CENTRE NATIONAL D'ÉTUDES SPATIALES	*IASI FM2 on METOP A Commissioning* *IASI L1 Cal/Val Team Report* *Activity : Cal/Val Phase A* *Assessment of the Ice Contamination Rate*		IASI
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Contents

1 OBJECTIVE

This document describes the surveillance of the radiometric calibration coefficients of IASI, which permits to assess the impact of the ice contamination over time. It corresponds to task A7.3 of the "IASI L1 Cal/Val Plan" (IA-PL-0000-2597-CNE).

2 METHODS

The method consists in analysing the temporal evolution of the radiometric calibration coefficients, as described in the document "IASI PFM Optical Vacuum Test Results – Analysis of the Contamination Rate" (IA-TN-1000-2670-CNE, section 2.1).

The ratio between the radiometric calibration coefficient slopes at a reference date and at a later date is computed for several dates and the evolution is analysed.

$$\frac{RadioCalCoeffSlope(t_{ref})}{RadioCalCoeffSlope(t)} = \frac{S_{BB}(t) - S_{CS}(t)}{S_{BB}(t_{ref}) - S_{CS}(t_{ref})} \frac{Planck(T_{BB}(t_{ref}))}{Planck(T_{BB}(t))}$$

3 SUCCESS CRITERIA

Contamination rates in accordance with (below) the ones observed in the optical vacuum tests.

4 PRODUCTS USED

First series (2006/11/29-2006/12/12):

[P0] IASI_xxx_00_M02_20061129141800Z_20061129160000Z_N_O_20061129155432Z (581)

[P1] IASI_xxx_00_M02_20061203143600Z_20061203161500Z_N_O_20061203161311Z (621)

[P2] IASI_xxx_00_M02_20061205153600Z_20061205171500Z_N_O_20061205171301Z (667)

[P3] IASI_xxx_00_M02_20061212080900Z_20061212094800Z_N_O_20061212094634Z (762)

Second series (2006/12/20-2007/01/03):

[P4] IASI_xxx_00_M02_20061220152400Z_20061220170600Z_N_O_20061220165929Z (880)

[P5] IIASI_xxx_00_M02_20061224035400Z_20061224053600Z_N_O_20061224053226Z (930)

[P6] IASI_xxx_00_M02_20061227162100Z_20061227180000Z_N_O_20061227175625Z (980)

[P7] IASI_xxx_00_M02_20061231045100Z_20061231063300Z_N_O_20061231062923Z (1030)

[P8] IASI_xxx_00_M02_20070103171500Z_20070103185700Z_N_O_20070103185104Z (1080)

5 RESULTS

In this study we limit ourselves to pixel number 1 and CDD 0. For each of the L0 products cited above, the calibration coefficient slopes (real and imaginary parts) were first averaged over the entire product (approximately one orbit). The ratios between the magnitudes of the averaged calibration coefficient slopes at the reference date and at each of the later dates in the series were then computed.

The obtained ratios are a little bit noisy (at the scale of the accuracy of the observations: a few tenths of %), as can be observed in Figures 5 and 6 given in the Appendix. Further smoothing was therefore performed by averaging 27 consecutive spectral samples (sliding window). The smoothed ratios are shown in Figures 7 and 8 in the Appendix. Due to slight variations in the temperature of the sensor, there is a certain bias that need to be compensated.

Figures 1 and 2 show the smoothed ratios of radiometric calibration coefficient slopes for the two time periods after approximate debiasing[1]. We see that the debiased ratios are generally very close to the theoretical curves (dotted lines)[2], except for the last date of the first series, where the differences are significant[3], and more generally for the upper half of the B3 band, probably due to instrument noise.

In Figure 3 the evolution of the smoothed and debiased ratios at 850 cm^{-1} are displayed for the two time periods. For the period 2006/11/29 – 2006/12/12 the decrease is about 0.13% per day, whereas it is about 0.11% per day for the period 2006/12/20 – 2007/01/03. Hence it can be assumed that transmission will decrease by less than 0.11% per day onwards. For comparison, the loss of transmission measured in the optical vacuum test was about 0.25 % per day (D. Blumstein, "IASI FM2 Optical Vacuum Test ─ Preliminary Results", ISSWG 20, Exeter, UK, 26-28 October 2004).

Figure 4 shows the instrument noise measured on 2006/12/04 and the estimated noise corresponding to a 20% loss in transmission where the water ice absorption is maximum (around 850 cm^{-1}). We consider this as the maximum loss that can be accepted with respect to the specification (which is also displayed on the graph).

1 The ice thickness (principal parameter) was first tuned in order to fit the theoretical curve as closely as possible to the overall shape of the measured ratios for each of the dates (considering in particular B1). Then the mean value of the measured ratios (for each band and date) were adjusted to fit approximately to the theoretical behavior.

2 The theoretical curves that we use as reference are computed from a model of the absorption coefficient of water ice as a function of the wave number, cf. "IASI PFM Optical Vacuum Test Results – Analysis of the Contamination Rate" (IA-TN-1000-2670-CNE).

3 The fact that this date is further away from the preceding decontamination than the other dates may explain the deviation.

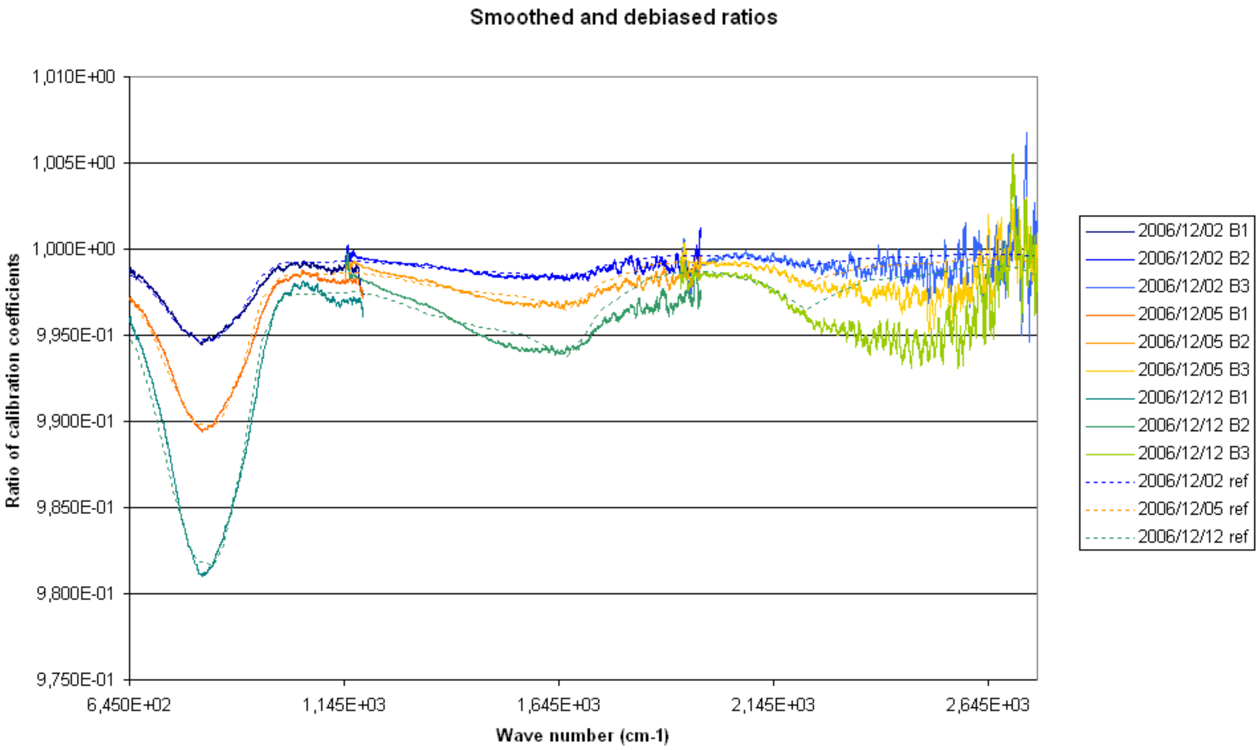

Figure 1: Smoothed ratio of radiometric calibration coefficient slopes for the period from 2006/11/29 (reference date) to 2006/12/12, after debiasing with respect to theoretical curves based on a model of the absorption coefficient of water ice (dotted lines).

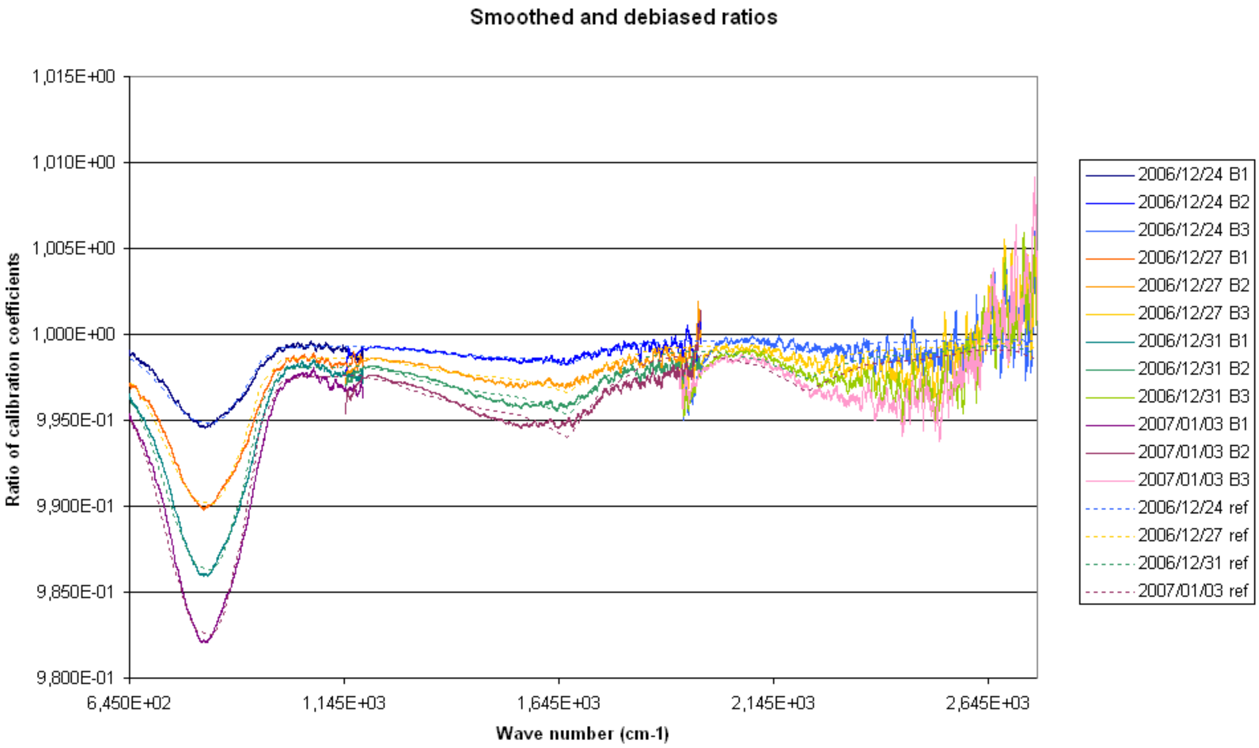

Figure 2: Smoothed ratio of radiometric calibration coefficient slopes for the period from 2006/12/20 (reference date) to 2007/01/03, after debiasing with respect to theoretical curves based on a model of the absorption coefficient of water ice (dotted lines).

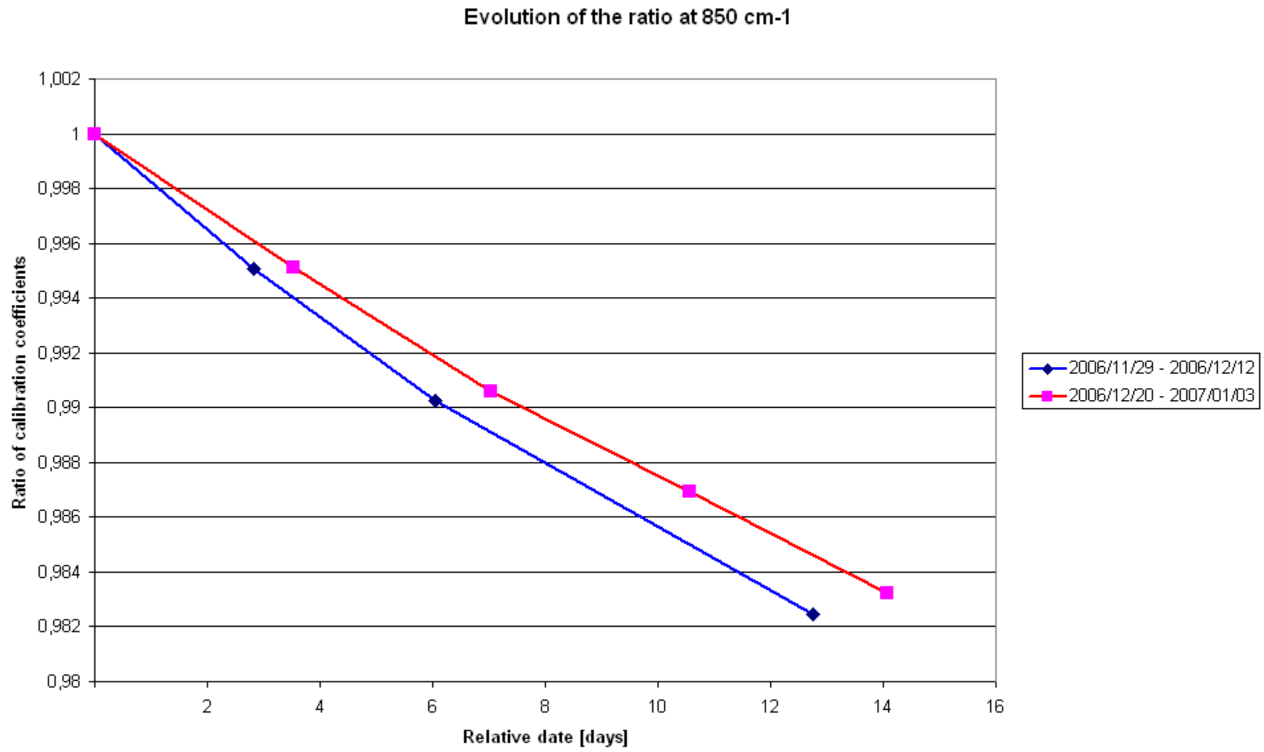

Figure 3: Evolution of the smoothed and debiased ratio of radiometric calibration coefficient slopes for the periods 2006/11/29 – 2006/12/12 and 2006/12/20 – 2007/01/03, respectively.

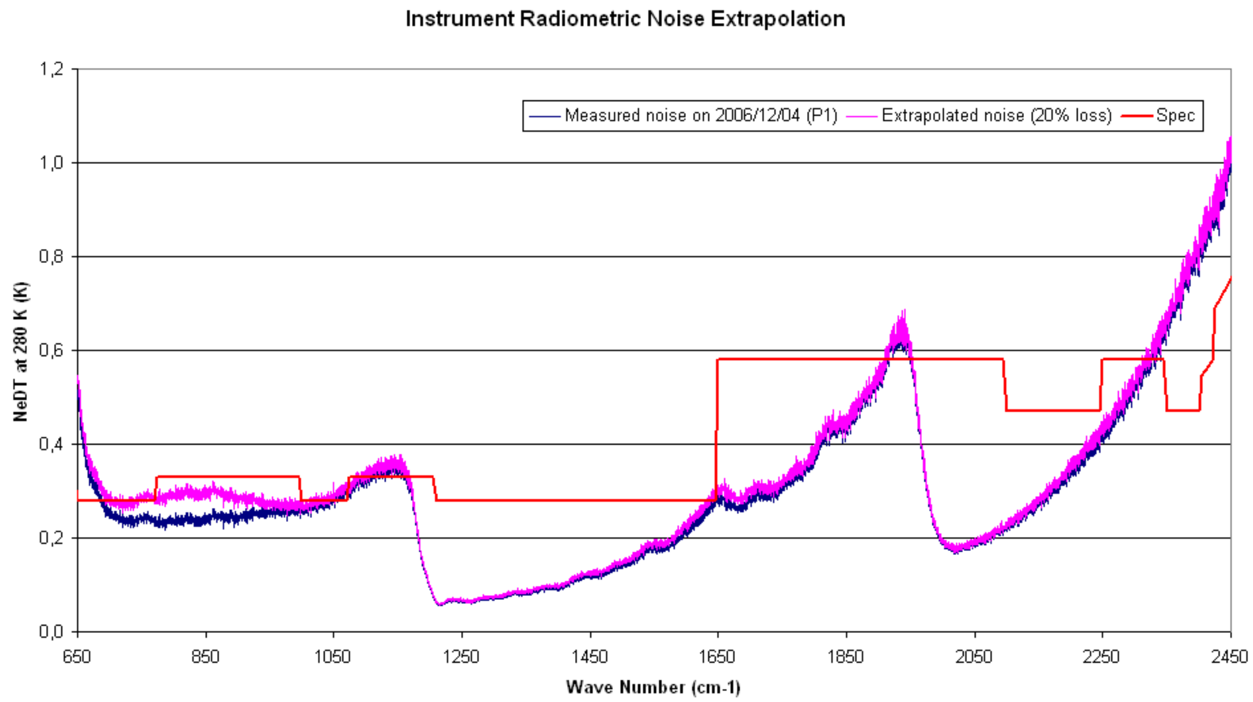

Figure 4: Measured radiometric noise and predicted noise for a 20% loss of transmission at 850 cm^{-1}.

6 CONCLUSION

The loss of instrument gain due to ice contamination is, as expected, decreasing over time. In the last period considered in this study (2006/12/20 – 2007/01/03), it decreases by about 0.11% per day.

Based on measured radiometric instrument noise curves[4], we propose to consider as acceptable a loss of transmission of 20% at the maximum of the water ice absorption (around 850 cm^{-1}).

Based on these figures, it is very likely that no decontamination will be necessary before 180 days after the preceding one. If the contamination rate continues to decrease, as for the two periods that we have monitored (about two weeks each), the number of days between decontaminations could be further increased. This delay will be reassessed even more accurately in one or two months time.

4 Radiometric instrument noise curves were last measured on 2006/12/04 and need to reassessed using an External Calibration Mode sequence as soon as possible.

7 APPENDIX

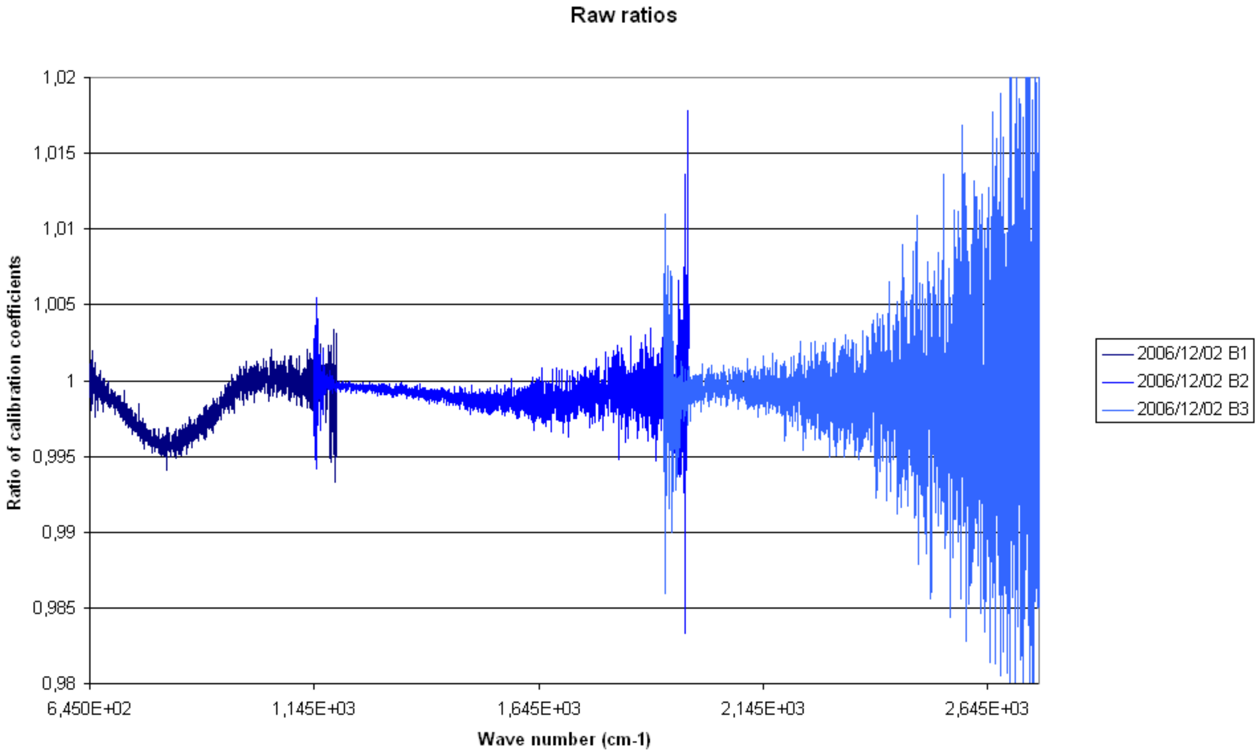

Figure 5: Example of ratio of radiometric calibration coefficient slopes for the first series (2006/12/03 vs 2006/11/29).

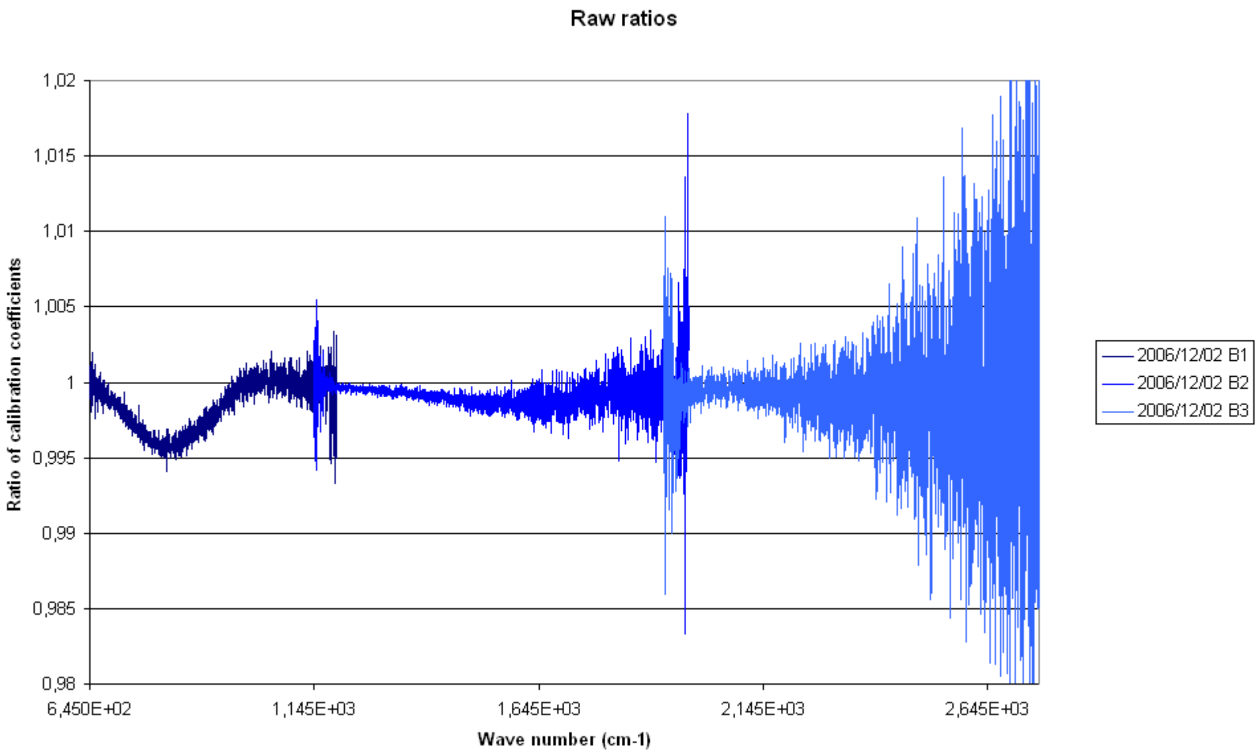

Figure 6: Example of ratio of radiometric calibration coefficient slopes for the second series (2006/12/24 vs 2006/12/20).

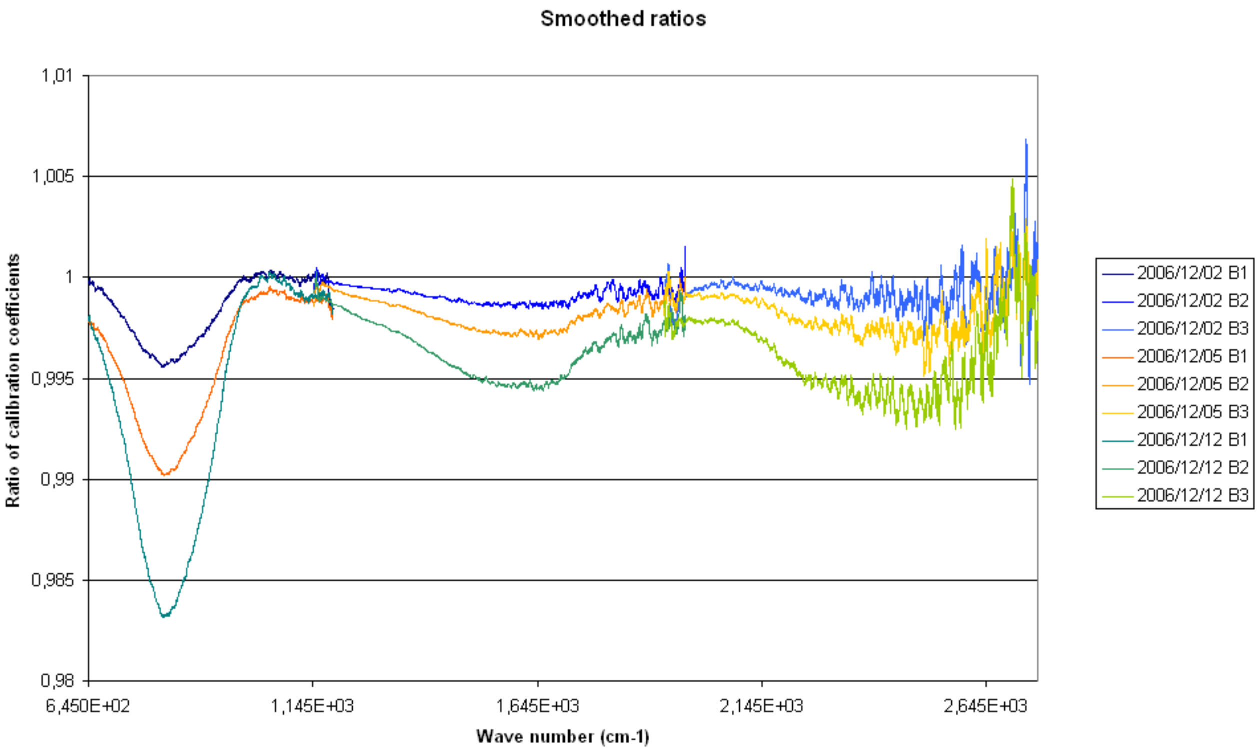

Figure 7: Smoothed ratio of radiometric calibration coefficient slopes for the period from 2006/11/29 (reference date) to 2006/12/12.

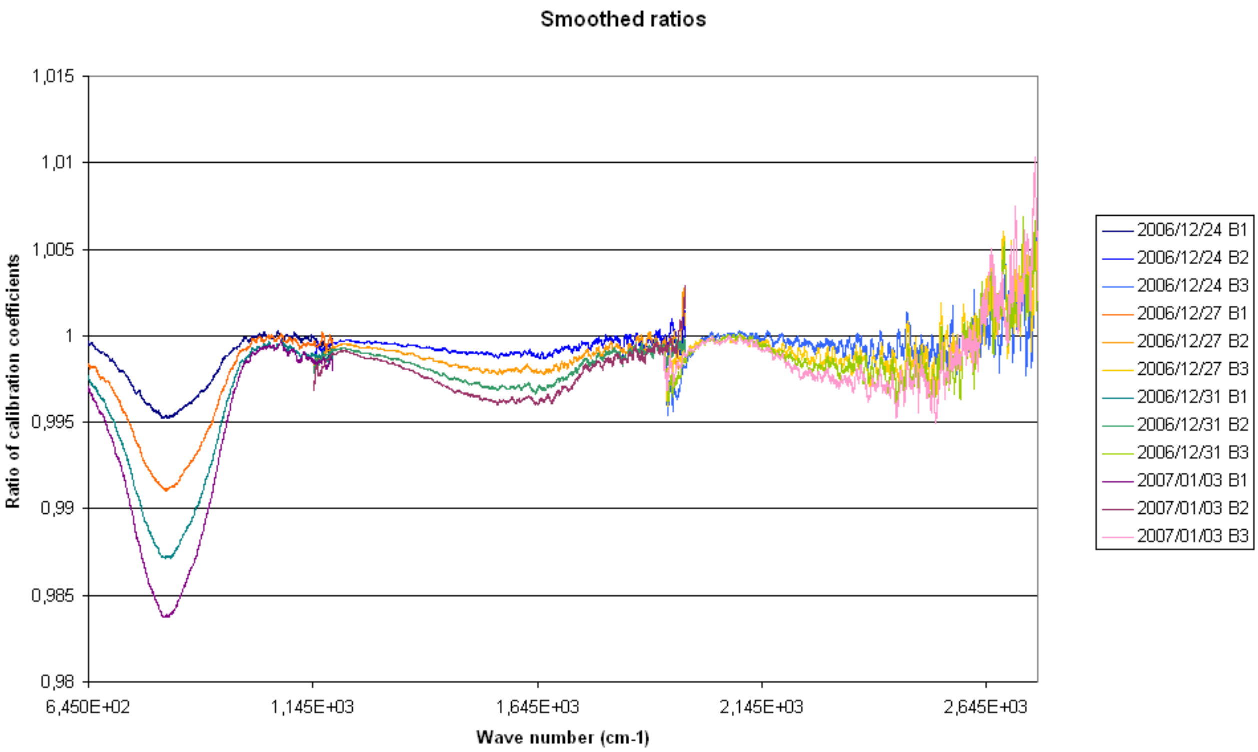

Figure 8: Smoothed ratio of radiometric calibration coefficient slopes for the period from 2006/12/20 (reference date) to 2007/01/03.