4.5 MOVING FROM RESEARCH TO APPLICATIONS: NASA's EOS DATA FOR DECISION MAKERS

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1. BACKGROUND

The Synergy program is a NASA funded initiative which began in 2000 with the goal of exploring the use of remote sensing data collected by Earth Observing System (EOS) satellites to develop applications relevant to federal, state, local and tribal agencies. Six application areas are identified under this program and include precision agriculture, community growth, natural resource management, water resource management, disaster management and weather, climate and human health. Synergy is a partnership between end users, academia and industry. Based on specific user requirements, scientists at several universities have been developing products from remote sensing data, and these products are being distributed through interactive web based tools hosted at virtual information centers called InfoMarts.

As shown in figure 1, successful application development requires continuous interaction between the product developers and users. The InfoMarts are not only developing remote sensing applications, but also study the impacts of their products on decision making by end users. The Synergy program is having positive impacts on the users by providing them with accurate geospatial information to support informed decisions.

The InfoMarts provide a set of specialized data oriented to the essential needs of a given set of users. This prevents the users from having to navigate large data sources while presenting the data in a way that is more relevant to the user. The InfoMarts similarly provide guidance on how to use the scientific data. Thus, the program aids the user in several ways by providing timely, accurate, site and application specific information that can be easily accessed and used.

A second task within Synergy is focused on improving accessibility and availability of EOS data to scientists and users. The EOS archive is large (several petabytes), tape-based, and primarily oriented towards supporting large-scale global climate research. To allow easier and faster access to EOS data, large on-line caches of frequently used data products, called Data Pools,

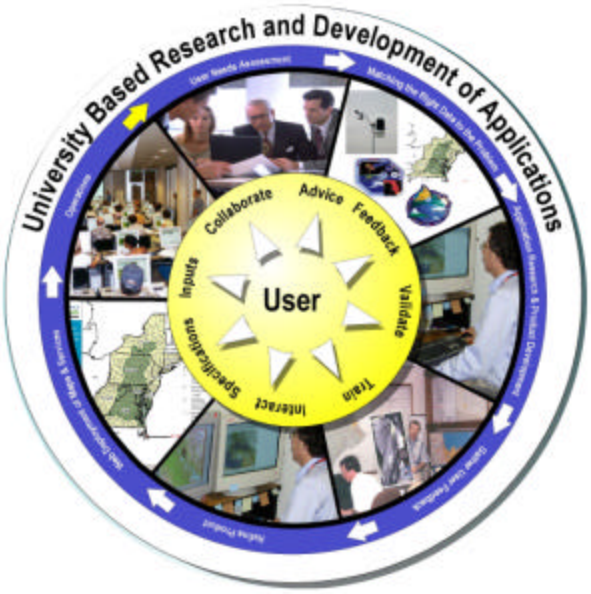

Figure 1. Synergy applications are user driven

have been established at the Distributed Active Archive Centers (DAACs). Data stored on Data Pool disk include products from the Terra, Aqua, and other earth-observing satellite missions, metadata files, and browse images.

The six application themes within Synergy are discussed below along with examples.

2. PRECISION AGRICULTURE

Under the aegis of the Synergy program, the Upper Midwest Aerospace Consortium (UMAC) has been supplying satellite imagery to several farmers and ranchers in N. Dakota, S. Dakota, Idaho, Montana and Wyoming during the growing season. The data sets include maximum value Normalized Difference Vegetation Index (NDVI) from AVHRR, MODIS, and true and false color composites from Landsat 5 and 7 (Fig. 2). Farmers are able to determine resource allocation such as fertilizer and herbicide based on crop condition determined from the image of their farm during the growing season, and apply these resources at variable rates using a GPS receiver mounted on a combine sprayer.

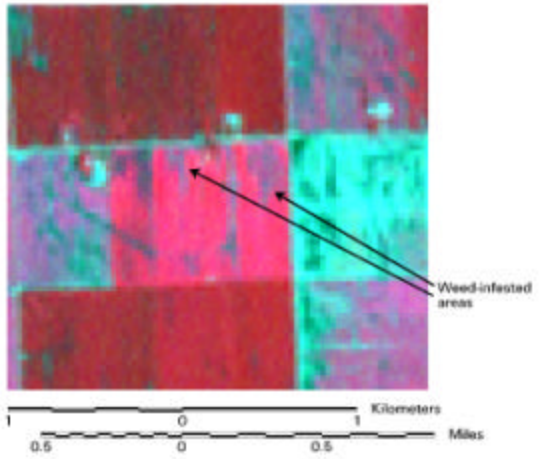

Figure 2. Landsat 7 image acquired July 13, 2002 near Moorhead, MN showing areas of weed infestation in an alfalfa field (R,G,B = 4, 3, 2) (*UMAC-Univ. of N. Dakota*).

3. MANAGEMENT OF NATURAL RESOURCES

Several university InfoMarts are developing applications to better manage natural resources. Remote sensing data are being used by ranchers and agency personnel in Arizona to monitor rangeland conditions (Fig. 3), while foresters in Idaho and Missouri are able to monitor forest health and identify areas for conservation respectively. Satellite data are also being used to map invasive species such as cheatgrass, leafy spurge and salt cedar in the several parts of the country.

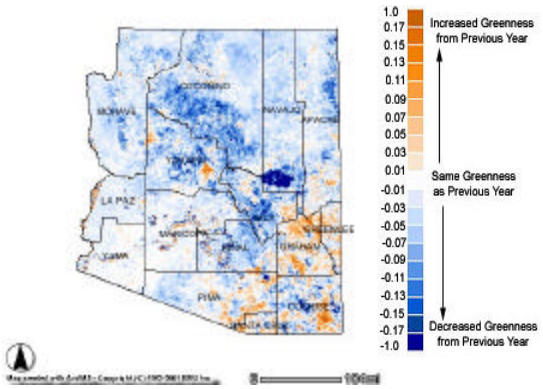

Figure 3. Deviation in maximum NDVI for the two-week period ending September 19, 2002 compared to the same bi-weekly time period from the previous year over Arizona. Data is from AVHRR (*RangeView*).

4. DISASTER MITIGATION AND MANAGEMENT

The University of Hawaii is collaborating with the U.S. Geological Survey's Alaska Volcano Observatory and other investigators in the analysis of volcanoes in the Pacific including, Hawaii, Alaska, and Philippines. Cloud-free Landsat mosaics of several volcanoes have been produced and digital elevation data are being used in numerical models that predict the path of lava flows (Fig. 4). Other applications include mapping the extent of damage due to natural disasters such as floods and wild fires by the University of Texas.

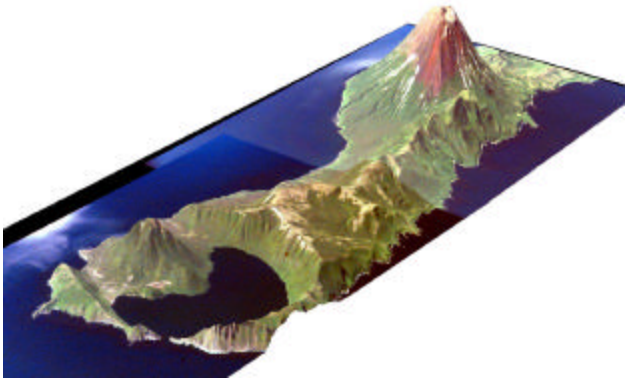

Figure 4. Digital Elevation Model (DEM) of the Kuriles derived from the Shuttle Radar Topography Mission (*Univ. of Hawaii*)

5. WATER RESOURCE MANAGEMENT

Modeling different components of the hydrological cycle accurately is important for efficient management of water resources. Synergy universities have developed models to estimate precipitation, snow water equivalent, evapotranspiration, runoff, and aquifer recharge using visible, thermal and passive microwave satellite data (*e.g.* Fig. 5). These data are being used by both federal and state agencies as an input to their planning process to manage water, particularly in western states with limited water resources.

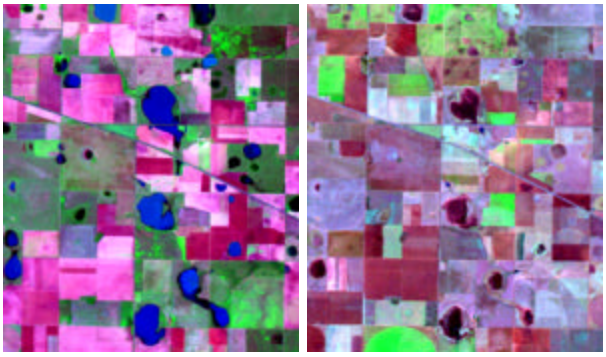

Figure 5. Landsat 7 ETM+ images showing water level in the playa lakes on the High Plains of Texas on July 15, 1999 (left) and July 13, 2000 (right). Such imagery is being used to determine how often playa lakes hold water to determine aquifer recharge (*CSR-U Texas*).

6. COMMUNITY GROWTH

Satellite data is being used to map impervious surfaces, urban sprawl, land use, land cover, and to create base maps for city planners in Missouri and the Chesapeake Bay at spatial scales ranging from 1m-30m (Fig. 6). The image basemaps have been widely used for a diverse set of needs/applications including creation of road centerline files, update of image base for parcel vector maps and detection of new buildings for tax assessment purpose. The impervious surface maps are useful to assess non point sources of pollution and model changes in storm runoff as a result of land cover conversion. Monitoring the nature and magnitude of urban growth is important for understanding

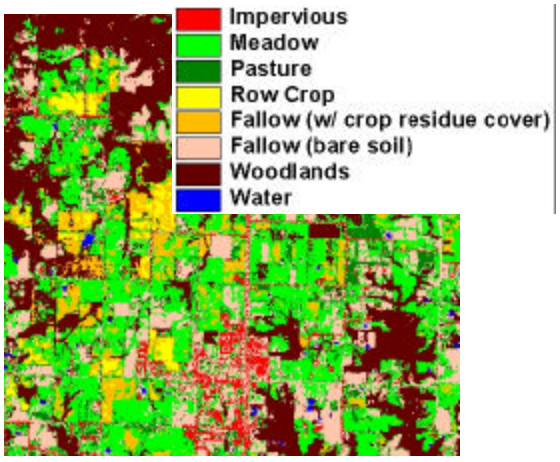

Figure 6. Land cover classification derived from ASTER over Columbia, MO. Image is from 1 August 2001 (*ICREST-U Missouri*).

population dynamics and is essential for planning services such as transportation and other civic amenities.

7. CLIMATE AND HUMAN HEALTH

Utilizing satellite data, the International Research Partnership for Infectious Diseases (INTREPID), is developing models to monitor and predict the spread of West Nile Virus (WNV), a potentially fatal infectious disease that is spreading rapidly across the United States. Environmental variables estimated from satellite data are used to map the habitats of mosquito vectors that spread the disease (Fig. 7).

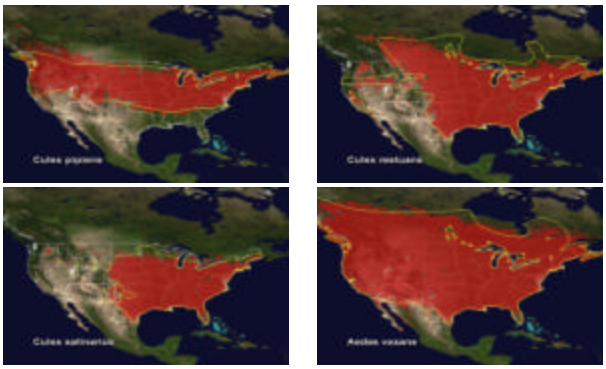

Figure 7. Satellite predicted presence/absence maps for four WNV mosquito vectors (*TALA Research-Oxford*).

8. SUMMARY

The Synergy program successfully demonstrated the applicability of NASA's remote sensing data for developing applications pertinent to state and local communities. Several successful partnership have been built between NASA, the universities, end users and industry through this program. Infomarts implementations provided a tool to access a smaller set of data and information that is oriented to the "essential" needs of a given set of users and mitigated the difficulties in "navigating" a significantly larger data source from NASA's archives. More information about the Synergy program can be found at:
http://www.earth-outlook.com

ACKNOWLEDGEMENT

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