<table>
<tr><td></td><td>Centre National d'Etudes Spatiales</td><td></td></tr>
<tr><td>SCA _RAD_05
TRO-34-NT-2784-CNES
Ed2</td><td>Activity : CAL/VAL
AP factor</td><td>Prepared by : A Rosak
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Contents

1. OBJECTIVE

The two main channels are channel 2 (solar channel, 0.2-4µm) and channel 3 (total channel, 0.2-200µm). Channel 2 is dedicated to measure solar radiance (L_{sw}). Channel 3 measures total radiance (L_{tot}), ie solar radiance and long wave radiance. With channel 2 and channel 3, a synthetic channel 5 can be generated for long wave radiance. This radiance (L_{lw}) is computed by the difference between total channel and solar channel: $L_{lw} = L_{tot} – A' L_{sw}$

A' represents the difference of sensibility in the SW domain, between channel 2 and channel 3. It can be measured with channel 2 and channel 3 looking both at a purely short wave scene. This type of scene does not exist. So the MS mode has been implanted in Scarab. In this mode, the filter wheel is activated to place identical solar filters on channel 2 and 3. So the two channels will receive only short wave radiation, coming exactly from the same geophysical scene. By comparison of the response of each channel, we can easily compute the A' factor. This is not purely the A' factor, as we have to remove the contribution of the solar filter in front of channel 3.

2. METHODS

2.1. MS MODE

$N_{2\_sw}(i,l)$ is the numerical count measured by channel 2 with MS mode, for pixel i, scan l.

$N_{3\_sw}(i,l)$ is the numerical count by channel 3 with MS mode, for pixel i, scan l.

$N_{2\_sw}(i,l)$ and $N_{3\_sw}(i,l)$ are both corrected from thermal leak, and from thermal gain variation.

A_{ms} is the quantity that minimize the term $\sum_{i,j}\left[N_{3\_sw}(i,l) - A_{MS}N_{2\_sw}(i,l)\right]^2$ for the image.

Then A' can be calculated with:

$A' = A_{ms} * G_{2\_sw} / G_3 / T_{filter}$

Two cases are considered:

A subset of the image for cold bright clouds ($L_{2\_sw} > 200$ W/m²/sr and $L^4_{ir} < 10$ W/m²/sr).

A subset of this image without dark pixels ($L_{2\_sw} > 15$ W/m²/sr).

2.2. MT MODE

This can be done also in MT mode (no filter), on night scenes or day scenes. For night scenes, in fact, it is equivalent to calculate this A' factor, or to calculate the ration G_{2_lw} / G_{3_lw} from the CALM sequence corresponding (no filter, detector in front of black bodies). So no MT mode by night is made. The gain ratio is used instead. $A_{MT\_night} = G_{2\_lw} / G_{3\_lw}$.

In all case, this value is not used in treatment, but it helps to follow the relative stability of the channels 2&3 in the LW domain.

A_{ms}, A_{MT_day} and A_{MT_night} should be stable. If one of them is not stable, it indicates:

- changes in the LW part of the channels 2/3 for A_{MT_night}. This can be seen of course on gain calibration
- changes in the SW part of the channels 2/3 for A_{MT_day} and A_{ms}
- changes in the filter part if A_{MT_day} is stable and A_{MS} is not stable.

2.3. NOMINAL MODE

It is possible to evaluate the A' factor with bright and cold clouds.

The idea is to select area where the short wave luminance is very high (L_{sw}> 250 W/m²/sr), and where the long wave luminance is very low (L_{ir} of Channel 4 < 5W/m²/sr).

When the Channel 4 is about 5 W/m²/sr, the long wave radiance of Channel 3 is about 50W/m²/sr. As the Chanel 2 is about 250W/m²/sr, we can't neglect the long wave part of the radiance in Channel 3, as it represents 20% of the radiance, even on these bright and cold areas.

By using the Channel 4, it is possible to give an estimation of the long wave radiance in the Channel 3. A polynomial P, established on night area, gives the link between Channel 4 and Channel 3.

$$L_{lw\_estimated} = P(L_{4\_ir\_window}).$$

In this condition, it is possible to estimate the A' factor :

$$A' = \frac{L_{3\_total} - L_{lw\_estimated}}{L_{2\_sw}}$$

3. SUCCESS CRITERIA

An evolution of 0.1% for A', A_{MS} or A_{MT} must be carefully instructed.

4. PRODUCTS USED

All MS/MT mode done before november 2012.

All CALM mode done before november 2012 for A_{MT_night}.

5. RESULTS FOR A'

5.1. MS MODE

Here is the A'_{ms} factor measured with the MS mode. The first point is the on-ground calibration in front of the integrating sphere.

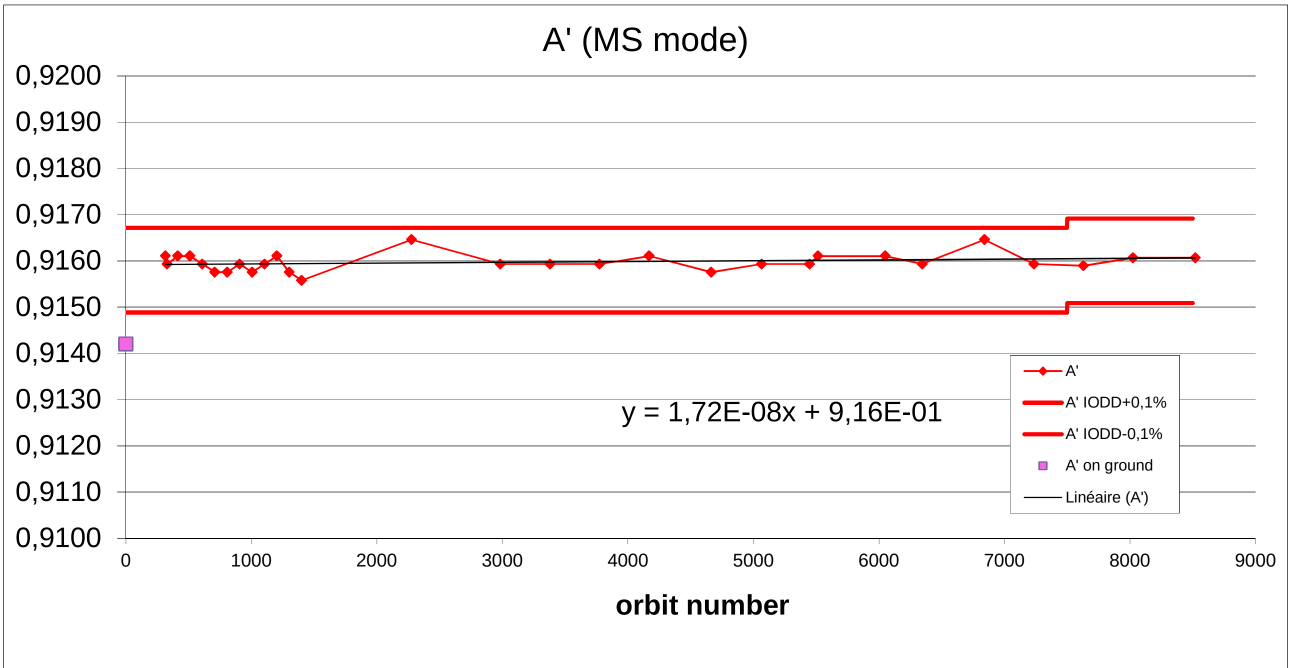


Figure 116. A' factor derived from MS measurements versus the date

The difference between the in orbit value and the sphere value is less than 0.2%. The stability of the A'_{ms} factor is about +/-0.05% for this first year.

The long term drift, calculated by linear regression, is very good. The value is roughly of 0.02% after one year and a half of life.

The A' factor is slightly adjusted by +0.02% after orbit 7500.

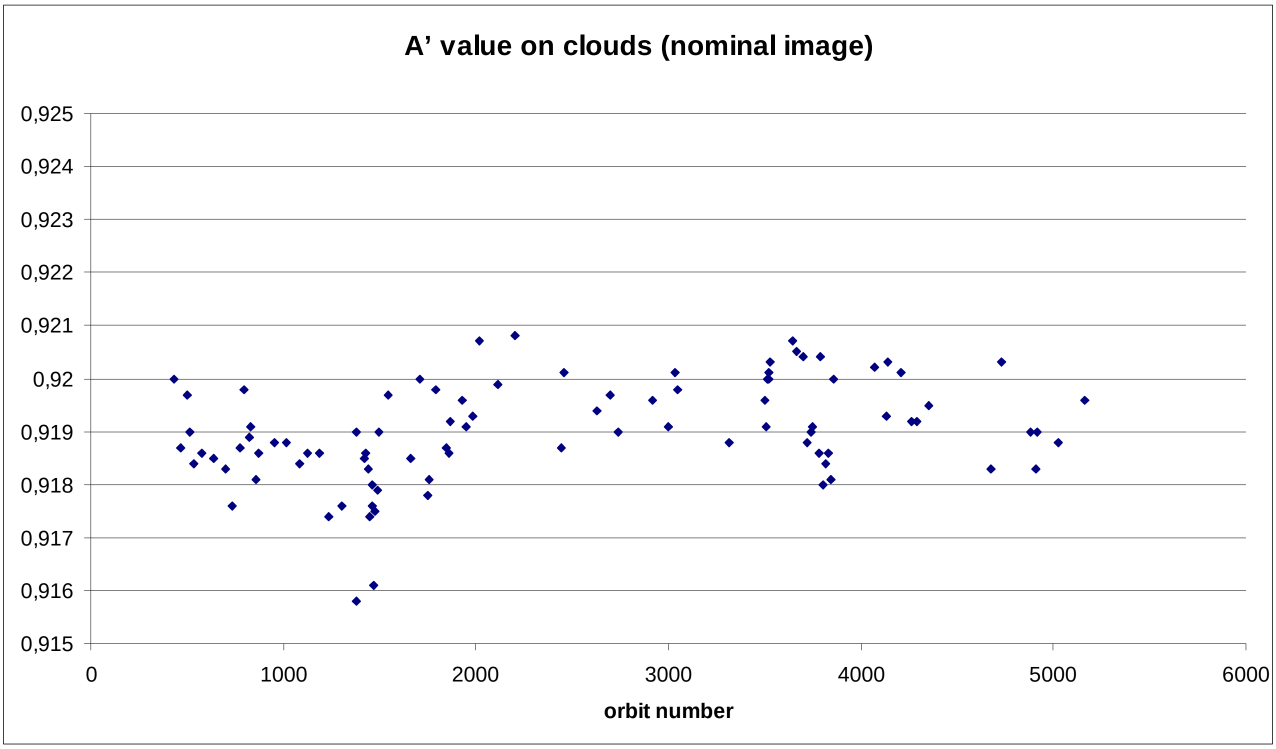
The mean value for Ams cold is 0.9595.

The mean value for Ams is 0.9592.

The difference between these 2 values is due to small spectral difference between Channel 2 and Channel 3. This difference is very small : 0.03%

5.2. NOMINAL MODE

Orbits with large clouds are selected to estimate the A' factor.



5.3. ANALYSIS

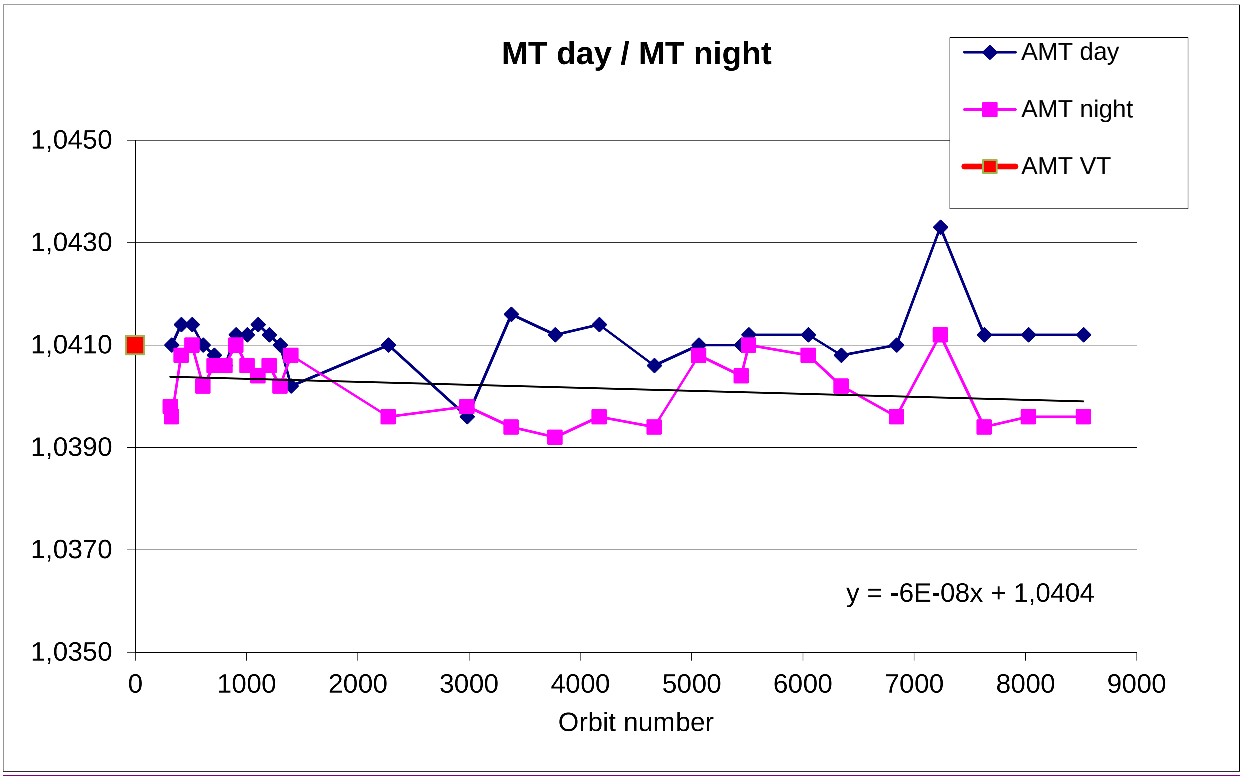
For the first 3 months (on MS calibration each week), the results are sum up in this table.

A' from MS mode	0.9159
A' nominal image (cold pixel)	0.9184
Bias between «A' for cold pixel» and «A'»	0.0004
A' nominal for all pixels	0.9180

The difference between the two values is about 0.2%.

6. RESULT FOR MT MODE

Here is the A'_{MT} factor measured with the MT mode. The first point is the on-ground calibration in front of the reference black bodies during vacuum tests.



Here is the mean of each value for the first 3 months, and the last three months.

	A_{MT} ground	A_{MT_night}	A_{MT_day}
First 3 months	1.0410	1.0405	1.0410
Last 3 months		1.0395	1.0412
Evolution		0.1%	0.02%

The coherence between A_{MT} ground and A_{MT_night} is very good (0.05%).

The stability is better than the criteria of 0.1% for MT day. MT day is another way to check the stability of the A' factor (without filter).

For MT night, the value is less accurate, as it is computed only with 50 scans (MT day is computed with 400 scans). But the value is still very low. If we compute the long term drift on MT night with a linear regression, the evolution is about 0.05%.