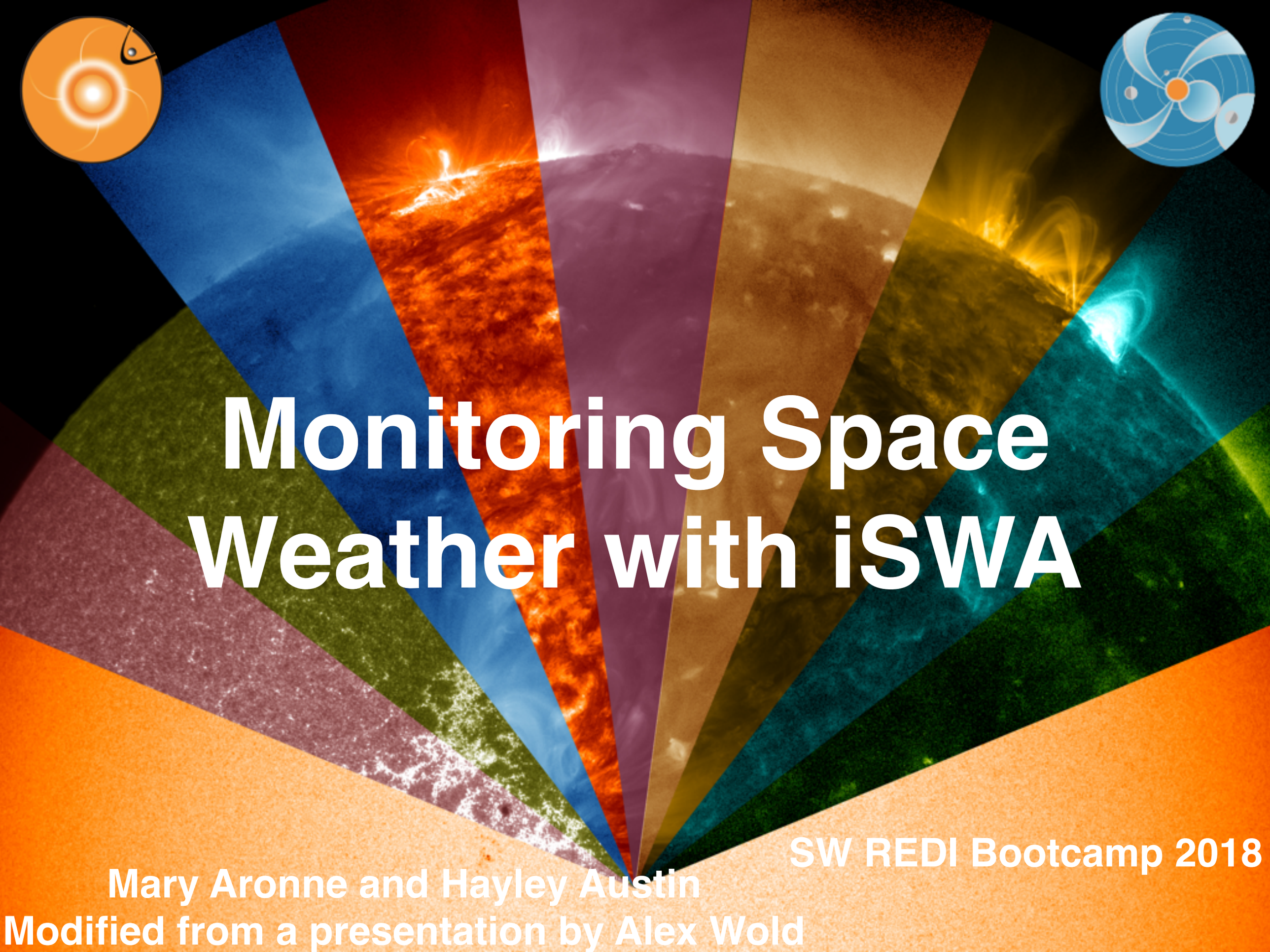


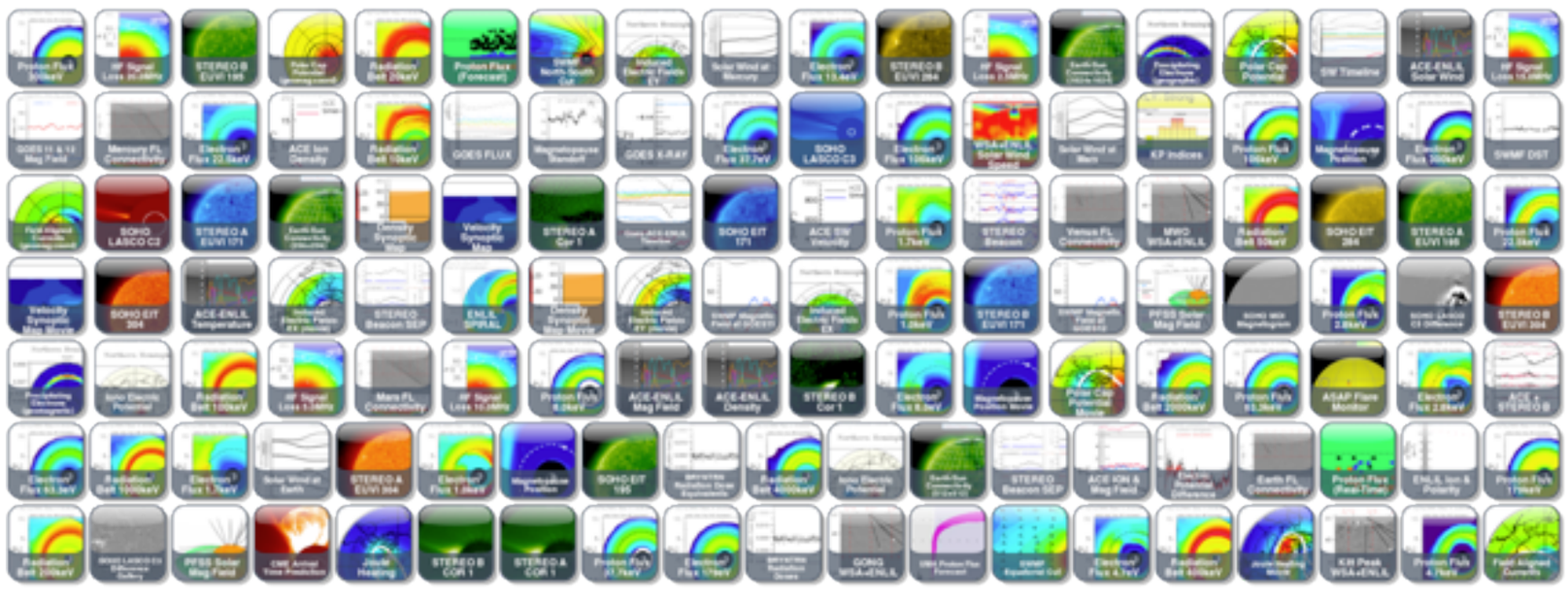
Monitoring Space Weather with iSWA

SW REDI Bootcamp 2018

Mary Aronne and Hayley Austin
Modified from a presentation by Alex Wold

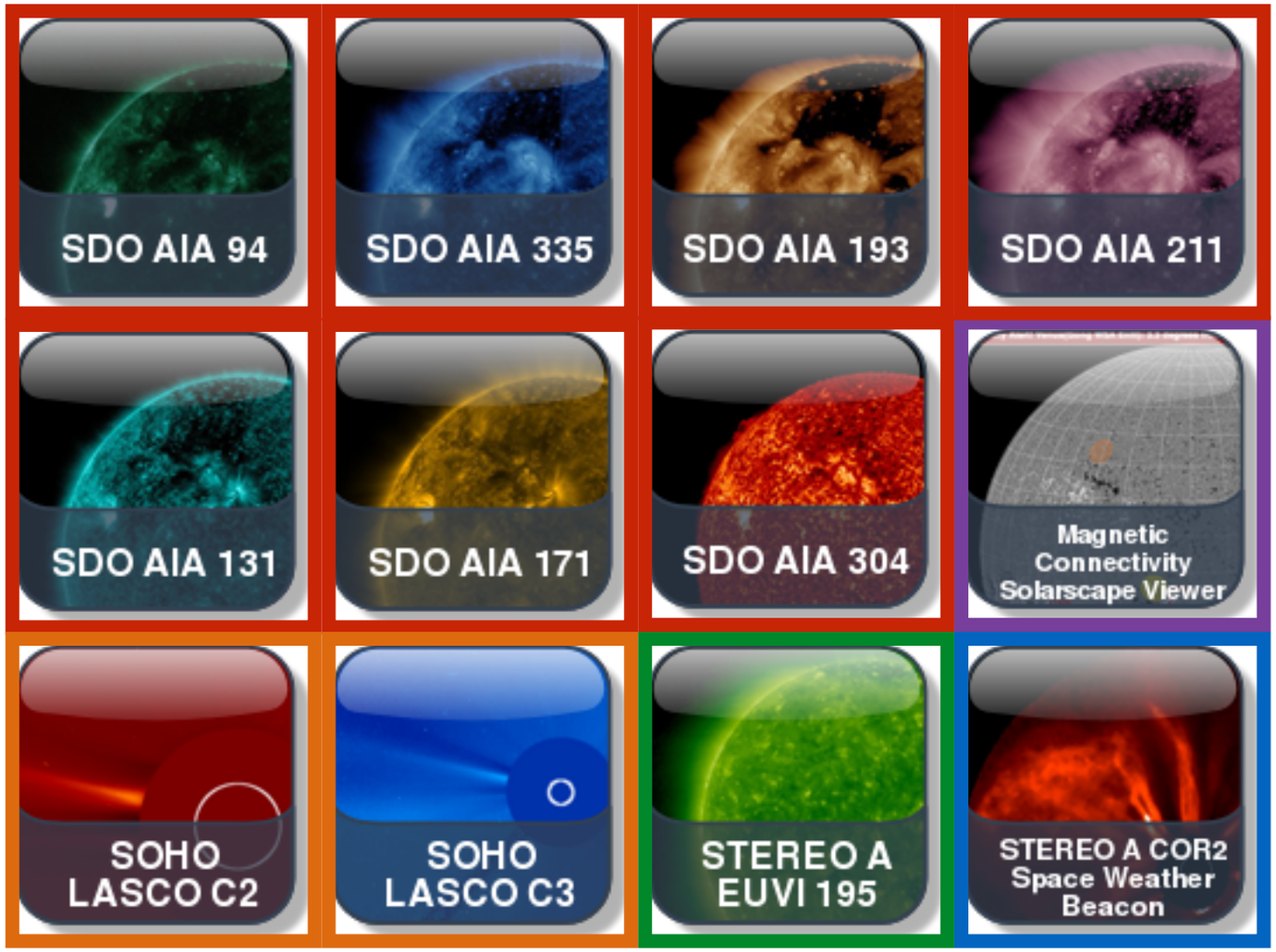
Introduction
Monitoring Space Weather with iSWA

- 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: 5×10^{-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: 5×10^{-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**
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- **Magnetic Connectivity Solarscape Viewer**
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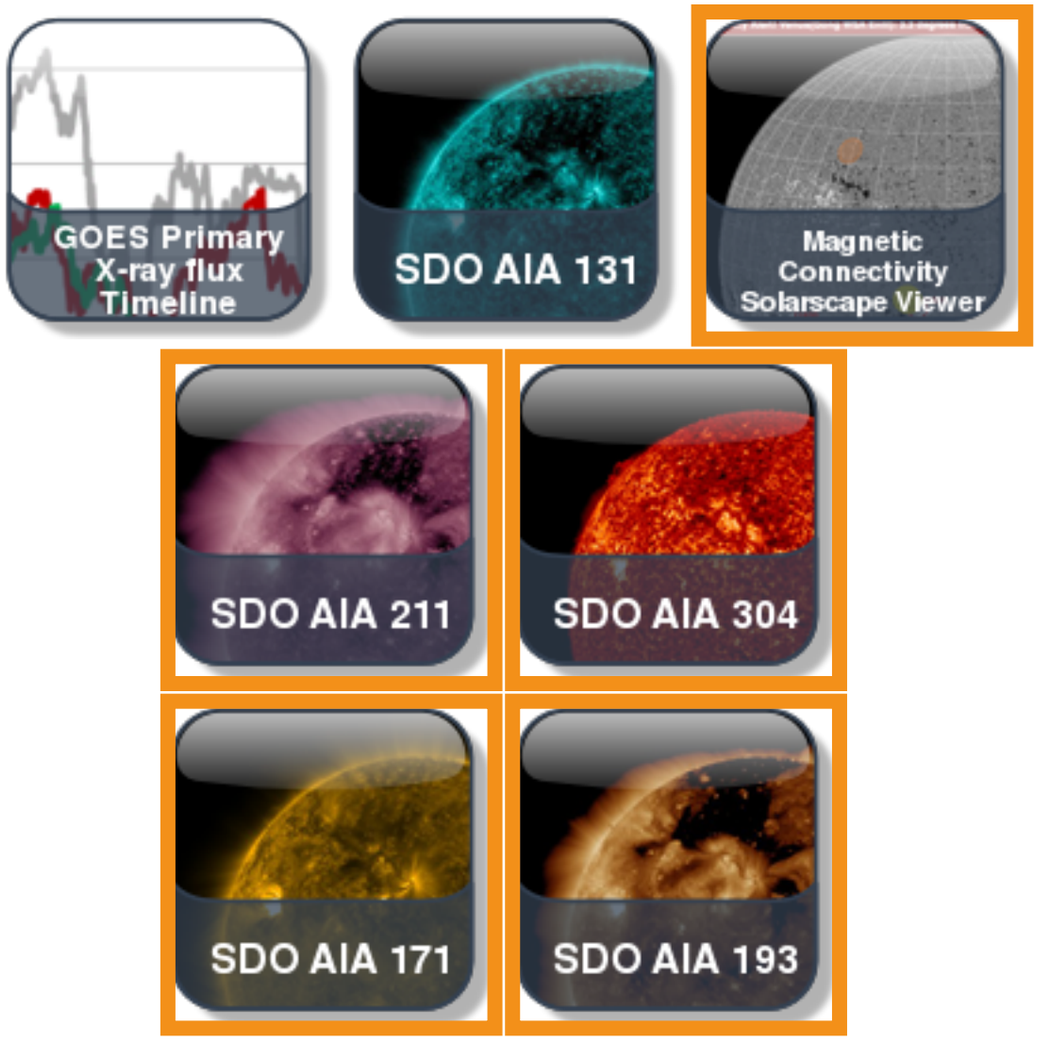

Solar Cygnets: Coronal Mass Ejections (CMEs)

- **SOHO LASCO C2 & 3 imagery — CMEs**
  - **C2 — 1.5 to 6 solar radii**
  - **C3 — 3.5 to ~30 solar radii**
  - **Threshold: measured >=500 km/s and modeled to impact Earth OR measured >= 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 >=500 km/s and modeled to impact Earth OR measured >= 800 km/s and modeled to impact other location
- 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
  - Threshold: measured >=500 km/s and modeled to impact Earth OR measured >= 800 km/s and modeled to impact other location
- **STEREO A EUVI 195 Å imagery — flares, eruptions, & coronal holes**
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  - lat/lon grid and active regions

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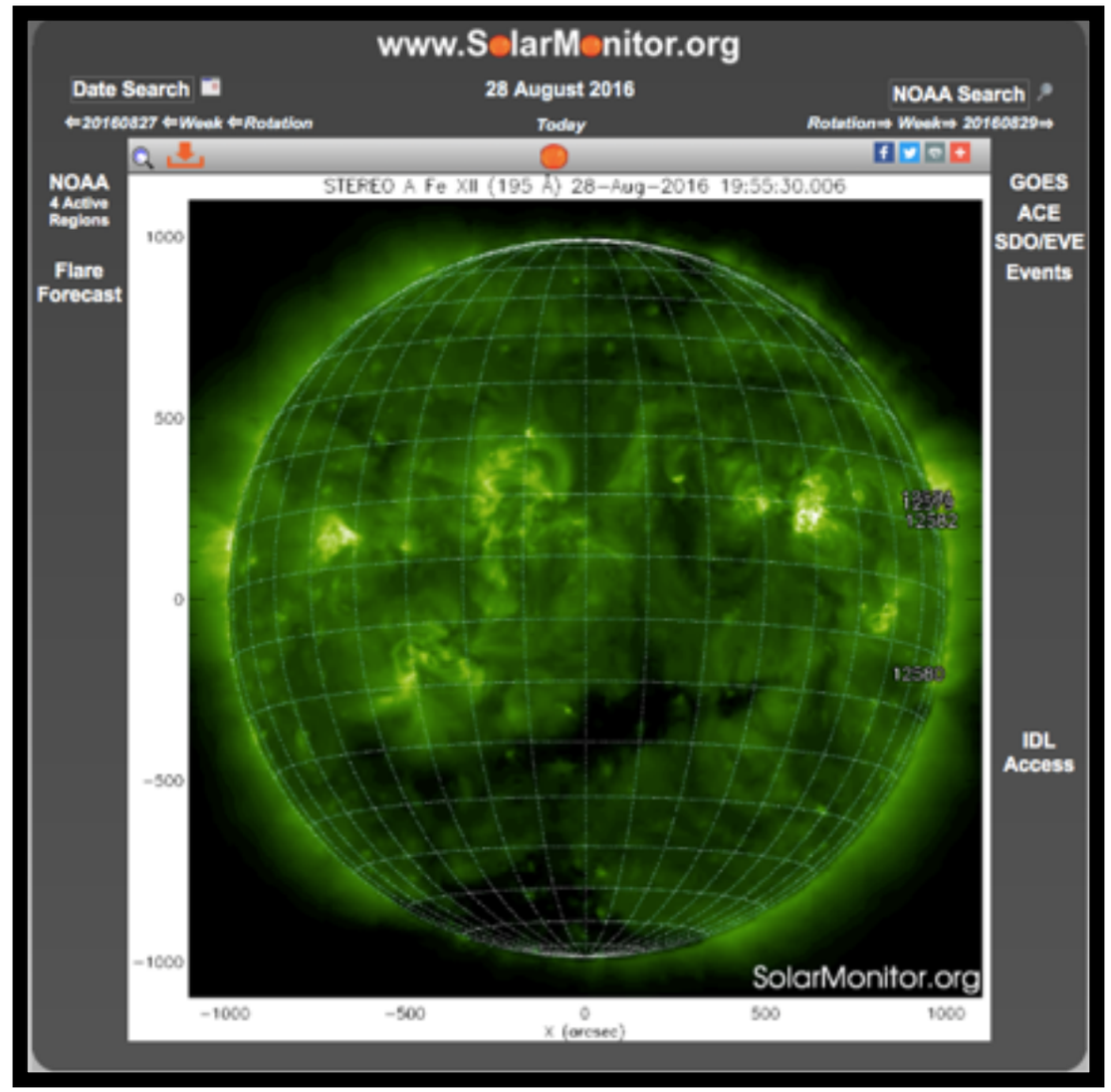
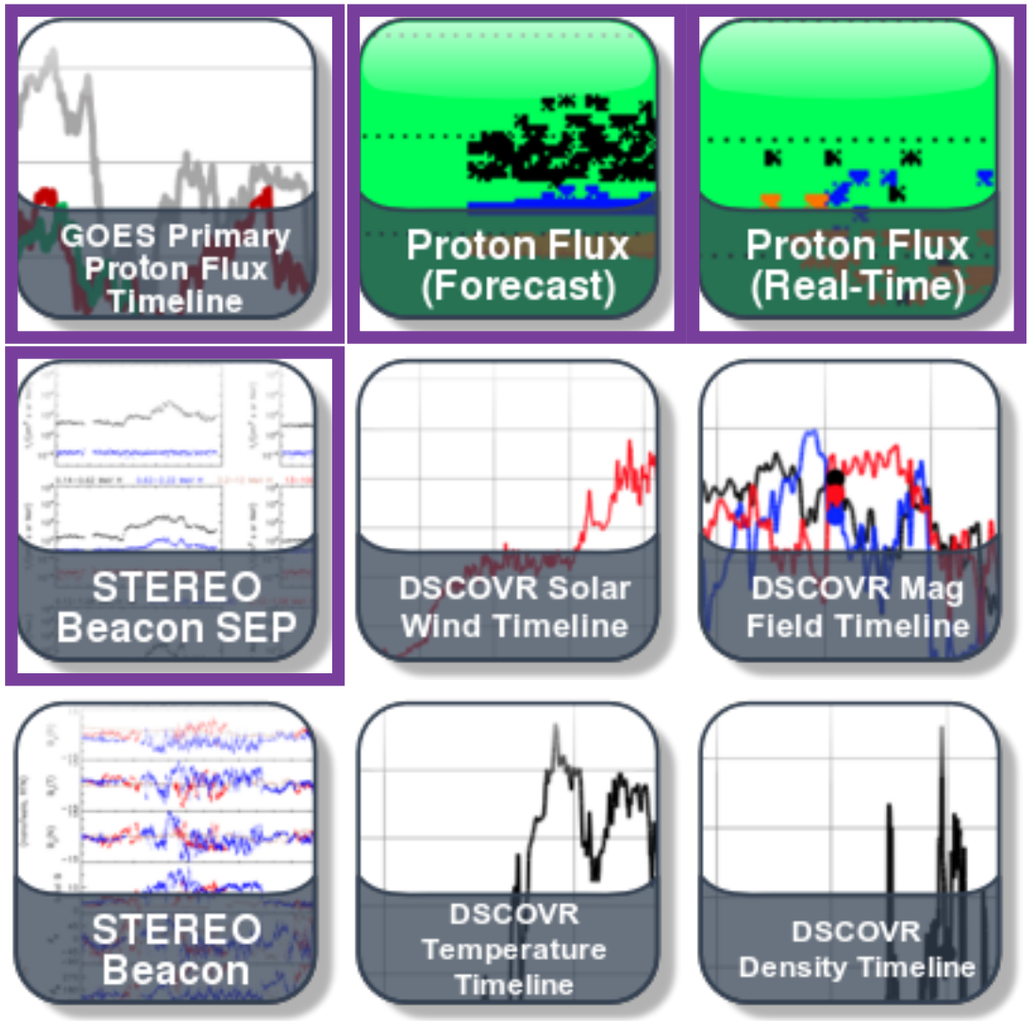
  - Threshold: measured >=500 km/s and modeled to impact Earth OR measured >= 800 km/s and modeled to impact other location
- **<u>www.SolarMonitor.org</u> (not on iSWA)**
  - **lat/lon grid**



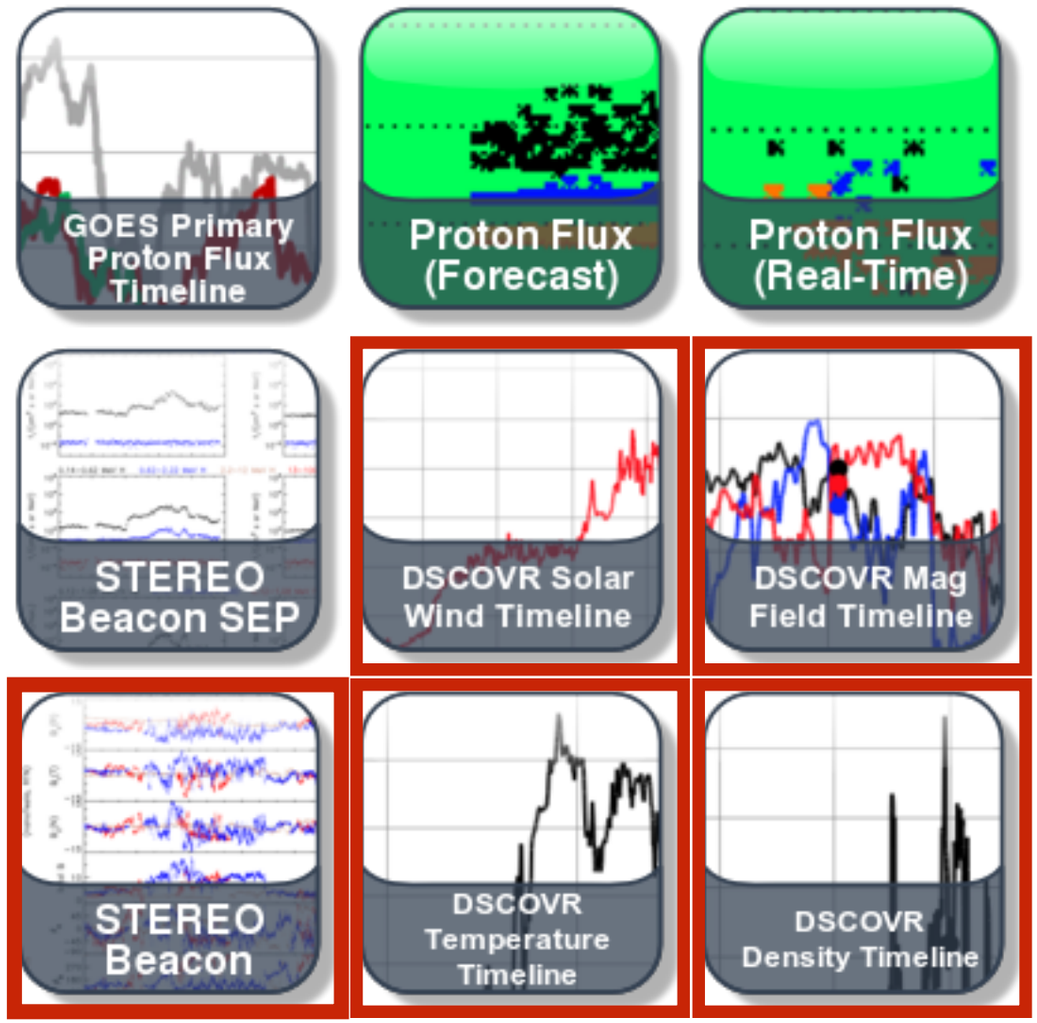
Heliosphere Cygnets: Solar Energetic Particles

- **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 >=10 nT amplitude jump)**
- **STEREO A IMPACT/PLASTIC**
  - **speed, magnetic field, temperature, & density**

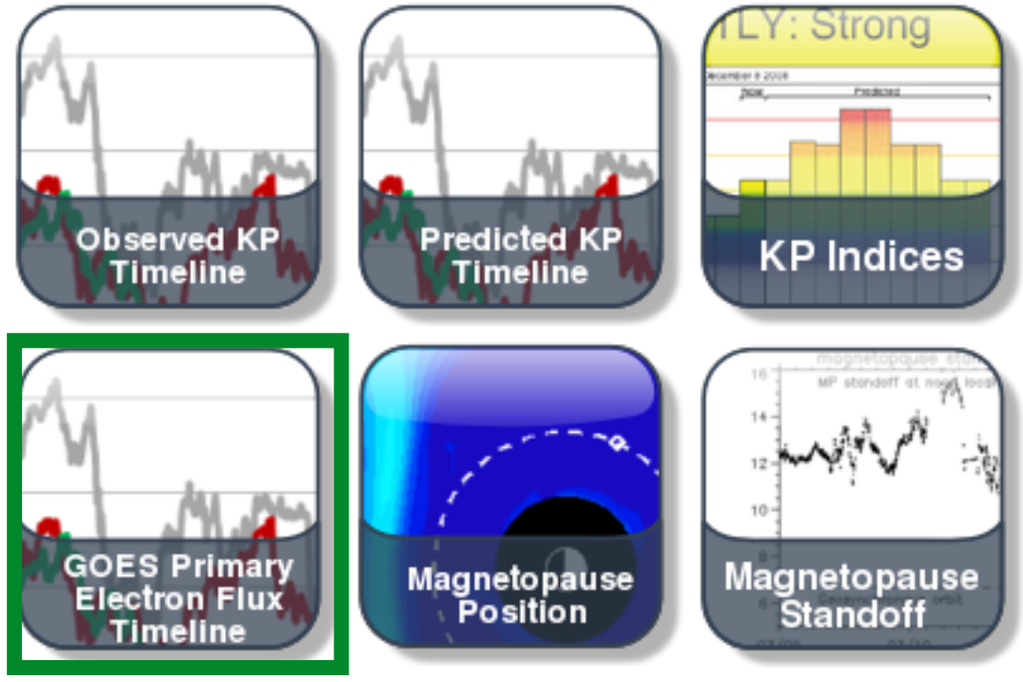


Magnetosphere Cygnets: Geomagnetic Storms

- **Kp index**
  - **level (0 to 9) of geomagnetic activity in the Earth's magnetosphere**
  - **Threshold: >=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

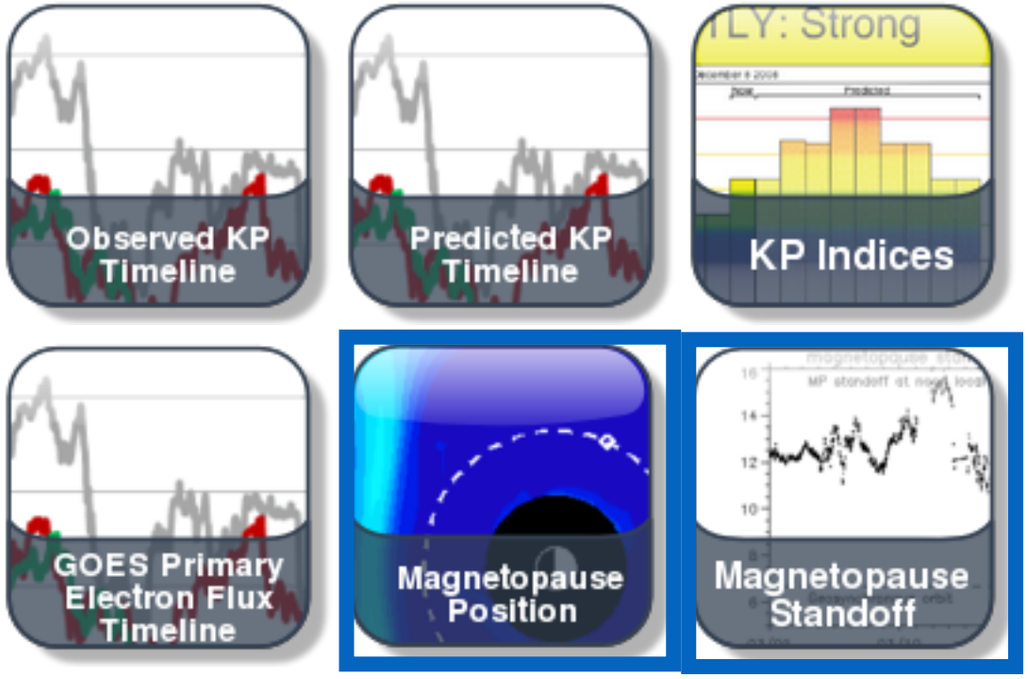
Magnetosphere Cygnets: Radiation Belt Enhancement

- Kp index
  - level (0 to 9) of geomagnetic activity in the Earth's magnetosphere
  - Threshold: >=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



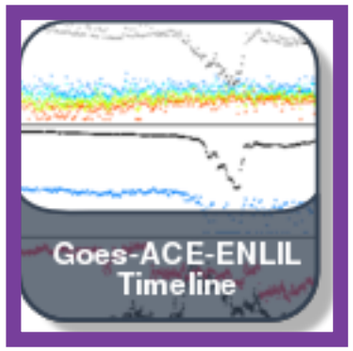
Magnetosphere Cygnets: Magnetopause Crossing

- 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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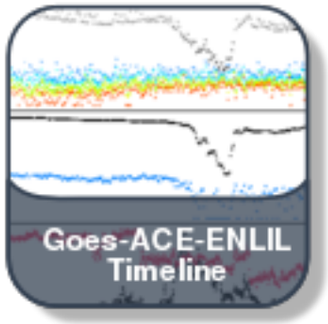

Activities

- 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