

Conversion from radiances to reflectances for SEVIRI warm channels

Doc.No. : EUM/MET/TEN/12/0332
Issue : v4
Date : 25 October 2012
WBS :

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Document Change Record

<i>Issue / Revision</i>	<i>Date</i>	<i>DCN. No</i>	<i>Summary of Changes</i>
v1	26/06/2012		Initial version
v2	02/07/2012		Added references on the solar irradiance spectrum
v3	18/10/2012		Added coefficients for MSG4

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1 INTRODUCTION

1.1 Purpose

The present document describes the conversion from radiance to reflectance for the SEVIRI reflective bands (VIS06, VIS08, NIR16 and HRV). The set of band solar irradiance values to be used to perform this conversion are provided for SEVIRI on-board MSG1, MSG2, MSG3 and MSG4.

1.2 Scope

The parameters given in the present report are based on calculation as done in the SEVIRI Solar Channel Calibration system (SSCC) [RD-1]. This system performs the vicarious calibration of the SEVIRI reflective bands. The band solar irradiance is estimated through the convolution of the original sensor spectral response functions [RD-2] with the solar irradiance spectrum. The solar irradiance spectrum implemented in SSCC is a re-sampled version of the original Kurucz spectrum [RD-3][RD-4] as in MODTRAN version 3 for instance. In SSCC, only the spectral interval ranging from 250 nm up to 4 μm is considered. The re-sampling was performed with a constant discretization step of 2.5 nm.

1.3 Applicable Documents

1.4 Reference Documents

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|------|--|-------------------------------------|
| RD-1 | <i>Y. Govaerts, M. Clerici. "MSG-1/SEVIRI Solar Channels Calibration. Commissioning Activity Report.". Technical report, EUMETSAT, 2004.</i> | <i>EUM/MSG/TEN/04/0024</i> |
| RD-2 | <i>MSG SEVIRI Spectral Response Characterisation (#1)</i> | <i>EUM/MSG/TEN/06/0010, Issue 2</i> |
| RD-3 | <i>Kurucz R., Furenhild I., Brault J., and Testermann L., Solar flux atlas from 296 to 1300 nm, national solar observatory atlas no. 1, National Solar Observatory, Sunspot, NM, USA
(www url: ftp://ftp.noao.edu/fts/fluxat/; update: http://cfaku5.cfa.harvard.edu/sun/irradiance2005/), June 1984.</i> | |
| RD-4 | <i>Kurucz, R., Bell, B. Smithsonian Astrophys. Obs., CD rom # 23, 1995.</i> | |

Notes:

#1. Accessible from the EUMETSAT website (<http://www.eumetsat.int/Home/Main/DataProducts/Calibration/MSGCalibration/index.htm?l=en>)

1.5 Document Structure

Section 1 General information (this section)

Section 2 Description of the conversion from radiance to reflectance for the SEVIRI reflective bands. Parameters needed to perform this conversion are also provided for the various MSG imagers.

2 CONVERSION FROM RADIANCE TO REFLECTANCE

The Bidirectional Reflectance Factor (BRF) for the SEVIRI warm channels can be calculated as follows:

$$r_{\lambda_i} = \frac{\pi \cdot R_{\lambda_i} \cdot d^2(t)}{I_{\lambda_i} \cdot \cos(\theta(t, x))}$$

Where

- i is the channel number (1 = VIS06, 2 = VIS08, 3 = NIR16, 4 = HRV)
- r_{λ_i} is the Bidirectional Reflectance Factor (BRF) for the channel λ_i
- R_{λ_i} is the measured radiance in $\text{mW} \cdot \text{m}^{-2} \cdot \text{sr}^{-1} \cdot (\text{cm}^{-1})^{-1}$
- $d(t)$ is the Sun-Earth distance in AU at time t
- I_{λ_i} is the band solar irradiance for the channel λ_i at 1 AU in $\text{mW} \cdot \text{m}^{-2} \cdot (\text{cm}^{-1})^{-1}$
- $\theta(t, x)$ is the Solar Zenith Angle in Radians at time t and location x

Table 1 provides the band solar irradiance to be used for converting radiances into BRFs for the various SEVIRI instruments. For MSG1/SEVIRI, the irradiance value for both the truncated and the extended HRV spectral response function (SRF) is provided. For MSG2, MSG3 and MSG4 only the values for the extended SRF are given.

Band solar irradiance values for the truncated HRV spectral response function can be provided for MSG2 and MSG4 on request.

Table 1: Band Solar Irradiance (I_{λ_i}) at 1 AU (expressed in $\text{mW} \cdot \text{m}^{-2} \cdot (\text{cm}^{-1})^{-1}$)

Channel	MSG-1	MSG-2	MSG-3	MSG-4
VIS 0.6	65.2296	65.2065	65.5148	65.2656
VIS 0.8	73.0127	73.1869	73.1807	73.1692
NIR 1.6	62.3715	61.9923	62.0208	61.9416
HRV	78.8952 (#1) 78.7599 (#2)	79.0113	78.9416	79.0035

Notes:

#1: The MSG-1 irradiance is based on the non-extended measurements of HRV spectral response.

#2: The MSG-1 irradiance is based on the extended measurements of HRV spectral response (recommended for use as it is the one used for deriving the calibration coefficients as stored in the Level 1.5 image headers).