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SOLAR CALIBRATION OF MSG SEVIRI

A “calibration reference”, based on simulated radiances over bright desert targets, has been established for the vicarious calibration of the solar channels of MSG/SEVIRI. The uncertainty characterisation of this “reference” is assessed comparing these modelled data with observations acquired by ERS2/ATSR-2, SeaStar/SeaWiFS and TERRA/MISR. These comparisons show that this “reference” agrees within 5% with observations.

1. INTRODUCTION

Meteosat Second Generation (MSG) is the new generation of European meteorological geostationary satellites operated at EUMETSAT, scheduled to be launched in August 2002. SEVIRI (Spinning Enhanced Visible and InfraRed Imager), the MSG main radiometer, will scan the earth disc at a 15 minute rate, within moderately small field-of-view sampled every 3 km at nadir. This radiometer measures the reflected solar radiation within three spectral bands centred at 0.6, 0.8 and 1.6 µm, and within a broad band similar to the VIS channel of the METEOSAT satellites (See Table 1). The calibration of these bands relies on a vicarious method [1].

	Channel Spectral Band in µm			Maximum Dynamic range	Short term radiometric error performances
	λ_{cen}	λ_{min}	λ_{max}		
1 HRV	Broadband (silicon response)			460 $Wm^{-2}sr^{-1}\mu m^{-1}$	0.93 at 4.6 W/(m² sr µm)
VIS0.6	0.635	0.56	0.71	533 $Wm^{-2}sr^{-1}\mu m^{-1}$	0.37 at 5.3 W/(m² sr µm)
VIS0.8	0.81	0.74	0.88	357 $Wm^{-2}sr^{-1}\mu m^{-1}$	0.37 at 3.6 W/(m² sr µm)
NIR1.6	1.64	1.50	1.78	75 $Wm^{-2}sr^{-1}\mu m^{-1}$	0.25 at 0.75W/(m² sr µm)

Table 1: Spectral characteristics of the solar channels of SEVIRI.

The absolute vicarious calibration of remote sensing data requires the definition of an independent “calibration reference”. Our reference relies on simulated top-of-atmosphere radiances generated in the 0.3 - 2.0 µm spectral region over bright desert targets using a data set of surface and atmospheric properties. This paper discusses the reliability of this reference. This reliability is established comparing the simulated radiances with calibrated spaceborne observations acquired by ERS2/ATSR-2, SeaStar/SeaWiFS and TERRA/MISR.

2. METHOD

2.1 Observation Acquisition

ATSR-2, SeaWiFS and MISR clear-sky observations (radiances) have been acquired over 19 different bright targets located in the Saharan and Arabian deserts in the 0.55, 0.65 and 0.85 µm spectral region. The location of these targets is shown on Figure 1. Each observation is characterised by the acquisition time, the sun and viewing geometry and finally the radiance. The study is limited to the nadir looking cameras.

2.2 Surface and atmospheric properties

Surface characteristics are represented with the Hapke model [2] that relies on the single scattering albedo, the anisotropy factor and a porosity coefficient. Atmospheric properties include the total column water vapour (ECMWF), total column ozone (TOMS) and aerosol optical depth (TOMS, AERONET) assuming “desert” aerosol type.

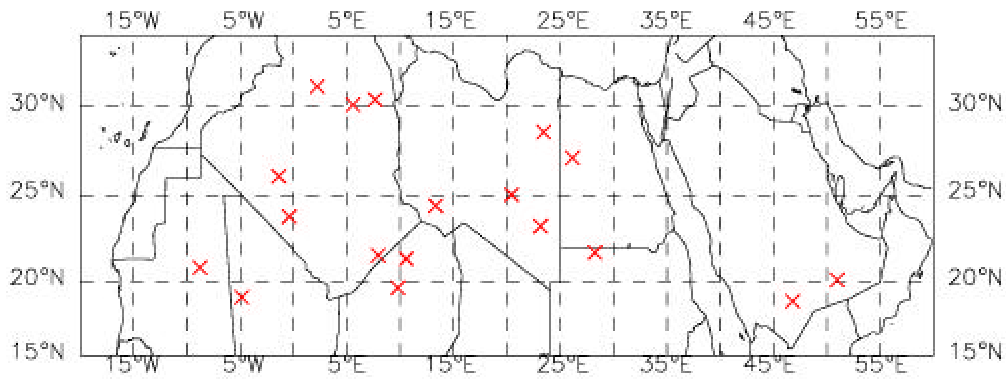

Figure 1: Location of the calibration targets over bright desert areas.

2.3 Radiance simulation

Each observation is simulated with the 6S radiative transfer model [3] accounting for the exact geometry of acquisition, the sensor spectral response and the surface and atmospheric properties.

3. RESULTS

Observations are compared with simulations. For each instrument, monthly relative differences between simulations and observations are averaged over the 19 targets. The results are shown on Figure 2.

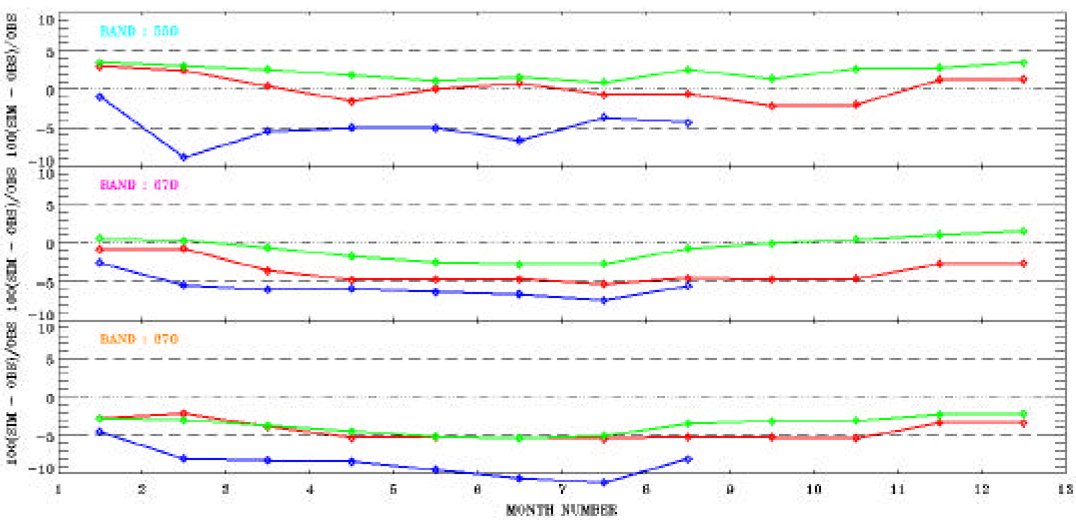

Figure 2: Seasonal trend of the monthly relative difference between simulations and observations over all targets. Comparison with ATSR-2 is shown in red, with SeaWiFS in green and MISR in blue.

4. CONCLUSIONS

Results show that the relative difference between simulations and observations do not exceed 5%, except for the MISR instrument (Table 2). The difference exhibits a small seasonal variations of about 3%. These comparisons also reveal the very similar radiometric behaviour of the ATSR-2 and SeaWiFS radiometers. With respect to these two instruments, our "reference" is accurate within 2 to 4% according to the spectral band.

	RADIOMETER		
BAND	**SeaWiFS**	**ATSR-2**	**MISR**
green	+ 2.1%	+ 0.3%	- 4.0%
red	- 1.0%	- 3.6%	- 5.7%
NIR	- 4.0%	- 4.3%	- 9.7%
Nbr. Obs.	4277	1239	147
Camera	-	Nadir	Nadir

Table 2: Averaged relative difference between simulations and observations

References

[1]. Govaerts, Y.M., Arriaga, A., and Schmetz, J. (2001) Operational vicarious calibration of the MSG/SEVIRI solar channels, Advances in Space Research, 28, 21-30.

[2]. Pinty, B., Verstraete, M.M., and Dickinson, R. (1989) A physical model for predicting bidirectional reflectances over bare soil, Remote Sensing of Environment, 27, 273-288.

[3]. Vermote, E.F., Tanré, D., Deuzé, J.L., Herman, M., and Morcrette, J.J. (1997) Second simulation of the satellite signal in the solar spectrum, 6S: An overview, IEEE Transactions on Geoscience and Remote Sensing, 35, 675-686.