TERRA, AQUA, AND AURA DIRECT BROADCAST – PROVIDING EARTH SCIENCE DATA FOR REALTIME APPLICATIONS

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1. INTRODUCTION

The need for realtime data to aid in disaster management and monitoring has been clearly demonstrated for the past several years, e.g., during the tsunami in Indonesia in 2004, the hurricane Katrina in 2005, and more recently, the Icelandic volcano eruption and the oil spill off the Louisiana coast. Users want (and often require) the means to get earth observation data for operational regional use, as near realtime as possible. This is especially true for events that can cause loss of human life and/or property. To meet this need, NASA's Earth Observing System (EOS) satellites, Terra, Aqua, and Aura, provide realtime data useful to disaster management teams. This paper describes the satellites, the Direct Broadcast (DB) system, how DB data are used, what it takes to deploy a DB ground station, and the support that NASA provides for making DB data usable for decision support systems.

2. TERRA, AQUA, AND AURA MISSION OPERATIONS

EOS Terra, Aqua, and Aura [1] [2] [3] were launched into polar, sun-synchronous orbits in 1999, 2002, and 2004, respectively. They are the flagship missions of NASA's Earth Science program. They continue to provide high quality Earth science data from a total of 14 operational scientific instruments. The Earth Science Mission Operations (ESMO) Project, located at NASA Goddard Space Flight Center (GSFC), monitors and operates the 3 satellites around the clock from the EOS Operations Center (EOC). The EOS Data and Information System (EOSDIS) Distributed Active Archive Centers and the Science Investigator-led systems process the Level-0 data to Level 1, 2, and higher level data products. The DAACs archive and distribute the data products to users around the world.

3. DIRECT BROADCAST OVERVIEW

The EOS Terra, Aqua, and Aura data sets are invaluable for disaster management and monitoring. However, the personnel and agencies involved in relief efforts often cannot wait for the time it takes to schedule downlinks to the primary ground stations, perform processing, and distribute the data through the normal channel, i.e., through the EOS data centers. Fortunately, all 3 satellites have the capability to transmit their data in realtime using their onboard Direct Broadcast (DB) system, which is part of the satellite's X-Band communications system. DB enables the realtime transmission of the Terra Moderate-Resolution Imaging Spectrometer (MODIS) data, the entire set of Aqua data, and the Aura Ozone Monitoring Instrument (OMI) data to Direct Readout (DR) capture stations on the ground. Terra and Aqua data are broadcast in realtime worldwide, except during periods when the science data on the solid state recorder are downlinked for capture at the EOS ground stations. The Aura OMI data are downlinked to the ground station in Sodankyla, Finland. There are now over 200 DB/DR stations around the world.

The DB system allows the users to receive the Earth observation data in realtime as they are being captured on the satellite, i.e., there is essentially no latency from observation to reception. There are some limitations (e.g., users do not receive data from other parts of the world; also, the transmission artifacts are still present in the raw captured data), but the benefit is almost instant availability. For some locations in the world, DB reception offers the additional advantage of easy and cost-effective access when broadband internet service is unavailable, restricted, or cost-prohibitive.

4. MAJOR USES

This paper provides examples of the uses of the Terra and Aqua data by the various countries and organizations that capture the DB data. Some of the operational applications include weather forecasting, disaster prediction, monitoring, and management, fire identification and monitoring, fisheries, air quality, etc.

5. DIRECT READOUT LABORATORY

NASA GSFC operates the Direct Readout Laboratory (DRL) as a technology and information conduit for the Direct Broadcast (DB) community [4]. The DRL acts as an intermediary between the EOS project teams and the DB community members that are not directly connected with the projects. The paper describes the coordination and support (including training) that NASA provides via the DRL on the use and processing of the DB data. DRL also makes the processing software easily available, so interested users have the choice of purchasing a ground station from a commercial provider or developing their own ground station using relatively inexpensive hardware.

6. REFERENCES

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[4] *DRL - Home*. NASA Goddard Space Flight Center, 8 Dec. 2009. Web. 10 Dec. 2009. <http://directreadout.sci.gsfc.nasa.gov/>.