



## **GEONETCAST AMERICAS – DELIVERING ENVIRONMENTAL INFORMATION USING COMMUNICATIONS SATELLITES**

GEONETCast Americas is a regional contribution to a developing, global, near-real-time, environmental data dissemination system in support of the Global Earth Observation System of Systems. It will be a contribution from the United States National Oceanic and Atmospheric Administration, whose goal is to enable enhanced dissemination, application, and exploitation of environmental data and products for the diverse societal benefits defined by the Group on Earth Observations. The societal benefit areas include agriculture, energy, health, climate, weather, disaster mitigation, biodiversity, water resources, and ecosystems. GEONETCast Americas will serve North, Central, and South America beginning late in 2007 using inexpensive satellite receiver stations based on Digital Video Broadcast standards and will link with similar regional environmental data dissemination systems deployed around the world. GEONETCast Americas will start broadcasting limited data in an early operational mode in late November 2007.



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### **1. INTRODUCTION**

Ministers from 58 countries and the European Commission agreed at the third Earth Observation Summit in February 2005 to put in place a Global Earth Observation System of Systems (GEOSS) to meet the need for timely, quality, long-term global information as a basis for sound decision making and to enhance delivery of benefits to society. The ministers also established the intergovernmental Group on Earth Observations (GEO) to take the steps necessary to implement GEOSS. The United States, represented by the National Oceanic and Atmospheric Administration (NOAA) Administrator Conrad Lautenbacher, serves as co-chair of GEO which now includes 71 member countries, the European Commission, and 46 participating organizations.

GEONETCast is an important global near-real-time data distribution system within GEOSS by which environmental data and products from participating data providers will be transmitted to users through a global network of communications satellites using a multicast, broadband capability. This general dissemination capability, manifested through a small number of regional but interconnected GEONETCast systems, may be especially useful in parts of the world where high speed land lines and/or internet are not available or in regions where terrestrial communication lines have been disrupted by disasters. It is intended to be complimentary with other existing dissemination systems using other delivery methods.

A motivating factor to increase the use of environmental data across the Americas and the world is to make it accessible to all nations in a cost-effective and efficient manner. GEONETCast promises to facilitate and enhance access to environmental data in the nine societal benefit areas of GEO (agriculture, weather, water resources, energy, health, climate, biodiversity, disaster mitigation, and ecosystems). NOAA, in support of the U.S. Integrated Earth Observation System (IEOS) and consistent with its own mission requirements, is a key global player in environmental data dissemination and the development of a GEONETCast system covering the Americas.

Following Co-Chair Lautenbacher's presentation and the GEO Executive Committee in September 2005, NOAA and the European Organization for the Exploitation of Meteorological Satellites (EUMETSAT) presented their vision for GEONETCast at the second GEO Plenary meeting in December 2005. The basic need was identified, and the GEO endorsed the concept and created a new GEO task that identified the development of the integrated GEONETCast system on a regional basis across the globe as a high priority for demonstration of early GEOSS success. In November 2006, early success in the development of GEONETCast was showcased at the third GEO Plenary meeting in Bonn, Germany through an international press conference. The importance of continued forward movement in development of the GEONETCast system in the Americas was discussed to add to similar developing systems in Europe, Africa, and Asia to achieve the desired global coverage.

### **2. SYSTEM CONCEPT**

The GEONETCast system follows the GEOSS concept in being a system of regional dissemination systems working together to form a global system. GEONETCast is expected to become a user-driven interconnected global network of near-real-time regional dissemination systems to link GEOSS environmental data/products/service providers and users across the globe. Each regional system will be focused on a specific sector of the globe, primarily supporting the specific needs of users in that sector. However, these regional systems will be interoperable with each other to allow data files to flow across the regional boundaries in both directions as needed by users in other regions.

The primary responsibility for development, management, and operations of GEONETCast within each region will reside with the GEO partner in that region that voluntarily agrees to perform that function. NOAA, in support of the Integrated Earth Observation System, which forms the U.S. contribution to GEOSS, will function as the initial GEONETCast operator and data/products/services purveyor in the Americas. This GEONETCast region includes North, Central, and South America and island regions of the central and eastern Pacific Ocean (see notional outline below in Figure 1). The initial operating capability for the operational demonstration period will cover most of continental North, Central, and South America but not the Pacific Ocean region. It is the intention that the initially non-covered regions will be covered in the future as additional funding becomes available or through other communications mechanisms as deemed appropriate among the cooperating parties.

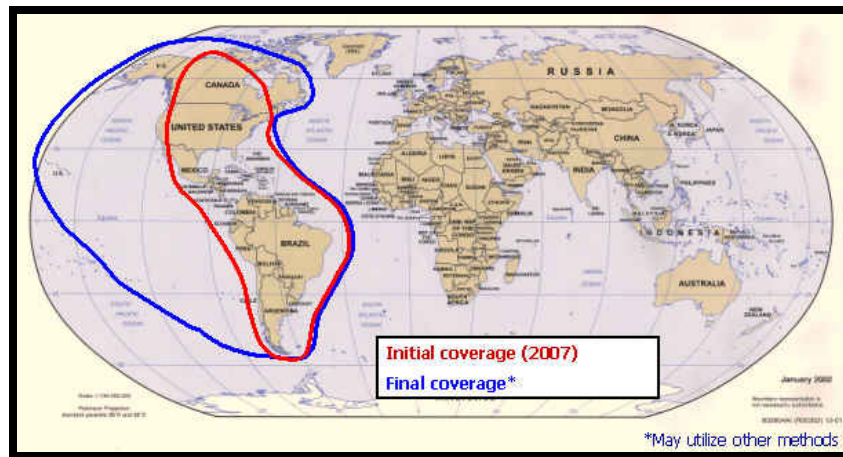


Fig. 1. Notional approximate geographic coverage of GEONETCast Americas.

This regional component of GEONETCast will be called “GEONETCast Americas”, and it will be integrated with similar developing GEONETCast systems such as EUMETCast and FengYunCast in other parts of the world (Fig. 2). GEONETCast Americas will utilize telecommunication technology including communication satellites and uplink ground stations. Data originating from each region will be disseminated within that region from a central network hub using one or more satellites with broadcast footprints that cover the identified region containing potential GEOSS data users. Other communication mechanisms may be utilized as appropriate to enhance global coverage, utilizing existing capabilities where available, within available funding.

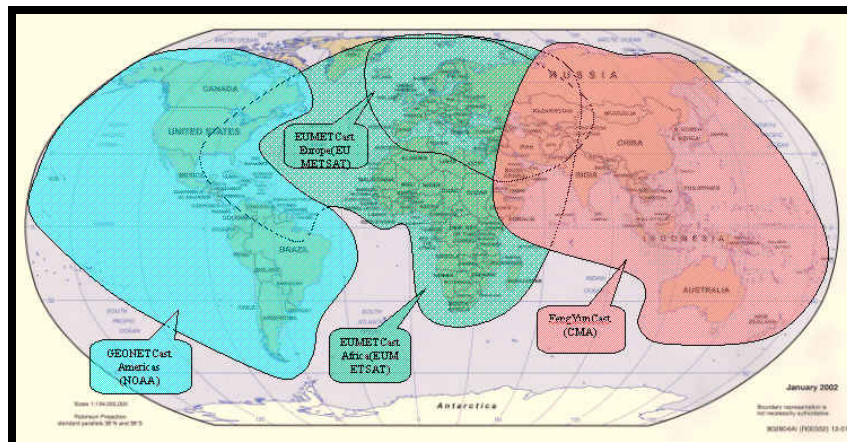


Fig. 2. Notional approximate geographic coverage of the global GEONETCast including other regional components.



## 2.1 Capabilities

The three primary capabilities of GEONETCast Americas include:

- Data acquisition - receipt of diverse GEOSS environmental datasets at a central regional location(s) from GEONETCast data providers in the Americas and eastern Pacific Ocean region,
- System and data management - data management, prioritization, and scheduling of GEOSS data for dissemination, and system administration
- Data dissemination - timely dissemination of GEOSS data within the Americas and Pacific Ocean region using satellite telecommunication infrastructure (uplink ground stations, satellites, and turnaround stations).

This satellite-based dissemination system is one component of a larger GEOSS data dissemination system that may include the internet and fiber optic land lines in the future.

## 2.2 Data Products, Formats, and Channels

GEONETCast Americas is envisioned to become a “one stop shopping” system for distribution of diverse environmental data and products for receipt by users with a single GEONETCast receive station. These data and products will be in the form of electronic data files. GEOSS data that will be disseminated through GEONETCast Americas may include diverse raw data or processed value-added products or services from any of the nine defined GEO societal benefit areas, particularly those areas that are currently underserved by existing dissemination systems. The products may include environmental data or products from any observing data platforms including operational or research-based, *in situ* or remote sensing systems such as satellites (polar or geostationary), ground-based, or airborne platforms. Other non-observational environmental information will also be disseminated such as text-based environmental data or products, e.g., climate assessments, fisheries announcements, earthquake advisories, or even environmental training materials that may support GEOSS user needs.

A channel capability will be developed for users to selectively choose categories of products they wish to receive on their receiver station and disable reception of files within product categories they do not need through NOAA’s establishment of broadcast channels that contain common data types or themes as appropriate, e.g., separate categories for each of the nine GEO societal benefit areas is an initial possibility. These product categories will be developed by the U.S. Group on Earth Observations (USGEO) in cooperation with participants from the Americas region. A special category of environmental products for urgent emergency response purposes, including Common Alert Protocol (CAP) products, may be appropriate and may be distributed via a dedicated emergency channel(s) or, at a minimum, be assigned highest priority for dissemination when the need arises. A low bandwidth announcement channel will also be implemented for distribution of administrative or other general use messages that all GEONETCast users would generally tune in to for information on new products, service change notices, or other information needing wide distribution.

Although dissemination of meteorological satellite products is within the scope of GEONETCast Americas, it is not intended to be the primary dissemination mechanism for NOAA’s meteorological satellite data nor a replacement for its existing meteorological satellite data dissemination systems. Neither is GEONETCast Americas intended to replace any other primary dissemination system(s) for environmental data, advisories, watches, warnings, etc. in NOAA or elsewhere. In these cases, GEONETCast Americas should be viewed only as augmenting existing dissemination systems via an alternative means.

Regarding data file formats, there is technically no restriction on formats for data products that a data provider might wish to contribute to GEONETCast for broadcast. Any of a wide variety of standard formatted products can be used, e.g., ASCII, JPEG, GIF, HDF, BUFR, NetCDF, GRIB2, and others. It is obviously in the best interest of the data providers that the data that they disseminate be in standard formats for ease of use, but the system itself imposes no specific requirements on file

format other than the information be file-based. Provision of any special decoding or processing software required to decode and/or use data files distributed by GEONETCast resides with the original data providers who contributed that data for broadcast.

A catalog of information about data products being carried on GEONETCast Americas and associated channel assignments and technical receive station information will be routinely updated as necessary and distributed by satellite broadcast as well as via a GEONETCast Americas web page for the benefit of the users and others desiring information on the service.

GEONETCast will comply with the data policies of GEO, i.e., full and open distribution. There will be no recurring subscription charges to obtain the GEONETCast Americas broadcast other than perhaps optional nominal software licensing costs for the client datacasting software that will reside on the receive station. Data files are distributed in the original file formats of the data providers. If particular data providers impose restrictions on dissemination of their data to certain users or classes of users, the providers are required to encrypt those files prior to sending it to the NOAA system for broadcast as it will provide no inherent access control services as a service to either data providers or data users. Users wishing to use any of these encrypted data files are required to work directly with the data provider to obtain any necessary decryption keys or software and/or pay any subscription fees if appropriate.

### 2.3 Global Participants

There are four major categories of participants in GEONETCast. The key participants are the **end users** who receive environmental data through GEONETCast. This data is supplied to the system by the many diverse **data providers** who voluntarily contributed data and products in file format for broadcast to the users. Often these two groups work together so that the products produced are the ones required by the users.

The communication “pipe” extending between the data providers and the end users is GEONETCast. It is composed of two main participants, the **dissemination service managers** and the **satellite service providers**. The service managers, including NOAA, EUMETSAT, and China Meteorological Administration (CMA), are the organizations who are currently developing and operating each of the regional systems for the benefit of the users in their regions. They provide the resources that make the system possible and sustainable. Together they form the GEONETCast Implementation Group and meet routinely to coordinate activities and assure interoperability of the regional components. The satellite service providers are generally commercial telecommunication vendors who provide the satellite broadcast infrastructure (processing hardware and software, ground stations, telecommunication satellites). They work directly with the dissemination service managers to assure that the system is operationally robust and reliable.

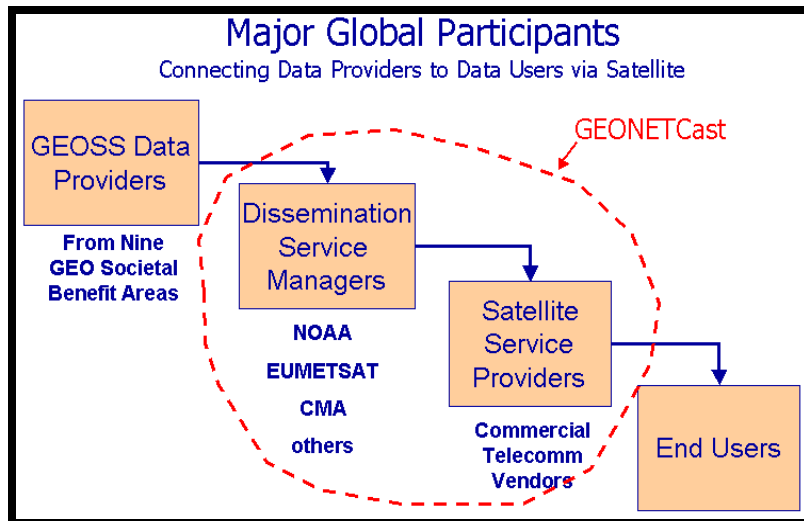




Fig. 3. Major participants in the global GEONETCast system.

### 3. SYSTEM ARCHITECTURE

There are two main system components of GEONETCast Americas: 1) a regional data collection, management, and dissemination system, and 2) distributed user receiver stations. These components are illustrated schematically in Fig. 4.

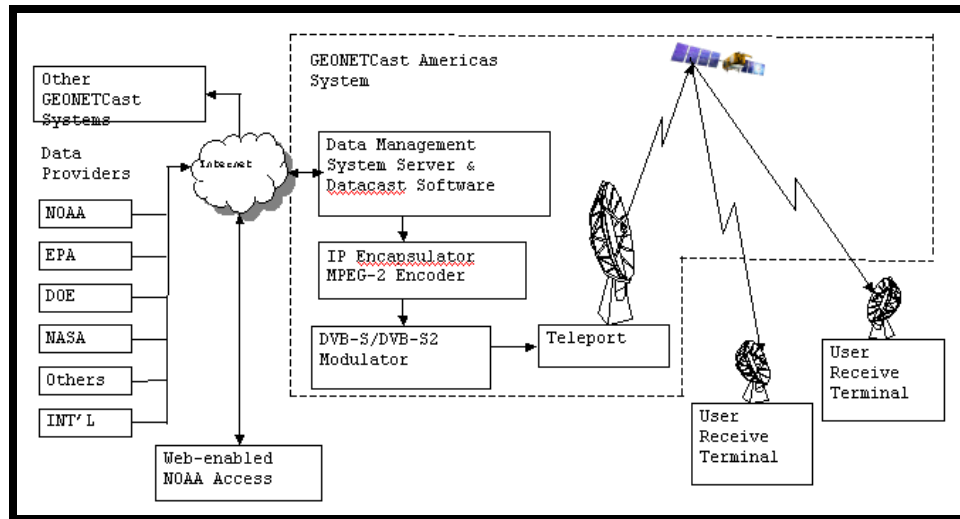


Fig. 4. System architecture illustration.

#### 3.1 Data Collection, Management, and Dissemination System

The general capabilities of the regional components of this system include one or more data collection, management, and dissemination data hubs that receive, prioritize, and schedule the incoming GEOS data files originating within the Americas sector as well as ones coming in from adjacent regional GEONETCast data hubs. The hub(s) then processes and forwards the prioritized data files to a satellite uplink ground station(s) which receives the data files, processes them for broadcast, and then immediately uplinks them to a communication satellite(s) for dissemination within the footprint of each satellite. Multiple satellites, uplink ground stations, turnaround ground stations, and other data dissemination capabilities may be necessary to cover the geographic region of interest. The downlink broadcast will be at either C-band or K-band as these are the commercial standards for DVB-S. These components of the system are enclosed in the dashed box in Fig. 4. Details of the system characteristics will not be known until NOAA acquires the commercial broadcast services. We are currently in the procurement phase for the GEONETCast Americas system.

GEONETCast Americas is a near-real-time dissemination system. This means that once data or information products arrive at the data hub they are turned around and rebroadcast in a timely manner. No near-real-time dissemination guarantees are implied for products that are late in arriving at the data hub from the data providers due to circumstances beyond the control of NOAA or the GEONETCast Americas system. Data providers may contribute any approved data or information products accepting the dissemination timeliness of the system.

#### 3.2 Receiver Stations

The satellite broadcast is received on the ground by relatively low-cost user receiver stations with commercial off-the-shelf components to the maximum extent possible to minimize user costs. These stations will include an appropriately-sized dish antenna (depending on broadcast frequency) and a standard personal computer and components necessary to decode the incoming satellite signal and create the data files on the station's hard disk. These components include a standard commercial

Digital Video Broadcast-Satellite (DVB-S) receiver box and client software. See Fig. 5. Standards and specifications for these components will be developed and published by NOAA for use by potential users and commercial vendors, and a suggested reference implementation of hardware and software will be provided by NOAA for demonstration and validation purposes. However the purchase and operation of the receiver station are the responsibility of the user and not the GEONETCast project or NOAA. Required receiver station hardware, software and instructions will be available from commercial vendors to decode the signal, select the data types of interest to the user, translate the signal into data files in their original format, and distribute the incoming data products into appropriate product category folders on the receiver station.

These receive station components are intended to be relatively affordable with a projected cost of approximately \$2000-2500 with the antenna probably being the largest cost at roughly \$1500. The commercial DVB receiver boxes cost approximately \$80-200.

It is recommended that the receiver station's personal computer be dedicated to receiving data to eliminate potential loss of data that might occur if the user is running other highly intensive processing applications concurrently. Further software processing of the received data, including data decompression, decoding, archive, and other value-added user processing and analyses, is best performed on external computers, which may be networked to the receiver station, again to prevent loss of incoming data. This additional software is not a part of the GEONETCast Americas system and is the responsibility of the users in cooperation with commercial vendors or other service organizations.

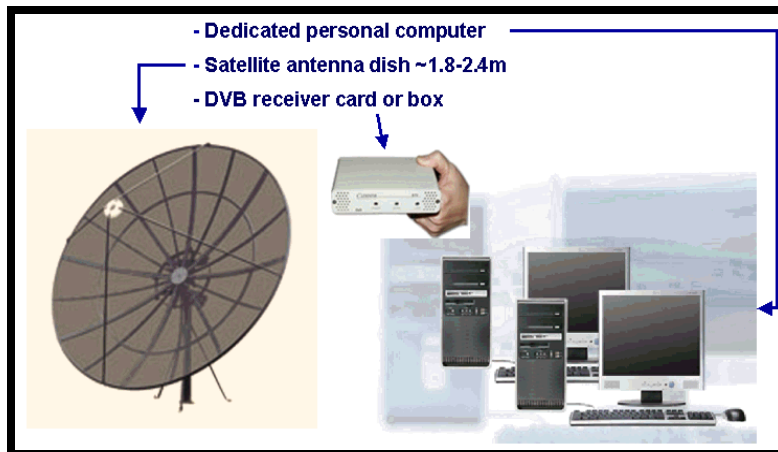


Fig. 5. Components of a typical GEONETCast Americas receiver station.

#### 4. GEONETCAST GLOBAL INTEROPERABILITY

Each of the regional GEONETCast systems, including NOAA's GEONETCast Americas in the Americas, EUMETSAT's EUMETCast in Europe and Africa, and CMA's FengYunCast in the Asia-Pacific region, will be interoperable with each other. Although each system may have unique system architecture characteristics, they will all be able to exchange data files in both directions in a manner that is transparent to the user. For example, data files originating in China or Africa or Europe will be received by GEONETCast Americas for broadcast as needed by users in the Americas, and similarly data files originating in the Americas will be sent to these other regional systems for broadcast in their regions (Fig. 6). There are two possible approaches to implement this data exchange, either through exchange by satellite telecommunication (assuming there are overlapping satellite footprints extending across regional boundaries) or through terrestrial communication lines (Fig. 7).

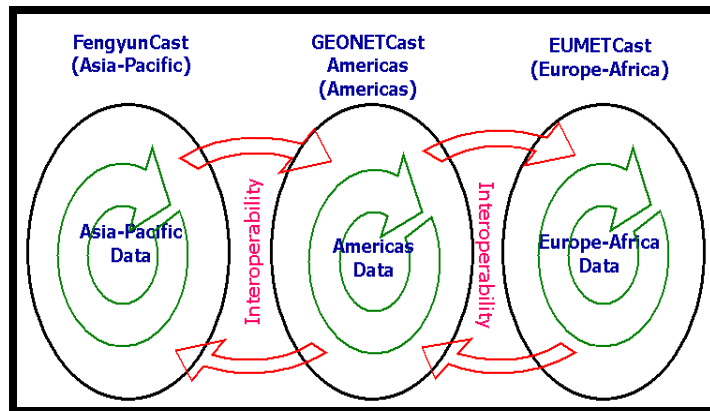


Fig. 6. GEONETCast global data exchange within and across regional boundaries.

It is not expected, however, that all data from a given region will be distributed to the other regions as this has resource impacts on each system (e.g., availability of limited satellite transponder bandwidth to carry all extra-regional data). Therefore there will need to be a coordination mechanism established to determine what products are required to cross regional system boundaries and what are their priorities for broadcast so that sufficient bandwidth is acquired and allocated to carry as many products as is affordable, particularly the highest priority products.

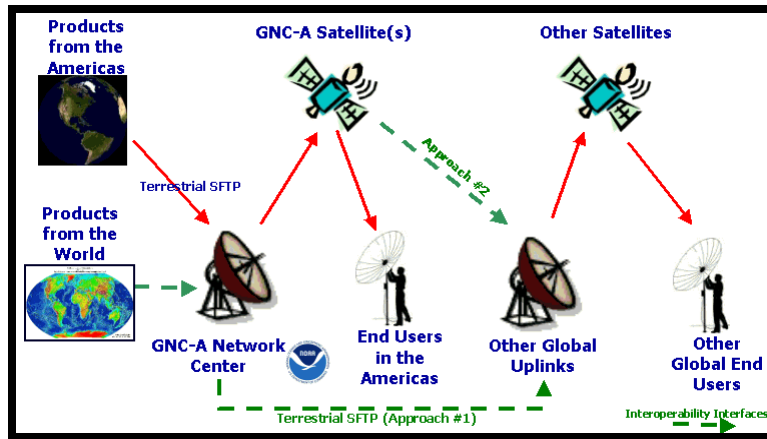


Fig. 7. GEONETCast Americas (GNC-A) data flow to and from the Americas.

## 5. ALTERNATIVE DISSEMINATION METHOD

NOAA’s past development activities of an “Alternative Dissemination Method (ADM)” system focused specifically on new methods for distribution of NOAA environmental satellite data and products have ended, and there are no plans to pursue further development or implementation of such an ADM system at the current time. This activity has been replaced by the development and implementation of the new GEONETCast Americas environmental data dissemination system to disseminate a broader range of environmental data beyond just remotely-sensed meteorological satellite data. As described previously herein, it has some similar functionality and technical capabilities (e.g., DVB-S technology) to the ADM framework proposed by the Coordination Group for Meteorological Satellites (CGMS) but also some differences related, for example, to requirements drivers.





Although GEONETCast Americas is in reality an “alternative dissemination method” for disseminating environmental data using commercial communications satellites, the focus and purpose is not to replace existing NOAA environmental satellite dissemination systems that perform that job today. Therefore NOAA does not view GEONETCast Americas as an ADM for disseminating its environmental satellite data, and it will not carry the full complement of such data that existing environmental satellite dissemination systems already provide. But NOAA does plan to distribute some of the derived satellite products via the GEONETCast Americas system as it is doing currently in a demonstration mode. The existing NOAA satellite dissemination systems will continue to serve as the primary data dissemination mechanisms for NOAA satellite data dissemination to satisfy satellite-related user requirements into the near future.

## **6. SUMMARY**

GEONETCast Americas is a developing environmental data dissemination system that currently will use commercial satellites for broadcasting information over the Americas. It is a regional implementation of a global integrated GEONETCast system and is a component of the Global Earth Observation System of Systems. The objective is to enable increased availability and utilization of environmental information across the globe and to foster improved communication and decision making for diverse societal benefits. One of the driving forces is to increase access to environmental information through a relatively inexpensive delivery system based on commercial telecommunication standards so that user’s costs are kept low. When this U.S./NOAA system is implemented in the fall of 2007, this vision can begin to be realized in the Americas and beyond through collaboration among all the GEONETCast Americas partners.