Stratospheric Aerosol and Gas Experiment I (SAGE I) Langley DAAC Project/Campaign Document

Summary:

The Stratospheric Aerosol and Gas Experiment I (SAGE I) instrument was launched February 18, 1979, aboard the Applications Explorer Mission-B (AEM-B) satellite (McCormick et al., 1979). The SAGE I instrument had four spectral channels centered at wavelengths of 1000, 600, 450, and 385 nanometers for nearly global measurement of aerosol extinction profiles and ozone and nitrogen dioxide concentration profiles. The AEM-B satellite was placed in an orbit of approximately 600 kilometers at an inclination of 56 degrees to extend the latitudinal coverage for the solar occultation measurements from 79 degrees South to 79 degrees North. The SAGE I instrument collected data for almost three years until the AEM-B satellite power subsystem failed.

The SAGE I instrument was a sun photometer that measured the attenuation of solar radiation through the Earth's atmosphere during spacecraft sunrise and sunset in the four spectral regions mentioned above. The solar radiance data were combined with spacecraft ephemeris and NOAA meteorological data and then numerically inverted to yield altitude profiles of aerosol extinction at wavelengths of 1000 and 450 nanometers and altitude profiles of ozone and nitrogen dioxide concentration.

The SAGE I aerosol data were validated by comparison with correlative lidar and dustsonde in situ measurements; the ozone data were validated by comparison with balloon ECC ozonesonde and rocket measurements; and the nitrogen dioxide measurements were compared with climatology.

Table of Contents:

1. Project/Campaign Overview:

Name of Project/Campaign:

Stratospheric Aerosol and Gas Experiment I, SAGE I

Project/Campaign Introduction:

The platform for SAGE I was the Applications Explorer Mission-B (AEM-B). Nominal orbit parameters for AEM-B are listed below:

- Launch Date: February 18, 1979
- Planned Duration: 1 year
- Actual Duration: 3 years
- Orbit: non-sun synchronous, circular at 600 km
- Inclination: 56 degrees
- Nodal Period: 96.8 minutes

Project/Campaign Mission Objectives:

The scientific objective of SAGE I was to develop a global stratospheric aerosol, ozone, and nitrogen dioxide data base that could be used for the investigation of the spatial and temporal variations of these species caused by seasonal and short-term meteorological variations, atmospheric chemistry and microphysics, and transient phenomena such as volcanic eruptions. The data base could also be used for the study of trends, atmospheric dynamics and transport, and potential climatic effects.

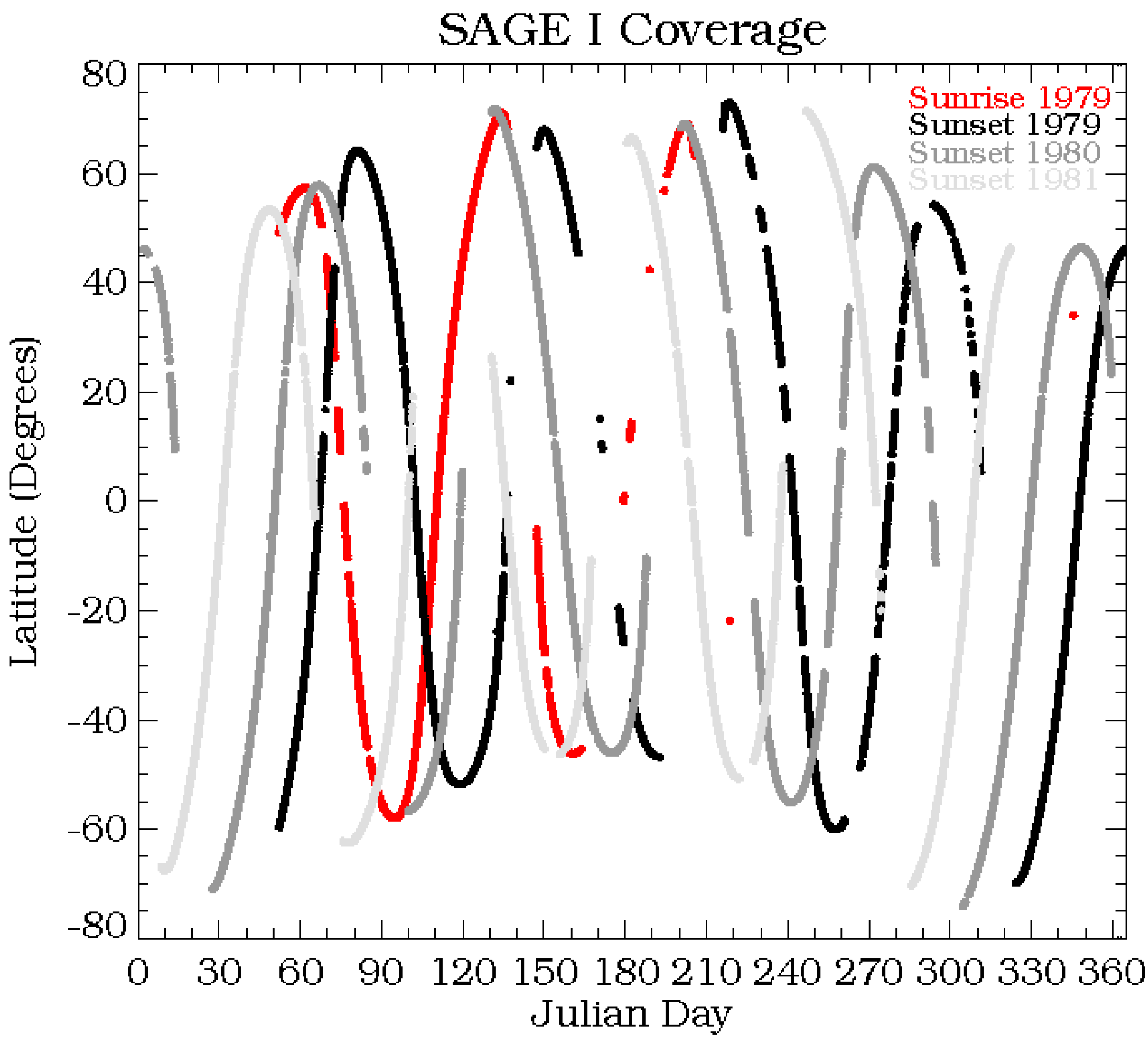
Discipline(s):

The measurement technique was solar occultation. The spectrometer was activated to take solar irradiance measurements during the periods when the line-of-sight from the SAGE I instrument to the Sun had tangent altitudes between sea level and 150 km. It was self-calibrating in that an exoatmospheric measurement was made before a sunset or after a sunrise measurement. Attenuation of sunlight by a species was measured and processed to produce profile data.

Geographic Region(s):

The latitude range for SAGE I varied with season. Overall coverage ranged from about 75 degrees North to 75 degrees South.

On a given day, the latitude coverage was from hundredths of a degree at the highest latitudes to 10 degrees near the equator. The longitudinal coverage was 360 degrees where the interval for consecutive sunrises or consecutive sunsets was about 24 degrees.



Detailed Project/Campaign Description:

The SAGE I instrument was a four channel Sun photometer using a Cassegrainian-configured telescope, holographic grating, and four silicon photodiodes to define the four spectral channel bandpasses. Solar radiation was reflected off a pitch mirror into the telescope with an image of the Sun formed at the focal plane. The instrument's instantaneous field-of-view, defined by the aperture on the focal plane was a 30 arc-second circle that produced a vertical resolution at the tangent point of about 0.5 km. Radiation passing through the aperture was transferred to the spectrometer section of the instrument containing the holographic grating and four separate detector systems. The holographic grating dispersed the incoming radiation into four spectral regions centered at 1000, 600, 450, and 385 nanometer wavelengths. Slits on the Rowland circle of the grating defined the spectral bandpass of the four spectral channels. The bandpasses were 50, 30, 20,and 10 nanometers, respectively, for the above mentioned wavelengths. The entire imaging and spectrometer system was inside the azimuth gimbal to allow the instrument to be pointed at the Sun without image rotation. The azimuth gimbal could be rotated over 360 degrees so that measurements could be made at any azimuth angle.

The operation of the instrument, during each sunrise and sunset measurement, was totally automatic. Prior to each sunrise or sunset, the instrument was rotated in azimuth to its predicted solar acquisition position. When the Sun entered the instrument's field of view, the instrument adjusted its azimuth position to lock onto the radiometric center of the Sun to within +/- 45 arc-seconds and then acquired the Sun by rotating its scan mirror to the proper elevation angle. As the Sun traversed between the horizon and the tangent height of 150 kilometers, the elevation mirror scanned vertically across the solar disc. The radiometric channel data were sampled at a rate of 64 samples per second per channel, digitized to 12-bit resolution, and recorded for later transmission back to Earth. Additional SAGE I instrument information can be found in McCormick et al. (1979).

2. Data Availability:

Data Type(s):

Atmospheric transmittance data at four wavelengths were obtained during solar occultation at each satellite sunrise and sunset. Solar irradiance measurements were made at 1000, 600, 450, and 385 nanometers. Supporting data included spacecraft location and velocity and conventionally collected meteorological data which included temperature, temperature error, geometric altitude, density, and density error at 18 pressure levels from 1000 millibars to 0.4 millibars. Model meteorological altitude and temperature at 0.1 and 0.04 millibars were supplied by the processing group at NASA LaRC. All data were time-tagged. Instrument housekeeping data were also provided.

Input/Output Media:

Data are available by FTP or on media.

Proprietary Status:

None.

3. Data Access:

Data Center Location:

Langley DAAC User and Data Services Office
NASA Langley Research Center
Mail Stop 157D
Hampton, Virginia 23681-2199
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Associated Costs:

None.

4. Principal Investigator Information:

Dr. M. Patrick McCormick, Principal Investigator and Science Team Leader

5. Submitting Investigator Information:

Dr. M. Patrick McCormick, Principal Investigator and Science Team Leader

6. References:

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7. Glossary and Acronyms:

EOSDIS Acronyms (PDF).

AEM-B - Applications Explorer Mission-B
DAAC - Distributed Active Archive Center
ECC - Electrochemical Concentration Cell
EOSDIS - Earth Observing System Data and Information System
LaRC - Langley Research Center
NASA - National Aeronautics and Space Administration
NOAA - National Oceanic and Atmospheric Administration
SAGE I - Stratospheric Aerosol and Gas Experiment I
URL - Uniform Resource Locator

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