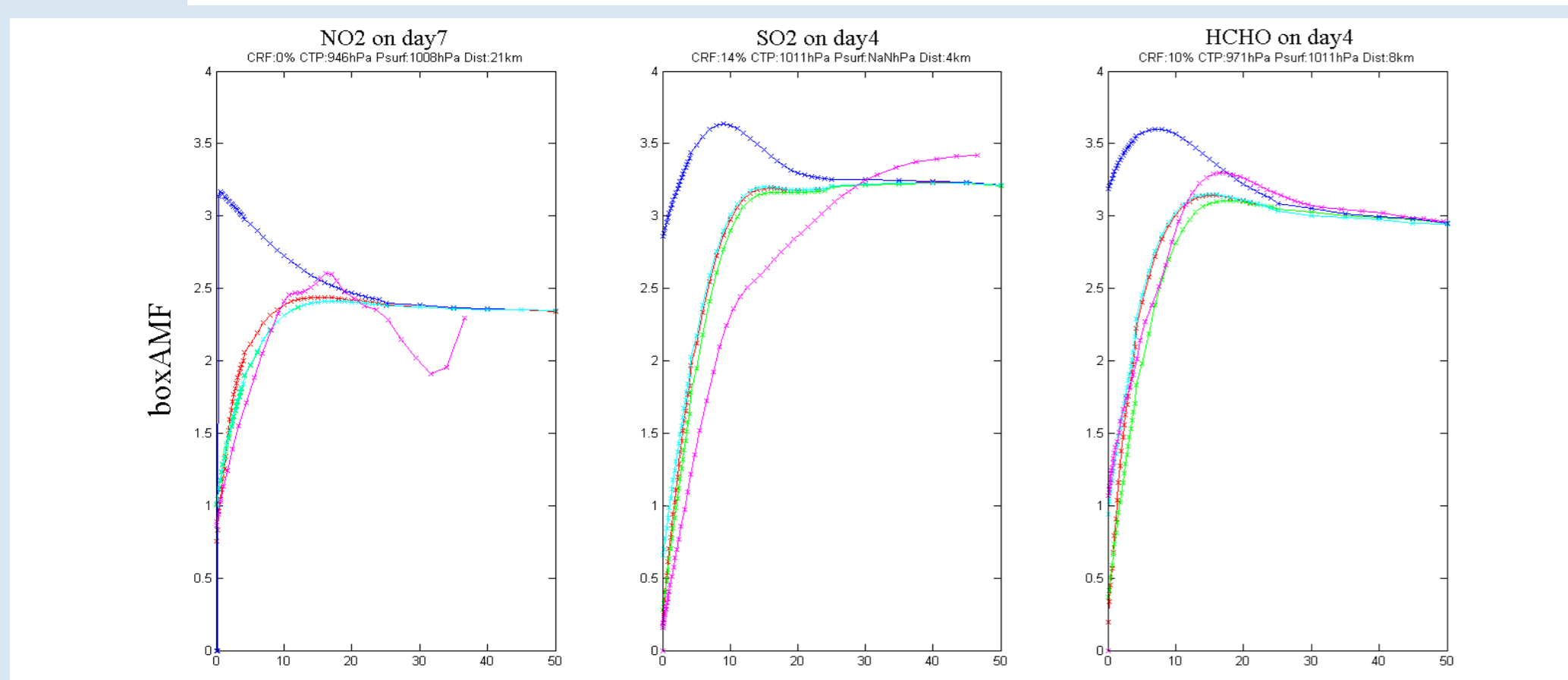
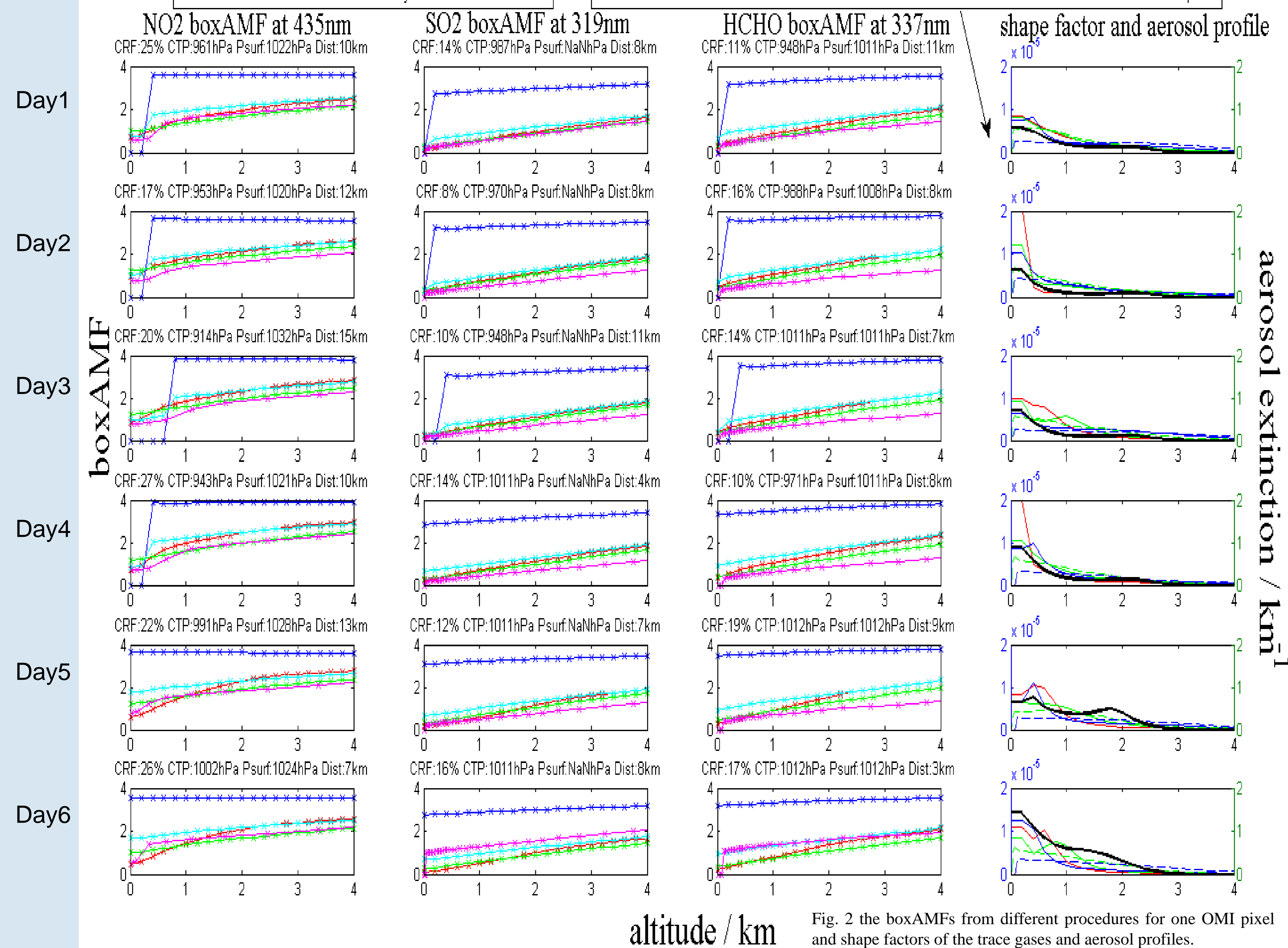


Fig. 4 Like Fig. 2 but for larger altitude range and for cases with small CRF. Currently we have no explanation for the discrepancies at altitudes above 10 km.

Aerosol, clear, total and STD AMFs are from the corresponding boxAMFs and MAX-DOAS shapefactors. **Aerosol, clear, total, STD and dataset VCDs** are from the corresponding AMFs and satellite SCD. **Dataset and dataset clear** indicate the values from **DOMINO and BIRA datasets**. MAX-DOAS VCDs are from the MAX-DOAS profiles.

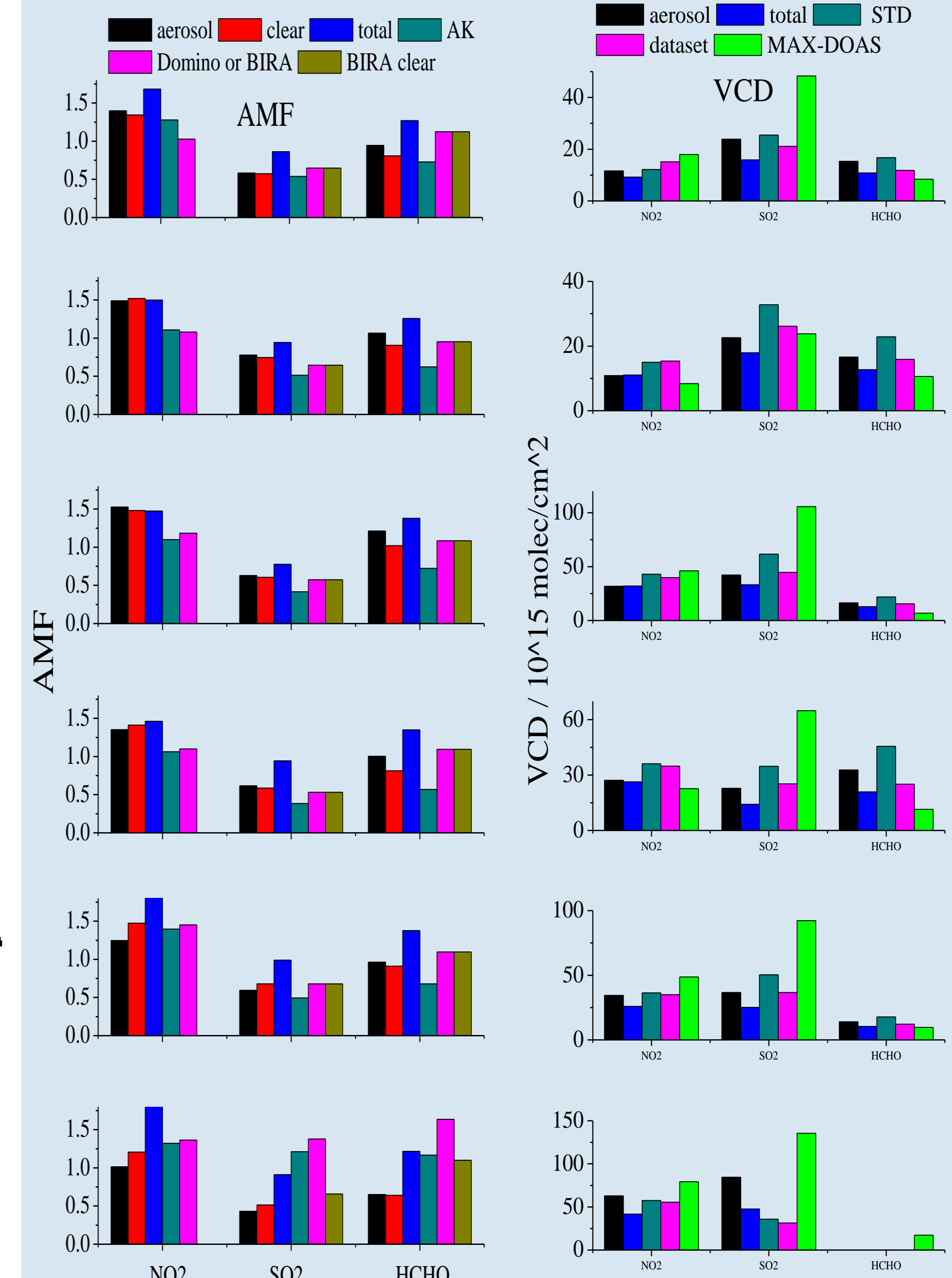


Fig. 3 the AMFs and VCDs from different procedures for one OMI pixel.

Aerosol effect
boxAMF:
1. decrease below 1km, increase above 1km;
2. strength of effect depends on wavelength (stronger for NO₂)
3. decrease for altitudes above cloud top height
AMF:
Differences between AMF_aerosol and AMF_clear are from 6 to -13% for NO₂, -18 to 14% for SO₂ and 0 to 35% for HCHO. Generally the AMF_total is much larger than AMF_aerosol up to 100%.

Shape factor effect:
The vertical distributions of SO₂ and HCHO from MAXDOAS are closer to the surface than those from the chemistry transport model. AMF including the MAX-DOAS shape factors are in general smaller than from the official datasets by 25% for SO₂ and 35% for HCHO and by -5% to 25% for NO₂
Effect on VCD:
Assuming the VCD_aerosol is most correct, the difference between OMI and MAX-DOAS VCD ranges from -40% to 28% for NO₂, from -70% to -8% for SO₂ and 40% to 200% for HCHO.