

**Session 7.8**

**SPACE WEATHER PRODUCT GENERATION TRANSITION  
FROM SWPC to NESDIS**

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**ABSTRACT**

Space Weather has demonstrated the potential to disrupt virtually every major public infrastructure system, including transportation systems, power grids, telecommunications, and global positioning systems. NOAA's Space Weather Prediction Center (SWPC) provides the Nation's official space weather alerts, warnings, watches and forecasts. The goal of these critical warnings is the securing critical data to enable long-term predictions and short-term warnings, and integrating space weather and terrestrial weather products to support key industries such as commercial airline, electric power, and the GPS industry.

Review of the current systems used at SWPC to receive the data and generate the Space Weather Products (SWP) needed by the forecasters generating the warnings and predictions showed an advantage in transitioning product generation into the NESDIS Office of Satellite and Product Operations (OSPO) product processing systems. Such a move will provide alternate processing facilities, enhanced security, improved support for 24x7 networks and processing support, and improved resolution of deficiencies. The NESDIS Office of Systems Development (OSD) is providing program management for this transition.

This paper describes the changes that will occur in the processing and generation of SWP. Although it will provide an overview of the transition plan for all of the current products, it will address in detail the changes to the data path and product processing of data from the Advanced

Composition Explorer (ACE) spacecraft.

Index Terms – Space Weather, Product Processing, ACE Satellite

**1. Introduction**

The Space Weather Prediction Center (SWPC), which is part of the National Oceanic and Atmospheric Administration (NOAA) / National Weather Service (NWS), provides space weather (SWx) alerts and warnings for disturbances that can affect people and equipment working in space and on Earth. They maintain a team of forecasters which monitor space weather on a 24x7 basis and issue forecasts, alerts, watches and warnings.

These alerts support the enhanced activity performed by humans and companies both in space and on the ground. Some of the key activities that are impacted by space weather include: the Aviation community, the Global Positioning Service, the electrical power grid, the unmanned satellites and manned spaceflight. The aviation community primary concerns are radiation hazards and communication loss on the now very popular polar routes. Solar weather is the primary source of both spatial and time error on the GPS signal. This impacts many of the other activities as GPS is now used to guide many other applications (aviation, power distribution, farm equipment, snow plows, etc). Even the Federal Emergency Management Agency (FEMA) recognizes that SWx incidents can result in a potential national catastrophe.

**2. Current SWPC Operations and the need to transition SWx Product processing to NESDIS**

Currently SWPC is receiving data and processing it to form the calibrated data that is used to

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generate the SWx products needed to provide forecast products and alerts.

Since the resultant data is critical to support SWx alerts, warnings, watches and forecasts to the critical infrastructure, the computers and operations of these computers is classified as a National Critical System with a HIGH impact. This places additional security requirements to assure that the data is available for the SWPC forecasters and the public.

Reviews of the present system showed several key issues that needed to be addressed. These included:

1. No alternate processing facility exists if the SWPC facility was unable to operate.
2. Although 24 hour forecaster coverage is maintained, the product processing facility was only staffed for a normal work day.
3. Key hardware and software components of the SWx product processing were not currently maintainable. Both obsolete hardware and operating systems were currently in use.

The decision was made to transfer the SWx product processing from SWPC to National Environmental Satellite, Data, and Information Service (NESDIS) facility. This move places the SWx product processing with the global weather product processing. It also prepares the way for the new GOES-R and DISCOVER SWX product processing. The NESDIS facility already has an alternate site and 24x7 operations.

Thus SWPC will switch from being a SWx satellite product producer to a user. It can then focus on the SWx forecast function. While the NESDIS SWx product processing will prepare for the instrument and product processing support needed for GOES-R.

### 3. Transition Project Roles and Responsibilities

The transition project has been organized between the four offices as follows:

- SWPC has provided: the current documentation; legacy software for the raw data ingest and SWx product processing; and a “reach-back” capability as needed to verify the upgraded code.
- The Center for Satellite Applications and Research (STAR) has responsibility for porting the code (ACE and GOES NOP) to

the OSPO/ESPC environment. This includes insuring that the code meets ESPC integration and standards requirements. STAR will also assume responsibility for calibration and validation for the products generated from these space sensors.

- Office of Systems Development/Ground Systems Division (OSD/GSD) has responsibility for: Project Management and coordination for the transition effort; developing the CONOPS; and planning and leading both the IT Security activities and the ESPC transition to operations.
- Office of Satellite and Product Operations (OSPO) has the requirement: to support the integration and test activities; product validation activities; and IT security. They also provide operational support activities (e.g., user services, product monitoring).

### 3. Transition Project Overview

Figure 1 shows an overview of the current SWPC processing. At the present time SWPC produces SWx products from the ACE and GOES NOP (13, 14, and 15) satellites. Generation of SWx products from the GOES I-M series will be terminated prior to the transition.

#### 3.1 ACE Overview

The ACE beacon data is received at SWPC over the Internet. The beacon data contains the Real Time Solar Wind (RTSW) Instrument data. This data is received by members of the RTSW net and transmitted to the ACE ingest processor where the data is checked and entered into the SWPC SWx processing system. The list of stations within this network is shown in the CONOPS overview (Figure 3). Figure 2 shows the overview of the system when it is moved to NOAA/NESDIS. In this configuration the same stations would use the internet to send the same data to either the NSOF building in Suitland, MD or to the backup facility in Wallops Island, VA. In both cases the raw satellite data (LVL 0) is not archived. The calibrated (LVL 1) and averaged (LVL 2) data is forwarded to SWPC for use in forecasts and predictions.

#### 3.1 GOES NOP Overview

The GOES NOP SWx data is transmitted using the Multi-use Data Link (MDL) to the MDL Receive System and Server (MRS&S) which is part of the mission management system. SWPC has

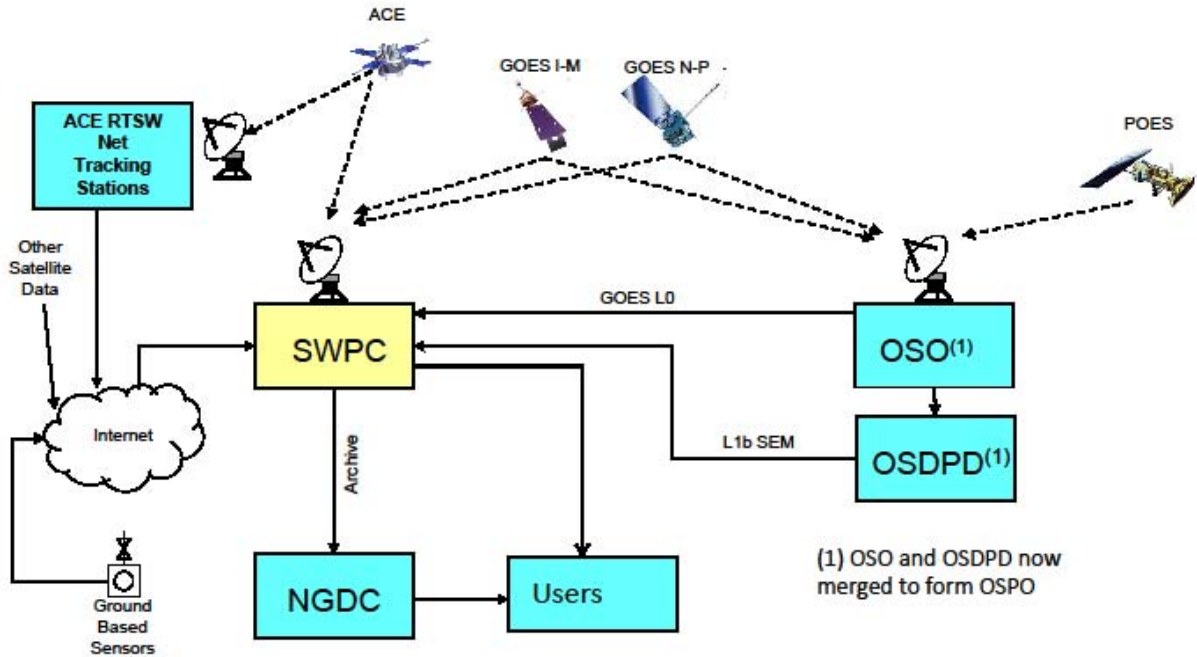


Figure 1 – Current SWPC Processing Overview

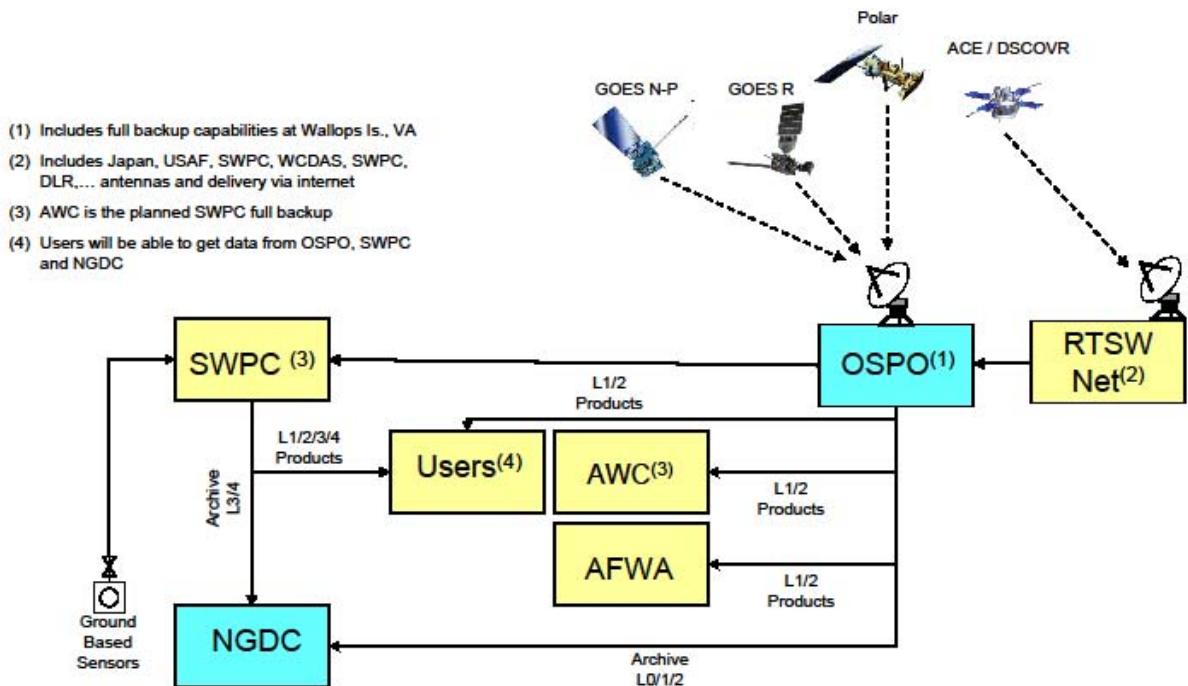


Figure 2 – Proposed NESDIS Configuration

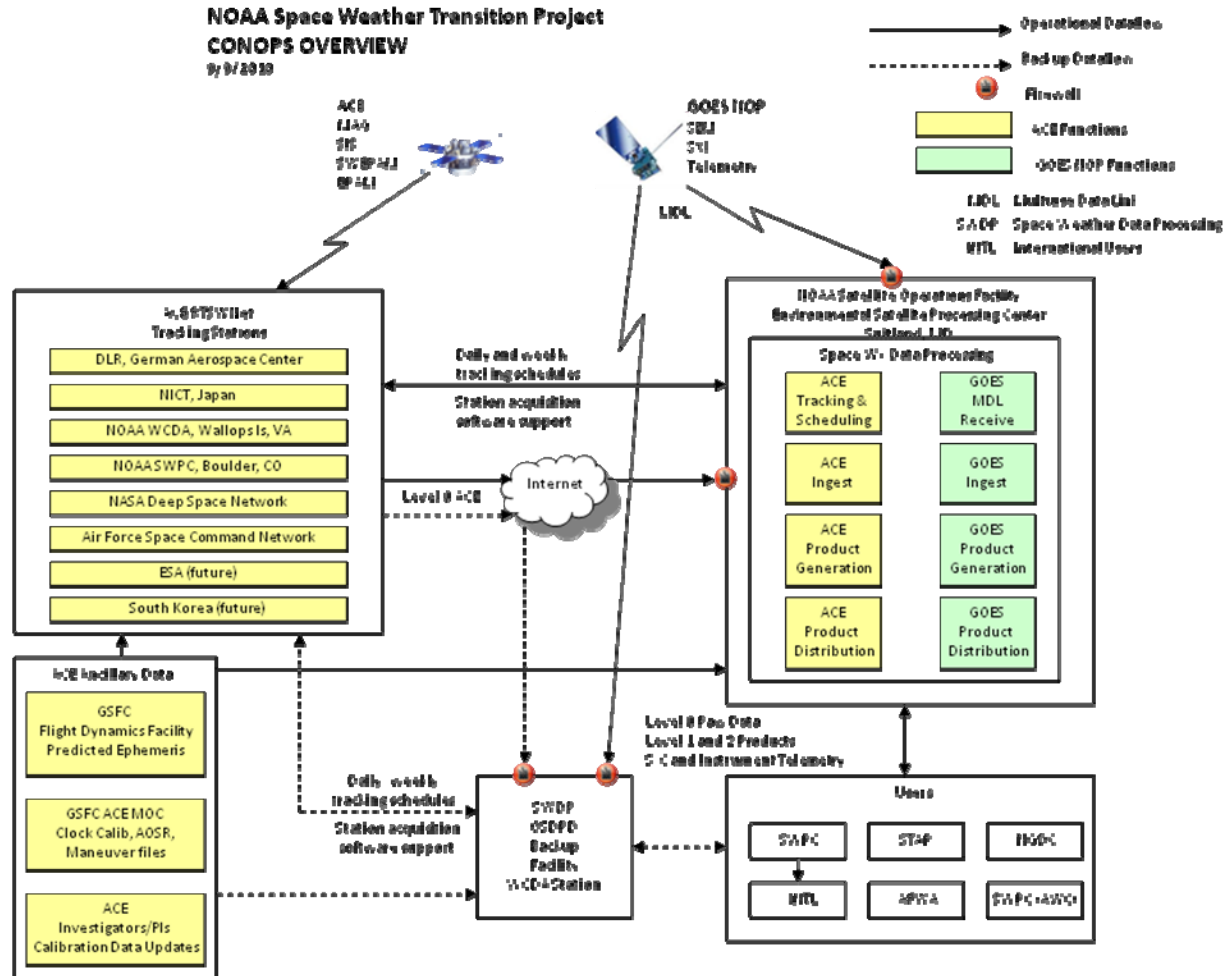


Figure 3 – NOAA Space Weather Transition CONOPS Overview

GOES NOP	GOES N(13), O(14), P(15) Series
SXI	Solar X-Ray Imager
SEM	Solar Environmental Monitor Suite
XRS	X-Ray Sensor
EUV	Extreme Ultra-Violet
MAG	Magnetometer
SEM EPS	SEM Energetic Particle Sensor Package
EPEAD	Energetic Proton, Electron, and Alpha Detector
MAGED	Magnetosphere Electron Detector
MAGPD	Magnetosphere Proton Detector
HEPAD	High Energy Proton and Alpha Detector

Table 1 – GOES NOP SWx Instruments

developed an MRS&S client which accesses the data from the MRS&S and forwards it through a secure link to the SWPC SWx product processing system. The data is calibrated, located (SXI), and averaged to provide the LVL 1 and 2 data that are used by SWPC.

The GOES NOP SWx instruments are shown within Table 1. Following the transition, ingest of the data will be directly to ESPC or its backup from the downlink antennae. It will not use the present mission management system MRS&S.

### 3.3 ESPC Backup Facility

The NESDIS ESPC satellite data product processing and distribution facility has a backup facility at the Wallops facility. In the event of loss of processing capability at the NSOF facility, the processing will be transitioned to the Wallops facility. This is not an automated failover and a

temporary outage will occur during this failover. In the case of ACE data ingest, the ground receive stations will have to be notified to send data to the backup instead of the primary processing site. Also, those primary users that are retrieving the SWx products will need to request the data from the backup site instead of the primary site.

### 3.4 Data Distribution Overview

The Data will be distributed in NetCDF format. The decision has been made that the data will be placed on a secure server and the primary users will retrieve the data that they desire.

The Primary users are:

- SWPC who will continue to use the data to develop Space Weather forecasts, warnings, and advisories. They will also continue to deliver the data to international users and provide science monitoring of the data.
- STAR will receive the data to perform science monitoring and product validation. This includes instrument monitoring.
- National Geophysical Data Center (NGDC) will continue to provide long-term archive data stewardship.
- Air Force Weather Agency (AFWA) uses the data to generate DoD space weather forecasts, warnings and advisories.
- The Aviation Weather Center (AWC) in Kansas City, MO is the SWPC backup facility.

These Operational Users will pull products from a secure ESPC distribution server.

### 4.0 Transition Progress

Following a series of technical interchange meetings the project has been organized. The roles and responsibilities have been defined and project management established.

SWPC has provided the source code and available documentation for the present system. They have also provided requirements that have been used to define the transitioned system.

OSD has established the project management including budgets, development of work assignments, and the various documents. The following documents are currently in review: CONOPS, System Requirements Document, Baseline Product List, and the Service Level Agreement.

STAR has completed the porting of the ACE code to the ESPC environment and is preparing for an end-to-end test with live data. They have also started to porting of the GOES NOP code.

### 5.0 Issues

The major issues are the satellite data ingest and the budget.

The ACE data ingest issue concerns the development of a process acceptable to security to receive the data in a similar method (via the Internet) used today. This appears to have been developed but testing will confirm that it has been closed. The GOES NOP ingest issue concerns the development of a cost effective way to remove the need to have a connection to the mission management network. Likewise it appears to be mitigated, but the budget is the issue.

The primary issue at the present time is the budget. Although transition costs are in the budget for this year, the continuing resolution (CR) makes the funds not available at the time that this session was presented.

### 6.0 Summary

SWPC and NESDIS recognize the need for SWx forecasts, alerts and warnings. The goal of this transition is to enhance the reliability of the underlying generation of the SWx products that are used by SWPC. The project is well underway, but the CR appears to be a major impediment to completing the transition in a timely fashion.

From a user standpoint, the failure to complete the transition will simply result in the SWx products being continued to be processed at SWPC.