2.2 AN OVERVIEW OF THE NOAA/NESDIS PRODUCT PROCESSING PLANS FOR THE INITIAL JOINT POLAR SYSTEM ERA

Stacy L. Bunin* and Diane Holmes
Mitretek Systems, Inc., Falls Church, Virginia

Pamela M. Taylor
NOAA/NESDIS, Washington, D.C

1. INTRODUCTION

The National Oceanic and Atmospheric Administration (NOAA) and the European Organization for the Exploitation of Meteorological Satellites (EUMETSAT) signed a Memorandum of Agreement in November of 1998 for participation in the Initial Joint Polar System (IJPS). IJPS is a cooperative effort between the United States and the Europeans to share responsibility for environmental polar satellite operations and to provide the continuity of observations from polar-orbiting satellites for operational meteorological and environmental objectives.

IJPS consists of two independent, but fully coordinated, environmental polar-orbiting satellite systems. In support of IJPS, NOAA satellites NOAA-N and -N' will be flown in a polar orbit with an afternoon (2:00 PM) equatorial crossing time. The National Environmental Satellite, Data, and Information Service (NESDIS) will continue to operate these afternoon operational NOAA satellites, as well as generate, distribute, and archive an extensive suite of environmental products. EUMETSAT, working together with the European Space Agency (ESA), will develop the Meteorological Operational (MetOp) series of satellites to be flown in a polar orbit with a mid-morning (9:30 AM) equatorial crossing time. The mid-morning and afternoon satellites will each carry a set of common instruments along with additional instruments specific to each orbit and operating agency. Through the use of these satellites, NOAA and EUMETSAT will support the generation of products and services for their respective user communities.

2. CURRENT SATELLITE STATUS AND PLANS

Currently NESDIS has two operational polar-orbiting satellites. NOAA-K, now designated NOAA-15, was launched into an early morning orbit (7:30 AM) in May 1998. NOAA-L, now designated NOAA-16, was launched into an afternoon (2:00 PM) orbit in September 2000. The next satellite in the series, NOAA-M, is scheduled for a March 2002 launch to replace NOAA-15 but will be put into a mid-morning orbit (10:00 AM). NOAA-M's new mid-morning orbit will allow for increased temporal coverage and production of numerous imagery-based products, such as aerosol and vegetation index, currently not available from early morning orbits due to sun angle constraints. The new channel 3a (1.6 micron) added to the NOAA-KLM series for enhanced discrimination between snow/ice and clouds is also optimized in the mid-morning orbit. Additionally, NOAA-M at 10:00 AM allows for a transition to and validation of the NOAA heritage instruments and their derived products scheduled for MetOp-1. The planned launch dates for the NOAA and MetOp satellites during the IJPS era follows:

NOAA-N – June 2004
MetOp-1 – December 2005
NOAA-N' – March 2008
MetOp-2 – August 2010

The first MetOp satellite is planned to become operational in 2006 after an extensive checkout period.

3. IJPS INSTRUMENTS

The core environmental instrument set used for product processing on the NOAA and MetOp satellites in the IJPS era are listed below. In addition, sensors for search and rescue and data collection are also part of the core instrument suite.

- Advanced Microwave Sounding Unit-A (AMSU-A) is a microwave sounder with 15 channels in the 23-90 GHz range. This instrument is used primarily for derivation of temperature soundings along with several surface and hydrological parameters.
- Advanced Very High Resolution Radiometer (AVHRR/3) is an imaging radiometer with six channels (3 visible/near infrared and 3 infrared) in the range of 0.6-12 microns. The MetOp spacecraft will have the capability to record full resolution 1-km global imagery. In addition to imagery this instrument supports the production of numerous ocean, land, and ice parameters along with hazard (fire, volcano) detection and monitoring.
- High Resolution Infrared Radiation Sounder (HIRS/4) is a temperature sounder with 19 infrared channels in the 3-15 micron range, and one visible channel. The HIRS/4 is an upgrade from the HIRS/3 currently orbiting aboard the NOAA-KLM series of satellites. The HIRS/4 has a smaller field of view at 10-km, compared to 20-km on the HIRS/3 model.
- Microwave Humidity Sounder (MHS) is a microwave sounder with five channels at 89, 157, and around 183 GHz supporting production of humidity profiles and other hydrological products.

* *Corresponding author address*: Stacy L. Bunin, Mitretek Systems; 3150 Fairview Park Drive South; Falls Church, Virginia 22042; e-mail: sbunin@mitretek.org.

- Space Environment Monitor (SEM/2) is a multi-channel charged-particle spectrometer.

In addition to the core instruments, the NOAA satellites will also carry:

- Solar Backscatter-Ultraviolet Radiometer (SBUV/2) is a spectral radiometer with 12 channels in the 252.0-322.3 nm in discrete mode and 160-400 nm in scan mode, used for generating ozone profiles.

The MetOp satellites will carry four new instruments:

- Advanced Scatterometer (ASCAT) is a pulsed C-band radar at 5.255 GH, used to generate ocean surface wind products.
- Global Ozone Monitoring Experiment (GOME-2) is a nadir-viewing spectrometer with four channels in the range of 0.240-0.790 microns.
- Global navigation satellite system Receiver for Atmospheric Sounding (GRAS) is a radio occultation receiver that uses signals from the global navigation satellite systems. GRAS will only initially be used by NESDIS for research applications including atmospheric temperature and moisture profiles.
- Infrared Atmospheric Sounding Interferometer (IASI) is a Michelson interferometer covering the 3.6-15.5 micron range. The IASI will be used initially by NESDIS and its users in a demonstration mode to complement the HIRS and AMSU-based soundings. Additional applications for the IASI may include sea surface temperature, clouds, Earth radiation budget, and land measurements.

Data streams from all core instruments, regardless of platform, plus the SBUV/2, will continue to be available at NESDIS in order to continue to meet current and planned Level 1 data and Level 2 product generation, distribution and archive requirements. In addition, access to the data and/or products of the four new MetOp instruments will be supported in order to enhance fulfillment of NESDIS requirements.

4. POLAR PRODUCT PROCESSING

NESDIS produces more than 140 products from NOAA's polar-orbiting satellites in several atmospheric, earth radiation, land, and ocean disciplines. Products are generated on a variety of temporal and geographic scales in support of NOAA's weather forecasting and ocean observation requirements and other domestic and international users.

Products in the IJPS era will become operational with a phased approach after the MetOp launch. Products will be classified as baseline or Day-1 if they are necessary for an operational transition from an older spacecraft (i.e. the NOAA-KLM series). Enhancements, or Day-2 products, are those that require further science validation, system verification development, and/or user evaluation before being deemed operational. In addition, some products will initially be classified as demonstration products while others will be used for research purposes as new applications are developed. NOAA's initial operational, demonstration, and research applications for the IJPS instruments are contained in Table 1.

4.1 *Day-1 Baseline/Operational Products*

Operational products are those that are supported by the NESDIS Office of Satellite Data Processing and Distribution 24 hours per day, 7 days per week in accordance with user product formatting, accuracy, and timeliness requirements. Processing systems will need to be able to process data from the new HIRS/4 and MHS instruments on NOAA-N for continuity of the afternoon mission. In order for the MetOp-1 satellite to replace NOAA-M as the operational morning satellite, keeping the continuity of the morning mission, the products currently generated from the core instruments are required to be generated, distributed, and archived on an operational basis. These include Level 1 and 2 products from AMSU-A, AVHRR/3, HIRS/4, and MHS, and Level 1 products from SEM.

4.2 *Day-2 Enhancements/Operational Products*

These products are generally from the new data streams aboard MetOp due to new instrumentation and enhanced recording capability. While they are not required for operational transition from an older spacecraft, they will be deemed operational on an individual basis as each meets operational status criteria. These products include the global full resolution 1-km AVHRR Level 1 datasets, Level 1 and 2 ASCAT data, IASI Level 1C data, and GOME Level 2 data.

4.3 *Day-2 Enhancements/Demonstration Products*

These products are also from new data streams aboard MetOp but are not required for operational transition. Demonstration products will provide global coverage in a timely manner to selected users for evaluation but will not have support 24 hours per day, 7 days per week nor will be archived. These products include Level 2 products from IASI and Level 2 products based on full resolution 1-km AVHRR data.

4.4 *Day-2 Enhancements/Research Products*

These products are under development and will initially have a research status. They are as a result of new data streams aboard MetOp and include Level 1 and 2 products from GRAS and direct application of Level 1 GOME datasets.

4.5 *Additional Product System Modifications*

In the IJPS era due to data volume and transmission capabilities, MetOp data will arrive at the NESDIS ingestor in granules, or small subsets, of the orbit versus full orbital transmissions from the traditional

NOAA satellites. Level 1 data will be produced in "pipeline" format to allow for the near simultaneous processing of each granule to meet dataset timeliness requirements. The polar product processing systems will also need to process the Level 1 data into Level 2 products via a pipeline format in order to meet user timeliness requirements. Enhanced formatting and distribution capabilities at this suborbital level are being investigated with users to further improve product timeliness while continued orbital formatting may be need for archive continuity.

Table 1. NOAA's Initial Applications for IJPS Instruments

	AMSU-A	AVHRR/3	HIRS/4	MHS	SBUV/2	SEM/2	IASI	ASCAT	GOME-2	GRAS
Aerosols		D1-O								
Atmospheric Moisture				D1-O						R
Atmospheric Temperature	D1-O		D1-O				D			R
Cloud Imagery		D1-O								
Ocean Winds								D2-O		
Ozone			D1-O		D1-O				D2-O	
Precipitation	D1-O	D1-O		D1-O						
Radiation Budget		D1-O	D1-O							
Sea Ice	D1-O	D1-O								
Sea Surface Temperature		D1-O								
Significant Event Imagery		D1-O								
Solar Environment Monitoring						D1-O				
Snow and Ice Cover	D1-O	D1-O								
Vegetation Index		D1-O								

D1-O: Day-1 Operational D2-O: Day-2 Operational D: Demonstration R: Research

5.0 CONCLUSION

Plans are in place to continue generating and distributing operational products, from both morning and afternoon environmental polar-orbiting satellites, with a core set of imagery and sounding instruments. In addition, new instrumentation on the MetOp satellites will give NESDIS users and scientists the opportunity to apply additional datasets to and develop new products for numerous atmospheric, ocean, and land applications.

The NESDIS SATellite PRoducts Overview Display (SATPROD) contains information on the current suite of NESDIS products, satellites and instruments that are involved in creating operational, experimental, and developmental products. SATPROD is available at the following web site:

http://osdacces.nesdis.noaa.gov:8081/satprod/

6.0 REFERENCES

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