



The Calibration of GEO and LEO Imager Radiances Using Hyper-Spectral Data from SCIAMACHY [494]



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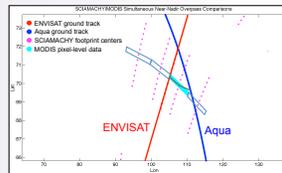
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Introduction

The calibration of the next-generation of GOES-R and JPSS VIIRS sensors will need to be vicariously validated to ensure that the cloud or aerosol retrievals are of climate quality. Envisat Scanning Imaging Absorption spectroMeter for Atmospheric CartograpHY (SCIAMACHY) hyper-spectral data have the potential to function as a transfer medium for the absolute calibration reference of the MODerate-resolution Imaging Spectroradiometer (MODIS) and geostationary satellite (GEO) imagers while being able to adjust for spectral response function (SRF) differences. Spatially and temporally matched inter-calibrations of MODIS and GEO visible radiances have been developed using a ray-matching cross-calibration technique. Ideally, this technique can be used to calibrate the next generation of GOES-R and JPSS imagers.

SCIAMACHY Direct Comparison Methodology

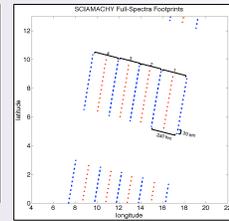
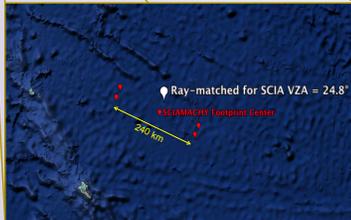
- Combined SCIAMACHY data from channels 1-6 provide continuous high-spectral-resolution radiances from 240-1750 nm
 - Spectral radiance and daily solar irradiance used to derive spectral reflectance over measured range
 - Spectra from each SCIAMACHY pixel convolved with imager SRFs to compute pseudo imager radiances for each footprint
- Simultaneous Near-Nadir Overpasses used for comparison with MODIS
 - Spectrally convolve the SCIAMACHY reflectances using MODIS Band-1 SRF
 - Compute average MODIS reflectance within the 9.68°-VZA SCIAMACHY footprint
 - Determine the relative calibration factor and stability using 48 months
- Simultaneous Angular Matching for comparison with GEO
 - Spectrally convolve the SCIAMACHY radiances using the GEO SRF
 - GEO radiances obtained using coefficients based on merged MODIS/DCC/Desert/GEO inter-calibration
 - Owing to sparse angular matching, must use 4-years of matched radiances to inter-calibrate SCIA and GEO



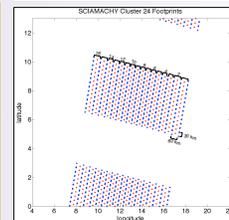
Roughly 1300 MODIS pixel-level reflectance values averaged within a SCIAMACHY footprint such that time-difference < 15 min. Local time = 11:45 am, mean AZA = 68.22°, MODIS-grid VZA = 9.78°. About 100 footprints sampled monthly from April-September for 8 years



Four ground locations corresponding to the four nominal SCIAMACHY/MET-8 angular matched 30-km x 240-km footprints



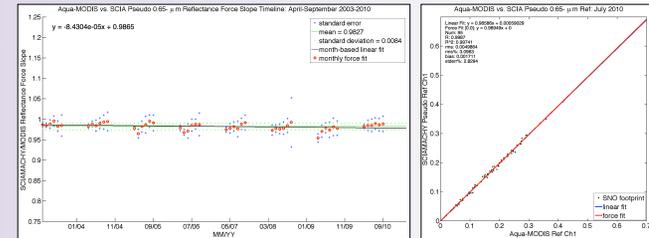
- 1-second integration of the spectral radiance yields a nominal footprint size of 30 km x 240 km at 4 viewing zenith angles (VZAs) covering the full spectrum



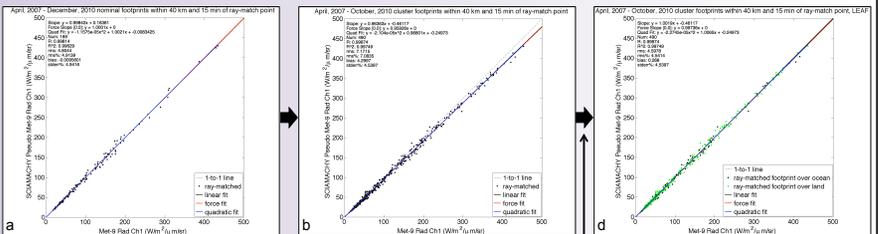
- Increase sparse sampling by using 0.25-second integration, yielding low-latitude cluster footprint size of 30 km x 60 km at 16 VZAs covering 612.715-725.99 nm (Cluster 24)

SCIAMACHY/MODIS Simultaneous Near-Nadir Overpass Comparisons

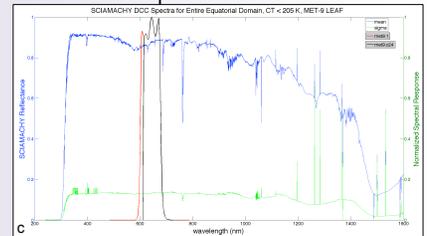
- SCIAMACHY and Aqua-MODIS each rely on a solar diffuser for on-orbit calibration
- SCIAMACHY is absolutely calibrated to within 2% between 604-805 nm, MODIS has ~2% absolute calibration uncertainty
- The 8-year mean relative SCIAMACHY/MODIS (0.65 μm) calibration factor is 0.983
- The relative stability between SCIAMACHY and Aqua-MODIS is -1% per decade
- Month-to-month standard-error-increase is attributed to shrinking dynamic range within monthly scatter plot



SCIAMACHY/GEO Simultaneous Angular Matching Comparisons



- Regression of Met-9 Band-1 radiances with nominal SCIAMACHY angular-matched radiances
- Limiting the SCIAMACHY spectral width to 612.715-725.99 nm, we increase our sampling
- However, energy is lost owing to GEO bandwidth now being wider than the spectral range of the SCIAMACHY 30-km x 60-km clusters. Must apply a Lost Energy Adjustment Factor (LEAF) by finding ratio of radiances convolved with both the SCIAMACHY Nominal and Cluster-24 spectra
- Standard error reduced, no land/ocean differences



Conclusions

- SCIAMACHY calibration is stable over time compared with Aqua-MODIS
- The methods differ by 1.5%, which is within the standard error of the direct comparisons
- Using SCIAMACHY to calibrate GEOs operationally is limited by ENVIAT orbit/scan duty
- Use of SCIAMACHY is advantageous because spectral band differences are accounted for, which can be on the order of 3% for similar bands, e.g., Met-9 and Aqua-MODIS Channel 1