Living With a Star
A Systems Approach to Sun-Earth Science

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The Sun-Earth Connected System

Magnetically-Variable Star

Varying
• Radiation
• Solar Wind
• Energetic Particles

Interacting
• Solar Wind
• Energetic Particles

Questions:
• How and why does the Sun vary?
• How does Earth respond?
• What are the impacts on humanity?
Why Do We Care?

- The Sphere of the Human Environment Continues to Expand Above and Beyond Our Planet.
  - Increasing dependence on space-based systems
  - Permanent presence of humans in Earth orbit and beyond
The primary goal of the LWS Program is to develop the understanding necessary to enable the U.S. to effectively address those aspects of the Connected Sun-Earth system that directly affect life and society.

• **Space Weather**

• **Sun-Climate Connection**
LWS is a Systems Approach

LWS focuses not on any one region of space, but rather on our Sun Earth Region as one system.

A very important part is the study of the connection between the regions and how one drives a response in another.
Spring 1999 - George Withbroe, SEC Theme Director began investigating the idea of a new initiative on Space Weather

Spring 2000 - GSFC scientists organized a community meeting to gather input for LWS program

Based on preliminary GSFC work, a new start was approved and moved up to 2001

LWS program became a partnership between GSFC and APL

2000-2001 - GSFC and APL scientists defined the program with the scientific community (Science Architect Team)

2001-2002 - GSFC scientists led science definition teams to prepare the SDO SDT report and the Geospace MDT report

2002-2003 – GSFC and APL scientists participated in TR&T SDT
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<tr>
<th>Name</th>
<th>Institute</th>
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LWS Program Components

• **Science Missions**
  - Solar Dynamics Observatory (SDO)
  - Geospace (I-T, RB, FUV)
  - Heliospheric Sentinels

• **Engineering Missions**
  - Space Environment Testbeds (SET)

• **Targeted Research and Technology (TR&T)**
  - Theory, Modeling, Data Analysis
  - Data Environment Development
  - Instrumentation Development
  - Sun-Climate Task Group
LWS Components Status

LWS Science Architecture Team
Chair: G. Mason
Generated program-level science requirements

SDO SDT
Chair: D. Hathaway

Pre-formulation
AO
Payload Selection
Formulation

Geospace MDT
Chair: P. Kinter

Pre-formulation
AO

TR&T SDT
Chair: J. Gosling

I-TSP
FUV
RBSP

Target Areas

Sentinels Strategy Panel
Study Scientist: A. Szabo

Sun-Climate Task Group
Leader: J. Eddy

Annual ROSS NRA
Science Community Involvement

LWS Science Workshops

• May 2000 in Greenbelt
• Nov 2002 at JHU/APL
• Winter 2004 (SDO-focus workshop in discussion)
• Fall 2004 (MSFC modelling workshop in discussion)

• LWS MOWG
E/PO

- E/PO efforts of Missions and Investigators are coordinated at the SEC Program Office at Goddard (both LWS and STP)
- LWS/STP Education focus has been K-12
- LWS/STP Public Outreach plan is being formulated
  - Steele Hill, Art Poland, Isabel Hawkins
Living With A Star Program

SOLAR DYNAMICS OBSERVATORY (SDO)

- Begin Pre-Form. 12/00
- Begin Formulation 3/02
- SRR/SCR 6/03
- ICR 12/03
- PDR 3/04
- CR 9/04
- LAUNCH 8/07
- DMSP Potential 1/10 (tentative)

SPACE ENVIRONMENT TESTBEDS (SET)

- Begin Pre-Form. 12/00
- Proposals Due 3/02
- SET carrier 5/04
- ATP 2/05
- NRA select 5/05
- SET-1 Delivery NET 9/06
- LRD 5/07
- NRA select 6/08 est.
- SET-2 LRD 5/09
- NRA select 6/10 est.
- SET-3 LRD 5/11
- NRA Select 6/12 est.
- SET-4 LRD 5/13

GEOSPACE

- ITSP Begin Formulation 8/02
- RBSP Begin Formulation 4/04
- ITSP PDR 10/05
- RBSP CDR 11/05
- ITSP CDR 10/06
- ITSP LRD 10/07
- RBSP PDR 8/08
- RBSP CDR 8/08
- RB LRD 8/10

SOLAR SENTINELs

- Formulation Study
- Development Prime Mission
- Extended Mission Subject to revision during Phase A

Status As Of: 05/02/03
Task Group Chaired by Jack Eddy met in June 2003

- Charter is to develop a comprehensive intellectual foundation for the scientific investigation of the influence of solar variability on climate, and through this process, to help refine the focus and definition of the Sun-Climate component of the NASA LWS Program

Goals
- to assess the current state of Sun-Climate science and associated uncertainties
- to identify high priority questions for future research
- to identify opportunities for progress in the next five years and the next decade
- to outline the essentials of a viable Sun-Climate research effort

Report will be generated based on meeting discussions presenting a well-reasoned foundation and priority goals for the study of possible solar influences on climate
# Sun-Climate Connection

## Task Group Members

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<td>George Withbroe</td>
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## EX OFFICIO:

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Summary

• Science Missions
  – Solar Dynamics Observatory (SDO)
    • Instruments selected; Completing Phase A
  – Geospace (I-T, RB, FUV)
    • AO for instruments in preparation
  – Heliospheric Sentinels
    • Strategy panel – leverage through International partners

• Engineering Missions
  • Space Environment Testbeds (SET)
    • Initial flight experiments selected; DMSP opportunity in 2006

• Targeted Research and Technology (TR&T)
  • Third round of NRA awards announced; SDT completing report
  • Sun-Climate Task Group; Initial meeting June 2003