Integrated Global-Sun Model of Magnetic Flux Emergence and Transport

Nagi N. Mansour, PI
NASA Ames Research Center

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Co-Investigators

Air Force Research Laboratory
C. Henney, Nick Arge

University of Michigan
W. Manchester

New Jersey Institute of Technology
A. Kosovichev

Stanford University
P. Scherrer, J. Zhao

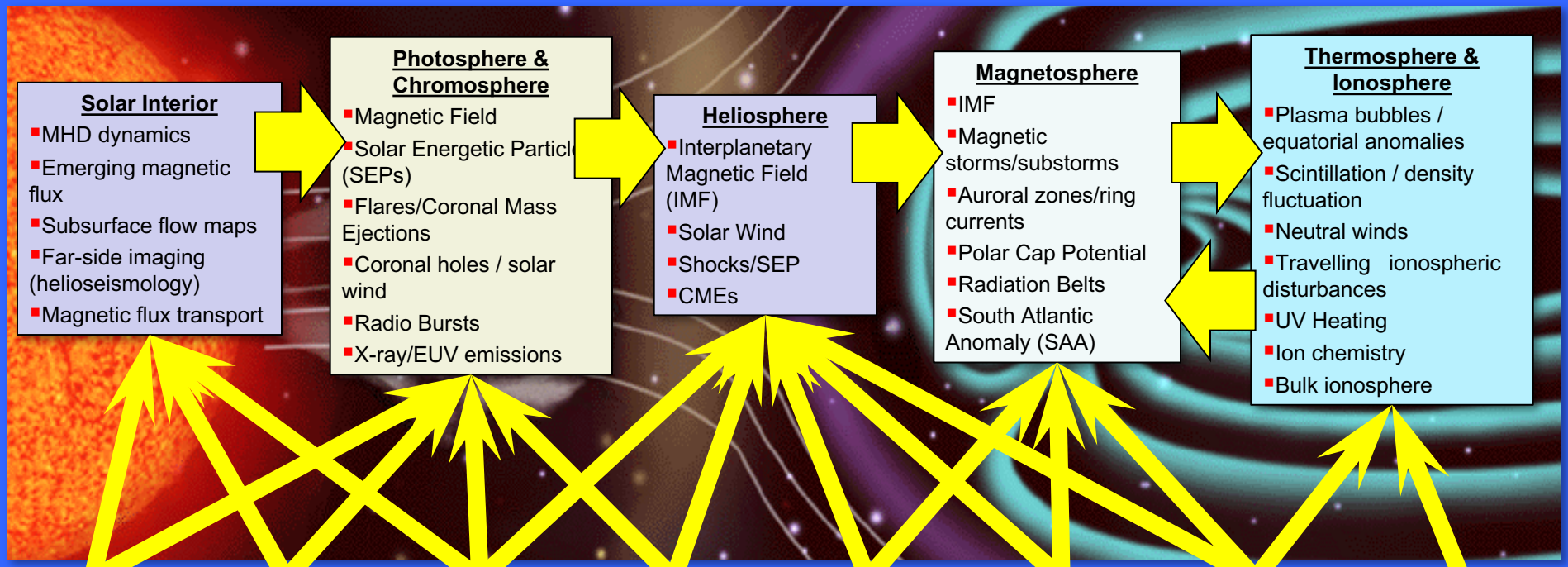
National Center for Atmospheric Research/HAO
Y. Fan

Michigan State University
R. Stein

NASA Ames Research Center
A. Wray, D. Hathaway, T. Hartlep, I. Kitiachvili

Los Alamos National Laboratory
H. Godinez, J. Koller

Place of the Project with respect to the NASA/NSF Space Weather Strategic Capability



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Nagi N. Mansour
NASA Ames Research Center

The Coronal Global Evolutionary Model (CGEM)
George Fisher
University of California

A Modular Capability for Community Modeling of Flares, CMEs and their Interplanetary Impacts
Spiro Antiochos
NASA Goddard Space Flight Center

Integrated Real-Time Modeling System for Heliospheric Space Weather Forecasting
Dusan Odstrcil
NASA Goddard Space Flight Center

Corona-Solar Wind Energetic Particle Acceleration (C-SWEPA) Modules
Nathan Schwadron
University of New Hampshire

Integration of Extended MHD and Kinetic Effects in Global Magnetosphere Models
Amitava Bhattacharjee
Princeton University

Medium Range Thermosphere Ionosphere Storm Forecasts
Anthony Mannucci
Jet Propulsion Laboratory

First-Principles-Based Data Assimilation System for the Global Ionosphere-Thermosphere-Electrodynamics
Robert Schunk
Utah State University

Magnetic Flux Emergence and Transport

Motivation

The Sun lies at the center of space weather and is the source of its variability. The primary input to coronal and solar wind models is the activity of the magnetic field in the solar photosphere. Without focusing on and refining our understanding of the driving source of space weather, a major source of uncertainty in space weather forecast will remain.

Goal

Develop physics-based models for the dynamics of the magnetic field from the deep convection zone of the Sun to the corona with the goal of providing robust near real-time boundary conditions at the base of space weather forecast models .

Magnetic Flux Emergence and Transport

With the goal of Impacting Space weather forecast, two capability objectives were set:

Objective 1: Operation (Technology) - Enhance the Air Force Data Assimilation Photospheric flux Transport model (ADAPT) by assimilating SDO-HMI data

Objective 2: Understanding (Science) - Develop Coupled Models for Emerging flux Simulations (CMES) from the deep interior to the corona within the Space Weather Modeling Framework (SWMF)

Expected Impacts: (1) Operational and (2) Refined models

Magnetic Flux Emergence and Transport
Achievements

- ✓ ADAPT-HMI maps fully integrated into WSA 4.2
- ✓ SURF: Surface Flux Transport model that mimics transport by supergranules with spectrum and lifespan that matches observations
- ✓ Development of new refined far-side imaging techniques
- ✓ Coupled FSMA+MURAM magnetic flux transport from the deep interior to the surface
- ✓ SWARM – magnetic flux emergence from the subsurface to the corona

Impact

- ✓ WSA 4.2 will soon be integrated into NOAA's WSA-ENLIL Solar Wind Prediction
- ✓ SURF: flexible Flux Transport model that enables long range forecast
- ✓ Far-side imaging has the potential of improving and extending space weather forecast by several days
- ✓ FSAM+MURAM & SWARM refine our understanding and move us towards NASA's Objective 1.4: Understand the Sun and its interactions with Earth and the solar system, including space weather