

SURA DISTRIBUTED COASTAL LABORATORY (DCL)

PROSPECTUS AND STRATEGIC PLAN 2008 - 2009

EXECUTIVE SUMMARY

The SURA Coastal Research Committee supports the establishment of a Distributed Coastal Laboratory (DCL). As conceived, the DCL will be a cyber-enabled *virtual organization* of scientists, data systems (including observatories, regional IOOS observing systems and satellite imagery), numerical models, and computing resources to advance scientific discovery and support applications. A unified interface will provide easy access to and manipulation of data and models. The DCL can transform coastal science by providing a trans-disciplinary computational environment to enable intersections of models of physical, ecological, biogeochemical and socioeconomic processes. Processes can be examined on a hierarchy of frequencies and spatial scales. The mission of the DCL is to enable transformational coastal science and, thereby, to contribute to the long range vision of safe and healthy coasts. The existing SURA Coastal Ocean Observing and Prediction Program (SCOOP) has, for the past few years, been advancing a prototype distributed facility that engages multiple universities to create a cyber infrastructure for coastal research and applications, focused on predicting and analyzing hurricane impacts and coastal inundation. By extending that infrastructure, the DCL can integrate data relevant to a variety of complex coastal issues, including Coastal Inundation, Coastal Circulation, Coastal Ocean and Wetlands Ecology, Morphodynamics and River Hydrology. The DCL can enable the effective coupling of trans-disciplinary models and facilitate multiple intersections among sub disciplines within the coastal community.

It is expected that the DCL will be governed by an independent board of scientists and stakeholders representing a cross section of the scientific community and involved federal agencies. The strategic challenges that must be met in order for the goals of the DCL to be achieved fall into four general categories: 1. Team building and engagement of the scientific community including the emergent IOOS regional associations; 2. Effective coordination and leadership of scientific teams; 3. Creating and sustaining the facilitating cyber infrastructure; and 4. Obtaining adequate funding support. The funding base must become diverse and robust and, to that end, resources should be pursued from multiple federal agencies, states, industry, and private foundations. The cost of implementing the essential core of the DCL (excluding leveraged external assets) is estimated to be in neighborhood of \$5M/yr initially, subsequently ramping up at the rate of \$1M/yr. Leveraged resources will, of course, add to the grand total.

MARCH 2008

SOUTHEASTERN UNIVERSITIES RESEARCH ASSOCIATION
COASTAL RESEARCH PROGRAM

INTRODUCTION

The Eastern United States and Gulf of Mexico combine to span more than two-thirds of the nation's tidal shores. They support 22 naval facilities, more than 30 major ports, essential commercial fishing enterprises, large oil and natural gas reserves, and thriving tourism industries. This dynamic coastline is at risk of degradation by human-induced changes and destruction by natural disasters. In order to protect its diverse coastal environment, in 1999, leaders from the Southeastern Universities Research Association's Council of Presidents recommended seeking ways to address these perennial threats. This led to the formation of the SURA Coastal Ocean Observing and Prediction (SCOOP) Program.

SCOOP is a prototype-distributed facility focused on improving predictability of coastal hazards. Since 2003, the SCOOP Program has brought together a collaboration of marine scientists and computer scientists from the University of Alabama, Huntsville, Louisiana State University, Texas A&M University, University of Florida, Virginia Institute of Marine Science, University of North Carolina, Renaissance Computing Institute, Gulf of Maine Ocean Observing System, and the Bedford Institute of Oceanography.

SCOOP provides an extensible and flexible cyberinfrastructure to support a much broader initiative called the Distributed Coastal Laboratory (DCL). The DCL will become a cyber-enabled *virtual organization* of scientists, sensor networks (including observatories, regional IOOS observing systems, and satellite imagery), forecast models, and computing resources to advance understanding of coastal phenomena. The DCL can integrate data relevant to a variety of complex coastal issues, including coastal inundation, coastal circulation, oxygen dynamics, wetlands ecology, morphodynamics, river hydrology and much more (Figure 1).

The SURA Coastal Research Program staff, in collaboration with the SURA Coastal Research Committee (CRC) initiated a strategic planning process in 2007 to establish a long-term vision and mission for the program, as well as a clear set of goals and objectives to advance SURA's contribution to broader U.S. ocean observing initiatives. The CRC, at its meeting in Dec 2007 recommended creating a DCL Prospectus. This prospectus and strategic plan serves as a working document for the SURA Coastal Research Program to orient programmatic direction and to guide activities within the scope of SURA's mission.

The SURA Coastal Research Program will evaluate progress annually and revisit its strategic goals and objectives as the DCL implementation structure and benefits are tested. This review will allow the program to align efforts with potential scientific and legislative changes and associated priority shifts, as well as the more comprehensive funding requests SURA is advancing through federal agencies, foundations, and other funding sources.

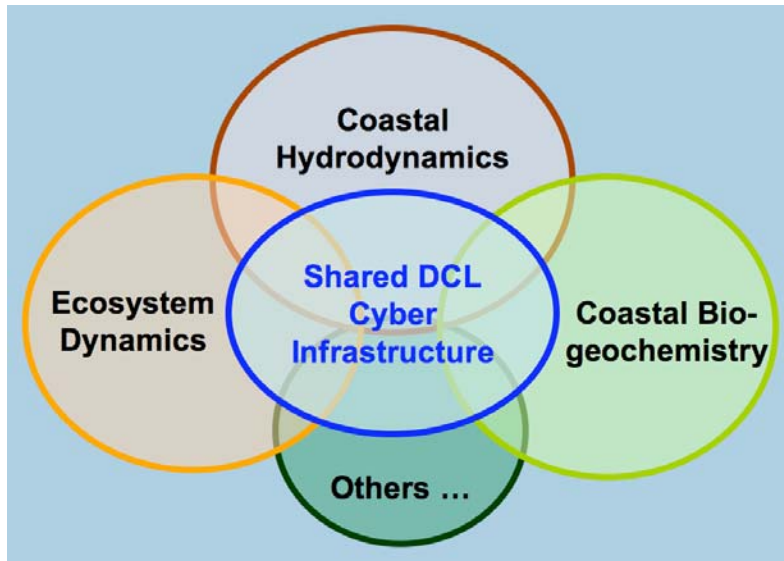


Figure 1. Conceptual diagram illustrating a single Cyber infrastructure serving multiple coastal sciences themes or domains. The underpinning of this shared infrastructure will be a Service Oriented Architecture.

STATEMENT OF PURPOSE

VISION

Safe and healthy coasts through transformational science

MISSION

To enable transformational coastal science

GOALS

- *Enable discovery of diverse and trans-disciplinary coastal phenomena;*
 - *Couple observation and modeling of processes across science domains;*
 - *Enable high resolution studies of multi-scale coastal phenomena;*
 - *Advance information and predicting services for science, safety, security, and commerce; and*
 - *Facilitate creation of innovative projects for education and public outreach.*
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RATIONALE FOR THE DCL

America's coastal waters, including continental shelves, bays, ports, and estuaries are of vital national importance but are uncommonly vulnerable to a host of natural and manmade hazards. There is an acute need to improve the understanding and prediction of critical phenomena that impact operations, activities and human health and safety in complex and sensitive coastal systems. These coastal systems also provide scientists with rich laboratories within which to explore complex, non-linear processes. Transformational scientific discoveries and innovations in coastal marine science await the ability to effectively integrate and disseminate diverse information. For coastal science, the challenges fall into three overlapping categories: (1) coupling observational data from various sources with numerical models; (2) enabling much higher resolution studies of multi-scale phenomena; and (3) coupling modeling of processes across science domains. New frontiers involve the study of interdependent suites of hydrodynamic processes, coastal and shelf morphologies, ecosystem dynamics and temporal sequences of change on space scales ranging from cm to 10^3 km and time scales of seconds to decades. The long range aim is to facilitate the next coastal science paradigm shift by building a "Distributed Coastal Laboratory (DCL)" that leverages existing or planned observing systems, intersects that information with a diversity of coastal ocean scientists, numerical modelers and theoreticians and enables non-linear interactions to be adequately modeled. A DCL can provide scientists with a valuable source of information and with a computational environment conducive to trans-disciplinary modeling. The DCL can also provide open access to information and computing resources that would otherwise be inaccessible to all but the most well-endowed research universities.

Sidebar: A possible academic-socioeconomic scenario

A graduate student and a public health official discuss a new fish disease that may be affecting people. The disease infects a commercial fish that has extended its range. The student wants to determine the possible processes that may be causing the disease. The student, using DCL, easily gathers river runoff data from the whole southeast, the fish distribution data, the coastal environmental data, the public health data and seamlessly analyzes it for her PhD dissertation. She simultaneously advises health and fisheries managers.

SURA COASTAL OCEAN OBSERVING AND PREDICTION PROGRAM (SCOOP): A PROTOTYPE FOR THE DCL

Over the past 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 an extensible and flexible infrastructure that can support a DCL (Bogden et al, 2007). In prototyping this distributed and virtual laboratory, SURA's partner institutions have applied modern Internet technologies to integrate disparate information.

Key ingredients are sound science and Internet technology underpinned by community and partnership. Following the ideals of the National Oceanographic Partnership Program, 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. Distributed resources provided by SURAgrid and Teragrid are currently supporting a variety of SCOOP component applications.

THE RELATIONSHIP OF THE DCL TO REGIONAL AND NATIONAL OBSERVING SYSTEMS AND OBSERVATORIES

The DCL is not intended to duplicate existing or planned observing systems. The DCL is an institution-neutral, community effort that will leverage existing systems and accelerate progress toward a future where interoperable sensor networks are the norm. This will allow scientists from different institutions to use shared cyberinfrastructure to conduct their research and to allow data and results to be utilized effectively by coastal managers and educational institutions at all levels. Data streams from many widely deployed sensor arrays will have been made interoperable well before they reach the scientists, and communities will collectively observe and study the earth in real time as a system of interacting systems. The vision builds from the premise that networked information technologies will transform the way we observe and predict environmental systems. The DCL will use focused systems-science themes to build the necessary connections in a distributed cyberinfrastructure that employs a service-oriented approach.

Progress toward observing system realization will take one of two paths, depending on present status. A service-oriented approach will integrate legacy data systems in a common “Federal Enterprise Architecture.” Satellite systems do this routinely, but the real challenge is with *in-situ* systems and predictive models. For example, two independent NOAA-sponsored conceptual design studies offered ambitious and extremely expensive 20-year proposals for an Integrated Ocean Observing System (IOOS). The EPA has its National Environmental Information Exchange Network, the USGS has a National Biological Information Infrastructure, and there are many others. An alternate path involves new sensor networks such as those envisioned by the cutting-edge NSF Ocean Observatories Initiatives (OOI). New OOI systems will, from the outset, utilize state of the art technologies throughout, and the integration challenges will be less formidable. Nevertheless, they too will incorporate a service-oriented approach when making their data available to distributed communities of scientists. And the list of systems extends well beyond single-agency initiatives to include multi-faceted public and private partnerships such as the Ocean Biogeographic Information System (OBIS), the National Ecosystem Observatory Network (NEON), the Encyclopedia of Life, and others. These systems will be networked with standards-compliant services of the type used in the SCOOP program, where our fundamental design principle is that standards enable innovation.

The DCL will add value to these programs by ensuring that the resulting information is effectively shared and well integrated across agencies and science domains. Doing this successfully rests jointly within the domains of information technology (IT) and cutting edge interdisciplinary coastal science. SURA and its member institutions possess exceptional capability in both domains.

THE DCL ROLE IN TRANSFORMATIONAL COASTAL RESEARCH & EDUCATION

The DCL has the potential to illuminate phenomena that were previously undiscovered, only peripherally understood, or beyond the reach of conventional research approaches. It is intended that the DCL will facilitate the fusion of observed information with models in multiple science domains. A key emphasis will be on facilitating computation across domains where non-linear interactions are likely. Effective modeling of non-linear processes across different disciplines offers the greatest potential for yielding transformational discoveries. In the vision of the DCL, information from multiple observatories, observing systems and numerical model outputs will be integrated and made widely accessible in standardized formats that allow phenomena operating on spatial scales of thousands of kilometers to be accessed, described and understood by a diverse, multi disciplinary scientific community. By way of the DCL, coastal science researchers from different sub disciplines can combine their discipline-specific modeling experience and capabilities to develop a set of coupled-model simulations to explore physical, biogeochemical, and ecological interactions. Better understanding of these interactions will allow more accurate predictions of the coastal impacts of climate change and extreme atmospheric events, as well as anthropogenic changes. Model output can be utilized to inform multi-billion dollar initiatives such as those to modify coastal geomorphology in attempts to restore healthy ecosystems as in the Florida Everglades and the Mississippi Delta. In addition, increased understanding of the science and management of our coastal ecosystems will foster greater public outreach, education, and training programs that will to entrain a new generation of scientists and informed citizens.

GOVERNANCE OF THE DCL

Effective and fully enfranchised governance is essential to realizing the vision of the DCL. It is expected that the DCL will be governed by an independent board of scientists and stakeholders representing a cross section of the scientific community and involved federal agencies. The governance structure that is adopted must enable ocean and coastal observing and modeling assets, including those related to IOOS, ORION, regional and state programs, military programs and private sector activities to be integrated. The governance structure must facilitate and expedite the integration of diverse capabilities and accommodate the needs of all stakeholders. We propose a shared governance model led by a strong and independent Board of Directors (BOD) with representation keyed to programmatic and operational drivers, and that is supported through advisory groups that are representative of stakeholder communities. The Coastal Research Committee (CRC), and specifically its Steering Group, should play key roles in selecting the members of the BOD but it is expected that this group would include senior level and highly respected academic researchers (not directly involved with DCL), agency program managers, and industry representatives.

In addition to the BOD, there could be considerable benefit to having a SURA-coordinated “Southeastern Coastal Council” made up of influential, non-academic, non-agency community leaders (such as CEOs, retired legislators, philanthropists, prestigious individuals) with interests in coastal problems or coastal environments. This council could assist the BOD in identifying issues of broad socioeconomic significance and could provide powerful advocacy for the emergence and growth of the DCL. A draft charter for such a council is in preparation.

FUNDING THE DCL

A robust and diverse funding strategy is essential to accomplishing the missions and goals set out above. The design and pursuit of such a strategy must emerge from, and be supported by, the research community at large. It cannot be the exclusive domain of a single agency, organization, or institution. Meeting our goals will also require leveraging talents, resources, and funding support beyond the immediate realm of the DCL specifically. There are numerous funding sources available for an overarching initiative that plays broadly to the needs of those interested in coastal phenomena. Most programs to date have relied on the federal government for funding. However, as we move forward in the present climate of dwindling federal research budgets, we must broaden our pursuits to include but also go beyond federal agencies to states, foundations, and the private sector. Each of these funding sources is envisioned to be additive to the current coastal and ocean funding for individual researchers, their institutions, and the regional associations, since the proposed DCL will aim at integration and larger-scale modeling and prediction that will be dependent upon the infrastructure and science already taking place. Expected costs in the initial implementation of the DCL infrastructure are on the order of \$5M per year. We expect that after the first two years, an additional \$1M per year would allow for expansion of science themes and continued operations and maintenance of the infrastructure.

Federal Agencies

NOAA is envisioned to be the lead agency for Congressional appropriations directed to the IOOS. However, other federal agencies, notably NSF through ORION and OOI, as well as ONR and NASA have made substantial commitments to research-focused, broad-based, ocean observing programs. The USGS stream gauging and shoreline monitoring programs and EPA efforts to monitor coastal and estuarine water quality are all potential data sources for the DCL. Other federal agencies with an interest in coastal waters include the Department of Homeland Security (including the US Coast Guard) and the US Army Corps of Engineers. Investments by multiple agencies should be sought. At the time of this writing (February, 2008), SURF has funding proposals for DCL activities under review by NOAA, ONR/NOPP, and NSF. Of course, effective coordination, from outside any single agency, will be essential to realizing the vision of coastal and ocean data integration and real-time cutting-edge environmental predictions.

Coastal States

While federal agencies remain among the target funding sources for the proposed DCL, other sources of capital should also be explored. Among these are the state governments. Some coastal states (e.g. CA and FL) are already investing heavily in ocean observing and have agencies in place to study and manage their coasts. But these entities recognize a critical need to interconnect and integrate their data sources, models, and analysis with others from across the country. The state of Louisiana has a profound interest in coastal science from multiple perspectives. Included among the coastal issues confronting Louisiana and its neighboring states are inundation and related hurricane hazards, land loss, and hypoxia. The DCL can provide an enabling infrastructure for addressing all of these issues simultaneously and we will begin to broker the appropriate partnerships to make this happen.

Foundations and the Private Sector

Private non-profit research foundations can also play a role in the funding strategy. Some possibilities for the DCL may include the Pew Foundation and the Packard Foundation among others. The best and most effective approach may involve enlisting the services of a consultant to explore the best opportunities. Finally and perhaps most uniquely, the for-profit private sector should be pursued to provide capital for the growth and ultimate utilization of a DCL. The operational aspects and real-time data from across states and region will enable those in weather prediction, tourism, fishing, energy (oil and gas), and others to make better, more cost-effective decisions about everything from off-shore platform location to product marketing. Some industries that could employ the DCL capabilities on a “technology transfer or fee for service” basis include the insurance industry, the offshore oil industry and the maritime industry.

A SURA Coastal Endowment?

In an interesting commentary in the December issue of *Oceanography*, Baker et al, (2007) offer the vision of a \$1B endowment to support long term observations in support of climate change studies. This is, of course an exceedingly optimistic vision. However, their vision should be ours. Why not pursue a significant endowment to support the DCL? Such an endowment is unlikely to emerge from a single benefactor but will need multiple contributors. To accomplish this, we will need a group of influential people to help carry the message. These people will not be academics or agency people; they need to be peers of potential benefactors. As suggested above in the governance section, we will need to assemble, educate and engage a "Southeastern Coastal Council" consisting of influential people like retired political leaders, retired Admirals, CEOs including one from the maritime/shipping industry, one from the petroleum industry and other prominent but interested people. The process of building an endowment will require some fairly careful and tedious nurturing; it is unlikely to involve an impulsive act on the part of a present day Rockefeller.

A BRIEF STRATEGIC PLAN

At the time of this writing (February 2008), the DCL exists largely as a concept, underpinned by a very real SCOOP prototype. Strategic planning for the implementation and evolution of the DCL vision as set out in foregoing must take account of the fact that the DCL is not intended to be a project, a single institution, an agency or any other sort of monolithic entity. It is a “*virtual organization*” that must derive its existence by weaving together talents, resources and foci from multiple and diverse projects, institutions, and agencies. As with any research endeavor, adequate funding will be crucial to the success of the DCL and, as discussed in the preceding section, this will almost certainly have to come from a diversity of sources, not from a single source. But the funds that become specifically dedicated to the DCL should not be regarded as the sole source of support for the “*virtual organization*”. The DCL will rely heavily on additional (though less tangible) assets leveraged through involved partners. The most essential of these assets will be the talents themselves; this means that effective engagement of a scientific team is a key to success. The specific goals to be addressed by the DCL are described below along with desired outcomes and the immediate beneficiaries or constituents.

INITIAL DCL GOALS

Goal 1: Enable discovery of diverse and trans-disciplinary coastal phenomena

SURA-sponsored workshops held as far back as 2001 identified several trans-disciplinary research themes that could only be adequately addressed by approaches similar to that of the DCL. Included were the following three examples: 1. How do the Coastal Ocean and atmosphere interact on synoptic scales during storms and on longer time scales? 2. How do the Coastal Ocean and its linked watershed and atmospheric boundary layer function as an interconnected system in physical, chemical, ecological, and geological terms and what are the frequencies, scales and mechanisms of the linkages? 3. In what ways and to what degree does the ubiquitous presence of river-supplied buoyancy, nutrients, sediments and toxins in coastal waters impact or modulate the physics, chemistry, biology and geology of the system? There are numerous other possible themes and these must be selected by the DCL teams that ultimately emerge.

Desired outcome of Goal 1: Identification of new phenomena and previously unrecognized process suites that transcend traditional science domains; paradigm shifts.

Constituency for Goal 1: The research and academic community; undergraduate and graduate students; future scientists; coastal resource managers and planners.

Funding targets for Goal 1: National Science Foundation (NSF), Department of Defense, Private Foundations.

Goal 2: Couple observation and modeling of processes across science domains

It is intended that the DCL will facilitate the fusion of observed information with models in multiple science domains. A key emphasis will be on facilitating data transfer and computation across domains where non-linear interactions are likely. In the vision of the DCL, information from multiple observatories, observing systems and numerical model outputs will be integrated and made widely accessible in standardized formats. This integration will allow phenomena operating on spatial scales of thousands of kilometers to be accessed, described and understood by a diverse, multi disciplinary scientific community.

Desired outcomes of Goal 2: Interdisciplinary integration of observed and modeled data; modeling of non-linear processes across disciplines; improve accessibility of observations to verify models; improved accessibility of model output to improve observations; improved trans-disciplinary computational capabilities.

Constituency for Goal 2: The research and academic community; environmental forecasters; undergraduate and graduate students; planners and engineers.

Funding targets for Goal 2: NSF, Environmental Protection Agency (EPA); Office of Naval Research/National Oceanographic Partnership Program (ONR/NOPP); National Oceanic and Atmospheric Administration (NOAA)

Goal 3: Enable high resolution studies of multi-scale coastal phenomena

Until now, it is not been feasible to study coastal phenomena with spatial coherence scales larger than a few tens of kilometers. The DCL can enable new paradigm shifts by exploring processes that span the entire U.S. Atlantic and Gulf coast and shelf. A key goal of the DCL is allow the study of hydrodynamic processes, coastal and shelf morphologies, ecosystem dynamics and temporal sequences of change on space scales ranging from cm to 10^3 km and time scales of seconds to decades.

Desired outcome of Goal 3: Identification of spatial scales of coherence in coastal regions where important physical, biological and biogeochemical phenomena are coupled non-linearly; more accurate resolution of high-to-low-frequency processes in complex coastal environments.

Constituents for Goal 3: The research community, coastal managers, operational modelers, coastal engineers charged with coastal restoration, fisheries managers

Funding targets for Goal 3: NOAA; US Army Corps of Engineers (USACE); NSF; Private Foundations

Goal 4: Advance information and predicting services for science, safety, security, commerce, education, and environmental management

The broader impacts of the DCL relate to solving formidable engineering, physical, ecological and socioeconomic problems involving such complex process suites as those that shape and alter major deltaic coasts and shelves, including the Louisiana coast which is plagued with land loss, inundation, and hypoxia. Anticipating the dispersal of toxins and pathogens in coastal and estuarine waters requires timely and accurate forecasting. As climate changes, the frequency and intensity of storm events, as well as the rates of freshwater, nutrient and sediment delivery to the shelf by rivers, can also be expected to change. Integrated forecasting of these changes will be essential to effective coastal management and planning and to reduce the costs of evacuation, the number of deaths, injuries, and property damage and reduce the costs of reconstruction and relief. Improved access to data for scientific research will enable more timely and accurate predictions and speed the transition from research to operations.

Desired outcomes of Goal 4: Greater coordination among existing observing systems to enable integration across programs as well as geographic boundaries; more accurate and timely predictions of coastal hazards; more timely and effective support for multi-faceted adaptive management of coastal regions; improved capacity for modeling coastal circulation to improve search and rescue efforts, and chemical spill tracking.

Constituents for Goal 4: FEMA, U.S. Coast Guard; Coastal Managers; Maritime and Petroleum Industry; Emergency Managers; Health Officials; Researchers; Educators

Funding Targets for Goal 4: Department of Homeland Security; NOAA; National Institutes of Health; states; industry

Goal 5: Facilitate creation of innovative projects for education and public outreach.

Increasingly, graduate education and graduate student dissertation research relies on students having online and real time access to information from coastal and ocean observations and model output. The DCL should become a revolutionary asset for all levels of education from K-12 through graduate and post-doctoral training. On a more fundamental level, the stronger interaction between basic research and practical applications enabled by the DCL could entrain a larger fraction of the student population into the world of science.

Desired outcomes of Goal 5: Entrainment of a larger fraction of the student population into the world of science; Better educational and outreach activities via easy access to standardized services and visualization; web access to data and model output maps for K-16 education; direct support for, and integration with, existing and planned COSEE programs.

Constituency for Goal 5: Educators at all levels; students at all levels; general public

Funding Targets for Goal 5: NOPP; NSF; EPA; Private Foundations

STRATEGIES FOR ADVANCING THE DCL AND MEETING GOALS

The strategic challenges that must be met in order for the five goals of the DCL to be achieved fall into four general categories:

1. Team building and engagement of the scientific community;
2. Effective coordination and leadership of scientific teams;
3. Creating and sustaining the facilitating cyber infrastructure; and
4. Obtaining adequate funding support.

The specific ways in which each challenge is met will vary somewhat with the goal, although overlap and commonality are generally greater than the differences. Some strategies are set out below and the relevant goals are indicated.

Category 1 Strategies: Team building and Community Outreach

- Identify and engage members of multi-disciplinary science teams from within the coastal science community, the emergent RAs, and state and federal agencies and enlist their participation in SURA-enabled DCL science programs through a series of workshops. These workshops must be planned so as to enfranchise the participants in formulating the specific interdisciplinary questions to be pursued, but they should facilitate effective synergies among several sub disciplines including coastal hydrodynamics, biogeochemistry, coastal and wetlands ecology, river hydrology, meteorology and coastal engineering (among other possible specialties). (Addresses Goals 1,2 &3)
- Establish a compelling and interactive collaboration environment (web site, wiki, blogs, mailing lists, web meetings) that enables the coastal community to learn of opportunities to participate in the DCL and that allows interested scientists (including students) to contribute their perspectives and ideas via on-line dialogue. (Addresses all 5 goals)
- Establish close communications with and reach out to scientific societies including the American Geophysical Union (AGU), the American Society of Limnologists and Oceanographers (ASLO), The Oceanography Society (TOS) and the Estuarine Research Federation (ERF). These societies should be invited to assist SURA in identifying cutting edge trans-disciplinary research questions and in formulating exciting hypotheses to be addressed utilizing the DCL capabilities. SURA and DCL team members should hold town meetings at regular meetings of these societies or, where appropriate, organize special sessions. (Addresses Goals 1,2,3 &5)
- Meet with representatives of the National Federation of Regional Associations and NOAA IOOS program managers to determine the data integration needs that can be met with the infrastructure and SOA available via the DCL. (Addresses Goal 4)
- Work with COSEE staff in the Mid-Atlantic and Southeast to identify funding opportunities for which we could develop a joint pilot. (e.g. <http://www.cosee-ma.net/public/resources/postcard.pdf>) (Addresses Goal 5)
- Begin discussions with museums (http://www.mos.org/events_activities/collaborations), aquariums and other education venues to inform and educate the public about DCL products and services. (Addresses Goal 5)
- Work with leaders in the Regional Associations and sub-regional associations to maximize effective outreach and community building.

Category 2 Strategies: Coordination and Leadership of Scientific Projects in DCL

- Work with professional ocean science educators (e.g. at COSEE) to define requirements for making data and model output available on www.openioos.org an asset to K-16 education. (Addresses Goal 5)
- Identify project leaders from within the broader community who enjoy strong reputations and are highly respected within their fields to lead targeted thrusts and prepare competitive funding proposals. SURA coastal staff will provide day to day support in the form of routine communication with team members, proposal submission and project management. (Addresses all goals).
- Work with SURAgrid partners to coordinate among domain scientists and Information Technology. The DCL can leverage the existing capabilities of the SURAgrid (http://sura.org/programs/sura_grid.html) infrastructure and community to help create a cyber environment capable of supporting the DCL. SURAgrid is a consortium of organizations collaborating and combining resources and expertise. The resulting regional grid infrastructure is secure, transparent, and scaleable. (Addresses all goals)
- Engage the Coastal Board of Directors (BOD), the SURA Coastal Research Committee (CRC) and the CRC Steering Group appropriately in setting priorities for funding allocations and divisions of responsibilities within DCL project teams. These governing boards should also have oversight of new pursuits to ensure their relevance to the DCL mission. They should also be empowered to allocate resources within projects so as maximize project success and the attainment of excellence. (Addresses all goals)
- Implement and maintain effective collaboration environment (web site, wiki, blogs, mailing lists, web meetings) for all DCL projects that enable research teams to stay abreast of the progress of their colleagues and to contribute ideas and emerging results in a timely fashion.

Category 3 Strategies: Creating and Sustaining Cyber infrastructure

- Develop a set of prototype trans-disciplinary computational capabilities and demonstrations that extend beyond the traditional reductionist approaches. (Addresses All Goals)
- Develop component-based architectures to advance community standards and specifications from main standard organizations: Open Geospatial Consortium (OGC), World Wide Web Consortium (W3C), International Organization for Standardization (ISO), Federal Geographic Data Committee (FGDC), etc. as endorsed by the Ocean.US Data Management and Communications (DMAC) Committee.
- Develop interfaces for trans disciplinary model coupling and provide multiscale adaptive data structures that facilitate model coupling across domains where codes vary in fundamental ways. This effort must offer universal and straightforward user interfaces and employ visualization methods that represent the underlying data generated from various disciplines.
- Develop data federation methods to represent heterogeneous data in a consistent and efficient manner. The Distributed Coastal Laboratory will contain a unified user interface that provides easy access to and manipulation of observational data and numerical models. An integrated modeling framework will be established to support coupled numerical simulations across multiple traditional science domains.

- Harden the prototype infrastructure within SCOOP to enable real time data integration into region-specific forecast models. Create an application manager that can pre-empt running jobs for timely model results. Improve security and QA/QC methods to ensure data are accurate.
- Integrate circulation models into the DCL infrastructure by enabling them to run using the application manager, cataloging and archiving the output and visualizing the results on Openioos.org.
- Demonstrate trans-disciplinary computational modeling capabilities and showcase the cyberinfrastructure and observational requirements for hypothesis testing. Such demonstrations may illustrate the tools and capabilities needed to carry out the next generation of interdisciplinary numerical experiments.

Category 4 Strategies: Funding the DCL

- Implement an accounting and financial management system that allows establishment of a diverse and sustainable funding base for the DCL by pursuing a mix of federal state, industry and philanthropic sources. (Addresses all goals)
- Submit competitive, multi institutional proposals to the National Science Foundation for funding trans disciplinary or potentially ground breaking research projects or educational (e.g. COSEE) initiatives that utilize the DCL cyber infrastructure. These may be in response to special RFPs or they may be submitted to core Geoscience funding cycles. These may be SURA led or they may be led by a partner institution with SURA support. (Addresses Goals 1, 2, 3, 5)
- Submit competitive multi institutional proposals to NOAA, EPA, USACE, DHS, ONR or other agencies for applied or operational research efforts. These may be SURA led or they may be led by a partner institution with SURA support. (Addresses Goal 4).
- Pursue partnerships and funding alliances with stakeholder industries, including offshore oil and gas, insurance, sensor manufacturers, systems integrators. (Addresses Goal 4).
- Seek private foundation support for focused projects that align well with the missions of specific foundations. (Addresses specific opportunities across all goals).
- Pursue the creation of a SURA Coastal Endowment to be supported by philanthropists.

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