4.3 NOAA/NESDIS SATELLITE PRODUCTS AND DIRECT READOUT OVERVIEW

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1. INTRODUCTION

The mission of the National Oceanic and Atmospheric Administration (NOAA) National Environmental Satellite Data Information Service (NESDIS) is to provide timely access to global environmental data from satellites and other sources to promote, protect, and enhance the Nation's economy, security, environment, and quality of life. To fulfill its responsibilities, NESDIS acquires and manages the Nation's operational environmental satellites, operates the NOAA National Data Centers, provides data and information services including Earth system monitoring, performs official assessments of the environment, and conducts related research.

1.1 POES

The Polar orbiting Operational Environmental Satellite (POES) spacecraft circles the Earth in an almost north-south orbit, passing close to both poles. These orbits have an altitude between 830 km (morning orbit) and 870 km (afternoon orbit), and are sun synchronous. One satellite crosses the equator at 10:00 a.m. local time, the other at 2:00 p.m. local time. Operating as a pair, these satellites ensure that data for any region of the Earth are no more than six hours old. Each satellite orbits the Earth 14 times per day, collecting global data for atmospheric and surface measurements in support of short term weather forecasting and long term global climate change research.

The primary mission of the POES system is to provide daily global observations of weather patterns and environmental measurements of the Earth's atmosphere and the proton and electron flux at satellite altitude. Since the beginning of the POES program, environmental data and products acquired by its satellites have been provided to users around the globe. These satellites increase the accuracy of weather forecasting by providing quantitative data required for improved numerical weather forecast models.

Currently NESDIS operates five polar orbiters. The NOAA-15, NOAA-16, NOAA-17 and NOAA-18 satellites continue to transmit data as secondary or stand-by satellites. NOAA-19 serves as the primary afternoon satellite as of June 2, 2009. Since May 2007, NOAA is using the METOP-A EUMETSAT satellite operationally for the primary morning orbit through a NOAA/EUMETSAT partnership.

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NOAA-19, the latest polar satellite launched February 6, 2009, caries the following instruments: the Advanced Very High Resolution Radiometer (AVHRR/3), High Resolution Infrared Radiation Sounder (HIRS/4), and the Advanced Microwave Sounding Unit (AMSU-A), the Solar Backscatter Ultraviolet Spectral Radiometer (SBUV/2), and the Microwave Humidity Sounder (MHS). These instruments provide environmental monitoring instruments for imaging and measuring the Earth's atmosphere, its surface and cloud cover, including Earth radiation, atmospheric ozone, aerosol distribution, sea surface temperature, and vertical temperature and water profiles in the troposphere and stratosphere and the measurement of proton and electron flux at orbit altitude. For more details of POES spacecraft specification and capabilities:
http://www.osd.noaa.gov/POES/NOAA-N_Prime_Booklet_12-16-08.pdf

1.2 OTHER NOAA POLAR SATELLITES

NOAA also manages the command, control, and communications function of the Department of Defense's (DOD's) Defense Meteorological Satellite Program (DMSP) constellations. Data from DMSP are used to see environmental features such as clouds, bodies of water, snow, fire, and pollution in the visual and infrared spectra.

NOAA acquires, produces, and distributes geophysical data from the Jason-2 Ocean Surface Topography Mission (OSTM). Launched in 2006, Jason-2 is a joint effort between NOAA, NASA, CNES, and EUMETSAT and takes precise measurements of ocean surface altimetry. This information is used to measure heat fluctuations, warm eddies, significant wave height, wave period, and to derive wind speed at the ocean surface.

For current polar satellite instrument health and status information and orbital equator crossing times see:
http://www.oso.noaa.gov/poesstatus/
http://www.wmo.int/pages/prog/sat/GOSleo.html#CurrentLEO

Figure 1 shows the current and future launch schedules for NOAA's polar satellites, effective as of December 2008. Future launches will ensure the continuity of measurements to support NOAA's mission.

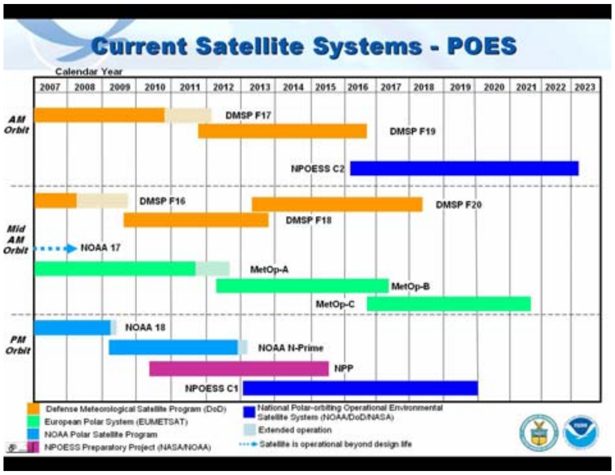

Fig. 1. POES current and future launch schedule and orbital location.

1.3 GOES

The GOES spacecraft, in contrast to the POES spacecraft, circles the Earth in a geosynchronous orbit, which means they orbit the equatorial plane of the Earth at a speed matching the Earth's rotation. There are currently four GOES spacecraft in orbit; two geostationary satellites, referred to as GOES-East and GOES-West, plus an on-orbit spare satellite. Each satellite continuously views nearly one third of the Earth's surface. The GOES-12 (also known as GOES-East) satellite is positioned at 75 degrees West longitude at the equator and monitors North and South America and most of the Atlantic Ocean. GOES-11 (also known as GOES-West) is positioned at 135 degrees West longitude at the equator and monitors North America and the Pacific Ocean basin. During special testing or in support of Post Launch Test, a 3rd GOES is often located at either 90 or 105 West longitude. GOES-13 was launched in 2006, and is the on-orbit backup for NOAA's geostationary satellite constellation. These satellites operate together to provide continuous monitoring necessary for effective and extensive weather forecasting, prediction, and environmental monitoring as seen in Figure 2. The fourth GOES, GOES-10, is currently providing observations focused on the Southern Hemisphere, and is planned to be deorbited December 2009. The geosynchronous orbit is about 35,800 km (22,300 miles) above the Earth's equator.

The latest GOES satellite, GOES-13, carries the following instruments: Imager (earth atmosphere), Sounder (earth atmosphere), Space environment monitor (SEM) (including: Energetic particle sensor (EPS), High energy proton and alpha particle detector (HEPAD), X-ray sensor (XRS), Extreme ultraviolet (EUV) instrument, Magnetometer), and a Solar X-ray Imager (SXI). These instruments continuously observe and measure meteorological phenomena in real time, providing the meteorological community and scientists with improved observational and measurement data of the Western Hemisphere. In addition to short-term weather forecasting and space environmental monitoring, these enhanced operational services also improve support for atmospheric science research, and numerical weather prediction models.

The GOES spacecraft host an imager capable of detecting atmospheric, sea surface, and land properties in five spectral bands including the 0.64, 3.9, 6.7, 10.7, and 13.35 μm wavelengths. The geostationary satellites transmit all five spectral bands simultaneously, providing the user community with continuous views of atmospheric measurements in various wavelengths, each with its own atmospheric, land, and ocean application. GOES spacecraft were designed for flexible scanning of the Earth and a variety of scans or sector coverage are scheduled. For example, the full-Earth disk is normally scanned once every 3 hours taking about 30 minutes to complete while the Contiguous United States (CONUS) is nominally scanned every 15 minutes. This routine monitoring schedule of GOES-East is depicted in Figure 3. Depending on requirements to monitor environmental hazards on the Earth's surface or in the atmosphere and per operational National Weather Service request, 7½- minute interval Rapid Scan Operations (RSO) scans over the CONUS are produced. To further support mesoscale and microscale analyses, 1000 km x 1000 km areas can also be scanned at 1-minute intervals known as Super Rapid Scan Operations (SRSO), to capture rapidly developing and dynamic environmental phenomena.

For current geostationary satellite instrument health and status information and orbital locations, see: http://www.oso.noaa.gov/goesstatus/ http://www.wmo.int/pages/prog/sat/GOSgeo.html#CurrentGEO

Figure 4 shows the current and future launch schedules for NOAA's geostationary satellites, effective as of December 2008. Future launches will ensure the continuity of measurements to support NOAA's mission.

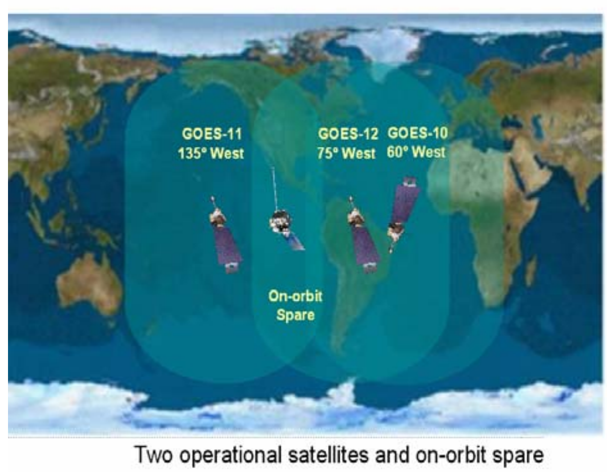

Fig. 2. Location and coverage of operational and spare GOES satellites.

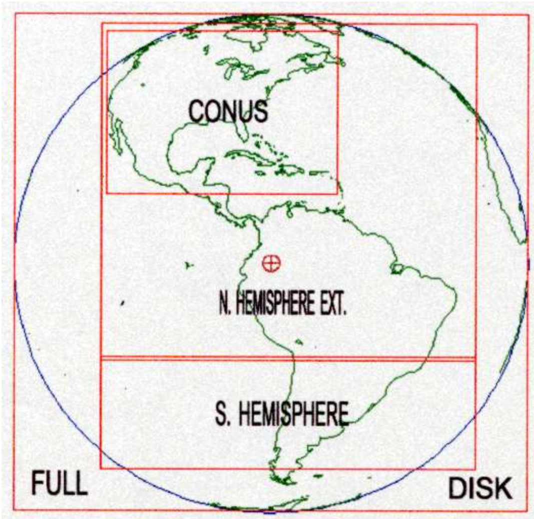

Fig. 3. Example of GOES-East Routine imager schedule.

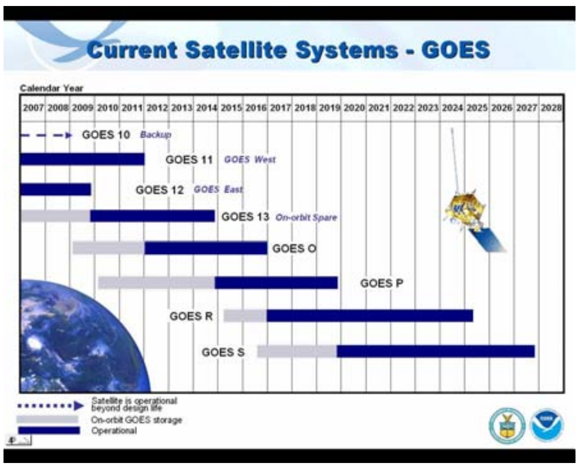

Fig 4. GOES current and future launch schedule and orbital location.

1.4 NON-NOAA ENVIRONMENTAL SATELLITES

To meet NOAA's global requirements, data from research and operational geostationary and polar orbiting satellites from national and international entities is required. Many non-NOAA satellites have sensor characteristics that are different from NOAA satellites and are needed to meet NOAA's mission. These include environmental satellite data from the international community, including Meteosat-9, Meteosat-7, MTSAT, FY-2C, ERS-2, ENVISAT and from NASA satellites such as SeaWiFS, QuikSCAT, TRMM, Terra, Aqua, Aura, CHAMP, COSMIC.

2. PRODUCT GENERATION AND DISTRIBUTION

2.1 ORGANIZATIONAL FUNCTIONS

Within NESDIS, the Office of Satellite Operation (OSO) and the Office of Satellite Data Processing and Distribution (OSDPD) are responsible for operating environmental satellites and generating satellite products respectively.

OSO operates Command and Data Acquisition (CDA) stations at Fairbanks, Alaska and Wallops, Virginia where commands are uplinked to NOAA satellites for command and control. Raw GOES data are received and processed at the Wallops CDA and redistributed to users via GOES. POES data are received at both CDAs and transferred to OSO's Satellite Operations Control Center (SOCC). The GOES and POES satellite data flow through OSO to OSDPD's Environmental Satellite Processing Center (ESPC), where products are created and distributed to users. Some products and communication services are distributed through the Wallops CDA. The SOCC and ESPC are located at the National Satellite Operations Facility (NSOF) in Suitland, MD.

OSDPD ingests, processes, and distributes environmental satellite data and derived products to domestic and foreign users and serves as the primary operating level interface with the civil sector users of data from operating earth satellites. OSDPD provides near real time environmental satellite data and services to a variety of operational and research users--within NOAA and worldwide--as well as the media and the public. OSDPD satellite data and products are provided routinely to users via landline push and pull systems and also via rebroadcast systems on NOAA's GOES and POES satellites. Products are often made available to users within minutes of receipt of ingested data. Imagery and products are delivered in a variety of formats, including McIDAS, BUFR and GRIB via highly robust product delivery systems located at the NSOF. Direct broadcast users are able to receive data even faster with use of their own direct receive equipment. Through manual processes, OSDPD provides interpretive and consultative services to various users and is responsible for the coordination and customer support for the transmission of data products to remote receiving stations and for the collection of environmental data from remote platforms using NESDIS and other satellites.

In addition, OSDPD generates GOES and POES images and animations of products onto several public websites http://www.osdpd.noaa.gov (http://www.ssd.noaa.gov www.goes.noaa.gov and http://coastwatch.noaa.gov/)

2.2 SATELLITE DERIVED PRODUCTS

OSDPD is responsible for the production of satellite imagery and products that are delivered in real time to the National Weather Service (NWS) and other users. Real time imagery from GOES is generated and delivered to the NWS for their use on the Advance Weather Interactive Processing System (AWIPS) as used for NWS forecasting and warning processes.

Derived products such as satellite derived rainfall estimates and stability parameters are delivered for use in AWIPS as well. These satellite products are also available to users via the NWS's Satellite Broadcast Network (SBN) called NOAAPORT http://www.nws.noaa.gov/noaaport/html/noaaport.shtml Other satellite derived products such as vertical temperature and moisture profiles, as well as radiance measurements, satellite derived winds, and ozone are provided to the NWS and are assimilated into the NWS's and other international organizational forecast numerical weather prediction production suites.

2.3 ENVIRONMENTAL HAZARD DETECTION

Several environmental hazards are detected and monitored 24x7 by OSDPD using satellite imagery and products from the suite of NOAA and non-NOAA satellites. What follows is a sample of the larger environmental hazard areas monitored by OSDPD. For additional products, visit http://www.ssd.noaa.gov and http://www.osdpd.noaa.gov .

2.3.1 VOLCANIC ASH

Volcanic ash detection from satellite imagery is performed by OSDPD's Satellite Analysis Branch (SAB). The SAB uses satellite imagery to monitor volcanic eruptions and track volcanic ash. The volcanic ash monitoring program at the SAB started in the 1970s and was first formalized with a Memorandum of Agreement with the Federal Aviation Organization (FAA) in 1987. The Washington VAAC (United States) was established in 1997 in agreement with the International Civil Aviation Organization (ICAO). The ICAO designated the NESDIS/SAB and the NWS/NCEP (National Centers for Environmental Prediction) as the regional Washington Volcanic Ash Advisory Center (VAAC).

The Washington VAAC area of responsibility includes the continental US, southward through Central America, the Caribbean, to 10S in South America and the US controlled oceanic Flight Information Region (FIR) as seen in Figure 5. The Washington VAAC is one of nine VAACs that cover the globe. The Washington VAAC issues Volcanic Ash Advisories (VAAs, WMO headers: FVXX20 KNES through FVXX27 KNES) which contain satellite information, reports of volcanic ash and a possible ash forecast if ash is seen in satellite imagery. VAAs are advisory in nature and are meant to complement and support, but not replace, meteorological and aviation related warnings which include Significant Meteorological Hazard Advisory (SIGMETs), and Notice to Airmen (NOTAMS). The Washington VAAC also issues Volcanic Ash Graphics (VAG) which depict the current location and movement of volcanic ash and its 6, 12 and 18 hour forecasted location. SAB analysts predominately use visible and thermal infrared and multispectral imagery obtained from the GOES to routinely detect ash.

Washington VAAC customers using the VAA and the VAG include Meteorological Weather Offices (MWOs), the NWS, Area Control Centers (ACC), the aviation and airline community and numerous government agencies such as the Department of Defense (DOD), the Aviation Weather Center (AWC) and the Air Force Weather Agency (AFWA). Customers use the information for air transit planning, aviation forecast, hazard mitigation planning, and in other ways. For more information on NESDIS volcanic ash products and the Washington VAAC, see: http://www.ssd.noaa.gov/VAAC/ http://www.osdpd.noaa.gov/ml/air/volcano.html

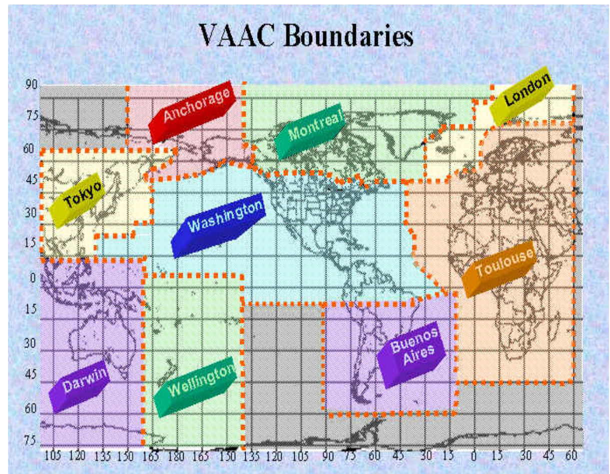

Fig. 5. Geographic coverage and areas of responsibilities of worldwide Volcanic Ash Advisory Centers

2.3.2 TROPICAL CYLONES

Tropical cyclone detection from satellites is performed by the SAB for all Oceanic Basins worldwide 24x7. Coordination with the NWS's Hurricane Center for position and intensity estimates is performed for systems in the Atlantic and East Pacific using the Dvorak technique (Dvorak, 1975, and 1984) and the Advanced Dvorak technique (ADT) (Olander and Veldon 2007). The Dvorak technique is a method using enhanced Infrared and/or visible satellite imagery to quantitatively estimate the intensity of a tropical system. Cloud patterns in satellite imagery normally show an indication of cyclogenesis before the storm reaches tropical storm intensity. Indications of continued development and/or weakening can also be found in the cloud features. Using these features, the pattern formed by the clouds of a tropical cyclone, expected systematic development, and a series of rules, an intensity analysis and forecast can be made. This information is then standardized into an intensity code.

A new operational product as of July 1, 2009 eTRaP (Ensemble Tropical Rainfall Potential), generates probabilistic forecasts of rainfall in addition to deterministic rainfall totals similar to what is currently provided by the TRaP product for named tropical storms. Each eTRaP is composed of forecasts using observations from potentially several microwave sensors - currently AMSU, TRMM, SSMI and AMSR-E initialized at several observation times, and possibly using several different track forecasts. An example of a 6 hour rainfall potential is depicted in Figure 6. The diversity among the ensemble members helps to reduce the large (unknown) errors associated with a single-sensor, single-track TRaP. The large number of perturbations leads to ensembles with many members, allowing probability forecasts to be issued with good precision and reliability. For information on eTRAP and other tropical support, see http://www.ssd.noaa.gov/PS/TROP/etrap.html and http://www.ssd.noaa.gov/PS/TROP/

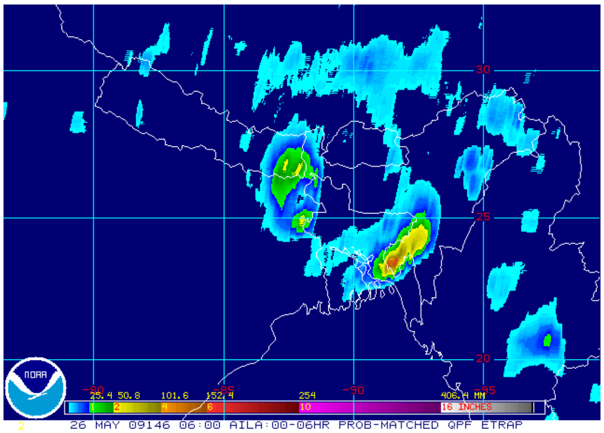

Fig. 6. Output example of eTRAP

2.3.3 RAINFALL AND MOISTURE ESTIMATES

Rainfall estimates derived from satellites are valuable in data sparse regions, specifically beyond the range of radar coverage or in-situ real time gauges. Based on the Oliver-Scofield technique (Scofield 1987; Vicente, et. al. 1998), the original Auto-Estimator algorithm was developed for deep, moist convective systems. Over time, enhancements and improvements to the program led to a completely new product, called the Hydro-estimator, which is currently in operational use by the National Weather Service for monitoring potential flash flood events. Precipitation rates are primarily based on the cloud top temperature obtained from GOES 10.7 um channel. Instantaneous, 1 hour, 3 hour, 6 hour, and 24 hour precipitation estimates are available. Numerous other factors, including the cloud-top geometry, the available atmospheric moisture, stability parameters, and local topography, are used to further adjust the rain rate. Based on these rainfall estimates, and satellite imagery interpretations, SAB analysts produce Satellite Precipitation Estimate (SPENES) (WMO header: TXUS20 KNES) Text Messages to indicate areas of heavy rain which may lead to flash flooding. Heavy snow including Lake Effect Snows is also monitored. For more details on satellite derived precipitation products, see: http://www.ssd.noaa.gov/PS/PCPN/ and http://www.osdpd.noaa.gov/ml/air/rain.html

For areas upstream of the CONUS, a new operational product implemented in 2009 is the Blended TPW (Total Precipitable Water) product, which shows atmospheric rivers of moisture in the form of TPW, and percent of normal TPW. Data from the Advanced Microwave Sounding Unit (AMSU) instruments on POES and METOP, the Special Sensor Microwave Imager (SSM/I) instruments on (DMSP) satellites, the sounder on GOES, and ground-based TPW retrievals are combined to form the Blended TPW product.

This blended product updates hourly, and provides a unified, meteorologically significant TPW field, which merges all available TPW products, with a non-gap global coverage as depicted in Figure 7.

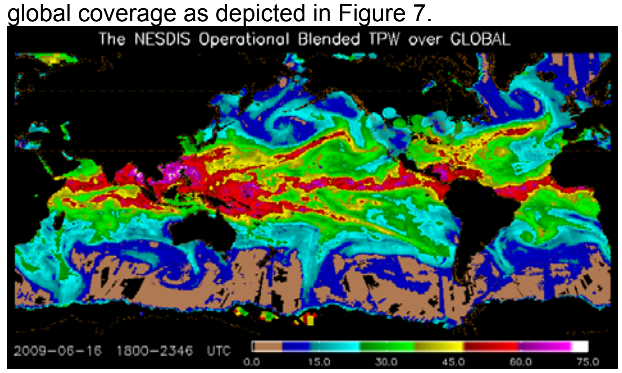

Fig. 7. Output example of blended TPW product

For more details on blended TPW, see: http://www.osdpd.noaa.gov/bTPW/index.html

2.3.4 FIRE AND SMOKE ANALYSIS

Environmental satellite data provides a unique capability to monitor large areas of the globe for the occurrence of fires and the smoke that they generate which can cause considerable degradation of air quality on a regional basis as can be seen in Figure 8. The Hazard Mapping System (HMS) incorporates polar and geostationary satellites into a single workstation environment (Ruminski, et. al. 2008). While individual satellite platforms can provide important information that can be used in air quality models, integrating several platforms allows for the combined strengths of various spacecraft instruments to overcome their individual limitations. Automated fire detection algorithms are employed for each of the sensors. Analysts apply quality control procedures for the automated fire detections by eliminating those that are deemed to be false and adding hotspots that the algorithms have not detected via examination of the satellite imagery.

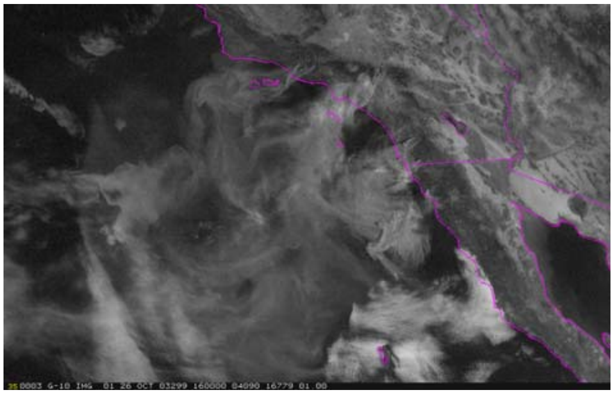

Fig. 8. Example of widespread smoke observed over southern California and adjacent areas.

2.4 PRODUCT DELIVERY TO INTERNET

Satellite imagery and satellite derived products are delivered to a host of web sites in addition to those listed within the hazard areas.

The Operational Significant Event Imagery (OSEI) web site http://www.osei.noaa.gov/ provides high-resolution, detailed imagery of significant environmental events which are visible in remotely-sensed data.

All product areas, including links to various static and looping real time imagery are available via the OSDPD home page at http://www.osdpd.noaa.gov Of specific interest for the media and general public interest is high resolution loops of hurricanes and other tropical storms. These images and loops are available at http://www.ssd.noaa.gov/PS/TROP/floaters.html and provide real time loops of hurricanes with various overlays. Other satellite imagery provided via the links within http://www.osdpd.noaa.gov/ml/imagery/index.html have various resolutions and satellite data worldwide, and provide overlays of other meteorological information.

Information on satellite status and schedules can be found on http://www.ssd.noaa.gov/PS/SATS/index.html Within this area, links to Bulletins and Messages provide users with up to date information on outages or anomalies with the satellite product processing system. These bulletins are also available via WMO headers NOUS71 KNES or xxxADANES for outage and anomaly messages NOUS72 KNES or xxxADMNES for other routine (i.e. RSO or GOES maneuvers) messages.

2.5 DIRECT READOUT CAPABILITES

In addition to the environmental and remote sensing capabilities of POES and GOES, both satellite series provide direct readout systems to various user groups to obtain data and information directly from the satellites to a ground based user readout terminal. A basic guide for the understanding of and the building of direct readout stations is available at http://www.noaasis.noaa.gov/NOAASIS/pubs/Users_Guide-Building_Receive_Stations_March_2009.pdf (NOAA/NESDIS 2009) and other direct readout information is available at http://www.noaasis.noaa.gov/ (NOAA/NESDIS/OSDPD/DSD 2009)

2.5.1 GVAR

The GOES PDR data transmission format, referred to as GVAR (GOES Variable Data Format) is used to transmit Imager and Sounder meteorological data in full resolution. GVAR is primarily used by NESDIS, NWS, DoD, Academia, Private Sector and others to obtain real time imagery of satellite data from GOES with a satellite receive system. Typical receive antenna sizes range from 4-7 meters in diameter. Data rate is 2.11 Mbps.

2.5.2 EMWIN

The Emergency Managers Weather Information Network (EMWIN) transmission is a communication service provided through a transponder onboard the GOES satellite. EMWIN is a suite of data access methods that make available a live stream of weather and other critical emergency information. As an integral part of its mission, the National Weather Service (NWS) recognizes the need to provide the emergency management community with access to a set of NWS warnings, watches, forecasts, and other products. NOAA satellites relay this critical information to users across the country with the GOES EMWIN system. Data rates are 9.6 Kpbs on GOES-11 and GOES-12 and are 19.2 Kbps on GOES-13. For more information on the EWMIN system, see:
http://www.weather.gov/emwin/index.htm

2.5.3 LRIT

GOES are used to relay satellite and weather products to users in remote locations that do not have landlines or internet connections. The digital Low Resolution Image Transmission (LRIT) service is a combination of several information sources onto a single higher capacity broadcast (128 Kbps) that contains more meteorological data, imagery, forecast charts and other environmental information. For more information on the LRIT system, see: http://www.noaasis.noaa.gov/LRIT/

2.5.4 DCS

NOAA satellites, both GOES and POES, are used to collect and relay scientific data from around the globe. The GOES data collection system (DCS) collects near real-time environmental data from data collection platforms (DCPs) located in remote areas where normal monitoring is not practical. The DCS receives data from DCPs on aircraft, ships, balloons, and fixed sites in a region from Antarctica to Greenland and from the west coast of Africa to just east of the Hawaiian Islands, an area covered by the GOES satellites. The system encompasses almost every level of the atmosphere,

land, and ocean. It is used to monitor seismic events, volcanoes, tsunami, snow conditions, rivers, lakes, reservoirs, ice cover, ocean data, forest fire control, meteorological and upper air parameters, and to provide ground truth information. For more information on the GOES DCS system, see:
http://www.noaasis.noaa.gov/DCS/

On POES DCS, a wide variety of data collection platforms dedicated to environmental study and protection, collect and transmit data within the 401.610-MHz receiver bandwidth. These platforms consist mainly of drifting and moored buoys, subsurface floats, and remote weather stations that serve meteorological and oceanographic applications. DCS platforms are used on fishing vessels for fishing resource management, and species monitoring for tracking animals for biological and species protection purposes. These platforms relay data such as atmospheric pressure, sea surface temperature and salinity, surface and subsurface ocean currents, sea and river levels, vessel positions, and animal temperature and activity. The DCS onboard the satellite collects the messages transmitted by these platforms, measures their received frequency, time tags, demodulates, and reformats the data and retransmits them to the ground. The data is transmitted in real time, along with the High Resolution Picture Transmission (HRPT) data, and is also stored onboard for later transmission from the satellite. For more information on the POES DCS system, see:
http://www.noaasis.noaa.gov/ARGOS/

2.5.5 SARSAT

NOAA satellites, both GOES and POES, are used to relay distress alerts from aviators, mariners and land-based users. The Search and Rescue (SAR) subsystem onboard each GOES satellite is a dedicated transponder that relays the distress signals broadcast by emergency locator transmitters (ELTs) carried on general aviation aircraft, emergency position indicating radio beacons (EPIRBs) aboard some classes of marine vessels, and portable personal locator beacons (PLBs). The SAR mission is performed by relaying the distress signals emitted from the ELT/EPIRBs via the GOES satellite to a Local User Terminal (LUT) ground station located within the field of view of the spacecraft. The UHF SAR distress signal is a digital signal that includes information identifying who the user is. This information may permit a Rescue Coordination Center to dispatch help to the downed aircraft, ship in distress, or individual carrying a PLB directly. If not, an emergency team could be alerted while waiting for a polar orbiting SARSAT to fly over the beacon and provide a position based on Doppler. For more information on the SARSAT system, see: http://www.sarsat.noaa.gov/

2.5.6 HRPT

High Resolution Picture Transmission (HRPT) on POES provides worldwide direct readout of full-resolution spacecraft parameters and instrument data to ground stations within the footprint of the NOAA polar-orbiting satellite. HRPT service was originally designed to provide timely day and nighttime sea surface temperature and ice, snow, and cloud cover information to diverse users, but applications have expanded because of the proliferation of moderately priced equipment and software. HRPT transmissions contain data from all instruments aboard the NOAA polar-orbiting satellites. The data stream includes information from the TIP (TIROS Information Processor), the AIP (AMSU Information Processor), and from the AVHRR/3, providing five of six channels at 1.131-km (0.703-mi) resolution. The TIP contains spacecraft attitude data, time codes, housekeeping, and low rate instrument science data from the HIRS/4, SEM-2, ADCS, and the SBUV/2. The AMSU-A and MHS are also included in HRPT from the AIP. To receive the data, users can purchase the necessary equipment (computer, software, and antenna) from commercial companies for unlimited access to HRPT signals. HRPT data rate is at 665 Kbps.

2.5.7 VHF

Very High Frequency (VHF) Beacon Transmission is available to users who do not intend to install the more complex equipment necessary to receive high data rate S-band service. The lower 8.32 Kbps data rate from the TIP permits the user to install less complex, less costly equipment to receive the data (HIRS/4, SEM-2, ADCS, and SBUV/2, but not AMSU).

2.5.8 APT

Automated Picture Transmission (APT) Data is smoothed 4-km (2.5-mi)-resolution IR and visible imagery derived from the AVHRR/3 instrument and transmitted within the footprint of the NOAA polar-orbiting satellite. Because APT data is captured on low-cost VHF ground stations, it is also very popular in schools. Users purchase the necessary equipment (computer, software, and antenna) from commercial companies for unlimited access to APT signals.

2.5.9 GEONETCast Americas

GEONETCast Americas is the Western Hemisphere component of GEONETCast, a near real time, global network of satellite-based data dissemination systems designed to distribute space-based, air-borne and in situ data, metadata and products to diverse communities at a data rate of 2Mbps using DVB-S technology.

This user-driven, user-friendly and low-cost information dissemination service aims to provide global information as a basis for sound decision-making in a number of critical areas, including public health, energy, agriculture, weather, water, climate, natural disasters and eco-systems. Accessing and sharing such a range of vital data will yield societal benefits through improved human health and well-being, environment management and economic growth. For more information on GEONETCast Americas, see: http://www.geonetcastamericas.noaa.gov/index.html

3. FUTURE NOAA SATELLITES

3.1 NPOESS

The National Polar-orbiting Operational Environmental Satellite System (NPOESS), the next generation of polar-orbiting satellites, will provide standard meteorological, oceanographic, environmental, and climatic information as well as space environmental remote sensing information. NPOESS will also continue to provide surface data collection and search and rescue capability. The Integrated Program Office (IPO), in consultation with the POES and DMSP program offices, is also studying additional potential cost effective approaches to maximize user satisfaction during the transition to NPOESS while guaranteeing continued non-interrupted data services. The first NPOESS launch is planned for 2013. Data transmission of HRD (High Data Rate) will be in the X-band at 20 Mbps and transmission of LRD (Low Data Rate) will be in the L-band at 3.88 Mbps. For more information on NPOESS, see: http://www.npoess.noaa.gov/

3.2 GOES-R

The GOES-R program is a key element of future NOAA operations. The GOES-R series of satellites will be comprised of improved spacecraft and instrument technologies, resulting in more timely and accurate weather forecasts, and improved support for the detection and observation of meteorological phenomena that directly affect public safety, protection of property, and ultimately, economic health and development. The first launch of the GOES-R series satellite is scheduled for 2015.

The Advanced Baseline Imager (ABI) on GOES-R will provide data in 16 spectral channels covering the full disk at least every 15 minutes with ½ km spatial resolution in the visible band (Schmit, et. al. 2005). The replacement to GVAR for data transmission will be the GRB (GOES ReBroadcast) and will be in the L-Band at 31 Mbps. For further information on GOES-R, visit: http://www.goes-r.gov

4. SUMMARY

NOAA/NESDIS operates numerous environmental satellites to obtain information about the atmosphere, oceans and land. Products are created and disseminated 24x7 for operational use in many areas, including hazard identification, tracking and mitigation. Direct broadcast capabilities on board NOAA satellites allow for the reception of satellite data and products via antenna. Products are distributed via other methods including the internet. Future satellite series will make for continued observations with increased fidelity and accuracy in products.

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6. ACKNOWLEDGEMENTS

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