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Spatial Non-Uniformity of Aerosols at the 15,500 Ft Level

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Mathews, L.A. and Walker, P.L. Spatial Non-Uniformity of Aerosols at the 15,500 Ft Level. Proceedings of 7he 13th Annual Review Conference on Atmospheric Transmission Models, 5-6 JUNE 1990; Kneizys, F.X.; Abreu, L.W. [eds.]
http://hdl.handle.net/10945/70614

SPATIAL NON-UNIFORMITY OF AEROSOLS AT THE 15,500 ft LEVEL

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Longjump III meteorology was reported on previously*. This work presents the results of a more detailed analysis of the aerosol data. That data was obtained from aircraft at 15,500 feet over a 100 mile course between mountain peaks. Samples were taken at three minute intervals. In general more haze was associated with the mountain peaks than for the region between them. Extinction fluctuated at shorter intervals (10 miles) along the flight path possibly due to the uplifting action of convection cells, but superimposed on this is noise caused by the short sampling intervals. Visibility was highly nonuniform being dominated by molecular scattering punctuated by regions of lower visibility.

*Characterization of the Atmosphere for Longjump III, Mathews and Walker, IRIS, Ames Research Center, 16 March 1989.

SPATIAL NON-UNIFORMITY OF AEROSOLS AT THE 15,500 FOOT LEVEL

by

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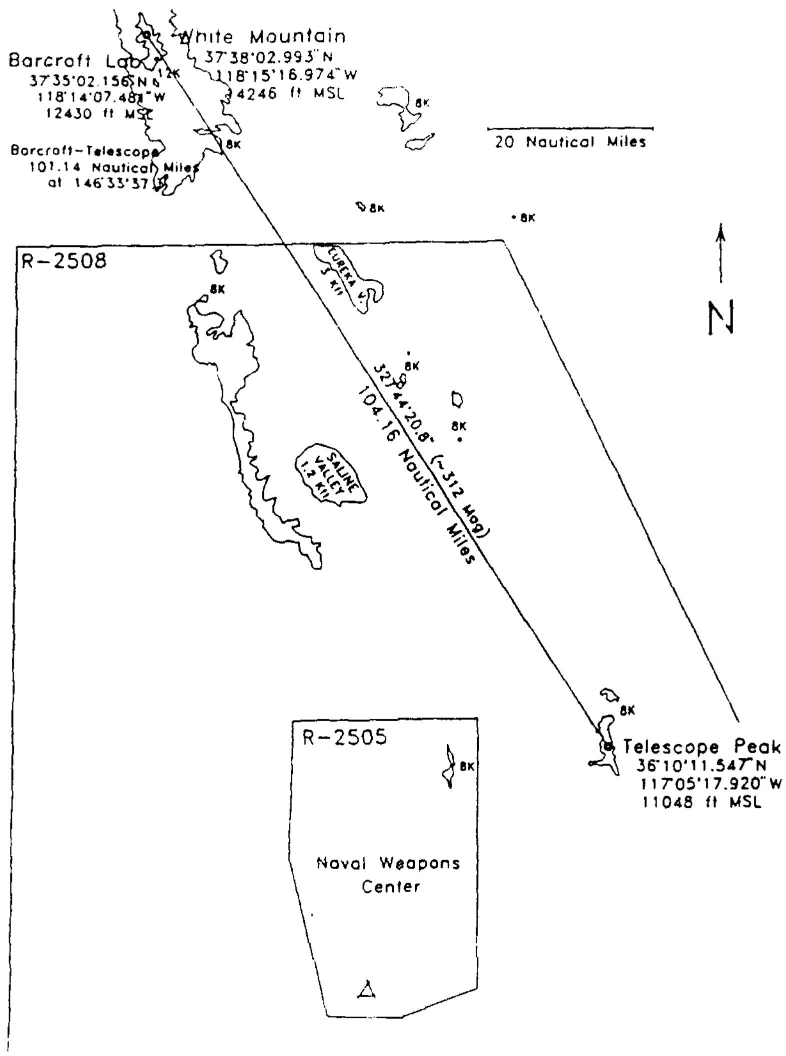
PROJECT LONG JUMP III

- **FIELD TEST OF VARIOUS DEVELOPMENTAL INFRARED INSTRUMENTATION**
- **CONTROLLED AIRCRAFT TARGETS**
  - SPECIFIC FLIGHT PROFILES
  - 11,500 TO 15,500 FT
- **BARCROFT LABORATORY (ELEV. 12,470 FT)**
  - ABOVE MAJOR PORTION OF ATMOSPHERIC CONTAMINATES
  - PROVIDES A HORIZONTAL, CLEAR LINE OF SIGHT FOR OVER 100 MILES



Long Jump III
Test Location

OBJECTIVE

TO DETERMINE:

(1) OPTICAL PROPERTIES OF ATMOSPHERE ALONG THE FLIGHT PATH AND AT BARCROFT

(2) OTHER METEOROLOGICAL PARAMETERS AT BARCROFT

BACKGROUND

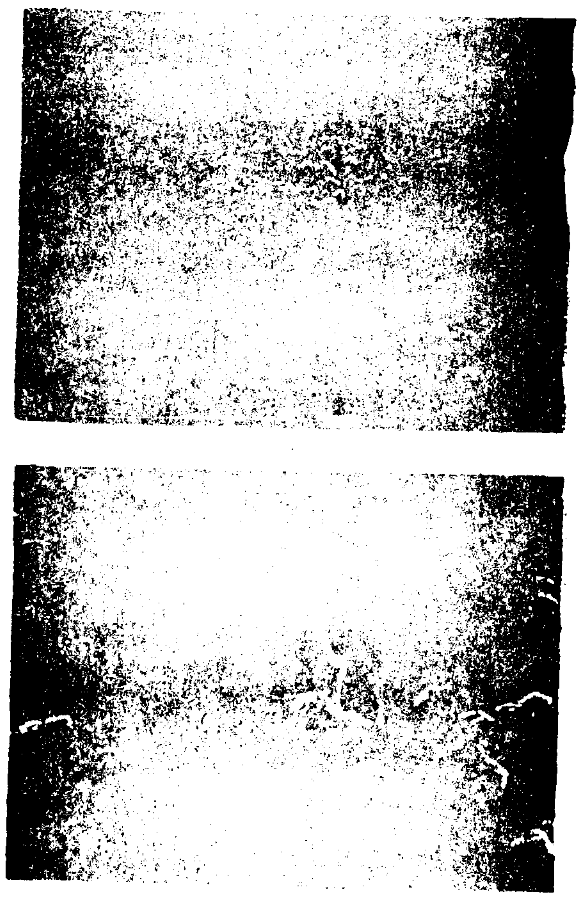
- LONG JUMP I
  - METEOROLOGICAL DATA
  - NEPHELOMETER - VISIBILITY
  - IMMEDIATE BARCROFT AREA
- LONG JUMP II
  - METEOROLOGICAL DATA
  - NEPHELOMETER - VISIBILITY
  - AEROSOL SIZE DISTRIBUTION
  - IMMEDIATE BARCROFT AREA
  - MAY NOT REPRESENT LINE OF SIGHT
    - OROGRAPHIC EFFECTS
    - DIFFERENCES IN AIR PARCELS
- LONG JUMP III
  - AN INSTRUMENTATED AIRCRAFT WAS USED TO SAMPLE ALONG OR NEAR THE FLIGHT PATH

MEASUREMENTS

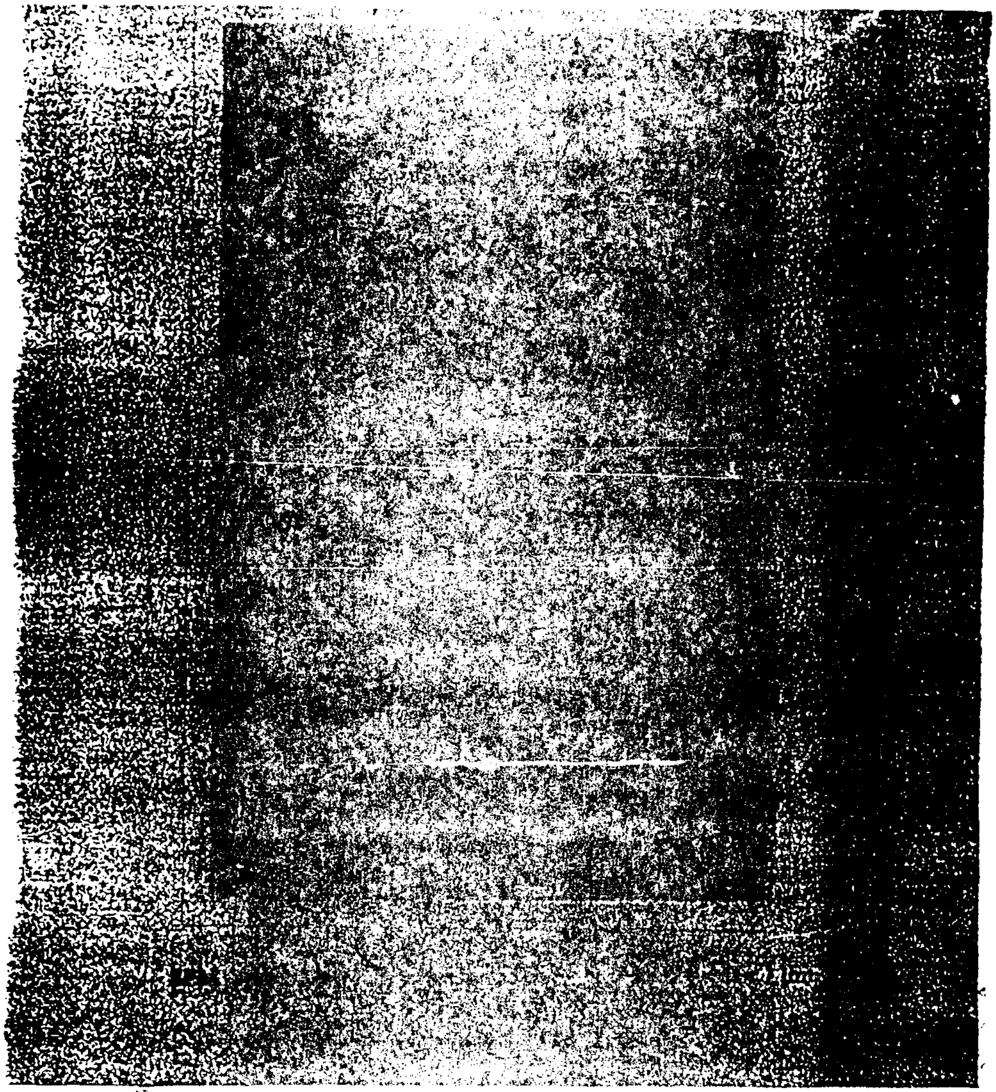
- **AT BARCROFT LABORATORY, THE FOLLOWING PARAMETERS WERE MEASURED**
  - AEROSOL PARTICLE SIZE DISTRIBUTION
  - PARTICLE SCATTERING COEFFICIENT (NEPHELOMETER)
  - RELATIVE HUMIDITY (WET AND DRY BULB TEMPERATURES)
  - AIR TEMPERATURE VERSUS SOIL SURFACE TEMPERATURE
  - INSOLATION
  - WIND SPEED AND DIRECTION
- **OVER BARCROFT AND ALONG THE FLIGHT PATH, THE FOLLOWING PARAMETERS WERE MEASURED:**
  - AEROSOL PARTICLE SIZE DISTRIBUTION
  - AEROSOL CHEMICAL COMPOSITION
  - AIR TEMPERATURE AND DEW POINT
  - CARBON DIOXIDE CONTENT

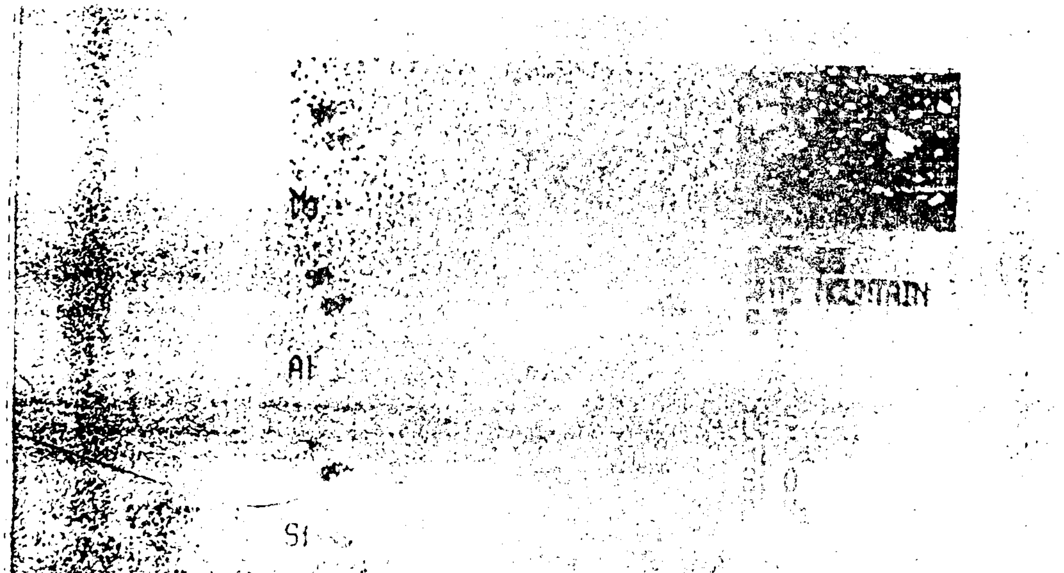
CAL

- CALCULATION OF
  COEFFICIENTS FOR
  WAVELENGTHS
  - MIE CODE FROM
    - INPUT
      - RELATIVE
      - PARTICLE
      - REFRACTIVE INDICES

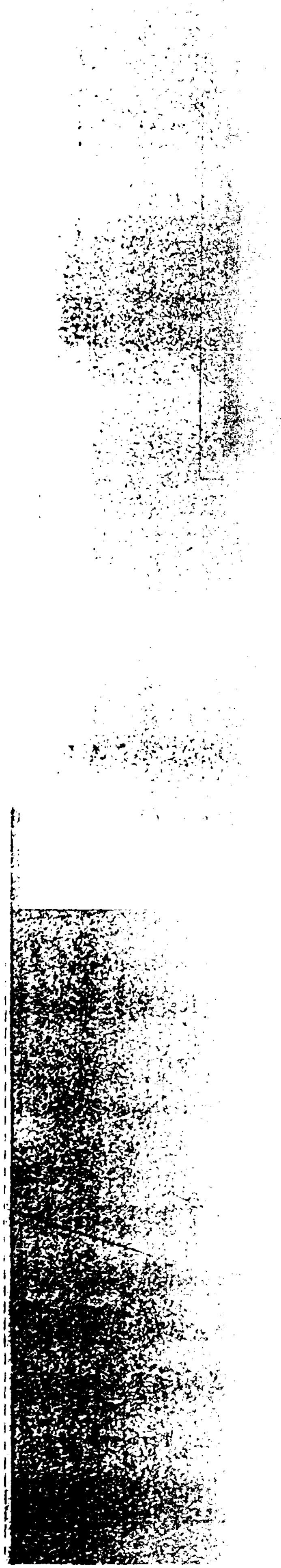


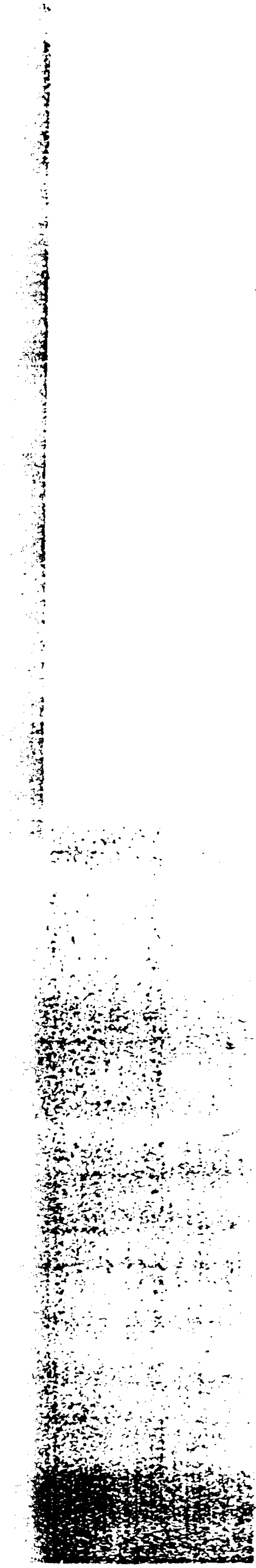
SEM Image < D < 0.4 μm.



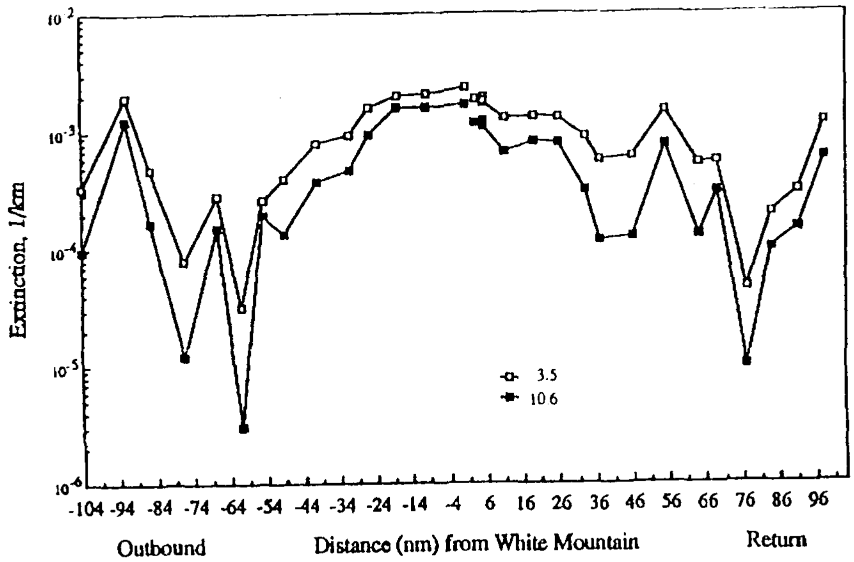


...of Elements Found
... Stage 7. Both alumino
...licate and sodium sulfate
... indicated.

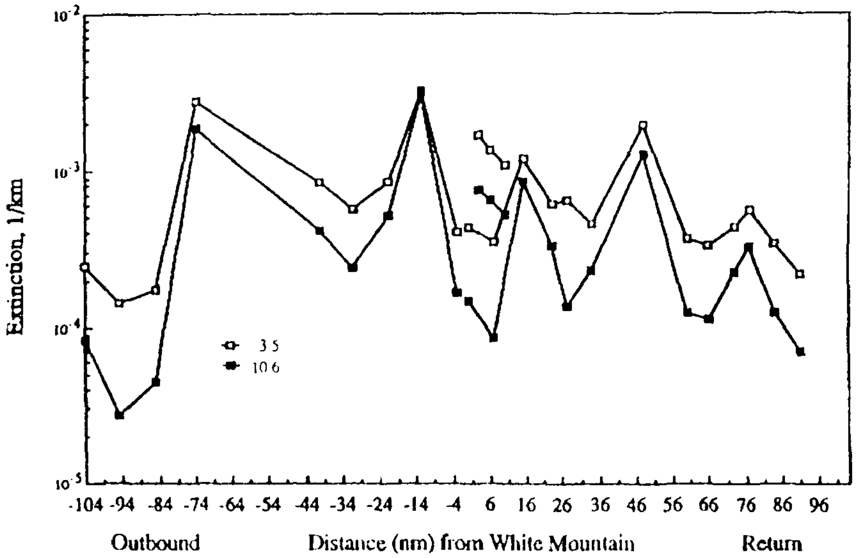




Extinction for Met Flight 5 at 1627 to 1754 PDT on 18 August



Extinction for Met Flight 6 at 0813 to 0947 PDT on 19 August

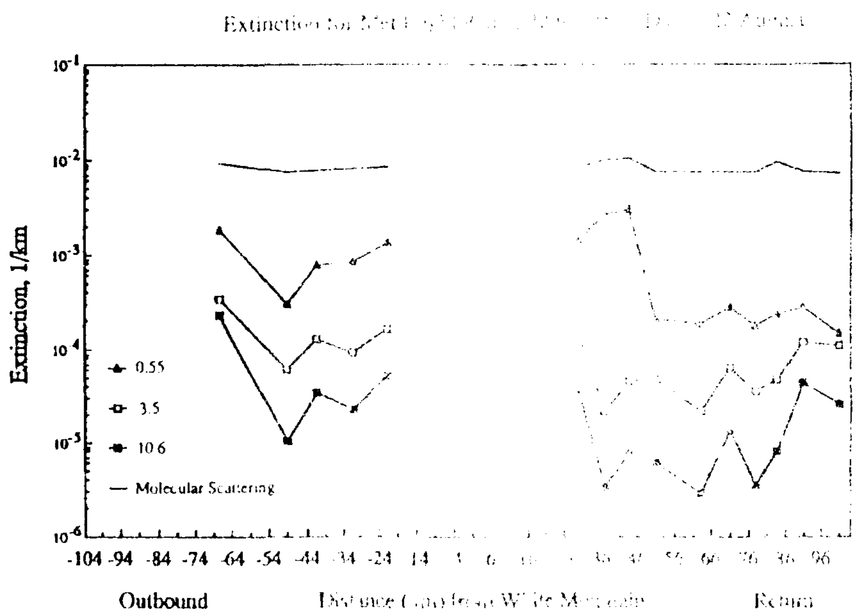


Possible causes of fluctuations are

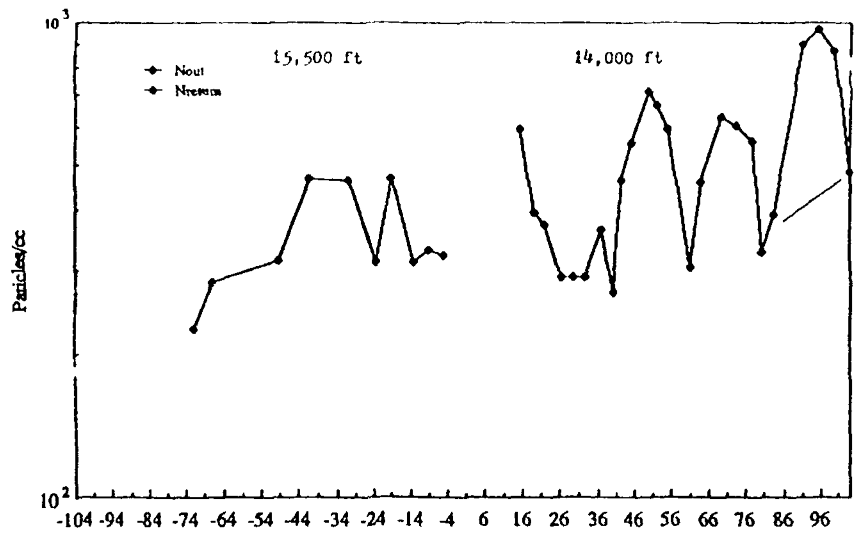
1. **Noise.** APS33 integration time per data point was 2 min. and that of the EAA was 1 min., but periodicity of the data is about 6 min.

2. **Terrain contour effects.** Aerosols may be concentrated in the vicinity of 7000 ft peaks along flight path and depleted elsewhere.

3. **Convection cells.** Cells can be expected to be 5 to 15 nm wide over the desert, during summertime conditions.



Accumulation Mode Aerosol Concentration from EAA Flight 15 at 1118 to 1238 PDT on 25 August

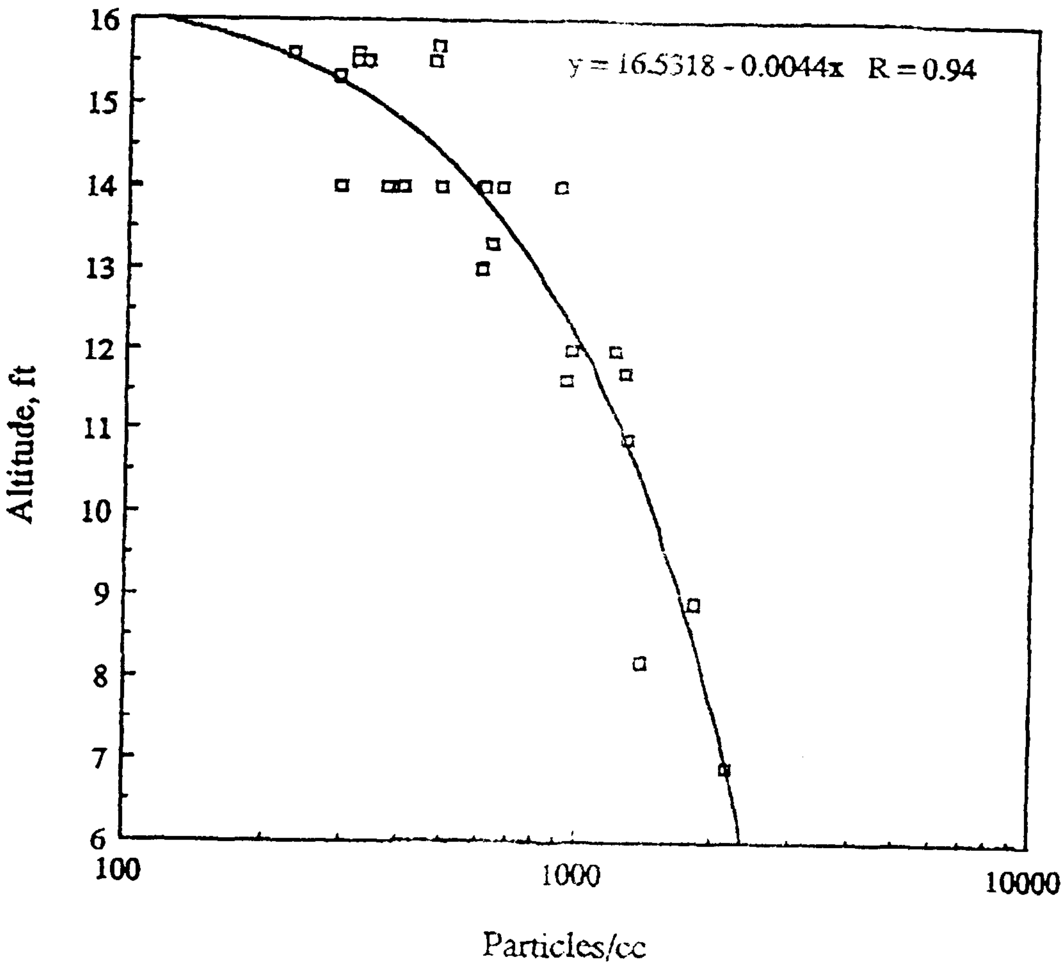


Fluctuation Widths

Week 1. The average fluctuation width was 26.6 nm, which was determined from the extinction minima. The fluctuation widths were determined from the APS33 data.

Week 2. The average fluctuation width was 19.4 nm determined from the particle concentration minima of the higher resolution EAA data.

Accumulation Mode Particle Concentration vs Altitude for Flight 15.



A METHOD OF ESTIMATING SURFACE METEOROLOGICAL RANGES FROM SATELLITE AEROSOL OPTICAL DEPTHS

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Measurements of aerosol optical depth from NOAA Advanced Very High Resolution Radiometers (AVHRR) aboard polar-orbiting satellites have been used to estimate the surface meteorological range over oceans. To do this, a lookup table of optical depth versus meteorological range has been developed which is based on the aerosol extinction profiles in LOWTRAN 7. To better simulate conditions over oceans, the boundary layer height has been lowered to 0.5 km and an extinction profile corresponding to a 150 km meteorological range has been added.

The lookup table has been applied to AVHRR aerosol optical depths near selected island locations where, in turn, the inferred meteorological ranges were validated against surface observations. Results show reasonable success in locating regions where meteorological ranges exceed 30 km, but more precise classification may not be possible due to uncertainties in both the measurements and observations. Unfortunately, the algorithm does not fare as well when the observed meteorological ranges are less than 30 km.

*Now at NRL.