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ACRF Instrumentation Status: New, Current, and Future

October – November 2007

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 Infrared Sky Imager (IRSI)

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.

1.3 Rotating Shadowband Spectrometer (RSS) 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 recommended the re-engineering of the RSS for implementation in FY2008.

1.4 Aerosol Particle-Sizing Spectrometer to Replace Optical Particle Counter (OPC) at Southern Great Plains

John Ogren has suggested replacing the aging optical particle counter (OPC) included in the SGP Aerosol Observing System with a new aerosol particle-sizing spectrometer (APS) to be integrated into the existing Tandem Differential Mobility Analyzer (TDMA).

STATUS – The ARM Science Working Groups and STEC approved the addition of an APS in FY2008 to replace the OPC component of the TDMA.

1.5 Infrared Thermometers (IRTs) 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 recommended the addition of the remaining SGP IRT's during FY2008.

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 (AERI)

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

SGP (C1) – Data quality looks good.

SGP (E14) – This system is experiencing some turmoil. For yet unknown reasons, the system becomes hung and only a manual restart of the interferometer seems to solve the problem. Thus, there are several gaps in the data for this month. Additionally, the noise level (determined during hot blackbody views) is much more variable than it has been before, which may suggest that the data quality is being compromised somehow. We are continuing to look at the data, both to see if the two problems are related and to understand them.

NSA (C1) – The thermistor that measures the blackbody support structure was providing suspicious data October 19-23 (values were 20-30 K too large). The temperatures used by this thermistor are used in calibration of the sky radiance data; however, the impact of this error is small due to the high emissivity of the blackbodies. Otherwise, the system seems to have run well. The hatch was closed on the October 22 and 31 for most of the day.

FKB (M1) – Data quality looks good. The hatch was closed for approximately 12 hours on the October 30.

TWP (C2) – Data quality looks good. The hatch was closed October 14-21; the problem was traced to a dirty rain sensor.

TWP (C3) – Data quality looks good. However, this system has been oscillating between two different gain settings for the longwave detector for the last several months. In October, the system appeared to settle down at the lower gain level with little oscillation. Naturally, it is preferred for it to settle down at the upper level, but we do not understand (a) why it was variable in the first place or (b) why it is suddenly settling down.

2.2 Aerosol Observing System (AOS)

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

STATUS – No new information provided.

2.3 Balloon-Borne Sound System (BBSS)

Mentor: Barry Lesht, Argonne National Laboratory

We completed the AIRS/IASI IOP in October with a final few launches from NSA, SGP, and TWP. Including AIRS/IASI soundings made on the NSA/C1 and TWP/C2 production systems (but not including those made on the NSA/S01 and SGP/S01/S02 systems), we added 452 data files to the Data Archive this month. Considering first the regularly scheduled soundings, overall radiosonde data recovery was excellent during September, with sounding reporting rates of FKB 127/124 (102%), NSA

62/62 (100%), SGP 121/124 (98%), TWP/C1 (Manus) 61/62 (98%), and TWP/C2 (Nauru) 63/62 (101%). These numbers take into account flights during which the radiosonde failed at launch (2 at FKB, 1 at SGP/C1, and 1 at TWPC2). Generally operators will launch a replacement sonde when this occurs. As noted, The NSA/C1 and TWP/C2 numbers do not include soundings done as part of the AIRS/IASI IOP (7 at NSA and 10 at TWP) which are done on the production systems.

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.

Broadband radiometer station (BRS) – No new information provided.

Solar infrared system (SIRS) – No new information provided.

Downwelling broadband solar and atmospheric irradiances (SKYRAD) – No new information provided

Upwelling broadband radiance (GNDRAD) – No new information provided.

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 (RCF) 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 (CO2FLX) instruments at 25 and 60 m on the SGP-CF tower are operating nominally. The 4-, 25-, and 60-m infrared gas analyzers (IRGAs) were calibrated in October.

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.

2.7 CO_2 Precision Gas System (PGS)

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

A comparison of precision gas system (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) – Data became available on October 11, 2007, after a problem with Unit #98 was resolved. (DQPR 1819)

NSA (Barrow C1) – Sent back for calibration in October due to Polar night.

SGP (CF) – Operating nominally.

TWP (Nauru) – Operating nominally.

2.9 Disdrometer

Mentor: Mary Jane Bartholomew, Brookhaven National Laboratory

Oklahoma's rainy 2007 seemingly came to an end in October and, for the second month in a row, with below-average precipitation. One particularly heavy rain occurred at the site on October 17 with 75 mm

of accumulated rain. Three other significant storms occurred on the October 2 (25mm), October 8 (10mm), and October 15 (14mm).

In Australia, several locations in the Northern Territory recorded scanty rainfall during the month mainly due to the passage of several cloud bands over the territory at different latitudes. The Victoria River district recorded good falls on October 25 and 26. Overall, average to below-average rainfall was recorded in the southern half of the Territory. The Victoria River district reported above-average rainfall, while the other districts in the Top End recorded average to below average rainfall for the month.

2.10 Energy Balance Bowen Ratio Station (EBBR)

Mentor: David Cook, Argonne National Laboratory

The measurements from the EBBR stations are contained in three datastreams (5-, 15-, and 30-minute). The data are being ingested and is available from the ARM 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.

Please see Section 6.3 Data Assessments by Site Scientist/Data Quality Office in the EBBR Handbook (at www.arm.gov/instruments/instrument.php?id=ebbr), under

Common Conditions Reflecting Correct or Incorrect Data, Wind Direction Dependencies for data validity dependence on wind direction.

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 a few nights for brief periods at a few of the extended facilities. Wind direction flops around 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 you read this report, 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 until October 18, 1700 GMT.

AEM stuck in between home positions resulting in incorrect sensible and latent heat fluxes October 18, 1700 GMT – October 31, 1700 GMT.

SGP (E7) – Data quality generally looks good.

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

The temperature from the right humidity probe sometimes spiked offscale; sensible and latent heat fluxes were incorrect when this happened.

SGP (E8) – Data quality looks good. Relative humidities 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 or less), resulting in sensible and latent heat fluxes being offscale and incorrect.

SGP (E12) – Data quality generally looks good.

Soil heat flow #2 was offscale at times October 15, 1230 GMT – October 16, 1400 GMT and October 20, 2200 GMT – October 22, 0000 GMT; sensible and latent heat fluxes were incorrect during these times.

AEM stuck in between home positions resulting in incorrect sensible and latent heat fluxes October 23, 1700-1730 GMT.

SGP (E13) – Data quality looks good.

SGP (E15) – Data quality generally looks good, when available. Data are missing from October 10, 1530 GMT – October 23, 1530 GMT and October 31, 1730-2330 GMT.

SGP (E18) – Data quality looks good when available. Data are missing October 6, 0600 GMT – October 8, 2000 GMT, October 18, 0100 GMT – October 23, 0530 GMT.

AEM stuck in between home positions resulting in incorrect sensible and latent heat fluxes October 23, 2030-2100 GMT.

SGP (E19) – Data are missing the entire month presently. Sneakernetted data for this period has not been ingested.

SGP (E20) – Data quality generally looks good.

Wind direction was off 65-70 degrees between October 15, 0000 GMT – October 24, 1900 GMT.

Soil temperature #1 spiking October 11 – 31; this sometimes caused sensible and latent heat fluxes to be 9999ed.

AEM stuck in between home positions resulting in incorrect sensible and latent heat fluxes October 24, 1900-1930 GMT.

SGP (E22) – Data quality generally looks good.

Sensible and latent heat fluxes were incorrect when soil heat flow #5 was offscale at times, October 1, 0000 GMT through the end of the month, and when soil heat flow #1 was offscale at times, October 21, 2000 GMT through the end of the month.

Net radiation and sensible and latent heat fluxes were incorrect when the net radiomter had water in it October 17, 1930 GMT – October 24, 2000 GMT.

SGP (E26) – Data quality generally looks good.

Sensible and latent heat fluxes were incorrect when the left T/RH probe temperature jumped around October 1, 0000 GMT – October 11, 1730 GMT.

AEM stuck in between home positions resulting in incorrect sensible and latent heat fluxes October 25, 1630-1700 GMT.

SGP (E27) – Data quality generally good.

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 offscale several times until it was fixed on October 24 at 1730 GMT; sensible and latent heat fluxes were incorrect when the AEM circuit board shorting occurred.

2.11 Eddy Correlation Station (ECOR)

Mentor: David Cook, Argonne National Laboratory

Ten ECOR systems are installed at ARM facilities: 9 at SGP and 1 at the AMF.

Please see Section 6.3 Data Assessments by Site Scientist/Data Quality Office in the ECOR Handbook (at www.arm.gov/instruments/instrument.php?id=ecor), under Common Conditions Reflecting Correct or Incorrect Data, Wind Direction Dependencies, for data validity dependence on wind direction.

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

Periods of precipitation, fog, and dew (frost) often cause incorrect water vapor and carbon dioxide measurements. This is caused by water lying on the lower window of the LI-7500 CO2/H2O sensor, thereby obstructing the passage of the sensing IR radiation (very light precipitation may have little or no effect). The CO2 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 CO2 flux is not.

I do not write DQRs or indicate time periods 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 SMOS rain gauges or the HandS ECOR plots to determine times of precipitation and you can assume that offscale or spiked readings in the few hours before dawn are often caused by dew or frost on the CO2/H2O sensor. I have written ECR 00536 to add a wetness sensor to the ECOR to provide more timely information on wetting conditions.

b) The CO2 mean sometimes flattens out during the daytime (see E24, August 1, 2005, and August 31, 2005).

c) Large spikes (positive and negative) in CO2 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 CO2 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 because 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 CO2 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) On 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 CO2, sensible heat, and latent heat at E21 Okmulgee forest are often larger than at other sites, particularly the fluxes of water vapor and CO2; 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 CO2/H2O serial datastream is not available (pressure and temperature missing), default values are used in the calculation of the CO2 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 offscale and CO2 and H2O densities, temperature, and pressure are often incorrect also.

n) The u and v directions of wind speed are not according to meteorological standards. For the ECOR, +u is for winds from the south and +v is for winds from the east. See Section 5.1.5 of the ECOR Handbook for more details.

Beginning in FY2006, DQRs are not written for missing data or for situations when qc flags clearly show 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. Data were missing October 9, 1900 GMT.

Pressure and temperature were missing October 1, 0000 GMT – October 17, 1900 GMT.

LE and CO2 flux were incorrect October 5, 1600 GMT – October 17, 1900 GMT.

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

Pressure and temperature are spiking to incorrect values many days between 0900 and 1500 GMT. This may be caused by condensation inside the LI-7500 sensor head.

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

CO2 flux and latent heat flux are incorrect because the analog channels of the sonic are not working and the upper and lower transducers of the sonic are switched.

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

SGP (E10) – All data were missing all month because no sonic anemometer was installed.

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

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

Data were missing October 11, 1600 GMT – October 31, 2330 GMT.

SGP (E21) – Data quality generally looks good, when available, except during precipitation and dew/frost.

Data were missing October 1, 0000 GMT – October 10, 1400 GMT and October 24, 1500 GMT – October 31, 2330 GMT.

SGP (E24) – Data quality generally looks good.

Pressure and temperature were missing the entire month; fluxes were not affected by this problem.

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 (GVR)

Mentor: Maria Cadeddu, Argonne National Laboratory

This month, data are continuous. Overall data quality looks good. Starting on October 5, the interference spikes have almost disappeared this month. Surface temperature readings are very unstable, and the sensor needs to be replaced.

2.13 Global Positioning System (SuomiNet)

Mentor: None (external data provided by SuomiNet/COSMIC) – Rick Waganer, Brookhaven National Laboratory is our infrastructure contact.

TWP (Manus) – Operating nominally.
TWP (Nauru) – Operating nominally.
TWP (Darwin) – Operating nominally.
NSA (Barrow) – Operating nominally using a spare ARM MET system.
NSA (Atqasuk) – Operating nominally.

SGP – Most stations appear to be operating nominally except two stations at E19 and E7.

Please see http://www.unidata.ucar.edu/data/suominet/ and http://www.arm.gov/xds/static/suomigps.stm for the deatils on the SUOMIGPS data.

2.14 In-Situ Aerosol Profiling (IAP)

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

STATUS – No new information reported.

The proposal to continue the IAP field campaign was declined. Aircraft (Cessna 206) mission and instruments are under review.

2.15 In-Situ Carbon Profiling

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

STATUS – No new information reported.

2.16 Infrared Thermometer (IRT)

Mentor: Vic Morris, Pacific Northwest National Laboratory

SGP – Data quality generally looks good at C1, E5, E6, E7, E8, E9, E10, E11, E15, E16, E19, and E20.

The data were missing at E7 from October 26 – 29, E13 from August 30 – October 31, E15 from October 11 – 22, and E19 from October 15 – 24.

NSA – Data quality generally looks good at C1 and C2.

TWP – Data quality generally looks good at C1, C2, and C3.

FKB – Higher sky temperatures were measured than the AERI at M1.

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

Mentor: Gary Hodges, NOAA/ESRL/GM Division

Multi-filter radiometer (MFR) 10-meter tower

NSA (Barrow C1) – Data quality looks good this month. Days are getting short. Instrument will be pulled from service soon for winter maintenance.

NSA (Atqasuk C2) – Data quality looks good. Days are getting short. Instrument will be pulled from service soon for winter maintenance.

SGP (C1 – 10 meter) – Data quality looks good.

MFR, 25-meter tower –

SGP (C1 – 25 meter) – Data quality looks good this month. As a reminder, this instrument is located above an active agricultural field. At times, data may look slightly strange or distorted when variable surface conditions exist.

Multi-filter rotating shadowband radiometers –

FKB (M1) – Data quality looks good.

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. Days are getting short though. The instrument's performance at high zenith angles is less than ideal. Suggest using the NIMFR instead.

Instrument was pulled on October 30 for the winter.

NSA (Atqasuk C2) – Data quality looks fine. Days are getting short though. The instrument's performance at high zenith angles is less than ideal. Suggest using the NIMFR instead.

SGP (C1) – Data quality looks good the entire month.

SGP (E1) – Data quality looks great, 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 great up until September 13 at 2300 UTC, when something failed. The instrument was pulled from service on September 19 for repair. Do not use data after September 13 at 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 October 2007 data.

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

SGP (E5) – Data quality looks good for most of the month until the heater failed on 10/30/2007 at 0830 UTC. Do not use data after this time.

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

SGP (E7) – Data quality looks good, though head temps are lower than we would like to see them.

SGP (E8) – Data are garbage until October 30, 2007, at 1900 UTC.

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) – The data quality looks okay 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 it is being produced.

SGP (E12) – Data quality looks good the entire month.

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

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

SGP (E16) – Data quality looks good until October 18 at 1730 UTC when the sensor failed.

SGP (E18) – Data are missing from October 18 through October 23 at 1600 UTC. Data on other days look fine.

SGP (E19) – Instrument is out of service.

SGP (E20) – Instrument is out of service.

SGP (E22) – Data from this instrument look a bit noisy. The cause is currently under investigation.

SGP (E24) – Data quality looks good the entire month.

SGP (E27) – The data look okay 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 it is being produced.

TWP (Manus C1) – Data quality looks good the entire month.

TWP (Nauru C2) – Data quality looks good the entire month.

TWP (Darwin C3) – Data quality looks good the entire month.

NIMFR

NSA (Barrow C1) – Data look okay. There were lots of overcast days, and the days are getting short. Instrument will be pulled for winter maintenance soon.

NSA (Atqasuk C2) – Data look okay. There were lots of overcast days, and the days are getting short. Instrument will be pulled for winter maintenance soon.

SGP (C1) – The instrument formally known as E13 is now C1.

The head temp is consistently hot through October 5 when a repair was attempted. After October 5, the tube heater is not running hot, but rather on the cool side. This is good as a hot tube heater is no longer influencing the head temperature, but there is still an issue with the tube heater not functioning properly. This should not cause a data problem, so after October 5, data should be fine.

2.18 Millimeter Cloud Radar (MMCR)

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

SGP – Data are not available for October 2, 2000 – October 3, 1400, October 9, 1300-1500. Uptime was at 97.6%. SGP MMCR performance problems we are still dealing with include the following:

- 10 dB reflectivity difference between WACR and MMCR
- differences in reflectivity in operating modes
- cirrus mode pulse coding problems.

NSA – Data are not available October 16, 1730 – October 17, 0200, October 17, 1800 – October 19, 1700. Uptime was at 92.5%.

The NSA MMCR antenna and wave-guide needed repair due to corrosion and misalignment. This task was performed; however, the antenna needs to be replaced. A recently procured and characterized antenna is being sent to Barrow for replacement during November. The radar data are being analyzed to understand and hopefully correct for the signal degradation over time.

TWP (Manus) – Data are not available October 3, 0500-0600. Uptime was at 99.7%.

TWP (Nauru) – Data are not available October 19, 0200-0600. Uptime was at 99.5%. The Nauru MMCR transmitter output power, as measured by the power detector, is fluctuating.

TWP (Darwin) – Data are not available October 4, 0000-0630, October 17, 0000-0200, October 30, 0300-0430, 0530-0630. There was poor sensitivity on October 30, 1730 – October 31, 2359. Uptime was at 94.4%.

The IEEE-488 pulse controller interface card was replaced; however, there are persistent problems with the controller. There may be issues with the integrity of the cable that will be further investigated.

2.18.1 Millimeter Cloud Radar (MMCR) 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 – Costs for the upgrade are substantially more than originally budgeted. We will be going back through the Science Working Groups for comment. A "Request of Interest" was posted, and three potential vendors have responded. Kevin Widener is working on a revision of the specification.

2.18.2 Millimeter Cloud Radar (MMCR) Processor Upgrades

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

STATUS – The PIRAQ-III (ECO-597) processor upgrade at Barrow is scheduled to take place during late November. This radar is a critical measurement for next spring's Indirect and Semi-Direct Aerosol Campaign (ISDAC).

2.18.3 Millimeter Cloud Radar (MMCR) 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 Cloud Radar (MMCR) 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 Cloud Radar (MMCR) 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.

2.19 Micropulse Lidar (MPL)

Mentor: Rich Coulter, Argonne National Laboratory

Overall, the MPLs had no critical performance 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. This continues to be an aggravating problem that can be fixed when we implement the software upgrades with the MPL vendor, Sigma Space. In the meantime, we have decided to manually reboot the systems every other Tuesday. Other than this, the data from the system at the SGP have continued unabated with little/no problems, although for a 4-day period between September14 and September 18, the polarizer was not switching. There was one period, November 1-2, when there was no apparent transmit signal; either a site-ops reboot or some other cause (condensation?) was cured. Good data to greater than 15 km is normal during nighttime and 10-15 km during daytime. No problems to report from the NSA system. There are no obvious problems in the data from Manus, either; 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. The MPL at Nauru has been working well; the last time the system locked up, the site personnel restarted the system successfully. 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. The new polarized MPL operating in Heselbach, Germany, with the AMF 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. Also for a period of time on Nov 1, no signal was detected form the AMF MPL and the cause in under review.

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 (MWR)

Mentor: Maria Cadeddu, Argonne National Laboratory

NSA (C1) – Data quality looks good this month. There are no data gaps.

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

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

TWP (Darwin C3) – Data quality looks good. There were no data interruptions.

FKB (M1) – Data quality looks good. There were no data interruptions.

SGP (B1) – This month, data are continuous. The radiometer is stable. See the following note about a possible bias in the brightness temperature measurements. When this instrument was at the SGP CF for testing, it was measuring a warmer 23.8-GHz temperatures than the C1 instrument. Comparison with radiosondes launched during 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 missing between October 5 – 9 and October 28 – 29 because of several software and communication problems. The problem is under investigation (see DQR D071011.4).

SGP (B6) – The wet window indicator was on most of the time during this month (see DQR D071011.3). The radiometer was taken to the SGP CF on October 24, and it was found that a wire was broken. After being repaired, the instrument was taken back to the boundary facility on October 26 (see DQR D071026.1 and DQR D071011.3). Data are continuous except for the days between October 24 – 26 when the radiometer was undergoing repairs.

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).

2.21 High-Frequency Microwave Radiometer (MWRHF)

Mentor: Maria Cadeddu, Argonne National Laboratory

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

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

FKB (M1) – The radiometer has been operating at the AMF since June 9, 2007, although data are available starting on June 22. For the months of July, August, and September, operations were continuous without interruptions. A LN2 calibration was performed on October 1, 2007. After this calibration, there were no successful tip curves until October 13.

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.

On October 10, the calibration file of the surface humidity sensor was successfully updated low (see DQR D071008.1). Data between June 22 and October 10 will be reprocessed.

2.22 Microwave Radiometer Profiler (MWRP)

Mentor: Maria Cadeddu, Argonne National Laboratory

NSA (C1) – Radiometer is out of service for repairs.

FKB (M1) – New calibration values for the 30-GHz channel were uploaded on October 9 at 1840 UTC (see DQR 071016.1). Data between September 17 and October 9 will be reprocessed. For the month of September, operations were continuous without interruptions and the instrument has been stable throughout October.

Both the K-band and V-band channels are in good agreement with model computations—there is, however, a 2 K bias in the 52.28-GHz channel when compared to the model.

PWV retrievals – The agreement between MWRP and MWR and radiosonde measurements are good.

LWP retrievals – LWP retrievals are slightly lower than MWR retrievals until October 9 due to a slight offset of the calibration of the 30-GHz channel. Data will be reprocessed.

2.23 Narrow Field-of-View (NFOV) Radiometer

Mentor: Gary Hodges, NOAA/ESRL/GMDivision

FKB (M1) – Channel 870 at times is not performing correctly. Data are affected from October 6 – 16. Users interested in data from this instrument should be able to edit out the offending data without too much trouble. Data outside this range look fine.

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 (RL)

Mentor: Rob Newsom, Pacific Northwest National Laboratory

The Raman lidar (RL) functioned well during October 2007. Uptime (percent of time scientific data were collected) was at 93%. The majority of the downtime occurred as a result of three separate events. First, a site-wide power outage resulted in the loss of about 18 hours of data on October 2 – 3. Second, the system shut itself down on October 16 due to apparent overheating of the cooling water. This resulted in the loss of about hours of about 12 hours of data. Lastly, about 5 hours were lost on October 23 due to the failure of a (new) flashlamp.

2.26 Rotating Shadowband Spectrometer (RSS)

Mentor: Peter Kiedron, NOAA/ESRL/GMD

RSS provided data during October 2007 except for day 10/02. Two calibrations with of the RSS were performed during October on; 10/11 and 10/25. The RSS raw data files are collected daily. Calibrated data till 09/26/07 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 (RWP) – 915, 1290 MHz

Mentor: Rich Coulter, Argonne National Laboratory

Three systems (915: C1, I1, I2;) are operating as of the end of October, 2007. Data from the SGP CF look very good. The configuration file has been returned to the normal operation of hi/lo power, 10-minute RASS on the hour. Both Beaumont (I1) and Medicine Lodge (I2) have returned to operation with the new digital upgrade installed. There were a few problems with the ingest and data recovery that have now been ironed out.

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; however, there has been no word as to when this might actually occur.

The NSA machine 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. However, it appears that 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. Stay tuned.

The AMF 1290 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 (RWP) – 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 (SWATS)

Mentor: John Harris, University of Oklahoma

The soil water and temperature system (SWATS), deployed at the SGP sites, is designed to provide information about the temperature of the soil and the status of water in the soil profile. Because the SWATS array is aging, the sensor arrays are undergoing a replacement program.

SGP (E1) – 25-cm east (E) and 85-cm E and west (W) will be replaced.

SGP (E2) – Instrument is okay.

SGP (E3) – Instrument is okay.

SGP (E4) – Instrument is okay.

SGP (E5) – 25-cm E, 125-cm E, and 175-cm W will be replaced when the redundant sensor fails.

SGP (E6) – 175-cm E will be replaced in the future. 175-cm W is okay.

SGP (E7) – Instrument is okay.

SGP (E8) – 15-cm W and 35-cm W will be replaced in the future. E is okay. 35W occasionally produces good data.

SGP (E9) – Instrument is okay.

SGP (E10) – 15-cm E temperature rise is spotty for a few days, October 23 – 28.

SGP (E11) – Instrument is okay.

SGP (E12) – Communications issues for most of the month, data were sneaker-netted and will be available.

SGP (E13) – 85 was replaced and will be operational soon. All other data appears okay.

SGP (E15) – 5-cm E is inoperative, 5-cm W is okay though.

SGP (E16) – 15-cm W, 85-cm E, and 175-cm W will be replaced in the future. The opposite sensor is okay.

SGP (E19) – 5-cm W, 60-cm E, 85-cm E, and 125-cm W have been replaced and will be operational when soil has returned to equilibrium. Sneaker-netting data for now.

SGP (E20) – 5E, 15E, 60E, 85W, and 125 have been replaced and will be operational when soil has returned to equilibrium.

SGP (E22) – All data are okay.

SGP (E24) – Data not representative of true conditions due to gypsum outcropping. It is the opinion of the instrument mentor that the SWATS at Cyril not be refurbished. User should contact the instrument mentor with any questions.

SGP (E27) – 8-cm W will be replaced, but it occasionally produces good data. User should contact mentor with questions. 35 cm E ,T-rise spotty until October 10, then is okay until October 21, then spotty again.

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 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 (SWS)

Mentor: Scott Kittelman, University of Colorado

In general, data collection and quality were good during the month of October. In fact, I would say the clear-sky spectral radiance data for this month was exceptional. Given the number of cloudy days in 2007, it was a pleasure to have a few clear sky days to analyze.

From September 25, 2007, to October 5, 2007, the SWS operated with no active control of the silicon spectrometer temperature. 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 nm to 981 nm may have errors as large as 4%. Typical spectral radiance value errors for the SWS are 2%. Because the instrument is not 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 nm to 981 nm are suspect; however, spectral radiance values from 982 nm to 2150 nm are recorded on a separate spectrometer and are not affected.

Adjustment to the frequency of dark signal recording made a small but worthwhile improvement to the data quality. Starting October 19, 2007, a 15-second dark signal is recorded every 3 minutes. This change reduced the small fluctuations induced at some wavelengths by cyclic changes in the Optical Trailer room temperature.

Data were lost on four occasions this month. Severe weather resulted in a power outage at 1945 UTC on October 2, 2007. As a safety precaution the SWS was powered down until the next day. Unfortunately, since the power outage, we have experienced three events when the SWS stopped writing to disk. One was on October 4 at 1338 UTC, another at 1425 UTC on October 26, and the last was on October 30 at 1629 UTC. On both October 4 and October 30, the instrument did not start taking data until the next day. On October 26, a site technician discovered the problem, and the loss of data was limited to just one hour.

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

Mentor: Mike Ritsche, Argonne National Laboratory

SMET

SGP (C1) – No problems were noted.

SGP (C2) – No problems were noted.

SGP (C3) – The tipping bucket rain guage measured 0.20 mm of rainfall on the October 29, and other sensors did not report rainfall.

Comparisons of SMET data with BBSS data show some biases in the SMET data occurring since sometime in January 2005. Notably, there is a continuing 1.5 hPa negative bias in the Nauru pressure data. A 3ºC negative bias occurred in the Darwin temperature data until the logger was replaced. Preliminary data suggest that a power surge caused by a downed power line contributed to/caused the offsets. The barometer was replaced at the beginning of December and appeared to correct the 1.5hPa offset, but further testing could not be accomplished because the sensor failed soon after install. The barometer was replaced on January 23. Further investigation points to issues at other sites that occur when the datalogger was replaced. The manufacturer of the dataloggers is involved and loggers have been sent back to them for testing. Logger SN 7116 was tested; the mother board was found to be noisy, and was replaced. Logger serial number 5964 was found to have a noisy resistor set that was replaced.

SMOS

All SMOS data quality looks okay 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.
- E15 data are missing from October 10 – 22.
- E7 Wind speed and direction data are suspect at this site during near calm conditions.
- E24 data missing from the October 3 – 5, 12 – 15, and 26 – 29.
- E27 wind direction reported at 360 for 24 hours starting on October 10 at 1500 GMT.

In 2003 corrections to sites E3, E4, E6, E7, and E27 were made due to measured inaccuracies for tower alignments to true north. Problems were noted recently with co-located EBBR and SMOS systems. After

review, errors in alignments of the EBBR wind sensors were found. A new tool to simplify EBBR wind vane alignments was built and distributed to the field technicians. Checks have been done but disagreement between the co-located EBBR and SMOS sites continue at E6 and E27. Further investigation into the failure of checks to eliminate or identify the problem has begun. A tool that allows the techs to mount to the tower cross arm and the wind monitor on the SMOS to hold it steady is in development.

The rain gauge dynamic calibration was concluded on all SMOS gauges. Ingest development is in progress. New field check procedures and check toolkits will be made for the technicians to verify proper gauge performance. The datalogger programs and ingest has been developed. New gauges were installed at sites where the serial numbers were duplicated. A new ARM-specific serial number for the gauges will be developed along with a tagging system that will contain the calibration coefficients.

Site E7 wind monitor was replaced, but the low wind speed issue remained. Additionally, the direction began to report 0 also. Comparisons to co-located EBBR and nearby Mesonet surface stations suggest the wind direction data is also suspect. I have asked the technicians to replace the wind monitor with a newly calibrated and checked sensor.

SURTHREF

SurTHRef data quality looks okay with the following exceptions:

- Sonde Present bit flag on for an extended period on October 23
- Vaisala probe V3 RH and Temp data suspect for short periods on the October 17 and October 26.

Sensor swaps began in May, but temperature dependence in the RH data was found. All calibration checks were halted until a determination on how to proceed is made. It is likely that multi-temperature RH calibrations will be required so corrections to the data can be made.

THWAPS

All THWAPS data quality looks okay with the following exceptions:

- B5 RH values 10% higher than actual through October 11.
- B5 T/RH probe was changed and the span for RH% was incorrectly set through the October 11 leading to erroneous readings.
- The wind sensors calibration checks have begun. Site B5 is the only one left to be accomplished and is overdue.

MET

AMF MET 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. Upgrades to the field techs test equipment were done and new procedures are in development.

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 (TDMA)

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 (TPS)

Mentor: Mark Ivey, Sandia National Laboratory

The instrument has been offline since September. It was recently returned from repair at Yankee. We hope to get the instrument re-installed and data flowing in November.

The total precipitation sensor (TPS) in Barrow was returned to Yankee Environmental Systems after data analyses at Sandia and the University of Alaska Fairbanks determined there were problems with the instrument. The TPS appeared to register precipitation when none was evident either by local observer or

other nearby instruments. Discussions with Yankee led to the conclusion that the instrument should be returned. It was shipped to Yankee in September.

In late October, the TPS instrument was returned by Yankee Environmental Systems to Barrow. The TPS and interface computer were shipped to Jessie at UAF for checkout prior to installation in Barrow. Jessie is currently evaluating the instrument. Her test plan includes a short trial at a field location in Fairbanks with a nearby precipitation instrument for data comparison.

2.34 Total Sky Imager (TSI)

Mentor: Vic Morris, Pacific Northwest National Laboratory

SGP (C1) – Data quality generally looks good.

NSA – Data were missing at C1 on October 5 because it was shutdown for the winter.

TWP (C1) – Data quality generally looks good.

TWP (C2) – Data quality generally looks good.

TWP (C3) – Data quality generally looks good. The shadowband was misaligned at C3 from October 23 – 27.

FKB (M1) – Data quality generally looks good.

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 (TWR)

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 CF tower elevators were not used during October. T/RH/VP measurements for October 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.

The following data are missing:
West 25m: None
West 60m: None
Southeast 10X: None

The following data are incorrect:

West 25m:
West carriages lowered for removal of LI-7500 for calibration, October 1, 1725-1812 GMT.
West carriages lowered for installment of LI-7500, October 3, 1736-1820 GMT.

West 60m:
West carriages lowered for removal of LI-7500 for calibration, October 1, 1725-1812 GMT.
West carriages lowered for installment of LI-7500, October 3, 1736-1820 GMT.

Southeast 10X: None

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 (VCEIL)

Mentor: Vic Morris, Pacific Northwest National Laboratory

SGP (C1) – Data quality generally looks good.

SGP (B1) – Data quality generally looks good.

SGP (B4) – Data quality generally looks good.

SGP (B5) – Data quality generally looks good. Electronic ringing in the backscatter plot is visible at B5 until October 23, when the data become intermittent.

SGP (B6) – Data quality generally looks good.

NSA (C1) – Data quality generally looks good.

NSA (C2) – Data quality generally looks good.

TWP (C1) – Data quality generally looks good.

TWP (C2) – Data quality generally looks good.

TWP (C3) – The instrument at C3 appeared to have decreased sensitivity to low clouds at night from July 11 – October 23.

FKB (M1) – Data quality generally looks good.

2.37 W-Band (95 GHz) ARM Cloud Radar (WACR)

Mentor: Kevin Widener, Pacific Northwest National Laboratory

SGP – The WACR is down awaiting repair. Uptime was at 0%. The EIKA failed, but it is still under warranty. The EIKA was replaced, and it was found that a power detector also failed. A replacement is being ordered but, in the meantime, ProSensing will install a loaner. It is anticipated that the WACR will reinstalled by mid-November.

FKB (M1) – There were no problems. There were no data (disk swap) on October 10, 0900-1000, 1100-1200. Uptime was at 99.7%

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. A companion ECR was entered, ECO-00575, to study the network transfer of MMCR and WACR spectra to 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 is in the release process to test ECO-00391 and 00575. 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. A design goal will to be enhance the measurement range of our MWRs to include low liquid water path and low water vapor atmospheres, while improving calibration accuracy. The workshop will be held on November 13, the day before the joint meeting of the Cloud Properties and Cloud Modeling Working Groups.

STATUS- A very productive meeting was conducted that included ACRF science, infrastructure, and contracting staff , and principle MWR vendors. A technical specification is under development by our MWR Instrument Mentor, Maria Cadeddu. If the recommendations of the MWR futures and science working groups gain favorable review of our STEC and IMB—a competitive procurement will commence in early calendar year 2008.

3.2 Atmospheric Radiation Measurement Program Volume-Imaging Array (AVA)

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 2009 or beyond, when simulations have been carried out to demonstrate its capabilities and further refine its requirements.

3.3 Collaborative Adaptive Sensing of the Atmosphere (CASA)

ACRF is a member the Collaborative Adaptive Sensing of the Atmosphere (CASA) consortium, and this concept is being assessed to determine utility to ARM and ACRF science objectives. There is a good analysis data set available to the community that spans the CLASIC experiment. The precipitation fields and related data products from the CASA array are being incorporated into ARM cloud modeling and properties research. In parallel, a lifecycle cost and logistical feasibility assessment is underway within the ACRF infrastructure including; site preparation and leasing, infrastructure, operations, towers, installation costs, radar modifications, data infrastructure, and processing impacts. See www.casa.umass.edu .

STATUS: Ongoing review of needs and impacts.

3.4 Absolute Scanning IR 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. At this time, an estimated beginning of the instrument deployment would be FY2009—depending on STEC/IMB review of overall instrument priorities.

3.5 Raman Lidar for Optical Extinction and Water Vapor Profiles

There is the need to deploy a Raman or HRSL extinction lidar at our North Slope of Alaska, Barrow research site to provide measurements of optical extinction and water vapor profiles.

STATUS – Scientists within our ARM working groups are refining science needs and discussing instrument and measurement approaches. A target milestone for deployment, pending favorable scientific and infrastructure review, will take place in FY2010.

3.6 Oxygen A-Band Spectrometer

The A-band spectrometer has potential in understanding 3D RT effects and in validating BBHRP. Initial costs estimates were spread over 3 years and were prohibitive for our program. A revised, more acceptable cost estimate to complete this system in 1-2 years has been submitted; however, no high-level data products are provided. The development of retrievals would need to be funded separately—to simultaneously retrieve cloud optical depth and effective radius for low LWP clouds. Simulations demonstrate that accuracies for cloud optical depth, effective radius, and liquid water path are 2%, 10%, and 2g/m2, respectively.

STATUS – In queue for discussion and recommendation during the December STEC meeting.

3.7 1.6 micron MFRSR Channel

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 WG 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.

STATUS – In queue for discussion and recommendation during the December STEC meeting.

3.8 MFR - Upwelling Radiation Measurements for the ARM Mobile Facility

Downward-looking MFRs for the AMF are needed in order to estimate the surface spectral albedo. Two systems are recommended, one for the main AMF facility and one for its 'extended' facility. These radiometers are to be placed on 10 m towers for a standard WMO measurement configuration.

STATUS – In queue for discussion and recommendation during the December STEC meeting.

3.9 Automatic Radiosonde Launcher for the NSA Barrow Research Site

The sonde launcher is proposed to optimize downstream operational costs and thereby enable additional daily sonde launches. However, additional information is requested as to its ability to work reliably in such an extreme climate. This information may be obtained either from demonstration or, perhaps, verification from operations in a similar site.

Doug Sisterson has talked with Vaisala about this system. Their specification does state performance in climates from tropical to polar and there is a need to verify NSA suitability. There is an Autosonde operating in Whitehorse, Yukon, but that is only at about 60.66 N (Barrow is at 71 N). There is also a system at Bodo, Norway, 69 N. Barry is checking with Vaisala to see if it has any installed at higher latitudes and to ascertain performance.

STATUS – In queue for discussion and recommendation at the December STEC meeting.

3.10 Photo Acoustic (PA) Soot Spectrometer/SGP AOS

Photoacoustic extinction observation for the AOS at the SGP. This new observational capability will help investigate the reported bias in the absorption measurements made by the PSAP instruments.

STATUS – In queue for discussion and recommendation at the December STEC meeting.

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."

See 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.