

# Radiative Processes Working Group: Value Added Product (VAP) Updates

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RPWG Translator/Developer Team

RP/CM WG Meeting, November 19, 2008



# Cloud Classification VAP

## Jennifer Comstock

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- ▶ **CLOWD-sponsored VAP**
- ▶ Produces cloud phase (ice, water, mixed) and cloud classification (stratus, cirrus, deep convection, etc.)
- ▶ Uses multiple remote sensing measurements and Wang and Sassen (JAM, 2001) algorithm
- ▶ 3 years of data processed at SGP
- ▶ Data will be posted on ARM Evaluation website within next few weeks (currently writing documentation)
- ▶ Contact [Jennifer.Comstock@pnl.gov](mailto:Jennifer.Comstock@pnl.gov) for more information

# Status of RPWG Operational VAPs

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- ▶ BE Flux (Best Estimate Flux from 3 radiometers at SGP)
  - run daily up through current
- ▶ QC RAD (Data Quality Assessment for Radiation Data)
  - c1, s1 level data – waiting for MFRSR reprocessing at SGP sites
  - c2 level data – processing global shortwave correction; waiting for information on instrument swap-outs
  - c1, s1 level data available (in archive) for AMF deployments at Pt. Reyes and COPS; Niamey available shortly
- ▶ Shortwave Flux Analysis
  - Runs monthly on all fixed sites except Darwin (processed once/year); 1-2 months behind current
- ▶ SFC Cld Grid (Surface cloud grid)
  - Run ~twice/year - currently processed through July, 2008
- ▶ SW Diff Corr (Shortwave Diffuse Correction)
  - All data have been sent to archive; VAP retired

# Current Development Efforts

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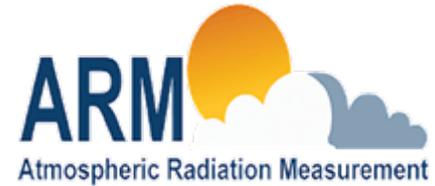


- ▶ **BAEBBR** (Best-Estimate Fluxes From EBBR Measurements and Bulk Aerodynamics Calculations)
- ▶ **SfcSpecAlb** (Surface Spectral Albedo)
- ▶ **QCRad** for Niamey/China AMF deployments
- ▶ **BBHRP** (Broadband Heating Rate Profile)

# BA-EBBR

Krista Gaustad, Dave Cook, S. Xie, S. McFarlane

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- ▶ Best-Estimate Fluxes From EBBR Measurements and Bulk Aerodynamics Calculations
  - Important for variational analysis
  - Data currently available only through 2003
- ▶ Updates
  - Corrected use of fixed vegetation height; now using site specific height
  - Corrected errors in logic in VAP
  - Updated to add qc flags
  - Updated variable names to comply with new ARM conventions (no single letter names, etc.)
  - Created vegetation height files for missing data
  - Created automated method of using monthly vegetation heights file
- ▶ Current status:
  - Code is ready to release
  - Waiting for new DODs and re-processing of EBBR data
  - Data should be available by end of 2008

# Surface Spectral Albedo VAP

Krista Gaustad, Sally McFarlane, Chuck Long, Eli Mlawer



- ▶ Objective: produce high-resolution surface spectral albedo for use in radiative transfer calculations
- ▶ Measurements: Upward-looking MFRSRs and PSPs and downward-looking MFRs and PSPs on 10m and 25m towers at SGP
- ▶ Procedure:
  - Do QC, fill in missing data; Produce broadband and 6-channel tower surface albedos
    - Preliminary data files exist as Evaluation product; cleaning up variable names and preparing to release as separate VAP
  - Predict surface type based on 6-channel values
    - snow, brown, vegetated, or partial vegetation
  - Extrapolate albedos to high-resolution, extended spectral range
    - Mlawer algorithm: information from spectral albedo libraries to predict spectral albedo given surface type and albedo at MFR wavelengths
    - Currently testing algorithm against field data and broadband measurements
    - Will supply initial files to SW QME effort for analysis

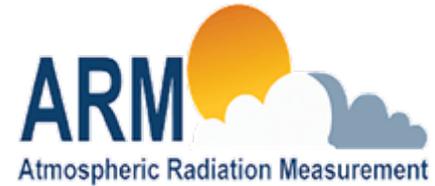
# QCRad for AMF Deployments

Yan Shi, Sally McFarlane, Chuck Long



- ▶ QCRad .s1. files are recommended ARM broadband radiation datastream
- ▶ QCRad processed (and available in archive) for Pt. Reyes and COPS deployments (including auxiliary sites)
- ▶ Niamey
  - Beta version available for main and auxiliary sites; examining potential sun tracker problem in early part of deployment
- ▶ China deployment
  - Main and auxiliary sites will be processed at end of deployment when all data available
- ▶ Azores deployment
  - Will run initial processing with thresholds from other sites to produce timely data (beta or evaluation product)
  - Will reprocess with updated thresholds after several months of data

# Upcoming RPWG VAP Efforts



- ▶ Full Radiative Flux Analysis (RFA) - [approved](#)
  - Adds LW information to SW Radiative Flux Analysis
  - Will include revamping of SW codes to make processing more efficient
- ▶ Potential Efforts – [for discussion](#)
  - Radiative Flux Analysis for AMF
    - Modest effort required for Pt. Reyes, COPS
    - More substantial effort required for Niamey and China due to heavy aerosol loading
  - AERI noise filter
    - Improve/update processing code
  - AERI Prof at Nauru
  - GVR 183-GHz Radiometer
    - MWRRET-type retrieval that includes statistical and physical retrievals for best estimate
    - Combine with current MWR for best estimate over entire range
  - Interfaces to radiative transfer codes

# BBHRP (Broadband Heating Rate Profiles)

Tim Shippert, Sally McFarlane, Eli Mlawer



## ▶ 2008 Accomplishments

- Released 1 year of v1.5 at SGP site
  - Available as ARM Evaluation Product
- Developed aerosol climatology and new aerosol methodology for SGP and NSA sites
  - New NSA runs for Microbase and Shupe-Turner
  - Microbase runs will soon be available as Eval. Product
- Developing BBHRP Testbed concept and infrastructure
  - Improving BBHRP infrastructure aimed at more efficient processing of cloud retrievals, especially in the testbed environment
  - Started CLOWD-BBHRP Intercomparison
- Processed 'historic' cloud retrievals at SGP to evaluate against Microbase

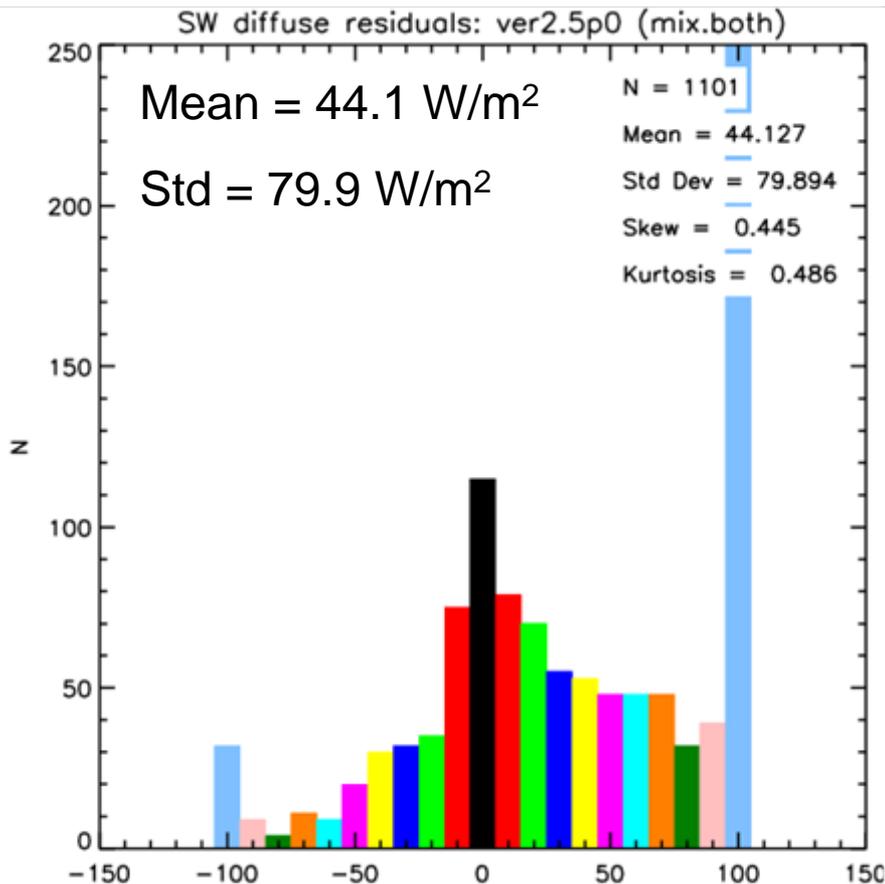
# BBHRP – Aerosol Climatology

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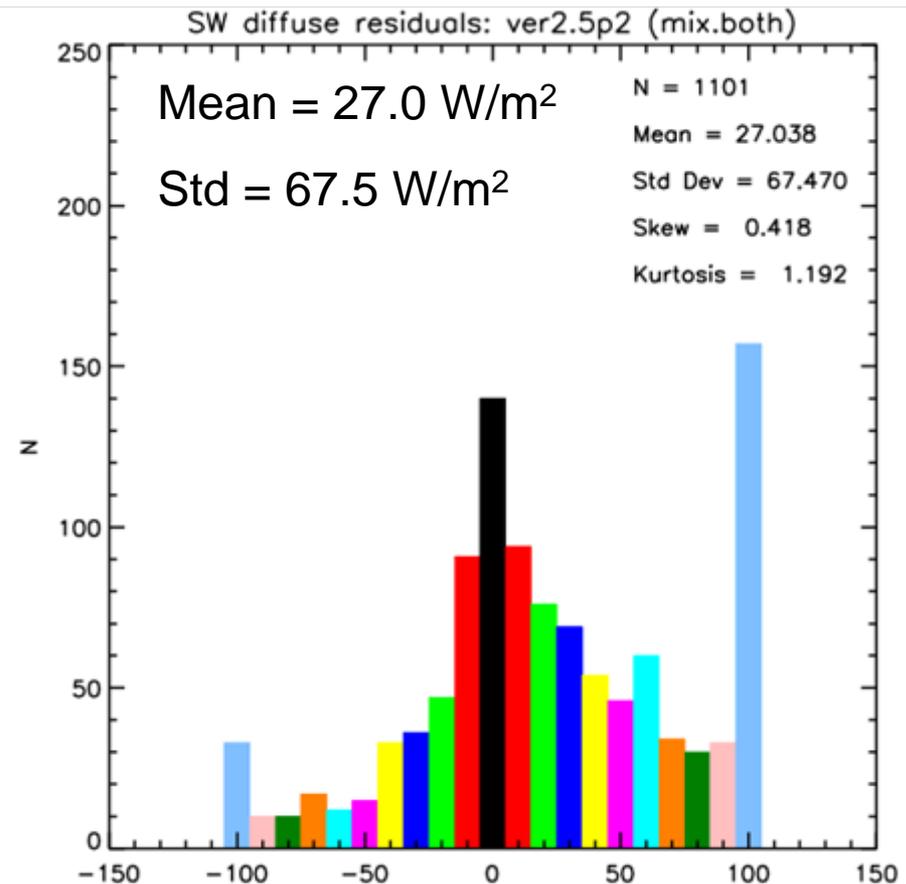


- ▶ Developed aerosol climatology and new aerosol methodology for SGP and NSA sites
  - Monthly (SGP) or seasonal (NSA) climatology developed from Aerosol Best Estimate VAP (ABE)
  - Climatological values used during cases with cloudy sky and no ABE retrieval
  - Fixed bug in BBHRP aerosol input during thin cloud cases
  - Greatly increases number of SW cases and improves performance at NSA (slight increase in cases at SGP)
    - June 2004 NSA test: increased clear sky cases by 15% and cloudy sky cases by 45%

## Mixed-phase cloud cases – SW residuals



Old Aerosol



New Aerosol

# BBHRP – Community Testbed

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- ▶ Development of ARM community testbed for evaluation of cloud retrievals
  - Consistent set of radiative transfer calculations, input fields, and observed fluxes for evaluation of PI retrievals
  - Benchmark set of calculations based on standard BBHRP runs
  - Auxiliary inputs; PI only has to provide retrieval dataset to be evaluated, rather than developing full set of model inputs
  - Use of Infrastructure resources to run radiative transfer computations
  
- ▶ Challenges
  - Improve BBHRP efficiency
  - Modularize inputs so datasets can be easily switched and ‘standard’ datasets with all info required for run are provided for reference
  - Limit infrastructure effort as much as possible to running of cases, not development of input datasets
  - Develop code that can be distributed to PIs to run their own cases

# BBHRP – Current Testbed Procedure

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- ▶ PIs can submit retrievals for any periods for which all standard inputs are available and reference version of BBHRP has been run
- ▶ Standard inputs to current reference version (v1.5) of BBHRP are:
  - atmospheric profile information ([MergedSounding](#) + TOMS ozone)
  - cloud properties ([MicroBase](#))
  - surface properties (spectral albedo)
  - aerosol properties ([AerosolBestEstimate](#))
  - measured surface/TOA fluxes (for analysis/evaluation of results; [BEFlux/QCRad](#) and [GOES/CERES](#))
- ▶ Current reference periods available:
  - Mar 2000 – Feb 2001 at SGP
  - Mar 2004 – Feb 2005 at NSA
  - Working on expanding time periods of reference calculations
- ▶ For non-reference periods, PI/case organizer must provide ALL inputs:
  - Example: CLOWD Pt Reyes intercomparison

# BBHRP Testbed - CLOWD Intercomparison

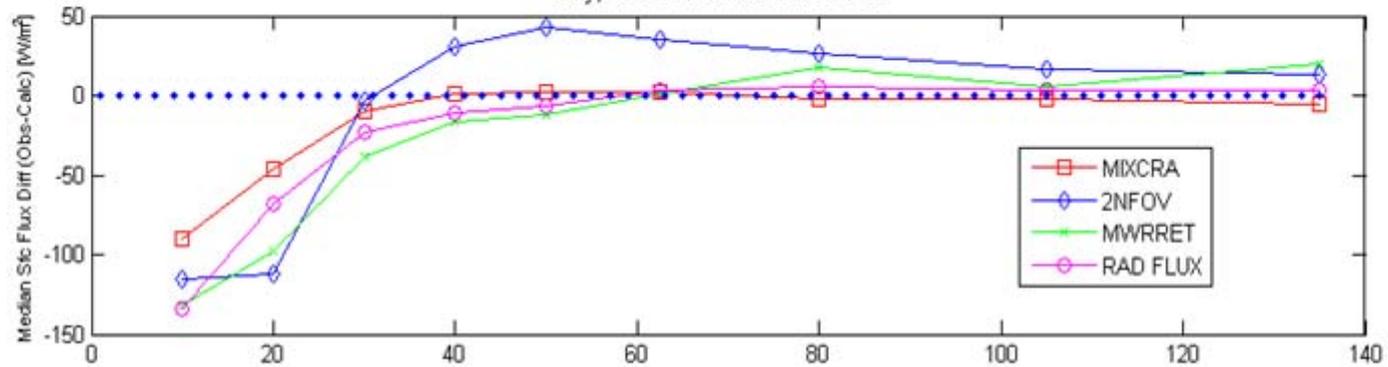
Led by J. Comstock



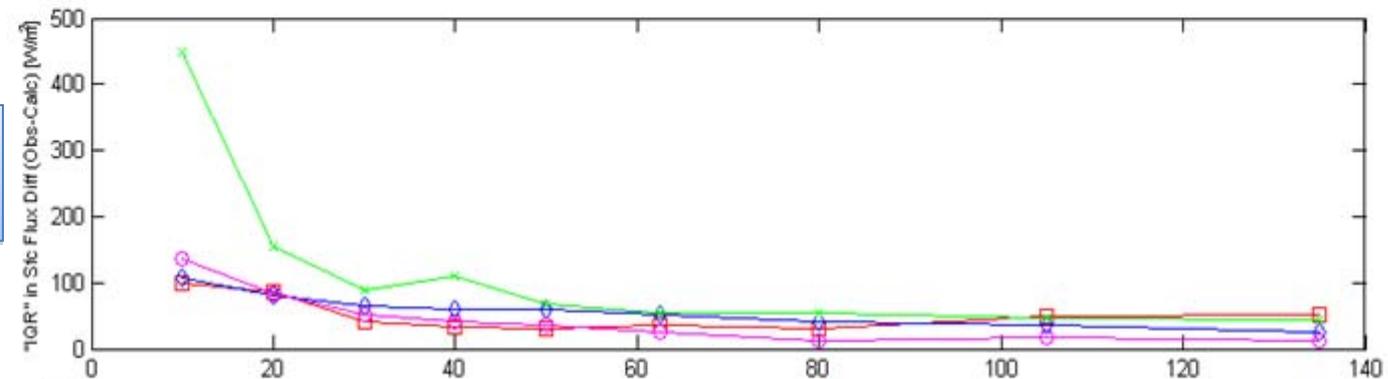
- ▶ CLOWD - Clouds with Low Optical Water Depts
- ▶ CLOWD-BBHRP
  - Intercomparison of retrieval algorithms using the BBHRP framework to vet algorithms for a CLOWD VAP
  - Series of surface and TOA radiative flux closure exercises using BBHRP
  - Develop statistical dataset of low LWP clouds ( $<100 \text{ g/m}^2$ )
  - Pt. Reyes July-Aug 2005 (Stratiform clouds, i.e., single-layer and plane-parallel-ish)
  - Currently 5 participants/ 6 retrieval algorithms; more welcome
- ▶ Datasets
  - Case organizer responsible for providing non-standard datasets (clouds, surface albedo, aerosol) in required format
  - Case participants provide cloud datasets in required format
    - Vertical structure and  $r_e$  assumed for OD-only retrievals
  - J. Comstock developed surface albedo input dataset
  - No aerosols included
  - Atmospheric state uses Merged Sounding
  - M. Khaiyer providing improved TOA closure datasets

# CLOUD Results – Shortwave Diffuse

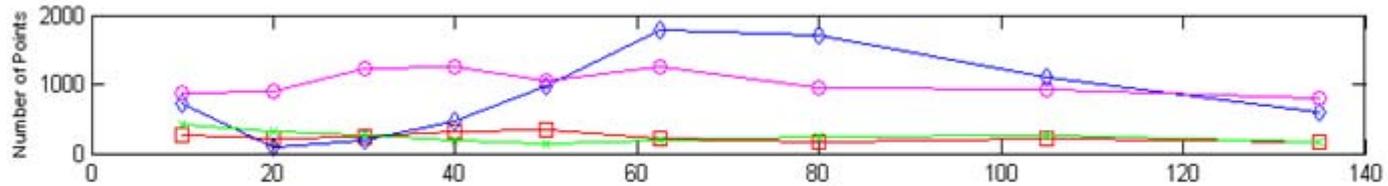
July, 2005 SW Surface Diffuse Flux



Median  
Flux  
Residual



75<sup>th</sup>-25<sup>th</sup>  
Interquartile



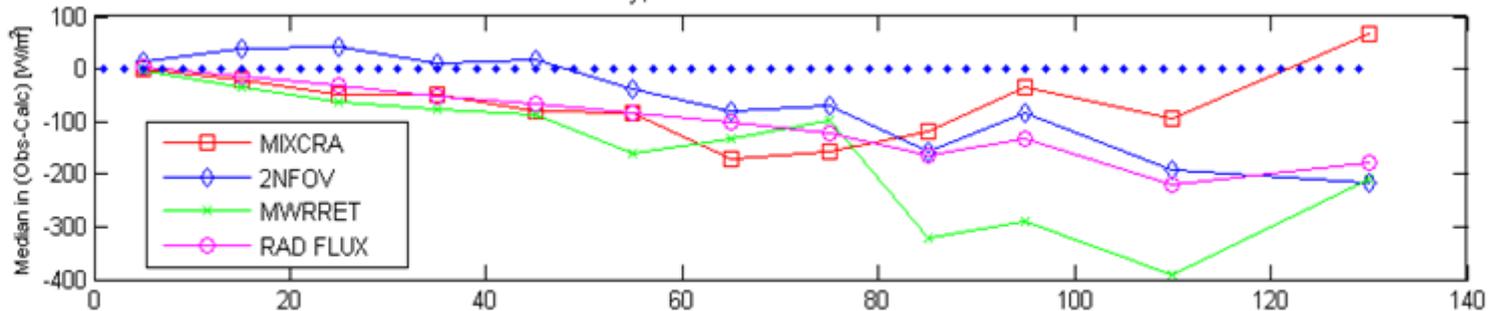
Number of  
Points

Liquid Water Path (g/m<sup>2</sup>)

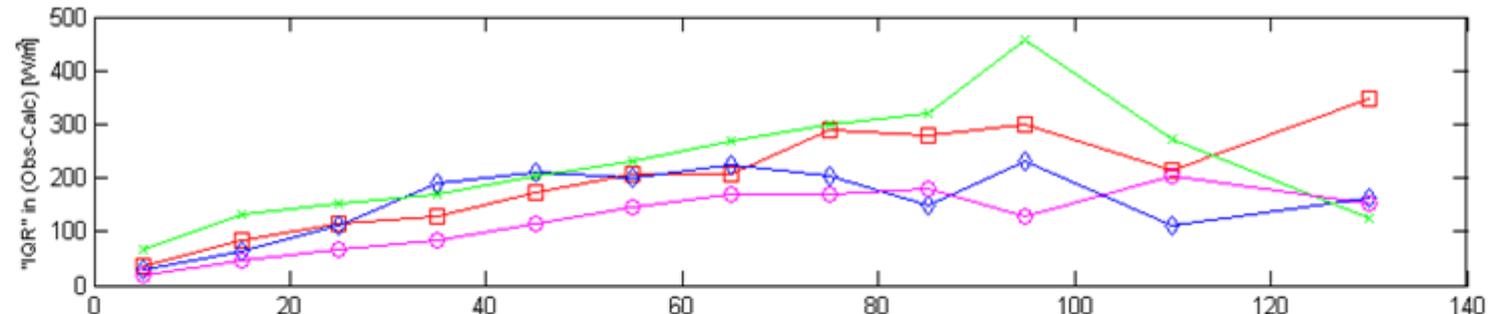
# CLOUD Results – Standard Deviation

## Shortwave Diffuse Flux

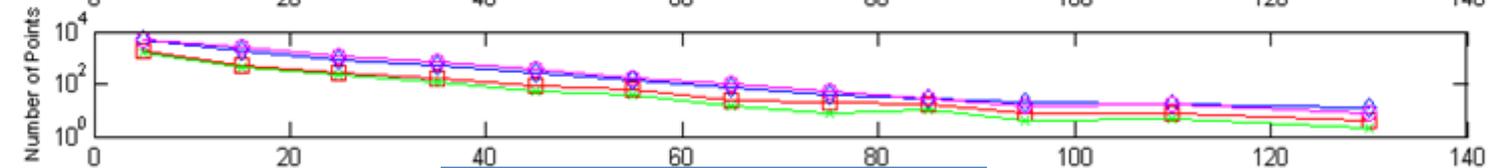
Median  
Flux  
Residual



75<sup>th</sup>-25<sup>th</sup>  
Interquartile



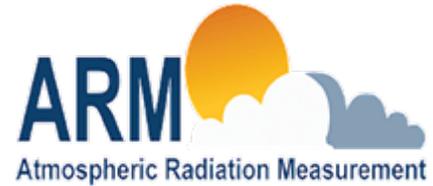
Number of  
Points



Measured Diffuse Flux  
Standard Deviation

# BBHRP Testbed – Mixed-Phase Cloud Intercomparison (Led by D. Turner and M. Shupe)

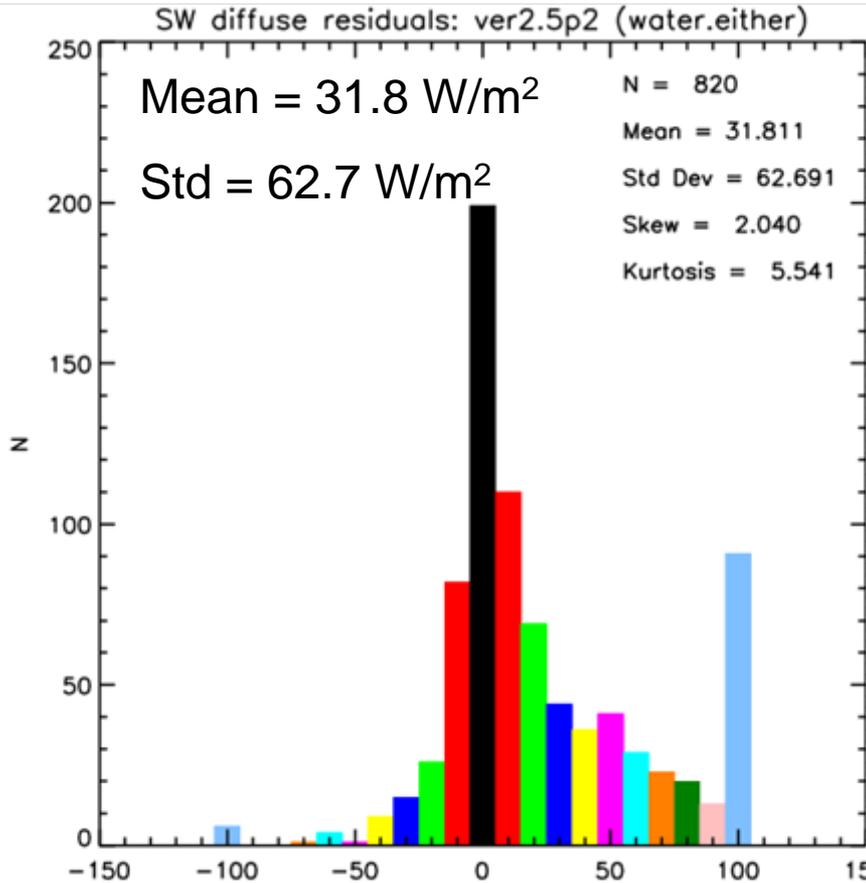
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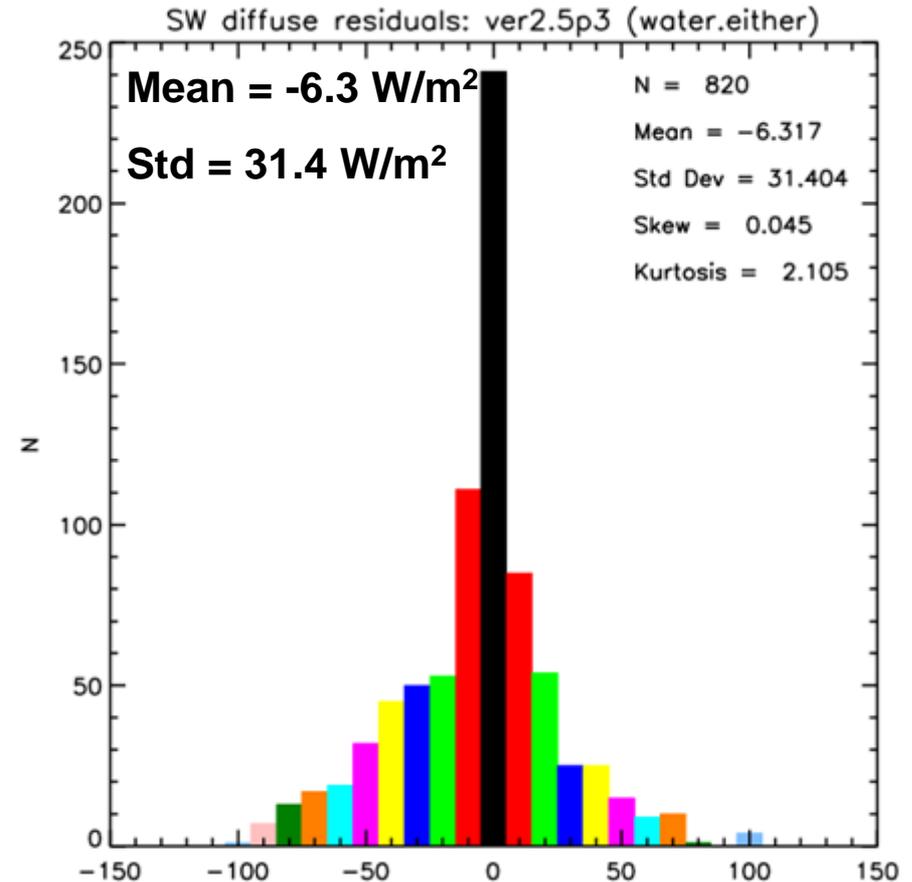
- ▶ Evaluate retrievals, including mixed-phase clouds, at NSA
  - Evaluate Shupe-Turner algorithm for replacement of Microbase at NSA as standard ARM cloud retrieval
- ▶ Datasets
  - 1 year (2004) of data at NSA
  - Surface albedo provided by Mlawer algorithm using MFR data
  - Atmospheric state from Merged Sounding
  - Aerosol from ABE and climatology
  - Cloud properties
    - Microbase
    - Shupe-Turner (reference)
    - Other NSA cloud retrievals welcome – contact Sally or Dave
- ▶ Future work
  - Improve surface albedo through consideration of spatial heterogeneity

# NSA Intercomparison – Liquid Clouds

## Cases Identified as Liquid Cloud by Either Algorithm



Microbase

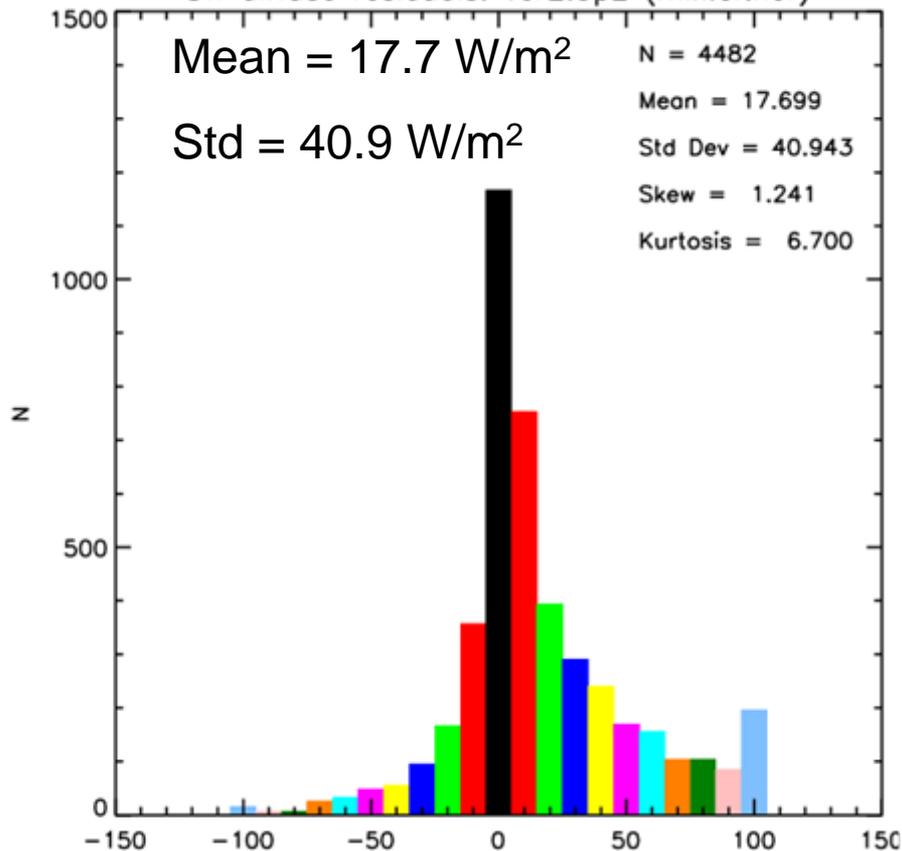


Shupe-Turner

# NSA Intercomparison – Mixed Phase

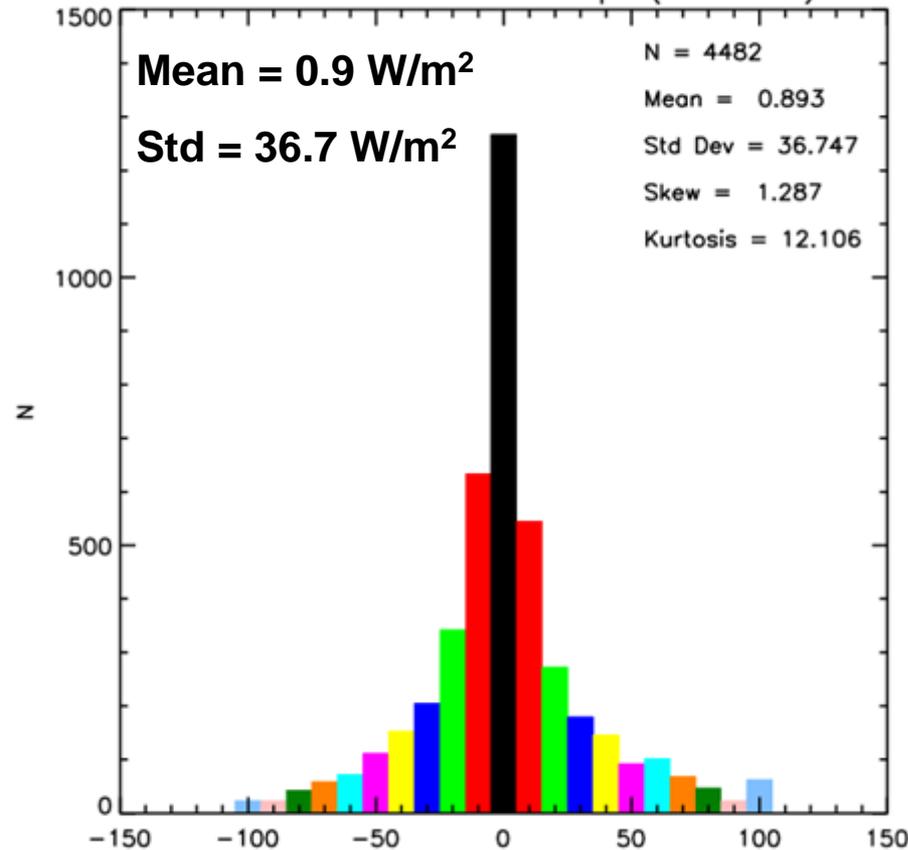
## Cases Identified as Mixed Phase by Either Algorithm

SW diffuse residuals: ver2.5p2 (mix.either)



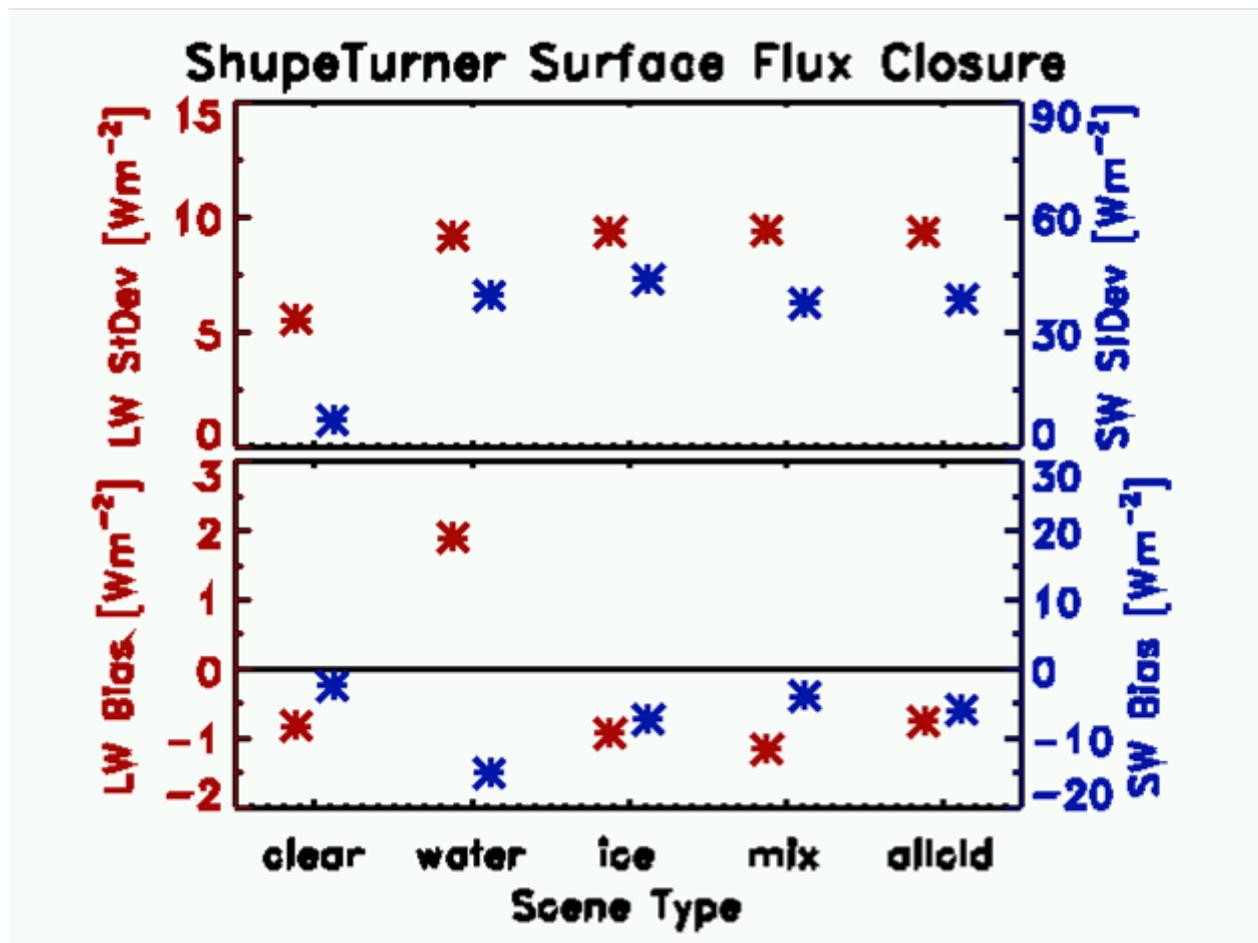
Microbase

SW diffuse residuals: ver2.5p3 (mix.either)

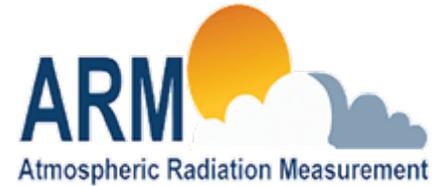


Shupe-Turner

# NSA Intercomparison – Evaluating and Improving Retrieval



# BBHRP – Future Plans



- ▶ Release multiple years of ver 1.5 at SGP and ver 2.5 at NSA
  - SGP – collecting datasets; will begin processing shortly
  - NSA – waiting more years of Microbase and ABE
- ▶ Continue work on testbed
  - Improve efficiencies of BBHRP processing
  - Continue CLOUD/NSA intercomparisons
  - Develop version that can be run by PIs
- ▶ Improve surface albedo treatment
  - Implement SfcSpecAlb VAP into BBHRP at SGP (and NSA?)
  - Implement methodology for considering cloud effect and spatial heterogeneity on surface albedos
- ▶ Implement BBHRP for TWP sites
  - Merged Sounding and Microbase available
  - ABE not available; Initial runs will be no aerosol
  - Develop a surface albedo dataset (no downward looking MFRs at Manus or Nauru)