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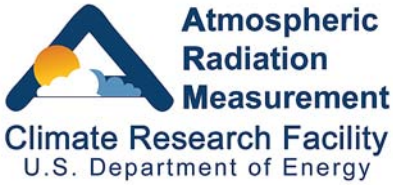
ACRF Instrumentation Status: New, Current, and Future

November – December 2007



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Abstract

The purpose of this report is to provide a concise but comprehensive overview of Atmospheric Radiation Measurement Climate Research Facility 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) Small Business Innovation Research 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 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 ARM Climate Research Facility (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 of 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/. An Intensive Operations Period Request (IOPR), IOPR-2007-05707, was submitted by Mary Jane Bartholomew. Upon approval, the TC-RSR will be deployed at our SGP site to evaluate performance and perform preliminary inter-comparisons with ACRF instruments. The resulting data set will be documented and archived for scientific record at our ARM Data Archive.

1.2 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 site 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 the SGP site 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; Vic is collecting the data for archival and analysis.

Instrument	Data Available
Blue Sky Imaging Ltd. (BSI) All Sky Thermal IR Camera 320C	09/02 – 10/10/2007
Solmirus All Sky IR Visible Analyzer	08/28 – 09/11/2007
Heitronics Nubiscope	08/27 – 10/05/2007
Atmos Cloud IR Radiometer 4	08/30 – 09/28/2007
Atmos Cloud IR Radiometer M	08/30 – 09/17/2007

1.3 Rotating Shadowband Spectrometer Overhaul

Peter Kiedron demonstrated that the rotating shadowband spectrometer (RSS), built by Yankee Environmental Systems, Inc., 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 – An Engineering Change Request (ECR) needs to be submitted. The Working Groups and the Science Team Executive Committee (STEC) recommended the re-engineering of the RSS for implementation in FY2008.

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

John Ogren 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 Working Groups and STEC approved the addition of an APS in FY2008 to replace the OPC component of the TDMA. Don Collins, TDMA Instrument Mentor, has responsibility for integrating the APS with the SGP AOS. See ECO-00640, *Replace AOS Optical Particle Counter with Aerodynamic Particle Sizing Spectrometer*.

1.5 Infrared Thermometers for the Southern Great Plains Extended Facility Sites

In FY2004, 6 infrared thermometers (IRTs) were purchased, 9 additional IRTs were purchased in FY2005. Some of these have been deployed with the AMF. There are 12 SGP extended facility sites

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 Working Groups and STEC recommended the addition of the remaining SGP IRTs during FY2008. Please reference ECO-00345, *Install Zenith-Pointing IRT Network at SGP*. Vic Morris is the leader.

1.6 Add Scanning Capability to the W-Band ARM Cloud Radar

During the December 2007 ARM STEC meeting a scientific and programmatic consensus was reached to add a scanning capability to our SGP w-band ARM cloud radar (WACR). This enhancement to the WACR will provide an ACRF product for evaluating the 3D cloud properties first at the SGP site and then, depending on portability (or transportability) and robustness, other ACRF research sites.

STATUS – ECR-00658, *WACR–Add Scanning Capability*, is open and in discussion to scope the initial science, operational, and technical objectives of the development. Kevin Widener is the leader.

1.7 Oxygen A-Band Spectrometer

The A-band spectrometer is approved by the ARM STEC (December 2007) to advance our understanding of 3D radiative transfer effects and in validating broadband heating rate profiles. The objective is to simultaneously retrieve τ_{cloud} and r_{eff} for low LWP clouds. Simulations demonstrate that accuracies for,τ_{cloud}, r_{eff} , and LWP are 2%, 10%, and 2g/$m_{2,}$ respectively.

STATUS – An ECR needs to be submitted. Qilong Min is the principal investigator.

1.8 Next-Generation Microwave Radiometers

The Working Groups and the STEC have approved the competitive procurement of next-generation microwave radiometers (MWRs). The systems are specified to provide three channels operating at 23, 31, and 90 GHz. The strategy is to replace our current aging MWRs with systems that broaden our measurement performance parameters and provide an economic product life cycle for the future. A procurement specification is in development based on the November 2007 “ACRF MWR Futures” workshop outcomes.

STATUS – A procurement specification is under development by Maria and the ACRF Engineering team. An ECR needs to be submitted. Maria Cadeddu is the leader.

1.9 Photoacoustic Spectrometer

The December STEC approved the Working Group’s recommendations to deploy an instrument that provides photoacoustic (PA) extinction of aerosols. The PA instrument and associated measurements will be added to the existing ACRF AOS and the SGP. A science objective is to produce a high-quality data

set to investigate the reported bias in the absorption measurements made by the particle/soot absorption photometer instruments.

STATUS – An ECR needs to be submitted. Dubey Manvendra is the leader.

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 database (http://www.db.arm.gov/IMMS/), which can be used for a collective view of instrument status. Individual IMMS reports may be reviewed by following links to specific instruments from our Instrument Webpage (http://www.arm.gov/instruments). Information related to the progress and status in instrument engineering is also used from our Engineering Change Order (ECO) database (http://eco.arm.gov) where status updates are available.

2.1 Atmospherically Emitted Radiance Interferometer

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

SGP-C1:

The system ran well and the data quality is good.

SGP-E14:

This system continues to experience problems related to the interferometer (see PIF P071102.2). As a result, data were lost on the 4th, 9th, 11th-13th, 19th, 21st, 24th-26th, and 27th. Additionally, approximately 16.5% of the data that were collected suffer from calibration problems and should not be used. The mentors have created simple netCDF data quality files that users should use to identify these samples. These DQ files will be made available to the ARM Program. The remaining data look to be of good quality, however.

NSA-C1:

There is a gap in the data on November 2, when site operations took the instrument offline to replace the scene mirror. Unfortunately, a thermistor was broken when the instrument was brought back online, which caused the radiance data to be calibrated incorrectly (see PIF P071105.2). The data were improperly calibrated from November 2 – 29 (when the broken thermistor was replaced). The data have been reprocessed to correct this, and data are now being made available to the ARM Program. Otherwise, the data look very good. Less than 1% of the data were flagged as bad by the new DQ script.

FKB-M1:

The instrument ran well this month. There is a gap in the data on the 16th-17th for several hours. We continue to have problems with the limit switches/cabling that indicate whether the hatch is open or

closed, and we are investigating ways to identify this using the radiance data. The DQ script indicated that approximately 2.5% of the data failed the quality checks.

TWP-C2:

The system ran well and data quality looks good. The DQ script indicated that 2.4% of the data did not pass the quality checks.

TWP-C3:

The system ran well and the data quality looks good. The responsivity of the channel 1 detector seems to have stabilized on the lower value (it has been oscillating between an upper and lower value for the last several months) after the 7th. The DQ script indicated that approximately 2.9% of the data did not pass quality checks.

2.2 Aerosol Observing System

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

STATUS – No new information provided.

2.3 Balloon-Borne Sound System

Mentor: Rich Coulter (with Mike Ritsche and Donna Holdridge), Argonne National Laboratory

November was a relatively quiet month with respect to radiosonde operations. With the exception of the AMF deployment in Germany, no IOPs or field campaigns involved extra radiosonde launches. In total we added 418 files to the ARM Data Archive this month. Overall radiosonde data recovery was excellent during September, with sounding reporting rates of FKB 123/120 (102%), NSA 55/60 (92%), SGP 120/120 (100%), TWP/C1 (Manus) 62/60 (103%), and TWP/C2 (Nauru) 58/60 (97%). These numbers take into account flights during which the radiosonde failed at launch (two at FKB and two at SGP/C1). Several flights were not attempted at NSA because bad weather conditions made it impossible to get to the site. Operators will generally launch a replacement sonde when this occurs.

2.4 Broadband Radiometers

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 – No new information provided.

Solar IR system – No new information provided.

Downwelling broadband solar and atmospheric irradiances (Sky Radiometers on Stand for Downwelling Radiation) – No new information provided

Upwelling broadband radiance (Ground Radiometers on Stand for Upwelling Radiation) – 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 – Earth System Research Laboratory's Global Monitoring Division.

STATUS – Reda has replaced the fluid in the pyrgeometer blackbody calibration system at the National Renewable Energy Laboratory (NREL) with a new Dow Corning 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 10 years old and needs to be updated. 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, R*eplace 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 Central Facility tower are operating nominally.

2.6 Carbon Monoxide System

Mentor: Sébastien Biraud, Lawrence Berkeley National Laboratory

No new information provided.

2.7 Carbon Dioxide Precision Gas System

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

No new information provided.

2.8 Cimel Sun Photometer

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

SGP: Operating nominally.

NSA: Out for calibration.

Nauru: Operating Nominally until 11/27. Missing data since November 27, 2007. (Entered DQPR).

FKB: Data availability intermittent due to weather and maintenance issues. Robot locked up in GOSUN position and rain sensor was iced over.

2.9 Disdrometer

Mentor: Mary Jane Bartholomew, Brookhaven National Laboratory

In Oklahoma, no part of the state managed to eclipse normal rainfall for the month. In fact, most of the Oklahoma Mesonet sites measured less than an inch or precipitation for the month. The statewide average total was just under one half of an inch, more than two inches below normal. Meanwhile in Australia, afternoon storms were a feature of November 2007, especially at Darwin, with rainfall recorded on 21 days during the month. This was the second-highest number of rain days ever recorded in November at the Darwin Airport site, with only November 2001 recording more (22 days). Despite the high number of rain days, the rainfall total was close to the long-term average.

2.10 Energy Balance Bowen Ratio Station

Mentor: David Cook, Argonne National Laboratory

The measurements from the Energy Balance Bowen Ratio Station (EBBR) stations are contained in three datastreams (5, 15, and 30 minutes). The data are being ingested and are available from the ARM 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.

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:

E2: Data quality good.

E4: Data quality good.

E7: Data quality generally good.

Relative humidity (RH) 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.

E8: Data quality good when available. RHs are too high, but this does not affect the sensible and latent heat flux measurements.

Data missing 11/24 0630 GMT – 11/29 1800 GMT, and 11/30 1730-2330 GMT.

E9: Data quality generally 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.

E12: Data quality generally good.

Data missing 11/21 1030 GMT – 11/22 1700 GMT.

E13: Data quality good.

E15: Data quality generally good, when available. Data missing 11/01 0000 GMT – 11/05 2200 GMT and 10/31 1730-2330 GMT.

Soil heat flow #4 went offscale frequently 11/14 0900 GMT – 11/30 2330 GMT; sensible and latent heat fluxes were incorrect when this happened.

E18: Data quality.

E19: Data missing 11/01 0000 GMT – 11/20 1700 GMT, 11/20 2100 GMT – 11/21 1830 GMT, 11/25 1130-1200 GMT presently. Sneakernetted data for some of this period has not been ingested.

E20: Data quality generally good.

E22: Data quality generally good.

Sensible and latent heat fluxes were incorrect when soil heat flow #5 was offscale at times throughout the entire month, and when soil heat flow #1 was offscale at times, 11/01 0000 GMT – 11/20 2030 GMT.

E26: Data quality good.

E27: Data quality generally good.

Low supply voltage caused many of the measurements to be incorrect 11/20 0500 GMT – 11/23 0600 GMT, 11/23 1100 GMT – 11/25 0900 GMT, 11/26 1430 GMT – 11/30 2330 GMT.

2.11 Eddy Correlation Station

Mentor: David Cook, Argonne National Laboratory

Ten Eddy Correlation Station (ECOR) systems are installed at ARM facilities−nine at the SGP site and one 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:

(a) Periods of precipitation, fog, and dew (frost) often cause incorrect water vapor and 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 IR 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.

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 collocated or nearby SMOS rain gauges or the HandS ECOR plots to determine times of precipitation and one can assume that offscale or spiked readings in the few hours before dawn are often caused by dew or frost on the CO_2/H_2O sensor. I have written ECR-00536 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 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 (l ve) 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) On rare occasions, the flag for elevation (angle of attack of the wind) is exceeded, normally on the positive side. The flag limits for elevation 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 water vapor 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 cannot be interpreted by the ECOR software. Fluxes are usually incorrect or offscale and CO_2 and H_2O 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.

E1: Data generally good except during precipitation and dew/frost.

E3: Data generally 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.

Data missing 11/24 1400 GMT – 11/20 2330 GMT.

E5: Data not good.

CO_2 flux and latent heat flux are incorrect because the analog channels of the sonic are not working and the upper and lower transducers of he sonic are switched.

E6: Data good, when available, except during precipitation and dew/frost.

Data missing 11/30 2200-2330 GMT.

E10: Data was missing 11/01 0000 GMT – 11/14 1500 GMT because no sonic anemometer was installed.

Pressure and temperature are missing 11/14 1530 GMT – 11/30 2330 GMT; sensible and latent heat fluxes are not affected.

E14: Data good except during precipitation and dew/frost.

E16: Data good, when available, except during precipitation and dew/frost.

Data was missing 11/01 0000 GMT – 11/07 1700 GMT.

E21: Data generally good, when available, except during precipitation and dew/frost.

Data was missing 11/01 0000 GMT – 11/07 1800 GMT.

E24: Data generally good.

Pressure and temperature were missing 11/01 0000 GMT – 11/21 1600 GMT; sensible and latent heat fluxes were not affected by this problem.

Analog signals from the CO_2/H_2O sensor were missing, and thus CO_2 and H_2O means, CO_2 flux and latent heat flux were missing 11/03 2000 GMT – 11/05 0930 GMT and 11/28 2200 GMT – 11/30 2330 GMT.

Data missing 11/21 2100 GMT – 11/27 1500 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.

Data missing 11/05 1500 GMT.

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 began at Argonne in mid-January on an ECOR system similar to the ACRF ECORs. 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

NSA, Barrow (C1) Site: This month, data are continuous. Overall data quality looks good. Interference spikes have almost disappeared this month. Surface temperature readings are very unstable and the sensor needs to be replaced (see DQR D071214.1).

2.13 Global Positioning System (SuomiNet)

Mentor: None (external data provided by SuomiNet/COSMIC) – Rick Wagener, 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 five stations: E3, E6, E7, E15, and E19.

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

2.14 Infrared Thermometer

Mentor: Vic Morris, Pacific Northwest National Laboratory

SGP: The data were generally good at C1, E5, E6, E7, E8, E9, E10, E11, E13, E15, E16, and E20. The data were missing at E6 from 11/23, E7 from 11/3 to 11/8 and from 11/24 to 11/26, E15 from 11/1 to 11/5, and E19 from 11/9.

NSA: The data were generally good at C1 and C2.

TWP: The data were generally good at C1, C2, and C3.

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

2.15 Multi-Filter Rotating Shadowband Radiometer and Related Systems

Mentor: Gary Hodges, NOAA/ESRL/GM Division

Multi-filter radiometer (MFR) 10-meter tower;

No new information provided.

MFR, 25-meter tower;

No new information provided.

MFRSRs;

No new information provided.

Normal Incidence MFR;

No new information provided.

2.16 Millimeter Wave Cloud Radar

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

SGP
No problems.

Uptime: 100%

NSA
No data: 11/3/2007 0000-1130, 11/27/2007 1900 – 11/30/2007 2359

Uptime: 87.7%

Manus
No data: 11/19/2007 0230 – 0330, 11/24/2007 0100 – 0200

Uptime: 99.7%

Nauru
No data: 11/3/2007 0900 – 11/4/2007 2359, 11/28/2007 0130 – 0400

Uptime: 94.2%

Darwin
No data: 11/10/2007 0000 – 1230

Poor sensitivity: 11/1/2007 0000 – 11/5/2007 1900

Uptime: 82.3%

2.16.1 Millimeter Wave Cloud Radar Digital Transceiver Upgrade

The main focus of the millimeter wave cloud radar (MMCR) digital receiver upgrade is to develop a completely digital transceiver, as indicated in ECO-00610, *MMCR Digital Transceiver Upgrade*. 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 five 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. MMCR upgrades are on hold pending recommendation to resume by STEC.

2.16.2 Millimeter Wave Cloud Radar Processor Upgrades

The C40 processors are being replaced with PC-integrated acquisition system (PIRAQ)-III processors, as documented in ECO-00283.

STATUS – The PIRAQ-III (ECO-00597) processor upgrade at Barrow is now complete.

2.16.3 Add Polarization at Barrow

(ECO-00552) Because the PIRAQ-III 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*.

2.16.4 Millimeter Wave Cloud Radar Spare Components

New traveling wave tubes (TWTs) 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 Coherent Up-Down Counter is in the procurement queue for FY2008, along with two TWTs, two Antennas, and a spare PIRAC board. Our FY2009 procurement plan includes three additional TWTs and two antennas. Radar data availability and quality are high priorities of the Working Groups.

2.16.5 Millimeter Wave Cloud Radar Calibration Study

A calibration study of the ACRF MMCR systems was recommended and approved by the STEC for FY2008. A contract will be awarded to perform an end-to-end characterization of the MMCR transmitter/receiver calibration.

2.16.6 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.

2.16.7 Refurbish Millimeter Wave Cloud Radar Antennas

Beginning in 2007, over a three-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 installed. For FY2008 and FY2009 antennas procurements are planned for the SGP and Tropical systems.

2.17 Micropulse Lidar

Mentor: Rich Coulter, Argonne National Laboratory

Overall, the MPLs had no show-stopping issues during November, 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 if we implement the software upgrades with Sigma Space. In the meantime we have begun to manually reboot the systems every other Tuesday. Other than this, the data from the system at the SGP site has continued unabated with little/no problems. Good data to greater than 15 km is normal during nighttime and 10-15 km during daytime. For almost a two-day period between November 21 and 23, all the temperatures (scope, detector, laser) dropped

dramatically, with the scope temperature dropping to about 3 °C (20 °C. is normal). After some investigation I found out that the heater/air conditioner in the trailer had inadvertently been switched to air conditioning during this period. No apparent damage resulted and the system continued to operate.

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 so perhaps they are getting the hang of the thing. Both Manus and Nauru had the USB cable installed to the polarizer, which permits operation of the version 2.20 software and will allow for remote operation with the expected software upgrade.

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 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. On 11/21 (1800 hr) the scope temperature increased rapidly to ~26°C (from 18°C) and has remained in that approximate region ever since. It is not clear why this has occurred, but at the same time, the variations apparent associated with the heater turning on and off have disappeared. I have asked for an explanation but have as yet heard no reply. Because the heater is not turning on/off, the vertical striping has disappeared.

2.18 Microwave Radiometer

Mentor: Maria Cadeddu, Argonne National Laboratory

NSA
C1:
Data are good this month. There are no data gaps.

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 are good and continuous this month. The ambient sensor readings are showing incorrect values with intermittent data and spikes (see DQR D071208.1)

C2 (Nauru): Data are good this month. No data interruptions.

C3 (Darwin): Data were good at this facility. There is a short data gap (a few hours) on 11/12 due to loss of communication with the radiometer.

FKB:

M1: Data at this facility are good with no interruptions.
SGP
B1: This month the radiometer has had a major malfunction and data are mostly unusable. The malfunction started on November 6. The tip data have erratic values and the black body voltages, and sky voltages are out of range as well. The radiometer completely stopped acquiring valid tip curves on November 21 and was removed on November 26. Data for this month should be disregarded (see DQR D071129.1 and DQR D071129.2).

B4: Data are good and continuous this month.

B5: (SN12): This month data at this facility are intermittent between November 1 and November 21. On November 21 the radiometer was removed to test the serial ports on the instrument and computer. The radiometer was taken to the Central Facility and will be reinstalled at this facility in December (see DQR D071011.4). Between November 1 and 21 data are good when available.

B6: Data at this facility are continuous this month. Data quality is good.

C1: The radiometer was reinstalled at this facility on November 19 after undergoing extensive repairs due to possible lightning damage. Data between November 19 and 21 are in need of reprocessing because the radiometer had to acquire enough tip curves to update the calibration coefficients (see DQR D071128.2). Data from 11/21 are good and continuous.

E14: Data at this facility are continuous this month. After radiometer SN 10 (C1) was reinstalled at the Central Facility, brightness temperatures were compared to see if the bias documented in DQR D070802.1 was still present. The 23.8-GHz brightness temperature of the E14 radiometer channel is still about 1 K higher than the collocated C1 radiometer. The new data have been sent to the manufacturer.

2.19 High-Frequency Microwave Radiometer

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.

2.20 Microwave Radiometer Profiler

Mentor: Maria Cadeddu, Argonne National Laboratory

NSA C1: Radiometer is out of service for repairs.

FKB M1: For the month of November operations were continuous without interruptions. The instrument has been stable this month. This month has been very rainy and wet so that a large part of the data are affected by rain. The user should pay extra attention to screening the data by using the window flag and setting some threshold for brightness temperatures.

K-band channels: The K-band channels are in good agreement with model computations.

V-band channels:
The V-band channels are in good agreement with model computations, and the 51.25 and 52.28-GHz channel appear to have a bias of about 2 K compared to the model.

Precipitable water vapor retrievals:
The agreement between MWRP and MWR and radiosonde measurements are good.

LWP retrievals are in agreement with the MWR retrievals although the noise level is higher.

2.21 Narrow Field-of-View Radiometer

Mentor: Gary Hodges, NOAA/ESRL/GMD

No new information was reported.

2.22 NOAAFLASK

Mentor: Sébastien Biraud, Lawrence Berkeley National Laboratory

No new information was reported.

2.23 Raman Lidar

Mentor: Rob Newsom, Pacific Northwest National Laboratory

The Raman lidar functioned well during November 2007. The instrument's uptime (percent of time scientific data were collected) during this period was 97.0%. The most significant period of downtime occurred on November 2 as a result of a blown fuse in the UPS. Other than that, the system experienced only brief periods of downtime due to routine maintenance.

2.24 Rotating Shadowband Spectrometer

Mentor: Peter Kiedron, NOAA/ESRL/GMD

RSS provided data every day during November 2007. Three RSS calibrations were undertaken during November-- two on 11/08 and one on 11/27.
Status: The RSS is approved for re-engineering in FY2008. An ECR will be submitted to document the plans and tasks to be performed.

2.25 Radar Wind Profiler – 915, 1290 MHz

Mentor: Rich Coulter, Argonne National Laboratory

Three systems (915: C1, I1, I2) are operating as of the end of November 2007. Data from the Central Facility of the SGP look very good. The configuration file has been returned to the normal operation of hi/lo power, 10 min 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. During this process it was discovered that there is a DSL connection to the Beaumont site, so we actually do have access to this system.

The Meeker site continues to await a reinstallation of supply (power) lines. It appears that the radar wind profiler (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. We are still awaiting a few minor tests by site operations and/or return of the phase shifter to us for analysis.

The AMF 1290-MHz 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 vendor shipped the final amplifier out to the manufacturer for repair. Upon its return, Vaisala discovered some problems in its own equipment that integrate with the final amplifier. The system was overnighted to the SGP site for shipment back to the AMF in time for inclusion in a shipment to China. Thus, we will not know its true state until after it arrives in China, which will be close to the 1-year warranty period.

2.26 Radar Wind Profiler – 50 MHz

Mentor: Rich Coulter, Argonne National Laboratory

In January 2006 the 50-MHz RWP at the SGP site 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 is down.

2.27 Soil Water and Temperature System

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.

No new information was provided.

2.27.1 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: five sites per year over four 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.

2.28 Shortwave Spectrometer

Mentor: Scott Kittelman, University of Colorado

Data collection was halted on November 16, 2007 at approximately 16 utc. The instrument has been shipped out for an annual calibration and should return to the ARM SGP Central Facility some time in December.

Baseline Change Request (BCR-01428) was approved to return the Shortwave Spectrometer and 12” integrating sphere to California for a NIST-traceable annual calibration using the Ames Research Center Airborne Science and Technology 30" integrating sphere. A DQR (D0071116.1) was filed to explain the gap in data and any instrument changes that occur do to recalibration.

2.29 Surface Meteorological Instrumentation Mentor: Mike Ritsche, Argonne National Laboratory

SMET

SGP (C1) – No problems were noted.

SGP (C2) – T/RH data poor on the 23rd from 2333-2343 GMT and on the 30th at 0207-0215 GMT.

SGP (C3) – no problems noted.

Comparisons of SMET data with BBSS data show some biases in the SMET data occurring since sometime in January 2005, notably a continuing 1.5 hPa negative bias in the Nauru pressure data. A 3°C negative bias in the Darwin temperature data occurred 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 installation. 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 and the mother board was found to be noisy. It was replaced. Logger serial number 5964 was found to have a noisy resistor set that was replaced. I am continuing to investigate the continued 1°C difference between the SMET and BBSS surface data at Darwin. A decision on what to do with the temperature data when the difference was -4-C needs to be made. Either we flag it and leave it or we reprocess and correct it. An investigation as to whether or not the difference is BBSS- or SMET related is continuing.

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.
- E6 data missing from 1607 – 1615 GMT on the 1st.
- E7 data missing from 0300 – 0500GMT on the 9th.
- E5 wind sensor data incorrect due to icing on the sensor from 24th at 2343 GMT through the 25th at 0338 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 collocated 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 collocated 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. This tool will remove subjectivity from this process. A collar has been constructed and work for a tail connector to hold the sensor in place is in the works. Field checks are expected to be made in December.

- The wind monitor calibration checks are over due at sites E1, 3, 6, 13, 21 and 24.
- 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. Another sensor was installed and comparison to the collocated EBBR show improvement.

SURTHREF

SurTHRef data quality looks okay with the following exceptions:

- Sonde Present bit flag on for an extended period on the 3rd.

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. We are in the process of formulating a check of the probes using the Thunder Scientific Calibration Chamber. No progress is expected until after the first of the year.

THWAPS

All THWAPS data quality looks okay.

MET

AMF MET data quality looks okay.

METTWR (NSA Site)

C1 experienced short-term single minute missing values at different levels of the tower and with the CMH and PWS data throughout the month.

- All 4 levels of T/RH and WS/WD data missing during calibration checks on the 8th – 9th and the 25th – 26th.
- C1 PWS data is missing on the 17th from 1433 GMT through the 18th at 0338 GMT and again on the 21st from 1229 GMT through the 22nd at 0935 GMT.
- C1 error code is 02 suggesting that the PWS data is questionable.
- C1 and C2 Wind direction sensors collect ice making them sluggish. See figure 40mwdfroze.jpg for an example of the C1 40m sensor being non-responsive. The following table gives the percentage of time by level the sensor was non-responsive this month.
- C2 PWS data missing on the 16th from 1341 GMT – 2112 GMT.

Table 1: Percent of Time Wind Direction Sensor is Sluggish

	C1	C2
2m	Less than 1%	N/A
10m	Less than 1%	<1%
20m	6%	N/A
40m	Less than 1%	N/A

- A daily self-test by the chilled mirror causes data from it to be incorrect once a day. See Figure NSA08a.bmp. When temps are below 0 °C, however, this does not occur.
- C1 QLI data collection problems are very infrequent (T/RH and WS/WD data) but have continued to be a problem, especially in the wind speed data at different levels.

2.29.1 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 RH 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 RH probes with new, heated probes designed to operate in cold environments. This is documented in ECO-00595, *Upgrade T/RH probes and Wind Sensors for NSA Met System*.

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

2.30 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 ARM Data Archive as "beta data." 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.

2.31 Hot Plate Total Precipitation Sensor

Mentor: Mark Ivey, Sandia National Laboratory

The total precipitation sensor (TPS), TPS-3100, was returned by Yankee Environmental Systems, Inc. in October. We shipped the instrument to Jessica Cherry at the University of Alaska Fairbanks (UAF). Jessie will set up the instrument at UAF for evaluation.

2.32 Total Sky Imager

Mentor: Vic Morris, Pacific Northwest National Laboratory

SGP: The data were generally good at C1.

NSA: The data were missing at C1 because the instrument was shut down for the winter.

TWP: The data were generally good at C1, C2, and C3.

FKB: The data were generally good at M1.

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.

2.33 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

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 ARM 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 November. T/RH/VP measurements for November 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: none

West 60m: none

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.

2.34 Vaisala Ceilometer

Mentor: Vic Morris, Pacific Northwest National Laboratory

SGP: The data were generally good at C1, B1, B4, B5, and B6. The data were intermittent at B5 from 10/25 to 11/7 due to a failing processor board.

NSA: The data were generally good at C1 and C2.

TWP: The data were generally good at C1, C2, and C3.

FKB: The data were generally good at M1.

2.35 W-Band (95-GHz) ARM Cloud Radar

Mentor: Kevin Widener, Pacific Northwest National Laboratory

SGP – The WACR, which had been down awaiting repair, was reinstalled during November. Unfortunately, the frequency modulator has failed. A replacement modulator is being located by ProSensing to return the SGP WACR to operation.

FKB (M1) – There were no problems. There were no data (disk swap) on November 6, 0900-11:30.

Uptime was at 99.7%

2.35.1 Study Network Transfer of Millimeter Wave Cloud Radar and W-Band ARM Cloud Radar Spectra to Archive

ECO-00369 presents a mechanism to transport MMCR and WACR spectra data from the measurement site to the ARM 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 ARM 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 /ECO-00575. Implementation is underway and documented in BCR-1349.

3. Future Instrumentation Planning

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

3.1 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 value-added product (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, is on hold, until simulations have been carried out to demonstrate its capabilities and further refine the requirements.

3.2 Collaborative Adaptive Sensing of the Atmosphere

ACRF is a member the Collaborative Adaptive Sensing of the Atmosphere (CASA) consortium; this concept is being assessed to determine its 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 life-cycle 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 impact

3.3 Absolute Scanning Infrared Radiometer

To provide an absolute infrared (IR) flux reference, which could be used to calibrate the Eppley PIRs, Ells Dutton suggested that ARM develop an absolute scanning infrared radiometer (ASIR). This instrument would be functionally equivalent to an ASIR 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 cost estimates have been received from several interested organizations. At this time, an estimated beginning of the instrument deployment would be FY2010—depending on the review of overall instrument priorities by the STEC and the ACRF Infrastructure Management Board.

3.4 Raman Lidar for Optical Extinction and Water Vapor Profiles

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

STATUS – Scientists within 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.

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

3.5 Upwelling Spectral Measurements Using Multi-Filter Radiometers at ARM Mobile Facility Sites

Approved for FY2009 Implementation – Downlooking MFRs for the AMF are needed to estimate the surface spectral albedo. The Working Groups and STEC recommend acquiring two, one for the main AMF facility and one for its ”supplemental” facility. The radiometers will be placed on 10-m towers for better representative measurement.

STATUS – ECR-00659 was entered to guide and document the addition of Up-welling MFRs to the ACRF AMF. Gary Hodges is the leader.

3.6 1.6-Micron Multi-Filter Rotating Shadowband Radiometer Channel

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

STATUS – Approved by the STEC to continue for evaluation.

3.7 Automatic Radiosonde Launcher for the North Slope of Alaska 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 at a similar site.

Doug Sisterson talked with Vaisala about this system. Their specification does state performance in climates from tropical to polar; 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, at 69 N. Barry is checking with Vaisala to see if it has any installed at higher latitudes and to ascertain performance.

STATUS – Based on the December STEC meeting discussions, this system is on hold until possibly FY2010.

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.