The United Arab Emirates Unified Aerosol Experiment: Investigations into the properties of heterogeneous environments

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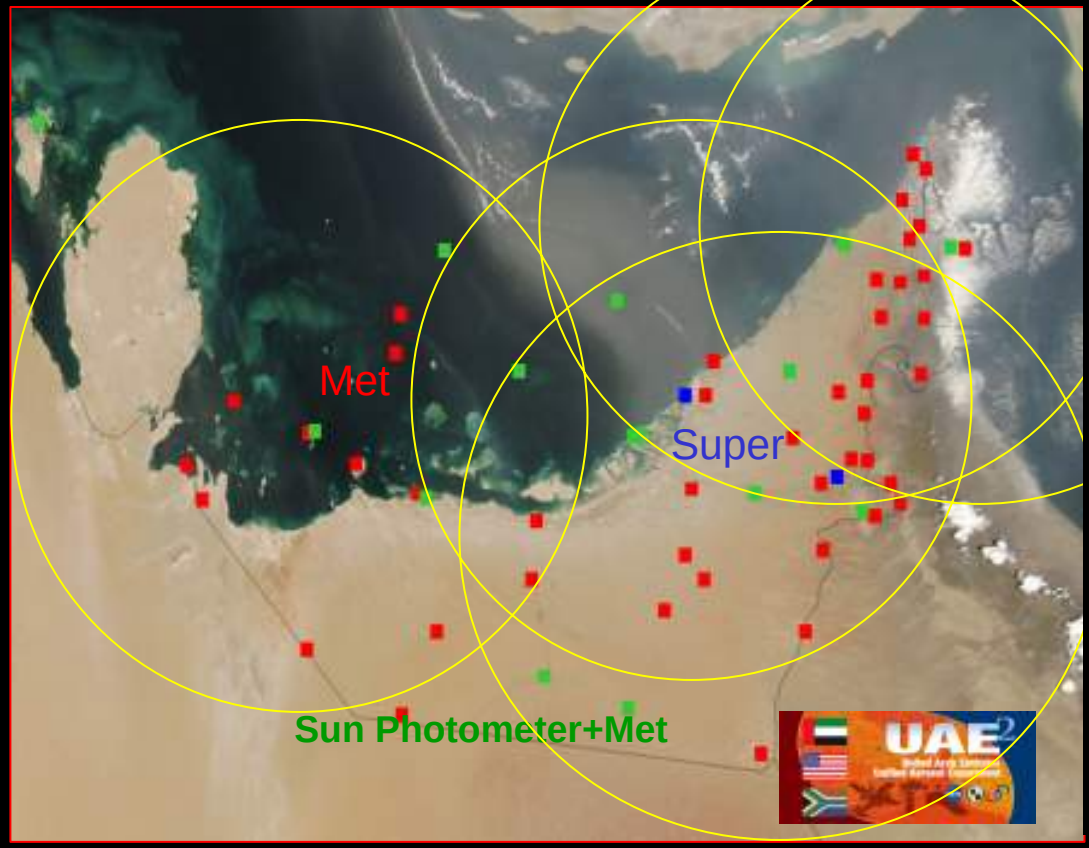
And a Cast of 50+

NCAR

UAE^2 in a Nutshell

- Excellent local resources and development through DWRS
- Micro-synoptic meteorology, microphysics, radiative transfer
- Papers currently being submitted to JGR special issue



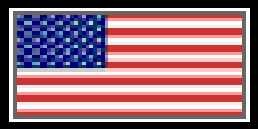
<u>Assets</u>

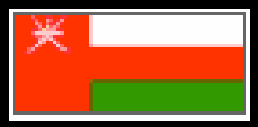
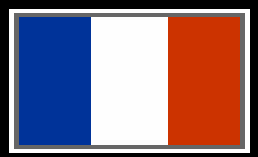
SA Aerocommander Aircraft (70 hrs)
NRL MAARCO: Coast
NASA SMART: Inland desert
5 Doppler radars
15 AERONET sites
15 Satellite sensors
52 Surface stations
4 Mesoscale models
- COAMPS®
- MM5&MM5 RTTDA
- WRF

1 Global model (NAAPS)

Participating Institutions

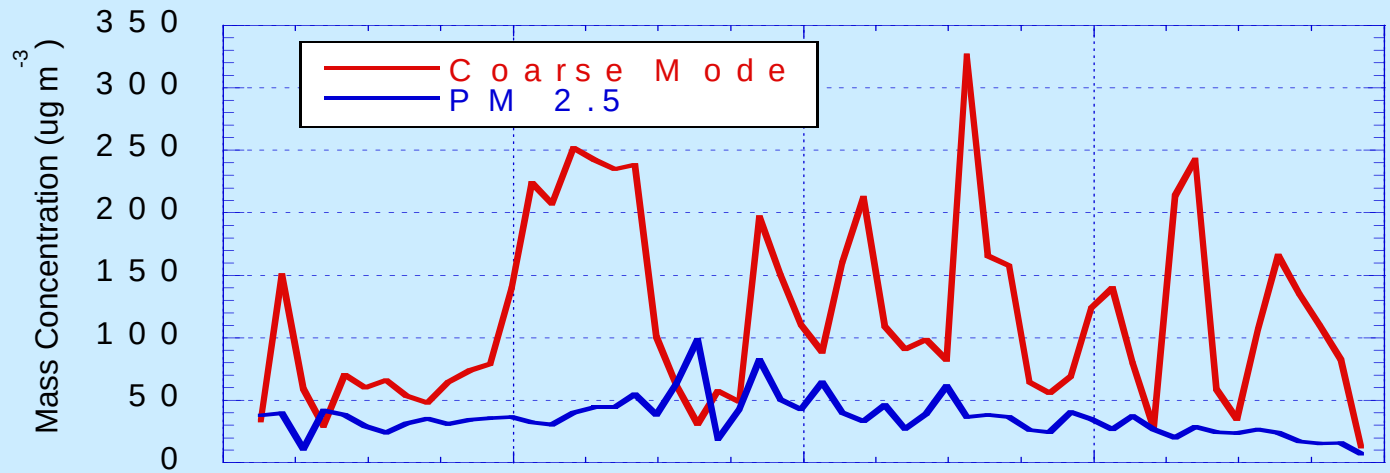




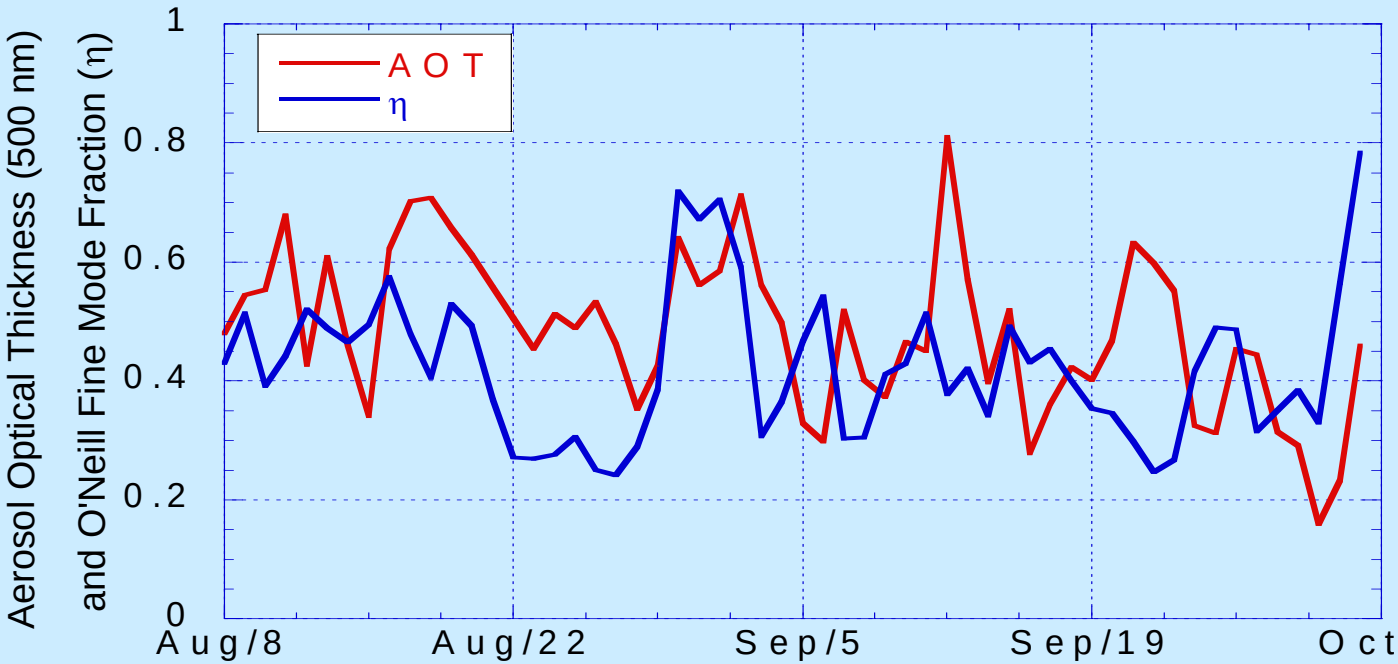





Dept. of Water Resources, Office of the President, United Arab Emirates
Desert Research Institute, Univ. of Nevada
Droplet Measurement Technologies, Inc
Jet Propulsion Laboratory, Pasadena, CA
National Center for Atmospheric Research, Boulder CO
NASA Goddard Space Flight Center, Greenbelt MD
Naval Postgraduate School, Monterey, CA
Naval Research Laboratory, Monterey, CA
Naval Research Laboratory, Stennis, CA
North Carolina State University, Raleigh, NC
Oman Weather Service
Orsmond Aviation, South Africa.
Scripps Institution of Oceanography
South African Weather Agency
TNO Physics and Electronics Laboratory, The Hague, Netherlands
Universite de Shebrooke, Sherbrooke, Quebec, Canada
University of Alabama, Huntsville, AL
University of California, Davis, CA
University Corporation for Atmospheric Research
University of Hawaii, Honolulu HI
University of Lille, France
University of Maryland Baltimore County (GEST), Baltimore MD
University of Maryland, Collage Park, MD
University of Muscat, Oman
University of Witwatersrand, South Africa
Warsaw University, Warsaw, Poland

Aerosol Mass Concentration and Optical Depth at MAARCO



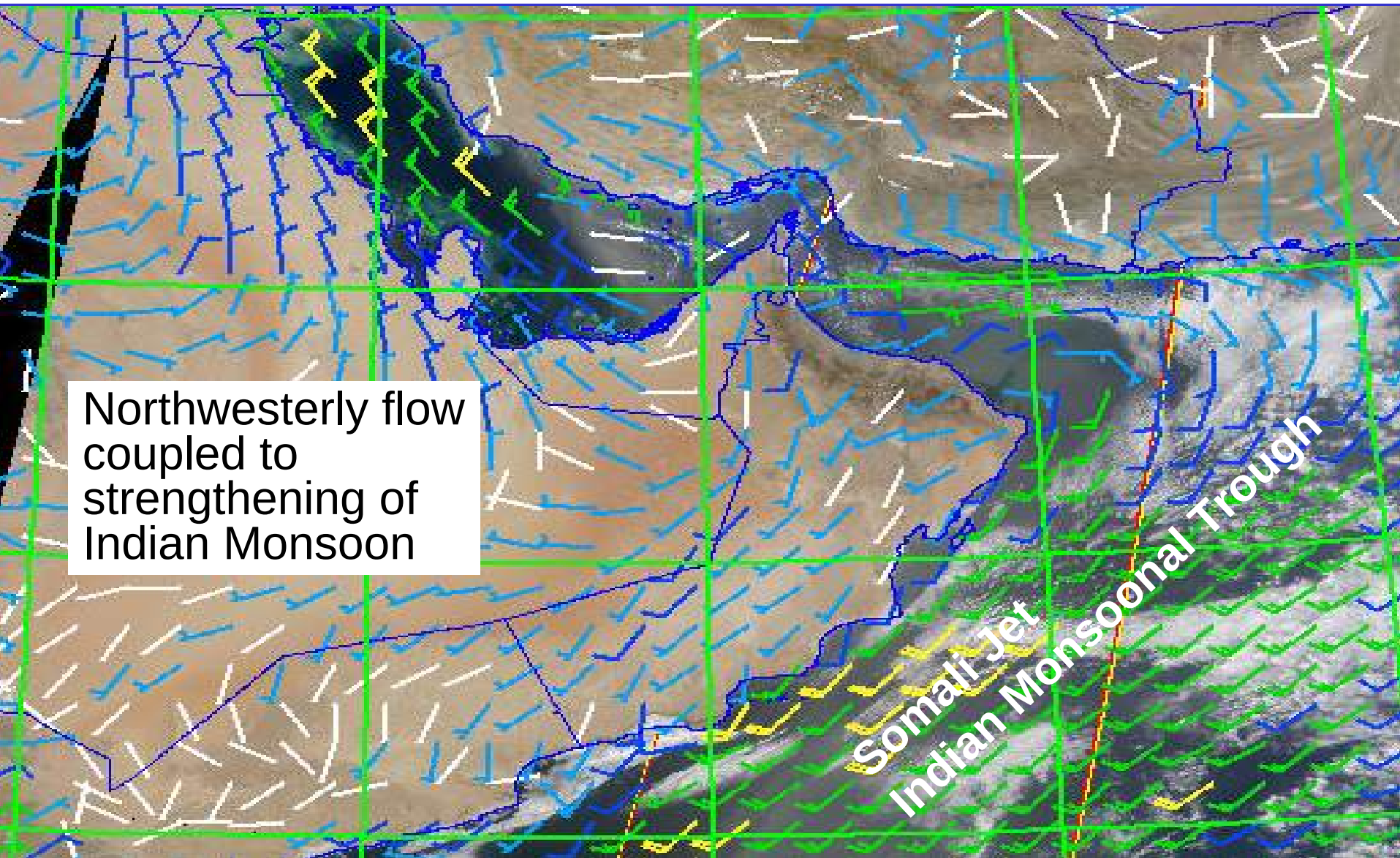
High periodic levels of both dust and pollution



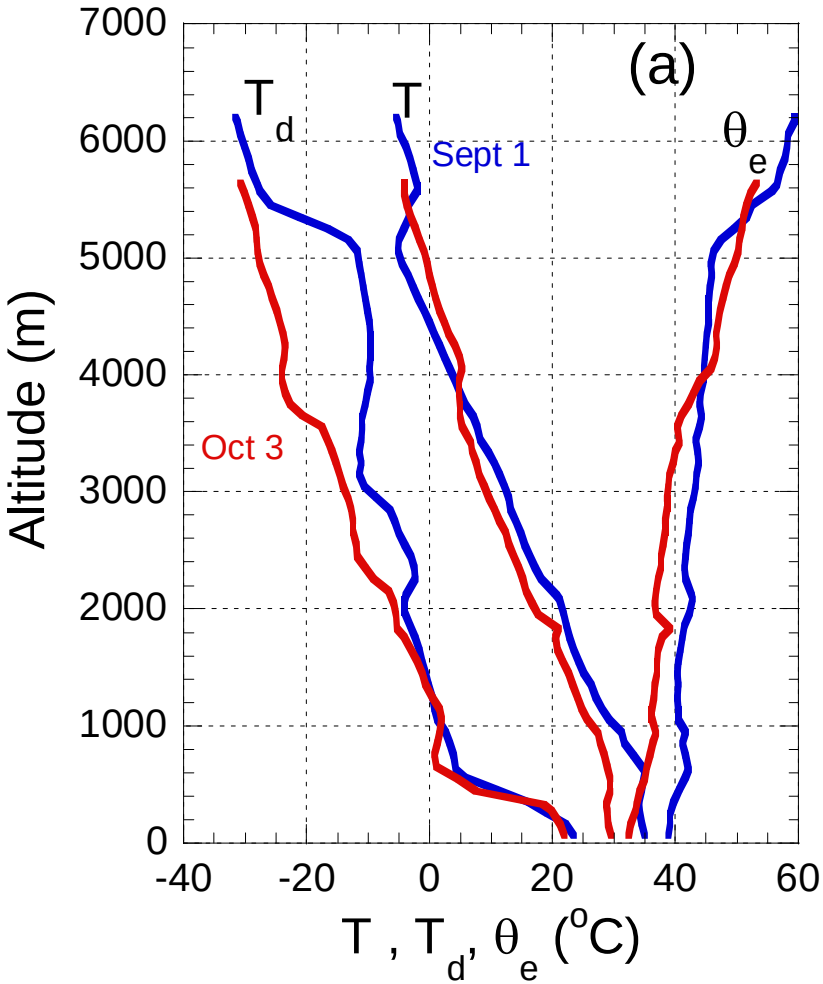
Aerosol optical depth fine mode fraction varies between 0.2 to 0.8 for high AOTs (>0.4 at 500 nm)

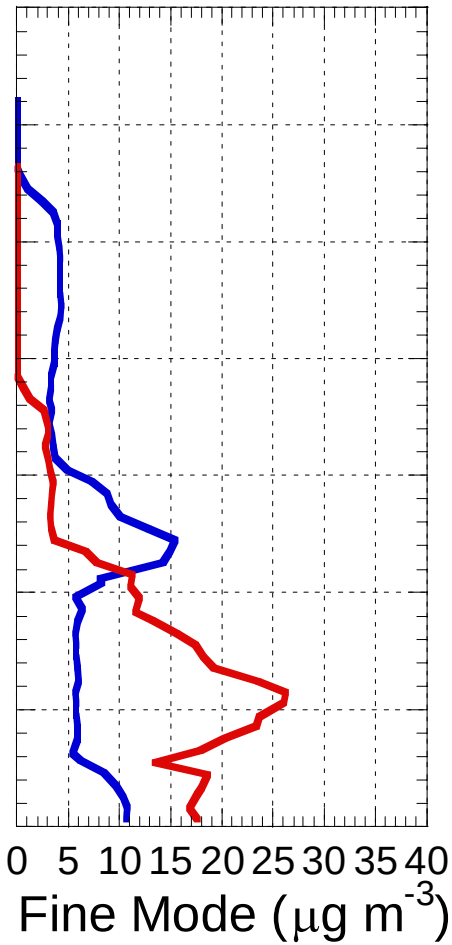
Variable Source Regions

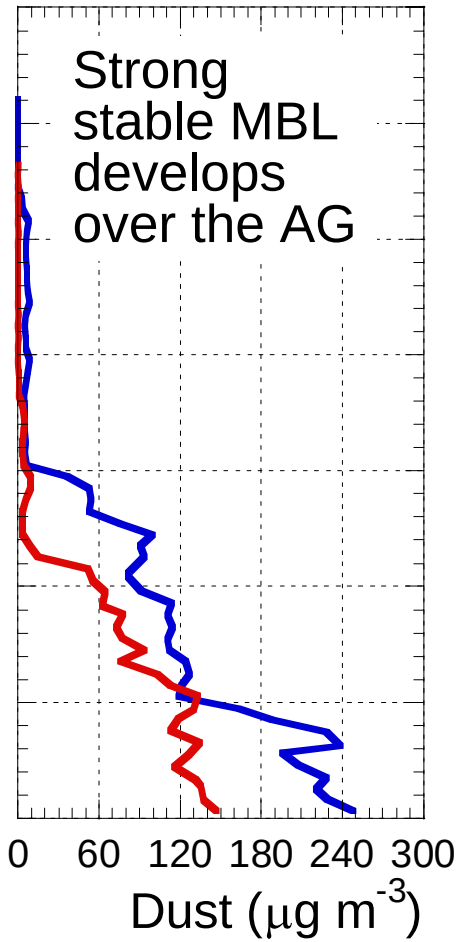
Northwesterly flow brings dust from Iraq. Sept 12th



Aircraft Observations: NW Flow

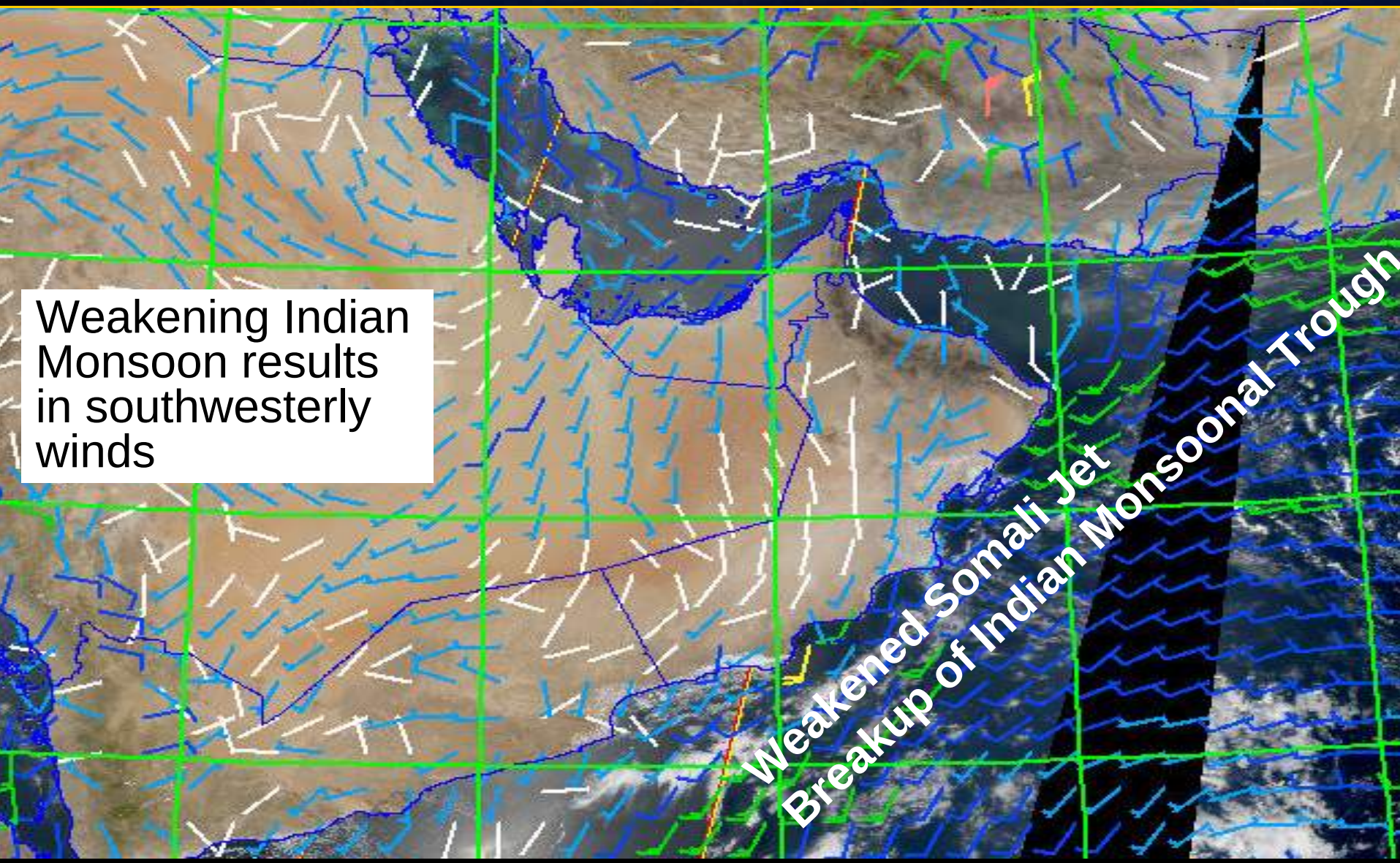






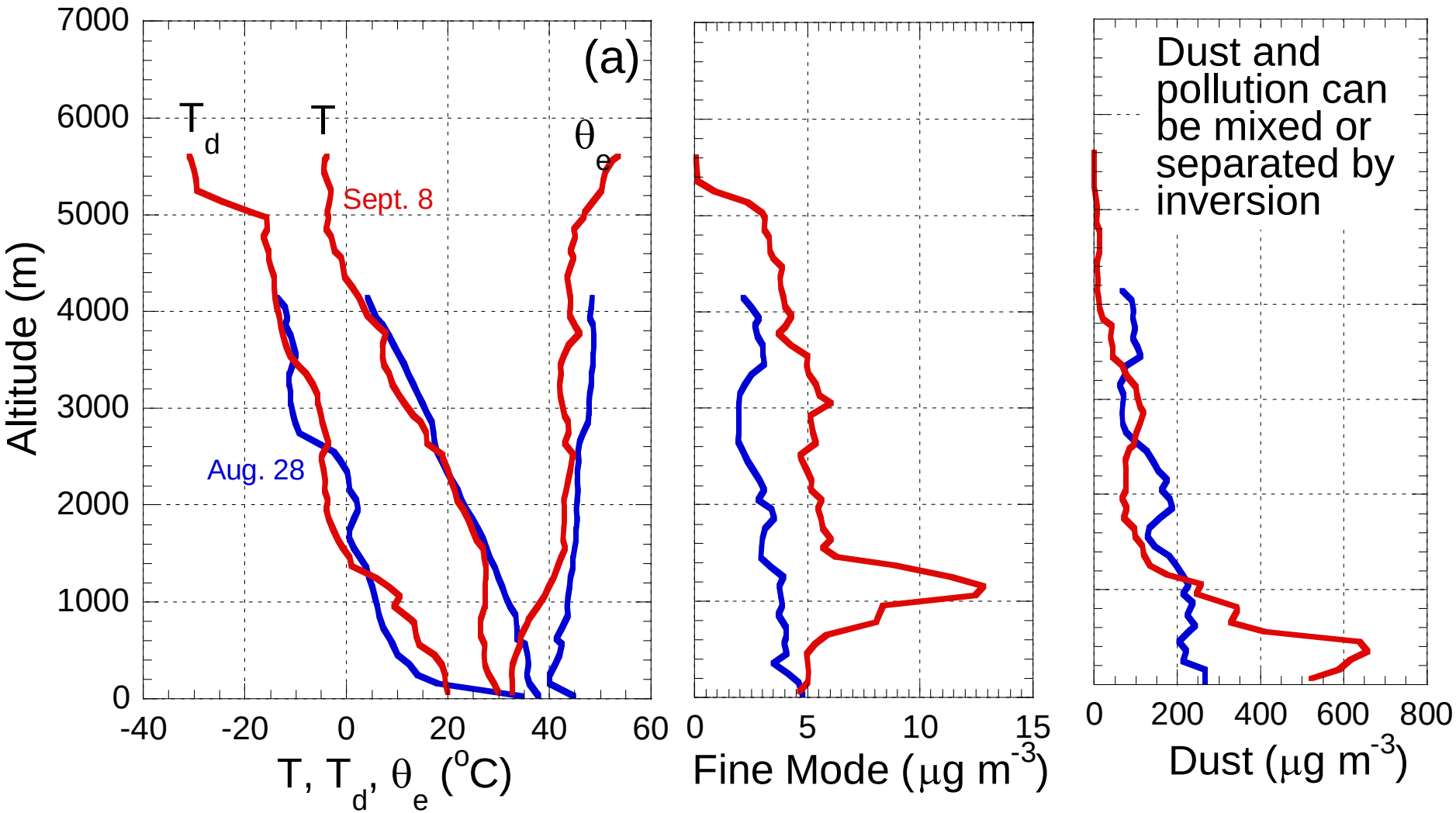
Variable Source Regions

Southwesterly flow brings dust from Interior: Sept 8



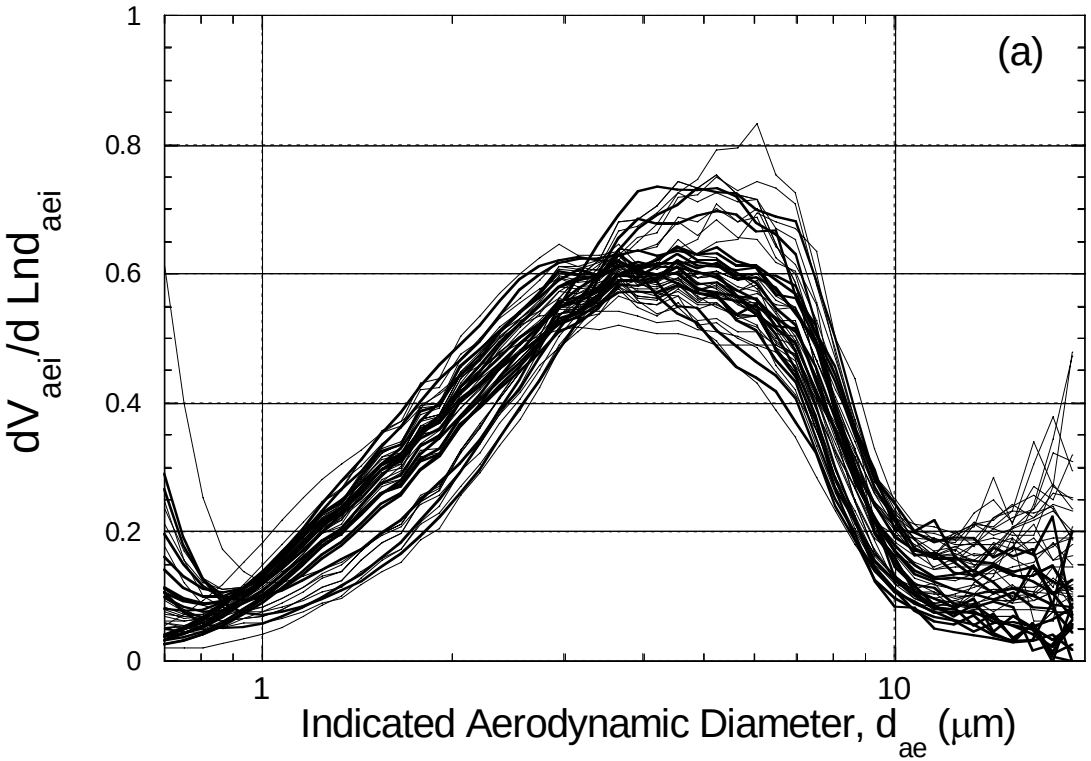
Aircraft Observations:

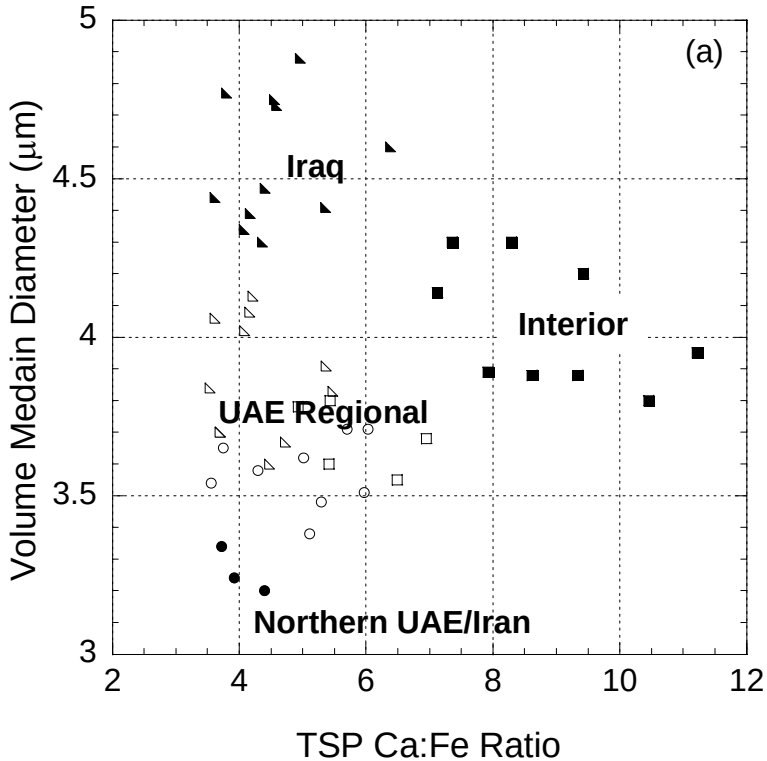
SW Flow: Well mixed and developed boundary layer



Example Result 1: Dust Size is Source Region Specific

Dust size distributions always fell into one of 4 distinct groups. This corresponded to specific source regions and particle chemistries regardless of production wind speed and transport characteristics.



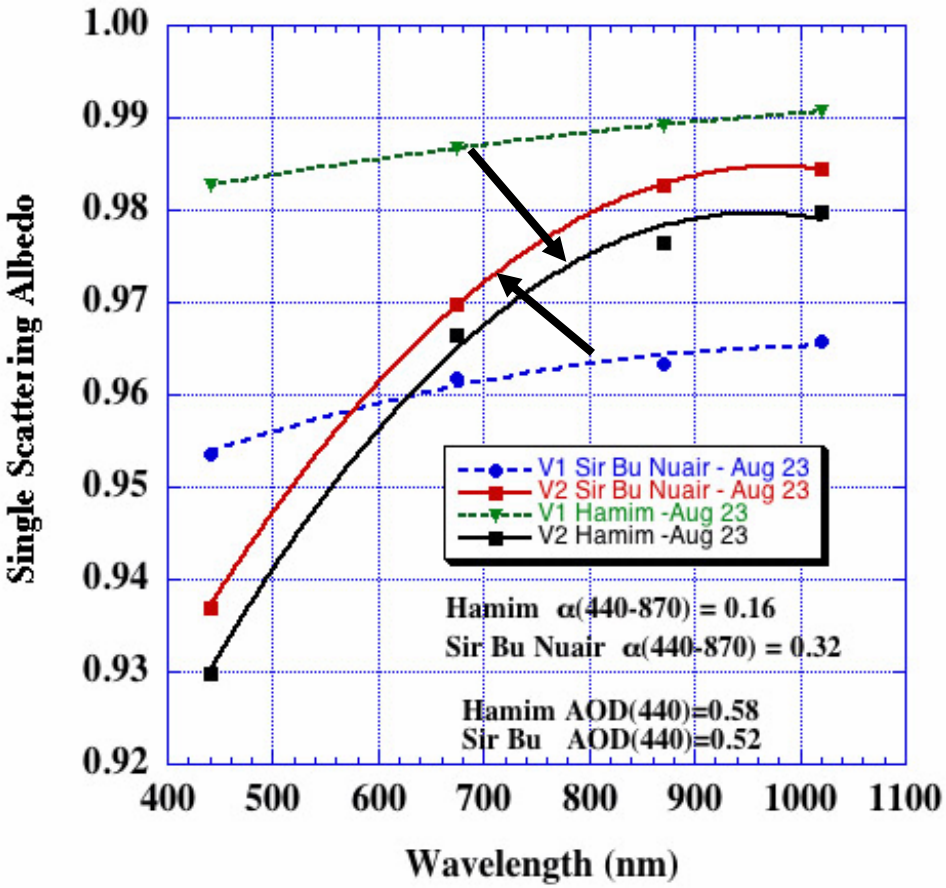


Reid et al., Dynamics of Southwest Asian Dust Particle Size Characteristics with Implications for Global Dust Research, JGR Submitted

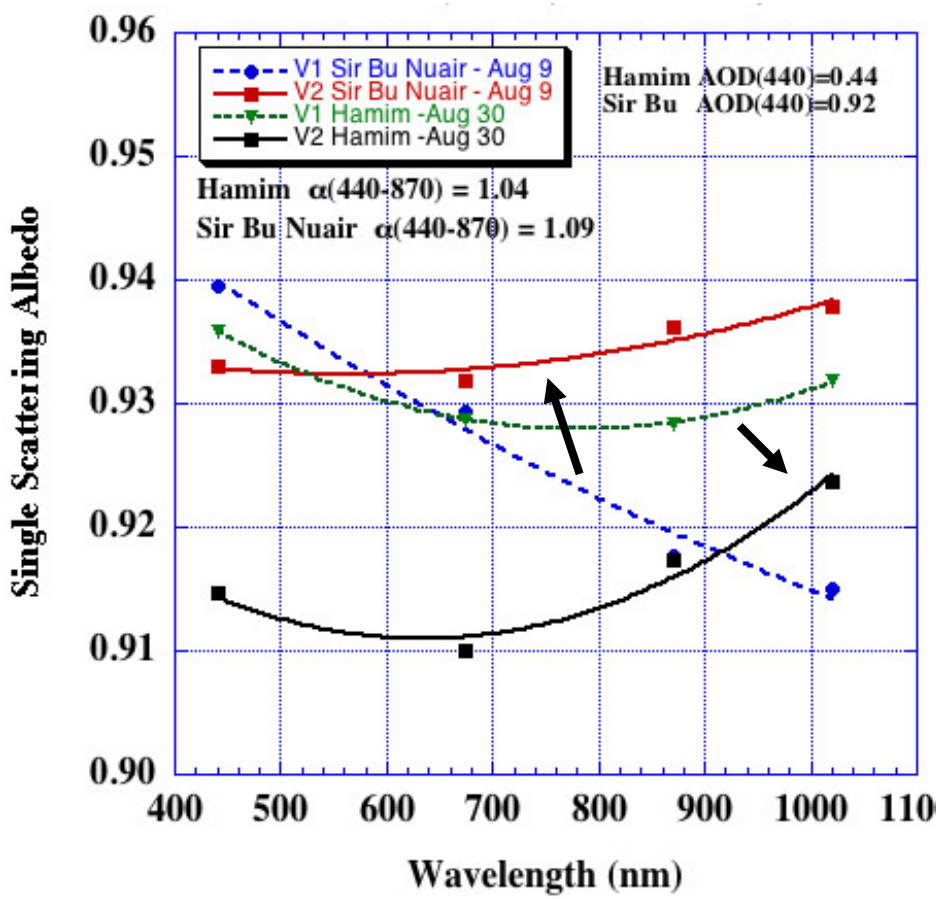
Example Result 2:

Major Revision to AERONET Retrievals Version 2: SSA

Dust Dominated



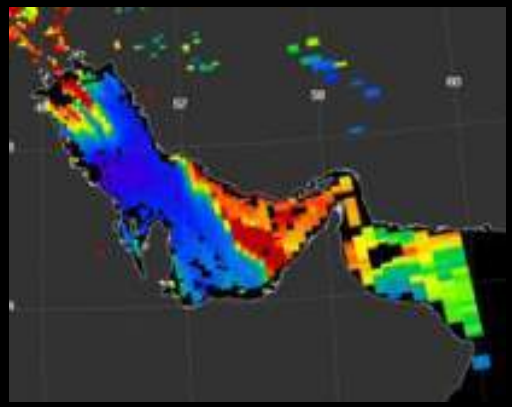
Significant Pollution



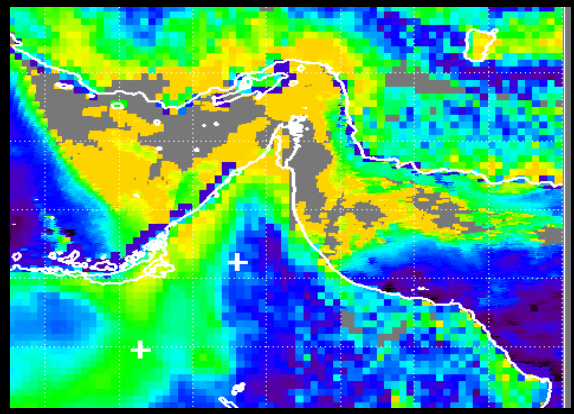
Eck et al., Spatial and Temporal Variability of Column Integrated Aerosol Optical Properties in the Southern Arabian Gulf and United Arab Emirates in Summer, submitted JGR

Example Result 3: Satellite Cal Val for dusty, bright and heterogeneous environments

New algorithms look very good.

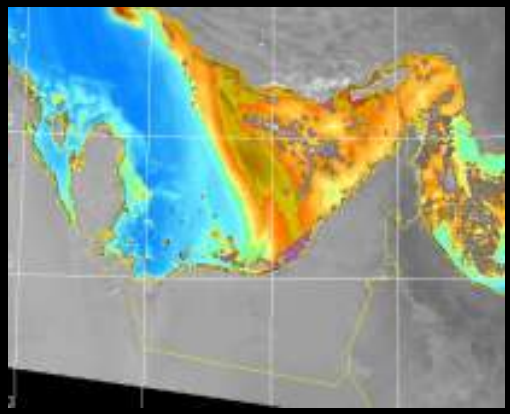


MODIS: Kuciauskas

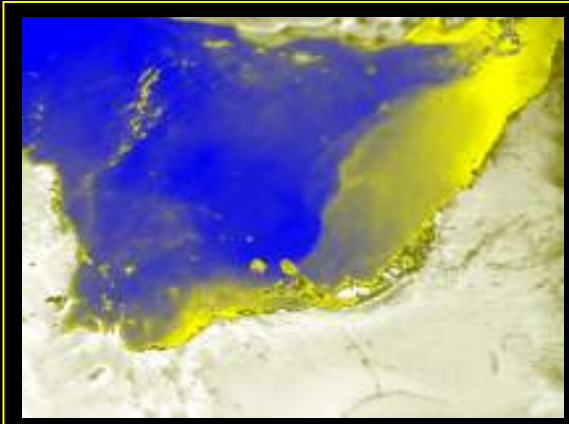


Deep Blue: Hsu

MISR: Kahn



AVHRR N16/17: Kuciauskas



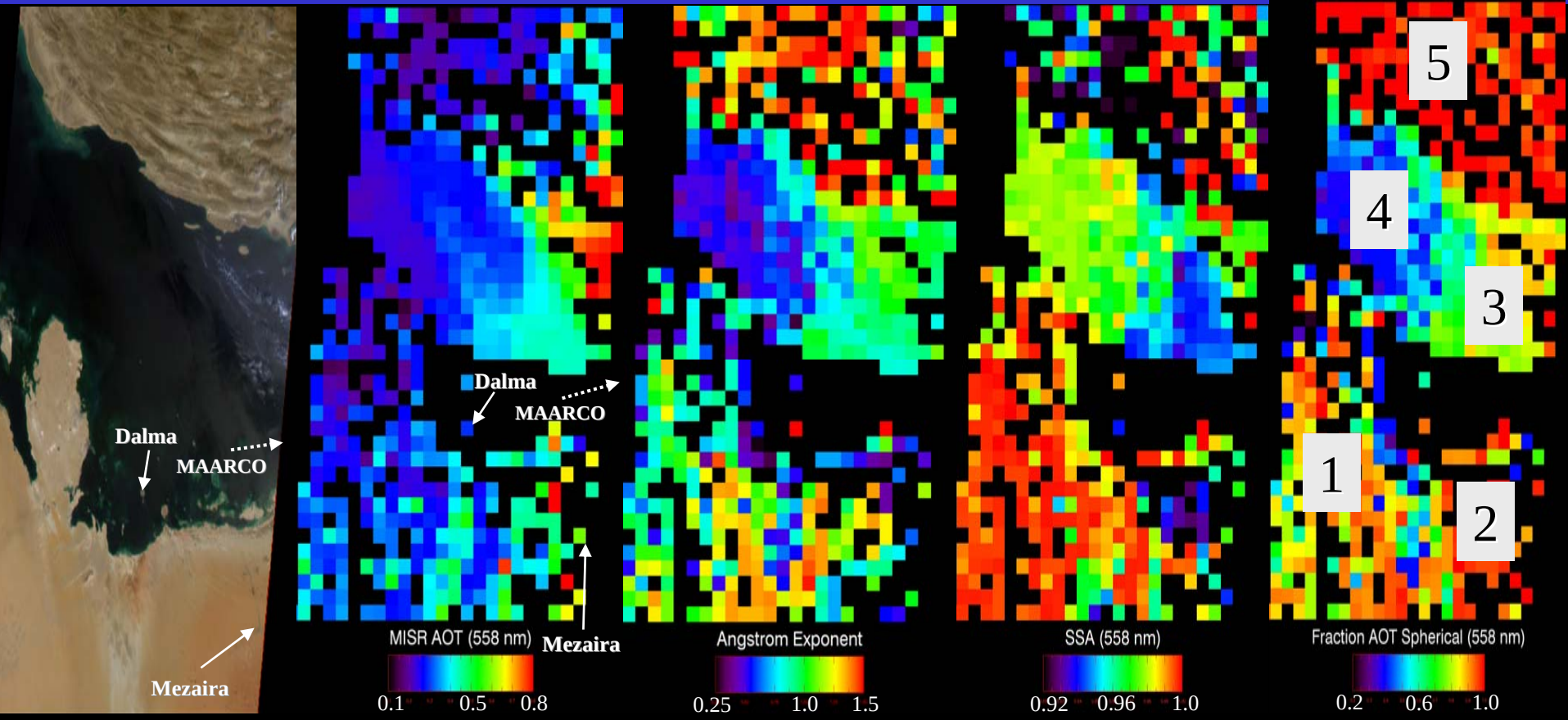
AATSR: Schoemaker

Quickbird: Vincent

Plus: CERES, AMSU A/B, AMSR-E, HIRS, AIRS, Meteosat-5/MSG

Distinct Regional Aerosol Air Mass Types Identified
Dust + Pollution: UAE2 Campaign MISR Data, R. Kahn

September 01, 2004 Orbit 25032 Path 162 Blocks 68-72 V16



MISR 26˚f Image | MISR AOT | Angstrom Exponent | SSA | Fract. Spherical

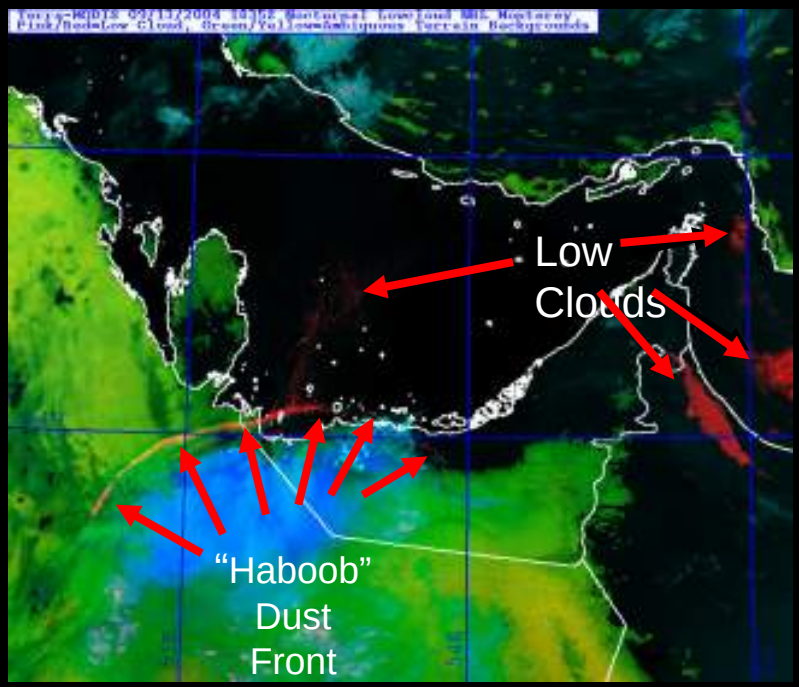
Approximately five air masses : Higher ANG --> Lower SSA

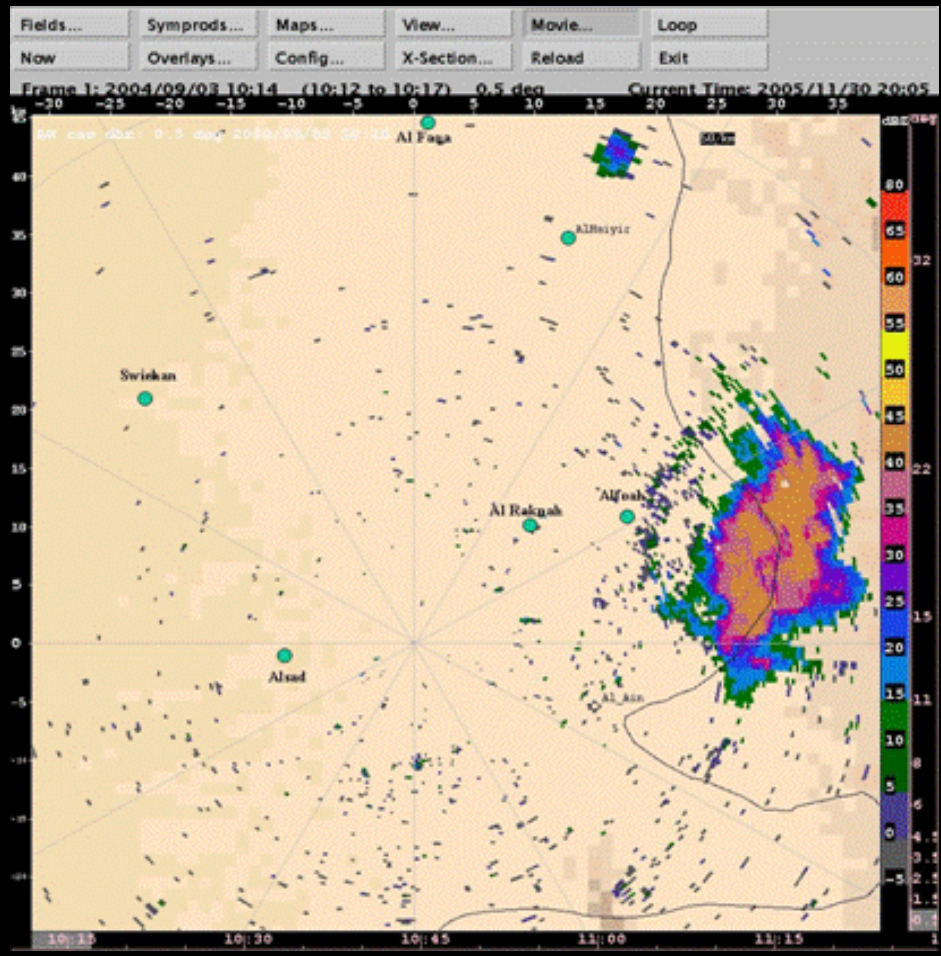
West Side (including Dalma): Spherical, clean + Dust mixtures dominate

East Side (includes Sir Bu Nuair, MAARCO off swath): More Pollution, less Dust

Example Result 4:

Comprehensive Study of Haboobs, Miller et al. JGR: Haboobs are significant in regional dust budget





Motion calculations:

Convective cell: **7.1 ms^{-1}**

Haboob: **8.8 ms^{-1}**

UAE^2: Summary of key results

- SW Asia is a crossroads of 5+ sub-continents. Aerosol sources in all of these regions need to be modeled well *(Walker et al.).*
- Pollution is every bit as important as dust for AOT and forcing in the region. Particles are mostly ammonium bi-sulfate/H_2SO_4 with some black carbon. Very few organics. *(Ross et al.).*
- Micro-meso-synoptic meteorology are all present. Mesoscale features are extremely important in the regional dust budget. (*Miller et al.; Eager et al.)*
- Previous descriptions of how particle vertical distributions relate to the inversions is grossly oversimplified. *(Reid et al.; Walker et al.).*
- Next generation of over-desert AOT algorithms have been tested *(Hsu et al., Kahn et al., Kuciauskas et al., Schoemaker et al., Vincent et al.)*
- SW Asian dust high in evaporates. Implication: Dust is a good CCN, and may have some hygroscopic growth; not surprising since dust is frequently from saline beds. *(E. A. Reid et al.)*