

ID: RS-OMIE-KNMI-210
 Title: Required Signal-to-noise levels for OMI for DOAS products
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 Version: 1 of 28 November 2000
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Required Signal-to-Noise levels for OMI DOAS products

Abstract

The required signal-to-noise (S/N) levels for OMI DOAS products are determined.

1. Method

The method to estimate the required S/N for DOAS products is described in R1. As shown in R1, there is a relation between the S/N ratio and the error in the slant column density:

$$S / N = [\Delta SCD]^{-1} [stdev(\mathbf{s}_x)\sqrt{N}]^{-1} \quad (1)$$

where ΔSCD is the error in the slant column density

$[stdev(\mathbf{s}_x)\sqrt{N}]$ is a factor that is determined by the differential absorption cross section of the species x and the number of wavelengths used in the DOAS fit. The values for $[stdev(\mathbf{s}_x)\sqrt{N}]$ for ozone, NO₂, BrO, SO₂, OCIO and HCHO for OMI are given in Table 1.

Using equation 1 the required S/N are determined by using the errors in the SCD as input.

Table 1. $[stdev(\mathbf{s}_x)\sqrt{N}]$ for ozone, NO₂, BrO and SO₂, OCIO and HCHO

	Fit window [nm]	$[stdev(\mathbf{s}_x)\sqrt{N}]^{-1}$ [DU]
Ozone	325 - 335	2100 *
NO ₂	425 - 450	43 *
BrO	345 - 360	1.8 *
SO ₂	314 - 327	320 *
OCIO	355 - 385	1.1
HCHO	335 - 360	240

* From R1

2. Results

In R2 requirements are given for the accuracy of OMI data products. These requirements are for the vertical column densities. In Table 2 the minimum error for vertical column densities are given, and the pixel size for which they are valid. To use these numbers, they are translated to errors in the slant column by multiplying them with an airmass factor of 2, representing the case when OMI is looking at nadir and the solar zenith angle is 0 degrees. The resulting error in the slant column is also given in Table 2.

The required S/N is calculated using equation 1 using the information provided in Tables 1 and 2. The resulting S/N values are given in the third column of Table 3. Note that these values are for the pixel size given in Table 2. Also given in Table 3 are the required S/N for a pixel of 13 × 24 km² (OMI global mode) and for 13 × 12 km² (OMI zoom-in mode).

Table 2. Minimum values for the vertical column densities for the given pixel size. Also given are the errors in the slant column densities assuming an air mass factor of 2.

	Pixel Size [km ²]	Δ VCD [molec/cm ²]	Δ VCD [DU]	Δ SCD [DU]
Ozone	20 × 20		4	8
NO ₂	40 × 40	1·10 ¹⁴	3.7·10 ⁻³	7.4·10 ⁻³
BrO	40 × 40	1·10 ¹³	3.7·10 ⁻⁴	7.4·10 ⁻⁴
SO ₂	40 × 40		0.4	0.8
OCIO	40 × 40	1·10 ¹³	3.7·10 ⁻⁴	7.4·10 ⁻⁴
HCHO	40 × 40	1·10 ¹⁵	3.7·10 ⁻²	7.4·10 ⁻²

Table 3. Required S/N for the SCD errors listed in Table 2. The third column is the S/N for the pixel size given in Table 2, the fourth column is for OMI global mode pixel (13 × 24 km²) and the last column for OMI zoom-in pixels (13 × 12 km²).

	Fit window [nm]	S/N	S/N Global	S/N Zoom-in
Ozone	325 - 335	263	232	164
NO ₂	425 - 450	5805	2563	1813
BrO	345 - 360	2430	1073	759
SO ₂	314 - 327	400	177	125
OCIO	355 - 385	1485	656	464
HCHO	335 - 360	3240	1431	1012

3. Conclusions

The required S/N values for DOAS products of ozone, NO₂, BrO, SO₂, OCIO and HCHO for OMI are determined. The S/N for OMI global mode and zoom-in mode pixels is given in Table 3. Note that these required S/N values are only given for the DOAS products. For other products, additional S/N requirements are needed.

4. References

- R1. Van Oss, R.F., Relation between signal-to-noise of Earth radiance measurements on DOAS column error, 20 October 1999.
- R2. Science Requirements Document for OMI-EOS version 2 draft, RS-OMIE-000-KNMI-001, 22 August 2000