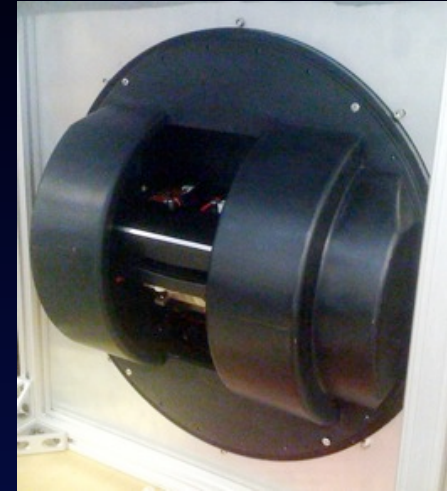


SEAC⁴RS Remote Sensing Observations: AirMSPI



Spectral bands: 355, 380, 445, 470*,
555, 660*, 865*, 935 nm
(*polarimetric)

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

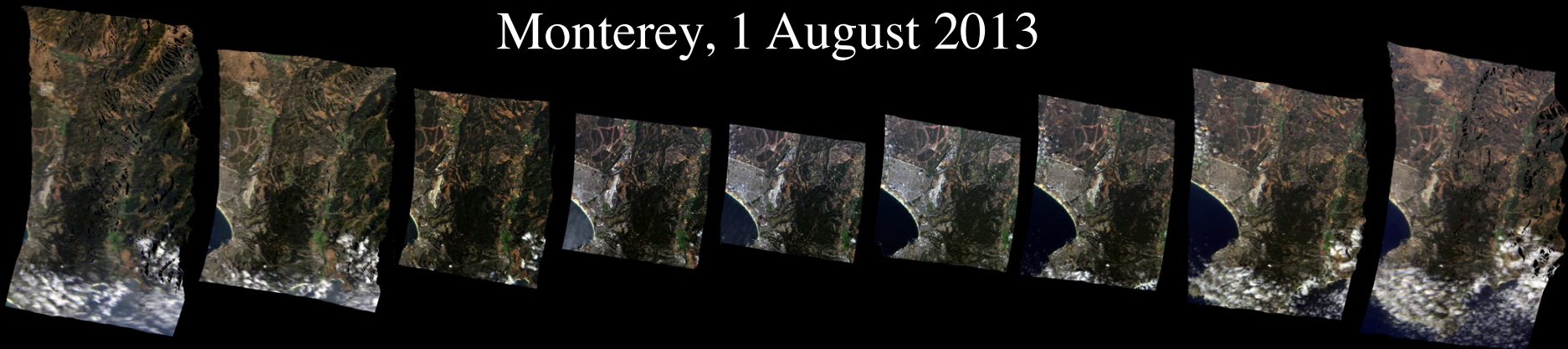
Flying in the nose of NASA ER-2

Has flown since Oct 2010

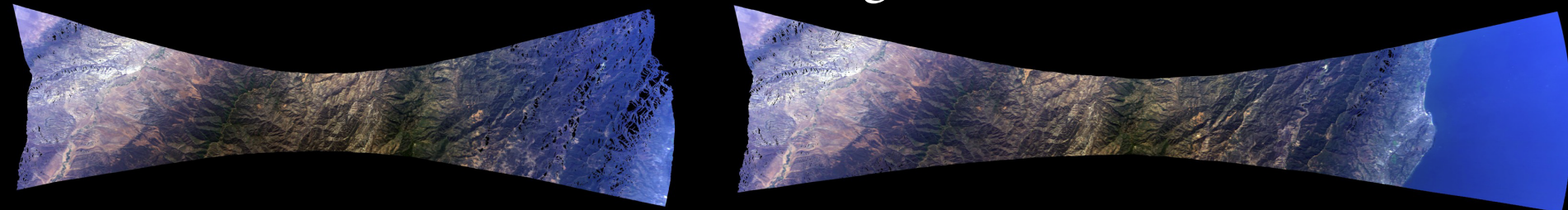
Multi-angle viewing between $\pm 67^\circ$
using single-axis gimbal

AirMSPI DATA Status

Monterey, 1 August 2013



Santa Barbara, 1 August 2013



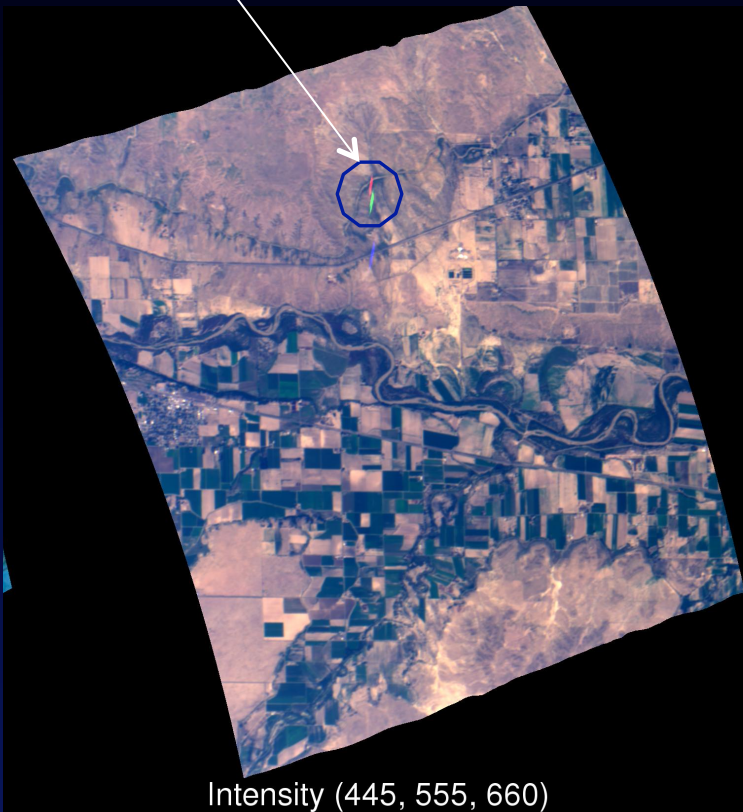
SEAC⁴RS Level 1B2 imagery is publicly available at the NASA Langley ASDC

https://eosweb.larc.nasa.gov/project/airmspi/airmspi_table

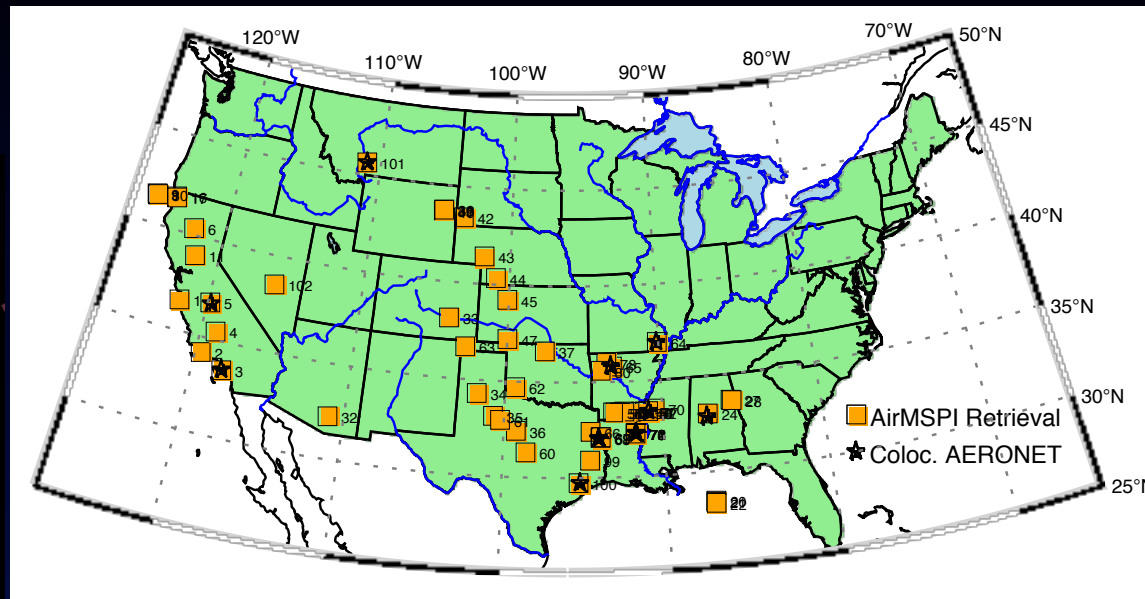
- Steady improvement in radiometric, polarimetric, and geometric calibration
- Ellipsoid (mean sea level) and terrain projected
- Complete SEAC⁴RS dataset will be reprocessed in CY 2015

AirMSPI Collocations With Aeronet & DC-8

DC-8



August 18, 2013
Fowler at 19:06:12Z



- 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

AirMSPI sweeps

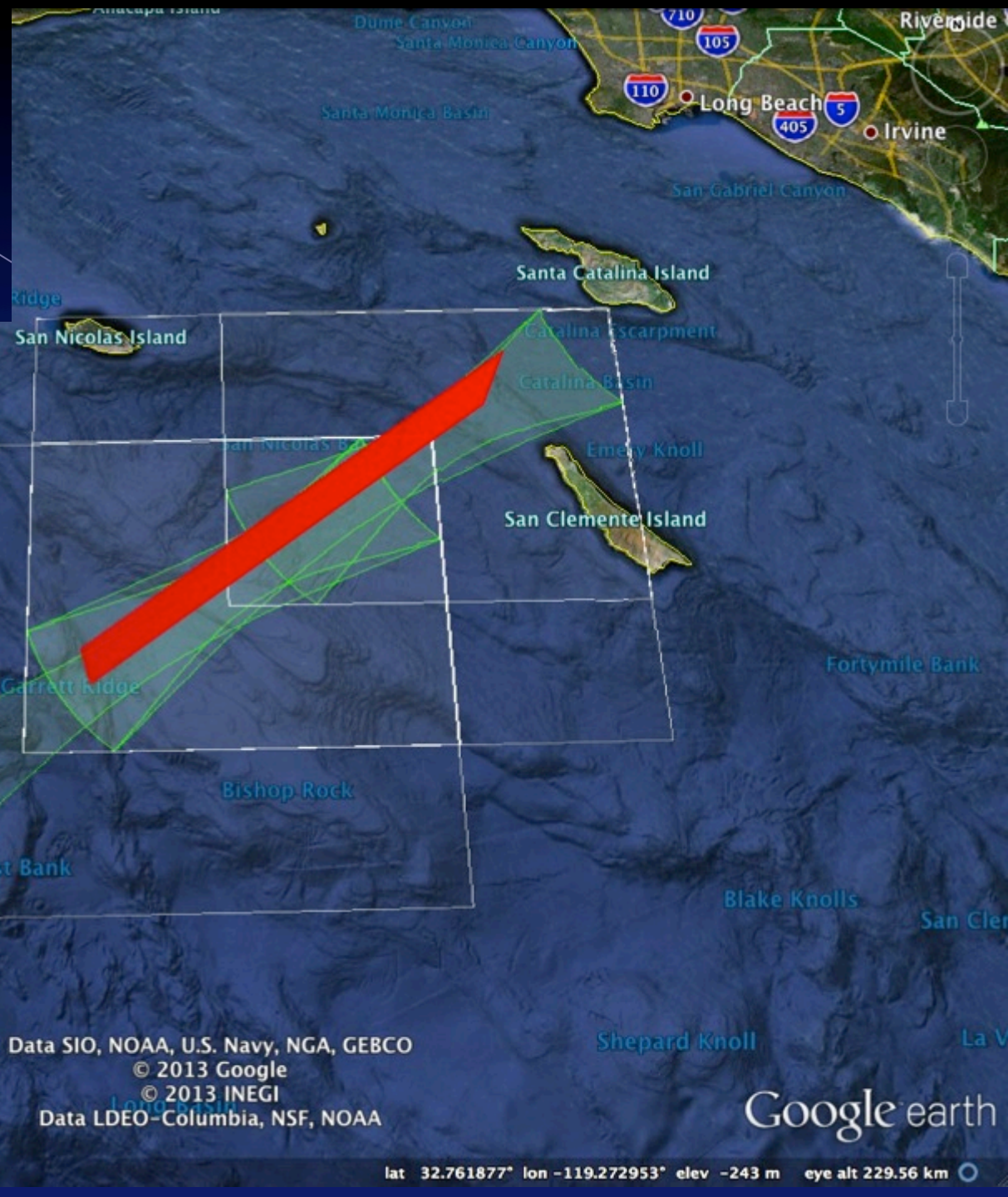
flight



25 m spatial sampling
~100 km target length

Backward sweep

Forward sweep



Data SIO, NOAA, U.S. Navy, NGA, GEBCO

© 2013 Google

© 2013 INEGI

Data LDEO-Columbia, NSF, NOAA

Google earth

lat 32.761877° lon -119.272953° elev -243 m eye alt 229.56 km

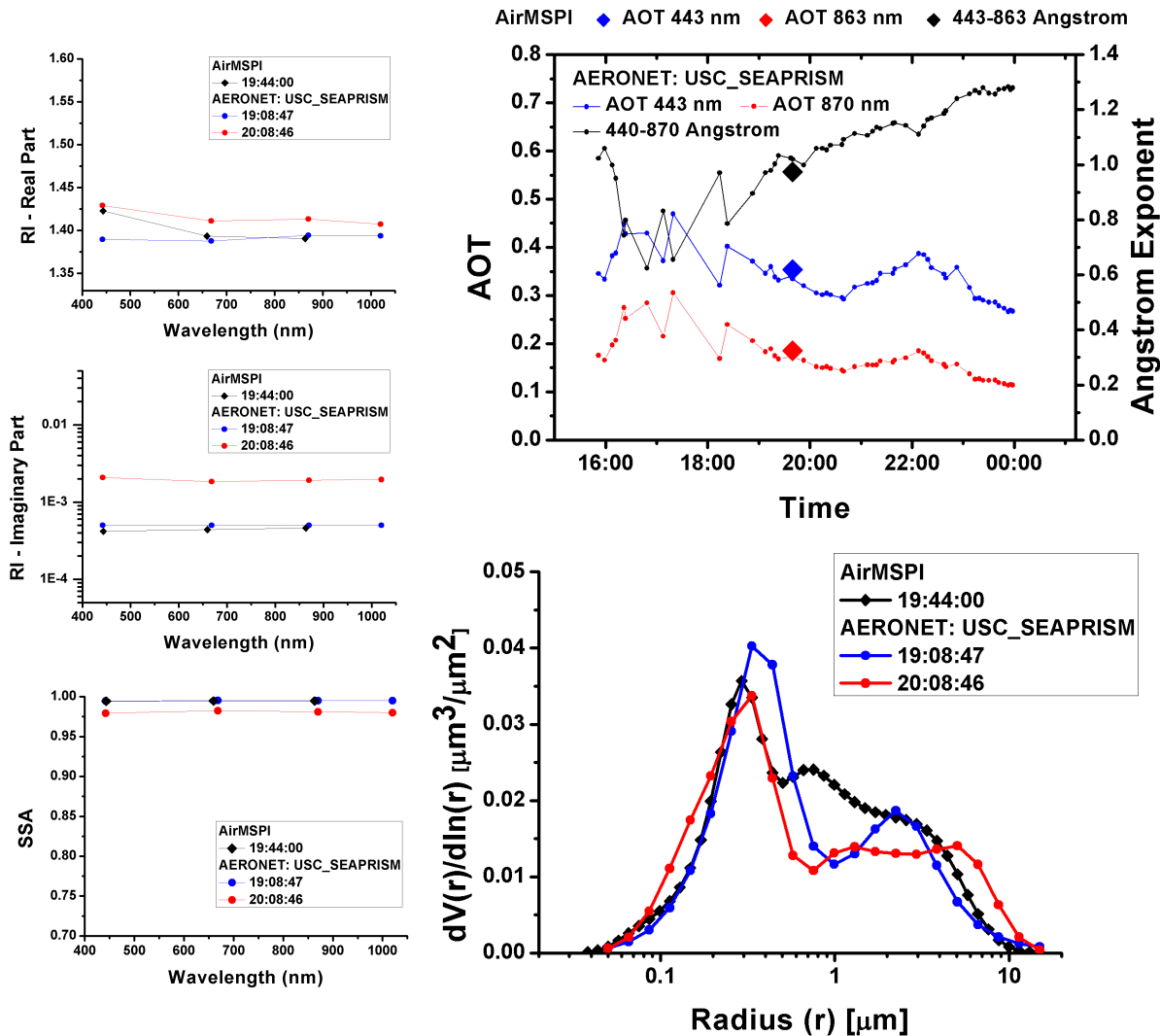
AirMSPI Unconstrained Aerosol Retrieval Approaches

- 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

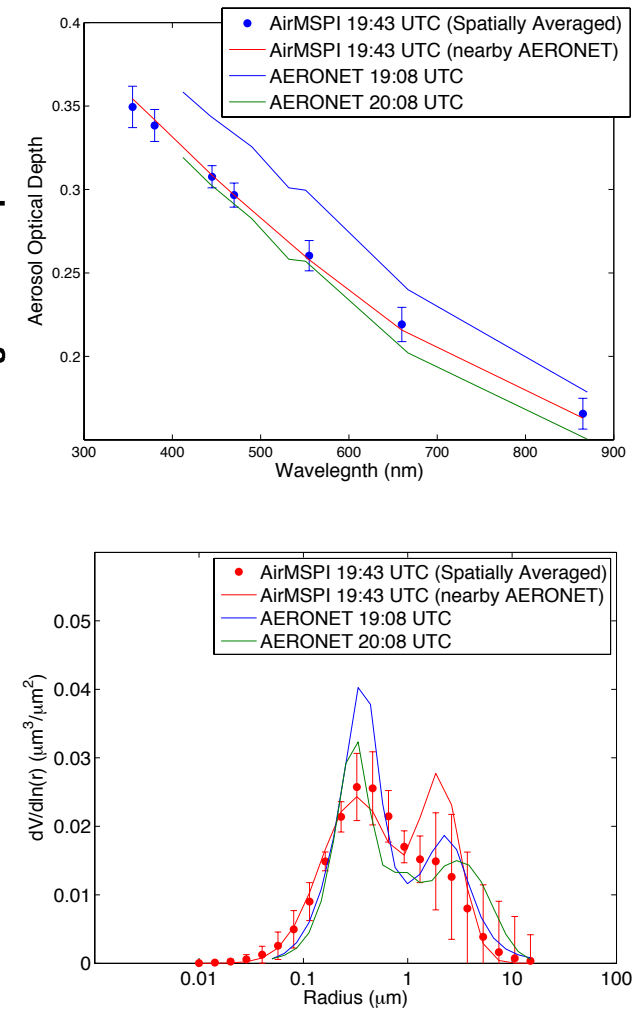
	JPL code (ocean, land)	GRASP (ocean, land)
Forward RT calculation method	Markov Chain + Doubling/Adding	Successive Orders of Scattering
Aerosol size model	Multi-bin, bimodal	Multi-bin, multi-modal*
Particle shape	Spherical	Non-spherical implemented
Refractive index	Different for each mode	Same for all modes
Land surface model	Modified RPV + Fresnel microfacet distribution	RPV + Maignan model
Ocean surface model	Cox-Munk + bio-optical	Cox-Munk*
Language	Matlab (for development), C++*	Fortran
Optimization approach	Multi-Patch retrieval algorithm (Dubovik, 2011)	Multi-Patch retrieval algorithm (Dubovik, 2011)

GRASP vs. Markov Chain

GRASP code

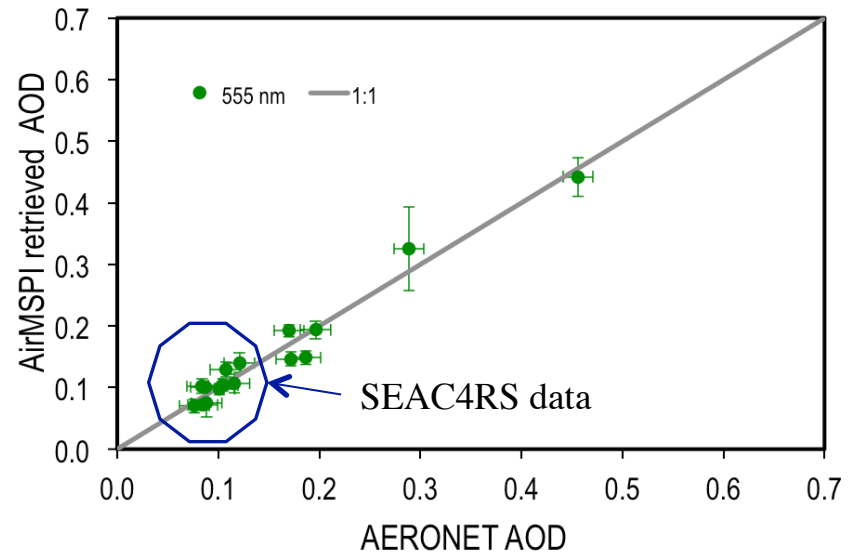
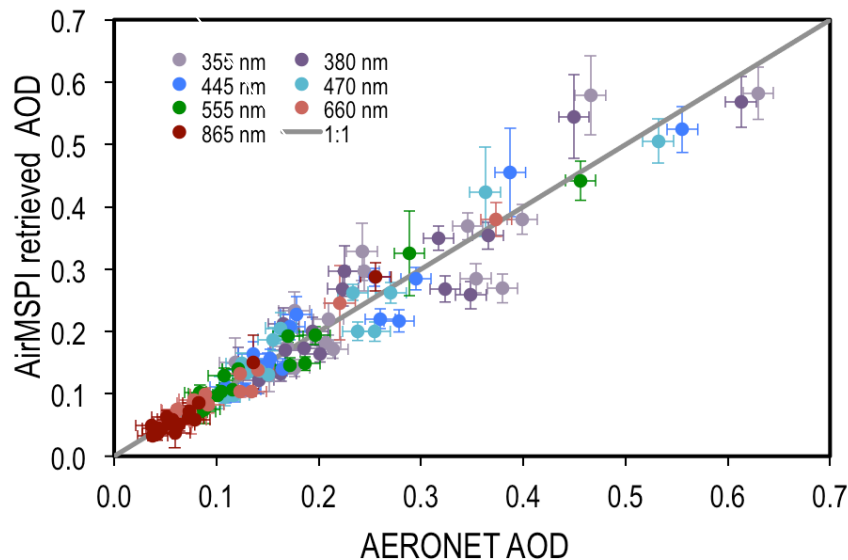


JPL code



AirMSPI aerosol retrievals (Markov-Chain JPL code)

Cloud free AIRMSPI-AERONET collocated step-and-stare data (all flights)



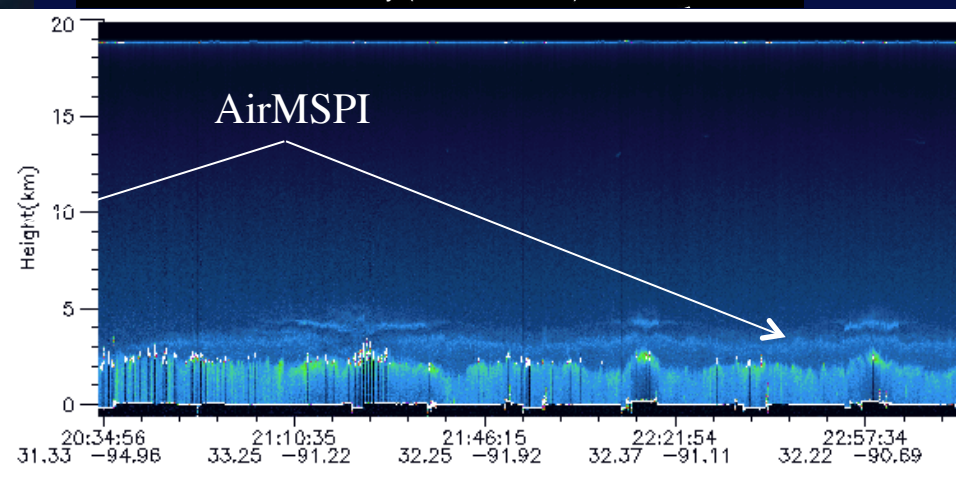
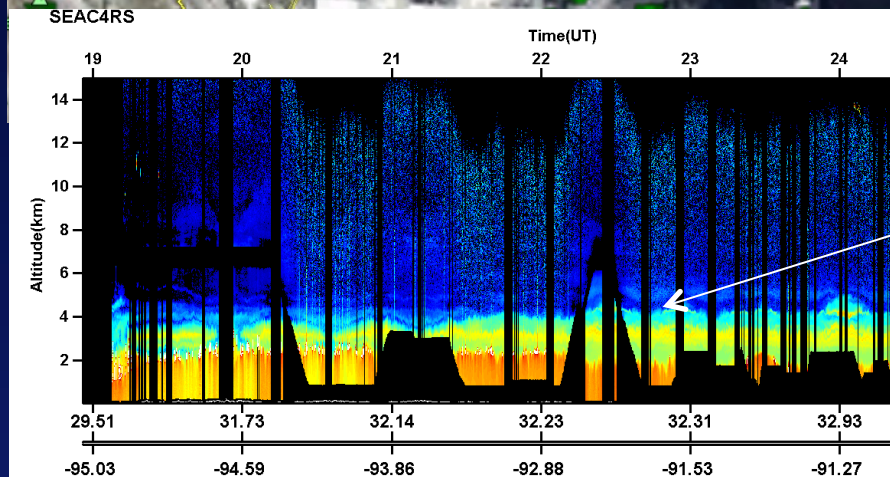
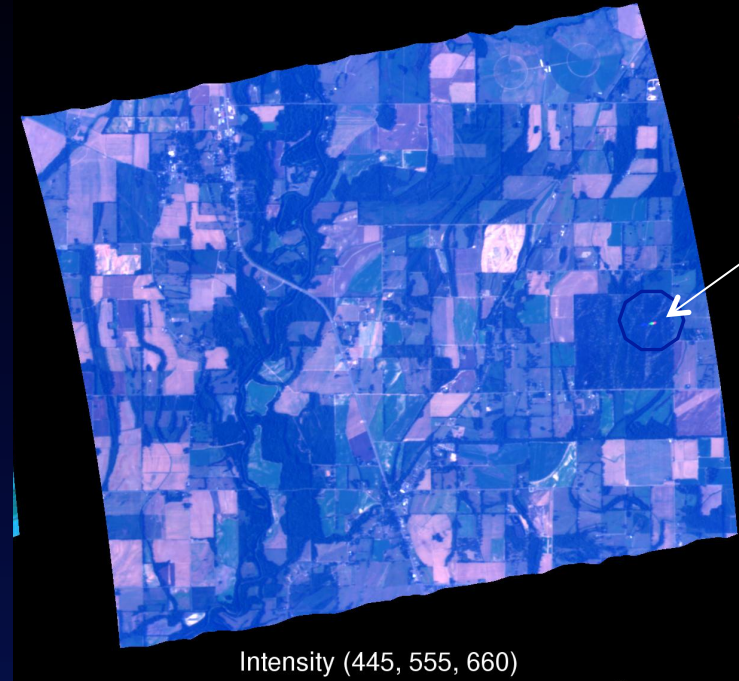
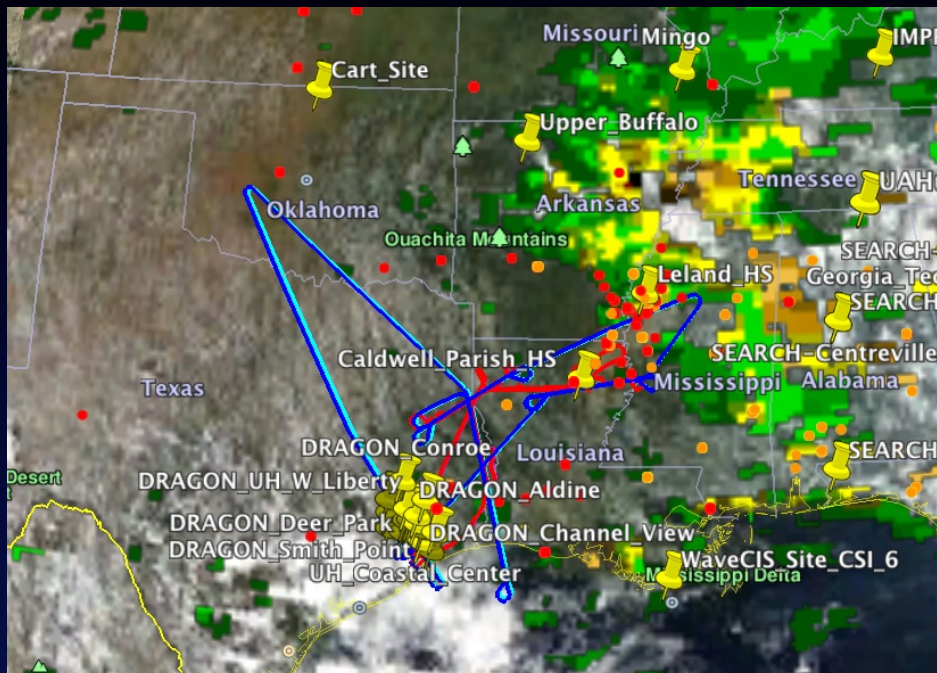
Cloud-free step and stare AirMSPI-AERONET collocations: 6

Fresno_2013-08-02T192900Z
Mingo_2013-09-06T224100Z
Baskin_2013-09-09T220600Z
Baskin_2013-09-09T222600Z
Baskin_2013-09-09T224800Z
Baskin_2013-09-09T230900Z

Fresno, August 2nd, 19:29 - Low AOD
Mingo, September 6, 22:41- No aerosol speciated PM data

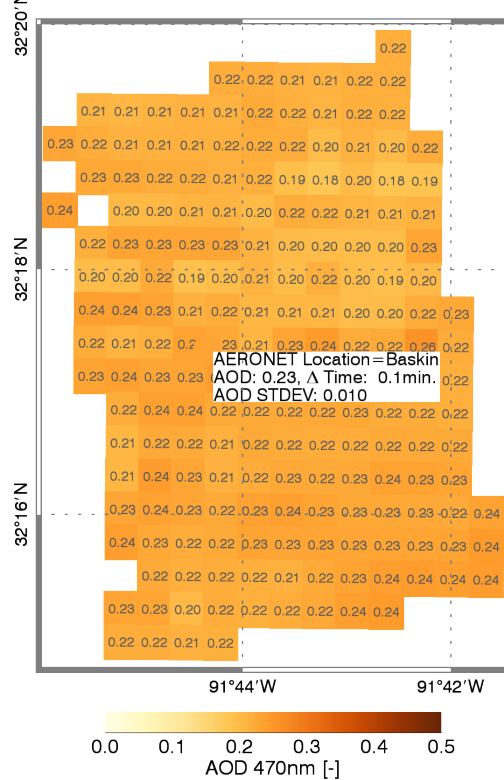
Baskin, September 9, 22:48 – DC-8 in the image – best AERONET collocation

September 9th, 2013, 22:48 - Baskin AERONET & DC-8

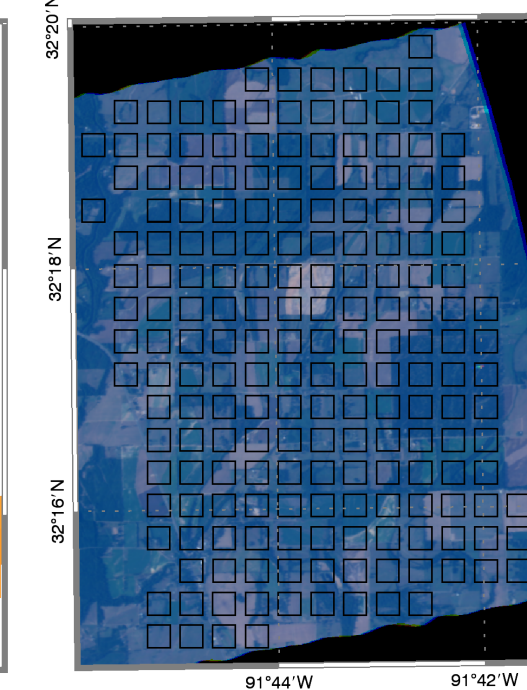


September 9, 22:48, AERONET Inter-Comparison (Baskin)

AirMSPI, 2013-09-09T22:48:00Z, Baskin

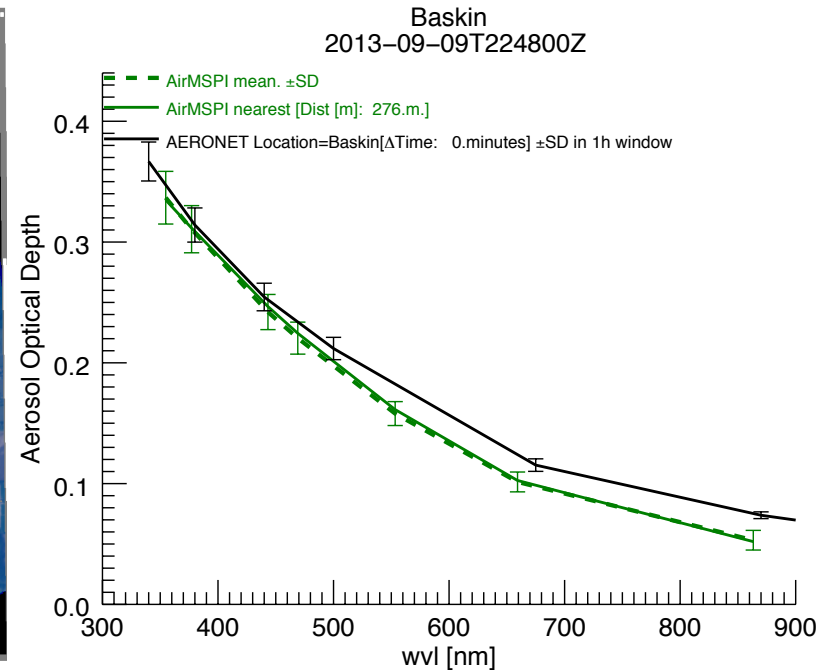


AirMSPI, 2013-09-09T22:48:00Z, Baskin



→ Aircraft heading

□ Land retrieval



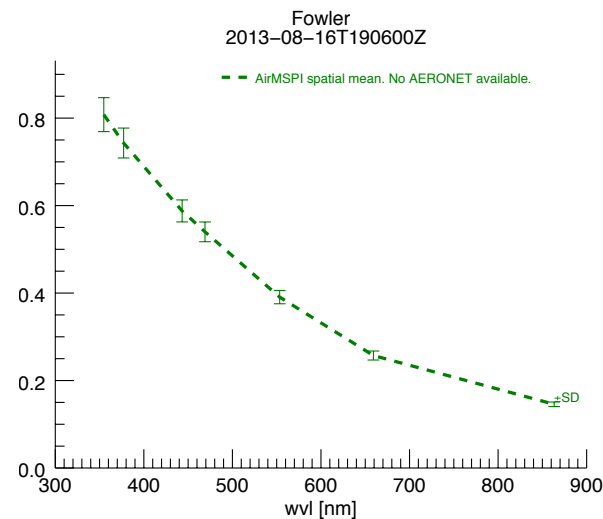
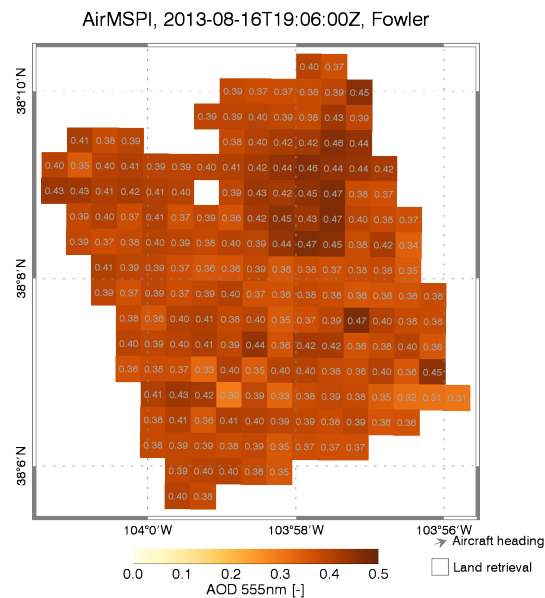
Work in progress is to inter-compare aerosol properties from AirMSPI with AERONET inversions and DC-8 measurements

Additional AirMSPI&DC-8 aerosol collocations

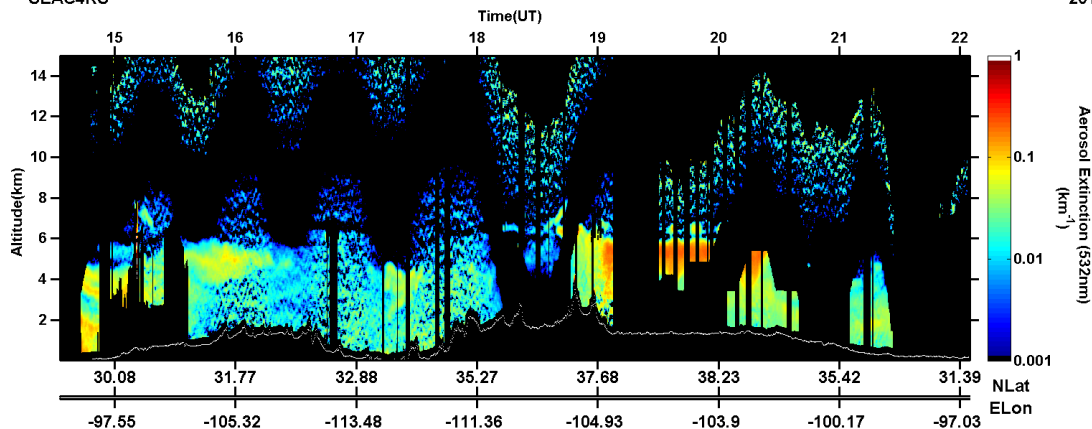
- AirMSPI Step-and stare
 - August 6th: Del Norte, 21:48:27, 22:09:15, 22:28:22
 - August 16th: Fowler, 19:06:12 – DC-8 profiles
 - August 19th: Thunder Basin & Kansas, 18:06:02 to 20:57:55
 - August 23^d: SouthEast Arkansas, 16:12:15 and 19:40:15
- AirMSPI Sweeps:
 - August 6th: 20:40:40, Oregon fires
 - August 8th: 22:47:07, Dust over the Ocean

August 16th, 2013, 19:06Z – Jeff's case

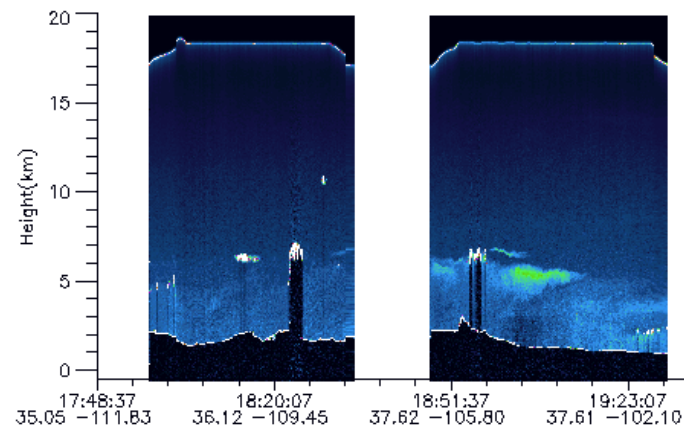
DC8 profiles are available



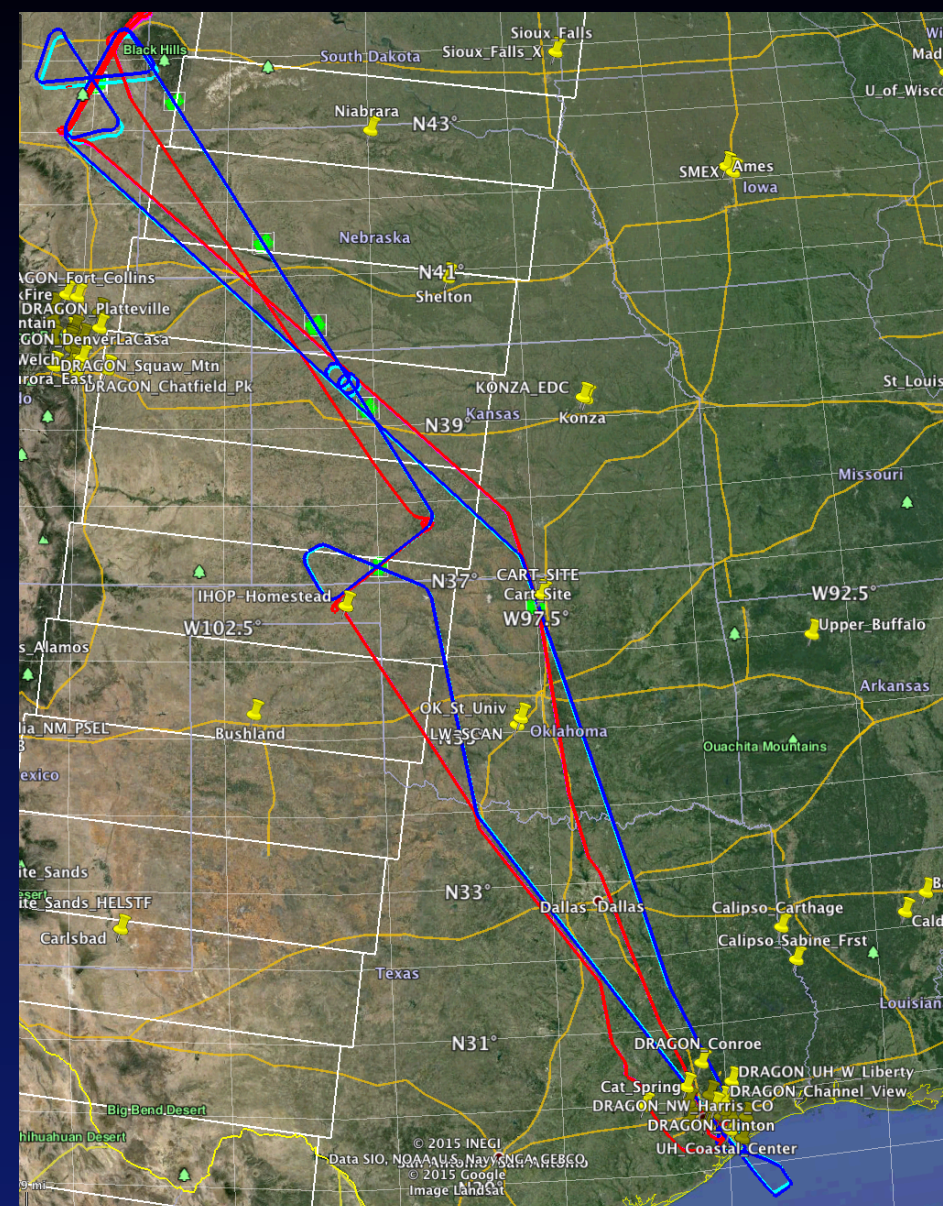
SEAC4RS



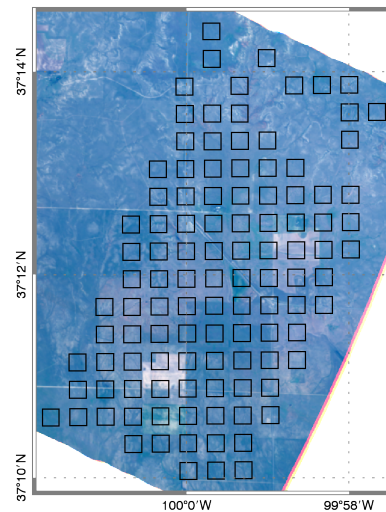
20130816



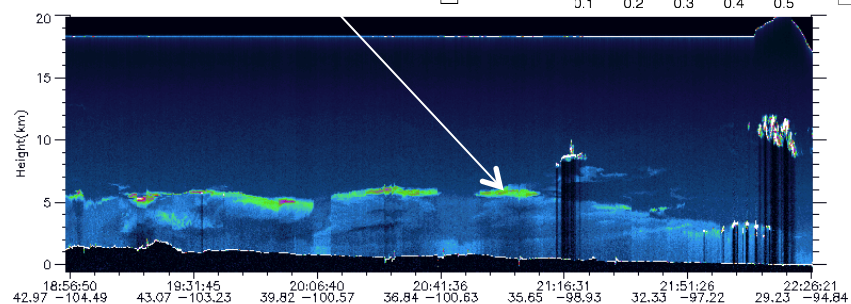
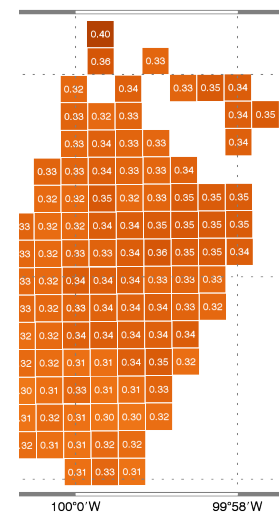
August 19th, 2013 – Ralph's case



AirMSPI, 2013-08-19T20:57:00Z, Southwest Kansas



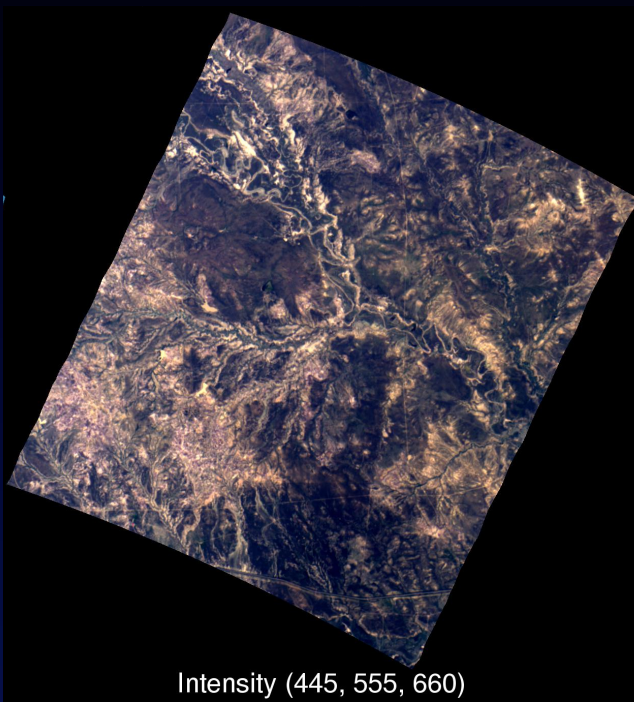
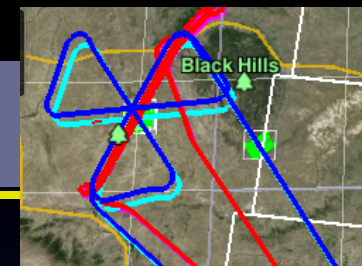
8-19T20:57:00Z, Southwest Kansas



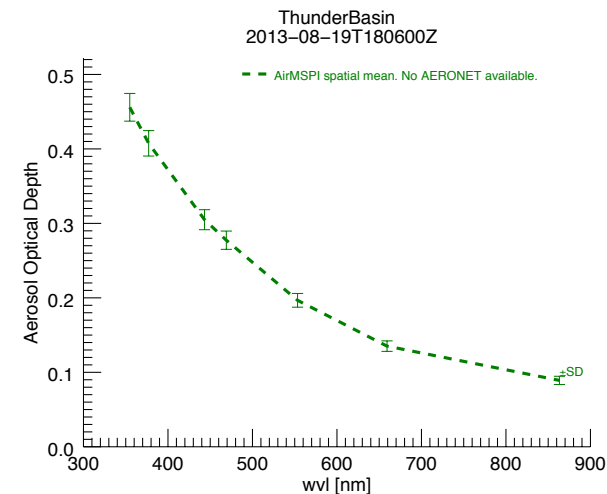
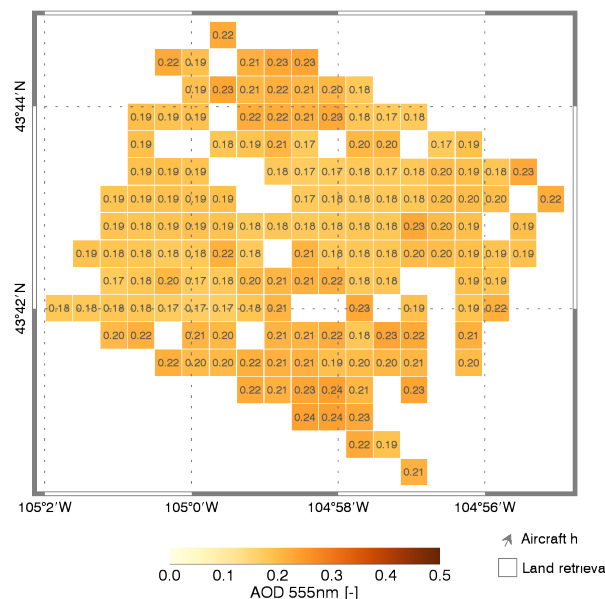
7 AirMSPI-DC-8 collocations:

- Lamont 16:23:30 – some clouds
- Thunder Basin (4) 18:06-19:11
- Southwest Kansas (2) 20:36, 20:57

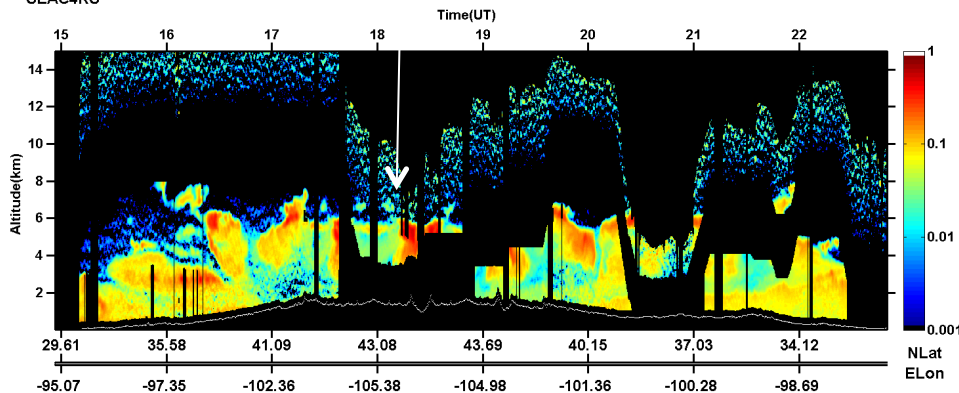
August 19th, 2013, 18:06Z – Ralph's case



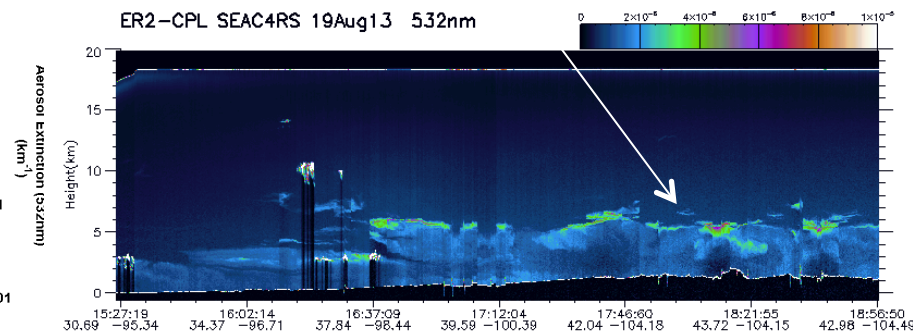
AirMSPI, 2013-08-19T18:06:00Z, ThunderBasin



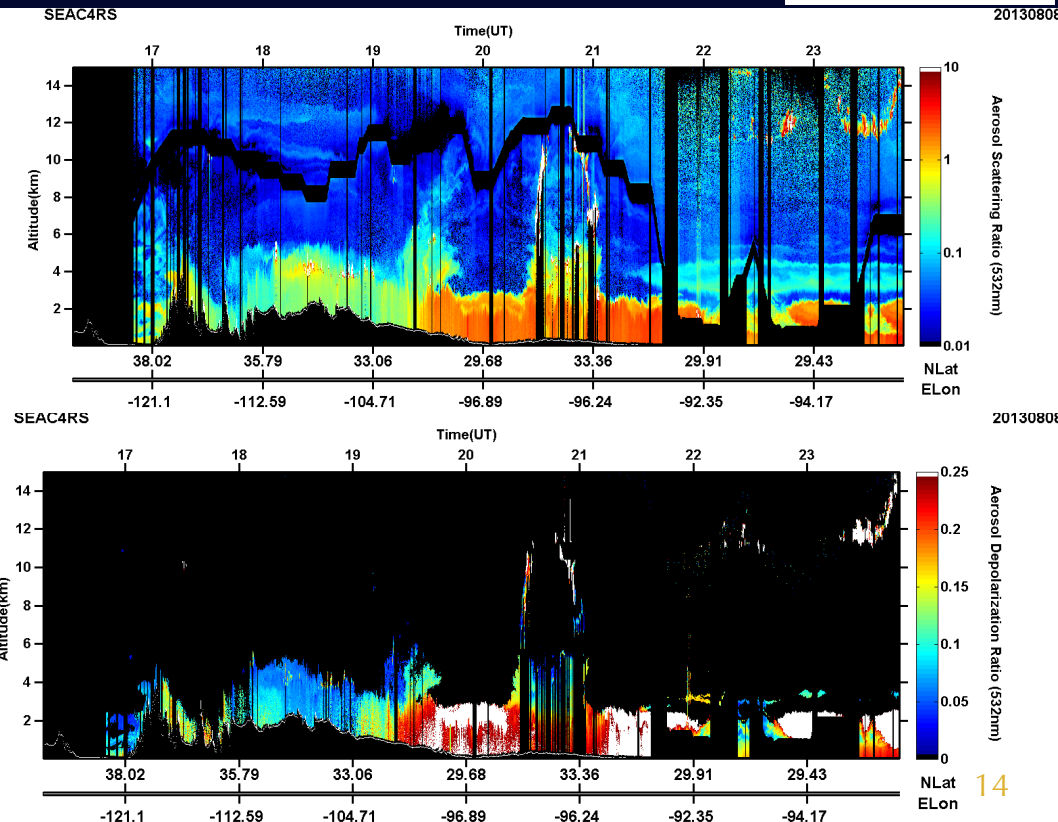
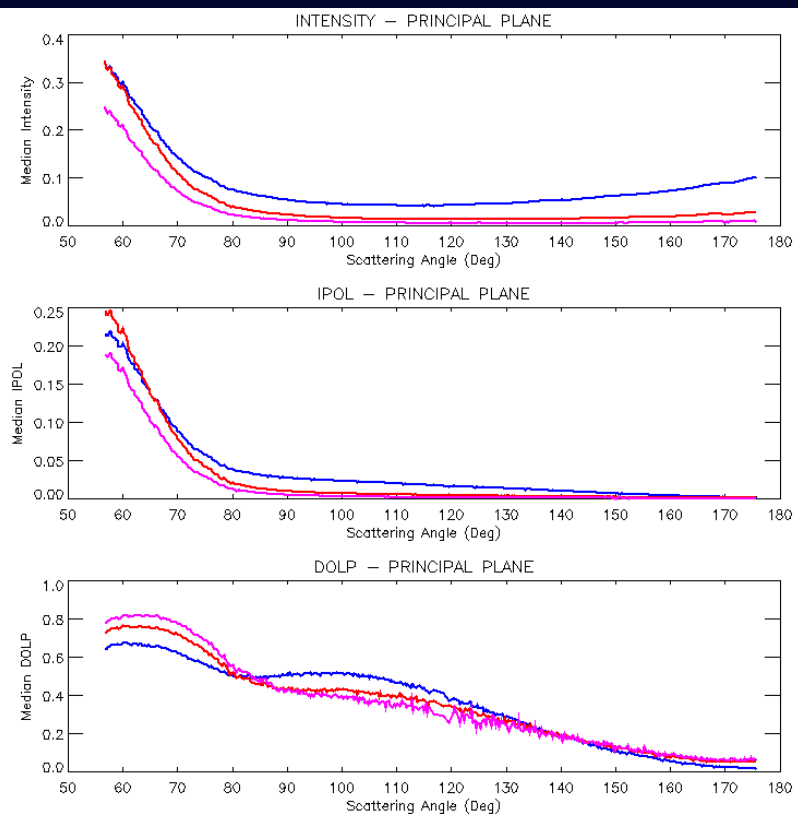
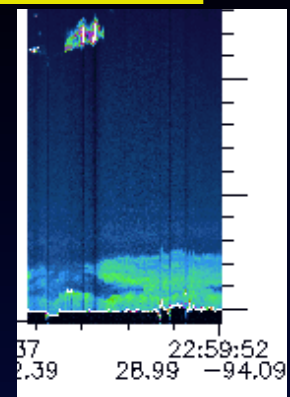
SEAC4RS



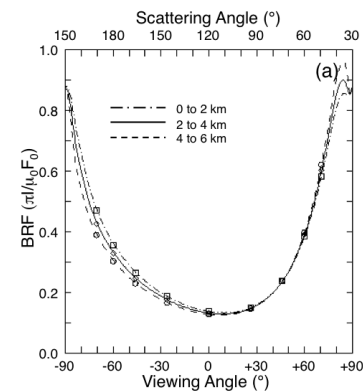
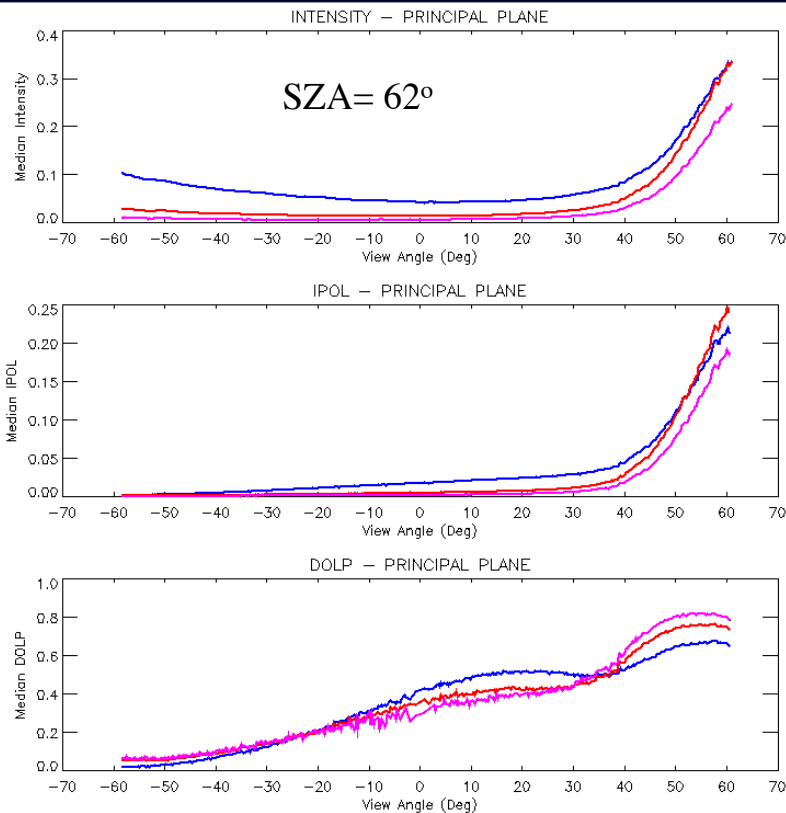
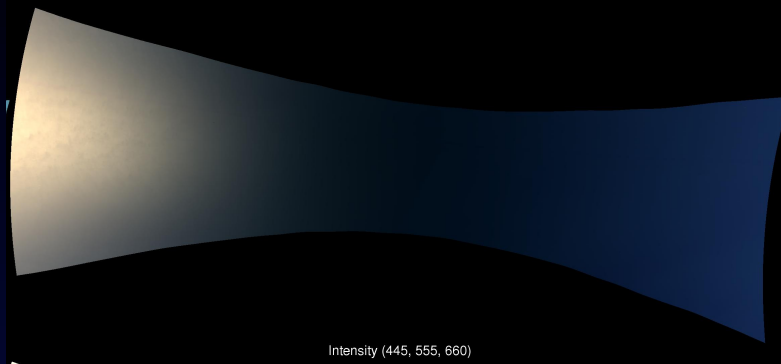
ER2-CPL SEAC4RS 19Aug13 532nm



August 8, 22:42-22:52 Dust over clear Ocean

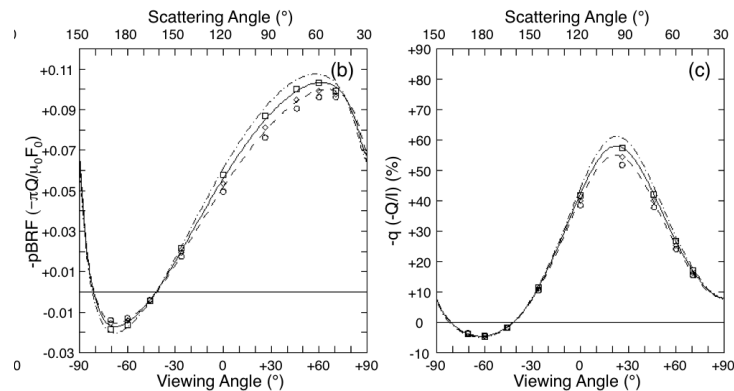


August 8, 22:42-22:52 Dust Over Clear Ocean



Kalashnikova et al., 2011

SZA= 60°
Principal plane
AOD=0.5
 $\lambda=445\text{nm}$

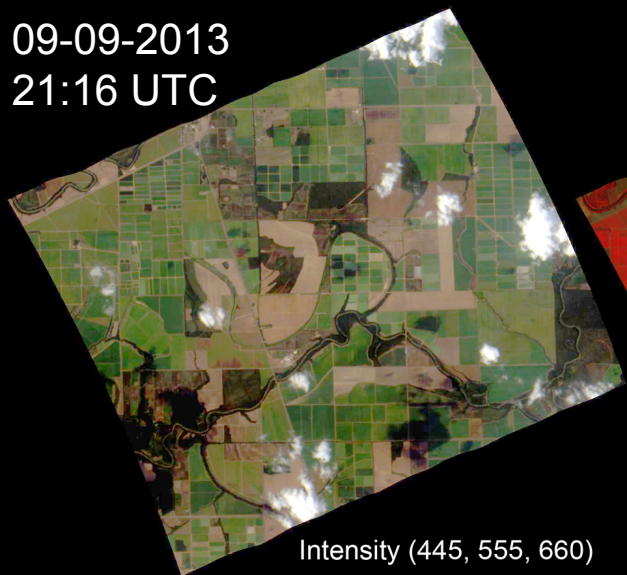


Summary

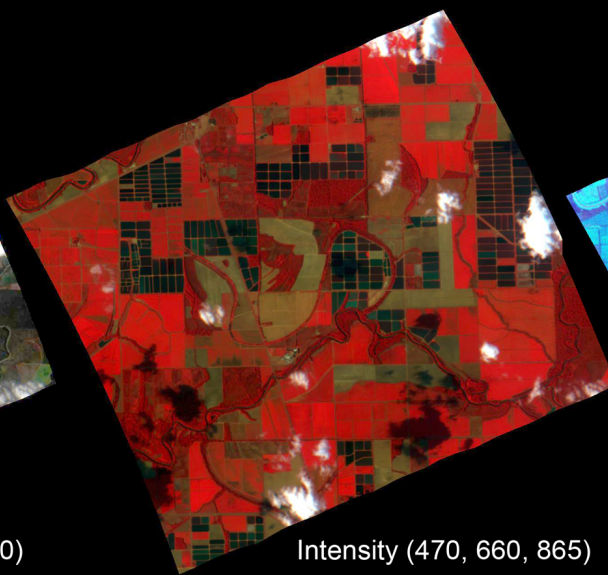
- Complete SEAC⁴RS dataset (L1B2 products) are available at:
https://eosweb.larc.nasa.gov/project/airmspi/airmspi_table
- Initial AirMSPI aerosol retrieval results from SEAC⁴RS are consistent with AERONET and 4STAR observations
- SEAC⁴RS data provides an excellent opportunity for new polarimetric retrieval 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”

September 9th: Near Leland_HS

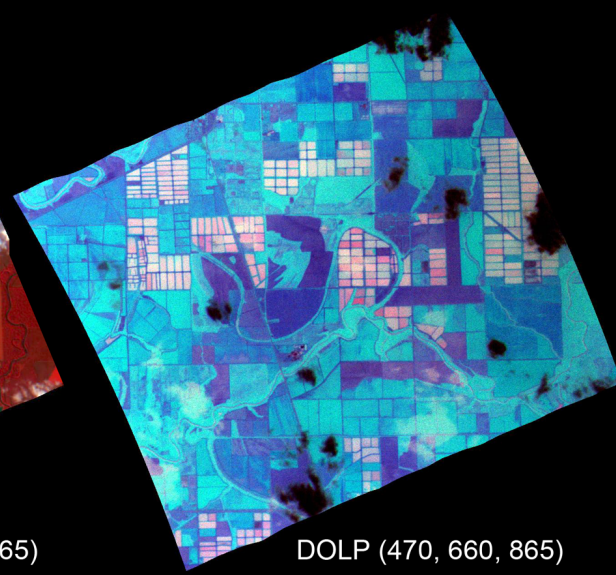
09-09-2013
21:16 UTC



Intensity (445, 555, 660)



Intensity (470, 660, 865)



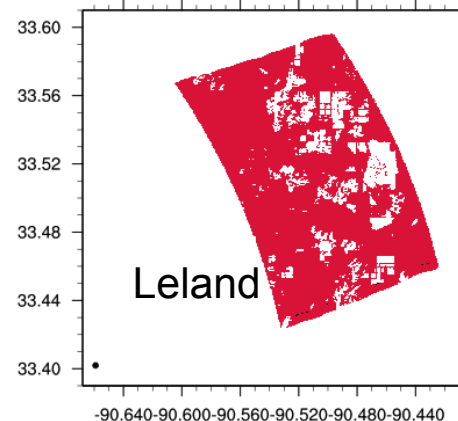
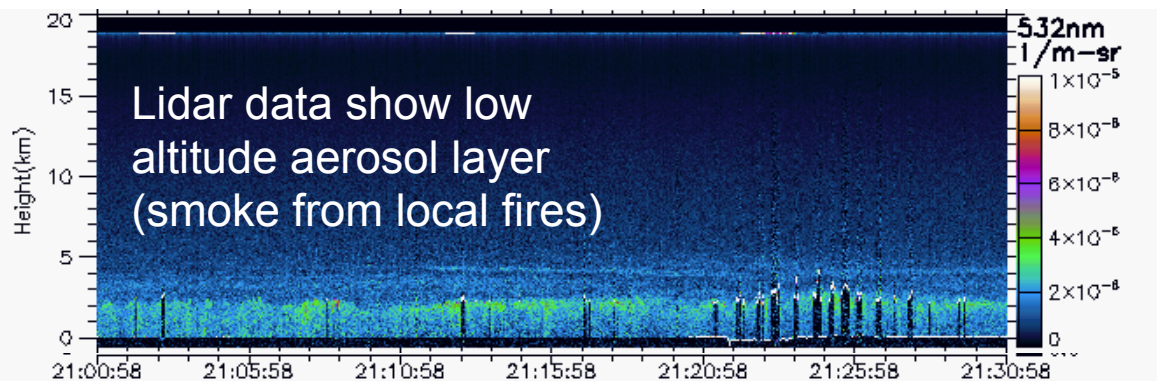
DOLP (470, 660, 865)

Absorbing Aerosol Index calculated using UV bands

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

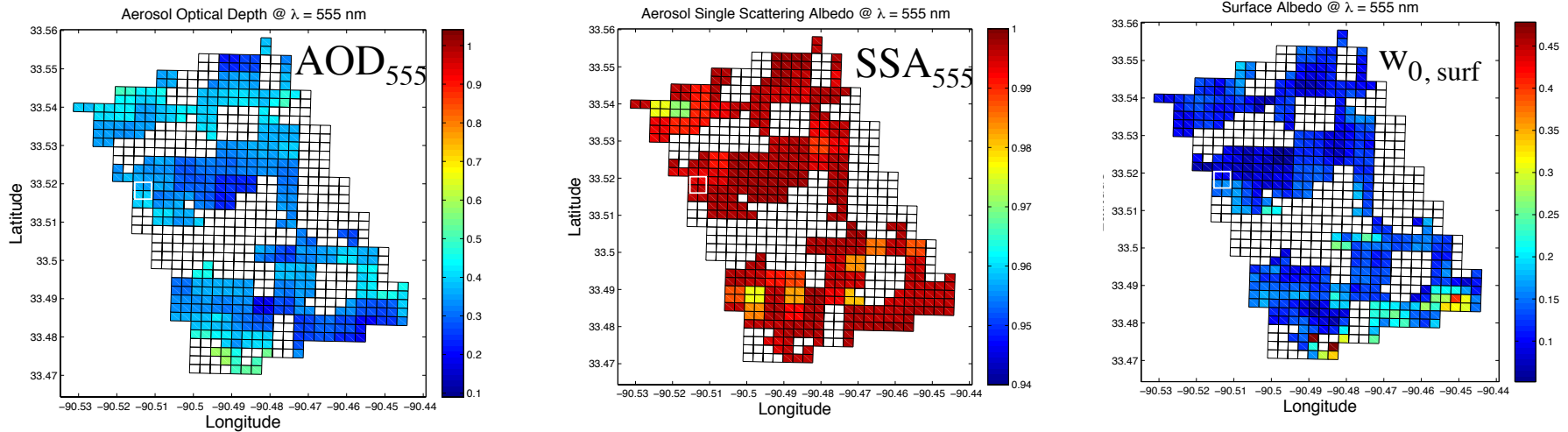
indicates the presence of absorbing aerosols

CPL backscatter

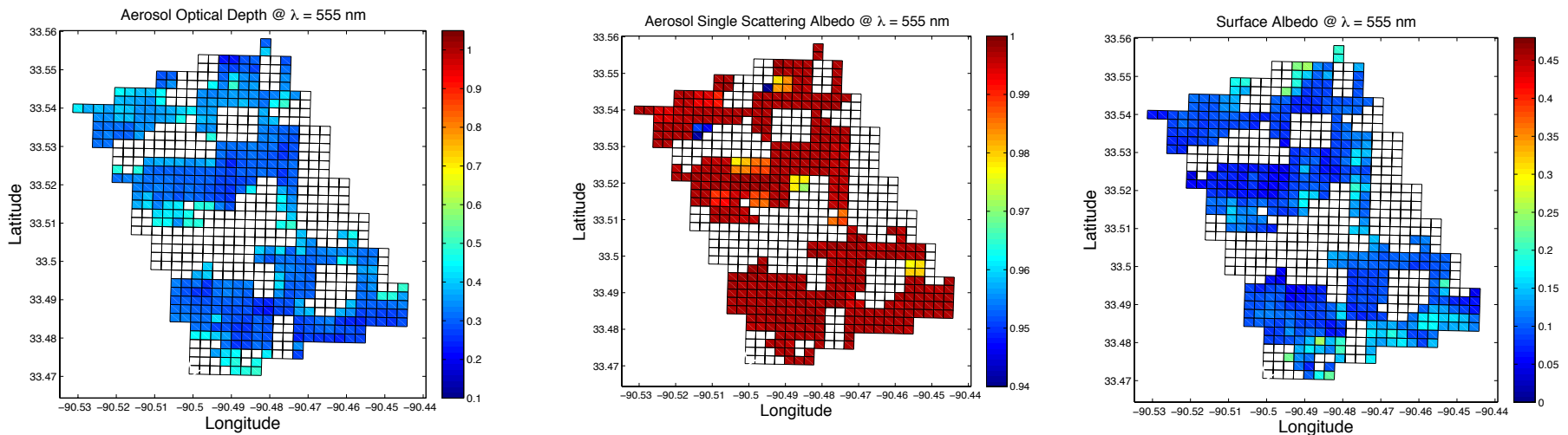


September 9th, 2013: GRASP vs. Markov Chain

Xu retrieval

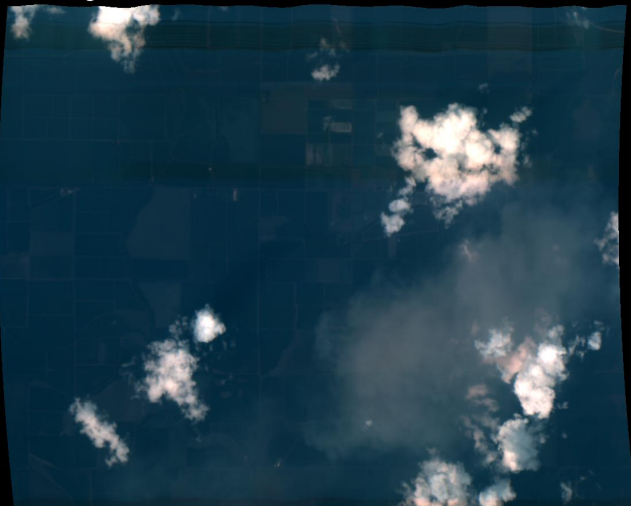


GRASP retrieval



August 23th, 2013, 19:40Z – Smoke above clouds

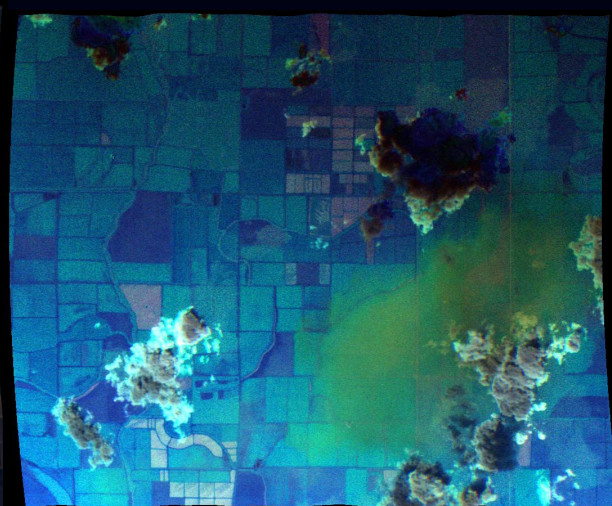
2013-Aug-23 19:40:15 UTC, SoutheastArkansas, view 000N, run 193405-14, version 004



Intensity (355, 380, 445)

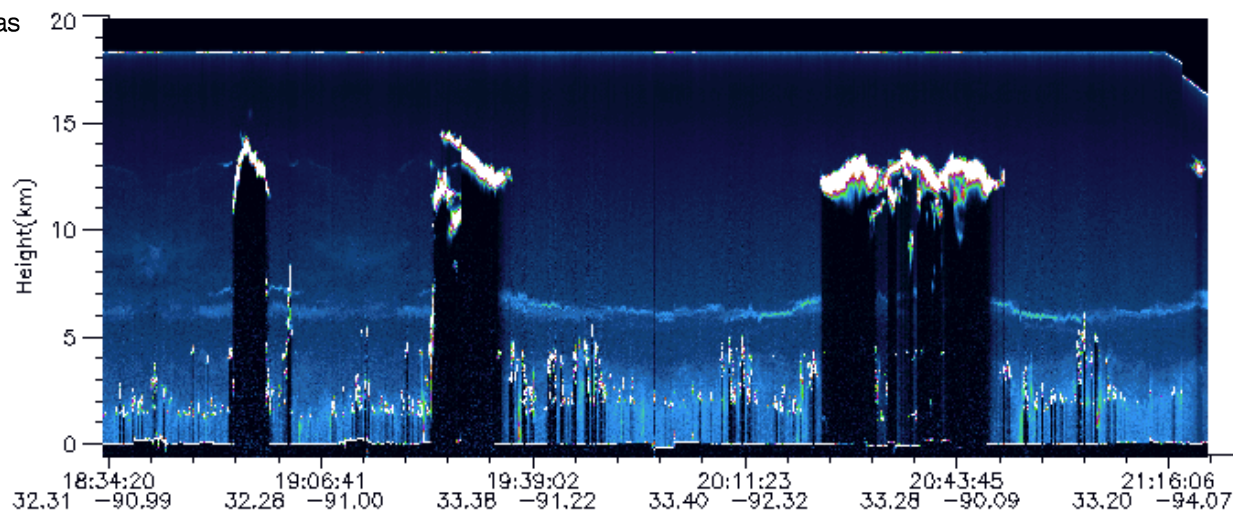
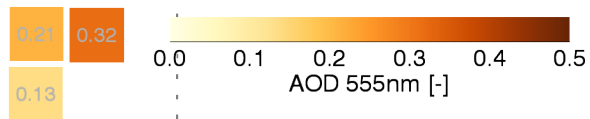
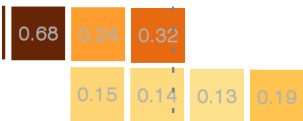


Intensity (445, 555, 660)

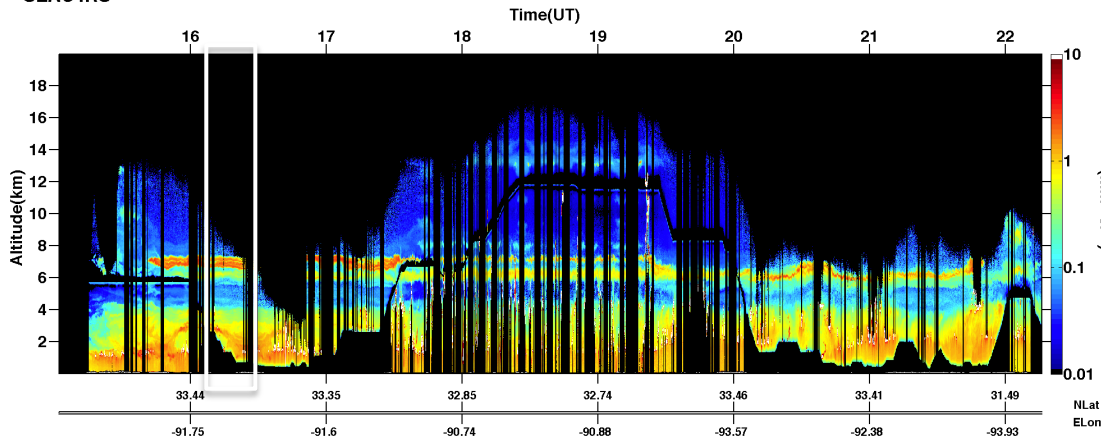
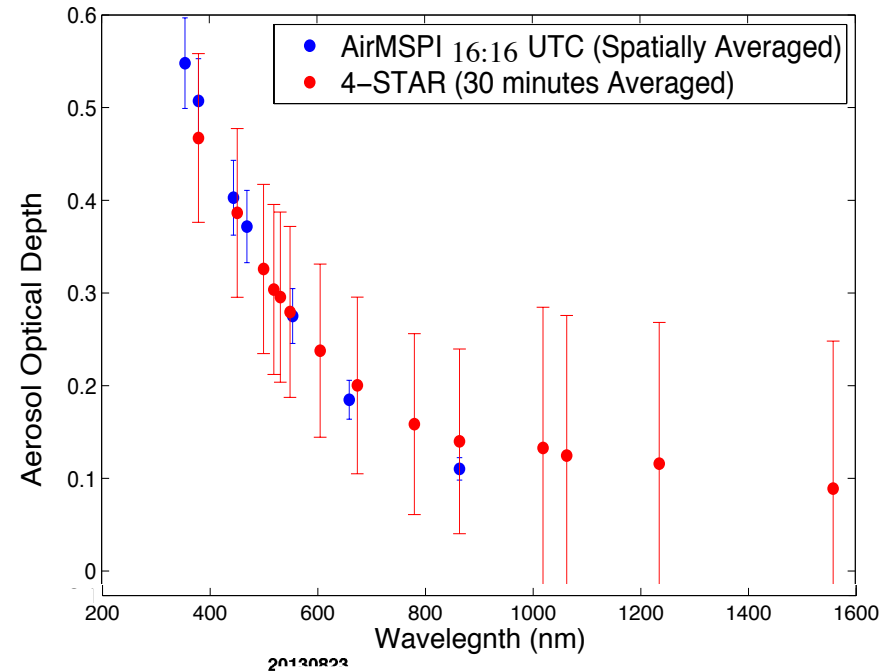
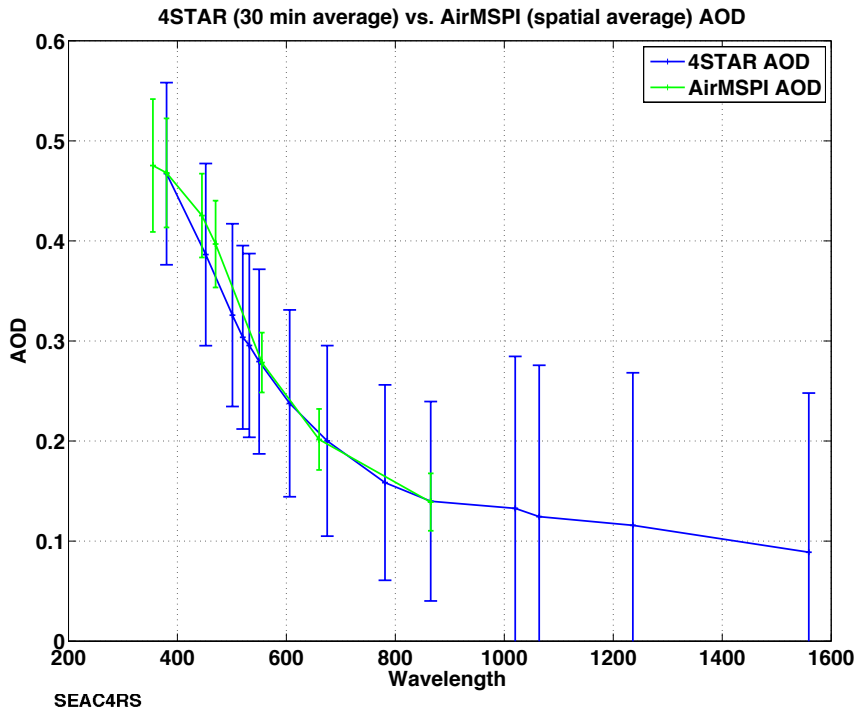


DOLP (470, 660, 865)

AirMSPI, 2013-08-23T19:40:00Z, SoutheastArkansas



August 23rd, 2013: GRASP vs. Markov Chain



Intensity RGB Image (Nadir View)

