

## **Availability of Research and Development Information from NASA Satellites**

This paper provides the NASA response to Action 31.10:  
R&D satellite operators are encouraged to make their data  
available for routine near real time.

## **Availability of Research and Development Information from NASA Satellites**

### **1. Overview**

NASA Earth Science Enterprise has launched about 18 missions/satellites over the last two decades for the study of planet Earth. These satellites have carried over 70 highly advanced remote sensing instruments used for multiple studies in the area of physical and biological oceanography, land cover and land use changes, atmospheric chemistry, solar radiation budget, precipitation patterns, hurricanes, surface topography, carbon cycle, and other science areas of interest. Some of this useful data and products are also being other operational Agencies such as NOAA (National Oceanic and Atmospheric Administration), USGS (United States Geological Service), and ECMWF (European Center for Medium Weather Forecast). The following sections list some specific examples of such products being utilized or evaluated by the operational Agencies.

#### **2a. *EP/TOMS (Earth Probe/Total Ozone Mapping Spectrometer)***

The EP/TOMS data are used in near-real-time by NOAA/NESDIS to produce maps of volcanic sulfur dioxide and ash clouds. NESDIS (National Environmental Satellite, Data and Information Service) sends these data to USGS which produces volcano hazard warnings. They have used the EP/TOMS data for this purpose since its launch in July, 1996. For a while, until the main EP/TOMS transmitter failed, USGS was receiving direct broadcast data at Fairbanks, Alaska and processing it on-site to produce volcano hazard warnings in the Alaskan area.

#### **2b. *Aura/OMI (Ozone Monitoring Instrument)***

There are plans to use OMI data in near real time. The OMI instrument is a Netherlands- provided instrument on EOS/Aura, scheduled to be launched in June this year. USGS has officially requested NASA HQ for access to OMI volcanic products in NRT to produce hazard warnings. In addition, NOAA/NCEP wants to use the OMI NRT data to improve their weather forecast. Another group in NOAA/NESDIS is planning to use OMI NRT data to help EPA improve its Air Quality forecast.

#### **2c. *Quikscat***

The SeaWinds scatterometer on Quikscat measures backscattered microwave energy from capillary waves on the ocean surface. From these measurements, near real time ocean surface wind vectors are retrieved at high resolution over the global oceans. Quikscat data was first assimilated by the NASA Data Assimilation Office in June 1999, and operationally in real time by in August of 2001. Through a collaborative NASA/NOAA project, NOAA/NCEP (National Center for Environmental Prediction) began assimilating Quikscat data into their models in January 2002, resulting in improved forecasts of sea level pressure and surface winds over the oceans. Also, as a result of NASA/NOAA collaboration, NOAA's marine forecasters have used Quikscat data since 1999 to improve their warnings for ships at sea and other marine interests. This has resulted in the saving of lives, as well as substantial economic savings.

#### **2d. *Aqua/AIRS (Atmospheric Infrared Sounder)***

AIRS provides measurements of clear column radiances, as well as retrievals of temperature, moisture, CO<sub>2</sub>, ozone, and clouds. In the near future (beginning May 25) several operational numerical weather prediction centers (e.g., UK Met Office, ECMWF) will begin assimilating AIRS radiances in real time. NASA GSFC is currently assimilating AIRS temperature retrievals in research mode and demonstrating a significant impact on numerical weather forecasts. Real-time assimilation of AIRS retrievals is expected to begin at GSFC in the near future.

#### **2e. *TRMM (Tropical Rainfall Measuring Mission)***

TRMM data is used in real-time by operational weather agencies in the U.S. and abroad. The data used is from the TMI passive microwave instrument and the precipitation radar. The data are used by NWS/National Hurricane Center (NHC), Department of Defense's (DoD) Joint Typhoon Warning Center (JTWC) and international agencies to detect and monitor hurricanes and typhoons. This hurricane/typhoon

monitoring started in 1998. These data are also used by NWS/NCEP, ECMWF and JMA (Japan Meteorological Agency) as input to operational numerical forecast models (started in 2002). The TRMM real-time, multi-satellite rainfall product (3-hr time res.) is being used to monitor areas of potential flood and drought by a number of national and international agencies interested in various hydrological applications and in relief planning. Examples of these applications are crop monitoring in Central America and flood forecasting in Indochina being carried out by USGS/USAID (started in 2003).

**2e. MODIS on Terra and Aqua (Moderate Resolution Imaging Spectroradiometer)**

MODIS winds are currently used from Terra and Aqua in NOAA/NCEP operational studies. The basic idea is that imagery from MODIS can be used for deriving cloud-track and/or clear-sky water vapor winds in the regions where scenes from successive overpasses overlap, i.e. pole ward of roughly 65 degree latitude. The MODIS winds thus complement the winds from the geostationary platforms, the number and quality of which both drop off dramatically pole ward of about 60 deg latitude. NASA and ECMW and others have seen a substantial positive impact of these data on forecast skill, not only in the high-latitude regions where the winds are obtained but over the entire extra-tropical domain. NASA is also using Quikscat surface winds routinely. These data have a substantial positive impact in the Southern Hemisphere in particular.

**2f. MODIS and SeaWiFS (Sea Viewing Wide Field of View Sensor) Ocean Color**

The near real time ocean color data is provided for field experiment support. The SeaWiFS Project has supported roughly 440 cruises with near real time data (Oct 97- present). It is now providing MODIS/Aqua data as well (beginning February 1, 2004) i.e., operationally handling the ocean color data. The MODIS/Terra data has also been provided for near real time cruise support. NASA is also generating near real time MODIS/Aqua SST (Sea Surface Temperature) products (also beginning Feb 1, 2004). One of the primary users of this data is JPL (Jet Propulsion Laboratory) who are working with the CLIVAR (Climate Variability) GODAE (Global Ocean Data Assimilation Experiment) modeling/data assimilation program.

**2g. MODIS Rapid Response System**

The MODIS Rapid Response Project provides near-real-time active fire locations detected 4 times daily (2 daytime and 2 nighttime observations) by MODIS onboard Terra and Aqua to the USDA Forest Service and the National Interagency Fire Center. These fire locations are made available to the fire managers within 2-3 hours after data acquisition. MODIS fire data provides a regional overview of the fire situation essential for firefighting resource allocation. The project started in May 2001.

The MODIS Rapid Response Project also provides near-real-time MODIS imagery and fire information to the Air Force Weather Agency and the Navy over Iraq, Afghanistan and other regions of the world, twice daily, 2-3 hours after acquisition. This information is used by data analysts to monitor atmospheric conditions, dust storm in particular, that can impact ground troop or aviation safety. This imagery is also used to determine snow depth and water turbidity, and to monitor volcano ash. This collaboration started in February 2003.

The MODIS Rapid Response Project also provides near-real-time true-color and vegetation index imagery to the USDA Foreign Agricultural Service (FAS), twice daily, over most crop regions around the world. The FAS analysts monitor crop production regions to distinguish between different crops like wheat and rice, and to gauge the overall health of agriculture by comparing recent data with data from previous years, and to observe potential natural disasters affecting crops. The FAS analysts then derive harvest estimates for each region to help decision makers with US agriculture, trade policy, and food aid issues. This collaboration started in May 2003.

**2h. MODIS Air Quality**

NASA has developed an algorithm that shows a close correlation between the aerosol optical depth and the ground based aerosol measurements made by the ground based sensors operated by the Environmental Protection Agency (EPA). EPA has many of these sensors in large metropolitan areas through out the United States to provide real time information on the air quality index. Now, the MODIS direct broadcast capability can provide a greater spatial resolution (~2,200 km) in near real time and can help providing the air quality information for most of the United States.