

Multi-Filter Rotating Shadowband Radiometers Mentor Report and Baseline Surface Radiation Network Submission Status

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Overview

There are currently twenty-four Multi-Filter Rotating Shadowband Radiometers (MFRSR) operating within Atmospheric Radiation Measurement (ARM). Eighteen are located within the Southern Great Plains (SGP) region, there is one at each of the North Slope of Alaska (NSA) and Tropical Western Pacific (TWP) sites, and one is part of the instrumentation of the ARM Mobile Facility. At this time there are four sites, all extended facilities within the SGP, that are equipped for a MFRSR but do not have one due to instrument failure and a lack of spare instruments. A listing of all the sites the support MFRSRs along with the instrument status is provided in Table 1. In addition to the MFRSRs, there are three other MFRSR derived instruments that ARM operates. They are the Multi-Filter Radiometer (MFR), the Normal Incidence Multi-Filter Radiometer (NIMFR) and the Narrow Field of View (NFOV) radiometer. All are essentially just the head of a MFRSR used in innovative ways. The MFR is mounted on a tower and pointed at the surface. At the SGP Central Facility there is one at ten meters and one at twenty-five meters. The NSA has a MFR at each station, both at the ten meter level. ARM operates three NIMFRs; one is at the SGP Central Facility and one at each of the NSA stations. There are two NFOVs, both at the SGP Central Facility. One is a single channel (870) and the other utilizes two channels (673 and 870). A description of MFRSR derived instrument locations and their status is given in Table 2.

Table 1. The current status of all of the ARM MFRSRs is shown. Columns one and two provide the location of each instrument. The third column indicates if the instrument is currently operating, and the fourth column gives a short description of problems involving the instruments if applicable.			
Region	Site	Operating Status	Current Problems/Issues
SGP	C1 Central Facility	Yes	-----
SGP	EF-1 Larned KS	Yes	Channel 673 is intermittently noisy
SGP	EF-2 Hillsboro KS	No	Instrument failed and was removed from service July 2003.
SGP	EF-3 LeRoy KS	Yes	-----
SGP	EF-4 Plevna KS	Yes	Frequent drop outs in the head temp and logger voltage

Table 1. (cont'd)			
Region	Site	Operating Status	Current Problems/Issues
SGP	EF-5 Halstead KS	Yes	-----
SGP	EF-6 Towanda KS	Yes	-----
SGP	EF-7 Elk Falls KS	Yes	Head temp is consistently below minimum
SGP	EF-8 Coldwater KS	Yes	Channel 415 is working intermittently
SGP	EF-9 Ashton KS	Yes	-----
SGP	EF-10 Tyro KS	No	Instrument failed and was pulled from service in June 2001
SGP	EF-11 Byron OK	Yes	-----
SGP	EF-12 Pawhuska OK	Yes	-----
SGP	EF-13 Lamont OK	Yes	-----
SGP	EF-15 Ringwood OK	Yes	-----
SGP	EF-16 Vici OK	Yes	-----
SGP	EF-18 Morris OK	Yes	-----
SGP	EF-19 El Reno OK	No	Instrument damaged by lightning and pulled from service June 2004
SGP	EF-20 Meeker OK	No	Instrument failed and was pulled from service July 2003
SGP	EF-21 Okmulgee OK	MFRSR never Installed	NA
SGP	EF-22 Cordell OK	Yes	-----
SGP	EF-24 Cyril OK	Yes	Strange inverse relationship between head temp and logger voltage
SGP	EF-25 Seminole OK	Station not in Operation	Site was decommissioned April 2002
SGP	EF-26 Cement OK	MFRSR never Installed	NA
SGP	EF-27 Earlsboro OK	Yes	-----
NSA	C1 Barrow AK	Yes	-----
NSA	C2 Atkasuk AK	Yes	-----
TWP	C1 Manus	Yes	-----
TWP	C2 Nauru	Yes	-----
TWP	C3 Darwin	Yes	-----

Table 2. The current status of all of the ARM instruments derived from the MFRSR. Columns one and two provide the location of each instrument. The third column indicates if the instrument is currently operating, and the fourth column gives a short description of problems involving the instruments if applicable.

Region	Site/Instrument	Operating Status	Current Problems/Issues
SGP	C1 MFR10m	Yes	Data show a small dip close to solar noon. Cause is unknown at this time.
SGP	C1 MFR25m	Yes	Data often shows unusual characteristics mid to late morning. Likely the result of surface conditions.
NSA	C1 MFR10m	Yes	-----
NSA	C2 MFR10m	Yes	-----
SGP	C1 NIMFR	Yes	-----

Table 2. (cont'd)			
Region	Site/Instrument	Operating Status	Current Problems/Issues
NSA	C1 Barrow NIMFR	Yes	-----
NSA	C2 Atkasuk NIMFR	Yes	-----
SGP	C1 NFOV Single Channel	Yes	Condensation on the inside of the window is being frequently reported
SGP	C1 NFOV Dual Channel	No	Instrument has been pulled from service for maintenance and modifications

There are currently two major projects involving the MFRSR that are underway. The first is the purchase of replacement interference filters. Some of these instruments have been installed for close to ten years and ARM is starting to see failures related to the filters. At this time a bid for the job has been submitted and ARM is arranging to make payment. The goal is to have the purchase completed by the end of fiscal year 2005. The intent is to purchase 100 filter sets which is enough to service and repair all the MFRSR and derived instruments, as well as providing a supply of replacement sets for future repairs.

The other major project is the conversion to Campbell data loggers from the current Yankee logger boards. Once implemented, the Campbell loggers should prove less costly than maintaining the current loggers due to the relatively low cost of the hardware. Also, since Campbell loggers are ubiquitous within ARM, there will be more resources and support available. In addition to the cost savings, the Campbell loggers will provide improved programming flexibility and sampling rates, as well as possibly facilitating the installation and alignment of MFRSRs using innovative programming techniques.

Baseline Surface Radiation Network

The recent biennial Baseline Surface Radiation Network (BSRN) meeting took place July 2004 in Exeter, Devon, United Kingdom. With four stations being submitted, ARM is one of the better-represented organizations within the BSRN community. At the meeting it was agreed that data from ARM's TWP Darwin site should be included. Including Darwin will provide the BSRN community two co-located and independent sites to study. At this time the formalities for data submission have not been completed which is why it is not shown in the table below. At present, data have been submitted through January 2005 for the four ARM sites currently included in the archive, though the maintainers of the archive have not yet inserted these datasets into the archive.

Figures

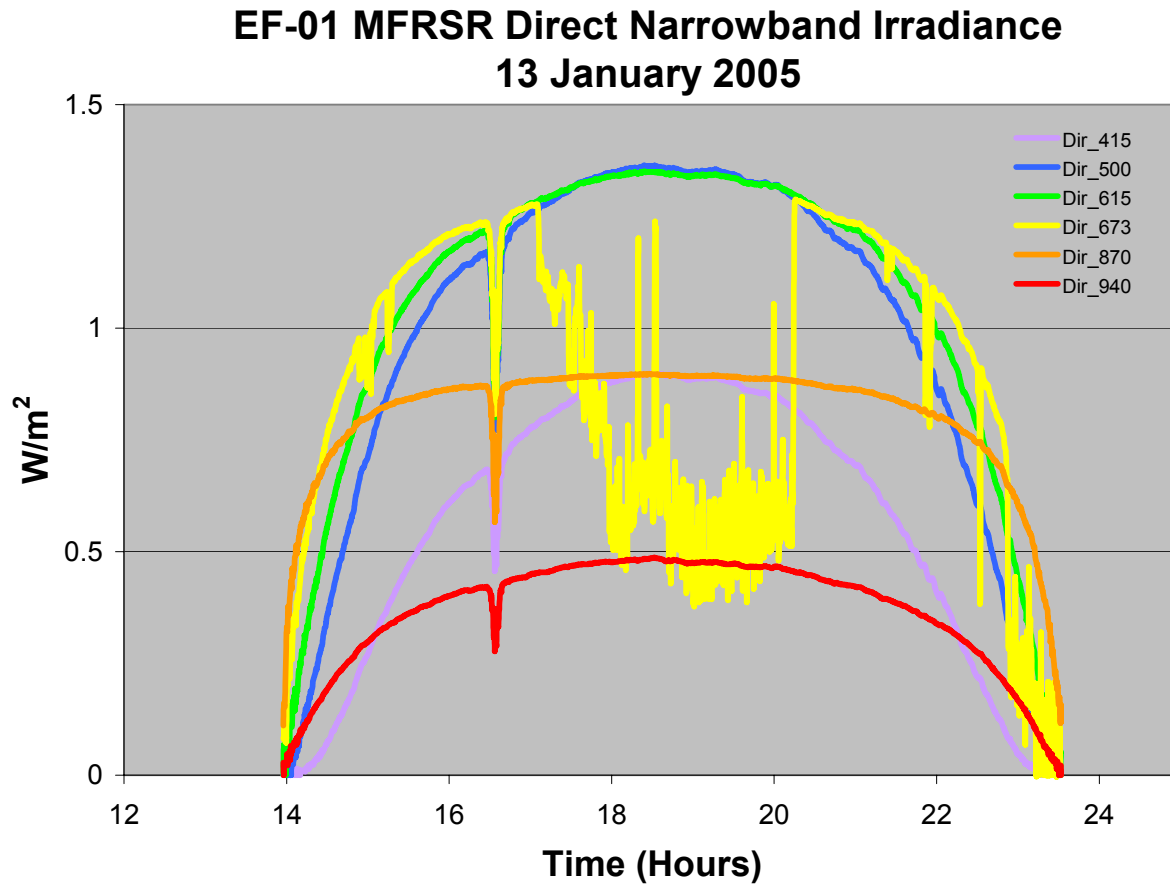


Figure 1a. Examples of some problems described in the table to the left. A plot of narrowband irradiance from the MFRSR located at EF-01 Larned, KS. In this plot it is clearly seen that channel 673 is noisy.

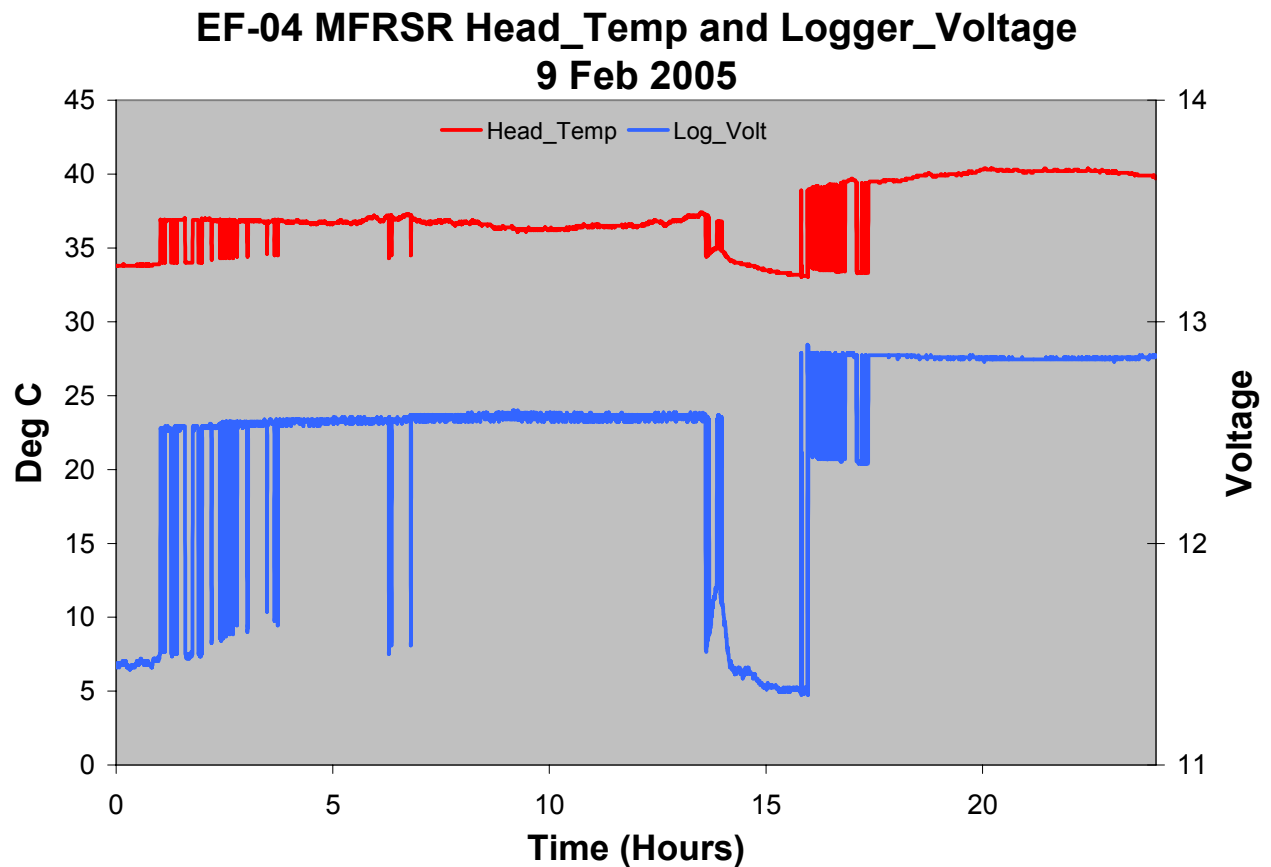


Figure 1b. This figure presents the MFRSR head temperature and logger voltage from EF-04 Plevna, KS. A relationship between the voltage drops and temperature drops is evident. Note that the irradiance measurements do not appear to be affected by this.

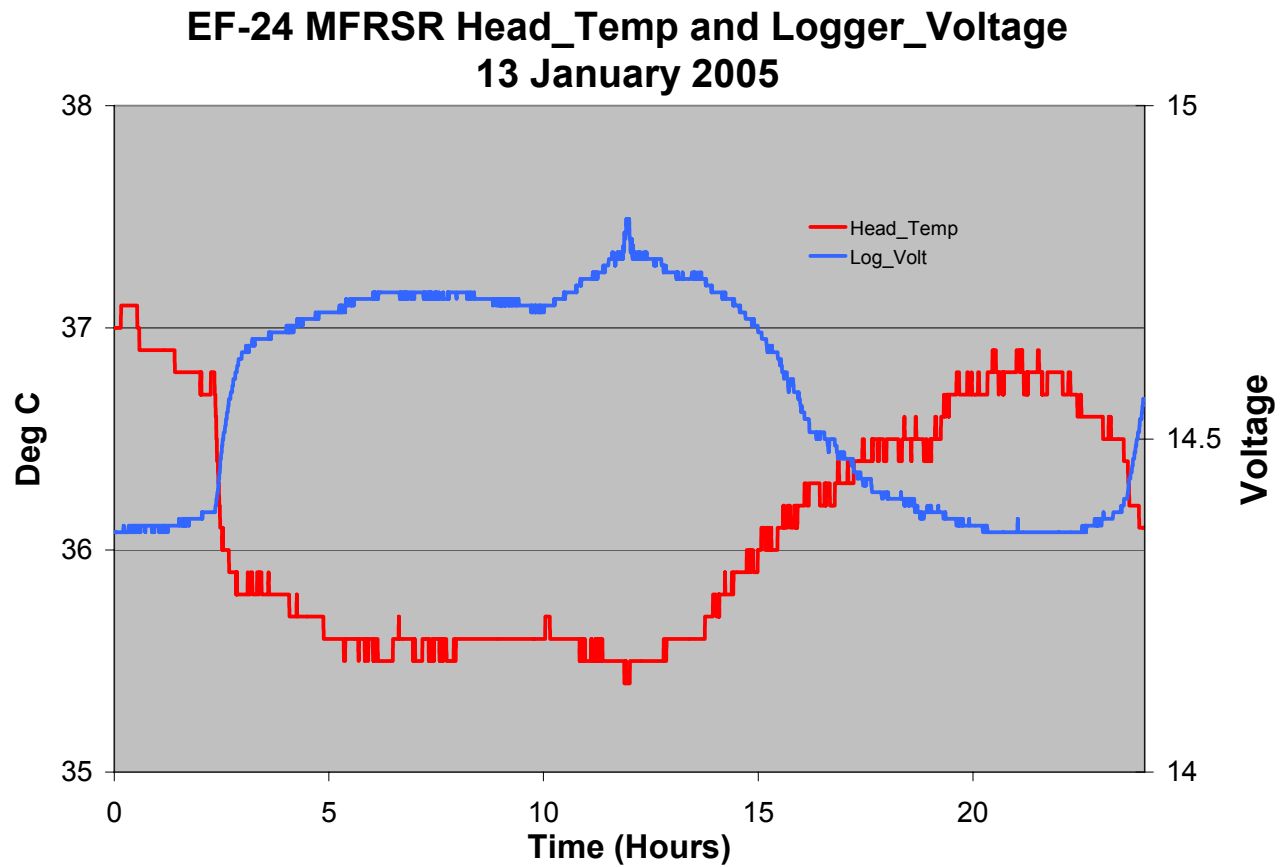


Figure 1c. Shows a strange inverse relationship between the head temperature and logger voltage of the MFRSR located at EF-24 Cyril, OK. This is the only MFRSR that shows such a relationship. The irradiance data at this site do not seem to be affected.

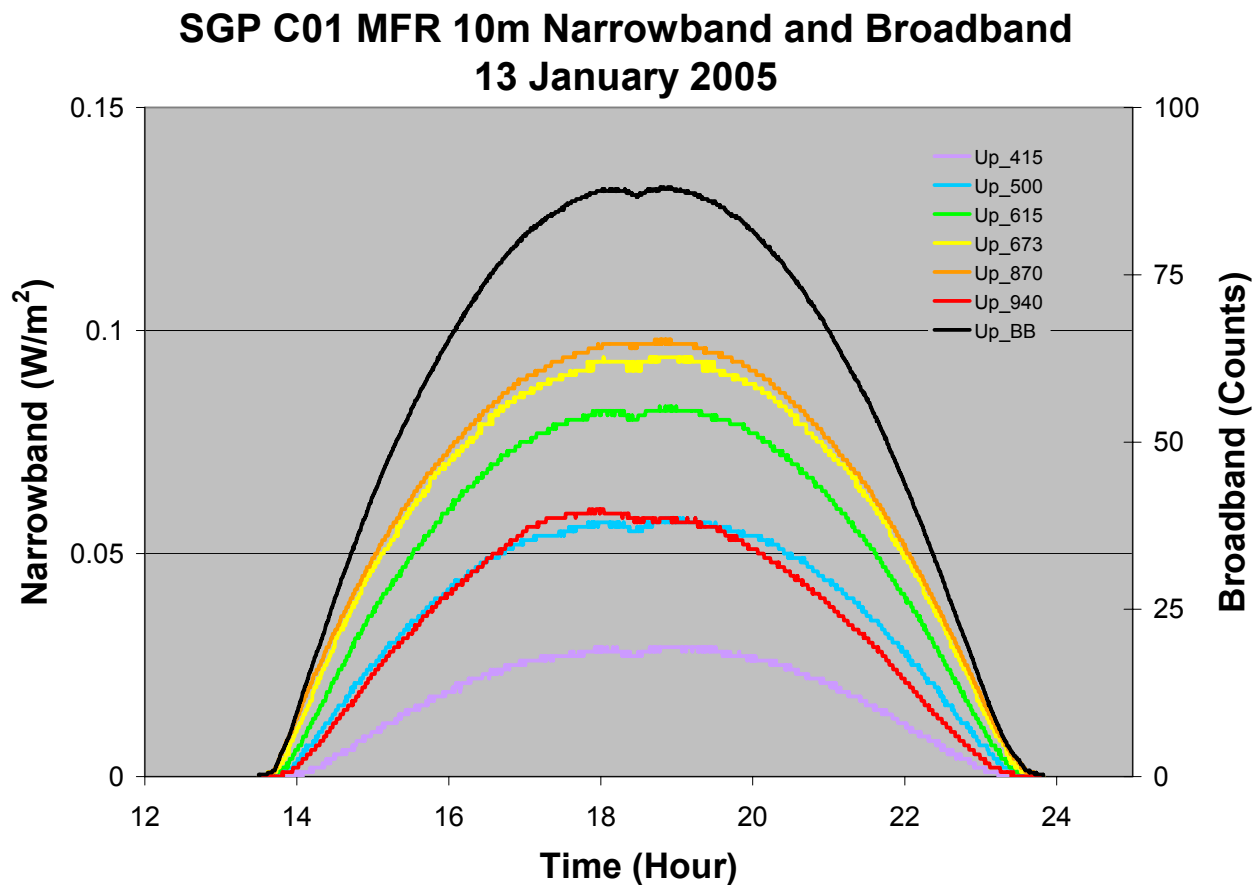


Figure 2a. A plot of the six narrowband channels and the broadband channel from the SGP CF 10 meter MFR. Notice that very near solar noon there is a slight dip across all channels. This dip is consistently seen on clear days during the winter months and goes back at least two years. Preliminary investigation has not revealed why this occurs.

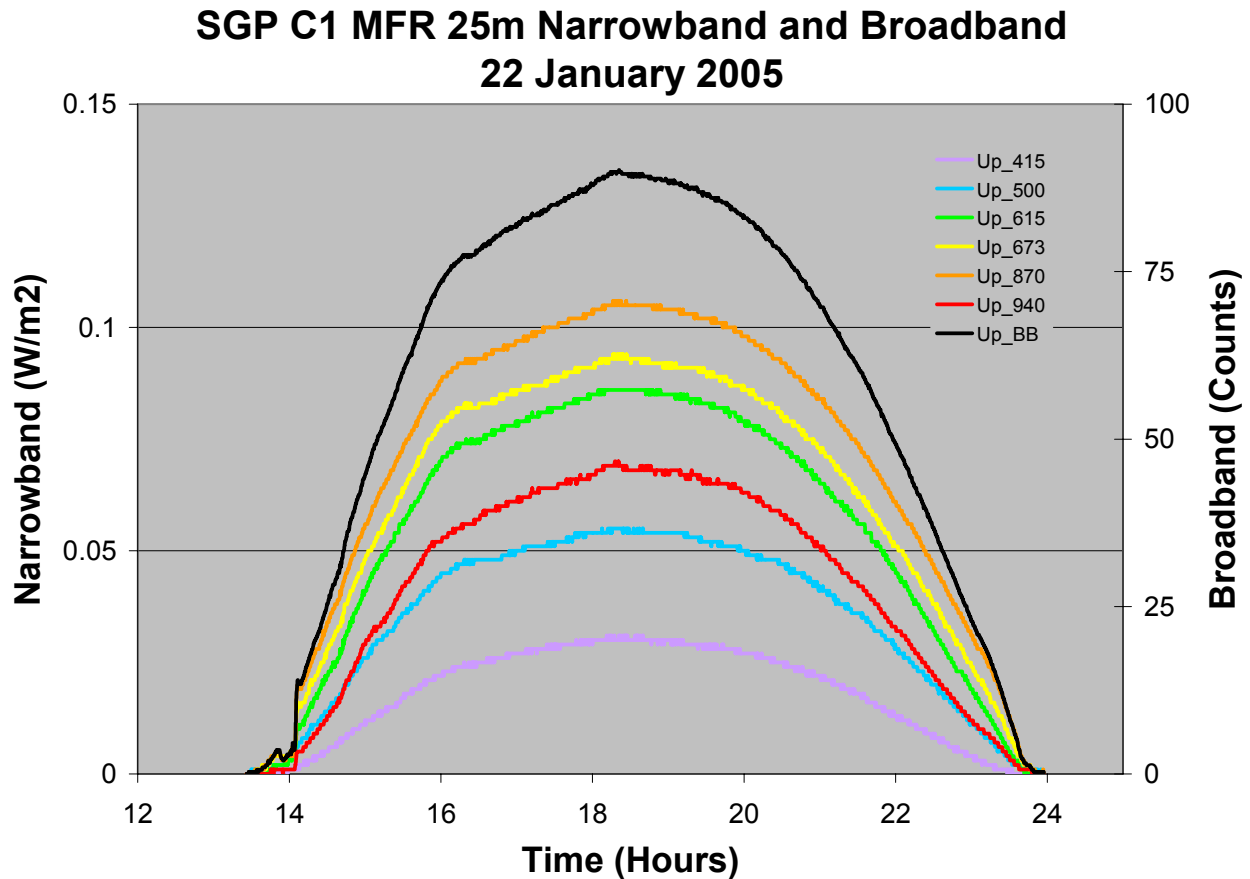


Figure 2b. Presents data from the SGP CF 25 meter MFR. In this plot a mostly linear rise in the data is observed between about 1600 UTC and 1900 UTC. Similar features can be seen on other, but not all, clear days. Though this has not been investigated fully, it probably results from inhomogeneous surface conditions around the base of the sixty meter tower. It should be noted that the 10 meter MFR is located on the EF-13 tower, and thus is seeing a completely different surface than the 25 meter MFR.



Figure 3. Photos of the various MFRSR derived instruments. Figure 3a shows the NIMFR that is located at the SGP CF. This instrument is located on the EF-13 solar tracker.



Figure 3b. An MFR – this instrument is mounted on towers pointed at the surface to provide data on reflected irradiances.



Figure 3c. An MFR contained in an insulated housing required for deployments in the NSA.



Figure 3d. The single channel and two channel NFOV instruments.



Figure 3e. A standard MFRSR in a typical deployment.

BSRN

Baseline Surface Radiation Network

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Baseline Surface Radiation Network (BSRN) World Radiation Monitoring Center (WRMC)

BSRN is a project of the [World Climate Research Programme \(WCRP\)](#) and the [Global Energy and Water Experiment \(GEWEX\)](#) and as such is aimed detecting important changes in the earth's radiation field at the earth's surface which may related to climate changes. The data are of primary importance in supporting the validation and confirmation of satellite and computer model estimates of these quantities. At a small number of stations (currently fewer than 40) in contrasting climatic zones, covering a latitude range from 80°N to 90°S (see [station maps](#)), solar and atmospheric radiation is measured with instruments of the highest available accuracy and with high time resolution (1 to 3 minutes). The BSRN was recently (early 2004) designated as the global baseline network for surface radiation for the [Global Climate Observing System \(GCOS\)](#). The GCOS monitoring principles are shown [here](#).

The radiation data are stored together with collocated surface and upper-air meteorological observations and station 'metadata' in an integrated database here at ETH Zurich, which has been designated as the World Radiation Monitoring Center (WRMC).

High accuracy BSRN radiation measurements are described in these pages and have been used to validate the radiation schemes in global climate models and satellite algorithms and are beginning to develop into an extensively documented and widely representative surface radiation data set. Further participation in the program by well supported long-term measurement programs, like those traditionally maintain by national governments and located in regions not currently well represented (see maps) is encouraged. Participation in BSRN permits direct interactions with a world community of surface radiation scientists and significant contribution to several international climate research programs.

For questions or comments about the BSRN data or this web site, please contact the WRMC data manager at 'bsrnadm[at]env.ethz.ch' (mailto:bsrnadm[at]env.ethz.ch) (mailto tool at bottom of left frame). For questions concerning the quality flags applied to the relational database please contact the WRMC quality manager at 'muller[at]env.ethz.ch'. Data quality flags associated with the FTP accessible data base are described [here](#). Other questions should be directed as appropriate to the individuals identified under [contacts](#).

Figure 4a. A screen capture of the BSRN home page <<http://bsrn.ethz.ch>>

	STATION	YEAR														TOTAL
		1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	
Project	ASP	-	-	-	12	12	12	12	12	12	12	12	1	-	-	97
Background	FLO	-	-	6	12	12	12	12	12	-	-	-	-	-	-	66
Objectives	REG	-	-	-	12	12	12	12	12	-	-	-	-	-	-	60
Measurement	TOR	-	-	-	-	-	-	12	12	12	12	12	9	-	-	57
State of affairs	CAR	-	-	-	-	4	12	12	12	5	-	-	-	-	-	46
Contacts	NYA	5	12	12	12	12	12	12	12	12	12	12	12	-	-	137
Stations	LIN	-	-	3	12	12	12	12	12	12	12	12	5	-	-	104
List	GVN	9	12	12	12	12	12	12	12	12	12	12	12	-	-	141
Information	TAT	-	-	-	-	11	12	12	12	12	12	12	12	3	-	103
Maps	SYO	-	-	12	12	12	12	12	12	12	12	12	-	-	-	108
Database	PAY	3	12	12	12	12	12	12	12	12	12	12	12	4	-	139
Schema	BAR	12	12	12	12	12	12	12	12	12	12	12	12	-	-	144
Description	BOU	12	12	12	12	12	12	12	12	12	12	12	12	-	-	144
Data file	BER	12	12	12	12	12	12	12	12	12	12	12	12	-	-	144
Status	KWA	9	12	12	12	12	12	12	12	12	12	12	12	-	-	141
Quality	SPQ	12	12	12	12	12	12	12	12	12	12	12	12	-	-	144
Data retrieval	E13	-	-	-	-	-	4	12	12	12	12	12	12	3	-	79
Other	BIL	-	6	12	12	12	12	12	12	12	12	12	12	3	-	129
Meetings	MAN	-	-	-	-	3	12	12	12	12	12	12	12	3	-	90
Publications	NAU	-	-	-	-	-	-	2	12	12	12	12	12	3	-	65
Status reports to WCRP/GEWEX	FPE	-	-	-	12	12	12	12	12	12	12	12	1	-	-	97
Radiation Panel	BON	-	-	-	12	12	12	12	12	12	12	12	1	-	-	97
News	GCR	-	-	-	12	12	12	12	12	12	12	12	1	-	-	97
Links	BOS	-	-	-	5	12	12	12	12	12	12	12	1	-	-	90
Sitemap	DRA	-	-	-	-	-	-	10	12	12	12	12	1	-	-	59
FAQ	PSU	-	-	-	-	-	-	7	12	12	12	12	1	-	-	56
Mailbox	CAN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
	ILO	4	12	12	5	-	-	-	-	-	-	-	-	-	-	33
	CLH	-	-	-	-	-	-	-	-	6	12	12	12	6	-	48
	DAA	-	-	-	-	-	-	-	-	7	12	12	12	1	-	44
	SOV	-	-	-	-	-	-	4	12	12	12	12	-	-	-	52
	TAM	-	-	-	-	-	-	-	-	10	12	12	-	-	-	34
	SBO	-	-	-	-	-	-	-	-	-	-	-	12	5	-	17
	CAM	-	-	-	-	-	-	-	-	-	7	-	-	-	-	7
	LER	-	-	-	-	-	-	-	-	-	6	-	-	-	-	6
	ALB	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
	LAU	-	-	-	-	-	-	-	5	12	12	12	1	-	-	42
	PAL	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
	Total	78	114	141	214	234	256	237	329	323	349	336	214	36	0	2916

Figure 4b. The site status page. Note that the status page does not reflect all the files that have been submitted. Currently all ARM sites have been submitted through January 2005 and awaiting insertion into the database. The ARM sites are E13, BIL, MAN and NAU. It is hoped that this year will begin Darwin data submissions to the BSRN archive.