SEAC⁴RS Remote Sensing Observations: AirMSPI

(*polarimetric)

Two Types of Sampling: Step-and-Stare and Continuous Sweep

Flying in the nose of NASA ER-2

Has flown since Oct 2010

Multi-angle viewing between ±67° using single-axis gimbal
AirMSPI DATA Status

SEAC\textsuperscript{4}RS Level 1B2 imagery is publicly available at the NASA Langley ASDC
https://eosweb.larc.nasa.gov/project/airmspi/airmspi_table

- Steady improvement in radiometric, polarimetric, and geometric calibration
- Ellipsoid (mean sea level) and terrain projected
- Complete SEAC\textsuperscript{4}RS dataset will be reprocessed in CY 2015
AirMSPI Collocations With Aeronet & DC-8

- AirMSPI step-and-stare images collocated with DC-8*: 17
- Aerosol-relevant AirMSPI sweeps collocated with DC-8*: 7
- Total SEAC4RS AirMSPI-AERONET collocations*: 18

*few to no clouds

Intensity (445, 555, 660)

August 18, 2013
Fowler at 19:06:12Z
### AirMSPI Unconstrained Aerosol Retrieval Approaches

- JPL-developed RT code used as basis of aerosol retrieval algorithm, with support from Oleg Dubovik (Univ. of Lille)
- GRASP code is being used / evaluated in parallel

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GRASP vs. Markov Chain

GRASP code

JPL code

AirMSPI
AOT 443 nm  AOT 870 nm

AirMSPI
19:44:00
AERONET: USC_SEAPRISM
19:08:47
20:08:46

AirMSPI
19:44:00
AERONET: USC_SEAPRISM
19:08:47
20:08:46

AERONET 19:08 UTC
AERONET 20:08 UTC

AERONET 19:08 UTC
AERONET 20:08 UTC

Wavelegnth (nm)

Aerosol Optical Depth

AirMSPI 19:43 UTC (Spatially Averaged)
AirMSPI 19:43 UTC (nearby AERONET)
AERONET 19:08 UTC
AERONET 20:08 UTC

JPL code

AirMSPI
19:44:00
AERONET: USC_SEAPRISM
19:08:47
20:08:46

AirMSPI 19:43 UTC (Spatially Averaged)
AirMSPI 19:43 UTC (nearby AERONET)
AERONET 19:08 UTC
AERONET 20:08 UTC

Radius (r) [µm]

dV(r)/dln(r) [µm^3/µm^2]

AirMSPI
19:44:00
AERONET: USC_SEAPRISM
19:08:47
20:08:46

0.00 0.01 0.02 0.03 0.04 0.05

0 0.01 0.02 0.03 0.04 0.05

Radii [µm]
AirMSPI aerosol retrievals (Markov-Chain JPL code)

Cloud-free step and stare AirMSPI-AERONET collocations: 6

Fresno, August 2nd, 19:29 - Low AOD
Mingo, September 6, 22:41 - No aerosol speciated PM data
Baskin, September 9, 22:48 – DC-8 in the image – best AERONET collocation
September 9th, 2013, 22:48 - Baskin AERONET & DC-8
Work in progress is to inter-compare aerosol properties from AirMSPI with AERONET inversions and DC-8 measurements
Additional AirMSPI & DC-8 aerosol collocations

- **AirMSPI Step-and stare**
  - August 16\(^{th}\): Fowler, 19:06:12 – DC-8 profiles
  - August 19\(^{th}\): Thunder Basin & Kansas, 18:06:02 to 20:57:55
  - August 23\(^{d}\): SouthEast Arkansas, 16:12:15 and 19:40:15

- **AirMSPI Sweeps:**
  - August 6\(^{th}\): 20:40:40, Oregon fires
  - August 8\(^{th}\): 22:47:07, Dust over the Ocean
August 16th, 2013, 19:06Z – Jeff’s case

DC8 profiles are available
August 19th, 2013 – Ralph’s case

7 AirMSPI-DC-8 collocations:
- Lamont 16:23:30 – some clouds
- Thunder Basin (4) 18:06-19:11
- Southwest Kansas (2) 20:36, 20:57
August 19th, 2013, 18:06Z – Ralph’s case

Intensity (445, 555, 660)

AirMSPI, 2013-08-19T18:06:00Z, ThunderBasin

Aerosol Optical Depth

AirMSPI spatial mean. No AERONET available.

ThorunBasin
2013-08-19T180600Z

ER2–CPL SEAC4RS 19Aug13 532nm
August 8, 22:42-22:52 Dust over clear Ocean
August 8, 22:42-22:52 Dust Over Clear Ocean

Kalashnikova et al., 2011

\[ \text{SZA} = 62^\circ \]

\[ \text{SZA} = 60^\circ \]

Principal plane

AOD = 0.5

\[ \lambda = 445 \text{nm} \]
Complete SEAC$^4$RS dataset (L1B2 products) are available at: https://eosweb.larc.nasa.gov/project/airsmspi/airsmspi_table

Initial AirMSPI aerosol retrieval results from SEAC$^4$RS are consistent with AERONET and 4STAR observations

SEAC$^4$RS data provides an excellent opportunity for new polarimetric retrieval validation, and for evaluating polarimetric contributions to the study of aerosol direct and indirect effects

Please consider submitting to AGU session: “Advances in Atmospheric Aerosol and Cloud Characterization”
Absorbing Aerosol Index calculated using UV bands

\[ A.I. = -100 \times \left[ \log_{10}(I_{355}/I_{380})_{\text{meas}} - \log_{10}(I_{355}/I_{380})_{\text{calc}} \right] \]

indicates the presence of absorbing aerosols

Lidar data show low altitude aerosol layer (smoke from local fires)
September 9th, 2013: GRASP vs. Markov Chain

Xu retrieval

GRASP retrieval
August 23th, 2013, 19:40Z – Smoke above clouds
August 23rd, 2013: GRASP vs. Markov Chain

![Graph showing 4STAR (30 min average) vs. AirMSPI (spatial average) AOD](image)

![Intensity RGB Image (Nadir View)](image)