

MFRSR Processing Solution

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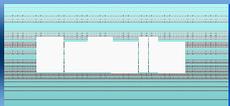




What We Did



- Complete review of historical algorithms and correction files
- Collected all calibration records into a central location, electronic database
- Reviewed all calibration files, with respect to calibration records

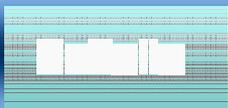




What We Did (cont.)



- Wrote new ARM ingest to process
 - New CR1000 logger MFRSR data
 - Yankee MFRSR logger data
- New algorithms incorporated in ingest
- New correction file formats
- New output data stream content
- Modifications to Langley and mfrod1barnmich VAPs (ongoing)



Shadowband Technique

- Measurements
 - th (total hemispheric)
 - fsb (side band 1) and ssb (side band 2)
 - blk (blocked measurement)

$$\text{Dir_horiz} = \text{blk} + (\text{th} - (\text{fsb} + \text{ssb})/2)$$

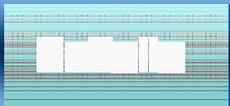
$$\text{Diffuse} = (\text{fsb} + \text{ssb})/2 - \text{blk}$$



Ingest Details



- Use “tu” (obtained from SUNY), to read raw Yankee logger data.
- All operating MFRSRs now collect irradiance data through the night
- Offsets computed from night time measurements, or when night time measurements are not available, use data from calibration records

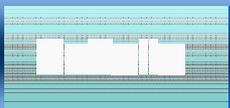




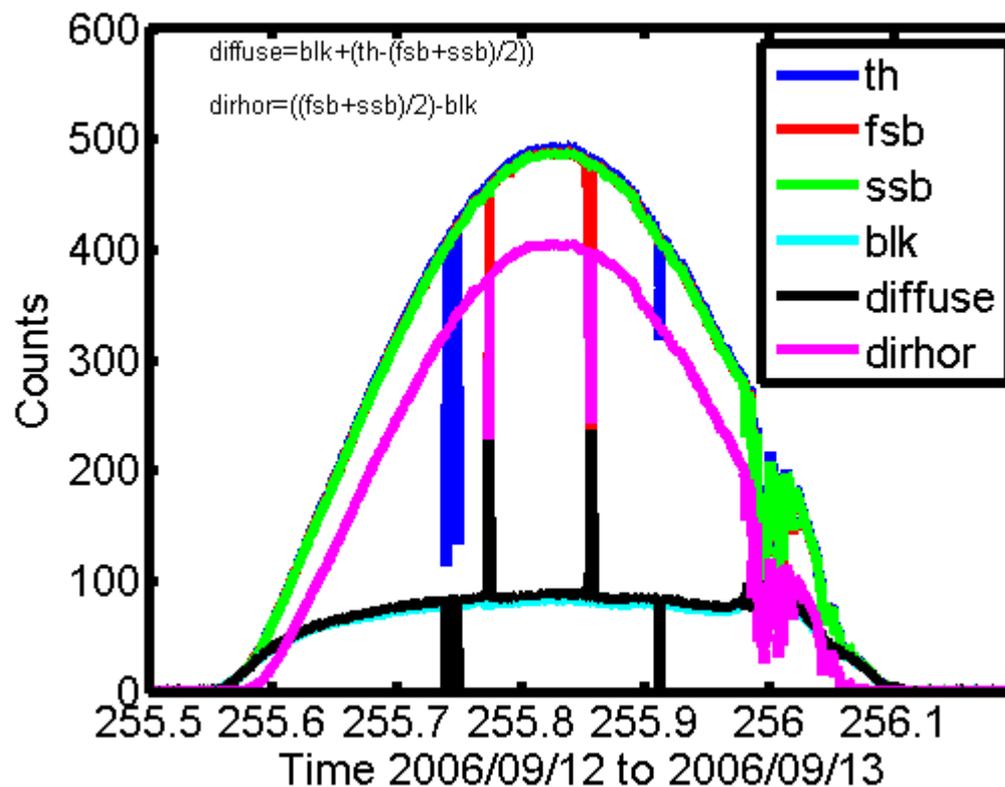
Campbell (CR1000) Data



- CR1000 records new information
 - total hemispheric measurements
 - first and second side band measurements
 - sun-blocked measurement
 - sun position coordinates (adjusted for atmospheric refraction)
 - airmass adjusted for spherical atmosphere
- New data stream: xxxmfrsrrawFn.a0



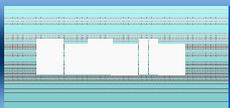
Compute Irradiance (th, dif, dirhor) from CR1000 Data



Computed Corrections



- $Cor_dif = (dif - offset) / diff_correction$
- $Cor_dir_horiz = dir_hor / cosine_correction$
- $Cor_th = cor_dif + cor_dir_horiz$
- $Cor_dir_normal = cor_dir_horiz / \cos(sza)$

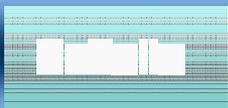




Corrections to a0 Data



- After generating a0 products for either Yankee or CR1000 loggers, subsequent processing is identical.
- Ingest finds correction files, based on unit ID/headID/time
 - CosineCorr, applied to direct irradiance
 - DiffuseCorr (diffuse correction factors, derived from CosineCorr)
 - FilterInfo (filter centerline and bandwidth data obtained during bench calibration)
 - NominalCal (factors used to nominally calibrate MFRSR data, based on calibration data)
 - OffsetInfo (Offset corrections, from calibration data, for cases where we do not have night measurements). Night time measurements are currently being collected from both CR1000 and Yankee loggers.

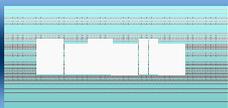




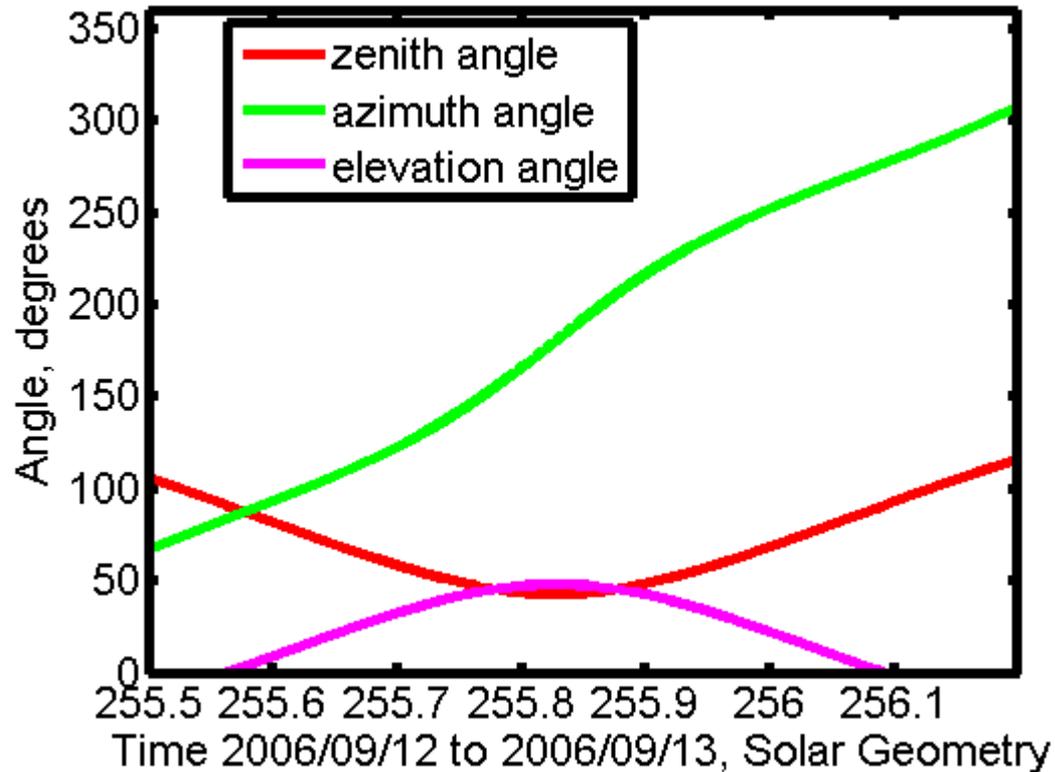
Corrections and Processing (continued)



- Cosine Correction
 - “sunae” (Michalsky), using official site/facility lat/lon for sun position calculations and 5 second adjustment to account for band motion
- Diffuse Correction
- Nominal Calibration
 - Applied to all spectral data
 - Broadband nominal calibration versus NIP
- Compute direct to diffuse ratio



Solar Geometry

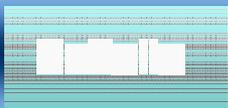




Data now available in netCDF (b1)



- Additional data now available in b1 files
 - Filter trace data (obtained during calibration), normalized transmittance as a function of wavelength
 - Cosine correction (obtained from CosineCorr file)
 - Computed cosine correction
 - Direct to diffuse ratio
 - Night time (“alltime”) channel data (if available)
 - Sun position: solar zenith angle, cosine(solar zenith angle), elevation angle, azimuth angle
 - Airmass
 - Offsets applied
 - Diffuse correction
 - Nominal calibration

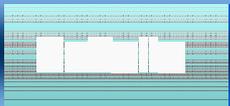




Reprocessing Plans



- Review and generate correction files for historical calibrations (OffsetInfo, FilterInfo, NominalCal)
- Comparison of night time offsets to expected offsets from calibration measurements.
- We will reprocess all data for all sites/facilities at ARM Archive Reprocessing center

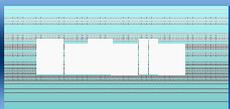




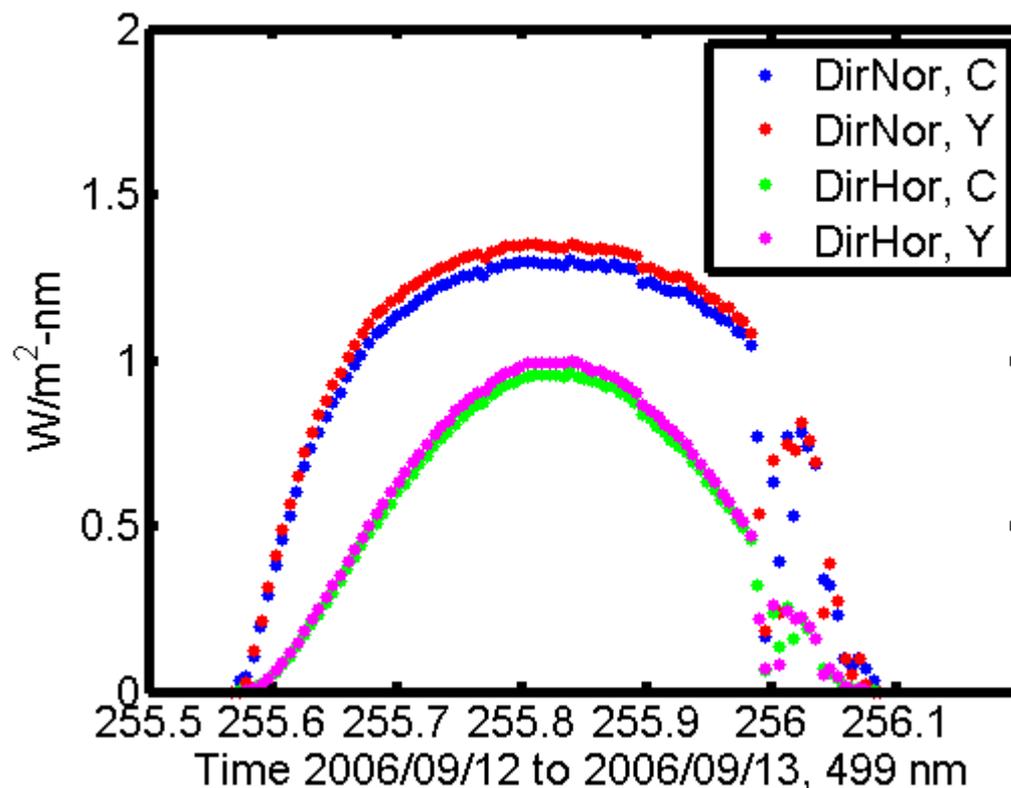
CR1000/Yankee Logger Comparison



- Comparison of side-by-side CR1000 and Yankee loggers, processed via new ingest
- NOTE: in the following slides, the data shown is nominally calibrated, taken from two MFRSRs operated side by side at PNNL.
- One CR1000 logger, one Yankee logger

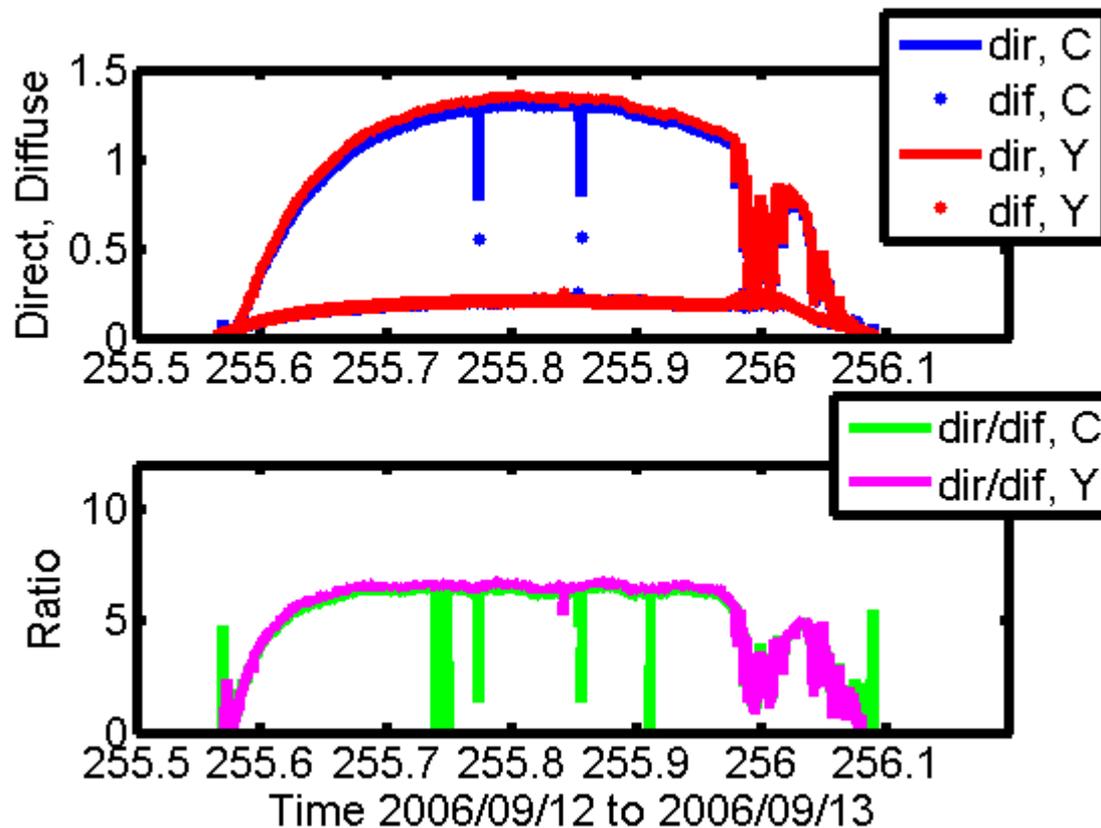


CR1000/Yankee Direct Normal Data, 499 nm

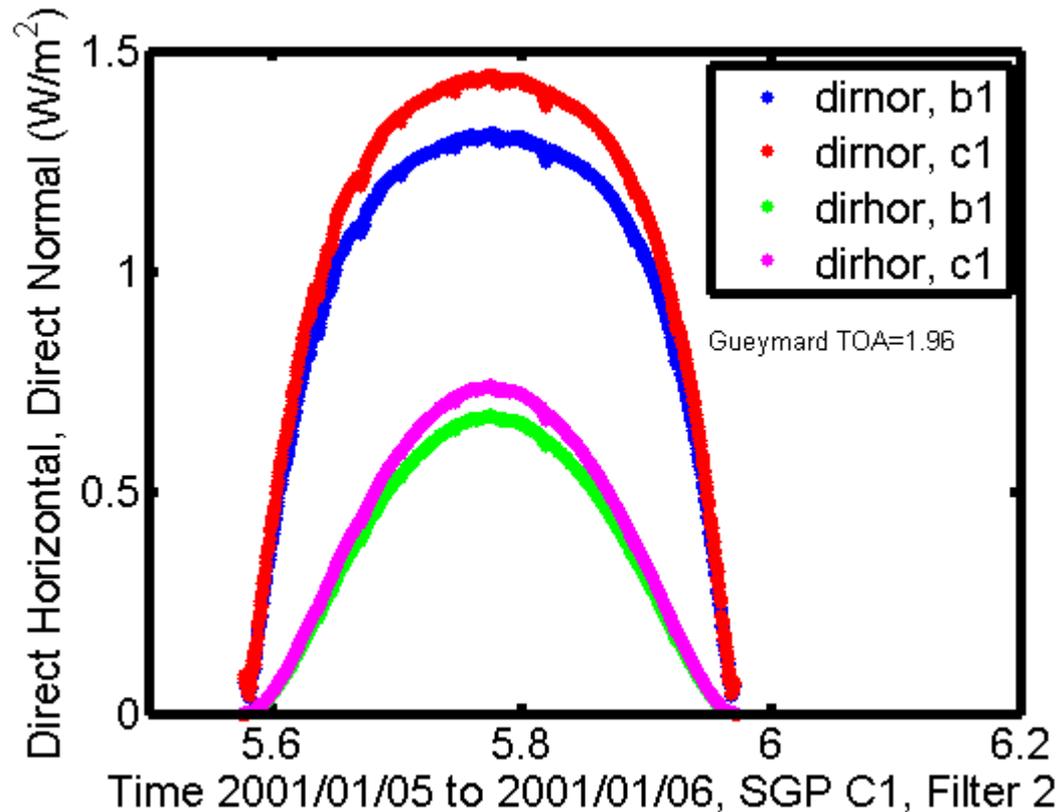


CR1000/Yankee

Direct/Diffuse Ratio, Filter 2



New VAP Product



Summary

- New data streams
 - xxxmfrsrrawFn.a0
 - xxxmfrsrFn.c1 (output from OD VAP)
 - work continues on the OD VAP, adding cloud screen, VAP QC, etc.
- CR1000 Loggers to be added in FY2007