GSICS Quarterly

Global Space-based Inter-Calibration System

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Dr. Robert A. Iacovazzi, Jr., Editor

GRUAN: Establishing a Worldwide Network for Climate-Quality Upper-Air Reference Measurements

The climate research community has long been calling for a ground-based reference network for accurately determining essential upper-air variables like temperature, geopotential, humidity and wind fields. The satellite community has strongly supported the establishment of long-term *in situ* reference upper-air observations for validation of satellite measurements and data products. Now, as the implementation of the Global Climate Observing System (GCOS) has evolved, a GCOS Reference Upper-Air Network (GRUAN) has started to take shape (GCOS, 2007; GCOS, 2008).

GRUAN is an international reference observing network, designed specifically to meet climate requirements and to fill a major void in the current global observing system. A first important step for realizing GRUAN was taken in 2007 when the World Meteorololgical Center (WMO) assigned the GRUAN lead centre to the Richard-Aßmann-Observatory in Lin-denberg, Germany. This year, detailed requirements for reference observations are being defined, and the first stations are expected to become operational in the beginning of 2009. GRUAN is envisaged to be a network of 30 to 40 stations, made operational in a phased process, that serves primarily as a long-term anchor to other networks. Therefore, GRUAN will not be globally complete, but will sample major climatic regimes, latitudes, altitudes, and surface types. Each network station will be associated with a host institution having the necessary scientific and technical exper-tise, and a commitment to the long-term operation of the site. GRUAN will measure the "essential climate variables" identified by GCOS using high-quality instruments to provide the most accurate data possible. A schematic setup of a typical GRUAN station is shown in Figure 1.

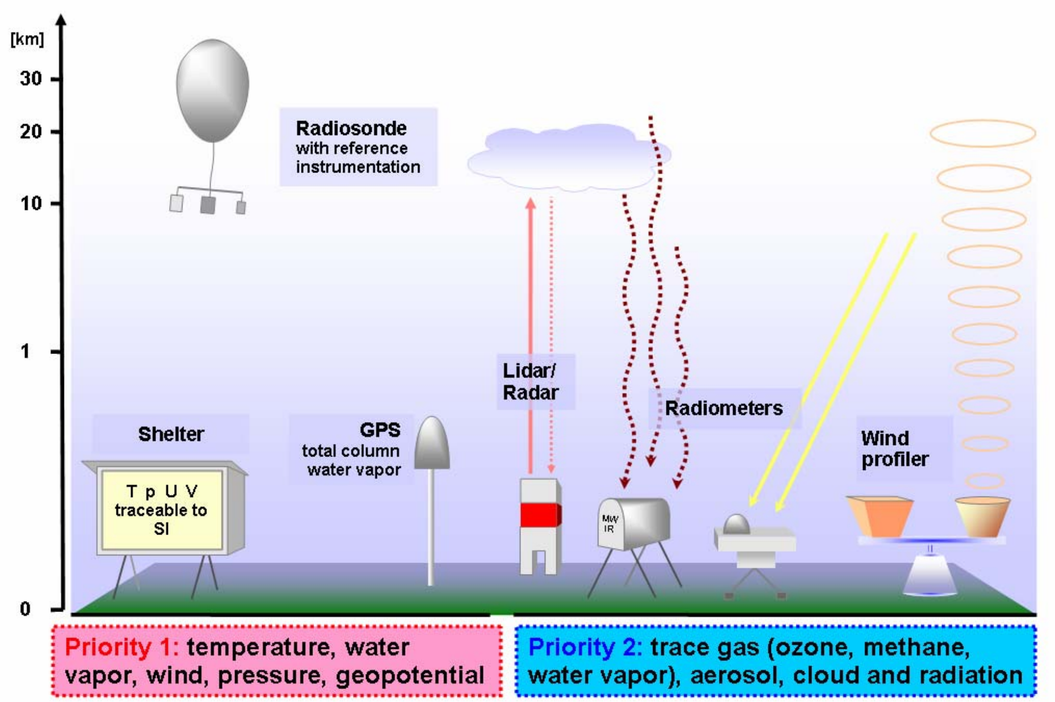

Figure 1: Schematic setup of a GRUAN site

The guiding principles for GRUAN observations are to use the best available technology, and to ensure that instrument errors can be fully characterized by:

- making redundant measurements of a given atmospheric variable;
- calibrating sensors with references traceable to SI standards whenever possible; and
- following the ISO Guidelines for calculating and expressing Uncertainty in Measurements (GUM).

Beyond adhering to the GCOS climate-monitoring principles, GRUAN will include high-level quality control procedures with real-time and retrospective data validation.

A strong GRUAN lead centre provides scientific leadership and oversight, manages the network, trains operators, and ensures proper data archival and dissemination. The lead centre is committed to coordinating with other existing networks and observing systems. For example, there is a close liaison between GRUAN and GSICS planning activities. The long-term stability ensured in GRUAN observations will be important for homogenizing satellite data products. In addition, GSICS requirements on GRUAN observations for satellite calibration and validation will be fully integrated in GRUAN planning and operations.

References

GCOS 2007: GCOS Reference Upper-Air Network (GRUAN): Justification, requirements, siting and instrumentation options. GCOS–112, WMO Tech. Doc. 1379.

GCOS 2008: Report of the GCOS Reference Upper-Air Network Implementation Meeting, *Lindenberg, Germany, 26-28 February 2008*. GCOS-121, WMO Tech. Doc. 1435.

(by F. Immler, gruan.1c@dwd.de, German Met. Service [DWD])

An SNO Analysis of IASI and AIRS Spectral Radiance

Data from both the Atmospheric Infrared Sounder (AIRS) on EOS Aqua and the Infrared Atmospheric Sounding Interferometer (IASI) on METOP-A are proving to be very valuable for numerous GSICS analyses. Having the combination of good radiometric accuracy and noise performance, and broad continuous spectral coverage, the observations from these high spectral resolution sounders are being used as a reference for evaluating broadband infrared observations from other geostationary and polar-orbiting sensors. In past studies, the Simultaneous Nadir Overpass (SNO) method has been applied to inter-compare these instruments over relatively large wavelength intervals (Iacovazzi and Cao, 2008 and Blumstein, 2008). In this analysis, we used the SNO method to inter-compare these AIRS and IASI at the finest spectral scale.

This study includes SNOs of AIRS and IASI from May 2007 to February 2008. For each SNO, the AIRS and IASI observations are required to be within two minutes of each other. This results in 284 SNOs, that occur in narrow latitude bands centered on 73.8° North and South (Figure 1). For each SNO, the mean (MN) and standard deviation (SD) of the AIRS Fields-of-View (FOVs) within 30 km of the SNO location (typically 6 to 8 FOVs per SNO) are computed. The same is done for IASI (typically three to four FOVs per SNO). For each SNO, the spectra are then processed to have common spectral resolution and sampling (i.e. de-apodize the IASI L1C spectra and convolve with the AIRS L1B SRFs, and then convolve the AIRS L1B spectra with the de-apodized IASI L1C SRFs) and the difference between the resulting radiance spectra are computed (e.g. $\delta_i = MN'_{AIRS,i} - MN'_{IASI,i}$).

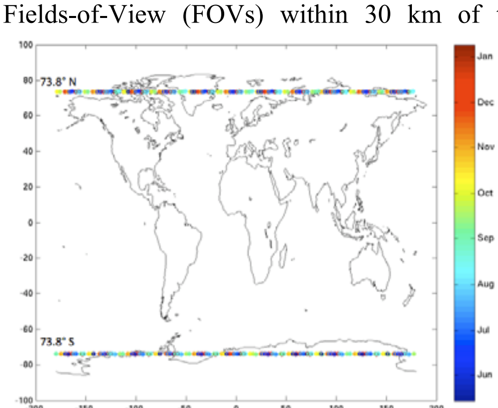

Figure 1: AIRS/IASI SNO locations and times

The resulting primary source of comparison error for each SNO case is due to the difference in the sparse sampling of the scene radiance provided by AIRS (near continguous 3x3 FOVs) and IASI (non-contiguous 2x2 FOVs). The 1-sigma uncertainty for each SNO case is therefore computed as $\sigma_i = [SD'^2_{IASI,i} + SD'^2_{AIRS,i}]^{1/2}$. These computations are performed individually for each spectral channel. Figure 2 shows that there is a high degree of correlation between the spatial standard deviations observed individually by IASI and by AIRS. Also, when the spatial standard deviations are low, the actual differences between AIRS and IASI are small, while larger differences are observed when the spatial standard deviations are high. Examination of the differences and uncertainties shows no long term trends in the differences for the time period examined. For the ensemble of SNOs, the spatial sampling differences are assumed to be random from case to case, and the mean differences between AIRS and IASI and their uncertainties are computed using weighted mean differences using the spatial standard deviations to compute the weights for each case (i.e. $\omega_i = 1/\sigma^2$, $\Delta = \sigma_\Delta^2[\Sigma_{i=1:N}\omega_i\delta_i]$, and $\sigma_\Delta = [\Sigma_{i=1:N}\omega_i]^{-1/2}$).

Using this analysis approach, the primary results of this study are shown in Figures 3 through 8, which show the mean spectra and differences for the northern and southern hemisphere SNOs. In these figures, the spectral differences are color-coded according to the AIRS detector array modules. Although the agreement between AIRS and IASI observed radiances is very good on one level, the SNO comparisons reported here reveal some fundamental measurement differences which can potentially impact both weather and

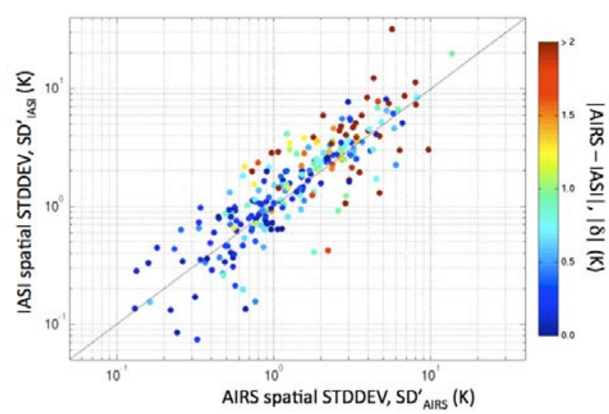

Figure 2: Brightness temperature differences for 900.31 cm^{-1} channel as a function of AIRS and IASI spatial standard deviations.

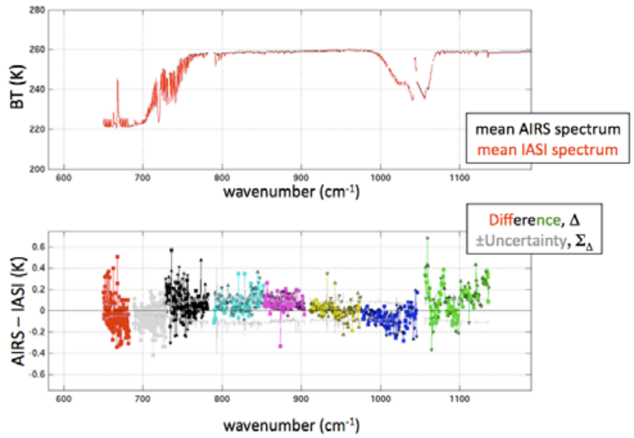

Figure 3: Mean spectra and differences for northern hemisphere SNOs. Longwave spectral region.

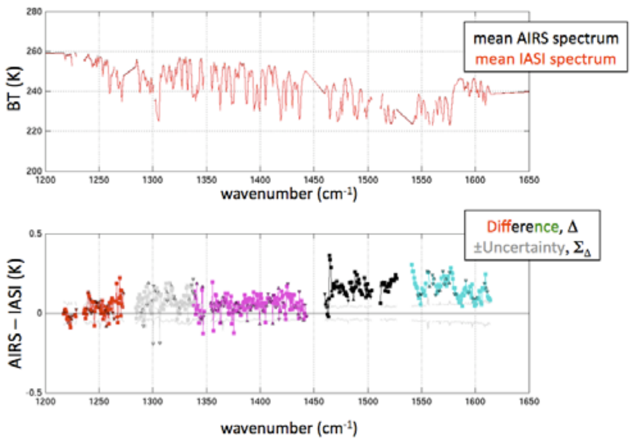

Figure 4: Mean spectra and differences for northern hemisphere SNOs. Midwave spectral region.

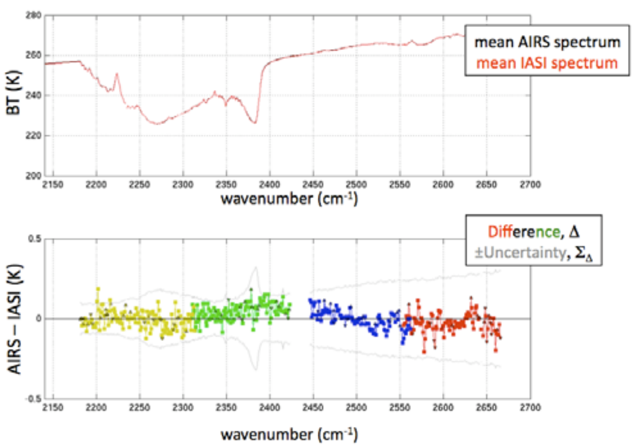

Figure 5: Mean spectra and differences for northern hemisphere SNOs. Shortwave spectral region.

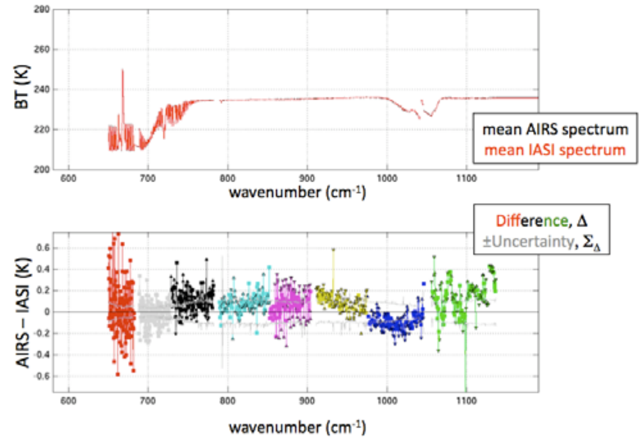

Figure 6: Mean spectra and differences for southern hemisphere SNOs. Longwave spectral region.

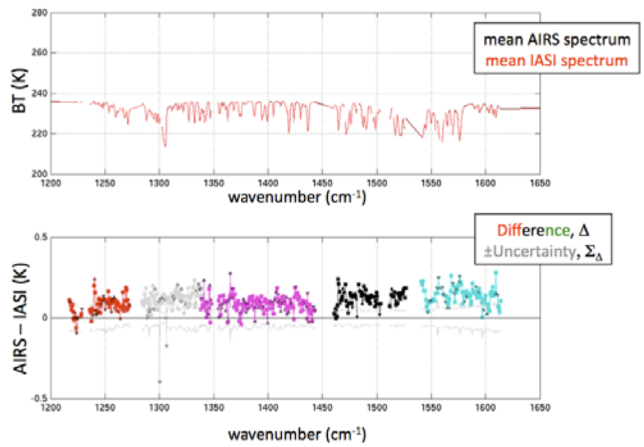

Figure 7: Mean spectral and differences for southern hemisphere SNOs. Midwave spectral region.

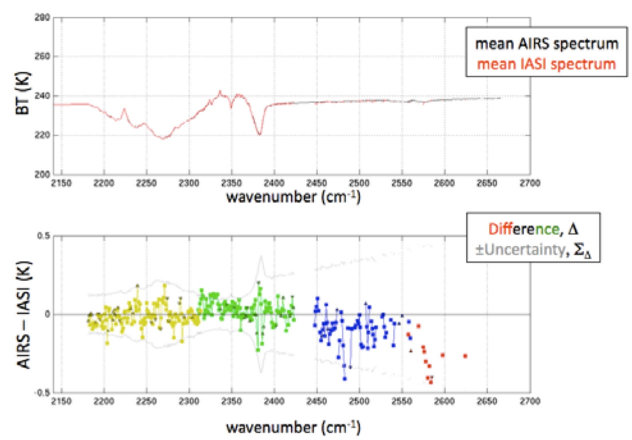

Figure 8: Mean spectral and differences for southern hemisphere SNOs. Shortwave spectral region.

climate applications. Some specific findings are noted here:

- In the longwave spectral regions, particularly for the AIRS detector array M-12 (649-681 cm^{-1}) for the southern latitude SNOs, significant differences, on the order of 500 mK, exist. Further analyses and comparisons with analyses of observed and calculated spectra by L. Strow suggest that these differences are due primarily to orbital variations of the AIRS spectral centroids, which are not included in the production of the AIRS L1B product. We anticipate re-doing this analysis after production of the AIRS L1C climate products, which are expected to include knowledge of these spectral shift variations;

- AIRS A-B state (notation indicating if one or both of the detectors of a given spectral channel are active and selected) related differences are observed within some detector arrays, most notably within array M-08 (851-903 cm^{-1}) with differences of approximately 400 mK between A-side only and B-side only channels;
- For upper-level water vapor channels, mean differences on the order of 200 mK are observed for AIRS detector arrays M-04a (1541-1623 cm^{-1}) and M-04b (1460-1527 cm^{-1}), while the mean differences for neighboring arrays are approximately zero; and
- The IASI shortwave channels are very noisy for the very cold southern latitude SNO scenes. Optimal random noise filtering and/or wavenumber averaging should be used to improve the comparisons for these cases.

This SNO-based evaluation study of AIRS and IASI has been used to quantify differences in the observations from the two sensors and reveal measurement characteristics of each sensor. For GSICS, this study, along with the other complementary studies mentioned earlier, can be used to quantify to what level the high spectral resolution observations can be treated as reference observations. However, some questions remain: 1) What calibration refinements can be implemented to account for the observed differences? 2) Are the differences reported here for relatively cold scenes representative of differences for warmer scenes? and 3) To what degree have the observed differences been absorbed, correctly or not, into forward model parameterizations, retrieval bias functions and/or derived climate products?

References

Blumstein, D., 2008: MetOp-A Level-1 Cal at IASI TEC. *GSICS Quarterly*, Vol. 2, No. 2, (online).

Iacovazzi, Jr., R., and C. Cao 2008: An AIRS-IASI Inter-comparison. *GSICS Quarterly*, Vol. 2, No. 2, (online).

(by Dr. D. Tobin, [CIMSS/SSEC/UW-Madison])

MetOp-A IASI and HIRS Inter-Comparisons

At EUMETSAT

Using High-resolution Infrared Radiation Sounder (HIRS) as an inter-calibration reference instrument is of great interest to the climate-monitoring community, as it provides a long time series of observations from satellites dating back to the late 1970s. As both HIRS/4 and the Infrared Atmospheric Sounding Interferometer (IASI) operate on MetOp-A, a global inter-calibration dataset can be derived, allowing us to investigate the sensitivity of the HIRS calibration, relative to IASI, to various instrumental and geophysical parameters. This article highlights some details specific to the generation of HIRS-IASI inter-calibration datasets, which differ from other instrument pairs.

Because HIRS and IASI are on the same satellite, their observations are simultaneous to within 15 seconds, and they can share the same viewing angle to within 0.75°. However, because of their different instrument scan patterns and Fields of View (FOV), there can be significant geolocation differences between MetOp-A HIRS and IASI pixels. In order to minimize data uncertainty, it is important to maximize the number of representative collocated pixels in the analysis, while reducing the negative impact of poor data collocation in highly inhomogeneous scenes. We satisfy these criteria by using a relatively large inter-pixel geolocation distance, and defining a representative *environment* to estimate the uncertainty introduced by geographic misalignment of each collocated pixel.

Two collocation methods are examined here:

A) Utilizes a distance threshold between collocated pixels of 11 km, which allows any pixels with any degree of overlap to enter the analysis (similar to that proposed by Wang et al., [2008]). Meanwhile, the environment is then defined by any IASI pixels with centers within 33 km (3x11 km) of the HIRS pixel.

B) Compares HIRS pixels with area-averaged IASI pixels. Only HIRS pixels within boxes marked by the centers of a set of four IASI instantaneous FOV (iFOV) are taken. These HIRS pixels are compared with the mean radiance of the four IASI iFOV, which are also used to define the *environment*. The box sizes range from 18 km x 18 km at nadir to 52 km x 29 km at the scan edges.

Method B results in fewer collocations than Method A, but with more representative environments. However, some scan

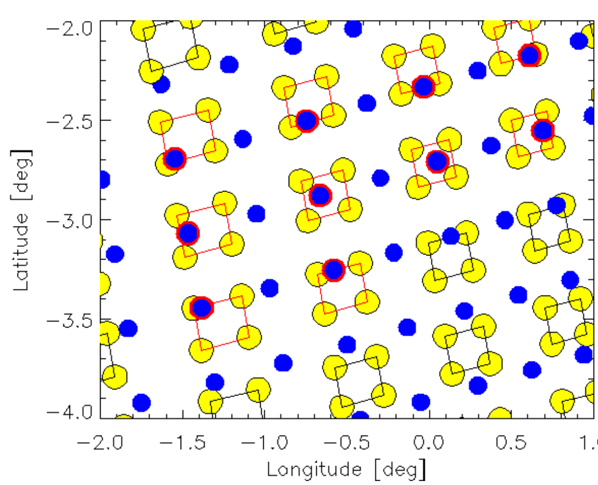

Figure 1: Map of HIRS pixels (blue) and IASI pixels (yellow). HIRS pixels meeting collocation criteria are highlighted (red). Red boxes of four IASI iFOV around HIRS pixels define the *environment*.

angles never produce any collocations within the IASI iFOV boxes.

The radiances of each collocated HIRS pixel are compared to the IASI radiance spectra, convolved with HIRS spectral response functions (SRFs), in the following manner. For each HIRS channel, the HIRS and IASI radiances for a given collocated pair of data are weighted by the inverse of the radiance variance of the IASI pixels within its *environment* (Hewison [2008]). Regressions are calculated between all collocated pairs of data within one orbital period. The slope of these regressions is not generally equal to 1. So to facilitate comparisons, reference scene radiances, L_{ref}, have been derived as the modes of brightness temperature (T_b) histograms of all clear sky pixels meeting the collocation criteria, in 5 K bins (bimodal distributions were averaged), as shown in Table 1.

The regression coefficients are applied to estimate the relative bias of HIRS-IASI for L_{ref}. The T_b biases for two cases, each comprising the night-time part of a MetOp-A orbit, are shown in Table 1. The bias uncertainties were calculated from the standard error of the regression coefficients, accounting for their correlation, with typical 1-sigma values of about 0.01 K.

All biases were found to be less than 1 K. The first case was processed using both Collocation Methods A and B**.** These gave very similar results for the shorter wavelength channels (Channels 8 to 19). However, the significant differences at longer wavelengths (Channels 1 to 7) warrant further investigation.

Table 1: Reference scene T_b and relative biases of HIRS-IASI for two MetOp orbits using Collocation Methods A and B. Typical 1-σ uncertainty on bias is about 0.01 K. The largest biases are emphasized in bold.

HIRS Channel	Reference Scene, T_{bref} [K]	HIRS-IASI bias at T_{bref} [K]		
		2007-04-27 19:38-		2008-05-07 20:56-
		A	B	B
1	230	-0.17	-0.35	-0.06
2	220	-0.24	-0.22	-0.06
3	215	-0.05	-0.03	-0.04
4	225	0.03	0.12	0.04
5	240	**0.63**	**0.60**	**0.61**
6	255	0.16	0.22	0.18
7	265	0.25	0.20	0.23
8	285	0.09	0.08	0.10
9	260	0.05	0.00	-0.01
10	280	0.19	0.18	0.21
11	260	0.01	0.02	0.01
12	235	-0.29	-0.25	-0.32
13	275	-0.02	-0.03	-0.06
14	260	0.04	0.04	0.02
15	250	**-0.72**	**-0.80**	**-0.76**
16	240	**-0.46**	**-0.46**	**-0.45**
17	280	0.15	0.11	0.13
18	285	0.10	0.09	0.11
19	290	-0.01	0.02	-0.02

A second case, from approximately one year later, has also been processed using collocation Method B. Although the first two channels had changed significantly, the other channels remained remarkably constant, with RMS differences of 0.03 K.

The biases were found to be statistically identical whether using weighted regressions of all collocated pixels, or only those collocated pixels where the standard deviation of the environmental radiances were less than $0.05L_{ref}$. This highlights the robustness of the weighted regression method. A stepwise multiple linear regression has shown the HIRS-IASI T_b bias has significant sensitivity to only radiance and scan angle.

These encouraging first results suggest it may be possible to use HIRS/4 as an inter-calibration reference instrument, as it has small, stable biases, which can be modeled simply.

References

Hewison, T. J., 2008: SEVIRI/IASI Differences in 2007, *GSICS Quarterly*, Vol.2, No.1, (online).

Wang, L. C. Cao and Y. Han, 2008: IASI HIRS Inter-calibration on MetOp-A, *GSICS Quarterly*, this issue.

(by Dr. Tim Hewison, [EUMETSAT])

At NOAA NESDIS

The Infrared Atmospheric Sounding Interferometer (IASI), launched on MetOp-A in 2006, provided an opportunity to create calibration links between NOAA High-resolution Infrared Radiation Sounder (HIRS), Earth Observing System (EOS) Aqua Atmospheric Infrared Sounder (AIRS), and the future NPOESS Cross-track Infrared Sounder (CrIS). As one key step towards achieving this goal, this study focuses on the global inter-comparison of IASI and HIRS observations from the MetOp-A platform.

The IASI level-1C data, which are apodized, calibrated spectra with a spectral sampling interval of 0.25 cm^{-1} ranging from 645 cm^{-1} to 2760 cm^{-1}, are convolved with the HIRS spectral response functions to simulate the 19 channels of MetOp-A HIRS observations. The HIRS nadir pixel, with a resolution of 10 km, is paired with the IASI 12 km nadir pixels for comparison when their ground distance is less than a threshold value. The brightness temperature (BT) difference is then calculated along the orbit.

The 0205 to 0353 UTC MetOp-A orbit of 19 April 2007 was selected in this study, since it passed over the Department of Energy (DOE) Atmospheric Radiation and Measurements (ARM) program Southern Great Plains (SGP) Cloud and Radiation Test Bed (CART) site at 0335 UTC on this day. At the same time, the WB-57 instrumented aircraft was flown in the stratosphere at altitudes near 18 km and carried out interferometric measurements with the NPOESS Atmospheric

Sounder Testbed Infrared (NAST-I) and Scanning High-resolution Interferometer Sounder (S-HIS) instruments in order to measure the atmosphere simultaneously with IASI. A couple of spectra have been taken from NAST-I and S-HIS for comparison with IASI measurements. Preliminary results indicate that they agree with each other well (see Tobin et al., 2007), assuring us that the IASI measurements can be assumed as a good reference to assess on-orbit calibration accuracy of HIRS infrared channels.

Figure 1 shows the IASI-minus-HIRS BT difference (black dots) as a function of HIRS scan line number for nadir pixels at channel 2 (with a weighting function 50hPa). This plot is overlaid with the HIRS (red) and IASI-convolved HIRS BT (gray), as well as the latitude of the scan line (blue). The mean BT difference is 0.057 K with a standard deviation of 0.198 K. This result reveals good agreement between IASI and HIRS on MetOp-A for this orbit. Further comparison still needs to be done to reduce the collocation uncertainties for the lower sounding and surface channels resulting from scene inhomogeneities and instrument geolocation and pixel differences. We also plan to extend this method to perform the spectral calibration of MetOp-A/HIRS in the future.

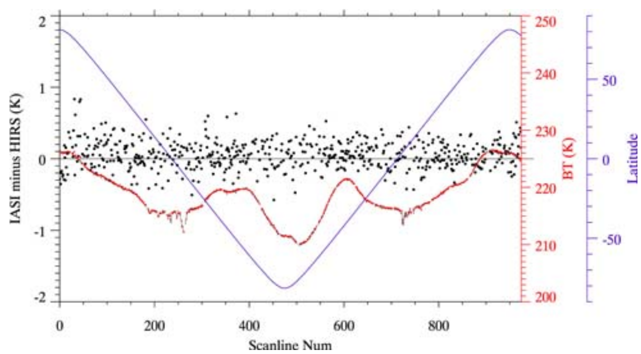

Figure 1: IASI-minus-HIRS brightness temperature (BT) difference (black dots) varying with the HIRS scan line number for nadir pixels at channel 2 (with a weighting function 50hPa). The plot is overlaid with the HIRS (red) and IASI-convolved HIRS BT (gray), as well as the latitude (blue).

Reference:

Tobin, D. and Co-authors, 2007: Radiometric and spectral validation of Infrared Atmospheric Sounding Interferometer (IASI) observations. 2007 Conference on Characterization and Radiometric Calibration for Remote Sensing, Logan, UT.

(by Drs. L. Wang and C. Cao, [NOAA])

Using IASI to Resolve HIRS SRF-Related Radiance Biases

The High-resolution Infrared Radiation Sounder (HIRS) on NOAA satellites provides a nearly 30-year observation record of the Earth's surface and atmosphere up to the stratosphere. However, since each HIRS instrument has a typical lifetime of three to five years, it is a significant challenge to make consistent time series from HIRS data taken from more than 13 satellites for the purpose of climate change detection. For example, even if each HIRS instrument were calibrated perfectly, there can still be significant radiance biases between instruments. One reason is that HIRS inter-satellite biases can be affected by differences in the spectral response functions (SRFs) between instruments. SRF differences can alter the height at which radiometers observes the atmosphere, which can translate to differences in brightness temperature if the atmospheric temperature lapse rate is non-trivial. The SRF dependent biases are further mixed with other effects such as:

- Diurnally- and seasonally-varying biases related to observation time differences and orbital drifts;
- Instrument detector uncharacterized nonlinearity;
- Blackbody surface temperature/emissivity uncertainty; and
- Calibration algorithm imperfections.

In this study, the Infrared Atmospheric Sounding Interferometer (IASI) observations are convolved with the SRF of each HIRS model to estimate HIRS radiances. This procedure is applied to orbital IASI data to expose SRF-related HIRS instrument radiance biases across different climate zones in different seasons. Since the biases are estimated using the same instrument, IASI, the cause of these biases are strictly limited to the SRFs of the HIRS instruments. In Figure 1, IASI-estimated HIRS radiances for consecutive HIRS instruments flown on NOAA and MetOp-A satellites are shown to vary as a function of the HIRS model, as well as climate zone (band 4 - 14.22 μm – is shown here). They also vary as a function of band (not shown). Understanding the characteristics of these variations is essential for resolving the SRF-dependent inter-satellite biases and the development of fundamental climate data records from HIRS. More details of this research are to be presented at the SPIE Optics and Photonics Conference in August 2008.

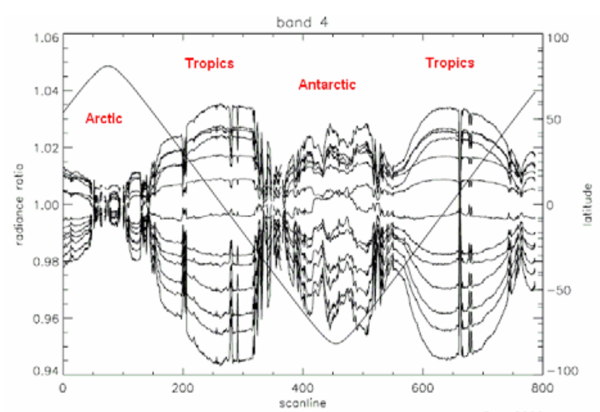

Figure 1: Radiance ratio versus scan line plot for one selected orbit of IASI data convolved with HIRS Channel 4 (14.22 μm) SRFs. Each curve represents a radiance ratio between subsequent HIRS operational instruments – e.g. rad(N7)/rad(N6), rad(N8)/rad(N7), etc. Note that the latitude of each scan line is also given in the plot.

(by Dr. C. Cao, M. Goldberg, Dr. L. Wang, and Dr. R. Iacovazzi, Jr., [NOAA], and Mr. D. Blumstein, [CNES])

News in this Quarter

FengYun-3A Launch Christens China's New Polar-orbiting Satellite Generation

At 11:02:33 am on 27 May 2008, the Feng Yun 3A (FY-3A) satellite was launched successfully at Taiyuan Satellite Launching Center, which is located in Shanxi Province, China. After 20 minutes, the satellite entered its polar orbit successfully. Together with the currently operational FY-2C and -2D satellites, the FY-3A satellite will offer meteorological services for earthquake relief and the Beijing Olympic Games.

The FY-3 satellite series is a new generation of polar orbit meteorological satellite. The FY-3A satellite carries several instruments including the:

- Visible and InfraRed Radiometer (VIRR);
- MODerate resolution visible and infrared Imager (MODI);
- MicroWave Radiation Imager (MWRI);
- InfraRed Atmospheric Sounder (IRAS);
- MicroWave atmospheric Temperature Sounder (MWTS);
- MicroWave atmospheric Humidity Sounder (MWHS);
- Total Ozone Mapper and Ozone Profiler (TOM/OP);
- Earth Radiation Budget Unit (ERBU); and
- Space Environment Monitoring Unit (SEMU).

The main function of the satellite is to provide multiple observational products. Products related to atmospheric variables include temperature, precipitation, integrated water vapor, moisture, etc. It can also offer data regarding land and ocean parameters, such as vegetation, land cover type, fire, ocean color and ocean temperature. Data from the satellite is designed to be transmitted to Earth using two X-band transmitters and an L-band transmitter.

The successful launch of the satellite is a milestone of the Chinese Satellite Program, which strives to improve the understanding of climate change in China. The FY-3A satellite is the first in a series of six satellites. Feng Yun 3B is planned for launch in 2009-2010.

(edited from an article by K. Yan and Z. Yong, [CMA])

The GEO/CEOS Workshop on Quality Assurance of Cal/Val Processes

The workshop was held at the National Institute of Standards and Technology (NIST) in Gaithersburg, Maryland, May 6-8, 2008. The workshop was in direct response to the Group on Earth Observations (GEO) task of "developing a data quality assurance strategy for Global Earth Observation System of Systems (GEOSS)" and the Committee on Earth Observation Satellites (CEOS) 2008 action for the space agencies to support GEO tasks. Organized by ESA and sponsored by NIST/NOAA/NASA, the workshop was attended by approximately 45 experts from more than ten countries and 20 agencies, the majority of which were CEOS/Working Group on Cal/Val (WGCV) members. Representatives included GEO Secretariat Mike Rast, CEOS Chief Executive Officer (CEO), Ivan Petiteville, and CEOS Strategic Implementation Team (SIT) member Mike Tanner. As one of the keynote speakers, Changyong Cao introduced the background of the CEOS/WGCV efforts in leading this task.

This workshop represents a major milestone for the WGCV, and will lead to the completion and delivery by the end of September of the document on data quality assurance for GEOSS, which includes 15 key guidelines. The document will then be distributed to the space agencies under the auspice of GEO to facilitate the interoperability of the space segment of GEOSS.

(Dr. C. Cao, [NOAA])

GSICS-Related Publications

Please send bibliographic references of your recent GSICS-related publications to Bob.Iacovazzi@noaa.gov.

Just Around the Bend …

GSICS-Related Meetings

- **SPIE Optics and Photonics, 10-14 August 2008, San Diego, CA, USA:** Conference on Atmospheric and Environmental Remote Sensing Data Processing and Utilization IV: Readiness for GEOSS II
- **CALCON Technical Conference, 25-28 August 2008, Logan, UT, USA.** Session on inter-calibration and validation of operational sensors.

GSICS Classifieds

HELP WANTED

***GSICS Quarterly* Asian Correspondent:** Join the *GSICS Quarterly* Press Crew in providing up-to-date news about calibration/validation activities from around the globe. The Asian Correspondent for *GSICS Quarterly* would be responsible for acquiring articles about GSICS-related activities occurring in Asia, and coordinating their publication in the newsletter with the *GSICS Quarterly* Editor, Bob Iacovazzi, Jr.. If you are interested in this unique opportunity, please e-mail Bob at Bob.Iacovazzi@noaa.gov.

Are you looking to establish a GSICS-related collaboration, or do you have GSICS-related internships, exchange programs, and/or available data and services to offer? *GSICS Quarterly* includes a classified advertisements section on an as-needed basis to enhance communication amongst GSICS members and partners. If you wish to place a classified advertisement in the newsletter, please send a two to four sentence advertisement that includes your contact information to Bob.Iacovazzi@noaa.gov.

With Help From Our Friends:

The *GSICS Quarterly* Editor would like to thank those individuals who contributed articles and information to this newsletter. The Editor would also like to thank *GSICS Quarterly* European Correspondent, Dr. Tim Hewison of EUMETSAT, in helping to secure articles for publication, and Ms. Regina Bellina for her help in proofreading this newsletter.

The *GSICS Quarterly* Press Crew is looking for short articles (<1 page), especially related to cal/val capabilities and how they have been used to positively impact weather and climate products. Unsolicited articles are accepted anytime, and will be published in the next available newsletter issue after approval/editing. **Please send articles to Bob.Iacovazzi@noaa.gov, *GSICS Quarterly* Editor.**