P79-10006
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NASA News

National Aeronautics and
Space Administration

Washington, D.C. 20546
AC 202 755-8370

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Press Kit

Project Stratospheric Aerosol and Gas Experiment (SAGE)

RELEASE NO: 79-6

(NASA-News-Release-79-6) SAGE TO EXAMINE EARTH'S STRATOSPHERE (National Aeronautics and Space Administration) 21 p CSCL 04A

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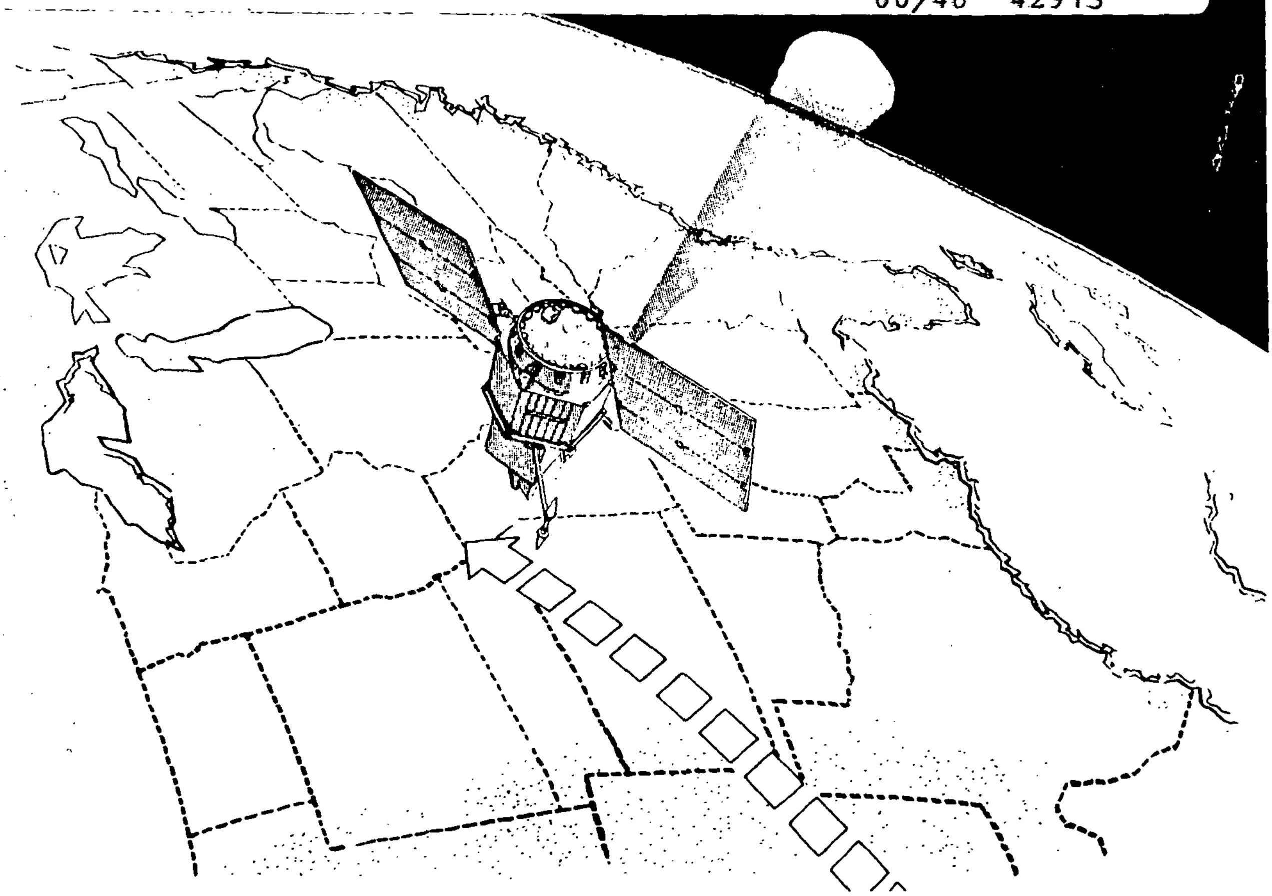

January 18, 1979

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CONTENTS

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RELEASE NO: 79-6

SAGE TO EXAMINE EARTH'S STRATOSPHERE

A 147-kilogram (324-pound) spacecraft will be launched by NASA Thursday, Jan. 25 to obtain data on the aerosols and ozone in the stratosphere. Called SAGE, for Stratospheric Aerosol and Gas Experiment, the applications satellite will be lifted into orbit from Wallops Flight Center, Wallops Island, Va., by a four-stage Scout launch vehicle.

The SAGE mission is international in scope, as its findings will be checked against extensive "ground truth" measurements conducted by special teams in the U.S., Japan and Europe.

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January 18, 1979

Besides man-made injections directly into the stratosphere, aerosols and gases are generated in the troposphere (starting at the Earth's surface and extending to the stratosphere) by processes that are only partly understood.

The main objective of SAGE is to obtain and use global data on stratospheric aerosols and ozone in various studies concerning the Earth's climate and environmental quality. The mission is designed to obtain this data from tropical to high latitudes for a period of at least one year.

Comparable aerosol data for the polar regions is being obtained by a Stratospheric Aerosol Measurement (SAM-II) experiment on the Nimbus-7 satellite, launched Oct. 24, 1978. The information will complement the SAGE data base.

The SAGE experiment aboard the Applications Explorer Mission-B (AEM-B) spacecraft will obtain its information by means of a photometric device. Flying at a 600-km (370-mi.) altitude in a circular Earth orbit, the SAGE photometer "looks" at the Sun through the stratosphere's gases and aerosols each time the satellite enters and leaves the Earth's shadow.

The aerosol population in the stratosphere, on the other hand, is changed abruptly by large volcanic eruptions which spew particles and gases into this region creating optical effects (e.g., prolonged and colorful sunsets) and possible cooling at the Earth's surface. Since trends in environmental quality or climate are usually masked by daily and seasonal variations, it takes a very long period of time to delineate them, says McCormick. Thus, a volcanic eruption during SAGE's measurement lifetime, would provide a unique opportunity for scientists to study the long-term distribution throughout the stratosphere of high-volume aerosols and other gases from a single point source.

The NASA Headquarters Environmental Observations Program has overall responsibility for the AEM/SAGE program. The NASA Goddard Space Flight Center, Greenbelt, Md., is responsible for project management of the spacecraft, scientific planning and coordination, and the tracking and data acquisition system. NASA Langley is responsible for the instrument module systems and the Scout launch vehicle. The NASA Wallops Flight Center at Wallops Island is responsible for the launching and launch support.

BACKGROUND

Aerosols and ozone play an important role in the radiation balance of the Earth's environment on a global scale. There is serious concern that industrial and aviation activities may lead to aerosol and gas entrapment and buildup in the stratosphere where constituents have residence times of three to five years.

In addition to natural or anthropogenic injections, aerosols and gases are generated by the atmosphere's chemistry through processes that are only partly understood. These, as well as unknown factors, determine not only the stratosphere's aerosol and gaseous content but also its changeable character. How much radiation the pollutants absorb, for example, is unknown because of ignorance about the optical properties of the aerosols themselves and their global distribution.

The concentration and distribution of ozone and, therefore, the ultraviolet radiation that reaches the Earth's surface must be better understood. Scientists know that: aerosols and lower stratospheric ozone act as tracers for circulation and transport phenomena; certain gases act as precursors for many of the aerosols; and the presence of aerosols may change the radiation fluxes in the ozone layer significantly. Very little is known, however, about the stratospheric aerosol or its optical properties. If one is going to determine the impact of new additions to the stratosphere, one must determine on a global basis: (1) the natural background or ambient constituents; (2) the aerosol and gaseous sinks; and (3) the aerosol and gaseous sources, both natural and anthropogenic (related to the activities of mankind).

Concern over the environmental quality of the stratosphere has been displayed recently by a sizable portion of the scientific community. New multi-million dollar international programs to study the stratosphere (e.g., the Department of Transportation's Climatic Impact Assessment Program) have emerged.

An evolution of new measurements is taking place concerning stratospheric gases, photo-chemical and chemical rate coefficients, ozone and submicron particulates. Many of these new measurements are being accomplished through the use of cumbersome laboratory equipment with stratospheric platforms provided by balloons and high-flying aircraft. Such measurements are not done quickly enough for many purposes not on a global basis. Both aspects are considered necessary for accurate monitoring. As a result, it is expected that monitoring will need to be done from space through remote-sensing techniques.

DATA COLLECTION AND PROCESSING

The SAGE sensor will measure the attentuation of the solar intensity by the limb of Earth's atmosphere in four separate wavelength bands during each spacecraft sunrise and sunset. With proper correction for atmospheric refraction effects, using measured or standard atmospheric temperature profiles, and solar limb darkening effects, data from each spacecraft sunrise and sunset will be converted to an intensity versus atmosphere tangent altitude profile.

Data from the SAGE instrument will be stored on-board the satellite and transmitted to a ground station once per day or more frequently, depending upon storage capacity and duration of events. Data will be gathered for a period of at least 12 months. Data collection will be the responsibility of the Goddard Space Flight Center Networks Directorate. SAGE raw data, along with orbital parameters synchronized to a common time base, will be provided to the experiment scientist at Langley Research Center.

The Goddard processed data will be reduced and analyzed at Langley utilizing computer programs developed at Langley and operational on Langley computers. The raw data will be converted first to measures of physical quantities and subsequently presented in a manner to permit the most rapid understanding of the physical processes being studied.

A SAGE Experiment Team (SET) has been created and will be involved in developing the data analysis techniques so that the resulting data products and software will represent a step toward truly operational methods.

Data from the SAGE instrument will be forwarded to the NASA National Space Science Data Center (NSSDC) at Goddard for archiving and distribution to other agencies and the scientific community on request.

MISSION DESCRIPTION

The Earth-orbital SAGE mission is to map vertical profiles in the stratosphere of ozone, aerosol, nitrogen dioxide and molecular extinction in a wide band around the globe. The ozone data will extend from about 9 to 46 kilometers (6 to 29 miles); aerosol data from the cloud tops to 35 km (22 mi.); nitrogen dioxide data from about 25 to 40 km (16 to 25 mi.); and molecular extinction from about 15 to 40 km (9 to 25 mi.).

SAGE INSTRUMENTATION

The SAGE sensor is a four-spectral channel radiometer which measures the extinction of solar radiation during solar occultation. As the spacecraft emerges from the Earth's shadow during each orbit, the sensor will acquire the Sun and measure solar intensity in four wavelength bands centered at 0.385 micrometers (um), 0.45 um, 0.6 um and 1.0 um.

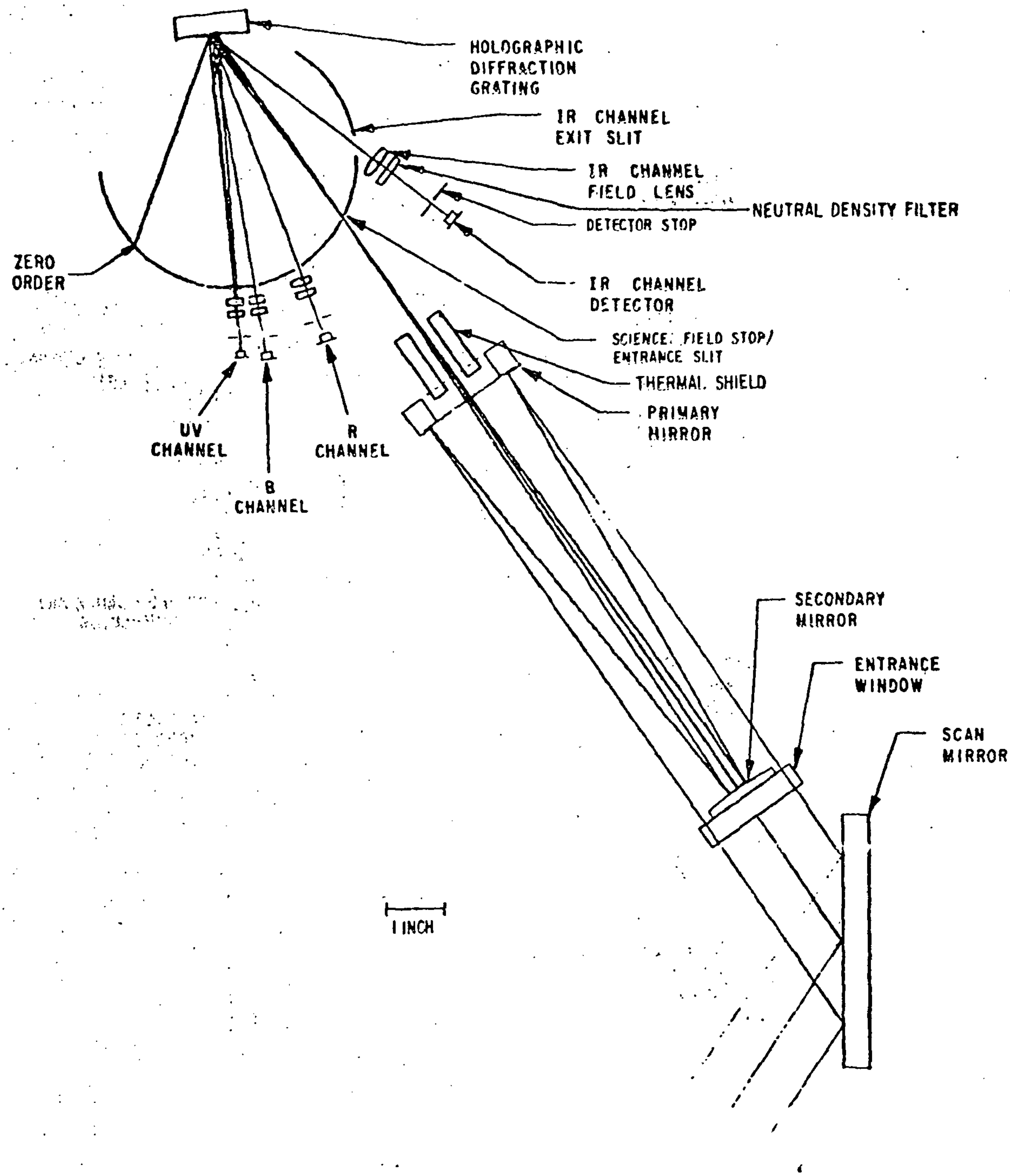
As the spacecraft continues in orbit, the line of sight from the spacecraft to the rising Sun will scan the Earth's atmosphere, resulting in a measurement of the attenuated solar intensity at different atmospheric layers. The procedure will then be repeated in a reverse sense during spacecraft sunset.

Each sunrise and sunset will be monitered from the top of the clouds to approximately 60 km (37 mi.) above the Earth's surface. The sensor has an instantaneous field of view of approximately 0.5-arc minutes, which corresponds to approximately 0.5 km (0.3 mi.) measured at the horizon for a 600 km (372 mi.) orbit.

The dynamic range of each radiometric measurement at the horizon is approximately 3,000 and the uncertainty in any radiometric measurement is specified to be less than 0.1 per cent of the unattenuated solar intensity. The sensor is partly self-calibrating in that a measurement of the unattenuated solar intensity is made before each spacecraft sunset or after each spacecraft sunrise.

The instrument module consists of optical and electronic subassemblies mounted side by side. The optical assembly consists of a flat scanning mirror, Cassegrain optics and a detector package.

The solar input is reflected from the scan mirror through the Cassegrain telescope, which produces a solar image upon the science detector aperture. The radiation through the aperture is dispersed by a holographic to four silicon photo diode detectors. The outputs of the detectors are fed to signal conditioning amplifiers. Their outputs go to the PCM encoder, which multiplexes and digitizes the signals and then transfers data to the AEM-B data system.



SAGE OPTICAL SYSTEM

THE SPACECRAFT

The SAGE AEM-B is a small, versatile, low-cost type spacecraft which uses three-axis stabilization for its viewing instruments. The structure primarily consists of two major components: a base module which contains the necessary attitude control, data handling, communications, command and power subsystems for the instrument module, and an instrument module containing the spectrometer and its supporting equipment. Two solar paddles for converting sunlight to electricity extend from the structure.

A yo-yo despin system is located on the base module cone section and below the solar array. Despin is accomplished by the transfer of some or all of the spacecraft's angular momentum into increased momentum of the yo-yo weights and cables. Weight release will be initiated by the spacecraft timer soon after the Scout's fourth-stage burnout.

Spacecraft characteristics follow:

Shape: Six-sided prism

Height:

Base module: 64.0 cm (25 in.)

Overall height
including antenna: 161.85 cm (63.7 in.)

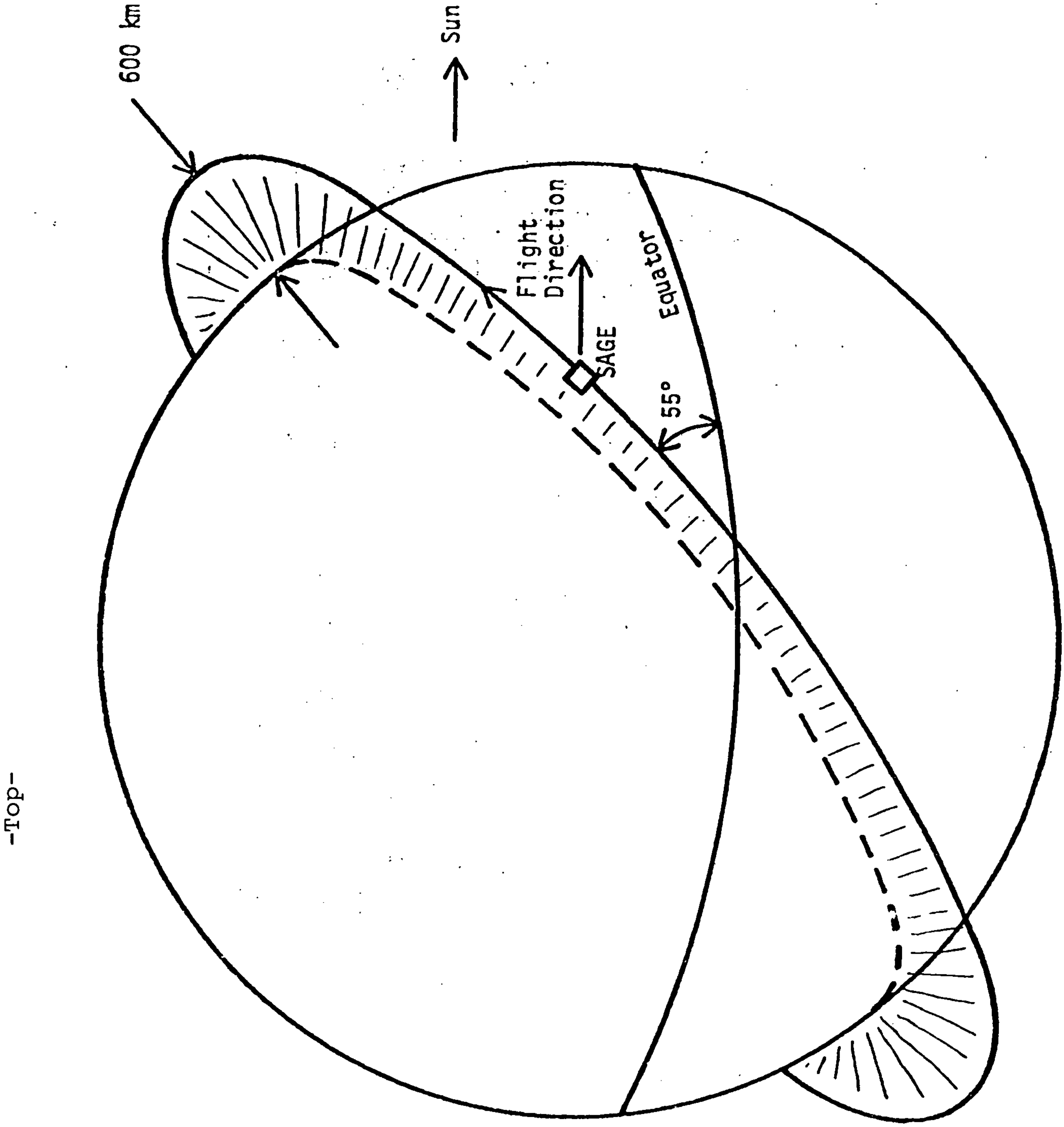
Weight:

Base module and adapter: 105.2 kg (232 lb.)

Instrument module: 27.7 kg (61 lb.)

Tape recorder: 14.1 kg (31 lb.)

Spacecraft total: 147.0 kg (324 lb.)



SAGE ORBIT

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