Report on Near Real-Time Availability of Data from the National Polar-orbiting Operational Environmental Satellite System

The USA provides an overview of the near real-time availability of global Stored Mission Data (SMD) and real-time High Rate Data (HRD) and Low Rate Data (LRD) from NPOESS. NPOESS global SMD will be routed to four (4) U.S. Operational Processing Centers for processing into Raw Data Records (RDR), Sensor Data Records (SDR), and Environmental Data Records (EDR). NESDIS will provide the worldwide user community access to near real-time processed NPOESS data and higher-level products via the NESDIS Central Environmental Satellite Computer System (CEMSCS) servers, as well as access to archived NPOESS data via other distributed servers at the NESDIS Data Centers.

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Introduction

Over the last seven years, the Integrated Program Office (IPO) has been developing the National Polar-orbiting Operational Environmental Satellite System (NPOESS). With a planned delivery of the first operational satellite in 2008, the IPO will begin launching NPOESS spacecraft into three orbital planes (0530, 0930, and 1330 equatorial nodal crossing times) to provide a single, national system capable of satisfying both civil and national security requirements for space-based, remotely sensed environmental data. The advanced technology visible, infrared, and microwave imagers and sounders that are being developed for NPOESS will deliver higher spatial and temporal resolution data to meet user validated requirements for 55 atmospheric, oceanic, terrestrial, and solar-geophysical parameters enabling more accurate short-term weather forecasts and severe storm warnings, as well as serving the data continuity requirements for improved global climate change assessment and prediction. Early flight-testing of instruments is planned to reduce development risk and to demonstrate and validate global imaging and sounding instruments, algorithms, and pre-operational ground processing systems prior to delivery of the first NPOESS spacecraft.

To meet U.S. requirements for the 55 geophysical parameters, including specific Department of Defense (DoD) and National Oceanic and Atmospheric Administration (NOAA) user requirements for data latency, the NPOESS Command, Control, and Communications (C3) system will deliver global Stored Mission Data to four (4) U.S. Operational Processing Centers (Centrals) for processing and distribution. Global Stored Mission Data (SMD) will be the complete, full resolution data set containing all sensor data and auxiliary data necessary to generate all NPOESS Environmental Data Records (EDR) at the Centrals. The IPO will install an Interface Data Processor Segment (IDPS) at each of the four (4) Centrals to process NPOESS Raw Data Records (RDR) into EDRs. Processing RDRs into Environmental Data Records (EDRs) will require production of intermediate-level satellite instrument Sensor Data Records (SDRs). The requirement for the SDRs is for user displays, retrospective processing leading to improved methods, and for sensor evaluation, trending, or troubleshooting. The SDRs contain the counts and calibration data at geo-located points. The calibration data and counts in the SDRs provide reversible data necessary to recreate RDRs for validation purposes. This intermediate-level data will be available through the Centrals as retrievable data records.

NPOESS spacecraft will also simultaneously broadcast two types of real-time data to suitably equipped ground stations. These direct broadcast/real-time ground stations (or field terminals) will be capable of processing NPOESS RDRs into EDRs by utilizing IDPS software appropriate for the type of field terminal. The NPOESS High Rate Data (HRD) broadcast will be a complete, full resolution data set containing all sensor data and auxiliary data necessary to generate all NPOESS EDRs and is intended to support users at regional hubs. The HRD broadcast will be transmitted at X-band frequencies, at a data rate of about 20 Mbps, and will require a bandwidth of nearly 50

MHz, with a receive antenna aperture not to exceed 2.0 meters in diameter. The IPO has reviewed alternative spectrum availability and has determined that the WARC-97 EESS X-band allocation at 7750-7850 MHz is suitable for this application. The NPOESS Low Rate Data (LRD) broadcast will be a subset of the full data set and is intended for U.S. and worldwide users of field terminals (land and ship-based, fixed and mobile environmental data receivers operated by DoD users and surface receivers operated by other U.S. government agencies, worldwide weather services, and other international users). Some data compression (Lossy or Lossless) may be employed for the LRD link. The LRD L-band broadcast will provide data at a rate of 3.5 Mbps at 1702.5 MHz with full CCSDS convolutional coding, Viterbi decoding, and Reed Solomon encoding/decoding into a receive antenna aperture not to exceed 1.0 meter diameter. The NPOESS LRD broadcast parameters (frequency, bandwidth, data rate, and data content) were selected to satisfy U.S. requirements for low-rate, real-time direct broadcast, as well as be closely compatible with the broadcast parameters for the Advanced High Resolution Picture Transmission (AHRPT) format that has been accepted and approved by CGMS and will be used on the European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT) Metop spacecraft. The NPOESS LRD broadcast is expected to provide microwave (from CMIS) and infrared (CrIS) sounding data, and selected imagery channels (from VIIRS). Future communications capabilities may allow other-than-direct data transmission to follow-on field terminal systems.

Data Types Available

Three types of NPOESS data will be made available through the four (4) U.S. Centrals:

Raw Data Records (RDRs)

Raw Data Records will be full resolution, unprocessed digital sensor data, time-referenced and earth (GEO) located (or orbit-located for *in-situ* measurements), with radiometric and geometric calibration coefficients appended, but not applied, to the data. Aggregates (sums or weighted averages) of detector samples are considered to be full resolution data if the aggregation is normally performed to meet resolution and other requirements. Sensor data will be unprocessed with the following exceptions: time delay and integration (TDI), detector array non-uniformity correction (i.e., offset and responsivity equalization), and lossless data compression are allowed. All calibration data will be retained and communicated to the ground without lossy compression. For the real-time transmission of raw data to field terminals, lossy compression will be allowed. Additionally, reduced resolution will be allowed in transmission of raw data to LRD field terminals.

Sensor Data Records (SDRs)

Sensor Data Records will be full resolution sensor data that are time referenced, earth (GEO) located (or orbit-located for *in-situ* measurements), and calibrated by applying the ancillary information, including radiometric and geometric calibration coefficients and geo-referencing parameters, such as platform ephemeris. These data are processed to sensor units (e.g., radar backscatter cross section, brightness temperature, radiance, etc.). Calibration, ephemeris, and any

other ancillary data necessary to convert the sensor units back to sensor raw data (counts) are included.

Environmental Data Records (EDRs)

Environmental Data Records are fully processed sensor data that contain the environmental (geophysical) parameters or imagery that must be generated as user products, as well as any ancillary data required to identify or interpret these parameters or images. EDRs will be generated by the NPOESS IPDS at each of the Centrals (or by IDPS software running on NPOESS compatible HRD or LRD field terminals) by applying appropriate algorithms to RDRs/SDRs.

Delivery Details

NPOESS data, including RDRs, SDRs, EDRs, stored raw mission data, stored and real-time telemetry, and stored Surface Data Collection data, will be distributed through the Data Routing and Retrieval (DRR) component of the NPOESS C3 segment to the four (4) U.S. Centrals. These Centrals are: the National Environmental Satellite, Data, and Information Service (NESDIS)/National Centers for Environmental Prediction (NCEP), the Air Force Weather Agency (AFWA), Fleet Numerical Meteorology and Oceanography Center (FNMOC), and the Naval Oceanographic Office (NAVOCEANO). At each of the four (4) Centrals, the NPOESS IDPS will store the raw data, process these data into SDRs and EDRs, using auxiliary and ancillary data as necessary, and store these processed data. The IDPS will provide sufficient temporary storage capacity (i.e., storage capacity for multiple passes – minimum of 24 hour storage) to store the RDRs/SDRs/EDRs and ancillary data for immediate use in the Centrals' higher-level product applications. Longer-term storage and archive of RDRs/SDRs/EDRs for use by the Centrals will be the responsibility of the respective Central. NESDIS will maintain the long-term archive of NPOESS data. Centrals may provide the raw and processed NPOESS data to local systems and other users, as required. The four (4) U.S. Centrals will be responsible for distributing NPOESS data and higher-level products to their respective users. NESDIS will be responsible for providing the worldwide user community access to near real-time processed NPOESS data and higher-level products via the NESDIS Central Environmental Satellite Computer System (CEMSCS) servers, as well as access to archived NPOESS data via other distributed servers at the NESDIS Data Centers. Other non-government users may also have an independent capability to receive NPOESS data. The processing, archiving, and dissemination of these data by independent users are their responsibility.