Creating a

Distributed Coastal Laboratory

Safe and healthy coasts through better science

National Need

America's coastal waters, bays, ports and estuaries are of vital national importance, yet uncommonly vulnerable to a host of manmade and natural hazards. These hazards include deliberately and accidentally introduced pathogens, toxins and physically destructive devices in addition to naturally occurring storms and biohazards. There is an acute need to improve the detection, diagnosis, observation and prediction of critical phenomena that impact operations, activities and human health and safety in the complex and sensitive coastal environment. Increased accuracy and timeliness of real-time predictions will facilitate planning for extreme events, such as hurricanes and tsunamis, improve safety and efficiency of maritime operations, and save lives, with untold benefits on human health and safety, homeland and national security and commerce. Unfortunately, operational technologies for predicting and preparing for hurricane impacts are well behind the "state of the science". Although substantial investments in coastal observations and linked models have been, and continue to be made, the emerging programs are largely disconnected and lack integration. With relatively modest additional investments, these disparate systems ("silos") can be merged into a unified and web-accessible system of systems that will effectively provide the nation with a geographically all-embracing "Distributed Coastal Laboratory". This can be done without sacrificing the identity or functionality of the individual systems.

Today: SURA's Existing Prototype

Over the last several years, the Southeastern Universities Research Association has evolved its coastal research initiative – the SURA Coastal Ocean Observing and Prediction (SCOOP) program – into a prototype of a new paradigm of interoperability between research and operational science. In prototyping this distributed and virtual laboratory, SURA's partner institutions have applied modern Internet technologies to integrate disparate information sources. Key ingredients are sound science and Internet technology underpinned by community and partnership. Following the ideals of the National Oceanographic Partnership Program and with federal funding provided by the Office of Naval Research and the National Oceanographic and Atmospheric Administration, SURA is striving to create an open-access, coordinated and shared community resource. When fully evolved, the underlying infrastructure will enable communities of scientists to share intellectual capacity, databases and computational resources among multiple institutions and complementary disciplines.

The Future: A Distributed Coastal Laboratory

As the next step, SURA envisions integrating the diverse and multi purpose coastal observing and predicting assets that already exist, or will exist, into a coherent geographically distributed but operationally integrated "Distributed Coastal Laboratory". The key players will include the research community, the private sector and government. This laboratory can ultimately transform the coastal sciences in ways analogous to the ways that the Hubble telescope has transformed astronomy. Like the Internet and its private-sector success stories (*e.g., Google*), this science-based system readily expands and tailors timely information to support those who need it most. When developed to operational reality, this distributed system will assure that operational science keeps up with technology, and that our nation's best science goes toward saving lives and enhancing quality of life. The mission of this Distributed Laboratory is to:

- Integrate real-time ocean observing systems,
- Enable the research needed to understand and predict environmental events, and
- Advance operational information services for safety, security and commerce.

What is "A Distributed Coastal Laboratory"?

The "Distributed Coastal Laboratory" must be much more than a mere federation of local or regional observatories. Existing and planned coastal observatories are intended to provide high resolution time series of specific parameters within a specified coastal region. These observatories will advance scientific understanding

of coastal phenomena that occur in particular coastal regions or estuaries. However, they are typically not intended to elucidate connections among different phenomena, across different regions, or between the coast and the deep sea. In this sense, regional observatories are ***not*** distributed laboratories. The idea of the Distributed Coastal Laboratory only begins to take shape when information from multiple observatories, observing platforms (i.e. those operated by NOAA, NASA, Navy, USGS, the private sector or universities), and numerical model outputs are integrated and made widely accessible in standardized formats that allow phenomena operating on spatial scales of thousands of kilometers to be described and understood. Doing this successfully lies jointly within the domains of Information Technology (IT) and cutting edge interdisciplinary coastal science, both of which are areas within which SURA and its member institutions possess exceptional capability. The (virtual) distributed laboratory will involve a network of data systems, forecast models, and supercomputers geographically distributed throughout the country. These system components will interact across standardized interfaces in ways analogous to the World Wide Web and will be networked to provide redundancy and reliability. The "Distributed Coastal Laboratory" that SURA envisions will be a national asset that provides timely high quality information on the shelf, coastal and estuarine realms of the entire U.S. Eastern Seaboard and Gulf of Mexico. The information will no longer be disparate.

Benefits to Regions & the Nation

- Greater coordination among existing observing systems will enable **integration across programs as well as geographic and political boundaries.**
- More accurate and timely predictions of storm surge and inundation will **reduce the costs of evacuation, the number of deaths and injuries, and property damage and reduce the costs of reconstruction and relief**; [i.e., for Katrina costs estimated at $200 billion.]
- **Improved capacity for modeling coastal circulation will improve** search and rescue efforts, and chemical spill tracking by marine operations by agencies such as NOAA, Navy, FEMA, Coast Guard and DHS.
- **Improved access to data for scientific research** will enable more timely and accurate predictions and speed the transition from research to operations.
- **Better educational and outreach activities** via easy access to standardized services and visualization will inform the end-user.

The Path Forward: Can We Afford A DCL?

The concept underlying SURA's Distributed Coastal Laboratory is not new. Last year, the National Oceanic and Atmospheric Administration (NOAA) engaged two large system integrators (Lockheed Martin and Raytheon) to design and estimate costs for a comprehensive integrated system of ocean observations. SURA partnered with two other ocean-research consortia (CORE & JOI) in a non-exclusive offering to represent the research community in this private-sector study. The information architecture of each of the independently proposed design studies – a so-called "service-oriented architecture – mirrors the architecture of SURA's prototype distributed laboratory. However, whereas Lockheed and Raytheon proposed efforts of $7-$50 Billion to transform concept to reality over twenty years, SURA believes that its working prototype can become operational much sooner and for a fraction of the cost. The DCL must enable transformational research while facilitating intimate connections with operational services. It must be affordable and it should be a shared community resource that makes no distinctions between research and applications.

References

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