A.3.7 LIVING WITH A STAR (LWS) TARGETED RESEARCH AND TECHNOLOGY

1. Scope of Program

The goal of the Living With a Star (LWS) program is to develop the scientific understanding needed for the United States to effectively address those aspects of the connected Sun-Earth system that affect life and society. The LWS Targeted Research and Technology (TR&T) program element solicits proposals leading to a physics-based understanding of the integral system linking the Sun to the Earth both directly and via the heliosphere, magnetosphere, and ionosphere. The program's objectives can be achieved by data analysis, theory and modeling, and technology improvements (e.g., software tools and instrument development). LWS is a cross-cutting initiative whose goals and objectives relate to all five of NASA's Strategic Enterprises, namely (and in no priority order):

- Aerospace Technology - LWS characterizes those aspects of the Earth's radiation belt environment needed to design reliable electronic subsystems for use in air and space transportation systems;

- Biological and Physical Research – LWS defines the environment beyond the Earth's magnetosphere to enable exploration of interplanetary space by humans;

- Earth Science - LWS improves our understanding of the effects of solar variability and disturbances on terrestrial climate change;

- Human Exploration and Development of Space - LWS develops the knowledge needed to predict solar energetic particle events that affect the safety of humans in space; and

- Space Science - LWS quantifies the physics, dynamics, and behavior of the Sun-Earth system over the 11-year solar cycle.

The LWS TR&T component is designed to support individual targeted research tasks that may employ a variety of research techniques in pursuit of LWS program goals and may involve the analysis of data from past and present NASA spacecraft or data from other nations and agencies that are in the public domain. This LWS TR&T program solicitation addresses four broad objectives (1 through 4 below) and six other more specific research topics of current interest given in item 5:

1. Scientific Understanding of Basic Physical Processes

Theoretical efforts, model development, and the analysis and interpretation of past and present data to identify and understand the basic physical processes underlying the Sun-Earth system, especially efforts that adopt a systems approach by linking models across discipline boundaries (e.g., solar irradiance models that include coupling to the dynamo

for long-term scenario studies, coupled ionosphere-thermosphere models, or the generation of energetic particles in the heliosphere and their subsequent entry into the Earth's magnetosphere).

2. Empirical Tools

New empirical tools and numerical simulations that predict the occurrence and amplitudes of solar, interplanetary, and geospace disturbances (e.g., thermospheric wind models, or high-latitude conductivity models incorporating the effects of EUV and solar radiant input), including software that identifies, retrieves, assimilates, and portrays data and model results from different sources for LWS forecasting and research objectives.

3. Understanding Terrestrial Climate

Studies that characterize the effects of solar influences upon the terrestrial climate with an emphasis upon investigations that employ data the from past (including paleo data) or from space missions, and/or that support future space missions (e.g., accurate determination of the role played by solar irradiance and cosmogenic proxies in climate models).

4. Characterization of Space Climate

Improved specification of the space environment and its variation over the solar cycle to enable the cost-effective design of spacecraft and subsystems by minimizing space environmental effects and damage (e.g., specification models for the radiation environment of the Earth's magnetosphere);

5. Specific Research Topics of High Current Interest

While proposals on all topics relevant to the objectives of the LWS TR&T program are welcome, theoretical and observational studies that address the following cross-disciplinary topics are particularly welcome at this time:

i. The magnetic field topology connecting the photosphere to the corona.
ii. The propagation of the background solar wind flow and superimposed disturbances through the heliosphere
iii. The generation and decay of the Earth's radiation belts as a function of geomagnetic and solar wind conditions.
iv. The geophysical conditions favoring the development of low- and mid latitude scintillations in the Earth's ionosphere.
v. The effects of varying solar EUV radiation on the Earth's ionosphere and atmosphere.
vi. The relationship between solar irradiance and cosmogenic proxies for long term solar activity.

Further background material concerning relevant research objectives can be found in the following documents:

- The National Academy of Sciences Web tutorial, entitled *Space Weather: A Research Perspective* (http://www.nas.edu/ssb/cover.html);
- The report on the Solar Influences Workshop (http://www.ispe.arizona.edu/research/sunclimate/);
- The Sun Earth Connection LWS WWW site (http://lws.gsfc.nasa.gov/);
- The LWS Science Architecture Team report to SECAS (http://lws.gsfc.nasa.gov/docs/LWSSAT_SECASreport_30Aug01.pdf);
- Other LWS resources (http://sec.gsfc.nasa.gov/sec_resources_presentations_lwsmowg.htm)
- *The Sun-Earth Connection Roadmap 2003-2028* (http://sec.gsfc.nasa.gov/SEC_2003_Roadmap.pdf);
- Report of the Living with a Star Geospace Mission Definition Team, *The LWS Geospace Storm Investigations, Exploring the Extremes of SpaceWeather* (http://lws.gsfc.nasa.gov/docs/Geospace/GMDTReportforWeb.pdf); and
- The NRC Decadal Survey Report, *The Sun to the Earth and Beyond* (http://www.nationalacademies.org/ssb/sspsuntoearth.html).

In addition to the opportunities described above, funds are also available to support small (~$20-30K), short term (1 year) awards to improve the accessibility of data sets relevant to the LWS program. Relevant tasks include (but are not limited to) placing data sets on-line, translating data sets into more readily accessible formats, providing visualization tools, improving metadata, and prototyping the distributed LWS data infrastructure. The titles of proposals submitted to this portion of the NRA must contain the words "Data Environment". As a departure from the default page limit specified in Section 2.3.1 of the *NASA Guidebook for Proposers* (see "IMPORTANT INFORMATION" in Section 2 below), the Scientific/Technical/Management Section (including figures) of proposals submitted to this portion of the NRA is limited to 5 pages.

Note that to enable NASA Office of Space Science to properly evaluate the relevance of proposals submitted to its programs, as well as track its progress towards achieving its goals as mandated by the Government Performance Review Act (GPRA), all research supported by NASA's programs must now demonstrate its relationship to NASA Goals and Research Focus Area's (RFA's) as stated in the latest version of its Strategic Plan (follow links from the Web site http://spacescience.nasa.gov/); see also the discussion in Section 1 of the *Summary of Solicitation* of this NRA. Therefore, all proposers to this program element are asked to state their perception of this relevance in terms of the Goals, Science Objectives, and RFA's given in Table 3 found in the *Summary of Solicitation*. In particular, this LWS TR&T program element is designed to help fulfill all of the RFA's for the first Sun-Earth Connection Science Objective under Strategic Goals I and II. The appropriate place for this statement of relevancy is in the introduction to the proposal's "Scientific/Technical/Management" section (see Section 2.3.5 in the *NASA Guidebook for Proposers*). The index numbers in this table may be used to identify

a specific RFA, for example, “Goal I, Sun-Earth Connection Theme, RFA 1(b)” or “Goal II, Sun-Earth Connection Theme, RFA 1(a).”

2. Programmatic Information

Given the unique nature of this LWS TR&T program, proposal reviewers will include both scientific peers and knowledgeable representatives from the LWS customer community. Proposals will be evaluated on the basis of their feasibility, intrinsic scientific merit, and compliance with requirements to provide public access to any tools and value-added products developed. Proposals should provide a detailed (half page) description of how the proposed work will benefit the objectives of the LWS program described in Section 1 above, and the timetable over which these benefits will accrue. The program will provide a WWW site (http://lwstrt.gsfc.nasa.gov/trt_proposals.htm) linking to all proposal abstracts, annual progress reports, software, and data products.

To aid in the identification of reviewers, it is essential that the electronically submitted *Cover Page* for LWS TR&T proposals (see further below) include a single choice of discipline descriptor (either G for Geospace or S for Solar & Heliospheric clusters) and the relevant program objective 1 through 5 as described in section 1 above. The *Cover Page* for the “Data Environment” proposals should put D for discipline descriptor.

An annual call for proposals for LWS TR&T investigations is now planned for the foreseeable future. The total funding available for new proposals submitted through this NRA and to be funded in Fiscal Year (FY) 2004 is expected to about $3M. Proposals for efforts up to three-years duration are solicited. To give perspective regarding the number of proposals that may be funded through this program, the average first year value of the selected LWS TR&T awards made through the ROSS-2002 NRA (for which ~$4M was available) was $113K; the Program may include larger awards for proposals of exceptional merit and breadth.

IMPORTANT INFORMATION

As discussed in the *Summary of Solicitation* of this NRA, the Office of Space Science (OSS) now uses a unified set of instructions for the preparation and submission of proposals given in the document entitled *NASA Guidebook for Proposers Responding to NASA Research Announcement – 2003* (or *NASA Guidebook for Proposers* for short) that may be accessed by opening http://research.hq.nasa.gov, and linking through "Helpful References” or by direct access at http://www.hq.nasa.gov/office/procurement/nraguidebook/ (note that the updated 2003-edition of the Guidebook is used for this solicitation). Section 6 of this NRA's *Summary of Solicitation* contains the Web address relevant to the electronic submission of a Notice of Intent (NOI) to propose and a proposal's *Cover Page/Proposal Summary/Budget Summary*, as well as the mailing address for the submission of the hard copies of a proposal.

Questions about this program element may be directed to the LWS Program Officer:

Dr. Madhulika Guhathakurta
Sun-Earth Connection Division
Code SS
Office of Space Science
NASA Headquarters
Washington, DC 20546-0001
Telephone: (202) 358-1992
Facsimile: (202) 358-3987
E-mail: Madhulika.Guhathakurta@nasa.gov