Monitoring Space Weather with iSWA

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Modified from a presentation by Alex Wold

SW REDI Bootcamp 2018
Introduction

Monitoring Space Weather with iSWA

- iSWA — Integrated Space Weather Analysis System
- Allows forecasters to customize a space weather monitoring layout
- https://iswa.gsfc.nasa.gov
Introduction
iSWA Imagers

- SDO AIA for the earth facing solar surface
- SOHO LASCO coronagraphs for CMEs
- STEREO-A EUVI for far-sided solar surface
- STEREO-A coronagraphs
- Magnetic Connectivity Solarscape Viewer
Introduction

iSWA Graphs/Timelines

• GOES (X-ray, Proton, & Electron Fluxes)
• SOHO/COSTEP Proton Flux (Real-time & Forecast)
• DSCOVR Solar Wind (Speed, Magnetic Field, Temperature, & Density)
• SWMF Magnetopause Standoff Position
• Kp (Observed & Predicted)
• STEREO Beacon (Solar Wind & SEPs)
• …and more!
Outline

• Solar Cygnets
  • Monitoring flares, eruptions, & CMEs
• Heliosphere Cygnets
  • Monitoring solar energetic particles, CME arrivals, and high speed stream arrivals
• Magnetosphere Cygnets
  • Monitoring geomagnetic storms, radiation belt enhancements, and magnetopause crossings
• Demonstration
  • Following the course of the June 21st 2015 CME
Solar Cygnets: Solar Flares

- **GOES 0.1-0.8 nm X-rays** — flares
  - **Threshold:** $5 \times 10^{-5}$ W/m$^2$ (M5.0)
- **SDO AIA imagery** — flares, eruptions, & coronal holes
  - 193 Å — EUV waves, dimming, post-eruption arcades, off limb (field lines)
  - 171 Å — off limb (field lines), post-eruption arcades
  - **131 Å** — flares
- **211 Å** — coronal holes
- **304 Å** — filaments

- **Magnetic Connectivity Solarscape Viewer**
  - SDO backgrounds, lat/lon grid, active region labels, and magnetic connectivity
Solar Cygnets: Eruptions & Coronal Holes

- GOES 0.1-0.8 nm X-rays — flares
  - Threshold: $5 \times 10^{-5}$ W/m$^2$ (M5.0)
- SDO AIA imagery — flares, eruptions, & coronal holes
  - 193 Å — EUV waves, dimming, post-eruption arcades, off limb (field lines)
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- Magnetic Connectivity Solarscape Viewer
  - SDO backgrounds, lat/lon grid, active region labels, and magnetic connectivity
Solar Cygnets: Coronal Mass Ejections (CMEs)

- **SOHO LASCO C2 & 3 imagery — CMEs**
  - C2 — 1.5 to 6 solar radii
  - C3 — 3.5 to ~30 solar radii
  - **Threshold:** measured \(\geq 500\) km/s and modeled to impact Earth OR measured \(\geq 800\) km/s and modeled to impact other location

- **STEREO A EUVI 195 Å imagery — flares, eruptions, & coronal holes**

- **STEREO A COR2 imagery — CMEs**
  - **Threshold:** measured \(\geq 500\) km/s and modeled to impact Earth OR measured \(\geq 800\) km/s and modeled to impact other location

  - lat/lon grid and active regions
Solar Cygnets: STEREO-A

- SOHO LASCO C2 & 3 imagery — CMEs
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- www.SolarMonitor.org (not on iSWA)
  - lat/lon grid and active regions
Solar Cygnets: STEREO-A

- SOHO LASCO C2 & 3 imagery — CMEs
  - C2 — 1.5 to 6 solar radii
  - C3 — 3.5 to ~30 solar radii
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- www.SolarMonitor.org (not on iSWA)
  - lat/lon grid
Heliosphere Cygnets: Solar Energetic Particles

- GOES > 10 MeV and > 100 MeV protons
  - Threshold: > 10 MeV above 10 pfu and/or > 100 MeV above 1 pfu
- SOHO COSTEP > 15.8 MeV proton channels
  - Threshold: $10^{-1}$ pfu/MeV
- RELEASE forecast for > 15.8 MeV proton channels
  - Threshold: $10^{-1}$ pfu/MeV
- STEREO A and B 13-100 MeV protons
  - Threshold: $10^{-1}$ pfu/MeV
Heliosphere Cygnets: Interplanetary Shocks/Arrivals

- **DSCOVR**
  - speed, magnetic field, temperature, & density
  - Threshold: significant shock passage at L1 (about $\geq 10$ nT amplitude jump)
- **STEREO A IMPACT/PLASTIC**
  - speed, magnetic field, temperature, & density
Magnetosphere Cygnets: Geomagnetic Storms

- **Kp index**
  - level (0 to 9) of geomagnetic activity in the Earth's magnetosphere
  - Threshold: \( \geq 6 \) (or larger than previous alert)
- **GOES > 0.8 MeV electrons**
  - state of the Earth's outer radiation belt
  - Threshold: \( 10^5 \) pfu (or 70-80 % from the threshold two days after)
- **Modeled magnetopause standoff distance**
  - location of the boundary between magnetospheric and solar wind plasma
  - Threshold: 6.6 Re
Magnetosphere Cygnets: Radiation Belt Enhancement

- Kp index
  - Level (0 to 9) of geomagnetic activity in the Earth's magnetosphere
  - Threshold: \( \geq 6 \) (or larger than previous alert)
- GOES > 0.8 MeV electrons
  - State of the Earth's outer radiation belt
  - Threshold: \( 10^5 \) pfu (or 70-80\% from the threshold two days after)
- Modeled magnetopause standoff distance
  - Location of the boundary between magnetospheric and solar wind plasma
  - Threshold: 6.6 Re
Magnetosphere Cygnets: Magnetopause Crossing

- **Kp index**
  - Level (0 to 9) of geomagnetic activity in the Earth's magnetosphere
  - Threshold: >=6 (or larger than previous alert)
- **GOES > 0.8 MeV electrons**
  - State of the Earth's outer radiation belt
  - Threshold: $10^5$ pfu (or 70-80% from the threshold two days after)
- **Modeled magnetopause standoff distance**
  - Location of the boundary between magnetospheric and solar wind plasma
  - Threshold: 6.6 Re
Other Useful Cygnets

- CCMC SWAN Space Weather Timeline Ensemble
  - Quick check of flare, SEP, radiation belt, and solar wind conditions
- iSWA Super Timeline
  - Make interactive plots of static cygnets
  - Plot SWMF Magnetopause Standoff Position with geosynchronous orbit
  - Plot CCMC-Predicted Kp with NOAA-Kp
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Activities

- iSWA basics demo
  - adding cygnets and navigating category tabs, using the super timeline, setting time periods locally and globally, and saving your layout
- Event walkthrough/chain of events