A New View of Coastal Oceans From the Space Station

Understanding and quantifying the natural processes that occur along coasts are critical components of managing environmental resources and planning and executing coastal operations, from humanitarian relief to military actions. However, the coastal ocean is complicated, with dissolved and suspended matter that hinders water transparency, phytoplankton blooms that can be toxic, and bathymetry and bottom types that vary over spatial scales of tens of meters, all of which affect processes in an area that spans millions of square kilometers.

A hyperspectral imager collects the spectrum of the light received from each pixel in an image. For environmental characterization, the wavelength range typically spans the visible and shortwave infrared wavelengths, and the spectrum is collected in contiguous spectral intervals 1–10 nanometers wide. This spectral information is compiled to provide significantly more information about vegetation, minerals, and other components in the scene than can be retrieved from panchromatic or even multispectral imagery, which rely primarily on chlorophyll a concentration (milligrams per cubic meter) from HICO data indicates the location of the HICO image relative to the MODIS image. Figure 1a) is a MODIS image (taken at 0500 UT) of chlorophyll a concentration (milligrams per cubic meter). The white areas indicate high chlorophyll a concentrations.

The HICO Instrument

Data from HICO are beginning to flow to the Earth-observing community. HICO (Fig. 1a), designed and built by the Remote Atmospheric and Ionospheric Detection System (RAIDS) Experimental Payload (HREP) module launched to the International Space Station, was integrated into the HICO-RAIDS Experiment Payload (HREP) module in 24 months, at a small fraction of the cost of a traditional space instrument. The data now being received are providing an exciting new view of coastal environments around the world.

Coastal Ocean

Geoscience Initiative Develops Sustainable Science in Africa

AfricaArray (http://www.AfricaArray.org) is a 20-year initiative in the geosciences to meet the African Union’s New Partnership for Africa’s Development (NEPAD) requirements for continent-wide cooperation in human resources development and capacity building. The name AfricaArray refers to arrays of scientists working on linked projects across the continent, arrays of shared training programs and recording stations, and, above all, a shared vision that Africa will retain capacity in an array of technical and scientific fields vital to its sustainable development.

AfricaArray officially launched in January 2005 and, with support from many public and private partners, has become multifaceted, promoting a broad range of educational and research activities and supporting a multi-institutional science program (Fig. 1). Through fostering geosciences education and research in South Africa was its initial focus, AfricaArray has expanded to 17 countries and is now branching out into all areas of the geosciences (Earth, atmosphere, and space).

The First 3 Years: Promoting Geophysical Research and Education in South Africa

AfricaArray was established through a partnership of three organizations: the University of the Witwatersrand (Johannesburg, South Africa), the Council for Geoscience (Pretoria, South Africa, formerly known as the South African Geological Survey), and Pennsylvania State University (University Park, Pa.). These institutions made a wide range of teaching, research, and data acquisition facilities available to launch AfricaArray. To reflect these investments, an organizational structure consisting of codirectors from each institution was put in place. The Incorporated Research Institutions for Seismology (IRIS) also helped in the launch of AfricaArray by providing data management services and refurbished data loggers.

Although the long-term vision for AfricaArray is to support capacity building in all geoscience fields, AfricaArray began with goals of (1) maintaining and expanding geophysical training programs, (2) promoting geophysical research, (3) improving diversity in the geophysical workforce, particularly in South Africa, and (5) establishing a network of seismic stations to obtain data for investigating scientific targets of economic, societal, and academic importance. Establishing a network was also considered important for assisting in the development of the African science community by providing data for student research and collaborative projects, as well as for fostering a culture of data sharing. During the initial phase of development (2005–2007), efforts focused on improving and expanding the only remaining Ph.D-granting geophysics program in South Africa, at the University of the Witwatersrand, coupled with the development of a seismic network in eastern and southern Africa. To accomplish this, an annual international geophysics field course was established, a multiproject research program in seismology was initiated, and a program for master’s and doctoral students was set up to allow students to spend up to 6 months each year studying and conducting research abroad with a professor at a university affiliated with AfricaArray. In support of these efforts, a chaired faculty research position in seismology was created, seismic recording equipment was purchased, and sustainable Science

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Fig. 1. Map showing the AfricaArray network as of May 2011. GPS is the Global Positioning System.

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Chile flanks the South American continent, an area with significant geophysical and hydrological activity. The geophysical processes that shape the Earth's surface are an integral part of the Earth's dynamic systems, and understanding these processes is crucial for predicting natural hazards and climate change. In recent years, there has been a growing interest in developing new technologies and methods to study these processes. One such technology is the Hyperspectral Imager for the Coastal Ocean (HICO) on the International Space Station (ISS), which has been used to study coastal ocean dynamics and to understand the complex interactions between the ocean and the atmosphere. The HICO instrument is optimized for imaging the vast open ocean, and its full vibrational and thermal vacuum testing, and calibration, have been performed to ensure that it can withstand the space environment at ISS. The HICO instrument has been successful in providing high-quality data on coastal ocean dynamics, and it has been used to study a wide range of oceanic phenomena, including the effects of climate change on oceanic processes. The HICO instrument has been a valuable tool for scientists and researchers, and it has played a significant role in advancing our understanding of the Earth's dynamic systems. The success of the HICO instrument has inspired the development of new technologies and methods, which are currently being used to study other aspects of the Earth's dynamic systems, such as the effects of climate change on the atmosphere and the oceans. The successful development of these technologies is expected to continue to improve our understanding of the Earth's dynamic systems.