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A. TITLE: Mission and Sampling Analyses for Atmospheric Satellite Experiments

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C. ABSTRACT OF RESEARCH OBJECTIVES:

Orbital analyses, instrument-viewing geometry studies, and sampling simulations are performed to define mission concepts for advanced atmospheric research satellite experiments. These analyses are conducted in collaboration with NASA Headquarters and working groups consisting of atmospheric scientists and experiment developers. Analytical techniques are developed and used to optimize geographical coverage, sensor-viewing geometries, data gathering strategies, sampling schemes, orbital characteristics, satellite launch times, and operational modes of the various experiments and mission concepts. Short-term (7 days) Shuttle missions, the Upper Atmosphere Research Satellite (UARS), and multisatellite missions such as the Earth observing system (Eos) are being studied. Atmospheric experiments which are being analyzed include nadir-viewing sounders, limb-emission scanners, laser systems, and solar-occultation techniques.

D. SUMMARY OF PROGRESS AND RESULTS:

Numerous studies have been performed in the past 2 years in support of experiment and mission development for Earth observations and atmospheric sciences research. A study was conducted to determine science requirements for global climate change studies and for regional climate process studies (ref. 1). Orbital trade-off studies were conducted to identify satellite systems with the temporal resolution necessary for meeting the observational requirements for this research (ref. 2). It was determined that a number of satellite combinations could provide the required coverage. The best combination was 4 sun-synchronous satellites equally spaced in equatorial crossing time. This system would include the proposed NASA polar orbiting platform and similar spacecraft flown by the European Space Agency or by Japan. Other good systems included 2 or 3 sun-synchronous satellites combined with the Space Station Freedom or with a spacecraft in a medium altitude (5200 km) equatorial orbit. High temporal resolution process studies are best accomplished with a geosynchronous platform. The results of these studies were presented at a workshop on Geostationary Earth Observing System Concepts and to the Global Change Technology Initiative Architecture Trade Study Team.

Orbital trade-offs and geographical coverage capabilities were analyzed for the Infrared Limb-sounder Experiment (IRLE) on the proposed Mesosphere Lower Thermosphere Explorer (MELTER) satellite. Latitude coverage during specified seasons was evaluated for a range of scan azimuths with the constraint of avoiding nearly-direct solar views in order to prevent damage to the IRLE instrument (ref. 3). Similar orbital and mission analysis studies were conducted in support of experiment development for Spectroscopy of the Atmosphere using Far InfraRed Emission (SAFIRE). Geographical coverage capabilities were calculated for the NASA and ESA sun-synchronous Eos satellites. The effects of launch time, season, scan azimuth, multi-azimuth scan modes, and instrument operational scenarios were considered in order to optimize geographical coverage while ensuring that solar viewing constraints are met. Special consideration was given to maximizing polar coverage in the winter hemisphere and, in particular, during October in the southern hemisphere for the purpose of viewing the ozone hole. Study results were included in the successful SAFIRE Eos proposal (ref. 4).

Algorithms were developed and studies conducted to determine coincident measurement opportunities between various types of scanning instruments onboard the Upper Atmosphere Research Satellite and the Shuttle-launched Atmospheric Laboratory for Applications and Science (ATLAS) experiment. The study examined orbital parameters which can be varied in order to optimize coincident measurement opportunities for specified instruments on each satellite. The results showed that a significant number of coincident views from different instruments can be obtained during short-term missions for sensor validation and for analyses involving synergisms between different instruments.

Mission analysis was performed in support of HALOE instrument applications on the UARS. Orbital analyses were conducted to optimize solar occultation coverage for HALOE on UARS for specific launch dates (refs. 5 and 6).

E. <u>REFERENCES</u>:

1. Suttles, John T., Edwin F. Harrison, and Gary G. Gibson: Identification of science requirements for measuring global climate change. Report to the Global Change Technology Initiative Architecture Trade Study Team, August 22, 1989.

2. Harrison, E. F., G. G. Gibson, J. T. Suttles, I. Taback, and J. J. Buglia: Satellite orbit considerations for Earth observation missions. Report to the Global Change Technology Initiative Architecture Trade Study Team, August 22, 1989.

3. A proposal to the NASA to conduct a Phase A study of a Mesosphere-Lower Thermosphere Explorer (MELTER). Hays, Paul B., Principal Investigator; Orbital analysis and IRLE instrument coverage study by E. F. Harrison, 1988.

4. An Eos proposal for Spectroscopy of the Atmosphere using Far InfraRed Emission. Russell, J., Principal Investigator; Orbital analysis by E. F. Harrison, 1988.

5. Harrison, E. F., F. M. Denn, and G. G. Gibson: HALOE geographical coverage for a December 5, 1990 UARS launch. Presented at the UARS/HALOE Science Team meeting. Jan 1988.

6. Harrison, E. F., G. G. Gibson, and F. M. Denn: Further Analysis of Solar Occultation Coverage for a December 5, 1990 UARS launch. Presented at the UARS/HALOE Science Team meeting (also, Memo to Dixon Butler, NASA HQ), February 1988.