Space Weather Prediction Center Update

Spring 2015 Meeting, Committee on Solar and Space Physics

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National Weather Service

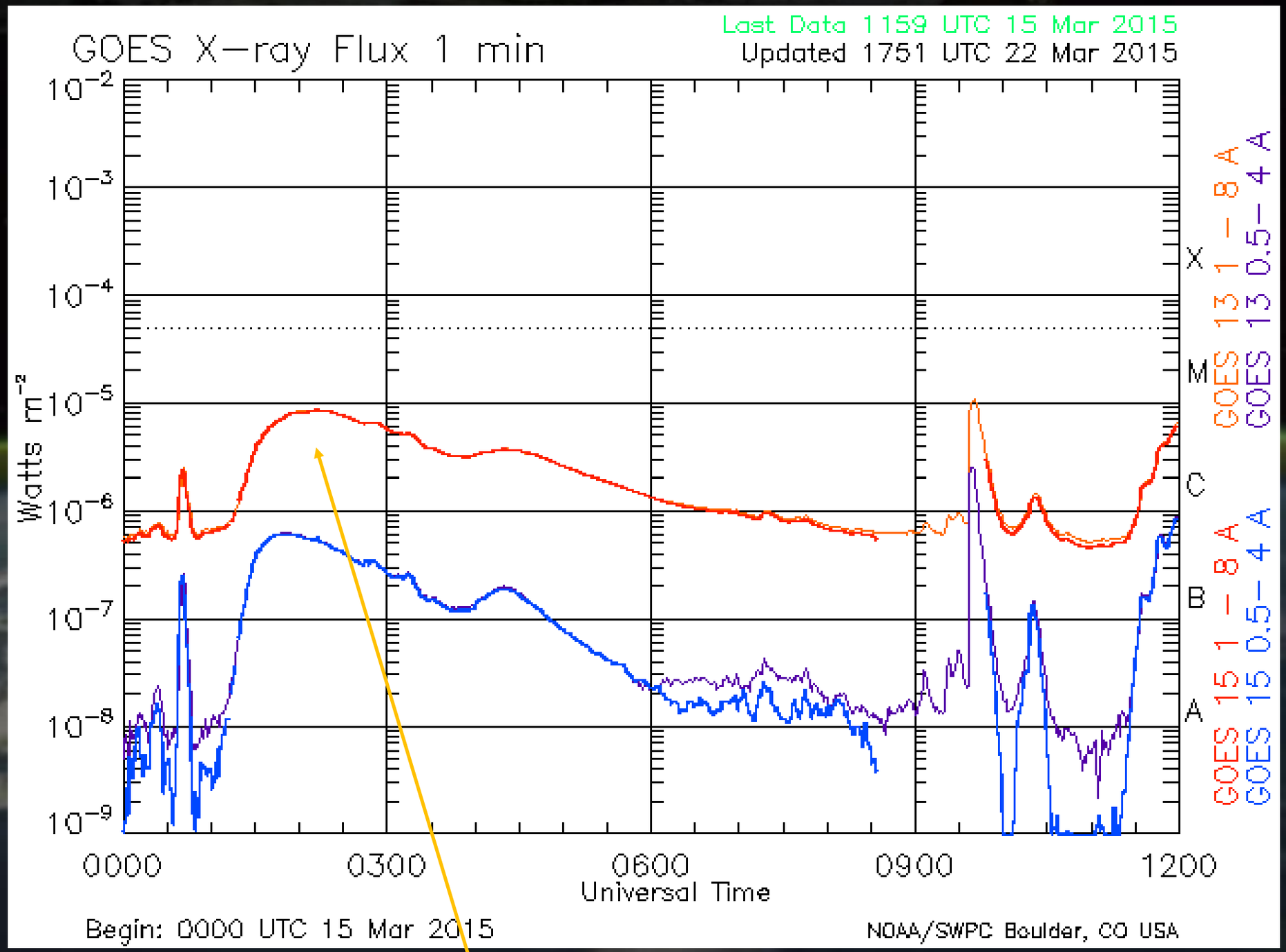
Outline

- Forecast Center: Recent Events
  - March 17th G4 Geomagnetic Storm
- Observations
  - DSCOVR update
  - GONG update
  - Space Weather Follow-On update
- Research to Operations
  - Geospace model progress
  - WAM/IDEA model update
- External Activities
  - Space Weather Operations Research and Mitigation participation
  - UKMet L5 mission economic impacts study
  - NASA/CCMC Letter of agreement

St. Patrick's Day 2015 Geomagnetic Storm

- G4 level (severe) geomagnetic storm Commencement: ~14:00 UT
- Duration: ~18 hours (G3/G4 conditions sustained for 12 hours)
- Maximum magnetic field (Bz): -30 nT (-20 nT sustained)
- Strongest G4 storm of Solar Cycle 24 (out of only 5)
- No proton or electron radiation enhancement with this storm (unusual)
- Cause: Coronal mass ejection(s) at ~0200—0230 UT on 15-March
- Impacts:
  - 200 mV/km induced electric field calculated for NE powerplant locations (about 1/10 of the March 13, 1989 values). No power failures reported to date.
  - Severe ionospheric density depletion above 45° latitudes; strong scintillation at equatorial latitudes reported (e.g. Brazil).
  - Spectacular auroral sightings from Michigan to Alaska and as far south as southern Colorado (Montrose county) on early morning of 17-March.
- Forecast accuracy:
  - CME was 15 hours ahead of forecast arrival. Intensity forecast was G1.
  - Warning/Alert lead time: G4 warning from ACE was 75 min before Alert of onset

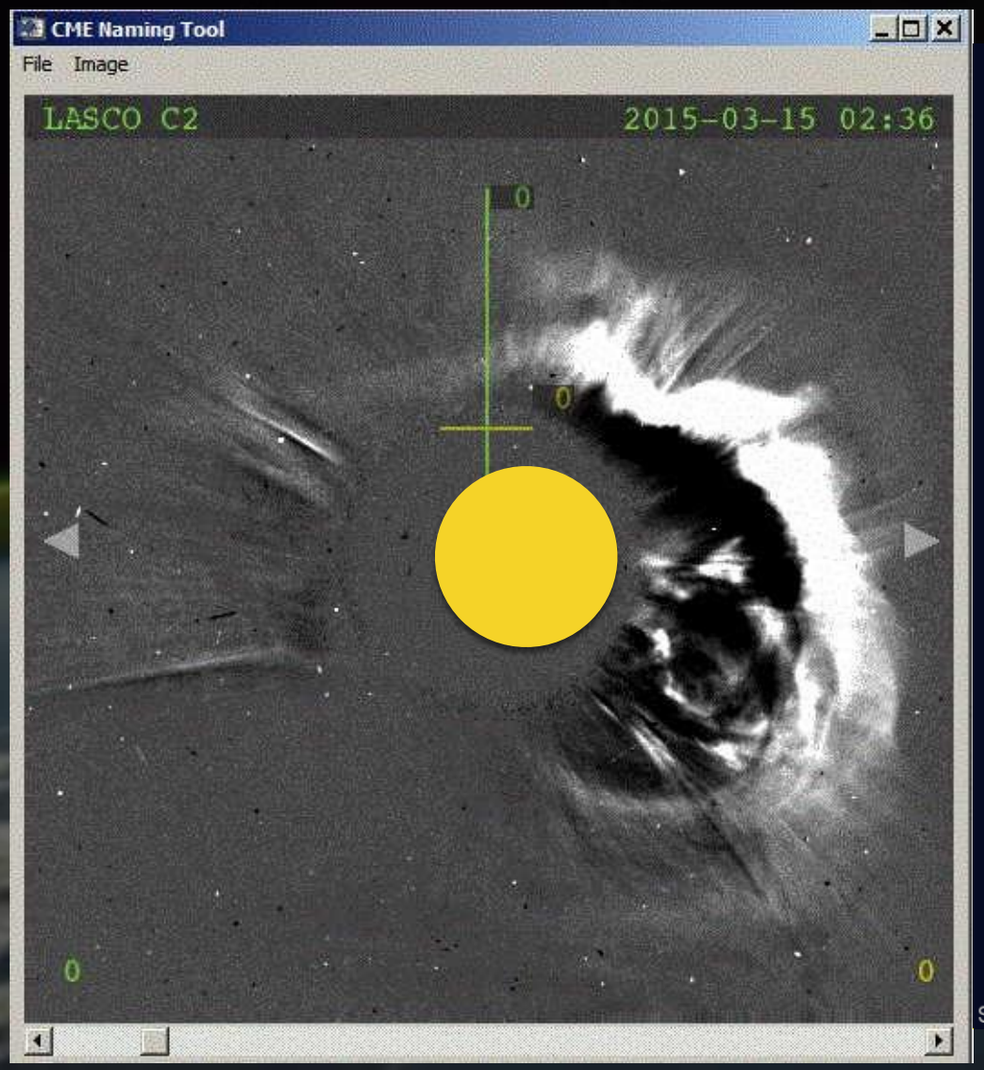
St. Patrick's Day 2015 Geomagnetic Storm

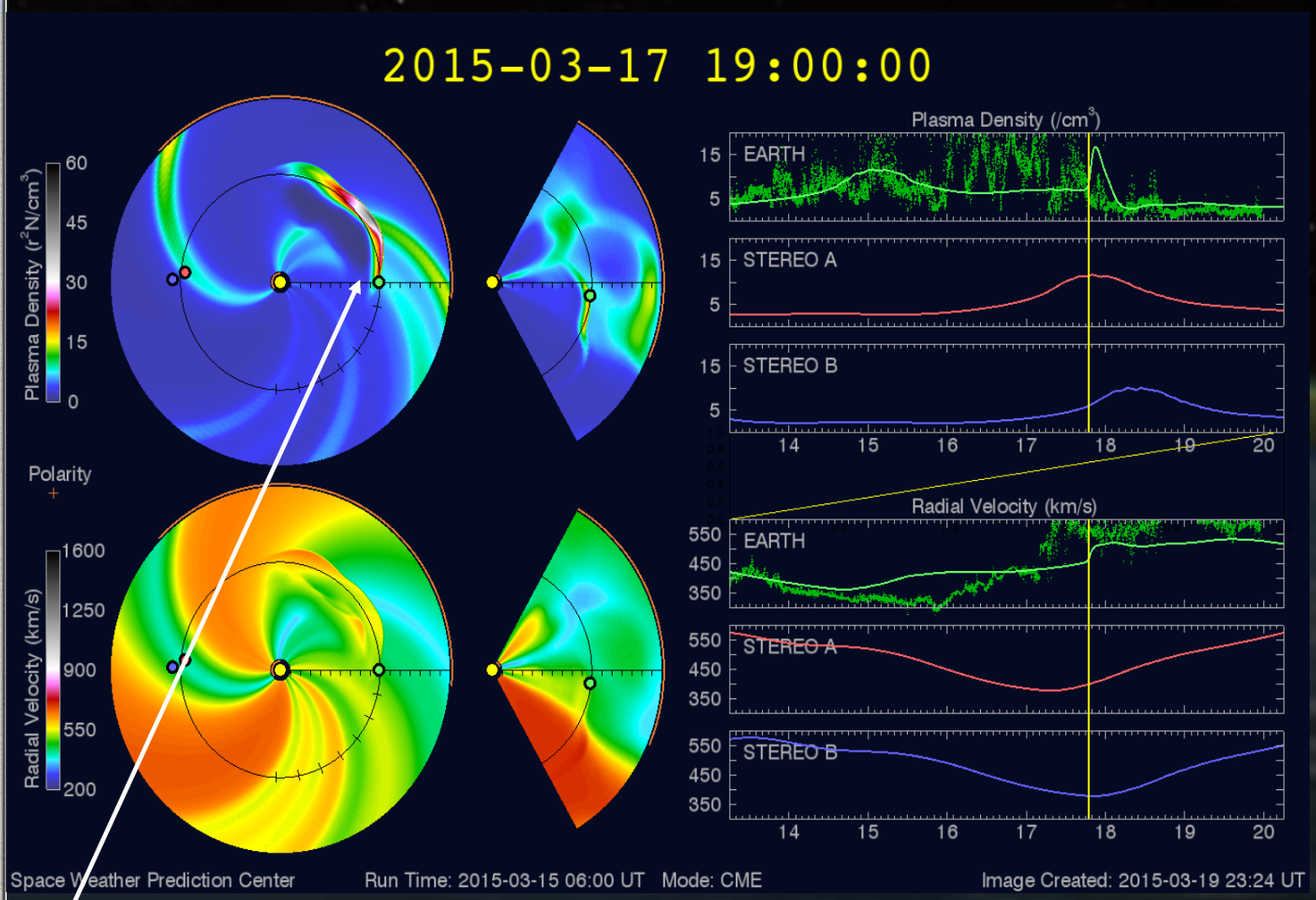


Long-duration C9/1f flare from AR 12297
GOES XRS Peak: 0213 UT
Type II radio emission: 745 km/sec

National Weather Service

St. Patrick's Day 2015 Geomagnetic Storm





AR 12297 CME 15-Mar-2015

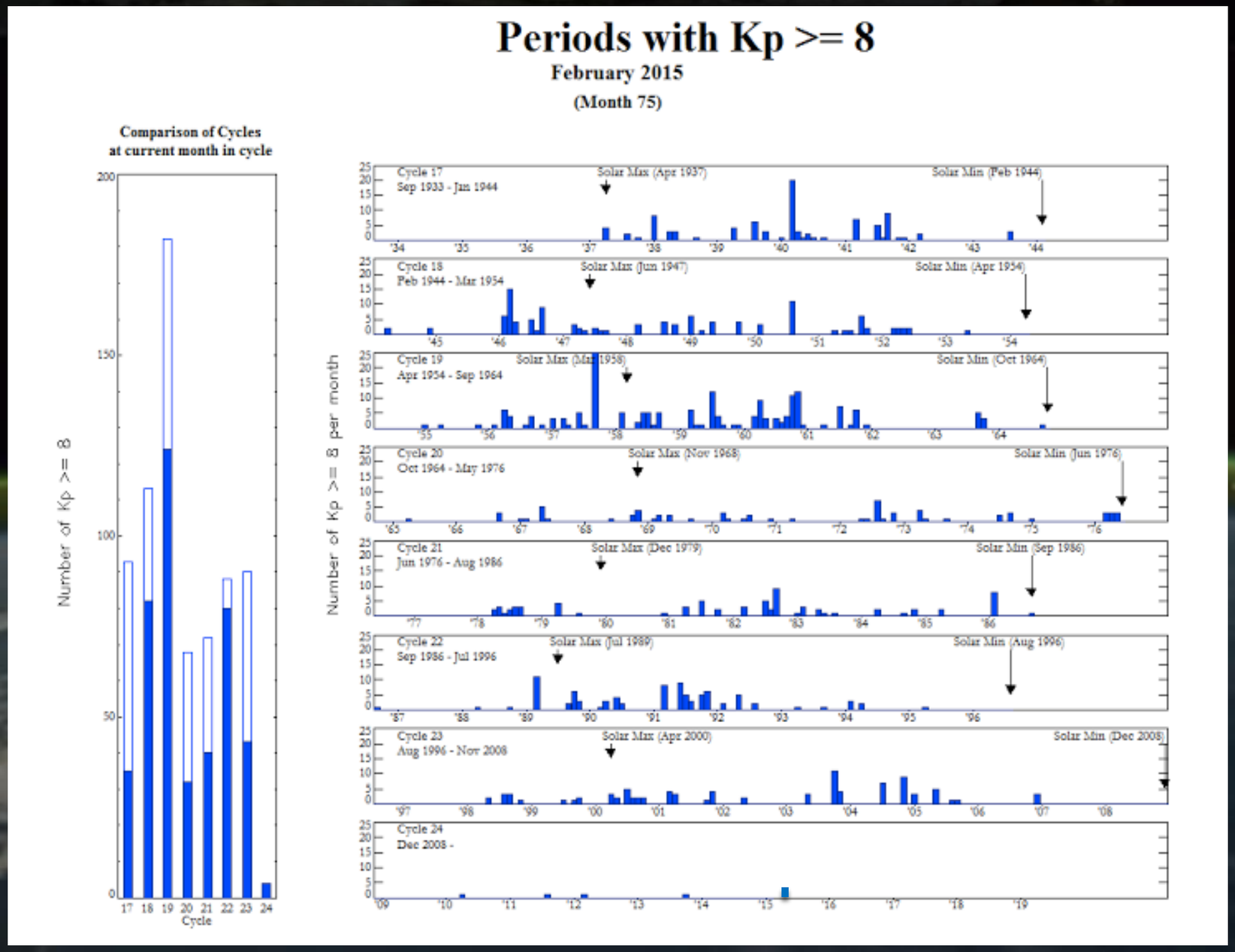
WSA/Enlil Run shows only "glancing blow" at Earth

National Weather Service

Products, Scales, and Event Progression Review

- SWPC issues Watches, Warnings, and Alerts (etc.) of space weather events
  - Watch: “Something has occurred and it may effect Earth”
  - Warning: “Observations indicate that impacts at Earth are likely”
  - Alert: “Effects at Earth have been/are being observed at Earth – event in progress”
- SWPC Scales
  - R-scale
    - Solar flare or “Radio Blackout” R1—5
    - Prompt: no watches or warnings, only alerts at >M5
    - Research needed!
  - S-scale
    - Solar energetic particles S1—5
    - Warnings and alerts issued
    - Perhaps the least understood space weather phenomenon
  - G-scale
    - Geomagnetic storms G1—5
    - Watches, Warnings, and Alerts issued
    - The most impactful event in terms of infrastructure
- Major Event Progression
  - GOES (and SDO) flare observations: R Alert
  - SOHO/LASCO CME observations: G Watch (14—72 hour lead time)
  - GOES particles: S Warnings and Alerts
  - DSCOVR observations: G Warning (~30 min lead time)
  - GOES magnetometer: G Alerts

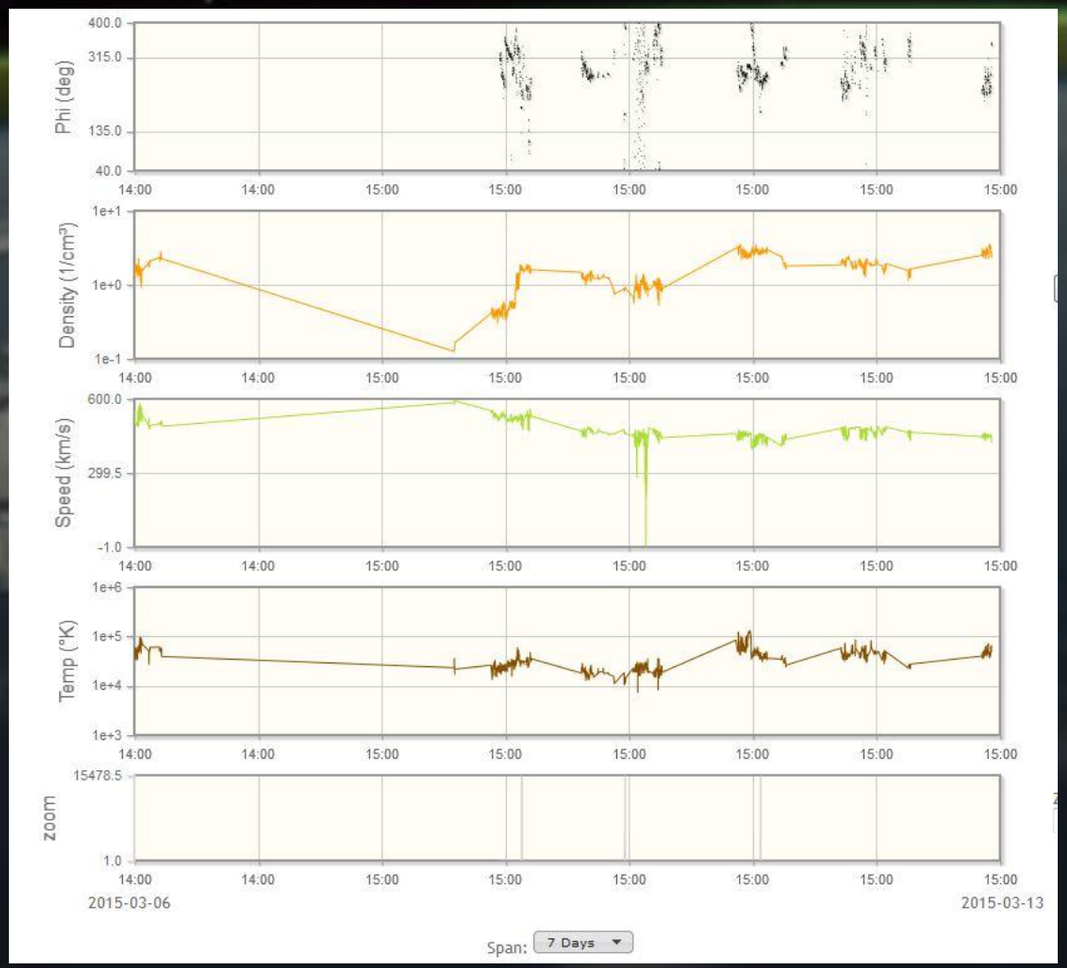
Solar Cycle 24: continued weakness



Historical Kp >= 8 (G >= 4) Periods
Solar Cycle 24 anomalously low

Observations

- DSCOVR update
  - Launch on 11-Feb-2015
  - Extremely good orbital injection: fuel budget optimistic
  - Currently about half way to L1
  - All instruments functioning nominally: First Wind!



Interplanetary magnetic field angle
(from magnetometer instrument)

Solar wind density
(from Faraday Cup instrument)

Solar wind speed
(from Faraday Cup instrument)

Solar wind temperature
(from Faraday Cup instrument)

Note: data are uncalibrated. Plots demonstrate reception of data from Wallops and Korea, basic processing, and display of data at SWPC only.

Observations

- GONG Update
  - FY16 PBR has $1M for SWPC to “operationalize” the GONG Network
  - Working with NSO in FY15 to establish baseline SWx data processing at SWPC
  - FY16 plans: full-time SWPC processing, dissemination, and archiving of H-alpha and Magnetogram data
  - FY16: ADAPT model running at SWPC as input to WSA-Enlil

Observations

- "Space Weather Follow-On" Mission update
  - 5 mission concepts currently under study
  - L1 coronagraph is the top priority observation
  - DSCOVR solar wind follow-on as well
  - Launch: 2020—2021
  - NRL "Compact Coronagraph" concept advancing:

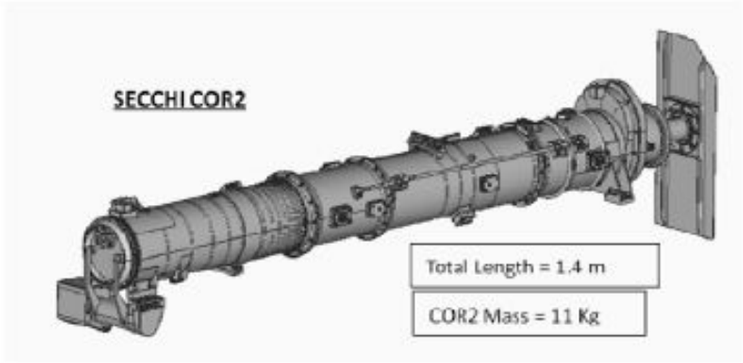


Figure 1-4. CCOR Comparison to Heritage SECCHI/COR2 Design

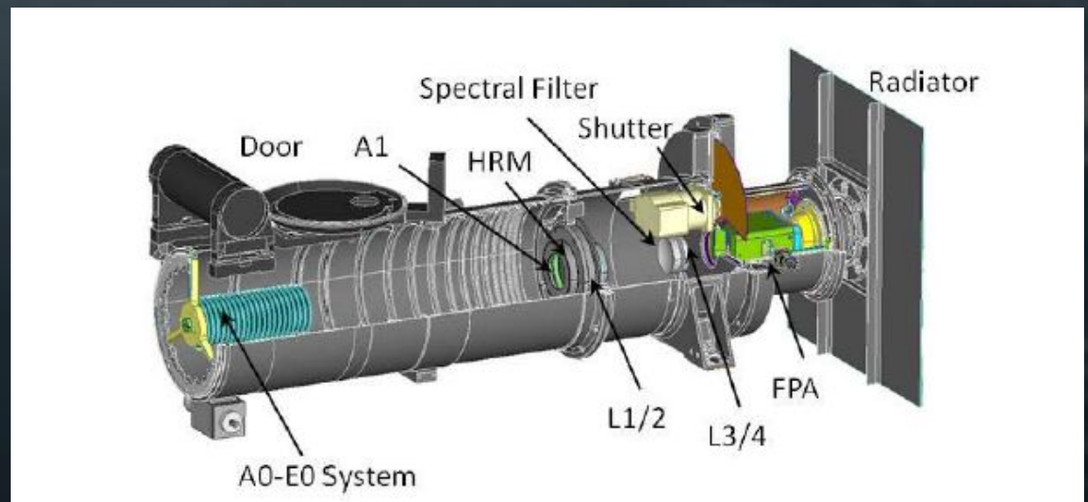
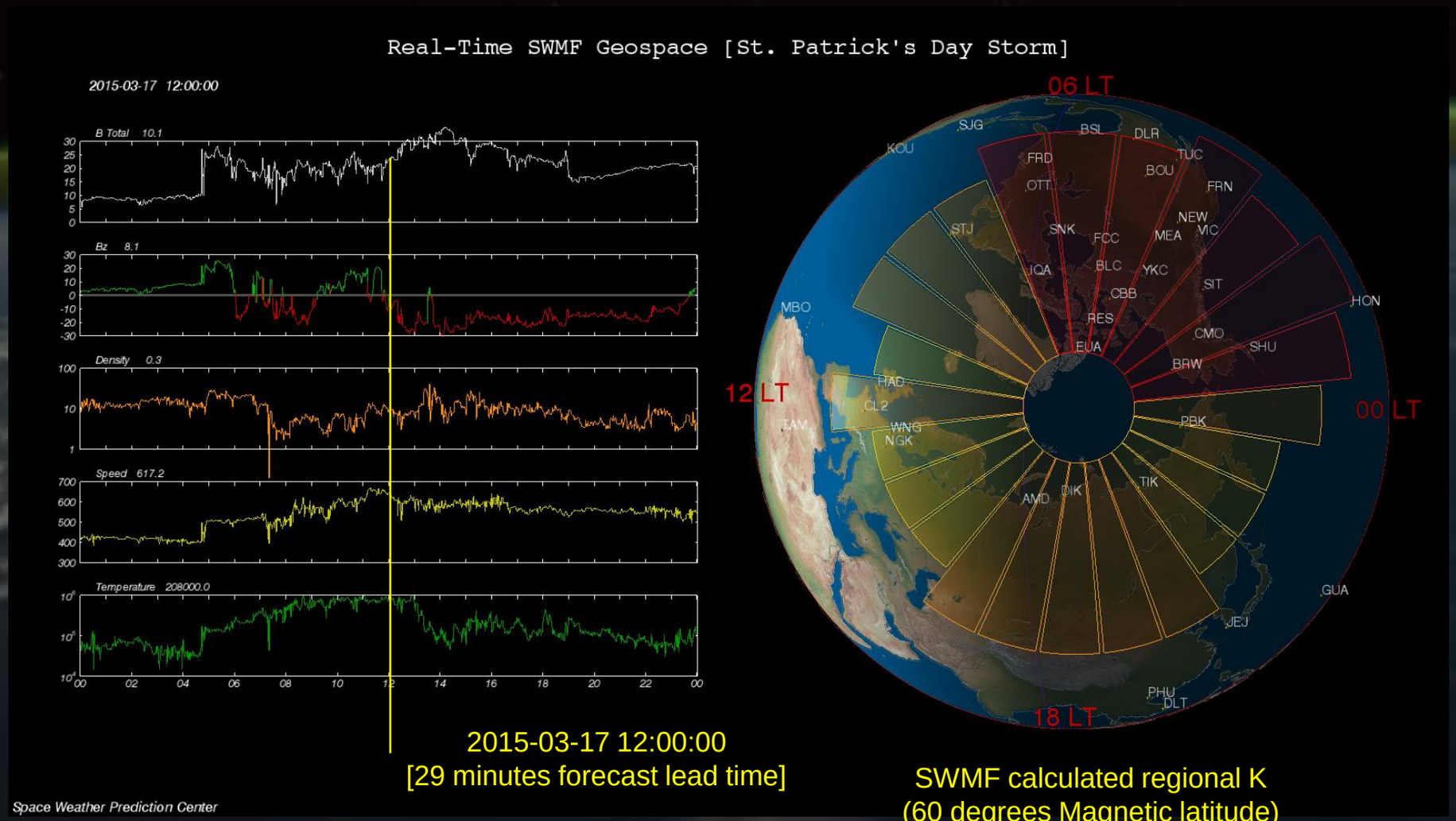


Figure 1-3. CCOR Conceptual Design

R2O Activities

- Geospace (Michigan SWMF) model update
  - Real-time runs on NWS WCOSS-dev machines in progress
  - Product development beginning
  - March 17th G4 Storm “predicted”!



2015-03-17 12:00:00
[29 minutes forecast lead time]

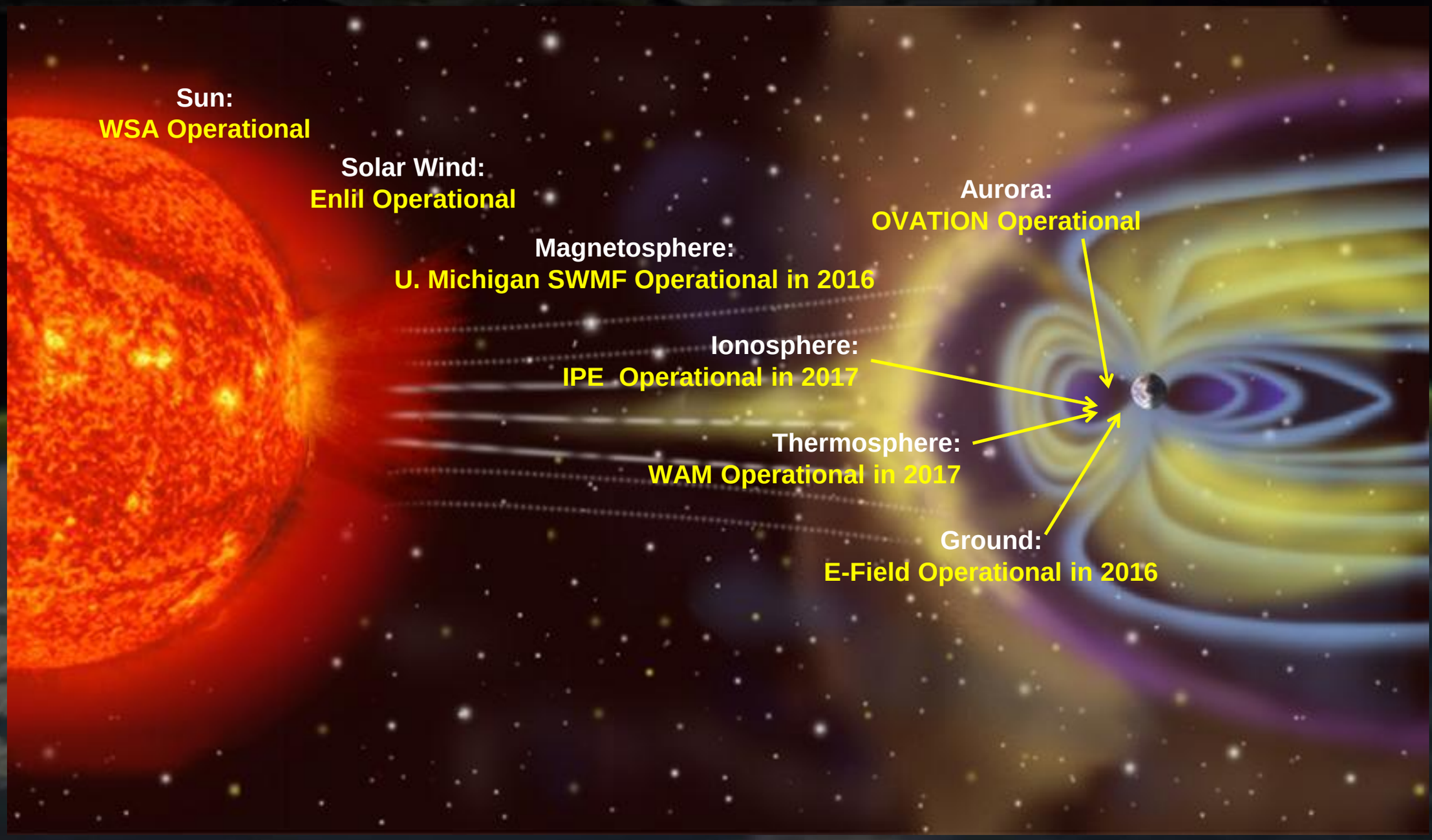
SWMF calculated regional K
(60 degrees Magnetic latitude)

K = 5, 6 | K = 7 | K = 8, 9

R2O Activities

- WAM/IDEA model update
  - WAM = Whole Atmosphere Model
    - WAM = operational GFS model with 600 km (vice 60km) top boundary
    - Neutral atmosphere only
    - Running on WCOSS-dev in FY15, operational Fy16
    - Satellite drag product potential
  - IDEA = Integrated Dynamics of Earth's Atmosphere
    - IDEA = WAM + Ionosphere/Plasmasphere Electrodynamics (IPE)
    - Major project involving NOAA/NWS, NOAA/OAR, UC/CIRES
    - FY17: transition to operations in one-way coupled form
    - FY19: two-way coupled model transitioned to operations
    - Physics-based Ionospheric forecasts are the goal

SWPC Modeling Framework



FY16 PBR: +$2.5M for SWPC R2O “Testbed” activities

External Activities (highlights)

- Space Weather Operations Research and Mitigation Task Force
  - OSTP Chartered effort to define national strategy for response, mitigation, forecasting and research related to extreme SWx events
  - Analogous to Pandemic Flu national strategy
  - Working groups for 6 major goals/objectives
  - National Space Weather Strategy open for public comment in early April
  - Final strategy and implementation released in 2015

- UKMet L5 mission: “Carrington”
  - Economic impact study just approved. SWPC and SANSA collaborating

- CCMC/SWPC Letter of agreement
  - Will define next steps for WSA/Enlil upgrades, Geospace model parameter studies, etc.
  - Nucleus of possible “O2R joint center” in discussion between NWS, NASA, and NSF