National Aeronautics and
Space Administration

December 15, 1997

NRA-97-MTPE-14

RESEARCH ANNOUNCEMENT

SAGE III OZONE LOSS AND VALIDATION EXPERIMENT (SOLVE)

Proposals Due February 17, 1998

OMB Approval No. 2700-0087

SAGE III OZONE LOSS AND VALIDATION EXPERIMENT (SOLVE)

NASA Research Announcement
Soliciting Research Proposals
for
Period Ending
February 17, 1998

NRA 97-MTPE-14
Issued December 15, 1997

Office of Mission to Planet Earth
National Aeronautics and Space Administration
Washington, DC 20546

Research Announcement for the **S**AGE III **O**zone **L**oss and **V**alidation **E**xperiment (A Joint NASA DC-8 and High Altitude Balloon Mission)

The **S**AGE III **O**zone **L**oss and **V**alidation **E**xperiment (SOLVE) is a proposed Arctic DC-8 aircraft and balloon measurement campaign designed to examine the loss rate of stratospheric ozone in early winter that remains unexplained by current chemistry and transport models. The mission will also acquire correlative measurements needed to validate the Stratospheric Aerosol and Gas Experiment (SAGE) III satellite mission and will use these satellite measurements to help quantitatively assess high latitude ozone loss. SOLVE is co-sponsored by the Upper Atmosphere Research Program (UARP) and Earth Observing System (EOS) of NASA's Office of Mission to Planet Earth as part of the validation program for the SAGE III instrument.

The SOLVE mission science/validation goals are described in more detail in Appendix A. These goals establish the measurement/instrument requirements. The mission will occur between November 1998 - early January 1999 time frame. The NASA DC-8 aircraft will carry instruments to examine Arctic ozone loss, halogen activation by aerosols and cirrus clouds, properties of polar stratospheric clouds, and to aid SAGE III validation. High altitude balloons will be flown carrying both in-situ and remote sensing instruments to examine the origin and composition of air that comprises the Arctic polar vortex, study halogen activation and reactive nitrogen removal by cold aqueous particles, and aid SAGE III validation. Intercomparison of the measurements made by the complementary aircraft-borne and balloon-borne instruments will enhance the scientific return and provide an increased understanding of atmospheric dynamical and chemical framework within which chemical ozone loss can be evaluated.

We expect to select instrument participants and a small theory team in early 1998. Instrument upload and testing on the aircraft will begin in mid-October/ early November 1998 following the DC-8 return from NASA's CAMEX mission. The DC-8 will be based at high latitudes in Fairbanks, Alaska; Keflavik, Iceland; or Stavanger, Norway. The balloon launches will possibly occur from Sondrestrom, Greenland; Thule, Greenland; Kiruna, Sweden; or Andoya, Norway. The theory team is expected to spend time in the field during the mission to obtain first hand familiarity with the airborne data and to collaborate with the measurement investigators in interpretation of the data. Instrument and meteorological data are to be made available to all investigators within approximately 24 hours after each flight. Mission activities will be broadcast in near real time via e-mail and a WWW site.

Proposals may be submitted at any time during the period ending February 17, 1998, but not later than 4:30 p.m. (EST) on February 17, 1998. Proposals received after that date will be handled in accordance with NASA policy concerning late proposals (NFS 1815.412). Proposals will be panel reviewed by approximately March 17, 1998. If accepted, they will be integrated into the FY98 research program beginning immediately.

Participation in SOLVE is open to all categories of organizations: educational institutions, industry, non-profit institutions, NASA centers, other US Government agencies, and international educational institutions, industries, and government agencies.

Funds are not presently available for awards under this NRA. The Government's obligation to make awards is contingent upon the availability of appropriated funds from which payment for award purposes can be made and the receipt of proposals which the Government determines are acceptable for award under this NRA.

Appendix B contains the basic guidance needed for preparation of proposals in response to an NRA. Appendix C provides guidance for foreign participation. Appendix D includes required certifications and proposal cover sheet, which must be completed and returned to NASA with any proposal submitted in response to this NRA.

Identifier:	NRA-97-MTPE-14

Submit Proposals to:

SOLVE NRA
Code Y
400 Virginia Avenue SW, Suite 700
Washington, DC 20024

For overnight mail delivery purposes only the recipient telephone number is (202) 554-2775.

Copies Required:	10
Selecting Official:	Director, Science Division
Obtain Additional Information From:	Dr. Michael J. Kurylo, Manager Upper Atmosphere Research Program NASA Headquarters, Code YS Washington, DC 20546 Tel.: (202) 358-0237 Fax: (202) 358-2770 e-mail: mkurylo@hq.nasa.gov

Your interest and cooperation in participating in this opportunity are appreciated.

W. F. Townsend
Acting Associate Administrator
Office of Mission to Planet Earth

Enclosures:

Appendix A, “Technical Description of the SAGE III Ozone Loss and Validation Experiment (SOLVE)”

Appendix B, "Instructions for Responding to NASA Research Announcements"

Appendix C, "Guidelines for Foreign Proposals"

Appendix D, "Required Certifications and Cover Sheet"

APPENDIX A:

Technical Description of the SAGE III Ozone Loss and Validation Experiment (SOLVE): A Joint NASA DC-8 and High Altitude Balloon Mission

1.0 Science Objectives

1.1 Polar ozone loss during mid winter.

Results from the 1995 DC-8 Tropical Ozone Transport Experiment and Vortex Ozone Transport Experiment, TOTE/VOTE (information available on the World Wide Web at http://hyperion.gsfc.nasa.gov/Analysis/aircraft/tote/vote_top.html) along with modeling studies suggest that models cannot currently account for the amount of ozone lost during the winter [A. Douglass, private communication]. This discrepancy has also been reported in comparisons with data taken during recent European campaigns (Hansen et al., 1997; Bregman et al., 1997). The TOTE/VOTE measurements suggested that an extreme amount of mixing is taking place in the polar lower stratosphere (25-14 km). Mid-latitude air mixes into the vortex and replaces the air that contains more ozone, which is descending out of the vortex base as a result of diabatic cooling. It is apparent that we still have a poor understanding of the balance of ozone production, loss and transport in the lower stratosphere even in the early winter period where chlorine chemistry is not very active.

To attack the issue of ozone chemistry and transport in the lower winter stratosphere, the SOLVE mission will utilize in situ ozone, temperature, trace gas, and aerosol measurements along with lidar ozone, aerosol, temperature and water vapor measurements from the NASA DC-8. The basic mission tactic for the DC-8 will be to fly across the vortex several times during the early and mid-winter periods to develop a climatology which, when combined with the balloon information, can be used to estimate the descent and mixing rates within the vortex. Meridional mixing will be estimated from models whose validity will be tested against the ozone profiles as was done during TOTE/VOTE.

In conjunction with the aircraft measurements, balloon trace gas, ozone, and aerosol measurements will be used to estimate descent rates and meridional mixing rates in an attempt to quantify the ozone budget in the lower stratosphere. The balloon-borne flights will use in situ instruments capable of providing high-precision, high-accuracy observations of long-lived tracers of atmospheric transport such as CO_2, SF_6, N_2O, CH_4, CFC-11, CFC-113, CFC-12, O_3, H_2O, pressure, and temperature in the critical region between 20 and 30 km altitude. Solar occultation FTIR remote sensing will be used to measure N_2O, H_2O, CH_4, HF, CFC-11, CFC-113, CFC-12, O_3, pressure, and temperature as well as photochemically active gases NO, NO_2, N_2O_5, HNO_3, HNO_4, $ClNO_3$, HOCl, HCl, H_2O_2, and O_3. The remote measurements of photochemically active nitrogen and halogen gases will allow quantification of the efficiency of heterogeneous processing in the 22 to 26 km altitude region, while the remote measurements of HNO_3, total NO_y, N_2O, and H_2O will provide important constraints on the phase and composition of PSCs and possibly on the mechanism for denitrification. Measurements of ClO, HCl, and O_3 obtained by a sub-millimeter wave limb sounding instrument for air masses adjacent to those sampled by an FTIR instrument will permit investigation of the budget and partitioning of the reactive chlorine family.

1.2. The Origin and Composition of Air Comprising the Arctic Polar Vortex

Understanding the origin and composition of air comprising the Arctic polar vortex is important for interpreting the subsequent cold temperature chemistry and ozone loss because the origin and composition define the initial states for O_3, the nitrogen and halogen compounds that interact with aerosols, and the HNO_3 and H_2O vapors that condense to form PSCs. Balloon-borne measurements allow this issue to be examined in several ways. First, the simultaneous vertical profiles of long-lived trace gases permit the diagnosis of rates of vertical descent and meridional mixing. Second, the observations of CO_2 and SF_6 yield the average age of the air being sampled. Third, scatter plots of different pairs of long-lived species define distinct relations for polar, mid-latitude, and tropical airmasses. These polar measurements of long-lived trace gases (combined with existing observations from the tropics, mid-latitudes, and the summer polar region) can help quantify how much of the vortex is composed of stagnant summertime polar air, mid-latitude air on the same isentropic level, and higher altitude air that has descended from above. Furthermore, profiles of O_3 and CH_4 in the incipient vortex greatly aid the estimation of O_3 loss rates from measurements by the HALOE instrument on NASA's Upper Atmosphere Research Satellite, which typically does not sample the vortex until later in the season. Finally, remote observations can define initial profiles of total reactive chlorine (Cl_y) and nitrogen (NO_y), as well as H_2O, CH_4, HNO_3, HCl, $ClNO_3$, and O_3 within the vortex.

These observations will allow for better understanding of the role of transport on the evolution of Arctic O_3 during a typical winter, as well as more reliable model predictions of the sensitivity of vortex composition to exhaust from (current and future) subsonic and (future) supersonic aircraft.

1.3 Halogen Activation by Aerosols and/or Cirrus

Data presented by Avallone et al. (1993) showed that ClO in the lower stratosphere was enhanced relative to the concentrations calculated from models that include heterogeneous conversion of N_2O_5 to nitric acid on sulfate aerosol. Ozone loss rates calculated from measured ClO were three times larger than predicted by standard models at 16 km. Contributing to this enhanced ozone loss were reactions from the ClO_x, BrO_x, and HO_x families. Avallone et al. speculated that chlorine nitrate is a much larger fraction of the inorganic chlorine budget than most models predict. Since publication of Avallone et al. (1993) laboratory measurements have shown that heterogeneous reactions of bromine compounds ($BrNO_3$, HOBr, and HBr) are considerably faster than their chlorine counterparts, and it is possible that such reactions can convert some HCl into chlorine nitrate in the lower stratosphere. Because HCl is the dominant reservoir of inorganic chlorine in the lowermost stratosphere and active chlorine is more easily released from $ClNO_3$ than from HCl, even a small conversion of HCl to $ClNO_3$ can result in significant enhancements of ClO.

Recently, Solomon et al. (1997) have proposed that inorganic chlorine can also be activated rapidly in cirrus clouds at even lower altitudes, and that resulting increases in ClO could be responsible for significant downward trends in ozone that have been observed by SAGE II. Unfortunately, there have been few direct measurements of ClO in cirrus, and those that exist have been ambiguous (Borrmann et al., 1997). Solomon et al. (1997) predict that heterogeneous reactions of chlorine nitrate and HCl can result in enhanced ClO mixing ratios as high as 10 ppt in summer and 50 ppt or higher in winter in the region near the tropopause. These are abundances that are readily detectable by existing in situ instruments. However, regions of active formation of cirrus have not been the focus of previous missions, and the aircraft in situ ClO instruments have typically been operated primarily in the stratosphere to protect the optics from condensation.

As part of this mission, we hope to examine these issues by augmenting the SOLVE DC-8 payload with in situ measurements of ClO, BrO, OH, and HO_2. Several reactions can activate halogens in the lower stratosphere, and possibly in the upper troposphere as well. Two of these ($ClNO_3 + H_2O$ and $BrNO_3 + H_2O$) produce HOCl and HOBr, species that can be important sources of Ho_x. The heterogeneous reactions HOBr + HCl and HOCl + HCl destroy potential sources of HO_x while activating halogen radicals. Because ozone loss rates in the lower stratosphere are dominated by HO_x, and because ozone loss is potentially enhanced if halogens are activated by lower stratospheric aerosols and cirrus, we hope to augment the DC-8 payload with fast-response in situ instruments to measure ClO, BrO, OH and HO_2. Important adjunct measurements will be those of particle surface area, water vapor, temperature, and tracers (needed to estimate Cl_y and Br_y). Other measurements which could be useful are those of HNO_3 and HOCl. If in situ measurements of nitric acid are not available then measurements of NO_y (e.g., NO, NO_2, HNO_4, N_2O_5, $ClNO_3$, and HNO_3) and NO_2 or NO can indicate the amount of HNO_3 and active nitrogen radicals. Changes in NO_y amounts should occur in the presence of cloud ice particles, thus we expect that proposed NO_y measurements use dual inlet techniques to estimate particle HNO_3 amounts. Nadir viewing aerosol lidar measurements and knowledge of the tropopause height from temperature profiles will also provide a survey of the occurrence of cirrus in the lower stratosphere.

1.4 Properties of Cold Aerosols and Polar Stratospheric Clouds

One of the major issues concerning polar stratospheric ozone loss is to understand the composition of PSCs. Reaction rates vary depending upon whether the aerosols are solids or liquids. They also vary with cloud exposure, frequency, and conditions of cloud formation. At present it is thought that many of the clouds are supercooled nitric acid/sulfuric acid/water solutions. However, DC-8 lidar data from AASE (an airborne campaign conducted in 1989) indicate that the aerosols were solids more that half the time on every flight on which PSCs were observed (Browell et al., 1990).

There are several techniques which allow one to determine the composition of the polar stratospheric clouds, infrared spectroscopy from the DC-8 being one that offers two basic advantages. First there are several EOS instruments scheduled for launch in the next several years that will observe PSCs at infrared wavelengths. In order to maximize the return from these instruments it is desirable to develop the link between PSC composition and infrared properties at the present time. We believe that these data will pave the way for interpreting future EOS observations. Secondly, it has already been demonstrated in AAOE (an airborne campaign conducted in 1987) that useful infrared spectra of PSCs can be obtained from the DC-8. The advantages of the technique are that the PSCs are not altered by the observation, as occurs with in situ techniques, and that the observations are sensitive to the molecular form of the PSC. That is, the spectra of nitric acid trihydrate (NAT), nitric acid dihydrate (NAD), and ternary $HNO_3/H_2SO_4/H_2O$ solutions are distinctly different - a fact which is used in laboratory studies of the clouds. A disadvantage of the technique is that a long path is observed. Hence, small volume PSCs may be difficult to detect. Also, since sunlight is required for the observation, only PSCs near the low latitude edge of the vortex are observable in mid-winter, and the aircraft must be properly positioned to observe the sun low on the horizon. Of course, low sun angles are also required for coincident SAGE III validation measurements so this is not necessarily a limitation in this experiment.

Balloon-borne remote sensing measurements of the concentration of gaseous HNO_3 and H_2O, combined with existing laboratory vapor pressure data, provide strong constraints on the phase and composition of PSCs. If Type 1 PSCs are composed of NAT, a significant fraction of the gas-phase HNO_3 will be removed by condensation within 2 to 3 °K below the NAT condensation temperature. On the other hand, if Type 1 PSCs are ternary solution droplets, significant gas-phase HNO_3 removal will begin at a lower temperature and occur more gradually as temperature decreases further. If PSCs are composed of NAD, intermediate concentrations of gas phase HNO_3 will result. Thus, balloon-borne measurements of the gases that compose PSCs, combined with DC-8 measurements of aerosol properties, should provide the constraints within which the composition of PSCs can be determined.

1.5 SAGE III Validation

SAGE III is the latest in a family of solar occultation satellite instruments designed to monitor distributions of stratospheric and upper tropospheric aerosol, ozone, water vapor, and nitrogen dioxide. Significant technical advancements over its predecessor (SAGE II) will also permit the measurement of temperature and pressure, as well as measurements during lunar occultation events of the nighttime species NO_3 and OClO (see McCormick, 1996). The first of three SAGE III instruments is scheduled for launch in August 1998 in a sun-synchronous orbit on board the Russian Meteor 3M spacecraft. Solar occultation measurements of SAGE III will occur mostly at high latitudes, while lunar occultation events will vary from pole-to-pole. A Figure showing the expected SAGE III measurement locations throughout the year may be accessed via the internet (see McCormick, 1997).

The validation of SAGE III science products requires airborne and balloon correlative measurements that are in close temporal and spatial coincidence in order to reduce uncertainties in representative sampling. Added correlative measurements are also needed along the line-of-sight between the satellite and the sun (or moon) to assess the impact of constituent inhomogeneity on the retrieval algorithm. This is especially true in the presence of polar stratospheric clouds or cirrus. The measurement requirements specified below are discussed further in the SAGE III Validation Plan (McCormick, 1997).

1.5.1 DC-8 Measurements for SAGE III Validation

1.5.1.1 Ozone

SAGE III will measure ozone concentration from cloud top to 85 km with an accuracy of about 6% at the peak and a vertical resolution of 0.5 km. Validation of this product over this height range is beyond the scope of this mission. Instead, this mission will focus on obtaining correlative ozone measurements in the upper troposphere and lower stratosphere. Accurate knowledge of ozone trends in this region near the tropopause is critical for assessing radiative forcing. Historically, this is the same altitude regime in which SAGE II has had its greatest uncertainties in ozone trend assessments (Harris et al., 1997).

To address the vertical extent of the SAGE III ozone measurement variability over the slant path (line-of-sight) of approximately 200 km for a given altitude, we hope to include zenith viewing lidar measurements of stratospheric ozone concentrations in the DC-8 instrument payload. Lidar measurements provide high precision, but have lower accuracy; thus, an in situ ozone concentration measurement will also be needed. Lidar profile measurements should extend to an altitude of at least 10 km above flight altitude.

1.5.1.2 Aerosols

SAGE III will measure aerosol extinction at seven wavelengths ranging from 385 to 1550 nm in the troposphere and stratosphere. Validation of these measurements as well as inferred products such as aerosol surface area will be based on intercomparisons with different instruments. We thus anticipate that many of the instruments identified in the SAGE III validation plan will be included in this mission.

1.5.1.3 Sun photometer

Solar photometers can provide slant path optical depth measurements at many of the same wavelengths measured by SAGE III. Such measurements can further be differentiated during aircraft ascents or descents to yield vertical extinction profiles for intercomparison. With such an instrument on the DC-8 payload, the profiles can be compared to those calculated by in situ particle samplers or inferred from lidar backscatter observations.

1.5.1.4 Lidar Aerosol and Cloud Measurements

Vertical lidar backscatter measurements provide an excellent method for examining the vertical and horizontal variability of aerosol and optically thin cloud along the SAGE slant path. Since the aerosol lidar retrieval is strongly affected by the normalization procedure, measurements should reach heights above 30 km, where the return is dominated by Rayleigh scattering. Measurements must have 0.5 km vertical resolution or better. Depolarization measurements are further required to discriminate between spherical and non-spherical particles. In support of these measurements, observations from a zenith viewing all-sky camera may also be desired to aid in the interpretation of clouds along the SAGE slant path.

1.5.1.5 In Situ Particle Samplers

Atmospheric chemistry models need accurate information on aerosol surface area to determine the effects of heterogeneous reactions on the ozone distribution. The multi-wavelength SAGE III aerosol measurements will be used to produce estimates of aerosol surface area, a research product that needs to be validated with in situ particle samplers. To fulfill this need, well-calibrated instruments are required that can obtain aerosol particle size distributions in the sub-micron size range. Information on variability of aerosol composition in the stratosphere and upper troposphere is also required, in order to the examine variability of the backscatter-to-extinction conversion factor. Instruments should be able to measure particle optical surface area to better than a factor of two.

In addition knowledge of the surface area of cirrus is required to understand the heterogeneous chemistry that may occur on such clouds. In this regard, replicators and holographic instruments that are capable of sizing ice crystals in the size regime below 50 mm would be useful. Consideration will also be given to instruments that measure ice water content.

Finally, we need to better understand the mode of formation of new particles in the upper troposphere and lower stratosphere. This requires measurements of the size distributions of particles beyond the few nanometer size range with good temporal resolution. There are currently no such data from the lower stratosphere and very few from the troposphere above the boundary layer.

1.5.1.6 Water Vapor

Although water vapor measurements of the upper troposphere and lower stratosphere have been conducted since the late 1940s, considerable disagreement remains between different measurement techniques. Consequently, SAGE III validation will require a series of water vapor measurement intercomparisons to bracket its accuracy among other aircraft and balloon instruments.

1.5.1.6.1 In Situ Water Vapor Measurements

Water vapor measurements with an accuracy of ~10% for the upper troposphere and <25% for the stratosphere will be needed. These observations will also be used to understand SAGE III aerosol/cloud measurements.

1.5.1.6.2 Lidar Water Vapor Measurements

Because of the variability of water vapor in the troposphere, lidar profile measurements are required to examine its inhomogeneity along the SAGE III slant path. Measurements are also desired in the stratosphere, where variations near PSCs could provide insight on cloud formation. Such profile measurements should extend at least 10 km above and 5 km below flight altitude in clear sky conditions.

1.5.1.7 Temperature

SAGE III will make temperature profile measurements, a capability not realized by either of its predecessors. Temperature profiles also will be used to help interpret PSC measurements and to delineate the altitude of the tropopause. Profile measurements are needed from a point several kilometers below the aircraft to a height of about 35 km. It is envisioned that several instruments will be needed to satisfy this requirement.

1.5.1.8 Altitude Registration of Transmission Profiles

The accurate determination of the transmission profile is fundamental to the retrieval of all species. For SAGE I, altitude registration errors of about 200 - 400 m resulted in biases in ozone mixing ratio and other species (Wang et al., 1996). For SAGE III, altitude registration with an uncertainty of < 100 m is desired. Validation may be achieved by measuring the altitude of the top of an optically thick cloud that lies along the slant path. It may also be achieved by matching profiles of aerosol, ozone, and water vapor, especially near the tropopause where strong vertical gradients exist. A combination of upward and downward viewing lidar profiles acquired along aircraft survey and staircase flights should provide this information.

1.5.1.9 Facility measurements

DC-8 facility measurements of time, position (latitude, longitude, and both radar and pressure altitude), attitude angles, and in situ temperature will be available to investigators.

1.5.2 Balloon-borne Measurements for SAGE III Validation

Balloon-borne FTIR remote sensing observations provide an alternate validation means for the SAGE III satellite instrument. The balloon-borne observations of O_3 and H_2O, which have been compared extensively to in situ data and have served as correlative measures for a number of instruments aboard The Upper Atmosphere Research Satellite (UARS), will be used in a similar capacity for SAGE III validation. In situ observations of O_3 and H_2O will also be used for such validation efforts. The remotely sensed balloon-borne observations of O_3 and H_2O can serve as a bridge between the in situ and SAGE III observations because both SAGE III and the balloon FTIR are solar occultation instruments with comparable vertical and horizontal resolution. Measurements of NO_2 by an FTIR instrument will be used for validation of SAGE III measurements of this species; similar viewing geometries are particularly helpful owing to the strong dependence of concentrations of NO_2 on solar zenith angle. In situ measurements of aerosol surface area will provide validation for SAGE III estimates of this parameter. The balloon-borne instruments will not obtain observations of NO_3 and OClO, two gases measured by SAGE III. However, measurements of vertical profiles of every important gas in the NO_y family other than NO_3 (e.g., NO, NO_2, HNO_4, N_2O_5, $ClNO_3$, and HNO_3) as well as O_3 by an FTIR solar occultation instrument will, together with photochemical models, provide useful constraints for the interpretation of SAGE III measurements of NO_3. In a similar manner, the balloon-borne observations of ClO, HCl, and O_3 by a submillimeter wave emission instrument will be particularly useful for guiding the interpretation of SAGE III measurements of OClO.

2.0 Measurement Requirements/ Instrumentation

2.1 Aircraft Payload

Potential DC-8 instrumentation is listed below in approximate mission priority. The basic mission consists of measurements 1-8 which meet SAGE III validation requirements and ozone loss science objectives. Instruments 9-14, complement these basic objectives with the additional science objectives discussed above.

1) Ozone profile (lidar)
2) Aerosol profile (lidar)
3) Aerosol optical depth (sun photometer)
4) Temperature profile (lidar, microwave)
5) Water vapor profile (troposphere)
6) In situ water vapor
7) In situ ozone
8) In situ aerosols - 0.1-5 mm, 0-0.1 mm (CN)
9) Water vapor profile (lidar, stratosphere)
---- meets basic mission SAGE III validation and ozone loss requirements

10) In situ long lived trace gases (CO, N_2O, CH_4, CFC's)
11) In situ radicals ClO, BrO, OH, HO_2
12) In situ aerosols - >5 mm
13) In situ reservoir gases HOCl, HNO_3
---- adds mission capability for investigating halogen/nitrogen chemistry in the lower stratosphere

14) Solar FTS
---- adds mission capability for investigating PSC composition

Instrument selection will be based upon a combination of cost, measurement priority, heritage of the measurements / instruments proposed, and available space on the DC-8. At the end of each flight, each investigator will be required to produce a preliminary data set for exchange with other measurement investigators and the theory team. Because of the volume of the lidar data, a field set of CD-ROMS or high capacity removable magnetic media may be produced for exchange using the Ames Aircraft Hipskind/Gaines format. A final submission of data with supporting documentation is required to a central data facility approximately six months following completion of the mission. Investigator teams are also expected to participate in a SAGE III validation workshop tentatively scheduled for October 1999.

2.2 Balloon Payload

The desired balloon-borne measurements are listed below. We expect that the balloon payloads will be similar to those flown during the in situ (Observations from the Middle Stratosphere, OMS) and remote sensing components of the STRAT and POLARIS aircraft missions.

Remote sensing, solar occultation: O_3, N_2O, CH_4, NO, NO_2, HNO_3, HNO_4, HCl, HOCl, $ClONO_2$, CH_3Cl, CFC-11, CFC-12, CCl_4, CFC-113, H_2O, SF_6, P, and T.

Remote sensing, submillimeter wave emission: ClO, O_3, and HCl.

These observations provide simultaneous measurements of long-lived tracers, the major components of the nitrogen and chlorine families, and ozone and water vapor. The two types of instruments should be flown together on the same gondola, using both O_3 and HCl to indicate how well the two are looking at the same airmass.

In-situ: O_3, CO_2, N_2O, CH_4, HCl, CFC-11, CFC-12, CFC-113, P, T, aerosol characteristics, and H_2O.

These observations provide the simultaneous measurements of long-lived tracers for determining the age of the air and give the useful scatter plots for measurements that are the same as those made in the middle latitudes, the summertime high latitudes, and the tropics.

If the existing OMS in-situ gondola is used, then water vapor, aerosols, and/or ozone may be measured (additionally or separately) on free-flying balloons launched simultaneously. This approach has been the most successful for getting high-quality water vapor measurements simultaneous with the other long-lived tracer measurements during previous OMS flights.

3.0 Mission Logistics

An initial science team meeting for selected investigators and program/project management will be held in March-April 1998 at a location yet to be determined.

3.1 DC-8 Deployment Schedule

The tentative schedule for the DC-8 is as follows:

Instrument integration and upload - mid-October through mid-November, 1998.
Test flights - late November, 1998.
Mission deployment - Transit to field site(s), SAGE III profile flights and ozone loss science flights possibly coordinated with balloon launch(es) from late November through mid-December, 1998 prior to returning to the NASA Langley Research Center around December 15, 1998.

Test flight - on or about December 30, 1998.
Transit flight to field site(s) and a series of local science flights - January 2 through January 13, 1999, with final return to NASA Dryden Flight Research Center by January 15, 1999.

Mission locations for the DC-8 are under consideration and will be finalized by early 1998. Under consideration are the US or NATO military installations at Stavanger, Norway; Keflavik, Iceland; or Fairbanks, Alaska. Experimenters can expect heated hanger space, but limited telecommunications and ground lab facilities. Theory teams are expected to bring their own data analysis computers into the field. Internet connections are not guaranteed except through commercial analog telephone service. Proposals from an experienced meteorological support team will also be considered.

3.2 Balloon Launch Schedule

Balloon operations will be conducted by the National Scientific Balloon Facility at Palestine, Texas. They will provide the balloon-launching capability, telemetry, and recovery as they have for operations in New Mexico, Brazil, and Alaska. Free flying, hand-launched balloons may be necessary for water vapor, aerosols, and/or ozone, in which case, the investigators would be responsible for the launches.

Balloon flights will be conducted from one of four sites: Sondrestrom, Greenland (67.0°N, 50.7°W), Thule, Greenland (76.5°N, 68.7°W), Kiruna, Sweden (67.8°N, 20.4°E), or Andoya, Norway (69.3°N, 16.0°E). The goal is to have the launches of the various in situ and remote sensing balloon payloads as close together in time and space as possible. However, it may be necessary to have separate locations for the remote sensing and in situ payloads in order to achieve the goals of long-lived measurements within the forming Arctic vortex for the OMS in-situ payload and overlapping measurements of the balloon-borne remote sensing and SAGE III instruments. Experimenters can expect limited telecommunications and ground lab facilities at these locations. Internet connections are not guaranteed except through commercial analog telephone service. The selection of a site will depend on the surface winds, logistical issues, and costs.

Launch periods:

November, 1998. The goal is to launch the balloon payloads into the Arctic polar vortex. A second goal is to make observations close in time and space to a SAGE III overpass. Both remote sensing and in-situ payloads will be deployed. Deployment of the remote sensing payload can be from all possible sites except Thule, which is too far into polar night. Based on past meteorology, all three sites have at least a 50% chance of launching into the Arctic polar vortex in late November. The selection of a site will need to be based in part on the wind climatology, which will dictate the overall chances of achieving a launch.

The temperatures will be dropping at the higher altitudes as the air cools, giving an opportunity to measure with remote sensing the changes in nitrogen and chlorine partitioning caused by cold heterogeneous processes as a function of altitude (and thus pressure, temperature, and aerosol loading).

January, 1999. If the SAGE III launch develops significant delays, then a January launch of the balloon-borne remote sensing payload would provide the validation for SAGE III. This launch together with a November launch would also provide information about the descent rates and meridional transport associated with the Arctic polar vortex in the November - January time frame.

Possible additional in-situ balloon flights at middle latitudes:

April, 1998. In order to use the OMS in-situ tropical data taken from Juazeiro do Norte, Brazil in February and November, 1997 to define the meridional mixing between the tropics and middle latitudes between 15 and 30 km, good mid-latitude vertical profiles with the same instruments are essential for several analyses. Thus a single flight of the selected in situ payload may be scheduled from Ft. Sumner, New Mexico in early April, 1998.

4.0 References

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Appendix B:

INSTRUCTIONS FOR RESPONDING TO NASA RESEARCH ANNOUNCEMENTS

(JANUARY 1997)

(a) General.

(1) Proposals received in response to a NASA Research Announcement (NRA) will be used only for evaluation purposes. NASA does not allow a proposal, the contents of which are not available without restriction from another source, or any unique ideas submitted in response to an NRA to be used as the basis of a solicitation or in negotiation with other organizations, nor is a pre-award synopsis published for individual proposals.

(2) A solicited proposal that results in a NASA award becomes part of the record of that transaction and may be available to the public on specific request; however, information or material that NASA and the awardee mutually agree to be of a privileged nature will be held in confidence to the extent permitted by law, including the Freedom of Information Act.

(3) NRAs contain programmatic information and certain requirements which apply only to proposals prepared in response to that particular announcement. These instructions contain the general proposal preparation information which applies to responses to all NRAs.

(4) A contract, grant, cooperative agreement, or other agreement may be used to accomplish an effort funded in response to an NRA. NASA will determine the appropriate instrument. Contracts resulting from NRAs are subject to the Federal Acquisition Regulation and the NASA FAR. Supplement. Any resultant grants or cooperative agreements will be awarded and administered in accordance with the NASA Grant and Cooperative Agreement Handbook (NPG 5800.1).

(5) NASA does not have mandatory forms or formats for responses to NRAs; however, it is requested that proposals conform to the guidelines in these instructions. NASA may acceptp proposals without discussion; hence, proposals should initially be as complete as possible and be submitted on the proposers' most favorable terms.

(6) To be considered for award, a submission must, at a minimum, present a specific project within the areas delineated by the NRA; contain sufficient technical and cost information to permit a meaningful evaluation; be signed by an official authorized to legally bind the submitting organization; not merely offer to perform standard services or to just provide computer facilities or services; and not significantly duplicate a more specific current or pending NASA solicitation.

(b) NRA-Specific Items. Several proposal submission items appear in the NRA itself: the unique NRA identifier; when to submit proposals; where to send proposals; number of copies required; and sources for more information. Items included in these instructions may be supplemented by the NRA.

(c) The following information is needed to permit consideration in an objective manner. NRAs will generally specify topics for which additional information or greater detail is desirable. Each proposal copy shall contain all submitted material, including a copy of the transmittal letter if it contains substantive information.

(1) Transmittal Letter or Prefatory Material.

(i) The legal name and address of the organization and specific division or campus identification if part of a larger organization;

(ii) A brief, scientifically valid project title intelligible to a scientifically literate reader and suitable for use in the public press;

(iii) Type of organization: e.g., profit, nonprofit, educational, small business, minority, women-owned, etc.;

(iv) Name and telephone number of the principal investigator and business personnel who may be contacted during evaluation or negotiation;

(v) Identification of other organizations that are currently evaluating a proposal for the same efforts;

(vi) Identification of the NRA, by number and title, to which the proposal is responding;

(vii) Dollar amount requested, desired starting date, and duration of project;

(viii) Date of submission; and

(ix) Signature of a responsible official or authorized representative of the organization, or any other person authorized to legally bind the organization (unless the signature appears on the proposal itself).

(2) **Restriction on Use and Disclosure of Proposal Information**. Information contained in proposals is used for evaluation purposes only. Offerors or quoters should, in order to maximize protection of trade secrets or other information that is confidential or privileged, place the following notice on the title page of the proposal and specify the information subject to the notice by inserting an appropriate identification in the notice. In any event, information contained in proposals will be protected to the extent permitted by law, but NASA assumes no liability for use and disclosure of information not made subject to the notice.

Notice

Restriction on Use and Disclosure of Proposal Information

The information (data) contained in [insert page numbers or other identification] of this proposal constitutes a trade secret and/or information that is commercial or financial and confidential or privileged. It is furnished to the Government in confidence with the understanding that it will not, without permission of the offeror, be used or disclosed other than for evaluation purposes; provided, however, that in the event a contract (or other agreement) is awarded on the basis of this proposal the Government shall have the right to use and disclose this information (data) to the extent provided in the contract (or other agreement). This restriction does not limit the Government's right to use or disclose this information (data) if obtained from another source without restriction.

(3) **Abstract.** Include a concise (200-300 word if not otherwise specified in the NRA) abstract describing the objective and the method of approach.

(4) **Project Description**.

(i) The main body of the proposal shall be a detailed statement of the work to be undertaken and should include objectives and expected significance; relation to the present state of knowledge; and relation to previous work done on the project and to related work in progress elsewhere. The statement should outline the plan of work, including the broad design of experiments to be undertaken and a description of experimental methods and procedures. The project description should address the evaluation factors in these instructions and any specific factors in the NRA. Any substantial collaboration with individuals not referred to in the budget or use of consultants should be described. Subcontracting significant portions of a research project is discouraged.

(ii) When it is expected that the effort will require more than one year, the proposal should cover the complete project to the extent that it can be reasonably anticipated. Principal emphasis should be on the first year of work, and the description should distinguish clearly between the first year's work and work planned for subsequent years.

(5) **Management Approach**. For large or complex efforts involving interactions among numerous individuals or other organizations, plans for distribution of responsibilities and arrangements for ensuring a coordinated effort should be described.

(6) **Personnel**. The principal investigator is responsible for supervision of the work and participates in the conduct of the research regardless of whether or not compensated under the award. A short biographical sketch of the principal investigator, a list of principal publications and any exceptional qualifications should be included. Omit social security number and other personal items which do not merit consideration in evaluation of the proposal. Give similar biographical information on other senior professional personnel who will be directly associated with the project. Give the names and titles of any other scientists and technical personnel associated substantially with the project in an advisory capacity. Universities should list the approximate number of students or other assistants, together with information as to their level of academic attainment. Any special industry-university cooperative arrangements should be described.

(7) **Facilities and Equipment.**

(i) Describe available facilities and major items of equipment especially adapted or suited to the proposed project, and any additional major equipment that will be required. Identify any Government-owned facilities, industrial plant equipment, or special tooling that are proposed for use. Include evidence of its availability and the cognizant Government points of contact.

(ii) Before requesting a major item of capital equipment, the proposer should determine if sharing or loan of equipment already within the organization is a feasible alternative. Where such arrangements cannot be made, the proposal should so state. The need for items that typically can be used for research and non-research purposes should be explained.

(8) **Proposed Costs.**

(i) Proposals should contain cost and technical parts in one volume: do not use separate "confidential" salary pages. As applicable, include separate cost estimates for salaries and wages; fringe benefits; equipment; expendable materials and supplies; services; domestic and foreign travel; ADP expenses; publication or page charges; consultants; subcontracts; other miscellaneous identifiable direct costs; and indirect costs. List salaries and wages in appropriate organizational categories (e.g., principal investigator, other scientific and engineering professionals, graduate students, research assistants, and technicians and other non-professional personnel). Estimate all staffing data in terms of staff-months or fractions of full-time.

(ii) Explanatory notes should accompany the cost proposal to provide identification and estimated cost of major capital equipment items to be acquired; purpose and estimated number and lengths of trips planned; basis for indirect cost computation (including date of most recent negotiation and cognizant agency); and clarification of other items in the cost proposal that are not self-evident. List estimated expenses as yearly requirements by major work phases.

(iii) Allowable costs are governed by FAR Part 31 and the NASA FAR Supplement Part 1831 (and OMB Circulars A-21 for educational institutions and A-122 for nonprofit organizations).

(9) **Security**. Proposals should not contain security classified material. If the research requires access to or may generate security classified information, the submitter will be required to comply with Government security regulations.

(10) **Current Support**. For other current projects being conducted by the principal investigator, provide title of project, sponsoring agency, and ending date.

(11) **Special Matters.**

(i) Include any required statements of environmental impact of the research, human subject or animal care provisions, conflict of interest, or on such other topics as may be required by the nature of the effort and current statutes, executive orders, or other current Government-wide guidelines.

(ii) Proposers should include a brief description of the organization, its facilities, and previous work experience in the field of the proposal. Identify the cognizant Government audit agency, inspection agency, and administrative contracting officer, when applicable.

(d) **Renewal Proposals**

(1) Renewal proposals for existing awards will be considered in the same manner as proposals for new endeavors. A renewal proposal should not repeat all of the information that was in the original proposal. The renewal proposal should refer to its predecessor, update the parts that are no longer current, and indicate what elements of the research are expected to be covered during the period for which support is desired. A description of any significant findings since the most recent progress report should be included. The renewal proposal should treat, in reasonable detail, the plans for the next period, contain a cost estimate, and otherwise adhere to these instructions.

(2) NASA may renew an effort either through amendment of an existing contract or by a new award.

(e) **Length.** Unless otherwise specified in the NRA, effort should be made to keep proposals as brief as possible, concentrating on substantive material. Few proposals need exceed 15-20 pages. Necessary detailed information, such as reprints, should be included as attachments. A complete set of attachments is necessary for each copy of the proposal. As proposals are not returned, avoid use of "one-of-a-kind" attachments.

(f) **Joint Proposals**.

(1) Where multiple organizations are involved, the proposal may be submitted by only one of them. It should clearly describe the role to be played by the other organizations and indicate the legal and managerial arrangements contemplated. In other instances, simultaneous submission of related proposals from each organization might be appropriate, in which case parallel awards would be made.

(2) Where a project of a cooperative nature with NASA is contemplated, describe the contributions expected from any participating NASA investigator and agency facilities or equipment which may be required. The proposal must be confined only to that which the proposing organization can commit itself. "Joint" proposals which specify the internal arrangements NASA will actually make are not acceptable as a means of establishing an agency commitment.

(g) **Late Proposals**. A proposal or modification received after the date or dates specified in an NRA may be considered if doing so is in the best interests of the Government.

(h) **Withdrawal.** Proposals may be withdrawn by the proposer at any time before award. Offerors are requested to notify NASA if the proposal is funded by another organization or of other changed circumstances which dictate termination of evaluation.

(i) **Evaluation Factors**

(1) Unless otherwise specified in the NRA, the principal elements (of approximately equal weight) considered in evaluating a proposal are its relevance to NASA's objectives, intrinsic merit, and cost.

(2) Evaluation of a proposal's relevance to NASA's objectives includes the consideration of the potential contribution of the effort to NASA's mission.

(3) Evaluation of its intrinsic merit includes the consideration of the following factors of equal importance:

(i) Overall scientific or technical merit of the proposal or unique and innovative methods, approaches, or concepts demonstrated by the proposal.

(ii) Offeror's capabilities, related experience, facilities, techniques, or unique combinations of these which are integral factors for achieving the proposal objectives.

(iii) The qualifications, capabilities, and experience of the proposed principal investigator, team leader, or key personnel critical in achieving the proposal objectives.

(iv) Overall standing among similar proposals and/or evaluation against the state-of-the-art.

(4) Evaluation of the cost of a proposed effort may include the realism and reasonableness of the proposed cost and available funds.

(j) **Evaluation Techniques**. Selection decisions will be made following peer and/or scientific review of the proposals. Several evaluation techniques are regularly used within NASA. In all cases proposals are subject to scientific review by discipline specialists in the area of the proposal. Some proposals are reviewed entirely in-house, others are evaluated by a combination of in-house and selected external reviewers, while yet others are subject to the full external peer review technique (with due regard for conflict-of-interest and protection of proposal information), such as by mail or through assembled panels. The final decisions are made by a NASA selecting official. A proposal which is scientifically and programmatically meritorious, but not selected for award during its initial review, may be included in subsequent reviews unless the proposer requests otherwise.

(k) **Selection for Award**.

(1) When a proposal is not selected for award, the proposer will be notified. NASA will explain generally why the proposal was not selected. Proposers desiring additional information may contact the selecting official who will arrange a debriefing.

(2) When a proposal is selected for award, negotiation and award will be handled by the procurement office in the funding installation. The proposal is used as the basis for negotiation. The contracting officer may request certain business data and may forward a model award instrument and other information pertinent to negotiation.

(l) **Cancellation of NRA**. NASA reserves the right to make no awards under this NRA and to cancel this NRA. NASA assumes no liability for canceling the NRA or for anyone's failure to receive actual notice of cancellation.

APPENDIX C:

GUIDELINES FOR FOREIGN PARTICIPATION

NASA accepts proposals from entities located outside the U.S. in response to this NRA. Proposals from non-U.S. entities should not include a cost plan. Non-U.S. proposals, and U.S. Proposals that include non-U.S. participation, must be endorsed by the respective government agency or funding/sponsoring institution in the country from which the non-U.S. participant is proposing. Such endorsement should indicate the following points: (1) The proposal merits careful consideration by NASA; and (2) If the proposal is selected, sufficient funds will be made available by the sponsoring foreign agency to undertake the activity as proposed.

Proposals, along with the requested number of copies and Letter of Endorsement must be forwarded to NASA in time to arrive before the deadline established for this NRA. In addition, one copy of each of these documents should be sent to:

NASA Headquarters
Office of External Relations
Mission to Planet Earth Division, Code IY
Washington, DC 20546
USA

Any materials sent by courier or express mail should include the street address 300 E Street, S. W., and substitute 20024 for the indicated ZIP code.

All proposals must be typewritten in English. All non-U.S. proposals will undergo the same evaluation and selection process as those originating in the U.S. Non-U.S. proposals and U. S. Proposals that include non-U.S. participation, must follow all other guidelines and requirements described in this NRA. Sponsoring non-U.S. agencies may, in exceptional situations, forward a proposal without endorsement to the above address, if review and endorsement are not possible before the announced closing date. In such cases, however, NASA's Mission to Planet Earth Division of the Office of External Relations should be advised when a decision on the endorsement is to be expected.

Successful and unsuccessful proposers will be contacted directly by the NASA Program Office coordinating the NRA. Copies of these letters will be sent to the sponsoring government agency.

Appendix D

Certification Regarding
Debarment, Suspension, and Other Responsibility Matters
Primary Covered Transactions

This certification is required by the regulations implementing Executive Order 12549, Debarment and Suspension, 34 CFR Part 85, Section 85.510, Participant's responsibilities. The regulations were published as Part VII of the May 26, 1988 Federal Register (pages 19160-19211). Copies of the regulation may be obtained by contracting the U.S. Department of Education, Grants and Contracts Service, 400 Maryland Avenue, S.W. (Room 3633 GSA Regional Office Building No. 3), Washington, DC. 20202-4725, telephone (202) 732-2505.

(1) The prospective primary participant certifies to the best of its knowledge and belief, that it and its principals:

(a) Are not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any Federal department or agency;

(b) Have not within a three-year period preceding this proposal been convicted of or had a civil judgment rendered against them for commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, State, or local) transaction or contract under a public transaction; violation of Federal or State antitrust statues or commission of embezzlement theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property;

(c) Are not presently indicted for or otherwise criminally or civilly charged by a governmental entity (Federal, State or local) with commission of any of the offenses enumerated in paragraph (1)(b) of this certification; and

(d) Have not within three-year period preceding this application/proposal had one or more public transactions (Federal, State, or local) terminated for cause or default.

(2) Where the prospective primary participant is unable to certify to any of the statements in this certification, such prospective participant shall attach an explanation to this proposal.

____
Organization Name PR/Award Number or Project Name

____
Name and Title of Authorized Representative

____
Signature Date

ED Form GCS-008 (REV.12/88)

Appendix D

Certification Regarding Drug-Free Workplace Requirements
Grantees Other Than Individuals

This certification is required by the regulations implementing the Drug-Free Workplace Act of 1988, 34 CFR Part 85, Subpart F. The regulations, published in the January 31, 1989 Federal Register, require certification by grantees, prior to award, that they will maintain a drug-free workplace. The certification set out below is a material representation of fact upon which reliance will be placed when the agency determines to award the grant. False certification or violation of the certification shall be grounds for suspension of payments, suspension or termination of grants, or governmentwide suspension or debarment (see 34 CFR Part 85, Sections 85.615 and 85.620).

This grantee certifies that it will provide a drug-free workplace by:

(a) Publishing a statement notifying employees that the unlawful manufacture, distribution, dispensing, possession or use of a controlled substance is prohibited in the grantee's workplace and specifying the actions that will be taken against employees for violation of such prohibition;

(b) Establishing a drug-free awareness program to inform employees about -

(1) The dangers of drug abuse in the workplace;
(2) The grantee's policy of maintaining a drug-free workplace;
(3) Any available drug counseling, rehabilitation, and employee assistance programs, and
(4) The penalties that may be imposed upon employees for drug abuse violations in the workplace;

(c) Making it a requirement that each employee to be engaged in the performance of the grant be given a copy of the statement required by paragraph (a);

(d) Notifying the employee in the statement required by paragraph (a) that, as a condition of employment under the grant, the employee will -

(1) Abide by the terms of the statement; and
(2) Notify the employer of any criminal drug statute conviction for a violation occurring in the workplace no later than
five days after such conviction;

(e) Notifying the agency within ten days after receiving notice under subparagraph (d)(2) from an employee or otherwise receiving actual notice of such conviction;

(f) Taking one of the following actions, within 30 days of receiving notice under subparagraph (d)(2) , with respect to any employee who is so convicted -

(1) Taking appropriate personnel action against such an employee, up to and including termination; or
(2) Requiring such employee to participate satisfactorily in a drug abuse assistance or rehabilitation program approved
for such purposes by a Federal, State, or local health, law enforcement, or other appropriate agency;

(g) Making a good faith effort to continue to maintain a drug-free workplace through implementation of paragraph (a), (b), (c), (e), and (f).

____

Organization Name　　　　　　　　　　PR/Award Number or Project Name

____

Name and Title of Authorized Representative

____

Signature　　　　　　　　　　　　　　　　　　Date

ED 80-0004

Appendix D

CERTIFICATION REGARDING LOBBYING

Certification for Contracts, Grants, Loans, and Cooperative Agreements.

The undersigned certifies, to the best of his or her knowledge and belief, that:

(1) No Federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.

(2) If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form-LLL, "Disclosure Form to Report Lobbying," in accordance with its instructions.

(3) The undersigned shall require that the language of this certification be included in the award documents for all subawards at all tiers (including subcontracts, subgrants, and contracts under grants, loans, and cooperative agreements) and that all subrecipients shall certify and disclose accordingly.

This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by section 1352, title 31, U.S. Code. Any person who fails to file the required certification shall be subject to a civil penalty of not less than $10,000, and not more than $100,000 for each such failure.

____
Signature and Date

____
Name and Title of Authorized Representative

____
Organization Name

Proposal Cover Sheet
NASA Research Announcement 97-MTPE-14

Proposal No. ______________________ (Leave Blank for NASA Use)

Title: ____

Principal Investigator:

Name: ____

Department:____

Institution: ____

Street/PO Box: ____

City: ____________________   State: __________   Zip: __________________

Country: ________________ E-mail: ____________________________________

Telephone: ______________________ Fax: ________________________________

Co-Investigators:

Name	Institution	Telephone

Budget:

1st Year: __________   2nd Year: __________   3rd Year: ________

Total: ____________

Authorizing Official: ____________________   ____________________

(Name)   (Institution)