

ARM Aerosol Working Group Value-added Products

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AWG Value-Added Products

- ▶ MFRSR/NIMFR: Langley, AOD, Ang exp., DirN/Diff
- ▶ AOS-family, extensive and intensive properties
- ▶ Aerosol-Best Estimate, SGP & NSA
- ▶ Raman Lidar processing and best-estimate

ARM performance metrics for 2008:

- ▶ Quarter 3: Niamey AOD product
- ▶ Quarter 4: Niamey “Dust” product

MPL products:

- ▶ Normalized/corrected profiles and cloud mask
- ▶ Polarized MPL processing

MFRSR AOD processing status

- ▶ Campbell datalogger migration complete at SGP.
- ▶ End-to-end review of corrections and processing.
- ▶ AOD VAP includes:
 - Exhaustive C-level file with instrument-level corrections, Direct/Diffuse ratio, Langley calibrations, TOA reference, Pressure-corrected Rayleigh OD, Ozone OD, and cloud-screened AOD with full bit-packed QC.
 - “Friendly” S-level file with only scientifically relevant fields.
- ▶ ARM-wide processing/reprocessing nearly complete:
 - AMF PYE and FKB underway
 - SGP EF 7-27 b1-level done, not yet through AOD
 - ALL other MFRSR data after mid-1997 finished
 - NIMFR done at SGP and NSA C1. NSA C2 underway.

Aerosol Observation System – Extensive and Intensive Properties

- ▶ Scattering coefficient, 1 and 10 μm , R G B
- ▶ Backscattering coef., 1 and 10 μm , R G B
- ▶ Absorption coefficient, 1 and 10 μm , R G B
- ▶ Hygroscopic growth factor for scattering coef.
- ▶ Angstrom exponents for scattering and absorption
- ▶ Single-scattering albedo, 1 and 10 μm , R G B, dry only
- ▶ Backscatter fraction, 1 and 10 μm , R G B, dry only
- ▶ Asymmetry parameter, 1 and 10 μm , R G B, dry only
- ▶ Submicron scattering and absorption fractions, R G B
- ▶ Aerosol forcing efficiency, 1 and 10, G

AOS/AIP processing, continued

- ▶ “AIP” contains 1-minute averaged data
- ▶ “AIP AVG” contains 1-hour averaged data
- ▶ C-level has exhaustive bit-mapped QC
- ▶ S-level has “friendly” QC

- ▶ SGP 1996-2008
- ▶ AMF PYE, NIM, FKB processed, under review
- ▶ NSA partially processed.

Aerosol Best-Estimate – SGP & NSA

- ▶ AOD from MFRSR, RL, AOS + RH + PBL
- ▶ Extinction profile from RL seasonal climatology vs AOD
- ▶ Aerosol surface properties from AOS
- ▶ RH profile from sonde
- ▶ Dry scattering coef. “humidified” through profile of RH
- ▶ Humidified scattering & absorption coef. yields SSA

- ▶ SGP 2001-2007
- ▶ NSA 2004-2005

Fixed some NaNs, Infs from climatology.
Evaluate using merge-sonde as input.

Raman Lidar processing, RL Prof

Rob Newsom, Jen Comstock, C. Sivaraman

- ▶ Significant improvements in deadtime determination and gluing the analog and photon-counting channels.
- ▶ Much improved day/night behavior
- ▶ Water Vapor residuals reduced

- ▶ With these improvements in the instrument corrections, the RL Prof processing has been accelerated.

ARM 3rd Quarter Performance Metric

Niamey AOD product

- ▶ ARM MFRSRs are calibrated via Langley regressions, AOD assumed constant throughout
- ▶ “Normal” ARM Langley yielded too few calibrations.
- ▶ Effect of relaxing acceptance criteria evaluated.
- ▶ At SGP, MFRSR and AERONET agree well, but not NIM.
- ▶ The discrepancy is observed having a strong correlation to AERONET coarse mode fraction and Angstrom exponent, but with a seasonal dependence.
- ▶ A semi-empirical correction was derived based on the Angstrom exponent that removes the bias.
- ▶ Year-long AOD and daily-averaged AOD was provided.

ARM 4th Quarter Performance Metric

Niamey “Dust” Product

- ▶ A metric was developed to indicate when surface aerosol conditions at Niamey were dominated by dust as opposed to biomass burning.
- ▶ This is NOT a standard ARM product.
- ▶ The AOS yields SSA and submicron fractions relevant to this question, but challenging operating conditions resulted in significant instrument downtime.
- ▶ Ad hoc relationships between AOS measurements and other measurements (CNC, CCN vs % SS, visibility) created proxy measurement to bridge data gaps.

Niamey “Dust” Product continued...

- ▶ 30 distinct “events” spanning 75 days were identified.

Final product was provided including hourly and daily-averaged values of:

- Extensive properties (scattering, absorption, backscattering)
- Intensive properties (SSA, g , Ang., sub-micron fractions)
- CCN fraction at different SS%
- AOD and angstrom exponent
- Horizontal visibility
- Met. Data
- Logical “dust” flag

MPL products:

MPLnor and MPLpol

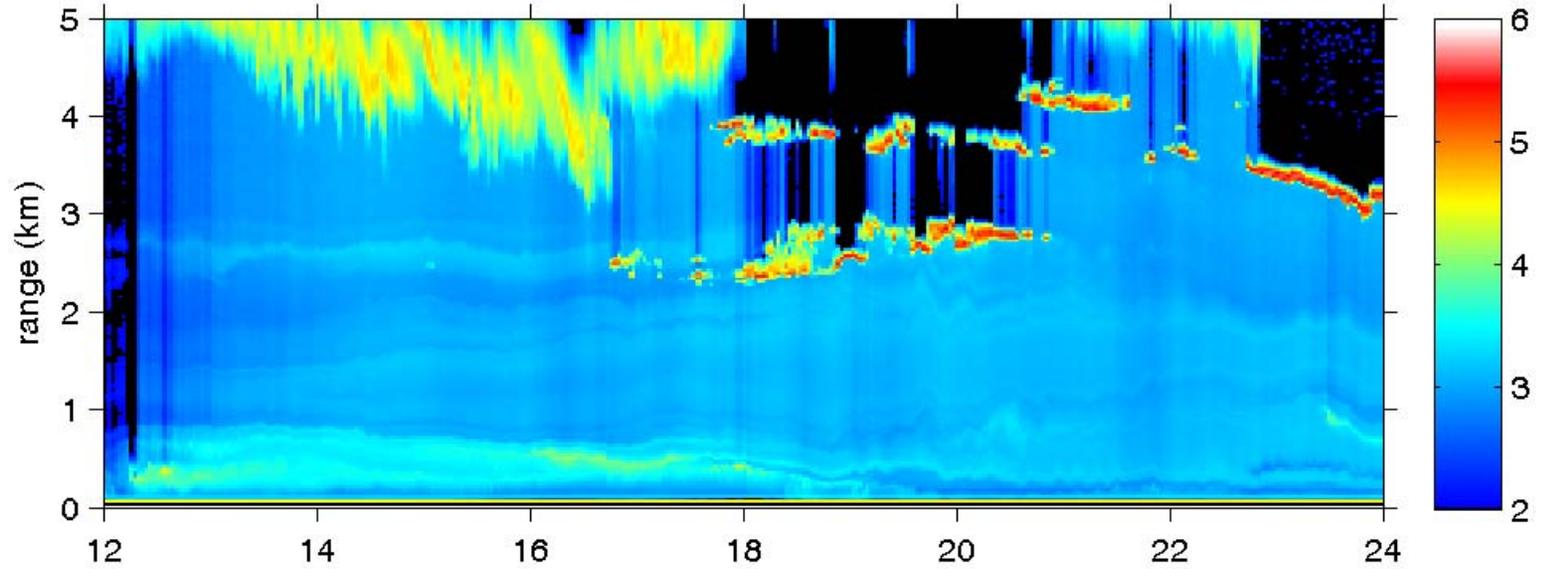
- ▶ Legacy data product designed for non-polarized MPL
- ▶ Typically requires instrument-specific corrections for:
 - Detector non-linearity (i.e., “dead-time”)
 - Detector afterpulse removal
 - Transceiver overlap correction
- ▶ Developed generic or nominal corrections to reduce processing burden.
- ▶ Have processed SGP May 1999 – May 2004 for evaluation release and for MPL Cloud OD VAP.
- ▶ Have evaluated nominal corrections at Nauru and Darwin.
- ▶ Cloud decision requires site-specific thresholds.

MPL pol: polarization-sensitive MPL

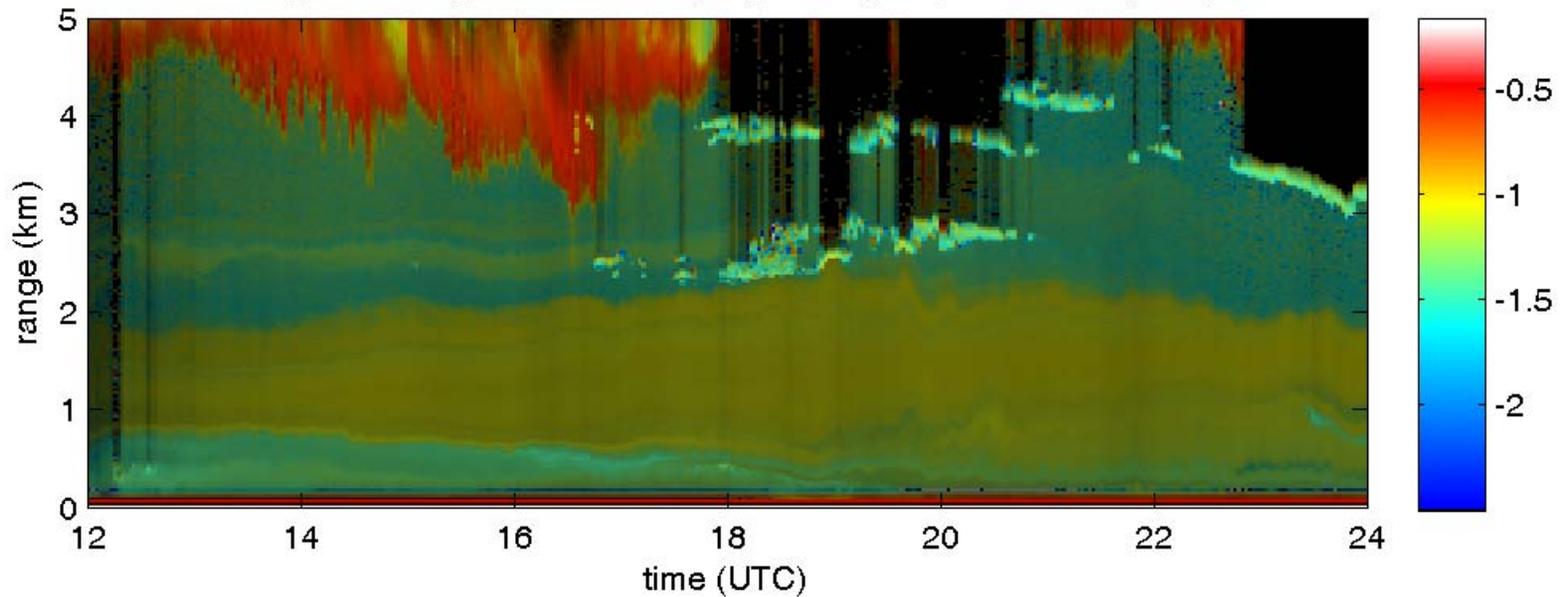
Polarized MPL systems at all sites

- ▶ Polarized MPL data now at all sites:
 - NSA: since MPACE
 - SGP: May 2006
 - Darwin: August 2006
 - Nauru: November 2006
 - Manus: January 2007
 - AMF: China
- ▶ Useful for cloud phase discrimination and aerosol characterization, but not suitable as input for MPLnor
- ▶ Real-time processing demonstrated for ISDAC.
- ▶ In addition to lidar depolarization ratio, this also yields output suitable for MPLnor, and shows potential for improving deadtime correction.

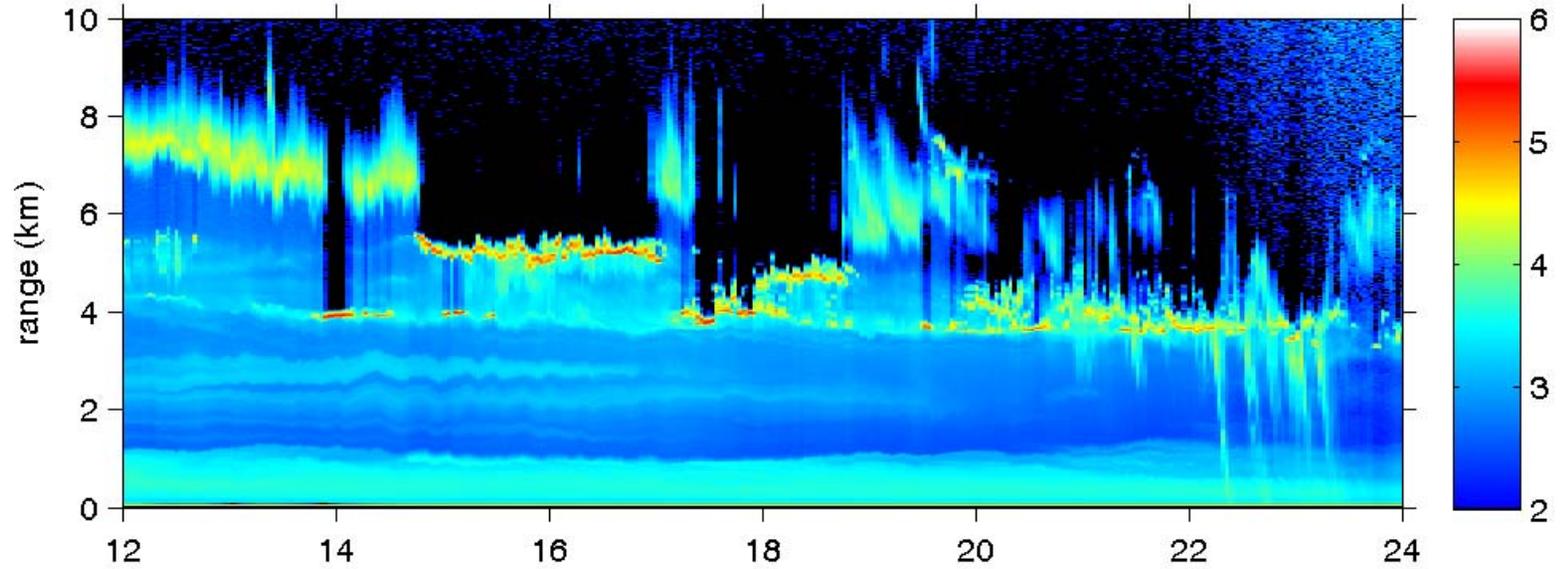
Attenuated backscatter: 2008-11-01 12-24 UTC



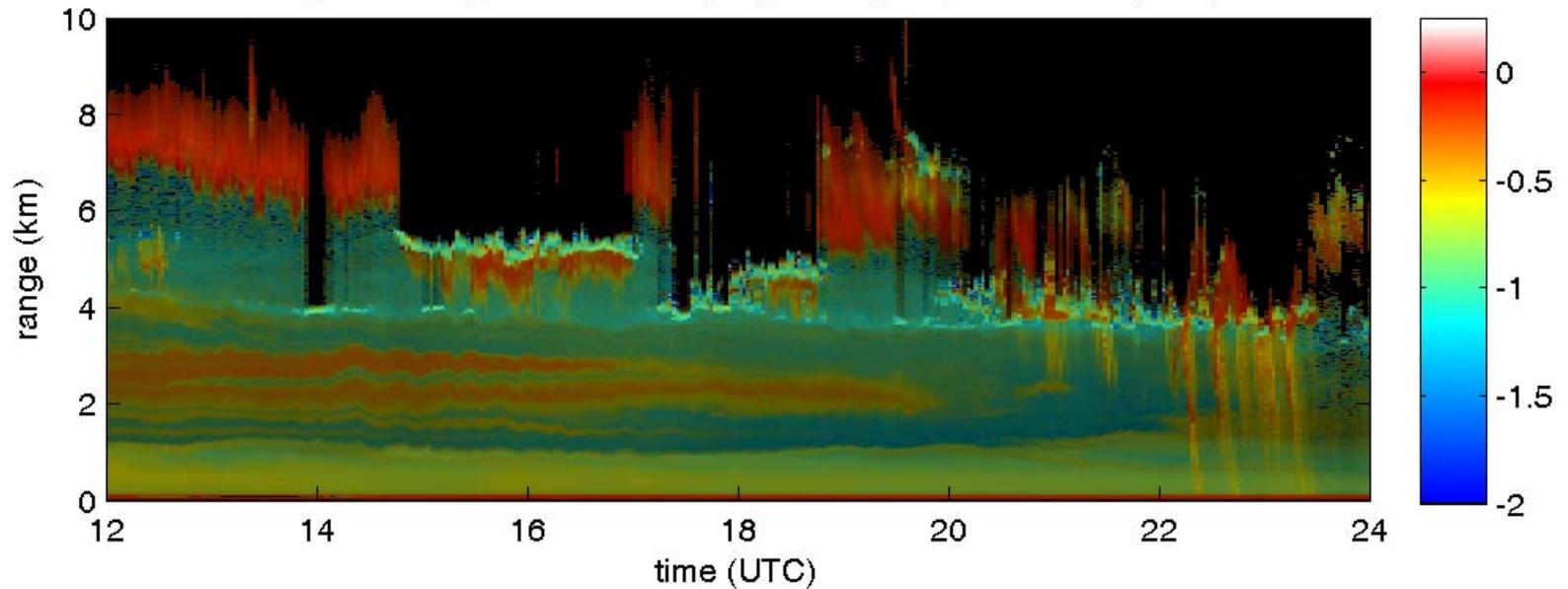
Composite image: backscatter (brightness), depolarization (color)



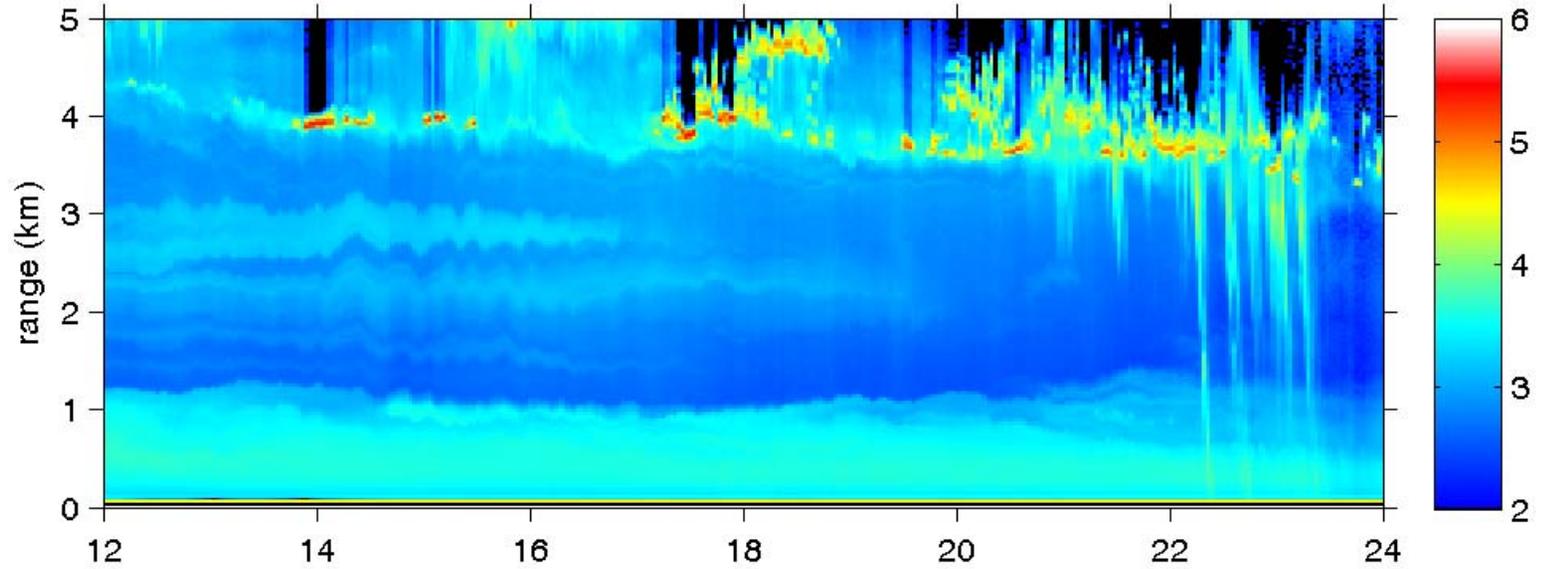
Attenuated backscatter: 2008-10-24 12-24 UTC



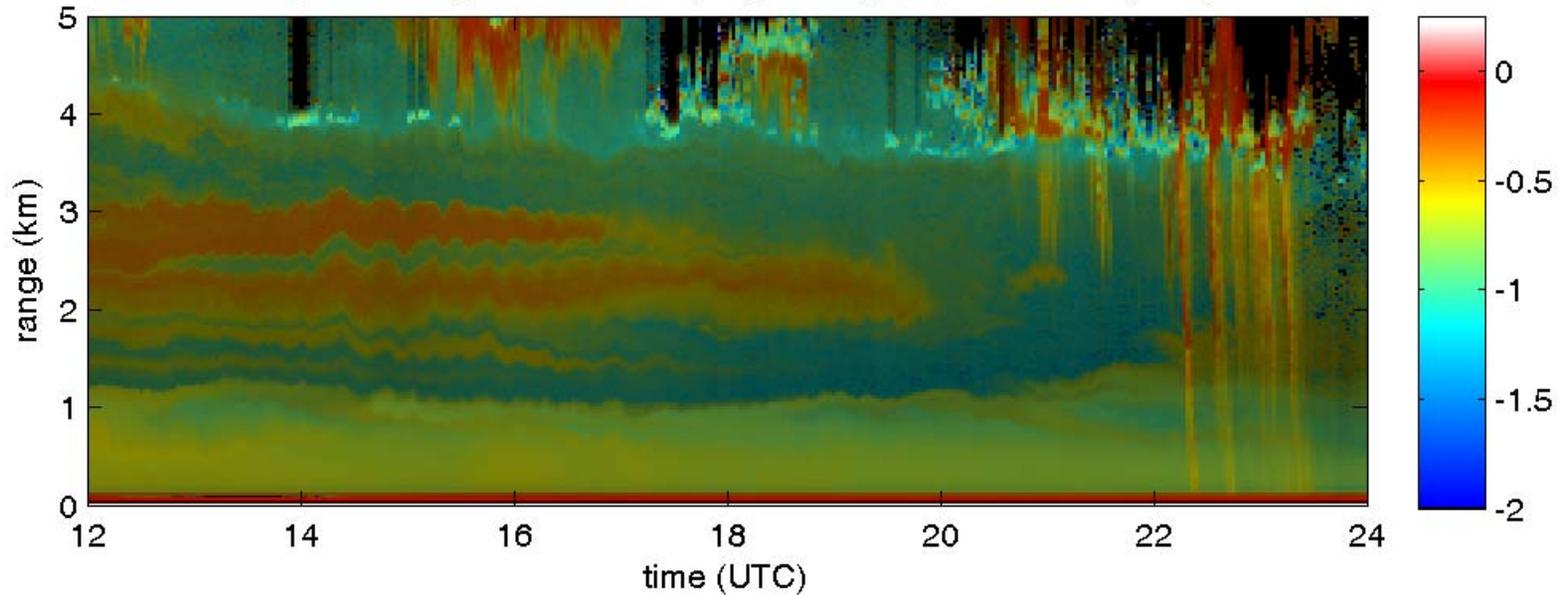
Composite image: backscatter (brightness), depolarization (color)



Attenuated backscatter: 2008-10-24 12-24 UTC



Composite image: backscatter (brightness), depolarization (color)



Summary – so little time, so much to do...

- ▶ Efforts nearing completion:
 - MFRSR AOD processing nearly caught up
 - AOS/IAP/AIP effort level declining

- ▶ Efforts getting more attention:
 - MPLpol, especially as input to MPLnor
 - MPLnor, especially site-specific thresholds
 - MPLext, currently field campaign mode

- ▶ Efforts in limbo:
 - Aerosol Best Estimate
 - AOD comparisons or best-estimate