# Quarterly Report of the Southern Great Plains Site Scientist Team

**For the period**
**September 1-November 30, 1998**

**Issued December 1, 1998**

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## 1. Introduction

The Southern Great Plains (SGP) Site Scientist Team (SST) is obligated to prepare quarterly Site Scientist reports, outlining site operations for the period covered by the report and assessing the efficacy of site operations in achieving the goals outlined in the *Site Scientific Mission Plan*. The reports are to be suitable for distribution to the ARM Science Team and delivered to the ARM Program Office on March 1, June 1, September 1, and December 1 of each year. This document focuses on our efforts relating to scientific support for site operations. Updates on our research and educational outreach programs are available in other documents provided to the ARM Program.

This Quarterly Report covers the period September 1 through November 30, 1998.

## 2. Goals for the Period as Outlined in the *Site Scientific Mission Plan*

Priorities for site activities for July-December 1998, as outlined in section 2.2 of the present *Site Scientific Mission Plan,* are as follows:

- Facilitate all data quality assessment efforts, particularly those focused on the development of a full suite of data quality analysis tools, participation in the development of an ARM data user interface, implementation of Quality Measurement Experiments (QMEs) and Value Added Procedures (VAPs), and better dissemination of information on data quality.
- Conduct an assessment of the measurement capability of the SGP CART site relative to Science Team needs.
- Plan and implement key Intensive Observation Periods (IOPs) and campaigns.
- Finish implementation of the Okmulgee extended facility.
- Support the Instrument Development Program (IDP).
- Continue review of routine site operations.

## 3. Site Operations in Support of Goals for the Period

*a. Facilitate all data quality assessment efforts, particularly those focused on the development of a full suite of data quality analysis tools, participation in the development of an ARM data user interface, implementation of Quality Measurement Experiments (QMEs) and Value Added Procedures (VAPs), and better dissemination of information on data quality.*

Mike Splitt and Chad Bahrmann, in particular, continued to spend significant effort developing new **data quality metrics and graphical displays** for diagnosing the quality of SGP data streams. This work also included participation in the design of Build One of the ARM Information Architecture (AIA) **Meta Data Navigator** (MDN). The SST also continued its role of issuing **work order guidance** to instrument mentors and site operations staff based on its quality analysis results. Randy Peppler helped oversee these activities and participated in the MDN Build One design.

New or additional **data quality metrics and associated graphical displays** were developed or started during this period for SIRS solar tracking, ECOR, SWS, downwelling SIRS pyrgeometers, MPLHR, BLC, VCEIL and a Central Facility thermodynamic comparison involving the BBSS, THWAPS, SMOS, and EBBR. Work has also started on documenting the long-term trends of the performance metrics.

**SIRS** efforts continued to involve more sophisticated diagnosis of **solar tracking** problems, with work done by both Mike Splitt and Chad Bahrmann. A plot has been under development that graphs the direct/total ratios versus total values over a long period of time. The idea behind this is to look at the long-term behavior of such plots in order to help us generate automated algorithms for defining when a tracking problem occurs. It appears that these plots will allow for the definition of an objective criterion (on the graph, a line) for determining the point past which a problem is likely. This work was done in part as a "mini" project for the Meta Data Navigator with site scientists from the TWP site.

New metric development took place this fall for the **EF ECORs**. It was done by Mike Splitt in cooperation with Dick Hart and is focusing first on the non-spectral data, though some preliminary work has been done on the spectral values. So far, metrics have been computed for the following: water vapor density, down-boom wind velocity, cross-boom wind velocity, vertical wind velocity, mean horizontal wind speed, mean air temperature, barometric pressure, sensible heat flux, and latent heat flux. The following are also being noted: number of missing sonic data points, number of sonic data from 10 100-Hz values, number of sonic data derived from interpolation, number of suspect hygrometer data values, number of hygrometer data derived by interpolation, and last hygrometer status.

Chad Bahrmann successfully made comparisons between the **shortwave spectrometer** (SWS) and the SIRS hemispheric broadband sensor at the Central Facility. This was done by summing SWS spectral values over the same range of wavelengths covered by the hemispheric broadband sensor, and has piqued the interest of the SWS instrument mentor (Jeff Griffin). This comparison helped detect a SWS malfunction early during this reporting period. Full SWS metrics are being developed by Mission Research Corporation.

Mike Splitt and Chad Bahrmann have developed a graphic to monitor the performance of **SIRS downwelling pyrgeometers**. Various estimates of the downwelling broadband longwave flux based on surface meteorological conditions are compared to the SIRS measurements. The estimates currently shown on the SST web site are based on either a clear sky or a cloudy sky and provide an approximate range with which one would expect the actual data to occur. The following methodologies were chosen:

Clear sky downwelling longwave estimates

1) Monteith, 1973: This estimate is based on algorithms from *Principles of Environmental Physics*, J.L. Monteith and M.H. Unsworth, 1973.

2) Prata, 1996: This estimate was taken from "A new long-wave formula for estimating downward clear-sky radiation at the surface", found in *the Quarterly Journal of the Royal Meteorological Society*, 1996, **122**, 1127-1151.

Cloudy sky downwelling longwave estimates

1) Monteith, 1973 (same reference as above - this work has just started)

2) Aubinet, 1994 (this work has just started)

A **cloud base height comparison** involving the BLC and the MPLHR at the CF is now being developed since both instruments are back on-line. Chad Bahrmann is working with Connor Flynn to develop the other informative comparisons using these instruments. Chad will also be developing metrics for the Boundary Facility VCEILs.

Chad Bahrmann finished a new **Central Facility thermodynamic comparison** at the end of this period. It builds upon previous work by Mike Splitt for the Water Vapor IOP of fall 1996. Two different types of plots have been created separately for temperature, relative humidity, and mixing ratio. Instruments included in the comparisons are sensors from the 60-m tower (both levels), the BBSS, THWAPS, SMOS, and EBBR. If possible, the first Raman lidar range gate will be added to the mixing ratio plot -- this is being looked into now. The first set of graphics are continuous plots of 60-m tower, THWAPS, SMOS, and EBBR values versus time, with superimposed discrete values from the BBSS. The second set of graphics focuses on the sonde launch times and plots BBSS soundings with superimposed discrete values (at the proper altitude) from the

other instruments. This will allow us to better monitor when one or more of these instruments is malfunctioning.

In addition, during the next three-month time period, we will begin generating statistics on the **long-term performance** of key metrics for each instrument platform, to be displayed on the SST data quality web site. These graphs and statistics will be developed to help assess and document the longer-term health of instrument performance. Randy Peppler and Chad Bahrmann will be particularly involved in this work. These analyses at first will include mean, standard deviation, the median, and the first and third quartiles.

**For the future**, we would like to begin a SIRS/GRAMS comparison, but this will be dependent on establishing scientific units for the GRAMS data and continuous instrument operation. A RSS/SWS (spectral radiometers) comparison would also be desirable, and could perhaps be extended to the Graeme Stephens SSP-3 that is supposed to be installed semi-permanently at the Central Facility. We would also like to begin analyses of the MWR/BBSS QME.

Mike Splitt and Chad Bahrmann continued maintenance and improvement of the **web site** that displays the performance metrics and other data quality analysis techniques described above. All tables and graphics on the web page are updated automatically once per day. The URL for this web site remains:

http://www.res.sgp.arm.gov/sst/dq_monitor/DISPLAYS.html

This included the creation of color-coded status boxes for performance of such instruments as the SIRS and SWATS, following the paradigm being established for color-coding for the Meta Data Navigator. These status boxes are automatically updated each morning.

The **AIA MDN** is an ARM-wide initiative to create a graphical WWW user interface for those wishing to obtain ARM data. It will include broad-brush information (daily time aggregate) on the quality of data sets (color coded for quality - green, yellow, or red, and existence - white or black), linkage of data quality reports (DQRs), graphical quicklooks for viewing sample data, and explicit data flagging within data files selected for use by the data user. The SST has been involved in this project since its beginning, helping to shape how the MDN will look and perform. The SGP SST, and those of the TWP and NSA sites, will be specifically responsible for data quality color coding and associated DQRs and descriptive text (this work will be done in conjunction with instrument mentors), and creation and implementation of data quality algorithms for producing automated data flags. Discussions on an e-mail list dedicated to the AIA MDN (aia@arm.gov) continue. During this period they have continued to include the question of how to provide color code for the 24-hour time aggregate, based on sample element quality codes or color information. A rather simple scheme was developed for

Build One, with resolution of the question obtained by the three SSTs (if at least 80% of the sample level elements are good, the 24-hour aggregate is deemed good, or green; if 20% or more of the elements are bad, the aggregate is deemed bad, or red; anything else is labeled as questionable, or yellow; if at least 50% of the data for a 24-hour period are missing, the aggregate will be labeled as missing, or black; absence of quality checking for existing data will result in the aggregate color white). Based on recent discussions, the coding of black has recently been changed to the following - if all data for a 24-hour period are missing, the aggregate will be labeled as missing, or black.

In related MDN activities, Mike Splitt and Chad Bahrmann continue to be active participants in the "**QC Mini-Project**" (ongoing) led by Eugene Clotheaux of the TWP SST. The goal of the project is to build a prototype site-wide data flagging algorithm that would eventually be ported into the MDN. The SIRS platform was chosen for this test project. TWP staff developed test code, which Mike ported into the SGP SDS. The code was then refined and extended by the SGP SST, and focuses on identifying severe tracking problems, embodied in our work on direct/total ratio versus total radiation plots (see above). The final product was delivered back to TWP scientists on September 25.

The SST more formally continued the process of including suggestions of **work orders** to instrument mentors in its **weekly status reports** on the instruments it currently scrutinizes (MWR, AERI, EBBR, SIRS, BRS, 915 and 50 MHz RWP, SWATS, MPLHR, SMOS, SWS, and Central Facility thermodynamics). This process appears to be working well in most cases, with prompt responses from mentors. Major work order actions during the past three months included SIRS pyrgeometers at a number of sites. Work is ongoing, but it appears that components of the electronics system leading to these sensors are the culprits. This exercise has led SIRS instrument mentor Tom Stoffel to initiate development of a SIRS troubleshooting guide that can be used by Mike Splitt and Site Operations to help translate what they see in terms of data quality and existence problems into recommended service actions that can then be performed by road technicians. This system should be in place by early 1999. Another major work order action occurred for the SWATS to troubleshoot both the datalogger programs and the datalogger electronics. A combination of both problems has led to poor data quality a number of SWATS sites. This work is also ongoing, but as of this writing all but two of the sites in the northern half of the network were operating properly. Other items under observation include improper MFRSR shading and 915RWP 60 Hz noise.

*b. Conduct an assessment of the measurement capability of the SGP CART site relative to Science Team needs*

Randy Peppler of the SST had polled members of ARM's scientific working groups and others in the ARM Program in April and May to assess their level of satisfaction relative to both the current routine **SGP measurement suite** and the site's **IOP measurement capability**, including heretofore-unmet measurement needs. This effort was done to

provide information to the STEC and AMT for planning purposes. Results of the document were presented in the last Quarterly Report, as bulleted recommendations (not repeated here).

It was hoped that ARM scientists and management could use this information to help guide the SGP CART site down the most scientifically and economically sound pathway possible. At some point it would be useful to prioritize the needs expressed here. To that end, the SGP Site Advisory Committee and ARM scientists in the Working Groups were asked to read and review this document and provide input helpful for prioritization. They are located on the WWW at:

http://parker.gcn.ou.edu/~cimms/ARM/meas98.html

However, to date, little feedback has been received:

http://parker.gcn.ou.edu/~cimms/ARM/feedback.html

*c. Plan and implement key Intensive Observation Periods (IOPs) and campaigns*

**IOP activities** have become increasingly important, as key scientific questions within the ARM Program require extra scrutiny with specialized instrumentation and scientific expertise. During September-November, no IOP activity took place, though elements of a continuing campaign were present at the Central Facility.

The Jet Propulsion Laboratory (JPL) deployed a **GPS instrument** for making water vapor measurements at the CF in late June. This instrument and a number of water vapor measuring devices (including a Radiometrics MWR) have resided at the Central Facility since then, and all but the Radiometrics MWR and a temperature profiling radiometer (removed in the fall) will remain at the Central Facility through the fall 1999 Water Vapor IOP. Chad Bahrmann had assisted in selecting locations for these instruments and helped troubleshoot the computing and communications problems of the JPL staff when they were on-site. The JPL project leader is Steve Keihm.

**Planned 1999 activities** known as of December 1 include:

- Winter (January 19-February 8, 1999) and spring (March 1-21, 1999) **SCM IOPs** will be conducted to study cold synoptically driven and cool stratus conditions, respectively. There may also be an SCM IOP in the September-October 1999 time frame to look at local convection.

- A "**mini**" **Shortwave IOP** will occur during the spring SCM IOP, as the Colorado State University scanning solar polarimeter (SSP-3) and the ASTI will be

deployed at the Central Facility. This activity will allow study of stratiform cloud conditions.

- MJ Post of NOAA-ETL and Russian colleagues are planning on deploying **GPS instrumentation** during the spring 1999 SCM IOP. This had been delayed from fall 1998. This will be known as the **ETL GPS Campaign.**

- Also from ETL, the "**mini-MOPA**" (a differential absorption lidar, or DIAL) may be deployed sometime during the spring or fall 1999 periods. Alan Brewer is leading this effort. It was previously deployed during the spring 1996 SUCCESS campaign.

- The **USDA ARS** is planning a smaller version of the SGP '97 exercise (**SGP'99**) for summer 1999 over the SGP CART site. Once again, Tom Jackson of ARS is leading the effort. More details will be provided in subsequent Quarterly Reports.

- An **International Pyrgeometer Intercomparison** will take place at the Central Facility RCF in September 1999. Joe Michalsky and Tom Stoffel are planning the campaign. It would be limited to working standards and not field instruments in order to limit the number of participants.

- The Water Vapor Working Group has proposed a third **Water Vapor IOP** for fall 1999. The IOP will focus on the 1) absolute calibration of instruments, 2) upper tropospheric measurements, and 3) an international radiosonde intercomparison. For the upper tropospheric measurements, the group strongly recommends the participation of DIAL, NASA LASE, and HIS systems, as well as aircraft-based (NASA DC-8) radiance observations. Availability of the DC-8 is not yet known. Jens Bosenberg is willing to participate with his DIAL system, though there are scheduling issues to be worked out. Dave Turner is the DSIT representative for this activity. It has been suggested that this collaborative experiment be called the ARM-FIRE Water Vapor Experiment (AFWEX).

- A **UAV IOP** may occur in fall 1999 to revisit ARESE with the Twin Otter and Altus. Plans at present are sketchy.

- JPL (Dave Rider) deployment of an **airborne emission spectrometer (AES)** over the Central Facility, perhaps involving the launch of ozonesondes. This is scheduled to occur during either March 1999 or during the fall 1999 Water Vapor IOP. The purpose of this visit will be to compare the AES instrument to others at the CF, especially the AERI. JPL will be able to provide the ozonesondes and ground station receivers, but may want to piggyback the ozonesondes on our BBSS sondes. The AES is a demonstration version of the troposphere emission spectrometer (TES), which will also be used in the experiment. The TES is a

device similar to the AERI-X that could be used for side-by-side comparisons and provide a calibration for the AERI-X independent of that of the AERI. The TES is an EOS Chemistry Platform instrument. This exercise is being referred to as the **AES Campaign**.

*d. Finish implementation of the Okmulgee extended facility/Other site development activities*

The SST plays an advisory role on site development activities and priorities. During September-November 1998, Site Operations and Site Development staff continued planning for instrument deployments at the Okmulgee wooded EF.

The **Okmulgee EF** has been a phased implementation. A 55-foot walk-up tower, shelter and infrastructure were completed in fall 1997. Electrical and phone service was established in May, and all other infrastructure needed to hold instruments was completed in July. MFRSR and SIRS will be installed when manpower is available. A SMOS is being procured, while an ECOR will be procured and deployed during the current fiscal year (October 1, 1998 through September 30, 1999). Dave Cook, the instrument mentor for the site, and Dan Nelson are working on a design for mounting instrumentation to the tower structure at Okmulgee.

**Road improvements near the CF** were previously negotiated but have not yet been made. These include shaling of the north/south road leading to the new IDP4 site, and making the east/west road leading east of the CF to the Kay County line an all-weather road. Improvements to the present all-weather road leading west out of the CF are also slated. Flooding in the vicinity of the Central Facility during late October and early November made this work even more imperative.

**IDP4** is a 150 foot by 175 foot graveled area located on the extreme southeast corner of the CF that was formerly occupied by a farmhouse. There is one doublewide storage trailer and one office trailer there, but both require modification before they can be occupied. Development of the area continues.

The final disposition of the planned **Ft. Cobb wheat EF** has not been determined. Past discussions have centered on moving this site to an area in Payne County near Stillwater to fill a void in the EF network. Discussions are ongoing. There also remains one placeholder for possible EF expansion.

Work is almost complete as of December 1 to finish the **Boundary Facilities** as originally planned, with the installation of VCEILs and AERIs at each site. Infrastructure was prepared during fall 1998, and instrument deployments began in

November. All VCEILs and AERIs will be in place by December 15, including the automatic rain hatch mechanisms for the AERIs.

One A**uxiliary Facility** may yet be established to house a second WSI.

A **Continuous Quality Improvement Program** (CQIP) has been developed and instituted. SGP staff representing site safety, data quality, and site/instrument maintenance) will visit each site according to a prescribed schedule to assess the efficacy of the sites from their point of view and will report on their findings. Dan Nelson, John Schatz, and Chad Bahrmann are the program designers and have developed a detailed CQIP checklist. The first CQIP visit was made to Pawhuska (E12) in late October, with Byron to follow. The anticipated result of this effort will be never-ending improvement of remote site operations.

*e. Support the Instrument Development Program (IDP), including new instruments*

The **IDP** has primarily come in the form of allowing guest instruments to participate in IOPs and campaigns. These periods allow for ARM instruments to be compared and calibrated against other state-of-the-art instruments from collaborating agencies such as NASA, NOAA, USDA, and various universities. Guest deployments of prototype instruments have led to eventual permanent deployments of hardened ARM versions at the SGP site (e.g., MMCR, RLDR).

Further work remains on instrument calibration and the generation of scientific units for the **GRAMS**. This instrument has great potential for the SGP site. Both GRAMS instruments suffered from overheating during the August 1998 IOP, and it is not known how successful their collections were. Tom Charlock and Seiji Cato conducted some special hand-operated shading exercises during the IOP. Tim Tooman is working on the creation of calibration units.

Operation of the **Raman lidar** (RLDR) can in a sense be categorized as part of the IDP, since we are still trying to determine the best way to operate the instrument. During its first year of operation, a number of costly fixes were required to keep the instrument running, but still there were significant downtime periods. Operations during the last six months have continued to be remarkably stable. In order to ensure operational stability for the RLDR, a three-phase uninterruptable power source (UPS) will be installed by February 1999. This major addition will allow the instrument to continue operation through the brief but numerous power dips and outages experienced at the Central Facility. This should improve data availability by as much as 50 percent. RLDR daily operations remain under the close scrutiny of Dave Turner of the DSIT, Chris Martin of Site Operations, and others.

Plans for the **UV spectral radiometer** are on hold. A number of logistical issues still need to be worked through. The earliest the deployment could occur is spring 1999.

Two new **radiometers** will be added to the suite of instruments at the Central Cluster. They are the Eppley 8-48 (close cousin to the PSP) and the Eppley TUVR (Total UV Radiometer). Both instruments are in hand at the Central Facility. The Eppley 8-48 will replace the shaded PSP in the SIRS testbed and the process will be managed through the BCR system. The reason for deployment of the Eppley 8-48 is to investigate the apparent nighttime offset experienced by the shaded SIRS PSPs. This work could be done before the end of January. The Eppley TUVR radiometer will be included in the BRS (Broadband Radiation Station). The conversion of the BSRN to the BRS will also be managed through the BCR and PRR systems. This conversion is significant, with earliest estimates for completion being late summer 1999.

Bob McCoy (Colorado State University) has requested the installation of a **scanning spectral polarimeter** (SSP-3) at the Central Facility for an indefinite period. This installation has been requested for the winter 1998-99 time frame. It will give the site yet another spectral radiometer.

Scott Richardson is continuing work on a number of fronts to improve the routine measurement of **water vapor** at the SGP site. One project involves the design and construction of a **relative humidity calibration facility** for the CF. This will allow all ARM humidity-measuring instruments (including those at the TWP and NSA sites) to be subjected to common calibration standards. It will provide checks and calibrations for the pyschrometers used on routine maintenance visits to Extended Facility SMOS and EBBR sites, as well as humidity sensor intercomparisons with the chilled mirror hygrometer at the Central Facility THWAPS. It can also be used to establish calibration for guest instruments during IOPs. The Thunder Scientific Model 2500 ST chamber was purchased this fall. It is now undergoing a shakedown phase in the laboratories of the Oklahoma Mesonet. Scott believes the chamber should be available for deployment at the Central Facility in spring 1999.

**Chilled-mirror hygrometers** will be installed on the 25-m and 60-m level of the 60-meter tower at the SGP CART Site central facility only during relevant IOPs and campaigns. Scott Richardson is the mentor. Chairman of the various Working Groups should notify the site of the need for the installation of these hygrometers no later than 30 days prior to the IOP or campaign period. This will allow for sufficient set-up and testing before the experimental period.

The **ARM electronics laboratory** instrumentation and furniture have arrived and were set up in November at the Central Facility. This lab allows site technicians to service and repair CART instruments and sensors, instead of sending them back to the vendors under expensive service contracts. In-house repairs will save the program an estimated $50,000 per year. In addition, repairs will be made must faster, usually within several days and returned to the field. Vendor service and repairs often have taken upwards of six weeks. In addition, the electronics lab will serve all three CART sites. Jim Teske is the point of contact for the electronics lab.

Dave Bigelow (Colorado State University) requested that a **USDA UV-B site** be installed indefinitely at the Central Facility. A full site includes an MFRSR (identical to ARM's), a Lee Harrison design UV-B MFRSR, a Yankee Instruments UV-B broadband radiometer, meteorological support sensors (temperature, pressure, and snow cover), and dataloggers. A PRR is currently in review by the ARM infrastructure.

A discussion occurred last July regarding a **Microtops handheld ozonometer** that was used to make total ozone measurements during the fall 1997 IOP. It could be used to make daily weather observation type measurements, or it could be used to collect data that become part of the routine ingested data stream from the site. The device is fairly simple to operate. Discussions are ongoing.

*f. Continue review of routine site operations*

**Routine site operations** in support of 24-hour per day, 7-day per week data collections remain the top priority of the SGP site. At this juncture of the ARM Program, this is embodied primarily in the (1) completion of the Okmulgee EF (see subsection d above), (2), new instrument deployments (see subsection e above), (3) automation of data collection through *ingest* (formally known as the instrument data processing circuit, or IDPC) of all remaining non-automated SGP data collections, and (4) routine maintenance and calibration of all sites and instruments. The SST plays a strong role in these activities by helping advise the Site Program Manager, the Site Operations Manager and his staff, the head of the Instrument Team and his mentors, and the head of the Site Data System and his staff regarding site priorities and procedures, and suggesting solutions or plans.

Discussions related to current instruments during this period included:

- **Relocation of the WSI to the east within the Optical Cluster** - This was scheduled to occur in September, but was delayed until December or early 1999 when a concrete pad is poured. This move will block spurious office trailer cluster light sources from reaching the instrument. A cable necessary for the move was received and installed in October at the present WSI location for testing purposes.

- **RSS** - Both versions of the RSS were removed in November and taken back to SUNYA for calibration. They should be returned in early 1999.

- **MFRSR shading issue** - No progress appears to have been made. John Schmelzer was onsite in early August to address chronic shadowband issues. Optimally, shadowband alignments should be done near solar noon on three consecutive clear days. However, in practice this is difficult to achieve since field technicians are limited to one site visit every two weeks, and may not be able visit near solar noon or have weather conditions conducive to adjusting the shadowband. Thus, the shading for either morning or afternoon periods is often not optimal,

depending on which time of day the shadowband adjustment took place. The present procedures used by field technicians are good in theory, but not in practice. The results of Schmelzer's visit are not yet known. However, once a proper alignment for an instrument has been achieved, it has been Schmelzer's experience that the shadowband stays in alignment for a long period of time. Thus, the normal two-week paradigm for visiting sites may have to be modified temporarily in the case of the MFRSR to truly solve this problem.

- **New SMOS towers** - New counter weighted, single pole, guy wireless towers, with easy lowering, and will be installed in FY1999. This activity will take place because some of the current towers have experienced failure points and were deemed a safety hazard to site technicians. The towers were delivered to the Central Facility in November. An engineering firm has been contracted to install the towers. All towers should be installed by April 1999. Also, Dick Hart, the SMOS mentor, instituted a new T/H sensor calibration check during the period that uses a traceable Vaisala transfer standard.

- **60 Hz noise problem in 915 RWPs** - Radian amplifier boards have been identified as the 60 Hz noise source and the mentor, Rich Coulter, continues to work on a solution. A PIF remains open.

- **Sondes** - The routine midnight launch (Monday-Friday) was restored at the Central Facility on December 1. Thus, there are now four launches made each weekday there. Also, the switch from the PC-Cora to the digi-Cora at the Central Facility is almost complete. A name for the datastream needs to be decided upon. Also, Scott Richardson has been in discussion with BBSS mentor Barry Lesht on the switchover from the RS-80 sonde to the new RS-90 version. The problem with the RS-80s - contamination of sensors by packaging material vapors - is now community knowledge. Abnormally low moisture readings in the upper atmosphere have affected National Weather Service model output.

- **RCF** - Use of the RCF during non-BORCAL and non-IOP periods remains under discussion. Tom Stoffel is preparing a comprehensive plan for use of the RCF.

- **MWR** - The new collection and processing software was successfully installed and validated at the Central Facility and all Boundary Facilities in late November. Some iteration of the final output took place during the period. Data quality now looks good.

- **SWATS -** As indicated in subsection a above, a great deal of troubleshooting took place during the period regarding SWATS datalogger programs and electronics. We now seem to be on the path toward good data quality at all sites. This will allow a general release of SWATS data.

- **SIRS solar tracking** - The new EPROMs installed at the EFs have dramatically improved SIRS tracking. Other more expensive options had included replacing current controller boards with a new model and obtaining an upgrade kit that allows for self-correction of the tracker orientation.

- **SIRS pyrgeometers** - This was discussed above in subsection a. The mentor, Tom Stoffel, is preparing a troubleshooting guide for Site Operations and the SST to help translate data quality problems into corrective actions. As of this writing, seven pyrgeometers across the network were experiencing problems likely due to electronics or cabling. None appear to be related to sensor heads.

- **ASTI** - The ASTI will continue to be an IOP-only instrument, but a permanent concrete pad for the instrument will be poured in January 1999 just to the west of the Optical Trailer.

- **AOS** - The Aerosol Observing System will be down from December 7-18 to install a humidified nephelometer. A number of minor repairs will also be made during this period. The new IDPC for the AOS will be tested after this work is completed.

- **Chilled Mirror Hygrometers** - Scott Richardson completed modification of our chilled mirror (CM) systems for remote deployments. He changed the datalogger program and added a Rotronic temperature and relative humidity sensor to detect hygrometer problems. He also wrote programs using Matlab to analyze CM data and to download ASCII data files to examine the differences between the CM and the Rotronic sensor. He has worked with Dave Cook on some of these issues. Site Operations staff has modified the CM air intake so that the effects of the filter on the CM system can be examined. It may be necessary to remove the air filter from the CM system because it looks like it is causing erroneously high dew points during the morning hours. This will be monitored.

There were a number of **IDPCs** under development or modification during the period that will eventually allow quicker and more complete data collection, ingestion, analysis, and dissemination, including inclusion of data quality flagging. IDPC activities during the period, as supervised by Trav Stratton of the SDS, included the following:

- **AOS** - A draft IDPC was developed and a data object design completed. It will provide for explicit flagging of bad or questionable data values. The IDPC will be applied after the December 1998 AOS addition of a humidified nephelometer.

- **AOSAIR** - An initial IDPC has been written for the instruments that will measure aerosols periodically on a light aircraft. This should be completed by March 1999.

- **BRS** - More work needs to be done by the instrument mentor, Tom Stoffel. The BRS will represent the reconfiguration of the Central Facility BSRN.

- **BBSS** - Work is complete on establishment of the digi-Cora at the Central Facility. All that is needed now is a new data stream name.

- **BLC** - The Cloud Working Group has asked that BLC backscatter profiles are included in the BLC ingest.

- **Chilled mirror hygrometer on THWAPS** - IDPC development continued. Scott Richardson has finished the initial IDPC.

- **EF ECORs** - Establishment of communications with EF ECORs has long been a problem. Much work during this period was done to further evaluate the problem. A test is being conducted as of this writing to determine whether ARM software or ATI software can communicate with a site. If a relatively simple fix can be made to establish communication, the SDS will make it a priority to do such work. If not, we will wait until ATI makes available its Y2K compliant version of the ECOR system, as the present system is not compliant. It has also been suggested that an automatic reset mechanism be placed on each sonic anemometer and hygrometer, as most problems with the sensors have been traced to the need for relatively frequent power resets.

- **Tower ECOR** - The mentor, Dick Hart, continues work for this installation.

- **MWR** - The new ingest and processing software to provide a revised collection schedule and to specify how and when tip calibrations should be made was turned on at all MWR sites in November. All seems to be going well after some early potholes. A large volume of data is being reprocessed to reflect the new paradigm.

- **NFOV** - IDPC development work was finished during the period and the instrument mentor continues the process of data validation.

- **Non-SMOS Raingages** - It was discovered late in the period that these data, which are logged by the SWATS, are not being ingested. This work will commence early in 1999.

- **RWP** - Collection software at the Intermediate Facilities will be upgraded in early 1999. Recent problems with the Central Facility 915 RWP were remedied.

- **SIRS** - Work was completed on the incorporation of the instrument mentor's sophisticated automated data-flagging scheme.

- **SWS** - This IDPC was completed and the mentor finished data validation.

- **BF AERIs, VCEILs, and THWAPS** - A terminal server system is being installed at each Boundary Facility. All BF AERIs and VCEILs were installed and connected to the SDS in November and early December. The VCEIL IDPC has been established and verified, and data are being delivered. AERI data are being verified as of this writing. Each BF THWAPS will be connected to the SDS after the winter SCM IOP.

- **WSI** - Work continues on the new IDPC. The SDS received new code from instrument mentor Tim Tooman, to be used for processing at the Central Facility.

**Data availability statistics** for the CART site as a whole during the period were generally in the 80 percent range, due mostly to glitches during the SDS upgrade to version 5.0 that took place. After all "sneakernet" data are accounted for, however, availability should increase to the mid-90 percent range. Site Operations personnel are to be commended for their fine efforts in establishing routine operations and their maintenance of the entire system. Corrective maintenance actions were done promptly after receipt on the two-week visitation cycle. Preventative maintenance and calibration checks were also performed tightly per schedules developed by Jim Teske and the instrument mentors.

Chad Bahrmann is continuing informal **Friday debriefings with field technicians**. These sessions are being held to gain more understanding about the effectiveness of current maintenance protocols, evaluation of current maintenance strategies, and formulation of fixes for chronic problems.

Chad also occasionally **accompanies field technicians** on their maintenance trips to learn more about the effectiveness of their activities and the procedures used. Such a trip was made during this period in late September/early October. A report was issued on his findings. Overall comments noted that the consistency and efficiency of the efforts of the road technicians was good to excellent, with the overall assessment that the field technicians are doing a good job. Concerns included the procedure for lowering the SMOS towers (this will be mitigated once the new towers are erected) and the cleaning of radiometer domes (both water and a glass cleaner were being used).

Chad also **assists Jim Teske and IOP scientists** regarding scientific issues as necessary. He wrote a computer script for Jim that helped automate part of his maintenance database and updated his data availability program. Randy Peppler maintains almost daily contact with **Doug Sisterson**, SGP Site Program Manager, on site scientific issues, and makes occasional visits to the Central Facility to visit with Jim Teske.

### 4. Other Activities Related to Scientific Support for Site Operations

The SST performs a number of additional activities that can be categorized as **scientific coordination tasks**. These include a weekly teleconference, participation in the Baseline Change Request (BCR) process, facilitation of e-mail and WWW-based discussions on

scientific issue facing the SGP site, and writing of the *Site Scientific Mission Plan* (with the Site Program Manager). The SST remains in periodic contact with the SGP Site Advisory Committee regarding scientific issues related to the site. The SST also participates in scientific meetings and workshops where the presentation of ARM results is warranted.

The SST conducts **research and educational outreach** (as provided by the Oklahoma Climatological Survey) programs as well. Updates on these programs are described in other documents provided to the ARM Program (an annual research update was completed in September). Outreach provided specifically by Chad Bahrmann, Mike Splitt, and Randy Peppler is noted at the end of this section.

The **SST weekly teleconference** is held every Tuesday morning. In addition to the SST, it is attended by the Site Operations Manager and his key staff, the Site Program Manager, the ARM Technical Director, the ARM Instrument Team leader, the DSIT leader, the SGP SDS leader, and the DSIT liaison to the Scientific Working Groups (which represent the ARM Science Team). Site status for the previous week is discussed relative to site operations, IDPCs, data quality, and site development. Current and future IOPs and campaigns are discussed, as well as other important scientific and operational issues affecting the site. The meeting is used for planning and assessment purposes, and for initiating action as appropriate. Minutes of meetings conducted since September 1995 are available at the following web site:

http://manatee.gcn.ou.edu/sscm/minutes.html

The **BCR process** was active during September-November, as BCRs 78-90 were submitted and considered. They are described in the table below. Priorities range from 1 (highest priority) to 5 (lowest priority). Note: previous BCRs 47 (MWR ingest) and 71 (move SIRS IDPCs from the Development to the Production System) were closed on December 15 and October 7, respectively. BCR 77 (modification of CF BBSS equipment), remains open.

| BCR # | Title (Priority) | Description | Submitted by | Open Date | Approval Date | Resolution |
|---|---|---|---|---|---|---|
| 78 | MPL - Upgrade of MPL to MPLHR (2) | As of 8/12/98, the MPL was taken off line permanently and replaced by the MPLHR | Connor Flynn | 9/2/98 | 10/6/98 | Approved - IDPC was completed and turned on around October 6 |

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|---|---|---|---|---|---|---|
| 79-80 | MWR - Placed in Tip mode for 1-2 weeks (1) | The former mentor asked that all MWRs be placed in tip mode starting 9/14/98 for a week or two to test mirror effects on calibration. | Jim Liljegren | 9/3/98 | 9/3/98 | Approved - The test was made and the mentor was to submit a DQR describing his findings |
| 81 | SDS - Upgrade (3) | The SDS will be upgraded to version 5.0, including an upgrade of the network and the mini mass storage system | Trav Stratton | 9/10/98 | 10/7/98 | Approved - final verification of the implementation of 5.0 continues. The network and mini mass storage upgrades are complete. |
| 82 | EBBR - Coefficient changes for E4 soil moisture #5 (2) | Recalculated coefficients are needed for soil moisture sensor #5 at E4 because the present ones are insufficient for dry soil | Dave Cook | 9/17/98 | 9/24/98 | Approved - the change was made. |
| 83 | MWR - Add internal temperature sensor (2) | A temperature sensor should be added to study a possible phase lag of the blackbody target temperature as compared to the noise injection temperature - the sensor should resolve the problem and improve calibration | Jim Liljegren | 9/29/98 | 11/17/98 | Approved - the sensor was installed on 10/21/98 and after an initial problem was working fine as of 11/13/98. |

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|---|---|---|---|---|---|---|
| 84 | SIRS - Controlled test of new EPROM in CSM1 portion of E16 SIRS (2) | Abnormalities in the Snet data collected from the SIRS CSM1 4mb data cards precipitates need to replace standard EPROM with a special one that eliminates need for handshaking during data transfer between the CSM1 and CR10-x logger | Dan Nelson | 10/1/98 | Open | Implementing - three data sets collected following installation show no signs of corruption. The test will be run for two more data sets before a conclusion can be made that the problem is fixed. |
| 85-86 | MDS - Relocation of SGP MDS to a location off site (1) | Change physical location of SGP MDS databases from the SGP site computers to BNL | Kathy Doty | 10/5/98 | 10/6/98 | Approved - work completed |
| 87 | AOS - Addition of a second, humidified nephelometer (3) | Following Aerosol Working Group recommend., a second nephelometer will be added to allow the determination of dependence of the aerosol light scattering coefficient on RH | John Ogren and Pat Sheridan (NOAA CMDL) | 11/16/98 | 12/15/98 | Approved - instrument is installed and all work should be completed (IDPC) to have the system up by December 18 |

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|---|---|---|---|---|---|---|
| 88 | SIRS at CF - Radiometer change at SIRS / C1 (3) | Due to its problem of nighttime offset, the SIRS Testbed (C1) shaded PSP will be replaced by an Eppley 8-48 black and white pyranometer, to evaluate zero offset characteristics of the PSP under shaded conditions | Tom Stoffel | 11 / 18 / 98 | 12 / 15 / 98 | Approved - implementation will be tracked. |
| 89 | AOS - Weekly PM procedure change (4) | To keep the TSI nephelometer from failing the span gas check, PM procedures 13 and 14 will be reversed so that the data interruption switch is disabled prior to the check. | Jim Teske | 11 / 19 / 98 | 12 / 7 / 98 | Approved - implementation will occur when Site Ops and MDS staff are ready to go. |
| 90 | TLVC - replacement of time lapse recorder | The TLVC recorder has experienced head-tracking problems and needs to be replaced. | Don Slater | 11 / 23 / 98 | 12 / 15 / 98 | Approved - a new recorder was installed on 12 / 10 / 98 |

Facilitation of **e-mail and WWW-based scientific discussions** relating to the SGP site is an ongoing task. This is done to generate timely discussions on important issues and to gather facts on long-term problems. The ongoing AIA MDN discussion is one example of such collaboration with other ARM scientists around the country. Another recent discussion involved the polling of the ARM scientific working groups relative to their thoughts on the adequacy of the current SGP measurement suite and their ideas for future IOPs (see subsection b). It needs to be turned into a recommendation document for use by the STEC.

Doug Sisterson and Randy Peppler had raised several issues since the summer of 1997 regarding the **best use of resources at the SGP site**. A number of issues related to the absolute necessity of some instrument platforms and/or their collection schedules were addressed. This information was presented to the STEC and AMT in summer 1997 and again to the AMT in summer 1998. This information was documented in the July-December 1998 issue of the *Site Scientific Mission Plan*. Feedback is still sought on a number issues that were allowed to remain open into fiscal year 1999. One action taken in late 1997 was the reduction of the BBSS launch schedule from 5 launches to 3 per day during non-IOP periods at the Central Facility and the discontinuation of the daily BF launches during non-IOP periods. This decision was upheld this summer, but the midnight launch, based on the urging of the Cloud Working Group, was reinstated on December 1.

Other scientific discussions during this period included final implementation of the new **MWR IDPC** and where and how **AERI data** should be made available from the three CART sites.

Writing of the ***Site Scientific Mission Plan*** has become more streamlined during the past two years. In addition, these documents are now available on the WWW. A standard process is in place for producing the next version of the plan. Randy Peppler of the SST makes a first modification of the document and then sends it to Doug Sisterson, who adds additional items. The document is then iterated until a draft suitable for the WWW site is produced. A final published version (and finalized WWW version) is issued after a general review by the ARM community. The July-December 1998 issue has been published in final form both on the WWW site and in hard copy. Work on the January-June 1999 edition is nearing completion and should be available in WWW form by early January 1999.

The SST has attempted to reestablish more regular contact with the **Site Advisory Committee** (SAC) regarding the scientific operation of the SGP site and other issues. During this period, Randy Peppler attempted to plan a next SAC gathering for late in 1998 or early in 1999, perhaps to be held at the next ARM Science Team meeting (March 1999) if individual schedules are not favorable for a meeting at the University of Oklahoma. The last such meeting was in June 1996. About half of the SAC members favor a formal meeting at the university, while others think a more informal annual gathering at the Science Team meeting is sufficient. Planning for this meeting is ongoing. The SAC provided some, but not a sufficient amount of feedback on the measurement assessment document and the resources/operations/cost study in the most recent *Site Mission Plan*. Given the wide background and stature of the SAC, the SST would view as very beneficial more guidance from the SAC on science-related issues.

At the urging of the SAC, Randy Peppler and Doug Sisterson are writing an overview manuscript describing the SGP CART site for the ***Bulletin of the American Meteorological Society***. We expect to submit this manuscript to the AMS early in 1999.

The SST participates in scientific meetings where the presentation of ARM results is relevant or invited. During September-November, Mike Splitt, Randy Peppler, and Scott Richardson attended the **Joint Meetings of the ARM Working Groups** held in Pleasanton, California, during the week of October 19. Mike gave a presentation at the Cloud workshop on the WWW site at the EC that allows access to radar reflectivity displays from the Vance AFB and Wichita WSR-88D radars for the summer 1997 IOP. He is creating the displays and the EC is providing the vehicle to access the displays. (See http://www.xdc.arm.gov/data/dev/sgp/wsr88d/). Mike also presented a discussion on the potential use of WSR-88D data in the context of ADAS analyses (particularly the cloud analysis package). This presentation received enthusiastic support from the SCM and Cloud Working Groups. As follow-up, Mike is working with Steven Lazarus and Carol Ciliberte at the University of Utah to create ADAS analyses for portions of the summer 1997 IOP for testing by the SCM Working Group. Advective tendency specification is an anticipated product from this effort. Preliminary results from this project are anticipated by the March 1999 Science Team Meeting.

Mike Splitt and Scott Richardson are preparing final revisions for a **manuscript on data collected the first Water Vapor IOP**, which includes information on lot-to-lot sonde variability. Recent sonde developments concerning packaging material contamination will be included. Barry Lesht is also an author.

Scott Richardson has started populating **mentor web pages** for the chilled mirror hygrometers and the RH calibration facility.

Scott has also been asked to write a chapter for a book to be published by McGraw-Hill titled ***Handbook of Weather, Climate, and Water***. His section is called "System Design, Calibration, and Quality Assurance Needs of Networks." He will be drawing from his ARM Program and Oklahoma Mesonet experiences in writing the chapter.

Mike Splitt and Randy Peppler both participated in the ARM's "**Ask a Scientist a Question**" program. Randy reviewed a comprehensive list of such questions for the new ARM "Professor Polar Bear" website.

Chad Bahrmann gave a **site tours** during this period to Alfred Garrett and Robert Kurzeja of the Savannah River Technical Center and to Chris Reilly of Argonne National Laboratory.

Chad also published his **M.S. thesis work** in September, in the *Journal of Geophysical Research* (volume 103, number D18, pp. 23,153-161). The article is titled "Influence of air

mass history on black carbon concentrations and regional climate forcing in southeastern United States".

Randy Peppler is helping **mentor high school students** from Emporia, Kansas, on science fair projects involving surface temperature and energy balance from Kansas Extended Facilities. He is doing this in the capacity as a scientific mentor for the ARM/Oklahoma Mesonet outreach program.

Randy Peppler is helping coordinate **a case study on the Central American smoke incident** this spring from the perspective of how it was detected by instrumentation at the SGP CART site. It involves both ARM and non-ARM scientists. If all goes well, a poster will be presented at the March 1999 Science Team Meeting, with eventual submission of a paper to the Bulletin of the AMS. So far, participants include Dave Turner, Rich Ferrare, John Ogren, Rangshai Halthore, Frank Murcray, Mike Poellot, and others, including possibly the Oklahoma Department of Environmental Quality.

Finally, Randy Peppler was responsible for producing or facilitating **reports** such as this one in fulfillment of our contract with ARM.