Mesoscale aerosol variability in the Asian outflow region

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Over-ocean spatial variability of sunphotometer AOD, MODIS AOD, and in situ aerosol properties in ACE-Asia, 2001

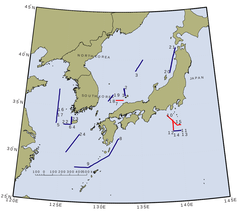
Goals of this project:

1) based on the combination of suborbital and satellite measurements, to determine the spatial variability of aerosol optical depth and assess how well current EOS satellite sensors capture or suppress such variability within their processing algorithms,

2) define a characteristic length scale, within which aerosol observations can be compared or usefully combined,

3) to compare the spatial variability in aerosol optical depth and columnar water vapor in different geographical regions, thereby assessing the performance of current EOS sensor algorithms under a variety of regional and climatic conditions.

Platform: NCAR C-130



Above: C-130 flight tracks during the 24 low-level flight segments used in the calculation of auto-correlations shown to the right.

Below: Example MODIS RGB imagery for six of the ACE-Asia flight days. C-130 low-level flight tracks are super-imposed when MODIS observations were coincident (i.e., within 30 minutes of C-130 observations).

Definition of auto-correlation:

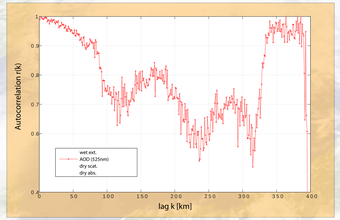
$$r(k) = \frac{\sum_{i}^{N}[(x_i - m_1)(x_{i+k} - m_2)]}{(N-1)s_1 s_2}$$

where k is temporal or spatial lag

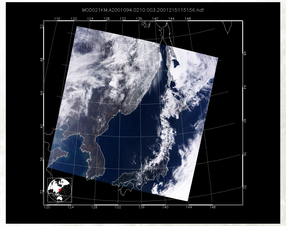
TABLE: Spatial lags k [km] in the various data sets that correspond to autocorrelations of 0.9 and 0.8 respectively.

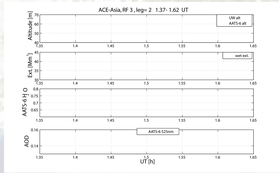
	Autocorrelation	
Type of data	0.9	0.8
Dry absorption 550 nm, in situ	73.2	124.5
Dry scattering 550 nm, in situ	86.5	133.6
Derived ambient extinction 550 nm, in situ	70.9	140.4
Aerosol optical depth, 525 nm, remote	74.9	91.7

Auto-correlation: a tool to study spatial variability



April 4, 2001





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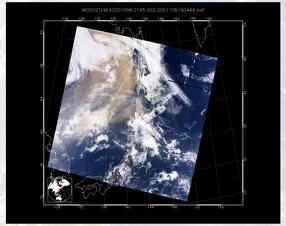

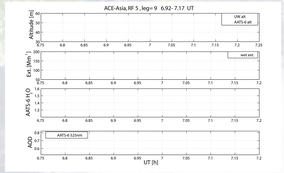

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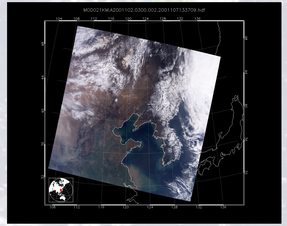

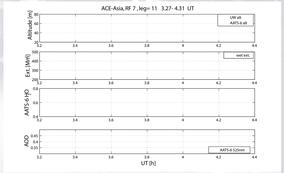

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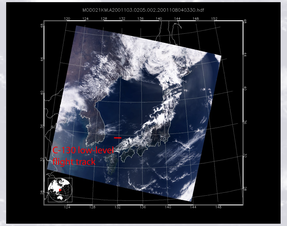
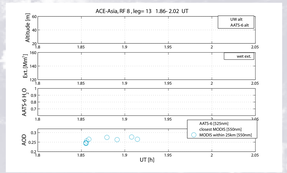
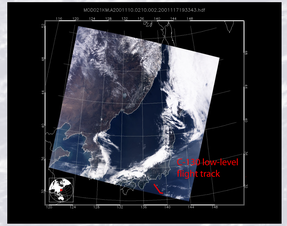
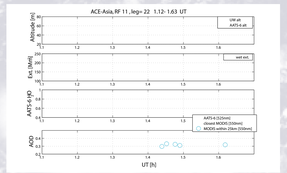




April 20, 2001





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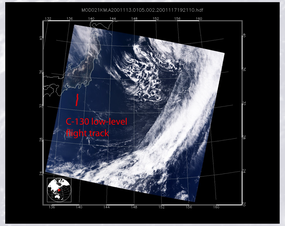
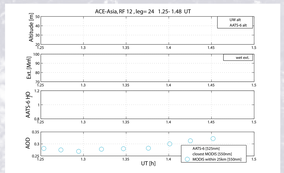




MODIS IR AOD validation and spatial variability of aerosol properties in the Extended-λ MODIS-Validation Experiment (EVE), 2004

Platform: CIRPAS Twin-Otter

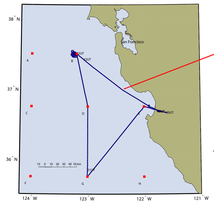
EVE flight calendar

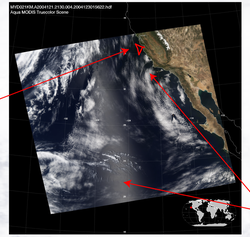
Date	Flight No.	Flight times (UT)	Comments	Terra overpass time(UTC)@Peak	Aqua overpass time(UTC)@Peak
04/16/04	CIR00	18.9 - 20.9	Test flight, possible comparison with Terra	19:46:07	A, B, C, D, E, F, G 21:22:16 E
04/21/04	CIR01	16.94 - 19.39	possible comparison with Terra	18:26:54	A, B, C, D, E, F, G, H 21:40:38 A, B, C, D, E, F, G, H
04/21/04	CIR02	21.14 - 23.18	with Aqua possible comparison	18:26:54	A, B, C, D, E, F, G, H 21:40:38 A, B, C, D, E, F, G, H
04/26/04	CIR03	17.22 - 20.58	with Terra possible comparison	18:45:20	A, B, C, D, E, F, G, H 21:58:59 A, B, C, D, E, F, G, H
04/26/04	CIR04	21.52 - 24.17	with Aqua possible comparison	18:45:20	A, B, C, D, E, F, G, H 21:58:59 A, B, C, D, E, F, G, H
04/28/04	CIR05	18.19 - 23.10	with Terra and Aqua possible comparison	18:33:01	A, B, C, D, E, F, G,H 21:46:42 A, B, C, D, E, F, G, H
04/30/04	CIR06	17.27 - 23.65	with Aqua	18:20:52	E, H 21:34:21 A, B, C, D, E, F, G, H

Blue letters A-H indicate points outside glint, with satellite elevation greater than 40° = good overpass

Red letters A-H indicate points outside glint, with satellite elevation between 30 and 40° = not as good

EVE flight domain and typical flight pattern

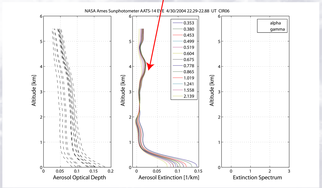




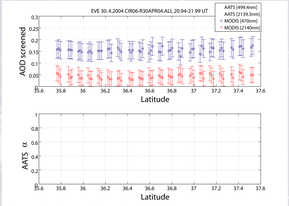
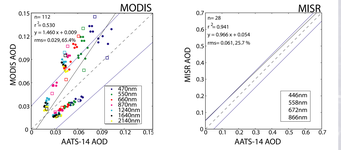
April 30, 2004

3 Foes of EVE:
- B-1-r-d-s = pilot talk for birds
- Low-level stratus off CA coast
- Glint in MODIS observations

1 Friend of EVE:
- Asian dust (gives IR AOD>0)



Preliminary MODIS AOD (IR) validation in EVE, 2004



Previous over-ocean AOD validation in CLAMS, 2001