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ACRF Instrumentation Status: New, Current, and Future

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Atmospheric Radiation Measurement
Climate Research Facility
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Abstract

The purpose of this report is to provide a concise but comprehensive overview of Atmospheric Radiation Measurement (ARM) Climate Research Facility (ACRF) instrumentation status. The report is divided into the following four sections: (1) new instrumentation in the process of being acquired and deployed, (2) existing instrumentation and progress on improvements or upgrades, (3) proposed future instrumentation, and (4) SBIR instrument development. New information is highlighted in blue text.

Acknowledgments

This report is developed largely from the information submitted to and managed within our Instrument Mentor Monthly Summary (IMMS) reporting system (http://www.db.arm.gov/IMMS/). Special thanks to our Instrument Team for providing timely and complete updates to the IMMS, to Kathy Doty our developer and administrator of IMMS, and Rolanda Jundt who ensures this information is posted accurately on the ARM website.

Contents

1. New Instrumentation

1.1 Thin Cloud Rotating Shadowband Radiometer for Liquid Water Path, Visible Optical Depth, and Effective Radius for Thin Clouds

Andy Vogelmann and Mike Reynolds have modified an existing Brookhaven National Laboratory (BNL) fast rotating shadowband radiometer (FRSR) to enable Qilong Min to apply his algorithms to retrieve liquid water path (LWP), visible optical depth (τ_{cloud}), and effective radius (r_{eff}) for thin clouds. The thin-cloud rotating shadowband radiometer (TC-RSR) will remain a BNL-owned instrument; however, the ACRF will incur costs that cover field operation and data reduction for each field campaign deployment.

This development work is documented in EC0-00635, Develop and Test Thin-Cloud Rotating Shadowband Radiometer (TC-RSR). The system is calibrated and currently undergoing final testing at RMR Co. before field-testing at the Southern Great Plains (SGP) site. Andy will submit a field campaign request when the system is ready for deployment, most likely in January 2008.

The development team is hopeful that measurement accuracies of optical depths within 2%, r_{eff} within 10%, and LWP within 2 gm^{-2} are attainable. Other field campaigns and experiments that might use this system include the ARM Mobile Facility (AMF) deployment to the Azores and with the VAMOS Ocean-Cloud-Atmosphere-Land Study (VOCALS) experiment off the coast on Chile. This instrument is well suited to study thin, oceanic clouds and marine stratus for shipboard and marine deployments.

STATUS – Development is in progress. See http://www.rmrco.com/dev/tcrsr/.

1.2 Optical Rain Gauge for the Southern Great Plains Site

Mentor: Mary Jane Bartholomew, Brookhaven National Laboratory

An optical rain gauge (ORG) will be acquired for the SGP to use with the Atmospheric Remotely Sensed Cloud Boundaries (ARSCL) value-added procedure (VAP). The AMF and Tropical Western Pacific (TWP) sites already have ORGs installed. This work is documented in ECO-00621.

STATUS – The ORG was delivered to SGP in mid-June. Mary Jane Bartholomew and Danny Nelson report in ECO-00621 that the ORG was installed at SGP on October 15, 2007. Final installation details, calibration, and ingest are being finalized. Sutanay Choudhury is developing the instrument collection and ingest.

1.3 Infrared Sky Imager

Mentor: Vic Morris, Pacific Northwest National Laboratory

An infrared sky imager (IRSI) from Blue Sky Imaging (http://www.aas.org/career/bluesky.html) was deployed at the SGP in September 2005 to provide nighttime cloud-cover measurements, which was documented in ECO-00429.

Problems with moisture infiltration of the imager necessitated its return to the manufacturer for repair/revision in October 2005. The unit was returned to SGP in late June 2006 and returned to service in August 2006. In late January 2007, SGP technicians resolved hardware problems and restored the IRSI to operation. Software modifications by the manufacturer have corrected the image mask problem, which has permitted cloud fraction to be derived from the images. In February 2007, Vic Morris conducted a comparison of cloud fractions from the IRSI and the total sky imager (TSI). The comparisons indicate the IRSI is still not producing correct cloud fractions.

STATUS – Vic Morris has completed an inter-comparison of IRSI systems. This field campaign was approved under IOP number 2007-05673, IRSI Inter-Comparison Study, associated EWO-12214, and conducted from August 27 to September 23, 2007. Four instruments were installed during the inter-comparison;

Instrument	Data Available
BSI All Sky Thermal Infrared Camera (ASTIC) 320C	9/02 - 10/10/2007
Solmirus All Sky Infrared Visible Analyzer (ASIVA)	8/28 - 9/11/2007
Heitronics Nubiscope	8/27 - 10/05/2007
Atmos Cloud Infrared Radiometer (CIR) 4	8/30 - 9/28/2007
Atmos Cloud Infrared Radiometer (CIR) M	8/30 - 9/17/2007

Vic is collecting the data for archival and analysis.

1.4 Add MFR to Cessna 206 (In-Situ Profiling Aircraft)

Mentor: Gary Hodges, NOAA/ESRL/GMDivision

Currently, spectral albedo measurements are only possible at the SGP Central Facility using downward-facing multi-filter radiometers (MFR) at the 25-m level of the 60-m tower over a wheat field and on a 10-m tower over the adjoining pasture. By adding an MFR to the Cessna 206 used for the in situ aerosol profile (IAP), routine measurements of surface spectral albedo could be acquired over a broader area around the SGP Central Facility. This work is documented in ECO-00584.

STATUS – The MFR with a 140º field of view and associated data logger are installed on the Cessna 206 and collecting data. Gary Hodges is evaluating design options for a mounting adapter on the MFR head to allow easier maintenance and calibration.

1.5 DigiCORA-III for Manus, Nauru

Mentor: Barry Lesht, Argonne National Laboratory

The digiCORA is the ground station for the Vaisala balloon-borne sounding system (BBSS). In FY2003-2004 new digiCORA-III systems were acquired and deployed at the SGP Central Facility, NSA Barrow site, and the AMF as the primary ground station. For reliability and compatibility reasons, it is necessary to replace the digiCORA-II systems at Manus and Nauru with the new digiCORA-III systems. This work is documented in ECO-00598.

STATUS – The new digiCORA-III was installed on Manus in June. For Nauru, the digiCORA-III system was successfully installed on August 18, 2007, with collected data stored locally. Data flow to the Data Archive was established on October 17, 2007.

2. Existing Instrumentation

This section describes the current status of existing instrumentation, including any planned or in-progress upgrades. The information is abstracted primarily from the Instrument Mentor Monthly Summary (IMMS) reports (available from the instrument web pages) and the Engineering Change Order (ECO) status updates.

2.1 Atmospherically Emitted Radiance Interferometer

Mentor: Dave Turner, Space Science and Engineering Center, University of Wisconsin

AMF (Heselbach) – Operating nominally. The instrument was shut down briefly on September 25 and 27 to allow the dewar/detector to warm up in a (successful) attempt to reduce the noise from the Sterling cooler.

NSA (Barrow C1) – This system ran well. Data quality looks good.

SGP (C1) – This system ran well. Data quality looks good.

SGP (E14) – Instrument had periods where the interferometer stopped collecting data (end of September 4 to middle of September 5, a few hours on September 13 and 20, end of September 23 to middle of September 24, and end of September 25 to middle of September 26). All data collected looks good.

TWP (Nauru C2) – This system ran well. Data quality looks good.

TWP (Darwin C3) – This system ran well. Data quality looks good.
Several AERI hatch systems (TWP and AMF) have manifested abnormal and unexpected status data. BCR-01399, Re-Wiring of AERI ach Controllers, was opened to resolve this condition. On October 22, 2007, Dennis Hackel reported that the hatch controller and position indication is functioning correctly. A data quality report will be issued to communicate any impact to data.

2.1.1 Windows and Rapid-Sampling Upgrade

Migration of the AERI software from OS/2 Warp to Windows XP and related computer hardware modernization that enables rapid sampling of the IR spectrum at 10-s intervals began in FY2004 and is documented in ECO-00286. Upgraded AERI systems are currently operational at the SGP, NSA Barrow site, TWP Nauru and Darwin sites, and the AMF site in Germany.

STATUS – The spare AERI system interferometer that was sent to Bomem for a laser replacement has just returned to the Space Science and Engineering Center (SSEC). The software on the last computer rack to be updated has been updated from OS/2 to Windows XP, and the most recent version of the AERI

operating software has been installed. This completes the ARM AERI computer upgrades from OS/2 to Windows XP.

2.2 Aerosol Observing System

Mentor: John Ogren and Anne Jefferson, NOAA/ESRL/GMD

AMF (Heselbach) – Operating nominally.

Edited data from the aerosol measurements for the third quarter of 2007 have been sent to the Data Archive. Aerosol observing system (AOS) data are checked daily and edited weekly.

During the sixth month of operation in Germany, the aerosol loading was low to moderate with aerosol scattering coefficients at 550 nm for sub 10 micron particles ranging from 2 to 80 Mm^{-1}. Angstrom exponents for the sub 10 micron aerosol ranged from 0.5 to 2.0. The Angstrom exponent for submicron aerosol ranged from 2.1 to 2.6. The aerosol single scattering albedo ranged between 0.6 to 0.92. The single scattering albedo was highly variable with low values lasting for anywhere from 2 to 8 hours. The aerosol hygroscopic growth factor for sub 10 micron size particles ranged between 1.2 and 1.9.

A new tower assembly for the AMF AOS is being designed to reduce the time required to set up the tower and eliminate the need to rent a crane to install it. Instead of using PVC pipe for the AOS inlet, the mentor is considering lightweight collapsible tubing. The new tower will be installed on a port on top of the AOS trailer. The AOS rack will be moved to the front of the trailer to make room for the AERI. Installation of the new tower is planned for November.

SGP – Operating nominally.

2.3 Balloon-Borne Sound System

Mentor: Barry Lesht, Argonne National Laboratory

Due to the conclusion of the AIRS/IASI IOP and a one-day shorter month, ARM made substantially fewer radiosonde flights in September (480) than in August (561). Considering the regularly scheduled soundings, overall radiosonde data recovery was excellent in September with sounding reporting rates of FKB 122/120 (103%), NSA 60/60 (100%), SGP 118/120 (98%), TWP/C1 (Manus) 59/60 (98%), and TWP/C2 (Nauru) 56/60 (93%). These numbers take into account flights when the radiosonde failed at launch (1 at fkb, sgpC1, and twpC1 and 2 at twpC2). Generally, operators will launch a replacement sonde when this occurs. The NSA/C1 and TWP/C2 numbers do not include soundings done as part of the AIRS/IASI IOP, some of which are done on the production systems. At SGP, the AIRS/IASI soundings are done on systems S01 and S02.

We have completed the final phase of the ARM AIRS (and IASI) validation sounding program. We started the program when AIRS became operational in late August 2002 and were fortunate to be able to include IASI when it began producing regular data in July 2007. Overall, we made nearly 3000 dedicated soundings that were closely coordinated with satellite overpasses.

2.3.1 Make Atmospheric Radiation Measurement Program-Barrow Soundings Available to the Global Telecommunication System

Soundings from the SGP and NSA Barrow sites are now available to the global telecommunications system (GTS). Soundings from TWP (Manus and Nauru) are also be available to the GTS now that the new digiCORA-III systems are installed and operational there.

2.4 Broadband Radiometers (BRS, SIRS, SKYRAD, GNDRAD)

Mentor: Tom Stoffel, National Renewable Energy Laboratory

Calibration – SGP/BORCAL 2007-01 has been completed. The newly calibrated radiometers will be exchanged with instruments in the field, which will then be included in SGP/BORCAL 2007-02. Broadband outdoor radiometer calibration (BORCAL) reports and reference irradiance data for all 11 years of radiometer calibrations at the SGP Radiometer Calibration Facility (RCF) are now available at http://www.nrel.gov/srrl/borcal.html.

BRS – Broadband radiometer station (BRS) data for September 2007 were excellent with 100% data collection. (**NOTE**: Data recovery statistics are based on ARM Data Quality Office monthly Health & Status reports accessed by "HandS Explorer" at http://dq.arm.gov/.) Of the 1-minute irradiance data collected, more than 96% of the shortwave and 100% of the longwave data passed automated data quality tests. "Failed" shortwave (solar) data are generally limited to high solar zenith angles or can be attributed to the varying thermal offsets and time responses of the thermopile-based radiometers to rapidly changing sky conditions, e.g., cloud cover and water vapor concentrations. Operation and maintenance of the BRS was excellent as seen from data comparisons with similar instruments at the Central Facility (SIRS C1 and E13). BRS measurement precision was within estimated total measurement uncertainties for the radiometers.

SIRS – Solar infrared station (SIRS) data for September 2007 were generally excellent with 100% data collection except at E15 (54%) and E19 (86%) due to communication problems between the data system computers and the SIRS data logger. (**NOTE**: Data recovery statistics are based on ARM Data Quality Office monthly reports accessed by "HandS Explorer" at http://dq.arm.gov/. At least two weeks of operational secondary data logger storage is available for the recovery of all measurements for potential inclusion in the final data archives.] Overall data recovery of all SIRS stations was 97.6%. Of the 1-minute irradiance data collected, more than 97% of the shortwave and 100% of the longwave data passed automated data quality tests. "Failed" shortwave (solar) data are generally limited to low irradiances (less than 300 W/sq m) at high solar zenith angles or can be attributed to the varying thermal offsets and time responses of the thermopile-based radiometers to rapidly changing sky conditions, e.g., cloud cover and water vapor concentrations.

SKYRAD – Downwelling broadband solar and atmospheric irradiances (SKYRAD) data for September 2007 were excellent with 100% data collection at all stations (NSA and TWP). Of the 1-minute irradiance data collected, at least 99% of the shortwave and 100% of the longwave data passed automated data quality tests. The AMF SKYRAD instruments at Heselbach, Germany, (FKB) continued to function normally. The effects of the slightly restricted solar access by the surrounding mountains are apparent for

about 1.5 hours before and following local geometric sunrise and sunset. Also, there are morning excursions between measured and calculated downwelling hemispheric shortwave radiation due to the differential shading of the radiometers by the valley sides.

GNDRAD – Upwelling broadband irradiance (GNDRAD) data for September 2007 were excellent with 100% data collection at all operational stations (FKB, NSA, TWP). Of the 1-minute irradiance data collected, more than 99% of the shortwave and 100% of the longwave data passed automated data quality tests. The AMF GNDRAD instruments at FKB continued to function normally.

2.4.1 Pyrgeometer Calibration Improvements

Tom Stoffel and Ibrahim Reda have initiated an investigation into the source of the bias in the ACRF pyrgeometer blackbody calibration system in accordance with ECO-00559. At blackbody temperatures less than -20°C, the Dow Corning 200 fluid viscosity increases, which inhibits mixing and results in a temperature gradient of 3°C from the base to the top of the hemispherical blackbody. A new set of fluid dispersion manifolds (perforated annuli) has been developed to reduce the temperature gradients in the blackbody. Additionally, a replacement fluid with better low temperature (viscosity) characteristics has been identified. Pyrgeometers calibrated using the new manifold and fluid will be compared with pyrgeometers having calibrations traceable to the World Infrared Standard Group (WISG) and with pyrgeometers calibrated by NOAA/GMD.

STATUS – Reda has replaced the fluid in the pyrgeometer blackbody calibration system at NREL with a new Dow fluid that offers better low temperature performance and provides more uniform blackbody temperature control. Preliminary data suggest the 3°C temperature difference between the top of the blackbody hemisphere and the 45° elevation at -30°C is now less than 1°C. Reda continues to explore methods for confirming/correcting this lower ΔT.

2.4.2 Radiometer Calibration Facility Data Acquisition System Replacement

The data acquisition system in the RCF used for annual BORCAL activities is more than ten years old and needs to be updated. National Renewable Energy Laboratory (NREL) has recently replaced their BORCAL data acquisition system using internal funds. The SGP system should be a duplicate of the NREL system for software compatibility and performance assurance. This system upgrade is approved for implementation in FY2008 and is covered by ECO-00642, Replace SGP/RCF BORCAL Data Acquisition and Control System.

2.5 Carbon Dioxide Flux System

Mentor: Marc Fischer, Lawrence Berkeley National Laboratory

The carbon dioxide flux system (CO_2FLX) instruments at 25 and 60 m on the SGP-CF tower are operating nominally. The 4-m system exhibited malfunctions of the H_2O and air-pressure channels and was sent to Licor for repair on September 25, 2007. Upon inspection at Licor, the firmware was found to be corrupted and was updated.

2.6 Carbon Monoxide System

Mentor: Sébastien Biraud, Lawrence Berkeley National Laboratory

The carbon monoxide (CO) instrument is operating nominally. CO data are checked daily and sent to the Data Archive every six months. Precision gas system (PGS) data are checked daily and send to the ARM archive weekly.

2.7 CO_2 Precision Gas System

Mentor: Margaret Torn and Sébastien Biraud, Lawrence Berkeley National Laboratory

A comparison of PGS CO_2 measurements against NOAA flasks and isotope flasks collected at all heights of the 60-m tower still shows a difference on the order of 1 ppm. PGS data are checked daily and sent to the Data Archive weekly.

2.8 Cimel Sun Photometer

Mentor: None (external data provided by NASA AERONET) – Infrastructure Contact is Laurie Gregory at Brookhaven National Laboratory

AMF (Heselbach) – Unit #98 has been installed. However, ongoing problems with the installation are being worked out and no data are available.

NSA (Barrow C1) – Operating nominally. Will be sent back for calibration in October due to Polar night.

SGP (CF) – Operating nominally.

TWP (Nauru) – Operating nominally. Cloud mode was enabled September 24, 2007.

Cimel Unit #168 (from Niamey) has been sent back to Aeronet for calibration.

2.9 Disdrometer

Mentor: Mary Jane Bartholomew, Brookhaven National Laboratory

In Oklahoma, the flooding rains of the previous few months diminished considerably during September, which ranked as the 55th driest on record, at just under an inch below normal. Severe weather was scarce as well. Notable rain events occurred at the site on September 4 (6 mm), September 8 (30 mm) and September 25 (8 mm). Near below-average rainfall was experienced across the Northern Territory of Australia. The exceptions were some pockets of above-average rainfall over the Top End and significantly below average in the far southwest. The Darwin site had one notable event on September 28 with accumulated precipitation of more 30 mm.

TWP (Darwin) – Operating nominally. Good comparison with neighboring rain gauges.

SGP – Operating nominally. Good comparison with neighboring rain gauges.

2.10 Energy Balance Bowen Ratio Station

Mentor: David Cook, Argonne National Laboratory

SGP – The measurements from the energy balance Bowen ratio (EBBR) stations are contained in three datastreams (5 minute, 15 minute, 30 minute). The data are being ingested and are available from the Data Archive. The 5-minute datastream contains primarily meteorological measurements. The 15-minute datastream contains primarily raw voltage and resistance measurements of most of the sensors (to be used in the final 30-minute calculations). The 30-minute datastream contains half-hour averages of most of the sensor measurements in engineering units, plus the energy balance components.

Beginning in FY2006, data quality reports (DQRs) are not written for missing data or for situations when qc flags clearly show that the data are incorrect (this is true for most of the conditions listed below). DQRs are written for periods when data are incorrect, when the situation is not represented by qc flags in the data, and it is not obvious that the data should have been flagged as incorrect.

Common conditions that result in incorrect or missing data include the following:

a) Sensible and latent heat fluxes are not accurate during times when the automatic exchange mechanism (AEM) is not functioning properly. The AEM switches the gradient measuring instrumentation between the top and bottom positions every 15 minutes; this reduces the effects of instrument offsets. Sometimes the AEM does not reach its full extent of travel, resulting in the home signal being zero.

b) Sensible and latent heat fluxes are sometimes incorrect when surface soil heat flow is out of range, as seen in the average soil heat flux (ave_shf).

c) Very light winds may be seen on occasional nights for brief periods at a few of the extended facilities. Wind direction changes a lot during low wind conditions and is probably unreliable during those periods.

d) Missing data periods occur at times; this is usually a site data system collection or communication problem. By the time this report is published, the data may have been filled in from manual or automatic re-collection of the data. The Campbell datalogger communications software is being updated to hopefully allow more complete collection of data in the future (from the storage modules).

Data quality issues at individual sites follow:

SGP (E2) – Data quality looks good.

SGP (E4) – Data quality looks good.

SGP (E7) – Data quality generally looks good, when available. Data are missing September 1, 0000GMT – September 4, 1930 GMT.

Relative humidity is too high all month, but this does not affect the sensible and latent heat fluxes.

SGP (E8) – Data quality looks good. Relative humidity measurements are too high, but this does not affect the sensible and latent heat flux measurements.

SGP (E9) – Data quality generally looks good.

Soil heat flow #3 sometimes spiked (usually only once in a day), resulting in sensible and latent heat fluxes being offscale and incorrect.

SGP (E12) – Data quality generally looks good.

Soil heat flow #2 was off scale at times September 23, 1630 GMT – September 25, 0200 GMT; sensible and latent heat fluxes were incorrect during these times.

SGP (E13) – Data quality looks good.

SGP (E15) – Data quality generally looks good, when available. Data are missing September 2, 1500 GMT and 1900-1930 GMT; September 17 1700 GMT; September 18, 1830 GMT; September 20, 0100 GMT; September 21, 1830 GMT – September 25, 1530 GMT.

Soil temperature #2 spiked September 11, 2030 GMT; sensible and latent heat fluxes were incorrect at this time.

SGP (E18) – Data quality looks good.

SGP (E19) – Data quality looks good when available. Data are missing September 26, 1930 GMT – September 30, 2330 GMT.

SGP (E20) – Data quality looks good.

SGP (E22) – Data quality generally looks good.

Sensible and latent heat fluxes were incorrect when soil heat flow #5 was off scale at times, September 15, 1630 GMT, through the end of the month.

SGP (E26) – Data quality generally looks good.

Sensible and latent heat fluxes were incorrect when the left temperature/relative humidity probe temperature jumped around September 28, 0140 GMT – September 30, 2330 GMT.

SGP (E27) – Data quality generally looks good. Data are missing September 12, 1730-1800 GMT.

The AEM circuit board was shorting to ground, causing a voltage to be imposed on the ground line of Multiplexer 2; this caused all of the voltage-based measurements that did not have capacitive shorting to go off scale at various times during the periods August 7, 2130 GMT – August 13, 1600 GMT and

August 19, 1300 GMT – August 29, 2130 GMT; sensible and latent heat fluxes were incorrect when the AEM circuit board shorting occurred.

ECO-00645 – Vaisala no longer repairs the combined temperature and relative humidity probes in the EBBR (two per system) but does still offer recalibration services. Replacement probes are available from the EBBR manufacturer. The mentor has proposed replacing all 32 probes in phases over 3 years. As the old probes are replaced, they can be used as spares for the systems that are not upgraded yet. These upgrades are covered by ECO-00645, Replace T/RH and PRTD Probes in EBBR with Combined T/RH/PRTD Probes.

2.11 Eddy Correlation Station

Mentor: David Cook, Argonne National Laboratory

Ten Eddy correlation station (ECOR) systems are installed at ARM facilities: 9 at SGP and 1 in the AMF.

SGP – Some common conditions that will be noted in the ECOR data include the following:

a) Periods of precipitation, fog, and dew (frost) often cause incorrect water vapor (H_2O) and carbon dioxide (CO_2) measurements. This is caused by water lying on the lower window of the LI-7500 CO_2/H_2O sensor, thereby obstructing the passage of the sensing infrared radiation (very light precipitation may have little or no effect). The CO_2 portion of the instrument is more sensitive to this condition, so it is not unusual for latent heat flux to be good, even though the CO_2 flux is not.

DQRs are not written and time periods are not indicated in the monthly report for this wetting condition, as it would be overly time-consuming. The data user should look at co-located or nearby surface meteorological observation system (SMOS) rain gages or the HandS ECOR plots to determine times of precipitation. It can be assumed that off-scale or spiked readings in the few hours before dawn are often caused by dew or frost on the CO_2/H_2O sensor.

ECR 00536 was written to add a wetness sensor to the ECOR to provide more timely information on wetting conditions.

b) The CO_2 mean sometimes flattens out during the daytime (see E24, August 1, 2005, and August 31, 2005.)

c) Large spikes (positive and negative) in CO_2 flux can occur when the flux is essentially zero (see E16, August 16, 2005, 0800-0930 GMT).

d) ECOR time stamps are for the beginning of the half hour, whereas those for the SMOS and EBBR are for the end of the half hour. Therefore, when comparing data for these systems, such as on HandS plots, the values for the ECOR show a half hour earlier than the commensurate values for the SMOS and EBBR.

e) Friction velocity (ustar) and momentum flux (k) are often flagged during light wind conditions. This is normal, as these measurements, as well as the fluxes of sensible heat flux (h), latent heat flux (lv_e), and CO_2 flux (fc) cannot be trusted because of the lack of ability of the sonic anemometer to measure properly during very low wind speeds (especially <1 m/s).

f) Momentum flux and friction velocity have opposite signs, and mirror each other since friction velocity is computed from momentum flux. In the HandS plots they are plotted to scales with opposite sign orientations, so they trend together.

g) Plots of water vapor flux (lv_e) and CO_2 flux (fc) normally mirror each other. In the HandS plots they are plotted to scales with opposite sign orientations, so they tend to trend together.

h) In rare occasions the flag for elev (angle of attack of the wind) is exceeded, normally on the positive side. The flag limits for elev are quite generous; this was done to try to accommodate the large angles that can occur at the forested Okmulgee site E21. However, the angles at the Okmulgee site can often be much larger than the qc limits because of the very uneven height of trees in the mixed deciduous forest at Okmulgee.

i) Fluxes of CO_2, sensible heat, and latent heat at E21 Okmulgee forest are often larger than at other sites, particularly the fluxes of H_2O and CO_2; the latter will often be twice what it is at the other ECOR sites.

j) The plots of data from the forest site at Okmulgee show more "jumping around" of the data than is seen at the other ECOR sites; this is expected and normal because the scale of eddies that carry the flux information over the tree structure is much larger than over grassland or crops.

k) When the LI-7500 CO_2/H_2O serial datastream is not available (pressure and temperature missing), default values are used in the calculation of the CO_2 and latent heat fluxes; when default values are used, resulting errors in the fluxes are within the ±10% system error.

l) Sudden shifts in wind direction are not handled well by the ECOR coordinate transform routine, often resulting in a spike in each of the fluxes for a half hour measurement period.

m) When the LI-7500 or Versalogic serial port is damaged, "garbled data" occurs. The datastream from the sonic anemometer to the Versalogic computer is typically too short and can not be interpreted by the ECOR software. Fluxes are usually incorrect or off scale and CO_2 and H_2O densities, temperature, and pressure are often incorrect also.

Data Quality Reports - Beginning in FY2006, DQRs are not written for missing data or for situations when qc flags clearly show that the data are incorrect (this is true for most of the conditions listed above). DQRs are written for periods when data are incorrect, when the situation is not represented by qc flags in the data, and it is not obvious that the data should have been flagged as incorrect.

SGP (E1) – Data quality generally looks good except during precipitation and dew/frost.

Pressure and temperature were missing September 1, 0000 GMT – September 30, 2330 GMT.

CO_2 flux and latent heat flux were incorrect September 1, 0000 GMT – September 20, 2030 GMT.

SGP (E3) – Data quality looks good except during precipitation and dew/frost.

SGP (E5) – Data quality generally does not look good.

CO_2 flux and latent heat flux incorrect because sonic upper and lower transducers are switched and because sonic analog channels were not working the entire month.

SGP (E6) – Data quality generally looks good, when available, except during precipitation and dew/frost.

Data were missing 09/11 0030-0130 GMT.

SGP (E10) – All data were missing all month.

SGP (E14) – Data quality looks good except during precipitation and dew/frost.

SGP (E16) – Data quality looks good, when available, except during precipitation and dew/frost.

Data were missing September 14, 0400 GMT.

SGP (E21) – Data quality good except during precipitation and dew/frost.

Data were missing September 29, 1600 GMT – September 30, 2330 GMT.

SGP (E24) – Data quality generally does not look good.

Pressure and temperature were missing September 1, 0000-0200 GMT; September 2, 1800 GMT – September 3, 0200 GMT; September 4, 2100 GMT – September 11, 0900 GMT; September 16, 1230 GMT – September 30, 2330 GMT; CO_2 flux and latent heat fluxes were not affected.

Data were missing September 2 1730-1800 GMT; September 4, 2100 GMT; September 9, 1100 GMT; September 10, 1800, 2300 GMT; September 16, 1230 GMT; September 19 1700 GMT; September 24, 2300 GMT; September 25, 1300 GMT; September 26, 1900 GMT; September 27, 1600-1630 GMT; September 28, 1830 GMT.

AMF – Data generally good, except during precipitation and dew/frost. Dew and light winds at night and in the early daylight hours often produced incorrect or suspect data.

2.11.1 Add Wetness Sensors

Periods of dew, frost, and precipitation often cause data from the CO_2/H_2O sensor and sonic anemometer to be incorrect. Adding a wetness indication would provide the data user with a more reliable source of information concerning this condition, as indicated in ECO-00536.

STATUS – Wetness sensor testing on an ECOR system similar to the ARM ECORs began at Argonne in mid-January. Testing so far indicates that different phases of water and types of dew/frost/precipitation produce different voltage levels from the wetness sensor. Changes to the ECOR programming are underway.

2.11.2 Improve Eddy Correlation Station Software

Tim Martin, in association with David Cook, has proposed to systematically evaluate, document, and reorganize the instrument software to allow for code maintenance and more flexible incorporation of additional logic and sensors, such as the proposed wetness sensor. In addition, the user interface needs to be improved to give access to more debugging and diagnostic messages from the ECOR program, as indicated in ECO-00633.

2.12 G-Band (183.3 GHz) Water Vapor Radiometer

Mentor: Maria Cadeddu, Argonne National Laboratory

The GVR is installed at the NSA Barrow site and is operating nominally. This month's data are continuous and overall data quality are good.

2.13 Global Positioning System (SuomiNet)

Mentor: None (external data provided by SuomiNet/COSMIC)

See http://www.unidata.ucar.edu/data/suominet/.

STATUS – No new information provided. Rick Wagener will add an entry for this system in our IMMS.

2.14 In-Situ Aerosol Profiling

Mentor: John Ogren and Betsy Andrews, NOAA/ESRL/GMD

STATUS – No new information reported.

The IAP field campaign is undergoing a science relevancy review. We anticipate that scientific peer review results of the IAP renewal proposal will be available in the near future.

2.15 In-Situ Carbon Profiling

Mentor: Margaret Torn and Sébastien Biraud, Lawrence Berkeley National Laboratory

A continuous CO_2 sampling system was added to the Cessna 206 aircraft in June, before CLASIC. A second continuous CO_2 sampling system was added to the CIRPAS Twin Otter aircraft in support of

CLASIC. The continuous sampling system supplements the 12-flask system already on the aircraft, which replaced a 2-flask system deployed on the earlier Cessna 172 aircraft since 2002.

2.16 Infrared Thermometer

Mentor: Vic Morris, Pacific Northwest National Laboratory

STATUS – No new information provided.

2.17 Multi-Filter Rotating Shadowband Radiometer and Related Systems (MFR, GNDMFR, NIMFR)

Mentor: Gary Hodges, NOAA/ESRL/GM Division

FKB (Germany M1) – Data quality looks good the entire month.

NSA (Barrow C1) – Channel 940 has not been functioning since installation in the spring. The decision was made to leave the instrument in place and make repairs when it is pulled this winter. If 940 data are required, look at the normal incidence multi-filter radiometer (NIMFR). All other channels look fine.

NSA (Atqasuk C2) – The shading issue reported in earlier months is not noticeable in September. Data quality looks good.

SGP (C1) – Data quality looks good.

SGP (E1) – Data quality looks good, but users should note the comments from the September report. "A step in the data across all channels occurs on 9/5/2006 around 1930 UTC. This coincides with a preventative maintenance visit to the site. The relative changes after the step appear to remain through to current data."

Any calibration issues should be resolved with the C1 data once it is being produced.

SGP (E2) – Data quality looks good until September 13, 2300 UTC, when something failed. The instrument was pulled from service on September 19 for repair. Do not use data after September 13, 2300 UTC.

SGP (E3) – Channel 940 is having problems for most of the month. All the other channels look fine. Do not use 940 from September 2007 data.

SGP (E4) – Values across the board are low. There are also a lot of noise and spikes. Data from this instrument should be treated with caution, avoid unless absolutely necessary, and then only with careful screening.

SGP (E5) – Data quality looks good the entire month.

SGP (E6) – Data quality looks good the entire month.

SGP (E7) – Data quality looks good, though head temps are a bit uneven. Generally not too far below 40ºC.

SGP (E8) – The instrument went down last month due to cattle. It was back in full operation on September 5 at 1900 UTC. Another failure occurred on September 12, 0830 UTC. Data are available post September 12, but look suspect. Mentor suggests not using these data.

SGP (E9) – Channels 415 and 673 are a bit noisier than those channels in other instruments. The shading issue is still there. Techs have been unable to resolve the problems at this site. It has been pushed up the list to receive one of the new systems. Do not use data from 1900 UTC until sunset.

SGP (E10) – Instrument is out of service.

SGP (E11) – Data quality generally looks good in that the instrument is functioning properly and there are no alignment/shading issues. However, channel 615 is reading noticeably high. Any calibration issues should be resolved with the C1 data once they are being produced.

SGP (E12) – Data quality generally looks good, but there is some spiking August 12 - 16 that does not look right. It would be easy for a user to edit out the spikes.

SGP (E13) – Data quality looks good the entire month.

SGP (E15) – Instrument is out of service for repairs.

SGP (E16) – Data quality looks good the entire month.

SGP (E18) – Data quality looks good the entire month.

SGP (E19) – Instrument is out of service.

SGP (E20) – Instrument is out of service.

SGP (E22) – A replacement instrument was installed late August. Initial data do not look good though. Some bugs need to be worked out, but we should have good data from this instrument soon.

SGP (E24) – Missing a day and a half of data at the start of the month. The rest of the month is available and looks fine.

SGP (E27) – Data quality generally looks good in that the instrument is functioning properly and there are no alignment/shading issues. However, channel 415 is reading noticeably high. Any calibration issues should be resolved with the C1 data once they are being produced.

TWP (Manus C1) – Data quality looks good.

TWP (Nauru C2) – Data quality looks good.

TWP (Darwin C3) – Data quality looks good.

2.17.1 Multi-Filter Rotating Shadowband Radiometer Calibration and Data Processing Improvements

Problems with the calibration and data processing of the multi-filter rotating shadowband radiometers (MFRSRs) were revealed during the ARM Lidar Validation Experiment (ALIVE) campaign, documented in ECO-00571. New calibration processing will be implemented, and old data will be reprocessed to apply corrections and the new processing algorithms.

STATUS – MFRSRs with refurbished sensor heads and new data loggers are now operational at E2, E5, E8, and E13. Ingest processing is being finalized so data from these systems are not yet available from the Data Archive.

2.17.2 Establish Multi-Filter Rotating Shadowband Radiometer Calibration Facility at the Southern Great Plains Site

The cosine bench and related equipment were installed at the SGP site. NOAA Global Monitoring Division (GMD) will oversee the establishment of the facility as well as the routine calibrations associated with using the facility. NOAA GMD staff will also prepare documentation, train the SGP calibration technicians, and review the resulting calibrations to make sure they are valid before field deployment. This is documented in ECO-00617. A monochromator and the associated computing hardware will be installed with the MFR cosine bench to enable characterization of the MFR filters.

2.17.3 Data Logger Replacement

The proprietary data loggers supplied with the MFRSRs and related instruments are to be replaced with Campbell Scientific CR1000 data loggers. This will permit them to be more easily maintained. It will also permit modifications to the operation of the instruments and data acquisition to be easily implemented. This is documented in ECO-00350.

2.18 Millimeter Cloud Radar

Mentor: Kevin Widener, Pacific Northwest National Laboratory; Karen Johnson, Brookhaven National Laboratory

SGP – No problems. Uptime was at 100%

NSA – No transmit on September 8, 0500 – 1300. Uptime was at 98.9%

TWP (Manus) – Data are missing from September 27. Uptime was at 99.8%

TWP (Nauru) – Data are missing September 26, 1930 – 2359. Uptime was at 99.4%

TWP (Darwin) – Data are missing September 18, 0100 – 0300; September 19, 0000 – 0430; September 21, 0000 – 0700; September 29, 0000 – 0230. Uptime was at 97.6%

2.18.1 Millimeter Cloud Radar Digital Transceiver Upgrade

The main focus of the millimeter cloud radar (MMCR) digital receiver upgrade is to develop a completely digital transceiver, as indicated in ECO-00610. This will provide new capabilities such as increased sensitivity using advanced modulation techniques and an up-to-date computing platform that will be supportable for a minimum of 5 years. Another significant improvement will be to provide for more robust calibration, health monitoring, and automatic notification of anomalies. The plan is to accomplish this upgrade in the following phases: 1) evaluation and design, 2) development and integration, and 3) testing, documentation, and training.

STATUS – A contract has been awarded to ProSensing to begin the design. Kevin Widener met with ProSensing representatives during CLASIC at SGP in mid-June for technical discussions.

STATUS – Costs for the upgrade are substantially more than originally budgeted. We will be going back through the Science Working Groups for comment.

2.18.2 Millimeter Cloud Radar Processor Upgrades

The C40 processors are being replaced with PIRAQ-III processors, as documented in ECO-00283.

STATUS – The PIRAQ-III processor upgrade at Barrow was unsuccessful due to a defective radar receiver. The antenna feed was found to be in very poor condition and was returned to satisfactory operational condition. Plans are in discussion to replace the antenna before hard winter sets in. This radar is critical measurement for next spring's Indirect and Semi-Direct Aerosol Campaign (ISDAC) and Routine *in situ* Cloud and Aerosol Measurements (RISCAM) field campaign.

2.18.3 Millimeter Cloud Radar Spares Kit

The plan is to buy the parts and build a kit with most things a technician will need to service the MMCRs, as indicated in ECO-00629. In addition, a radiofrequency (RF) signal generator and RF power meter will be acquired for the SGP (TWP already has these). Two sets of spare PC-integrated acquisition system (PIRAQ) boards will also be acquired: one set for TWP and the other set for SGP (which will also support Barrow).

STATUS – All parts have been received and are being held pending the determination on how to proceed with ECO-00610.

2.18.4 Add Polarization at Barrow

(ECO-00552) Because the PIRAQ processor does not support polarization, the installation of the orthomode transducer at Barrow is on hold until the next processor upgrade.

STATUS – This ECO will be in a hold status until the next processor upgrade to the Barrow MMCR, as tasked under ECO-00610, MMCR Digital Transceiver Upgrade.

2.18.5 Spare Traveling Wave Tubes

New traveling wave tubes (TWT) will be ordered to replace the TWTs originally delivered with the MMCRs, which are well beyond their rated lifetime and are beginning to fail. This is documented in ECO-00425.

STATUS – One additional TWT amplifier is in the procurement queue for FY2008, along with two TWTs. Our FY2009 procurement plan includes three additional TWTs. Radar data availability and quality are high priorities of the Science Working Groups.

2.18.6 Millimeter Wave Cloud Radar Spectra Processing

Spectra files produced by the upgraded MMCRs (C40 or PIRAQ-III processors) range from 8 to 15 GB per day. Algorithms for eliminating clear-sky periods and compressing the files need to be developed and implemented locally. This is documented in ECO-00391.

STATUS – The data are collected, processed, and shipped hourly. The MMCR spectra compression software has been running at the SGP site since October 1, 2007. BCR-01301 tracks this effort. The compression results are monitored via plots posted at: http://c1.dmf.arm.gov/data/process/sgp/sgpmmcrspecmaskC1.a0/2007/.

Overall, the results look very good. There is concern that spectra for some very thin potential clouds are being removed. Approaches to identify these features and retain the spectra at such time-height points without saving very large hydrometeor-free regions of data are under evaluation. All raw (uncompressed) spectra data are being retained for 90 days to allow time to review the compression results.

2.18.7 Refurbish Millimeter Wave Cloud Radar Antennas

Beginning in 2007, over a 3-year period, the MMCR antennas will be refurbished and characterized on an antenna range, as documented in ECO-00551. The spare antenna is complete and the contract for the new feed and sub-reflector has been placed. Once these are complete, they will be installed on the antenna reflector and calibrated. The Barrow MMCR antenna will be refurbished first to avoid impacting planned field campaigns at SGP.

STATUS – The new antenna for Barrow has been procured and tested. The antenna is planned for installation at Barrow during November 2007.

2.18.8 Radome or Radome Dryer

The detrimental effect on the data of standing water on the current fabric radome has prompted the pursuit of a more satisfactory solution. Unfortunately, discussions with potential suppliers have not been fruitful. This task is currently on hold. This is documented in ECO-00275.

2.19 Micropulse Lidar

Mentor: Rich Coulter, Argonne National Laboratory

SGP – Overall, the micropulse lidars (MPLs) had no show-stopping issues during September 2007. On the other hand, all the sites continue to lock-up on roughly a 21-day interval. See April's report for some detail on this issue. Memory-leak problems have been ruled out as a cause for this behavior. Other than this, the data from the system at the SGP has continued unabated with little/no problems although for a 4-day period between September 14 and September 18 the polarizer was not switching. This continues to be an aggravating problem that can be fixed if we implement the software upgrades with Sigma Space. Good data to greater than 15 km is normal during nighttime and 10-15 km during daytime.

NSA – No problems to report from the NSA system.

TWP (Manus) – There are no obvious problems in the data from Manu; however, the energy monitor has significantly larger variations (±0.1 uJ/s) than at most other sites (±0.01 uJ/s). This will have to be monitored.

TWP (Nauru) – The MPL at Nauru has been working well; the last time the system locked up, the site personnel restarted the system successfully so perhaps they are getting the hang of the thing.

TWP (Darwin) – The replacement MPL installed at Darwin on May 15, 2007, now seems to be operating pretty well with no sign of the upper level false echoes. There was only one brief interval with condensation this month.

AMF (Heselbach) – The new polarized AMF MPL operating in Heselbach, Germany, is running well; however, it shows the most evidence of the "striping" effect that coincides with the operation of the anti-condensation fan discussed last month.

2.19.1 Modify Micropulse Lidar Polarization Switching and Data Acquisition

Based on suggestions by Jim Spinhirne at NASA Goddard Space Flight Center, the new spare MPL will be modified as follows:

1. Switch polarizations between laser shots.
2. Use different data channels for each polarization. In combination with switching polarizations between laser shots, this will permit essentially simultaneous 30-second averages to be acquired for each polarization.
3. Use a ½-wave plate rather than a ¼-wave plate to acquire linear polarization directly.

STATUS – Before implementing these changes, a spare MPL will be loaned to Judd Welton and Tim Berkoff at NASA MPLNET for evaluation. MPL #104 (formerly at Darwin) has been returned to Sigma Space for repair. After it is repaired, it will be loaned to MPLNET for evaluation.

2.20 Microwave Radiometer

Mentor: Maria Cadeddu, Argonne National Laboratory

SGP –

SGP (B1) – This month, data are continuous. The radiometer is stable. See following note about a possible bias in the brightness temperature measurements. When this instrument was at the SGP Central Facility for testing, it was measuring a warmer 23.8-GHz temperatures than the C1 instrument.

Comparison with radiosondes launched during the Cloud and Land Surface Interaction Campaign (CLASIC) at the B1 facility, confirmed that the 23.8-GHz brightness temperature is consistently slightly higher than the model computations. This results in an overestimation of the PWV of about 1.3 mm on the average (see DQR 070801.1).

SGP (B4) – Data quality looks good and are continuous this month.

SGP (B5 – SN12) – This month, data at this facility are very intermittent. The software was losing communication with the radiometer. The problem is under investigation (see DQR D071011.4).

SGP (B6) – Data are continuous at this facility. Data appear to be good. The "wet_window" indicator is on most of the time during this month and it should be disregarded. The site technicians adjusted the moisture sensitivity on September 11; however, on September 18 the flag came back on (see DQR D071011.3).

SGP (C1) – The radiometer was removed on August 3 to investigate high noise level in the data (see DQR D070802.3). The instrument was sent for repairs on August 3 (see DQR D070904.2).

SGP (E14) – Data at this facility are continuous this month. The 23.8-GHz brightness temperature of this channel is constantly ~2-3K higher than the collocated C1 radiometer. Model computations and sonde PWV seem to be in better agreement with the C1 measurements (see DQR D070802.1).

NSA –

NSA (C1) – Data are good this month. There are short data gaps (a few hours) on September 8 due to software crash.

NSA (C2) – This month there are no data at this facility because the radiometer was removed and sent to the vendor for repairs (see DQR 060829.1).

TWP –

C1 (Manus) – Data quality looks good and continuous this month.

C2 (Nauru) – Data quality looks good this month. There were no data interruptions.

C3 (Darwin) – Data quality looks good at this facility. There were no data interruptions.

AMF - FKB

AMF (M1) – Data quality at this facility looks good with no interruptions.

2.21 Microwave Radiometer Profiler

Mentor: Maria Cadeddu, Argonne National Laboratory

AMF – FKB –

AMF (M1) – The radiometer was calibrated with LN2 on September 17. There was a first unsuccessful attempt at 1100 and a second successful attempt at 1400. Data between 1100 and 1400 UTC should be disregarded (see DQR 071009.1). The V-band calibration was successful and the K-band calibration was successful except for the 30-GHz channel. Calibration values for this channel will be updated from tip curves and data will be reprocessed.

For the month of September, operations were continuous without interruptions. The instrument has been stable this month.

K-band channels: See attachments fkb0709_tb.jpg for a comparison of the 23.8-GHz channel with the model and the MWR. The K-band channels are in good agreement with model computations. The time of calibration is shown in the figure.

V-band channels: The V-band channels are in good agreement with model computations, see attachment fkb0709_v_band.jpg for a comparison of measurements (solid lines) and model (red dots) for the 51.25 (black), 52.28 (blue) and 53.85-GHz (green) channels.

PWV retrievals: The agreement between MWRP and MWR and radiosonde measurements is good as shown in attachment fkb0709_pwv.jpg. Between September 1 – 17 the PWV was slightly higher due to the drift of the K-band channels that was corrected when the instrument was calibrated on September 17.

LWP retrievals: LWP retrievals are slightly lower than MWR retrievals due to the calibration of the 30-GHz channel, see attachment fkb200709_lwp.jpg and associated DQR. Data will be reprocessed.

2.22 High-Frequency Microwave Radiometer (MWRHF)

NOTE: The two high-frequency microwave radiometers (MWRHFs) are new instruments that are still under testing.

SGP –

SGP (C1) – Ingest is currently halted on this radiometer. Data will be processed probably next month.

AMF – FKB

AMF (M1) – The radiometer has been operating at the AMF since June 9, 2007, although data are available starting on June 22. For the month of July, August, and September operations were continuous without interruptions.

The data are strongly affected by dew formation at night. A heater will be added to the instrument soon (see DQR D070913.1). It is recommended that only day data be used.

The surface RH sensor measures an RH that is too low (see DQR 071008.1). The RH readings need to be corrected as explained in the DQR.

2.23 Narrow Field-of-View Radiometer

Mentor: Gary Hodges, NOAA/ESRL/GMDivision

The 2-channel narrow field-of-view (NFOV) radiometer is operational at Heselbach.

2.24 NOAAFLASK

Mentor: Sébastien Biraud, Lawrence Berkeley National Laboratory

Flask data are checked monthly and sent to the Data Archive.

Tower-based sampler: A comparison of PGS CO_2 measurements against NOAA flasks and isotope flasks collected at all heights of the 60-m tower still shows a difference on the order of 1 ppm.

Aircraft-based sampler: A comparison of the continuous CO_2 measurements against NOAA flasks shows an offset on the order of 1 ppm. This offset does not systematically vary with altitude.

2.25 Raman Lidar

Mentor: Rob Newsom, Pacific Northwest National Laboratory

The Raman lidar functioned very well during September 2007. The instrument's uptime (percent of time scientific data were collected) during this period was 98.6%. There were only brief periods of downtime due to routine maintenance. New boresite alignment software was installed on August 20, 2007, appears to be working well.

2.26 Rotating Shadowband Spectrometer

Mentor: Peter Kiedron, NOAA/ESRL/GMD

The rotating shadowband spectrometer (RSS) is functioning well and two calibration sessions were performed during September. Data for September are available.

The RSS is approved for re-engineering in FY2008. An ECR will be submitted to document the plans and tasks to be performed.

2.27 Radar Wind Profiler – 915, 1290 MHz

Mentor: Rich Coulter, Argonne National Laboratory

SGP – Only one system (915 at facility C1) is operating as of the end of September 2007. Data from the Central Facility look very good. During the month of September, the configuration files were changed to accommodate a field study of nighttime turbulence ongoing at the Central Facility. The system was operated in a single (low) power configuration with 25-minute wind and 5-minute RASS averages. Although the data ingest was not able to handle the temperature data, the data monitored by Radmin ensured that the data were viable.

Both Beaumont (I1) and Medicine Lodge (I2) are being set up remotely for digital upgrades and then having the site techs install them during normal sit visits. This procedure was delayed for some time while attempts were made to install LAXPM on the CorePC operating system. This was unsuccessful, and the system had to be restored to its initial configuration.

The Meeker site was vandalized on July 14, 2007; the power cable from the transformer at the street to the instrument shed was stolen for its copper content, apparently. We are awaiting a reinstallation of supply lines. It appears that the RWP equipment was not harmed, so this system will likely return to service in the foreseeable future.

NSA – The NSA system received its upgrade and was successfully returned to service following discussions with the site operators and remote access via Radmin to set up the correct configuration files. The systems runs well; however, it appears there may be a problem with the phase shifter, which is currently under investigation. We have determined that the new components appear to operate correctly and the signals to the phase shifter are appropriate. However, the way in which the phase shifter fails indicates that it is more likely that a cable on the board may be bad rather than the switches themselves.

AMF – The 1290-MHz RWP system stopped receiving usable signals on July 26 at 0912 GMT. This system will have to be repaired; note that it should be under warranty. The equipment has been at Vaisala since approximately September 30, awaiting analysis.

2.27.1 Upgrade to Digital Receivers

The four 915-MHz RWPs at the SGP are now 9-13 years old and are exhibiting increasingly frequent, strange, and expensive-to-repair failures. Due to the age of these systems, parts are increasingly difficult

to obtain. Vaisala offers an upgrade for these systems that will replace the present interface, receiver and computer (including a digital signal processor (DSP) board) with new components and will include the latest version of LAPXM, the operating system. The systems at SGP/CF and SGP/I3 have been upgraded. The systems at SGP/I2, SGP/I3, and NSA/C1 will be upgraded in 2007, as documented in ECO-00567.

STATUS – RWP digital upgrades have been installed at SGP Central Facility and Meeker sites so far. We are planning to install digital upgrades to NSA, Beaumont, and Medicine Lodge in the near future.

2.28 Radar Wind Profiler – 50 MHz

Mentor: Rich Coulter, Argonne National Laboratory

In January 2006 the 50-MHz radar wind profiler (RWP) at the SGP ceased transmitting. The transmitter was returned to ATRAD in Australia for diagnosis and repair. After reinstalling the transmitter the output power was still zero. In May 2007, the transmitter was shipped to Vaisala for diagnosis. The 50-MHz system is still awaiting diagnosis, so this system down.

2.29 Soil Water and Temperature System

Mentor: John Harris, University of Oklahoma

STATUS – No new information provided.

2.29.1 Replace In-Ground Sensor Arrays

New redundant sensor arrays will be installed at all SGP extended facility sites. These will be installed in a phased manner: 5 sites per year over the 4 years, beginning in 2005 with the sites having multiple failed sensors given highest priority. After the soil recovers from the installation process in 6-12 months, the new sensor array will be connected to the existing SWATS data acquisition system in place of the old sensor array. This is documented in ECO-00493.

STATUS – No new information provided.

2.30 Shortwave Spectrometer

Mentor: Scott Kittelman, University of Colorado

September was another good month for shortwave spectrometer (SWS) data collection. We achieved 100% data collection for the month. Beginning on September 25, 2007, at 1100 UTC, a heater controller failed on the silicon diode array spectrometer. This spectrometer records the spectral radiance values from 350 nm to 981 nm. Analysis of the calibration data taken before and during the malfunction shows spectral radiance values in the wavelength range from 900-981 nm may have errors as large as 4%. Typical spectral radiance value errors for the SWS are 2%.

Because the instrument is not entirely dependent on the proper operation of the spectrometer heater, the SWS was run until the controller was replaced on October 5, 2007. During the malfunction period, data

in the wavelength range from 350-981 nm are suspect; however, spectral radiance values from 982-2150 nm are recorded on a separate spectrometer and are not affected.

2.31 Surface Meteorological Instrumentation (SMET, SMOS, SURTHREF, THWAPS, MET, ORG, PWS)

Mentor: Mike Ritsche, Argonne National Laboratory

SGP (SMOS) – SMOS data quality looks good with the following exceptions:

Short-term spikes in the data occurred throughout the month but are associated with preventative maintenance and are not considered to be a significant problem with data quality.

SGP (E7) – Data are missing on the September 19. Wind speed and direction data are suspect at this site during near calm conditions.

SGP (E15) – Data are missing for a few hours on September 2 and 10.

NSA (METTWR) –

NSA (Barrow C1) – Experienced short-term single-minute missing values at different levels of the tower and with the chilled mirror hygrometer (CMH) and present water sensor (PWS) data throughout the month. All four levels of T/RH and wind speed/wind direction data missing on the 8th during apparent power disruption. The PWS data is questionable throughout the month. Failed PWS receiver was replaced but the calibration sequence was improperly conducted. Wind direction sensors collect ice making them sluggish.

NSA (Atqasuk C2) – CMH calibration on the 13th caused spikes in the data. Also, replacement and verification checks of t/rh probes and wind sensors caused data to be poor on the 27th.

TWP (SMET, ORG) –

TWP (Manus C1) – No problems noted.

TWP (Nauru C2) – No problems noted.

TWP (Darwin C3) – Upper wind sensor is binding at speeds below 2 m/s until September18 when both sensors replaced. Newly installed sensors show the lower sensor was binding from September 18 – 24 when it the two sensors were interchanged. The upper sensor then became the one that was binding. This problem continued until the end of the month.

AMF (MET, ORG) – Operating nominally, data quality looks okay.

2.31.1 Develop Dynamic Rain Gauge Calibration Facility

The tipping bucket rain gauges at the 15 SGP extended facility sites with SMOS are currently calibrated using only a "static" calibration: a measured volume of water is poured into the gauge and the number of bucket tips is checked to make sure they correspond. In reality, as the rain rate increases and the bucket tips more frequently, some rain is not collected. The purpose of the dynamic calibration is to determine the correction factor as a function of rain rate to account for this behavior. This is documented in ECO-00495.

STATUS – This ECR is near completion. New manuals and procedures need to be developed. Procedures were finished and the system is running. Upgrades to the field techs test equipment need to be made.

2.31.2 Upgrade Temperature/Relative Humidity Probes and Wind Sensors for North Slope of Alaska Met Systems

Ice develops on the wind vanes, cup anemometers, and aspirator inlets for the temperature and relative humidity sensors, which clog and affect the data quality. To alleviate these problems, the mentor has proposed to replace the wind speed and direction sensors at NSA (both Barrow and Atqasuk) with sonic anemometers and to replace the temperature and relative humidity probes with new, heated probes designed to operate in cold environments. This is documented in ECO-00595.

STATUS – Replacement sensors are on order. ECO-00595, Upgrade T/RH probes and Wind Sensors for NSA Met System, is in progress.

2.32 Tandem Differential Mobility Analyzer

Mentor: Don Collins, Texas A&M University

Data from the TDMA are currently acquired and processed by Don Collins. Processed data are then delivered to ACRF on a monthly basis and stored in the IOP area of the Archive as "betadata." An ingest is being developed to produce netCDF files for inclusion in the main Data Archive, as documented in ECO-00587.

STATUS – The communications group is contacting Don Collins to develop a web area, enter instrument metadata, and edit the instrument handbook. The TDMA needs to have an entry added to the IMMS reporting system.

2.33 Hot Plate Total Precipitation Sensor

Mentor: Mark Ivey, Sandia National Laboratory

The Yankee Environmental Systems (YES) total precipitation sensor (TPS) was returned for repair and calibration in early August 2007. This system has been out of service since the sensor was returned to YES. The calibration is now complete, and ACRF was notified that the TPS sensor was in transit to Barrow for reinstallation. A second TPS system is in the budget for FY2008.

2.34 Total Sky Imager

Mentor: Vic Morris, Pacific Northwest National Laboratory

STATUS – ECO-00644 was approved to upgrade the TSI software to allow use of new versions of the Axis camera. Concepts to incorporate the packaging and mechanical design of the new version of the Axis camera will be covered in a new ECR.

2.35 Meteorological Tower Systems

Mentor: David Cook, Argonne National Laboratory

The following three "tall" towers are at the ARM facilities:

1. a 60-m guyed triangular tower at the SGP Central Facility with meteorological and radiological instruments at 25-m and 60-m levels
2. a 21-m guyed walkup scaffolding tower at the SGP Okmulgee site (E21) with meteorological and radiological instruments at approximately 20 m
3. a 40-m guyed triangular tower at the NSA Barrow site with meteorological instruments at 2 m, 10 m, 20 m, and 40 m levels and a camera at 40 m.

SGP – 60 m Central Facility tower and met measurements (TWR)

The meteorological data from the 60-m SGP Central Facility tower is contained in three datastreams (sixtymeter25, sixtymeter60, sixtymeter10X). The data are being ingested and are available from the Data Archive. The first two datastreams contain measurements from the 25 m and 60 m levels, respectively, on the west (B) side of the tower, whereas the third datastream contains measurements from both the 25 m and 60 m levels on the southeast (A) side of the tower.

During some nights, large (4-8ºC) temperature gradients are measured. These are an indication of a strong inversion having set up in cloudless skies and possible de-coupling of the surface layer (below 60 m) from the atmosphere above. Such gradients are not uncommon in the summertime under very stable conditions accompanying dry weather and cloudless skies.

Beginning in FY2006, DQRs are not written for missing data or for situations when qc flags clearly show that the data are incorrect. DQRs are written for periods when the tower carriages are down; in this case, qc flags often do not appear in the data and it is not obvious that the data should have been flagged as incorrect.

The SGP Central Facility tower elevators were not used during September. T/RH/VP measurements for September are correct.

There is excellent agreement of the west and southeast 25-m measurements and very good agreement of the two sides at 60 m.

NSA – ECO-00645 was approved to provide a replacement meteorology system for the tower. The new system is using sonic anemometers in place of the cups and vanes, and a new Vaisala T/RH system in place of the present ones. Testing of the new system will begin in November at Argonne National Laboratory.

2.36 Vaisala Ceilmeter

Mentor: Vic Morris, Pacific Northwest National Laboratory

STATUS – No new information provided.

2.37 W-Band (95 GHz) Atmospheric Radiation Measurement Program Cloud Radar

Mentor: Kevin Widener, Pacific Northwest National Laboratory

AMF (Heselbach) – 100% uptime in June. No problems.

SGP – This system is down and awaiting repair of the EIKA/modulator assembly.

In February 2008, following the Germany deployment and before the China deployment, the AMF W-band Atmospheric Radiation Measurement Program cloud radar (WACR) will be collocated with the SGP WACR for calibration.

2.37.1 Study Network Transfer of MMCR and WACR Spectra to Archive

ECO-00369 presents a mechanism to transport MMCR and WACR spectra data from the measurement site to the Data Archive by shipping hard drives. However, the cost of shipping media is high, especially from the TWP island sites, and significant staff effort is required to manage the number of disks and to implement the process at the sites and the Data Archive.

ECO-00391 proposes that we evaluate the feasibility of implementing data reduction algorithms at each MMCR and WACR installation and shipping the resulting files to the Data Archive via the Internet.

STATUS – A version of this software has been tested. Implementation is underway and documented in BCR-1349).

3. Future Instrumentation Planning

In this section, instrumentation that have been proposed for future acquisition and discussed by the Science Team Working Groups – but not yet approved for purchase – are presented with any status information.

3.1 Future Microwave Radiometers

The two-channel MWRs range between 8-15 years old. They are no longer being manufactured. Warren Wiscombe and Eugene Clothiaux are organizing a workshop to discuss/determine ACRF's plans for

future microwave radiometers. The workshop will be held on November 13, the day before the joint meeting of the Cloud Properties and Cloud Modeling Working Groups.

3.2 Atmospheric Radiation Measurement Program Volume-Imaging Array

The ARM Volume-Imaging Array (AVA) is a proposed radar system to be deployed at the SGP site to address the ARM Program's need to map 3D cloud and precipitation structures at short to medium ranges (i.e., 20-75 km). The AVA system will provide time-resolved 3D precipitation fields, domain-averaged rainfall rate, cloud coverage throughout a volume, cloud-top heights, hydrometeor phase information (using polarization), horizontal and vertical variability of clouds and precipitation, and low-level convergence and divergence using dual-Doppler techniques. Principal elements of the AVA proposal prepared by Pavlos Kollias include the following:

- Three networked scanning radars arranged in a triangle with 20-30 km legs: one operating at 35 GHz (same 8.6-mm wavelength as the MMCR), capable of scanning the vertical region probed by the current MMCR, and two radars operating at 9.4 GHz (3.2-cm wavelength, so-called "X-band"). All three radars will be transportable, scanning, polarimetric, and Doppler.
- Development of a useful 3D cloud VAP similar to the existing ARSCL but on a regular 3D grid.
- Development of an "AVA Simulator." Patterned after the well-known ISCCP Simulator, the AVA Simulator will perform forward simulations of radar observables, using as input LES model and CRM outputs of cloud properties together with the characteristics of the AVA radars. The results will be used to develop and optimize volumetric radar scanning strategies, develop and evaluate inverse retrieval techniques, and develop prototype 3D ARSCL-like VAPs for the ARM community.
- A collaborative effort with the Center for Interdisciplinary Remotely-Piloted Aircraft Studies (CIRPAS) to deploy the CIRPAS 9.4-GHz phased-array radar at the ARM SGP site every year for 1-2 months of continuous observations.

STATUS – Consideration of the AVA, as such, has been deferred until 2008 when simulations have been carried out to demonstrate its capabilities and further refine its requirements.

3.3 Absolute Scanning Radiometer

To provide an absolute infrared flux reference, which could be used to calibrate the Eppley PIRs, Ells Dutton has suggested that ARM develop an absolute scanning radiometer (ASR). This instrument would be functionally equivalent to an ASR developed by Rolf Philipona for the World Meteorological Organization (WMO). This instrument would not be used for routine data acquisition, but instead would provide a calibration reference. As such, it would participate in WMO inter-comparisons at Davos, Switzerland, every five years.

STATUS – In December 2006, a description of the desired instrument capabilities was published in Fed Biz Ops (solicitation number 111506). Based on the published description, rough order of magnitude (ROM) cost estimates have been received from several interested organizations.

3.4 Portable Raman Lidar

Leosphere (http://www.lidar.fr/) offers a portable MPL-type lidar that can be augmented with Raman capability. Raymetrics (http://www.raymetrics.gr/), sold by Kipp & Zonen, also offers a Raman lidar. Iwona Stachlewska of Leosphere deployed their non-Raman EZ lidar at the SGP on October 19 for comparison with the ARM MPL system. Leosphere expects to have a commercial Raman system available in mid-to-late 2007. Raymetrics will not be able to furnish a demonstration Raman lidar system.

STATUS – Clarification of the scientific requirements for a portable Raman lidar is necessary before proceeding.

3.5 Rotating Shadowband Spectrometer Overhaul

Peter Kiedron has demonstrated that the rotating shadowband spectrometer (RSS) built by Yankee Environmental System is capable of providing valuable measurements of direct, diffuse, and global spectral irradiance. Peter has also identified problems with the RSS that affect the stability of its calibration and the linearity of its response. Peter has recommended that the RSS be removed from service and sent to him for a complete overhaul.

STATUS – The ARM Science Working Groups and STEC approved the re-engineering of the RSS for implementation in FY2008.

3.6 Add 1.6 µm Channel to Multi-Filter Rotating Shadowband Radiometer and Narrow Field of View

Alexander Marshak has recommended that ARM support the development of a NFOV radiometer at 1.6 µm to permit the retrieval of droplet size distribution. Andy Lacis and colleagues have suggested a 1.6 µm channel be substituted for the unfiltered (broadband) channel in the MFRSR. Because the unfiltered channel is now being used in a broadband radiometer best estimate VAP for quality checking purposes, only a limited number of MFRSRs would be modified to accept a 1.6 µm channel.

STATUS – This device was built by replacing and unfiltered channel on MFRSR with InGaAs detector and 1.6 µm filter for scientific evaluation. The Radiative Processes Working Group (RPWG) would like to have these data available for analysis and run the head at the SGP in the field campaign mode. Before a filed campaign we need to run this system through the SGP Cosine Bench Calibration. Pending review of the data, the RPWG would like to consider the costs to add a 1.6 µm channel to select ACRF MFR/MFRSR heads.

3.7 Aerosol Particle Sizing Spectrometer to Replace Optical Particle Counter at Southern Great Plains

John Ogren has suggested replacing the aging optical particle counter (OPC) included in the SGP AOS with a new aerosol particle-sizing spectrometer (APS) to be integrated into the existing TDMA.

STATUS – The ARM Science Working Groups and STEC approved the re-engineering of the RSS for implementation in FY2008.

3.8 Infrared Thermometers for the Southern Great Plains Extended Facility Sites

In FY2004, 6 IRTs were purchased, 9 additional IRTs were purchased in FY2005. Some of these have been deployed with the AMF. There are 12 SGP EF sites are currently equipped with IRTs; 10 additional IRTs would be needed to permit an IRT to be deployed at all 22 SGP extended facilities.

STATUS – The ARM Science Working Groups and STEC approved the re-engineering of the RSS for implementation in FY2008.

4. Small Business Innovation Research

The U.S. Department of Energy (DOE) Small Business Innovative Research (SBIR) web page is available at http://www.er.doe.gov/sbir/.

4.1 Eye-Safe Ultraviolet Backscatter Lidar for Detection of Sub-Visual Cirrus (FY2006/FY2007)

Based on recommendations from the 2004 Cloud Properties Working Group meeting, this subtopic was substituted for the A-band spectrometer subtopic. Connor Flynn is the technical contact. Phase I funding was awarded to Aculight Corporation for "Eye-Safe UV Backscatter Lidar for Detection of SubVisual Cirrus."

See http://www.science.doe.gov/sbir/awards_abstracts/sbirsttr/cycle24/phase1/039.htm.

Phase I funding was also awarded to Physical Sciences, Inc., for "Field-Worthy UV Backscatter Lidar for Cirrus Studies."
http://www.science.doe.gov/sbir/awards_abstracts/sbirsttr/cycle24/phase1/044.htm

STATUS – Awarded funding to proceed to Phase II development.
See http://www.science.doe.gov/sbir/awards_abstracts/sbirsttr/cycle24/phase2/p2_award.htm.

4.2 Instrumentation for Remotely Sensing Aerosol Optical Properties – Aerosol Phase Function (FY2006/FY2007)

Based on recommendations from the Aerosol Working Group, this subtopic was added to the aerosol measurements subtopic. Phase I funding was awarded to Aerodyne Research, Inc., for "CAPS-Based Particle Single Scattering Albedo Monitor."

See http://www.science.doe.gov/sbir/awards_abstracts/sbirsttr/cycle24/phase1/040.htm.

STATUS – Awarded funding to proceed to Phase II development.
See http://www.science.doe.gov/sbir/awards_abstracts/sbirsttr/cycle24/phase2/p2_award.htm.

4.3 Unmanned Aerospace Vehicle-Suitable Cloud Radar (FY2006)

Phase I funding was awarded to ProSensing, Inc., for "High-Power, Pod-Mounted W-Band Cloud Radar for UAVs."

See http://www.science.doe.gov/sbir/awards_abstracts/sbirsttr/cycle24/phase1/045.htm.

STATUS – This instrument system proposal did not receive SBIR Phase II funding.

4.4 In Situ Measurement of Cloud Properties with Large Sample Volumes (FY2007)

The following two proposals were selected for 2007 Phase I funding:

- "Dual Wavelength In-Situ Cloud Lidar" by Physical Optics Corporation
  NOTE: This is the same company that received 2005 Phase I funding for the Oxygen A-Band instrument.
- "A Dual-Wavelength In Situ Cloud Lidar with Very Large Sample Volume" by SPEC Incorporated.

STATUS – This instrument system proposal did not receive SBIR Phase II funding.