SEVIRI CALIBRATION

BY JOHANNES SCHMETZ, PAOLO PILI, STEPHEN TJEMKES, DIETER JUST, JOCHEN KERKMANN,
SERGIO ROTA, AND ALAIN RATIER

The thermal IR channels of SEVIRI are calibrated with an onboard blackbody (Pili 2000). The relationship between digital counts and the observed radiance is assumed to be linear:

$$C(L) = g\,R(\lambda,\ T) + C_0, \qquad \text{(S1)}$$

where $C(L)$ is the digital count output from SEVIRI, $R(\lambda,\ T)$ the measured radiance, λ is the wavelength (in practice a spectral interval), T is the effective blackbody temperature of an observed scene, g is the gain (the inverse is the calibration coefficient), and C_0 is the offset. The assumption of a linear relationship between counts and radiance is valid since small detector nonlinearities are corrected using coefficients measured before launch. Small differences in the sensitivity of the three detectors (nine detectors for the high-resolution VIS) are corrected through an equalization procedure, that is, a normalization, in a manner similar to the current GOES satellites (Menzel and Purdom 1994). The count values corrected in such a way form the level-1.5 image data to which the linear calibration can be applied.

SEVIRI uses the deep space as a cold source and an internal blackbody as a warm source for the calibration. While the deep space view is obtained by viewing through the complete optical path of the instrument, the blackbody is moved into the optical path avoiding the front optics. This design necessitates a correction to be applied to the blackbody calibration considering the optical properties of the front optics, whose characteristics have been measured before launch and whose temperature is monitored continuously. The blackbody can also be heated to allow for the determination of the correction factor. Overall a calibration performance of about 1 K is expected for all thermal IR channels (Pili 2000).

The conversion from SEVIRI radiances to equivalent brightness temperatures, which are often used in the quantitative analysis of images, is performed through an analytic relationship suggested by the spectral Planck function. For each thermal IR channel the following relationship between the equivalent brightness temperature T_b and the observed radiance R is established:

$$T_b = \left(\frac{c_2\ \nu_c}{\log\left(1 + c_1\ \nu_c^3 / R\right)} - B \right) \Big/ A, \qquad \text{(S2)}$$

with R the observed radiances in mW m^{-2}sr^{-1}(cm^{-1})$^{-1}$, T_b the equivalent brightness temperature in K, ν_c a central wavenumber of the spectral channel in cm^{-1}; $c_1 = 2hc^2$, $c_2 = hc/\kappa$ where h is Planck's constant, c is the speed of light, and κ is the Boltzmann constant. The central wavenumber ν_c and the so-called band correction coefficients A and B have been determined from a nonlinear regression of a precalculated lookup table using the Planck function for the different thermal infrared SEVIRI channels. Values for the band correction coefficients A and B and central wavenumber ν_c are provided on the EUMETSAT MSG Web site (www.eumetsat.de). It is noted that for MSG calibration coefficients are provided in different units [mW m^{-2}sr^{-1} (cm^{-1})$^{-1}$] than for the current Meteosat series (W m^{-2} sr^{-1}). This change aligns the operational calibration of European meteorological satellites with the practice applied by other satellite operators [e.g., National Oceanic and Atmospheric Administration/National Environmental, Satellite, and Data Information Service (NOAA/NESDIS).

The solar channels (channels 1–3 and 12; see Table 1 in *Bull. Amer. Meteor. Soc.,* **83,** 980) do not have an onboard calibration, but have to rely on a vicarious method based on radiance observations over well-characterized targets (clear-sky desert, clear-sky ocean, and optically thick high-level clouds) and radiative transfer simulations (Govaerts et al. 2001). This new method of solar channel calibration aims at an accuracy of the about 5% after the first year of operations as the characterization of targets improves and quality control parameters will become better tuned.

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