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

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And a Cast of 50+
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

Assets
- 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)
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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)
Northwesterly flow brings dust from Iraq. Sept 12th

Northwesterly flow coupled to strengthening of Indian Monsoon
Aircraft Observations: NW Flow

(a) $T_d, T, \theta_e$ (°C)

Oct 3

Sept 1

Strong stable MBL develops over the AG

Altitude (m)

Fine Mode ($\mu$g m$^{-3}$)

Dust ($\mu$g m$^{-3}$)
Weakening Indian Monsoon results in southwesterly winds
Aircraft Observations:
SW Flow: Well mixed and developed boundary layer

Dust and pollution can be mixed or separated by inversion
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
Major Revision to AERONET Retrievals Version 2: SSA

**Example Result 2:**

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 25082  Path 162  Blocks 68-72  V16

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\(^{-1}\)
UAE²: 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$_2$SO$_4$ 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.)