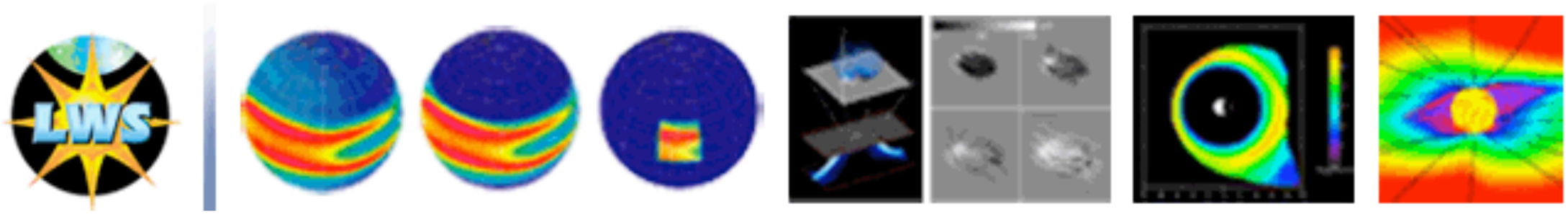
Living With A Star
Targeted Research and Technology



Future LWS contributions to CCMC

Bob Leamon, NASA HQ

CCMC Community Workshop, Annapolis MD,
2014 March 31

What FSTs and strategic capability products are ready to make the transition to CCMC?

As the solar cycle unfolds in an unexpected way, it is important to remember that

The Sun is NEVER Boring

To see this, we simply turn the solar cycle sideways:

Solar La Niña
(low sunspot number)

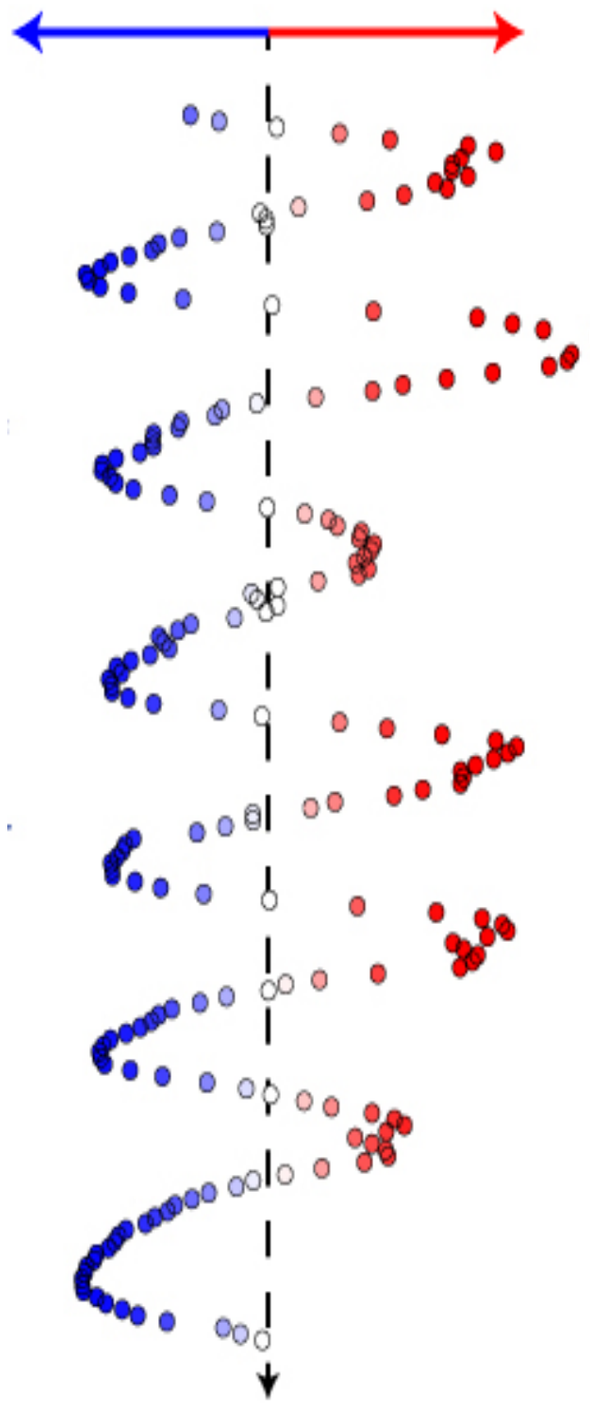
extreme galactic cosmic rays

rapid accumulation of space junk

sharp contraction of the heliosphere

collapse of the upper atmosphere

total solar irradiance changes



Solar El Niño
(high sunspot number)

super solar flares

extreme solar "cosmic rays" (energetic particles)

radio blackouts

extreme geomagnetic storms

melted power grid transformers – power blackouts

solar wind streams hit Earth

What deficiencies do we have in models, and how can we rectify them?

- Anything that uses F10.7 as a proxy
  - Lt.Col. Harris, this morning
- Anything that uses SSN as a proxy
- Empirical closure functions for coronal/ heliospheric MHD models
  - difference between research and operational models

What FSTs and strategic capability products are ready to make the transition to CCMC?

Integrated Model of the Atmosphere-Ionosphere System

- 2008 SC - Rolando Garcia, NCAR, PI
- Develop an integrated model of atmospheric dynamics, composition, chemistry, radiation,and plasma properties, from the Earth's surface to the top of the thermosphere/ ionosphere, driven by: inputs of solar spectral irradiance; natural and anthropogenic gases and aerosols; solar, magnetospheric, and galactic energetic particles; and magnetospheric electric fields and currents.
  ...
  The model must include provision for inputs of variable solar spectral radiation
- Most recent Annual Progress report implies good integration with WACCM and WACCM-X, and a GPS TEC model (but not Bob Schunk's GAIM, which is installed at CCMC...)

Physical modeling of the radiative Sun-Earth connection

- 2008 SC - Juan Fontenla, Colorado, PI [now Tom Woods]

- A model of the solar spectral irradiance and its variability from 1 to 2500 nm based on solar imagery and/or wavelength proxies, to inform and provide inputs to climate studies

- Most recent Annual Progress report discusses initial steps in integration with WACCM climate model...

- Would appear to be addressing the critical need of variable solar spectral radiation as input (and not proxies)

2009–10 Focused Science Topics

- Origin and Nature of the Slow Solar Wind, Associated Interplanetary Structures, and SEP Transport
- 2009 FST - Thomas Zurbuchen, Michigan, team lead
- Spiro's S-Web developed primarily through this award; integration with both PSI's MAS MHD model (at CCMC) and SEP transport modelling
- Predict the Onset and Space Weather Impacts of Fast CMEs/Eruptive Flares
- 2009 FST - Mark Linton, NRL, team lead
- LARE3D prime candidate for CCMC inclusion, especially when coupled to the PredSci MAS code

2009–10 Focused Science Topics

- Factors that Control the Highly Variable Intensity and Evolution of Solar Particle Events

- 2010 FST - Nat Gopalswamy, GSFC, team lead

- The practical goal is to enable a forecaster, during the first one-two hours following an eruption ... to make more accurate predictions of how intense, long-lasting, and far-reaching the SEP event will (or will not) be.

- Incorporating Plasma Waves in Models of the Radiation Belts and Ring Current

- 2010 FST - Richard Thorne, UCLA, team lead

- "The goal of this FST is to advance our predictive capabilities of ring current and radiation belt dynamics by incorporating improved models of plasma waves into our large-scale plasma and field models."

- Obvious extensions to LFM, Open GGCM, LANL* ...