Rotating Shadowband Spectroradiometer (RSS)

(a) Last four years performance
(b) Overhaul plan

Peter Kiedron

Joint Aerosol and Radiative Processes Groups Meeting 2007, Madison, WI

Mark Klassen	- Maintenance, calibrations
Jim Schlemmer	- Calibrated files generation, Langley, QC
Alice Cialella	- Langley directory updating
Rolanda Jundt	- Web pages update
Ken Kehoe, et al.	- QC images on ARM web pages
Dan Nelson, et al.	- LiCor lamp change experiment
SGP staff	- Computer maintenance, etc.

RSS shadowbanding refractive spectrograph radiometer

(1) RSS measurement (**1 every minute**) consists of 5 (up to 5 sec long) exposures of Dark, Unblocked, Correction(-9°), Blocked and Correction(+9°) at 1024 pixels out of which 1000 pixels covers a useful spectral range approx. **361nm-1066nm**. Resolution varies with wavelength from **fwhm=0.38nm** to **fwhm=3.83nm**, though fwhm is approximately constant when expressed in pixels.

(2) Unblocked signal is used to FFT correlate with a reference RSS spectrum to derive **relative pixel shifts in Blue and Red ends of the spectrum**. Then a pixel shift is calculated for each pixel assuming linear dependence in pixels.

(3) To obtain irradiances direct, diffuse and total **cosine corrected signals** are derived and then divided by the **responsivity** obtained with Li-Cor or PortCal calibrators. The calibrations are performed approximately **once every two weeks**. The two calibrators have been tracking each other to within ±1.25% (1-sigma) for all wavelengths over the period of 4 years. The applied responsivity is interpolated from the two nearest bracketing calibrations. From pixel shifts a **wavelength assignment for each scan** is calculated. Also relative (1-sigma) **noise-to-signa**l due to photon Poisson noise and CCD read noise are calculated. All these data (total seven 1040 long vectors per minute) are archived by ARM. Archived lamp calibrated irradiances might be 2-4% off in absolute scale.

(4) The lamp calibrated normal irradiances are used to perform Langley regression plots. First, all daily spectra are interpolated into the **reference spectrum's wavelength grid** to correct pixel shifts. Then mask of Langley points is obtained at 518 pixel (approx 500nm). Then Vo's for other pixels are obtained using the same mask. Up to two Vo's per day are obtained. Vo is accepted if Langley's RMS<0.01 at 518 pixel.

(5) All accepted Vo's are passed trough a combination of **median-mean filter** to generate **smoothed <Vo>** for every day between first and most recent successful Langley event. Again the median-mean filter selects Langley events using the 518 pixel and creates a mask that is used to smooth all other pixels in the same manner retaining the mutual coherence between pixels. The <Vo> as functions of pixels (in reference spectrum's wavelength grid) are available at http://iop.archive.arm.gov/arm-iop/0special-data/asrc-rss/rss105/langley/ . The most recent file covers 20070220-20070729 period.

(6) To obtain transmittance one takes irradiance for a given scan from archive and divide by **$\langle Vo \rangle / r^2$** (where r is sun-earth distance) for that day after <Vo> was interpolated into the scan's wavelength.

(7) The Langley regression process and Vo's smoothing process may have a potential for improvement and a better estimate of true <Vo> might be obtained after a better way of weeding the "false Langley" out is found.

RSS data, events update

» Almost 100% duty cycle data acquired.

» No major breakdowns; Shadowbanding - OK; Wavelength stability - OK (Fraunhofer correction to each scan).

» No changes in radiometric stability behavior (so-so); Responsivity corrected once every two week.

» Langley files generated every few months and uploaded to ARM IOP server (currently till 2007/07/29).

» Web pages updated several times a year (new documents, etc.).

» RSS verification with data from May 2003 IOP and ALIVE 2005.

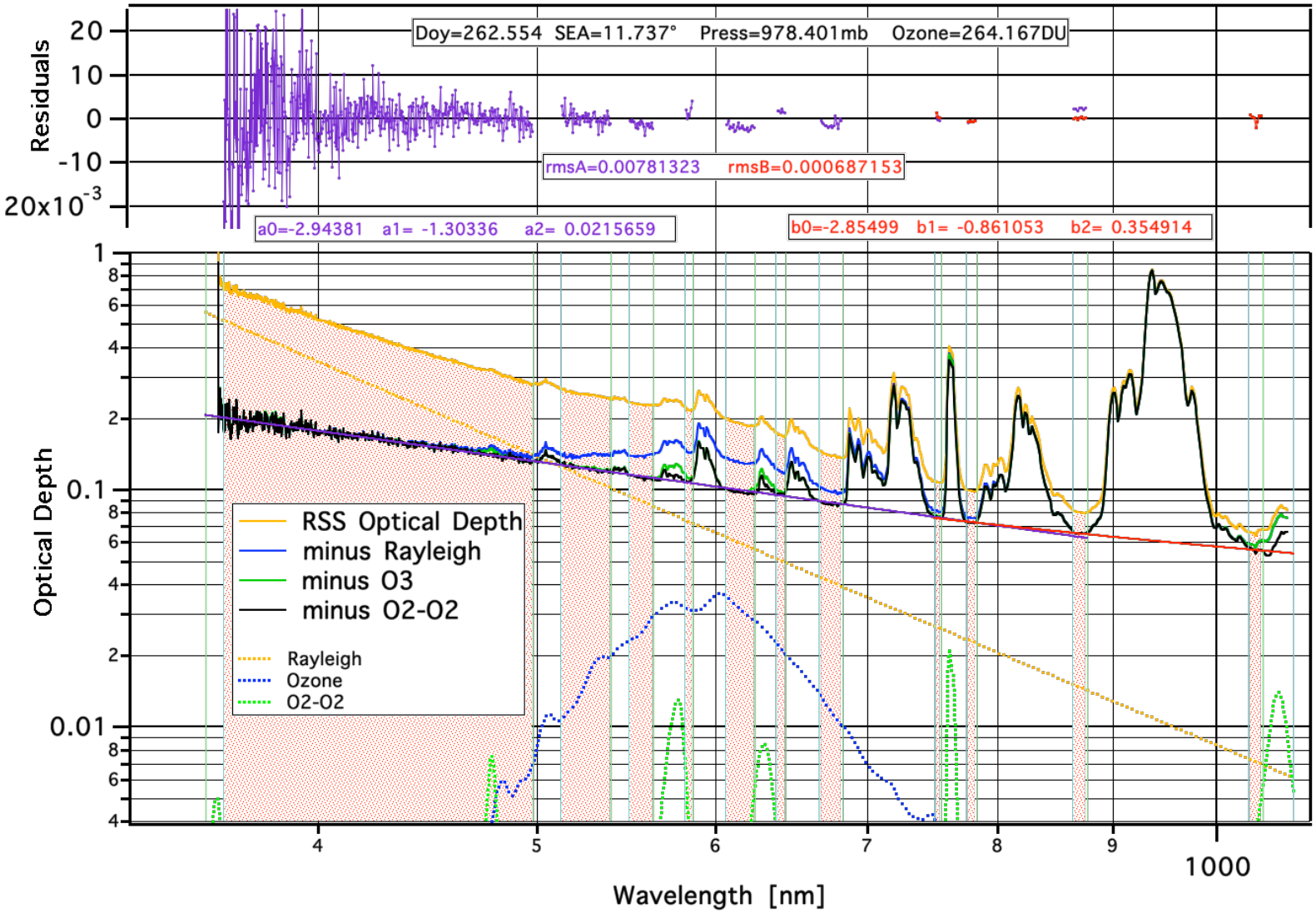
» New LiCor lamp introduced in calibration process.

» QC plots incorporated in ARM web pages.

» Short wave QME in planning stages.

» Automated calibration processing development in progress.

Verification of RSS accuracy via AOD comparison



RSS documentation and extra data via ARM web page

ARM - Instruments: Rotating Shadowband Spectroradiometer - Mozilla Firefox

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http://www.arm.gov/instruments/instrument.php?id=rss

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Rotating Shadowband Spectroradiometer (RSS)

Instrument Categories: Radiometric

General Overview

The Rotating Shadowband Spectroradiometer (RSS) implements the same automated shadowbanding technique used by the multifilter rotating shadowband radiometer (MFRSR), and so it too provides spectrally-resolved, direct-normal, diffuse-horizontal, and total-horizontal irradiances, and can be calibrated in-situ via Langley regression. The irradiance spectra are measured simultaneously at all spectral elements (pixels) in 360-nm to 1050-nm range. For more detailed information, refer to the RSS Handbook. Additional documentation and publications are also available here.

All RSS105 data are available from the ARM Climate Research Facility (ACRF) Data Archive in netCDF format. The RSS105 data are lamp calibrated irradiances. The accuracy of irradiance produced by the RSS is expected to be better than ±5%, which includes calibration and instrument stability errors. Higher accuracy (±1%) can be obtained when the responsivity is tied to the solar extraterrestrial irradiance via Langley regression plots. This approach is recommended when high precision measurements of optical depth are required.

The calibration constants from Langley regressions plots (so called Vo's) are available from the IOP Archive at http://iop.archive.arm.gov/arm-iop/0special-data/asrc-rss/rss105/langley/. The currently deployed RSS105 was preceded by two prototypes, RSS103 and RSS102, which operated at the SGP in three distinct periods since August 1997. Data from the two prototypes and data from the RSS105 from before March 30, 2006, are available at http://iop.archive.arm.gov/arm-iop/0special-data/asrc-rss/ in ascii format.

Lost? View the ACRF Help Diagram

Related Documents

- RSS Handbook (PDF)
- Instrument Mentor Monthly Summary (IMMS) reports
- RSS Data Quality Assessment (DQA) reports
- RSS netCDF File Header Descriptions (Data Object Design Files)

Order Data

Add to Cart

Done | Now: Mostly Cloudy, 73° F | Fri: 92° F

http://iop.archive.arm.gov/arm-iop/0special-data/asrc-rss/rss105/langley/

ARM Intensive Operational Period (IOP) Data Browser http://iop.archive.arm.gov/arm-iop/0special-data/asrc-rss/rss105/langley/

My IOP Download Page ARM IOP Data Browser ARM Archive User Interface ARM Homepage Direct URL: http://iop.archive.arm.gov/arm-iop/0special-data/asrc-rss/rss105/l

Langley RSS105 Data

File name: ForganStartDate_EndDate.Vo

This file contains Vo's that went through Forgan process. For each day between StartDate and EndDate three 1048 long columns of data are listed. The first column is wavelength that is the same for each day and in the second two are Vo's: Vo_f and Vo_fs.

The Forgan process begins with finding a mask from pixel 518 (580nm). Only Vo's from Langleys (good Langleys) that produce r fit better than 0.01 are used. For a given day between StartDate and EndDate N nearest good Vo's are sorted and then M<N Vo' that are nearest to the median are averaged. The indices (days) of those M points define a mask that is applied in processing for all other pixels. This way a coherance between pixels is preserved. Then Vo's obtained for every day between StartDate a EndDate are smoothed with moving average of length K. Most likely the following values have been used: N=31, M=15, K=11. (C the preamble in the files for their actual values.)

NOTE: All Vo's in the file: ForganStartDate_EndDate.Vo are normalized to Earth_Sun distance R=1, i.e., the Vo's from Langl were divided by (1/R^2). The values of R are available from the EarthSunDistance.txt file.

Vo_f values have telluric lines and the first several UV values and last several IR values replaced with smoothed to RSS resc Kurucz spectrum and in the case of UV region with Gueymard spectrum. The intervals for replacements are defined by the following table:

Pixel	interval	Wavelength	interval	
0	29	356.549	361.521	Gueymard
781	794	683.702	697.411	Kurucz
809	827	714.809	735.883	Kurucz
843	857	754.924	773.177	Kurucz
882	924	807.916	840.813	Kurucz
934	983	889.206	995.513	Kurucz
1029	1039	1066.36	1081.85	Kurucz

/arm-iop/0special-data/asrc-rss/rss105/langley/

Parent Directory

README.html
File last modified: Mon Mar 13 14:50:52 2006 UTC
File size: 7975 bytes
File description: HyperText Markup Language document

2003/
2004/
2005/
2006/
2007/

EarthSunDistance.txt
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File description: Text file

Forgan20030518_20051130.Vo
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Forgan20051103_20060124.Vo
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Forgan20051223_20060328.Vo
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Forgan20060218_20060524.Vo
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Forgan20060421_20060731.Vo
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File description: Unknown

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Package Type
- bzip2 tar file
- gzip tar file
- zip file

Directories/Files to Include
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Directories/Files to Exclude
Remove from list

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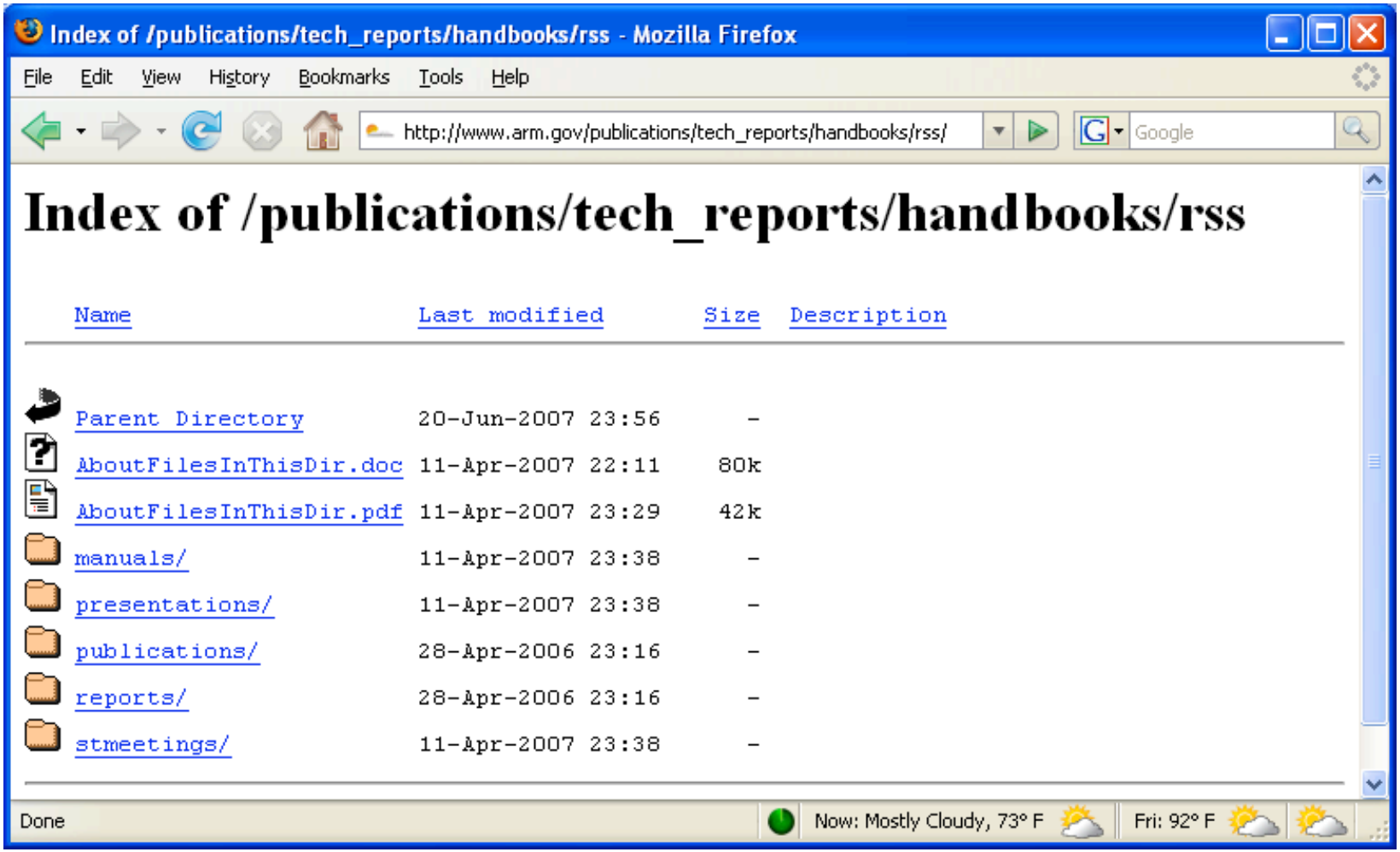
RSS documentation



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SUBDIRECTORY=manuals\

FILE NAME	CONTENT
AutomatedRadCalib_Feb2007.pdf	Automated radiometric calibration of RSS105
AutomatedRadCalibSupplementFiles.tgz or AutomatedRadCalibSupplementFiles.zip	Files to be used with AutomatedRadCalib_Feb2007.pdf
InstructionLicorOrielRSS.pdf	Instructions for Using Li-Cor and Oriel Spectral Calibrator with RSS
InstructionPortCalRSS.pdf	Instructions for Using Portable Calibrator with RSS
RSS105SignalNoise_Oct04_1pk.pdf	RSS algebra and noise
RSSAlogithmsDiagram.pdf	Diagrams of algorithms used in RSS data processing
Rss1024Manual.pdf	RSS/UVRSS-1024 Rotating Shadowband Spectroradiometer Installation and User Guide *Version 2.1* (YES, Inc.)
UserInfo(21).pdf	USING the RSS, low-level firmware command info UPDATED 06-06-2001 By L. Harrison, ASRC, SUNY at Albany
rss105CosCor_Aug04pk.pdf	Cosine correction in rss105

SUBDIRECTORY=presentations\

FILE NAME	CONTENT
RSSkied_AerosolsWGBoulder2005.pdf	P. Kiedron, "RSS: stability, calibration, Langley correction, aerosols OD", Aerosols Working Group, Boulder, CO, 2005
RSSkied_IRF_WGAnnapolis2005.pdf	P. Kiedron, "On RSS status", IRF Working Group, Annapolis, MD, 2005
RSSkied_AerosolsWGMonterey2007.pdf	Peter Kiedron, Connor Flynn, Richard Ferrare, Brent Holben, Joseph Michalsky, Beat Schmid and James Slusser, "Comparison of aerosol optical depth from passive and active measurements during the 2005 Aerosol Lidar Validation Experiment (ALIVE) at SGP", Aerosols Working Group at ARM Science Team Meeting, 2007
RSSkied_IRF_WGSantaBarbara2004.pdf	P. Kiedron, "Rotating Shadowband Spectroradiometer", IRF Working Group, Santa Barbara, CA, 2004
RSSkied_InstrMentrWGBillings2005.pdf	P. Kiedron, "RSS Mentor Presentation", Instrument Mentor Working Group, Billings, OK, 2005
RSSkied_SWQME_Monterey2007.pdf	P. Kiedron, "Brief guide to RSS for SW QME" SW QME Group at ARM Science Team Meeting, 2007
RSSkied_STM_IRFWGDaytonaBeach2005.pdf	P. Kiedron, "RSS history and current status", IRF Working Group, Daytona Beach, FL, 2005
RSSkied_IRF_WGWashDC2006.pdf	P. Kiedron, "Ozone daily variation at Table Mt., Boulder, CO and at SGP, OK, June 2003-July 2006 "
RSSkied_IRF_WGWashDC2006_1.pdf	P. Kiedron, "RSS Status…, AOD's for ALIVE 2005, Stability Issue"
RSSGueymard_IRF_WG WashDC2006.pdf	Chris A. Gueymard, "Broadband vs Spectral Radiative Closure: Synergy Between RSS Measurements and Modeling "
RSSkied_AerosolsWGSanFrancisco2006.pdf	P. Kiedron, "Comparison of Aerosol Optical Depth During ALIVE 2005 "

SUBDIRECTORY=publications\

FILE NAME	CONTENT
ASES2006_Gueymard.pdf	C. A. Gueymard, "PREDICTION AND VALIDATION OF CLOUDLESS SHORTWAVE IRRADIANCE FOR HORIZONTAL, TILTED, OR TRACKING RECEIVERS", Solar 2006 Conference, American Solar Energy Society, Denver, CO (July 2006)
ApplOpt1999_Kiedron.pdf	Piotr W. Kiedron, Joseph J. Michalsky, Jerry L. Berndt, and Lee C. Harrison, "Comparison of spectral irradiance standards used to calibrate shortwave radiometers and spectroradiometers", Appl.Opt. 38, pp.2432-2439, 1999
GRL1999_Harrison.pdf	Lee Harrison, Mark Beauharnois, Jerry Berndt, Peter Kiedron, Joseph Michalsky, Qilong Min, "The Rotating Shadowband Spectroradiometer (RSS) at SGP", J. Geophys. Res. 108: 4424, 2003.
GRL1999_Michalsky.pdf	J. Michalsky, M. Beauharnois, J. Berndt, L. Harrison, P. Kiedron, and Q. Min, "O2-O2 absorption band identi cation based on optical depth spectra of the visible and near-infrared", Geophys. Res. Lett. 26, 1581-1584, 1999
GRL1999_Min.pdf	Qilong Min and Lee Harrison, "Joint statistics of photon pathlength and cloud optical depth", Geophys. Res. Lett. 26, 1425-1428, 1999
GRL1999_Schmid.pdf	B. Schmid, J. Michalsky, R. Halthore, M. Beauharnois, L. Harrison, J. Livingston, P. Russell, B. Holben, T. Eck, A. Smirnov, "Comparison of Aerosol Optical Depth from Four Solar Radiometers During the Fall 1997 ARM Intensive Observation Period", Geophys. Res. Lett. 26, 2725-2728, 1999
GRL2000_Mlawer.pdf	Mlaver , E.J., S.A. Clough, Brown, P.D., L. Harrison, J. Michalsky, P. Kiedron, and T.R. Shippert,Comparison of Spectral Direct and Diffuse Solar Irradiance Measurements and Calculations for Cloud-Free Conditions, Geophys. Res. Lett., 27, 2653-2656, 2000
GRL2003_Kiedron.pdf	Kiedron, P., Berndt, J. Michalsky, J.Harrison, L., Column water vapor from diffuse irradiance, Geophys. Res. Lett. Vol. 30, No. 11, 1565, 2003
JGR2001_Kiedron.pdf	Kiedron, P., J. Michalsky, B. Schmid, D. Slater, J. Berndt, L. Harrison, P. Racette, E. Westwater and Y. Han, A Robust Retrieval of Water Vapor Column in Dry Arctic Conditions Using the Rotating Shadowband Spectroradiometer, , J. Geophys. Res. 106, 24,007-24,016,2001
JGR2001_Michalsky.pdf	Michalsky, J.J., Q. Min, P.W. Kiedron, D.W. Slater, and J.C. Barnard, A Differential Technique to Retrieve Column Water Vapor Using Sun Radiometry, J. Geophys. Res., 106, D15, 17,433-17,442. 2001
JGR2001_Min.pdf	Qilong Min, Lee C. Harrison, Eugene E. Clothiaux, "Joint statistics of photon path length and cloud optical depth: Case studies", J. Geophys. Res, 106, 7375-7385, 2001
JGR2003_Min.pdf	Qilong Min and Eugene E. Clothiaux, "Photon path length distributions inferred from rotating shadowband spectrometer measurements at the Atmospheric Radiation Measurements Program Southern Great Plains site", J. Geophys. Res, 108, NO. D15, 4465, doi:10.1029/2002JD002963, 2003
JGR2005_Gianelli.pdf	S. M. Gianelli, B. E. Carlson and A. A. Lacis, "Aerosol retrievals using rotating shadowband spectroradiometer data", J. Geophys. Res, 110, D05203, doi:10.1029/2004JD005329, 2005
SPIE02_4815_13_kiedron.pdf	Kiedron, P.W., L. Harrison, J.J. Michalsky, Jr., J. Schlemmer, and J.L. Berndt, "Data and Signal Processing of Rotating Shadowband Spectroradiometer (RSS) Data", Proc. SPIE 4815, pp.51-57, 2002

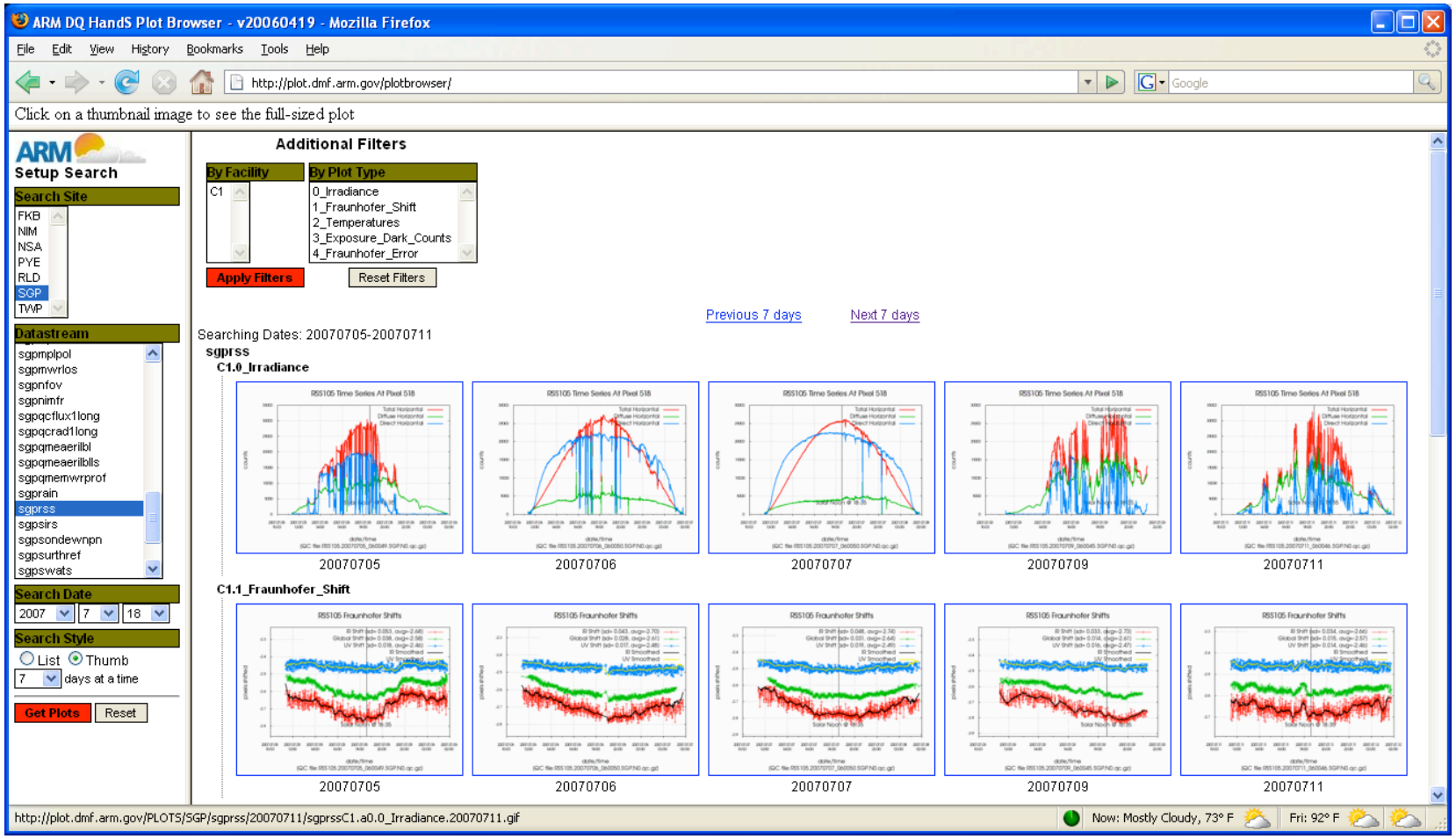
SUBDIRECTORY=reports\

FILE NAME	CONTENT
ETSpectraComparison_Feb1306.pdf	P. Kiedron, "Comparison of several extraterrestrial irradiances", February 13, 2006
RSSDataSGPtillMay2003.pdf	Data availability from RSS102 and RSS103 prototypes
RssPredeploy2003.pdf	P. Kiedron, "RSS Acceptance Tests and Pre-deployment Characterization", November 17, 2003
RssSGP1st6months2003.pdf	P. Kiedron, "RSS Performance Evaluation During First Six Months Since Its Deployment", November 17, 2003
rss&mfrsr_Dir2DifRatio.pdf	P. Kiedron, "Comparison of direct to diffuse ratio from RSS and MFRSR", December 13, 2005

SUBDIRECTORY=stmeetings\

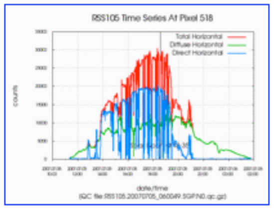
FILE NAME	CONTENT
RSS_ARM2000Kiedron.pdf	P. Kiedron, J. Berndt, J. Michalsky, Q. Min, D. Slater, "Robust retrieval of water vapor at NSA using rotating shadowband spectroradiometer (RSS)", ARM Science Team Meeting, 2000 (poster)
RSS_ARM2001Harrison.pdf	L. Harrison, J. Berndt, P. Kiedron, J. Michalsky, Q. Min, J. Schlemmer, "The Solar Spectrum 360 to 1050 nm from Rotating Shadowband Spectroradiometer (RSS) at the Southern Great Plains Site" , ARM Science Team Meeting, 2001 (poster)
RSS_ARM2001Kiedron1.pdf	P. Kiedron, K. Berndt, L. Harrison, J. Michalsky, Q. Min, "Column Water Vapor From Diffuse Irradiance", ARM Science Team Meeting, 2001 (poster)
RSS_ARM2001Kiedron2.pdf	P. Kiedron, "Spectral irradiance per interval of equal solar flux: convenient spectral grid for atmospheric radiation measurement and modeling" ARM Science Team Meeting, 2001 (poster)
RSS_ARM2001Mlawer.pdf	E. J. Mlawer, J. S. Delamere, C. J. Scott, and S. A. Clough , L. C. Harrison, J. J. Michalsky, and P. W. Kiedron , H. W. Barker, T. R. Shippert, "Comparison Between RSS Measurements and LBLRTM/CHARTS Calculations for Clear and Cloudy Conditions", ARM Science Team Meeting 2001, (proceedings)
RSS_ARM2003Kiedron.pdf	P. Kiedron, J. Berndt, E. Yager, J. Schlemmer, L. Harrison, and J. Michalsky, "Acceptance testing and characterization of the VIS-RSS slated for permanent deployment at the SGP site", ARM Science Team Meeting, 2003 (poster)
RSS_ARM2005Kiedron.pdf	P. Kiedron, and J. Schlemmer, "Rotating Shadowband Spectroradiometer (RSS) at SGP: Performance Data Processing and Value Added Products", ARM Science Team Meeting, 2005 (poster)
RSS_ARM2006Kiedron.pdf	Peter Kiedron, and Jim Schlemmer, "Spectrally resolved shortwave flux at ARM: History and the present status of RSS", ARM Science Team Meeting, 2006 (poster)
RSS_ARM2007Gianelli.pdf	Scott M. Gianelli, Andrew A. Lacis , and Barbara E. Carlson "Analysis of Bimodal Aerosol Size Distributions at SGP Using RSS 105 and AERONET CIMEL Data", ARM Science Team Meeting, 2007 (poster)
RSS_ARM2007Gianelli1.pdf	Scott M. Gianelli, Andrew A. Lacis , and Barbara E. Carlson "Analysis of

RSS QC plots: http://plot.dmf.arm.gov/plotbrowser/



sgprss

C1.0_Irradiance



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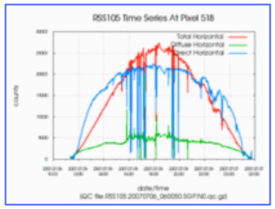

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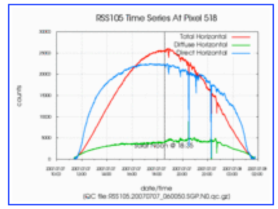

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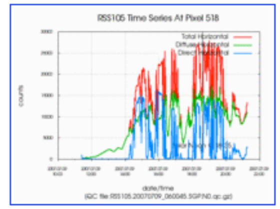

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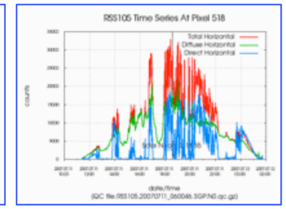

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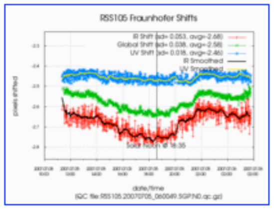

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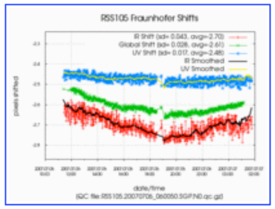

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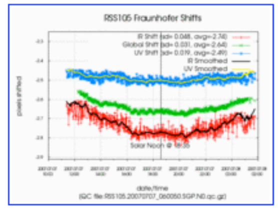

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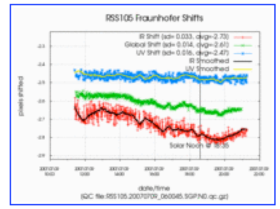

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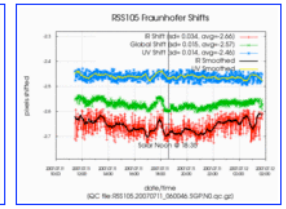

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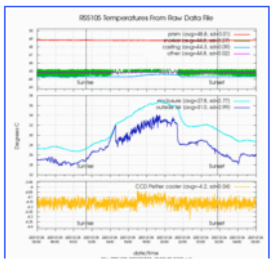

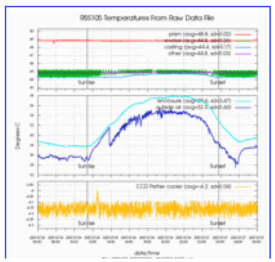

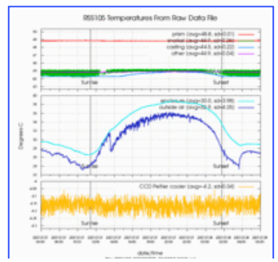

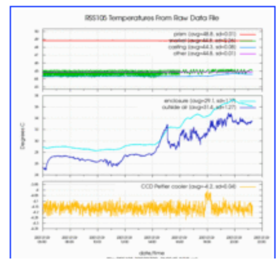

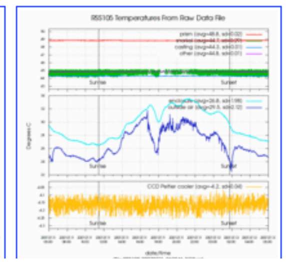

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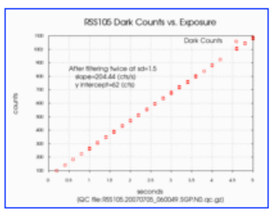

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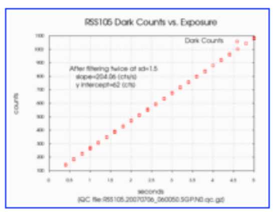

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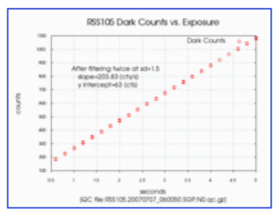

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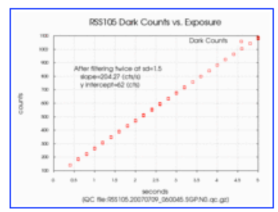

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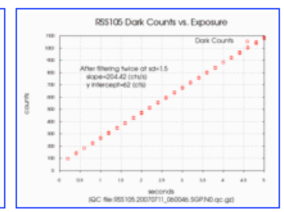
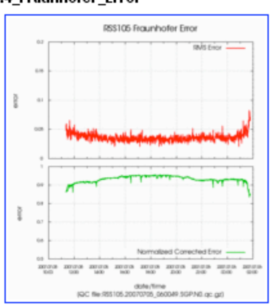


20070711

C1.4_Fraunhofer_Error



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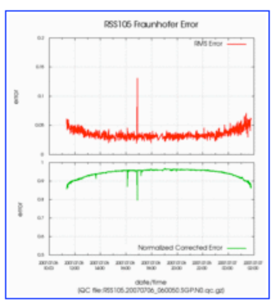

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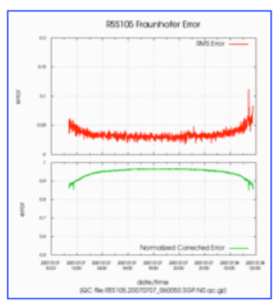

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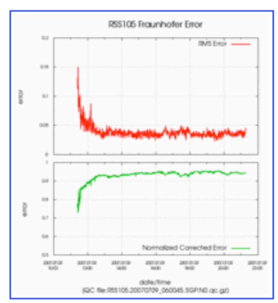

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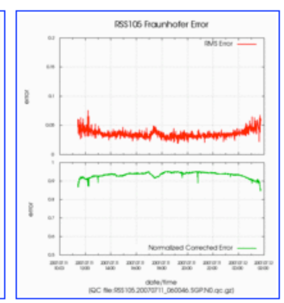

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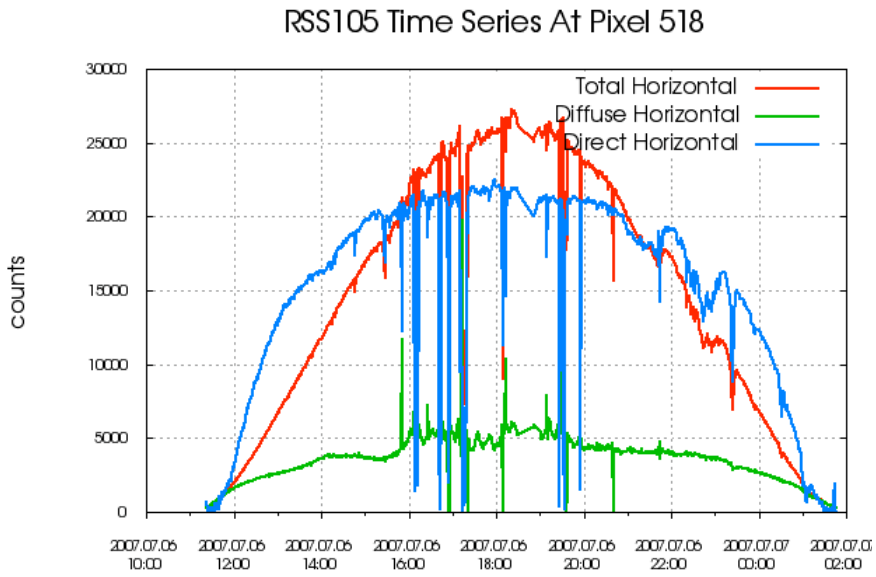
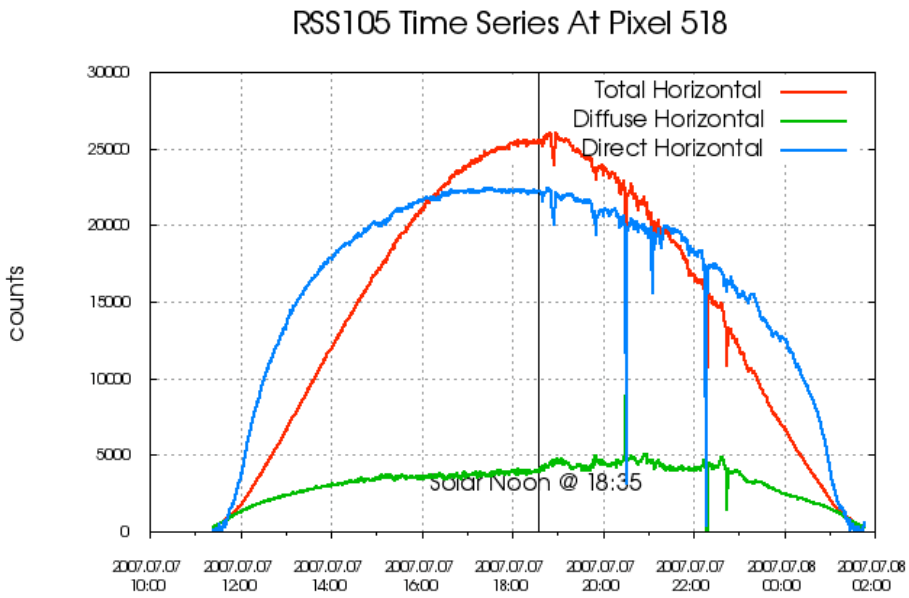
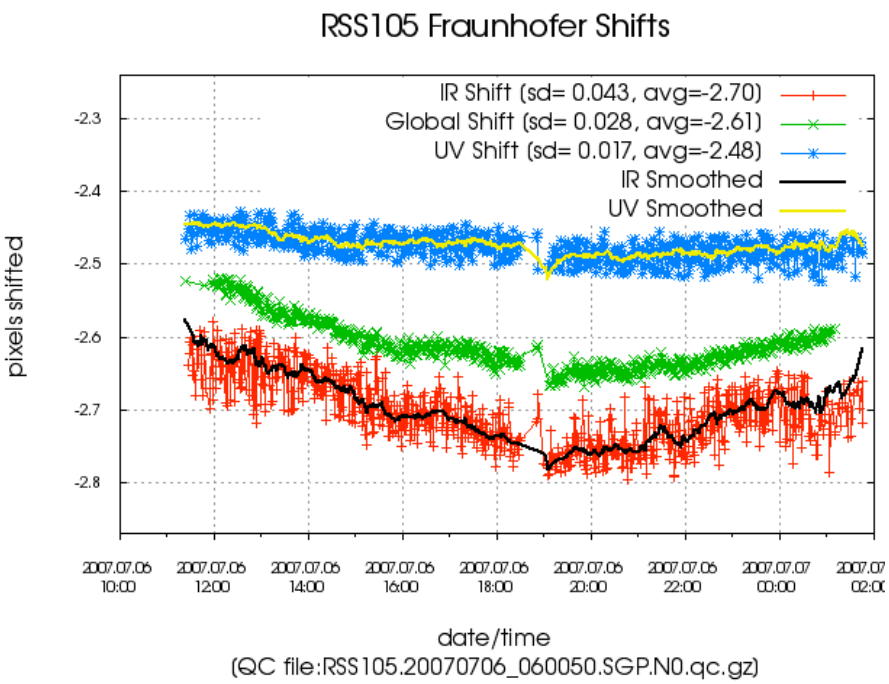
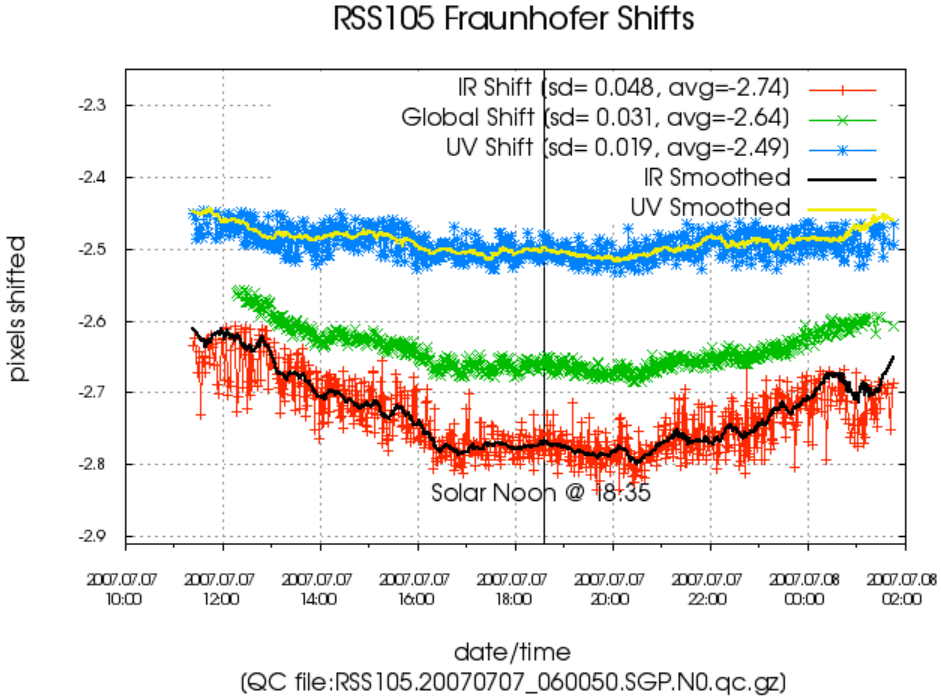
Signal strength and wavelength shifts daily traces

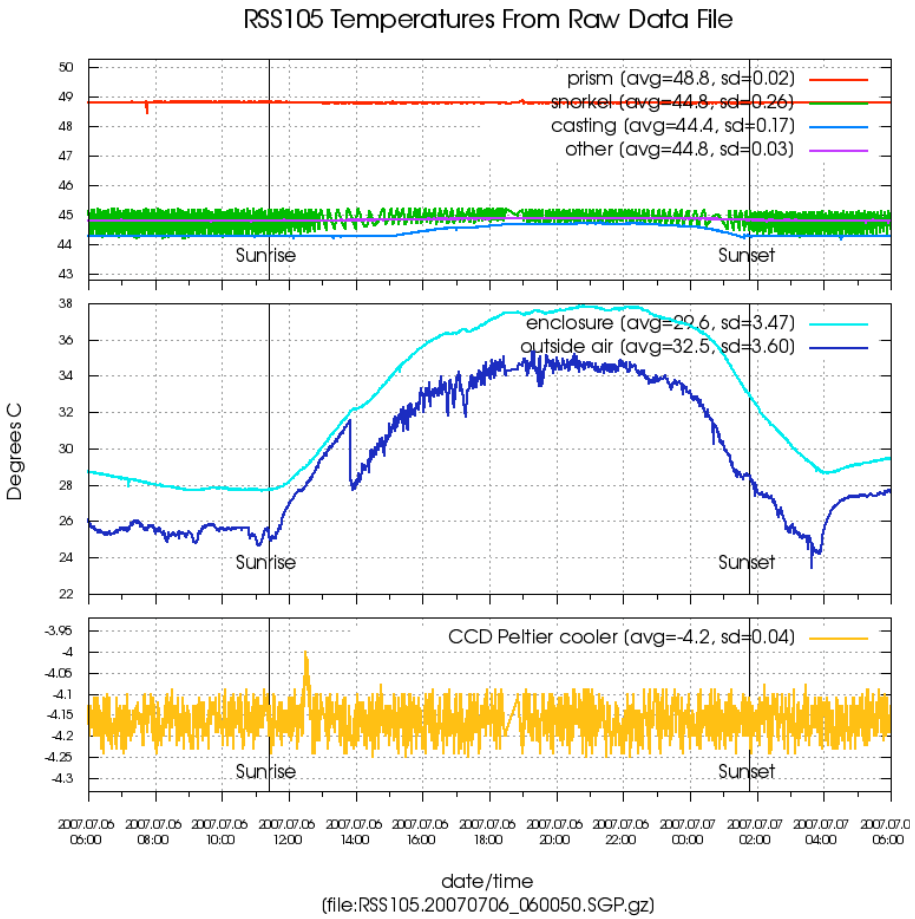


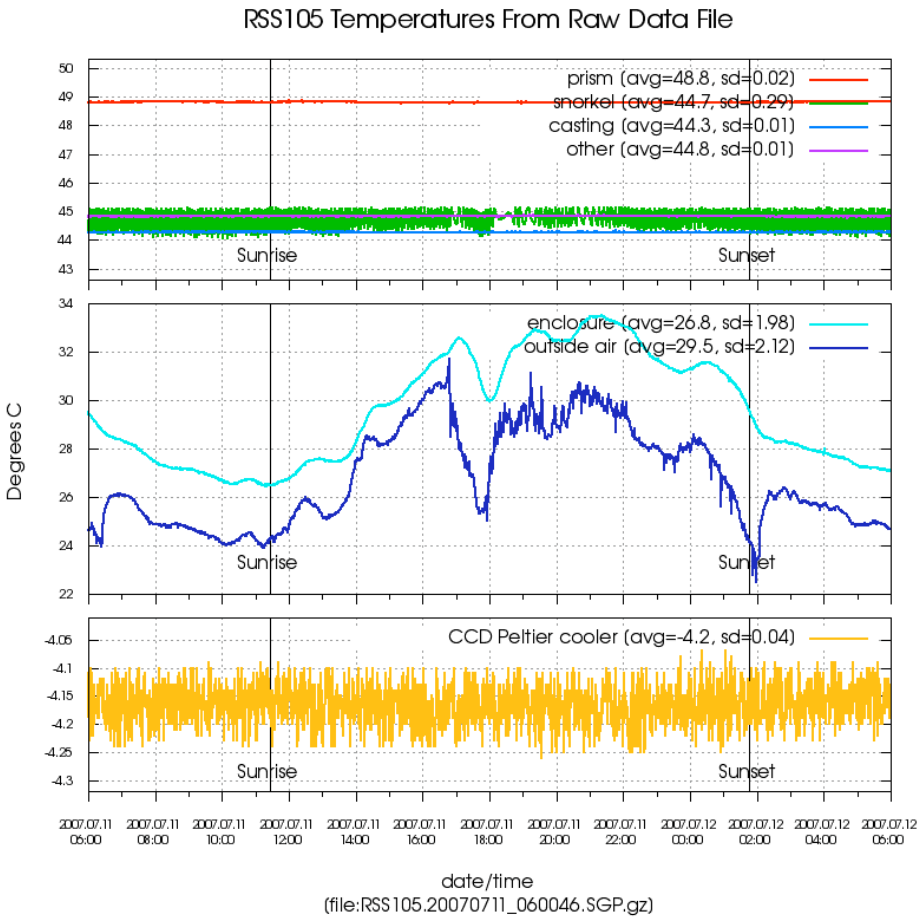






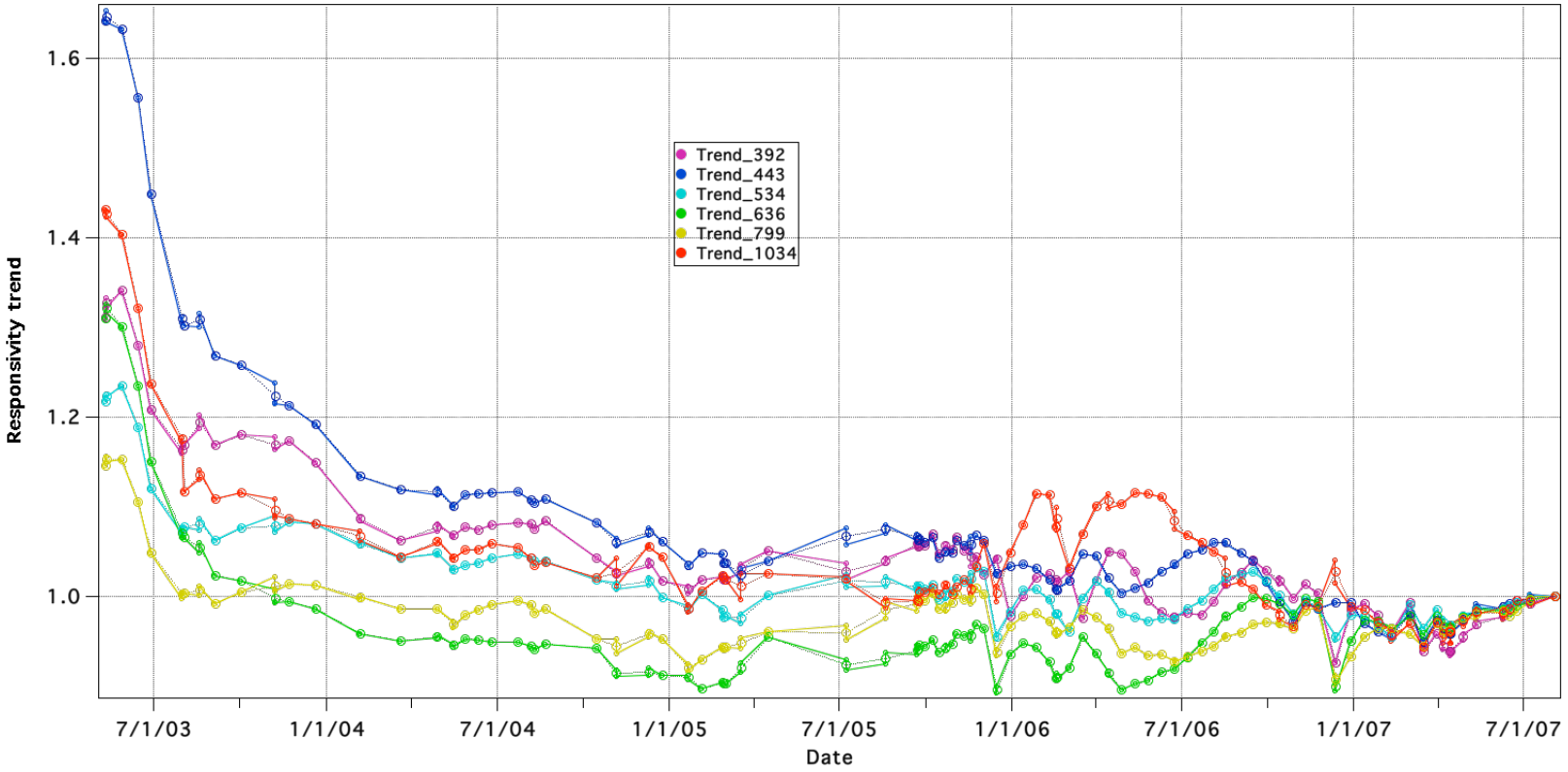
Temperature daily traces



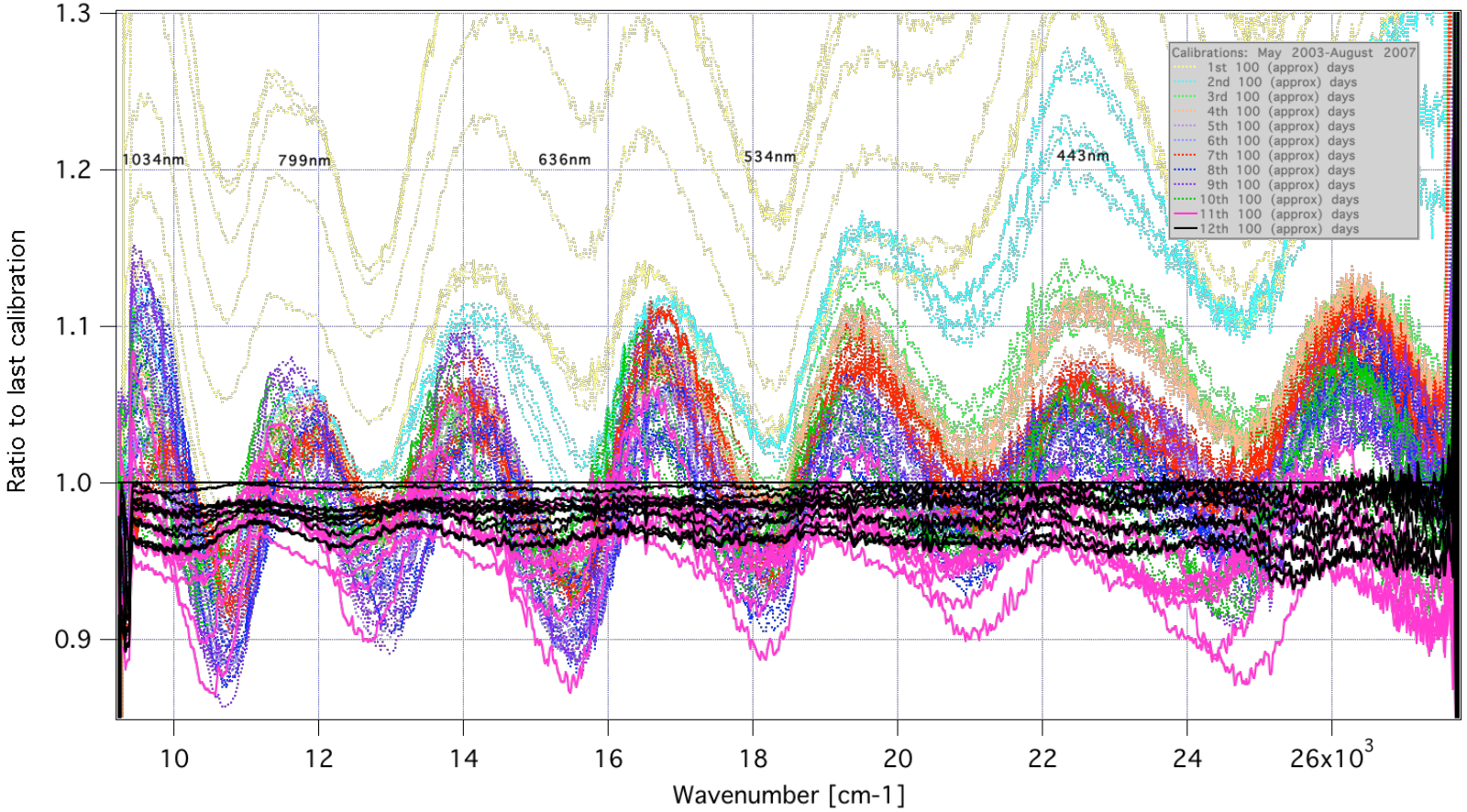


RSS overhaul: why, what, how, when, where, who

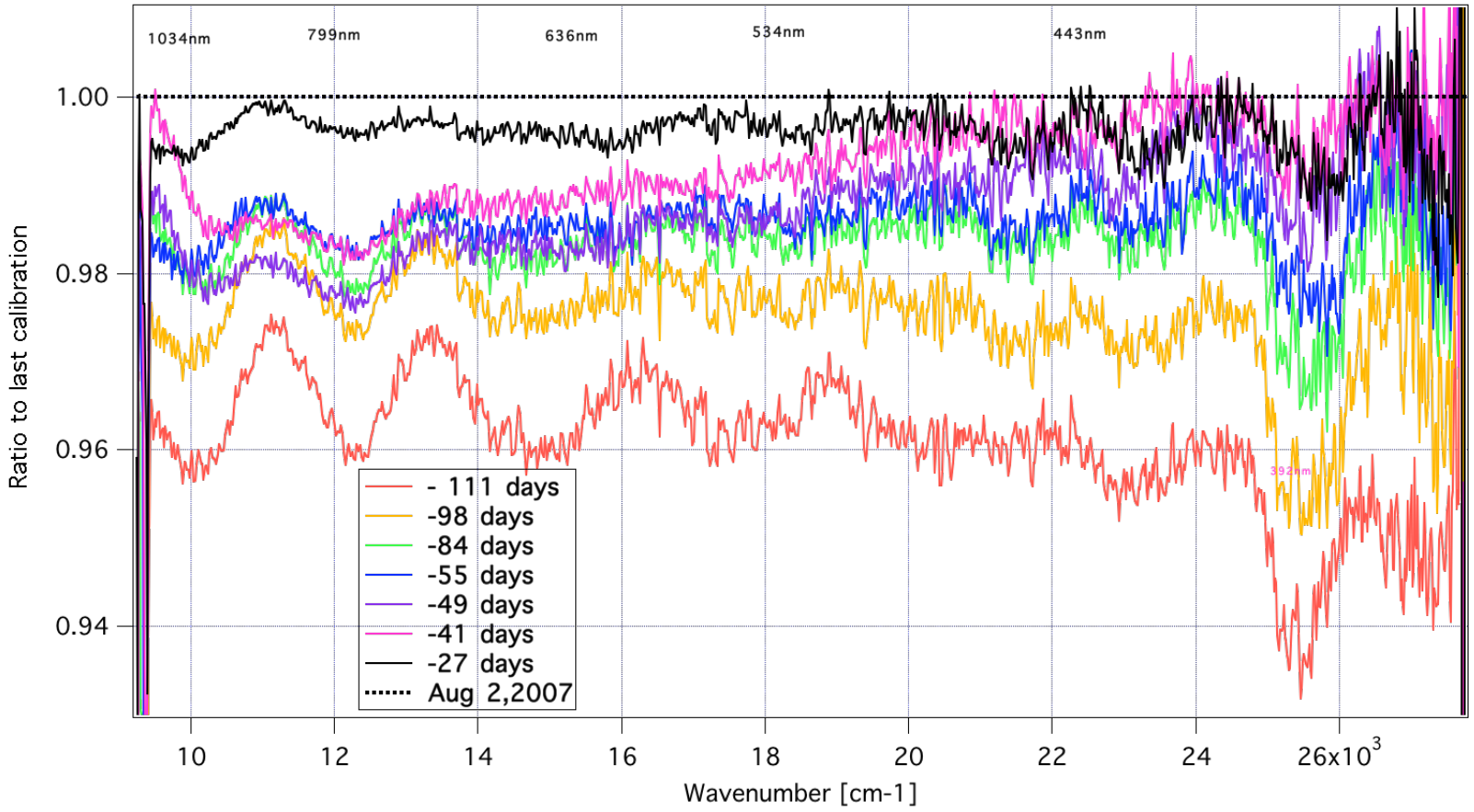
Responsivity Trends in Over 4 Years



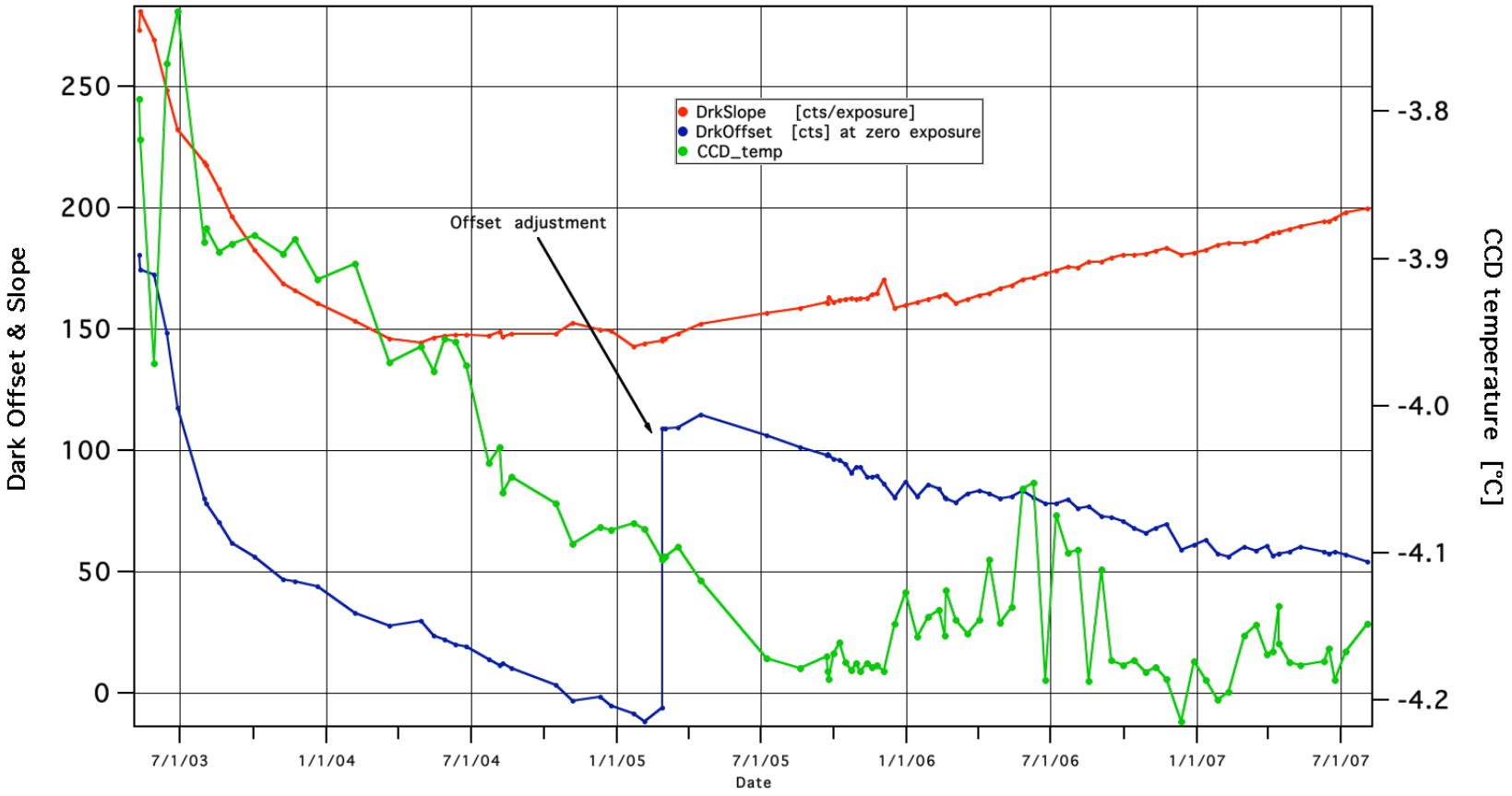
All 138 responsivities normalized by the last



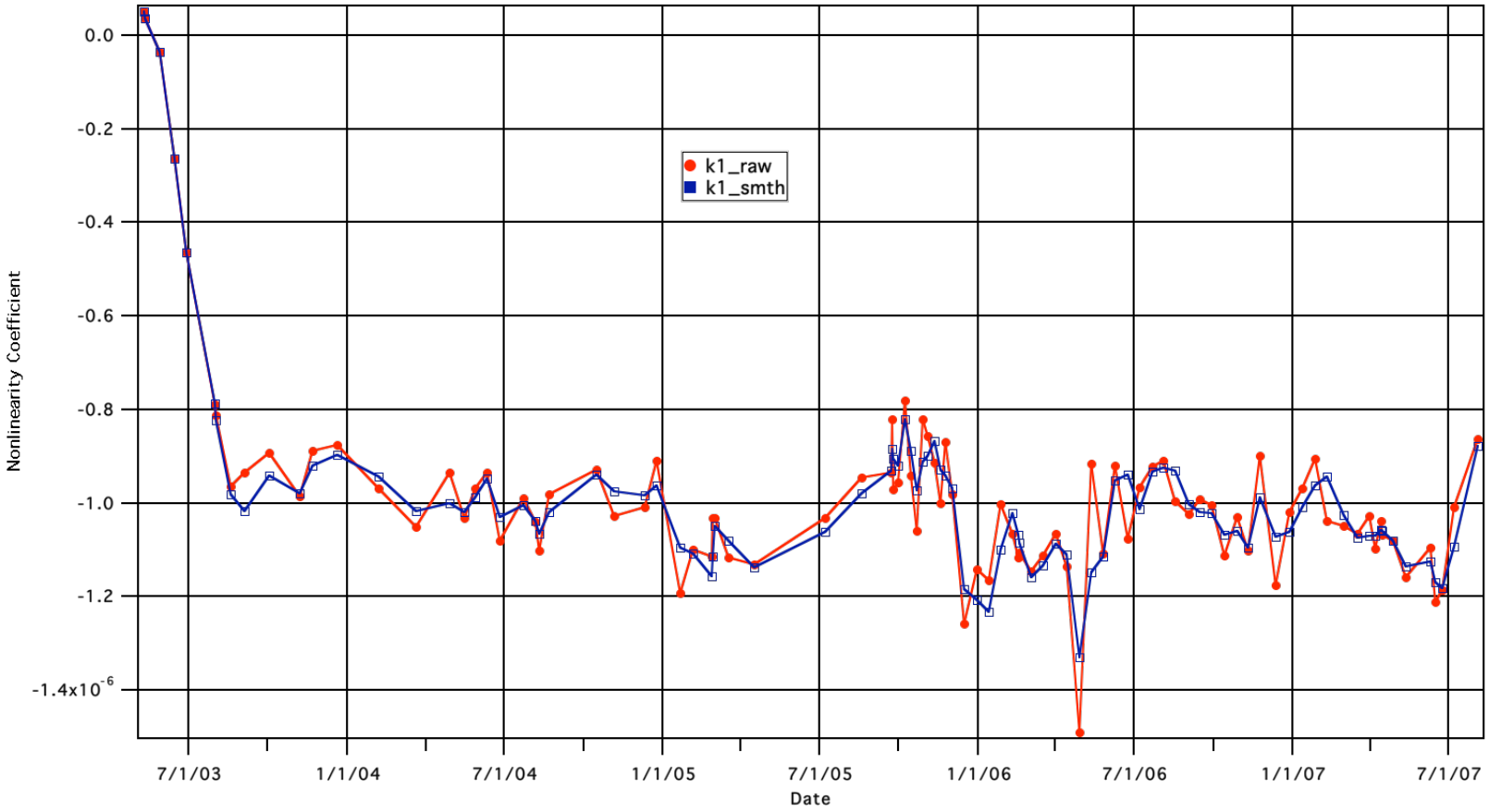
Responsivities In last 111 days



Dark Trends and TEC temperature

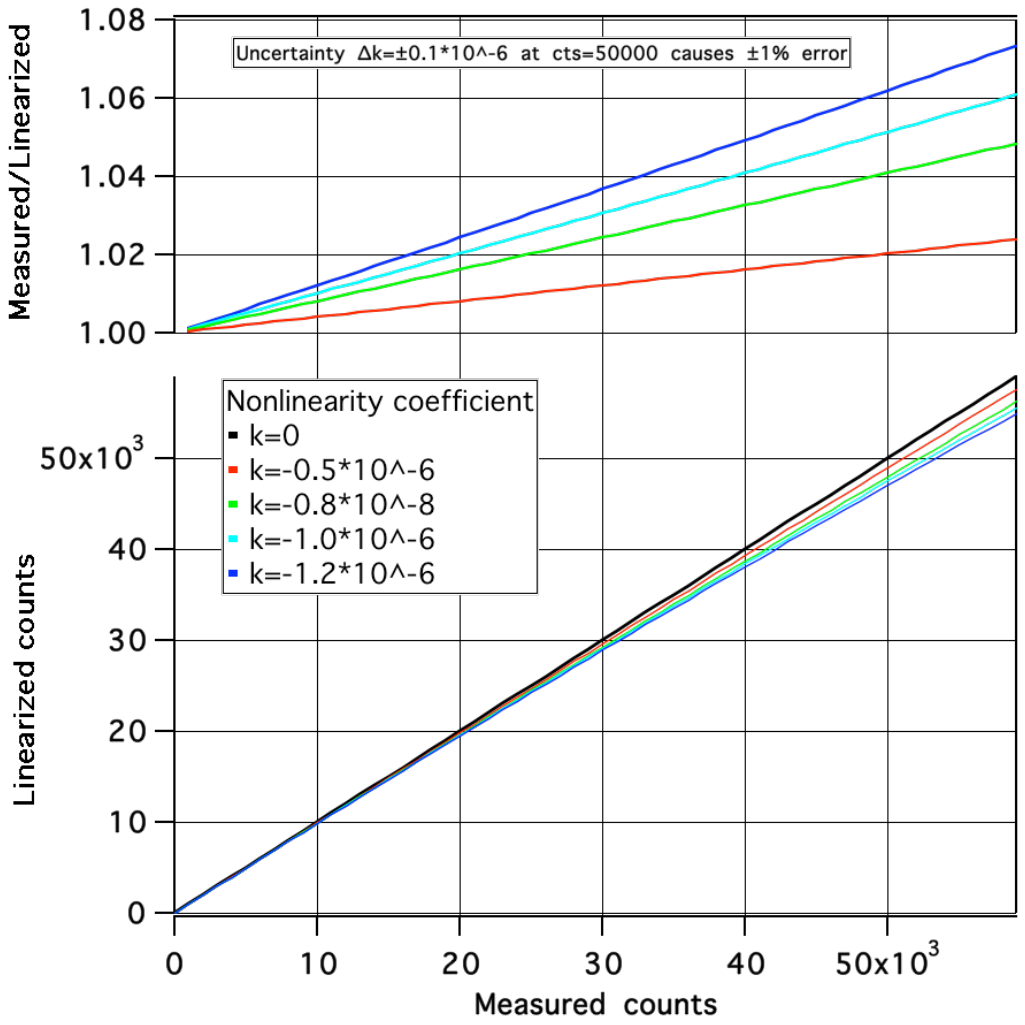


Nonlinearity coefficient trend



Nonlinearity Effect

$C_{linearized} = C_{measured} * \exp[k * C_{measured}]$, where k is negative for RSS105



Pixel shift trend and temperature history (during 138 calibrations)