Prologue: National Drivers for Coastal Community Science
September 21, 2009

A memorandum issued to Heads of Executive Departments and Agencies on June 12, 2009 by President Obama established a task force focused on a "National Policy for the Oceans, Our Coasts, and the Great Lakes". This memorandum noted that *"To succeed in protecting the oceans, coasts, and Great Lakes, the United States needs to act within a unifying framework under a clear national policy, including a comprehensive, ecosystem-based framework for the longterm conservation and use of our resources."* On September 10, 2009, the President's Task Force submitted its interim report http://www.whitehouse.gov/assets/documents/09_17_09_Interim_Report_of_Task_Force_FINAL2.pdf). Among the nine implementation objectives offered in that report were the following: (1). Adopt *ecosystem-based management* as a foundational principle for the comprehensive management of the ocean, our coasts, and the Great Lakes. (2). Implement comprehensive, integrated, ecosystem-based *coastal and marine spatial planning* and management in the United States. - - - and (9). Strengthen and integrate Federal and non-Federal *ocean observing systems*, sensors, and data collection platforms into a national system and integrate that system into international observation efforts. The report explicitly includes, as an essential element of objective (9) *Data management, communication, access, and modeling systems for the timely integration and dissemination of data and information products.*

The President's 2009 initiative follows a 2007 report by the National Science and Technology Council's Joint Subcommittee on Ocean Science and Technology (JSOST) entitled "*Charting the Course for Ocean Science in the United States for the Next Decade".* That JSOST report also emphasized the need for sustained ocean observations that are ultimately assimilated into predictive models that serve societal needs. In a recent brief communication, the president of The Oceanography Society, Carolyn Thoroughgood, poses an overarching question: "*But let us suppose that ample funding and data are pouring forth-is the oceanographic community positioned to assimilate these data and translate them into products that address societal needs?"* (C. Thoroughgood, 2009. *Oceanography* v. 22, #3, p 8). An affirmative answer to that question will depend on the existence of a robust coastal informatics infrastructure and the effective integration and *unifying* management of distributed, multi-scale and multi-disciplinary information, ideas and modeling results. SURA can, and should, play a vital role in helping the nation realize those essential capabilities. The strategic plan that follows is intended to outline the niche that SURA could appropriately fill, identify potential beneficiaries of SURA's pursuits and explore potential sources of support.

DRAFT SURA Coastal Strategic Plan
Updated September 21, 2009

Executive Summary

SURA can, and should, play a vital role in helping the nation meet the needs for a robust coastal informatics infrastructure and the effective integration and unifying management of distributed, multi-scale and multi-disciplinary information, ideas and modeling results. The SURA Coastal Ocean Observing and Predicting Program (SCOOP), which began in 2003, has now terminated. The next phase of SURA's coastal activities should fall within the broad definition of the Distributed Coastal Laboratory (DCL). The overarching mission of SURA's coastal program should be to enable our primary constituency, SURA's member academic institutions, to achieve transformational scientific advances via a distributed community approach that transcends the resources and capabilities of any single institution. The overarching *scientific goals* that SURA intends to assist the community in addressing include the following:

Goal 1- Enable discovery of diverse and trans-disciplinary coastal phenomena;
Goal 2- Couple observation and modeling of processes across science domains;
Goal 3- Enable high resolution studies of multi-scale coastal phenomena;
Goal 4- Advance information and predicting services for basic and applied scientific research and innovative education and outreach.

By way of the DCL, coastal science researchers from different sub disciplines should combine their discipline-specific modeling experience and capabilities to develop sets of coupled-model simulations to explore physical, biogeochemical, and ecological interactions. In this new DCL phase we are striving to add the following sub disciplinary foci:

- *Coastal riverine and flood plain hydrologic modeling*
- *Coastal Mesoscale Atmospheric Modeling*
- *Baroclinic coastal circulation modeling and assimilation*
- *Ecosystem forecasting*
- *Management of Super-regional or Multi-regional Modeling Test Bed*

The three most critical strategic challenges are:

- *Team building and engaging potential users* includes workshops that enfranchise the participants in formulating specific interdisciplinary questions and establishing a compelling and interactive collaboration environment.
- *Effective coordination and **leadership** of scientific teams* requires identifying project leaders from within the broader community and within SURA to lead targeted thrusts and prepare competitive funding proposals.
- *Funding the DCL, and other Coastal Programs* at adequate levels for sustained periods of time is undeniably essential to the future of SURA's coastal programs. We must continue to pursue federal funding from multiple sources including competitive federal sources, private industry, foundations and states. In addition, we should consider developing IT capabilities that can generate "fee for services" revenue.

Assumptions Underlying SURA's 2009 Coastal Strategic Plan

1. The SURA Coastal Ocean Observing and Predicting Program (SCOOP), which began in 2003 with funding from ONR and NOAA and involved numerous academic partners from SURA institutions as well as non-SURA entities, has now terminated and final reports have been completed. The next phase of coastal activities involve the Distributed Coastal Laboratory (DCL) (See DCL Prospectus of March 2008). The DCL succeeds SCOOP and builds on the capabilities advanced by SCOOP.

2. SURA's main constituency is its member academic institutions. Therefore, the primary customers (beneficiaries) of SURA's coastal program should be academic researchers and educators. Operational users, federal agencies, and industries should be considered as potential customers that add value, help support programmatic objectives and make SURA's pursuits relevant to national priorities.

3. The overarching mission of SURA's coastal program should be to enable our primary constituency to achieve transformational scientific advances via a distributed community approach that transcends the resources and capabilities of any single institution. New understandings that are truly transformational can be quickly followed by new solutions to societal problems provided that there is effective engagement of and communication between scientists and end users. SURA can enable the dialogue that is essential to real interoperability.

4. Coastal informatics is the primary niche that SURA always intended for SCOOP and now the DCL program, to fill. SURA defines coastal informatics to include integrating observed data/ information, enabling improvements in the modeling and forecasting of environmental phenomena, and providing essential and accessible information services.

5. Although providing 24/7/365 data and model output for the purpose of making operational forecasts may not be the highest priority goal for SURA's coastal programs, the provisioning of versatile and robust cyber infrastructure capable of serving data on a 24/7 basis for research purposes is. With the appropriate disclaimers to release SURA from liability, this same infrastructure can be used to support operational activities. It is not, however, SURA's intent to usurp NOAA's role as an operational entity but rather to assist our constituent scientists in transitioning their products from research to operations.

6. Scientific paradigms and insights evolve rapidly and we must avoid rigidity and remain agile, but at the same time remain focused and avoid frequent or unreasoned changes in direction. In planning for the next five years we must think in broad terms, adapting as new insights emerge, while being cognizant of the fact that the systems and acronyms in vogue one year may be passé the next.

7. SURA must agree on a set of underlying principles to guide our relationships with federal agencies, especially NOAA and its IOOS office. We will, of course, be directly accountable to federal agencies for contracted activities. However, contracted activities should not supersede allegiance to the SURA research community. SURA must find a synergistic balance among a diverse funding base that includes multiple agencies. Guidance from the CRC will be needed to achieve this vision.

8. SURA can engage with and provide federal relations support for multi-institutional endeavors that are consistent with its mission.

I. **Services and Benefits Offered by SURA's Coastal Programs**

A) Program Goals and Services

The overarching *scientific goals* that SURA intends to assist the community in addressing include the following:

Goal 1- Enable discovery of diverse and trans-disciplinary coastal phenomena;
Goal 2- Couple observation and modeling of processes across science domains;
Goal 3- Enable high resolution studies of multi-scale coastal phenomena;
Goal 4- Advance information and predicting services for basic and applied scientific research and innovative education and outreach.

The services SURA's coastal program, including SCOOP have aimed to provide for the scientific community (with varying success) to facilitate the goals above include :

- Providing OGC standards-compliant tools and a prototype cyberinfrastructure for coastal data integration. Examples of such tools prototyped in the SCOOP Program are: 1) A file format structure for numerical models; 2) Maps of model output; 3) A registry for data collections; 4) An archive for model runs; 5) Tools for publishing results in a common format; 6) A portal for model comparisons.
- Deploying and managing a *cyberinfrastructure* that meets the functional requirements of academic and applied end-users. Going forward, emphasis should be on serving the needs of researchers by encouraging their input and serving data in formats and at the expected levels of "undigested" detail.
- Providing a *community structure* that involves key stakeholders and facilitates multidisciplinary and multi-institutional synergies. Examples of community coordination services that SURA has provided to date include: 1. The *SCOOP* Program; 2.the Open Geospatial Consortium Oceans Interoperability Experiment to advance standards; 3. OOSTethys activities including software development for observing systems; 4. participation in the Marine Metadata Initiative (MMI); and other NOAA and interagency working groups.
- Acting as an *institution-neutral organization*, SURA facilitates and sometimes leads multi-institutional and multi-disciplinary coastal science proposals involving five or more institutions.
- Providing *management of multi-institutional community projects* including proposal preparations, budgetary oversight, compliance with federal regulations, and integration and timely reporting of results.

B) Alternative providers

- ***Other non-profit organizations*** that assist the ocean and coastal science community include the Consortium for Ocean Leadership (COL), National Association of State Universities and Land Grant Colleges (NASULGC), the National Association of Marine Laboratories (NAML) and the National Federation of Regional Associations (NFRA) under the auspices of the NOAA IOOS office. In addition scientific societies such as the American Geophysical Union (AGU), the Oceanography Society (TOS) and the American Society for Limnology and Oceanography (ASLO) provide traditional venues for the exchange of scientific information and advances. None of these entities provides informatics services or proactively facilitates the preparation and coordination of proposals for focused multi-institutional programs. However, by teaming with organizations like COL or NFRA, SURA could help to advance innovative coastal science on a

global or national scale.

- ***Federal agencies*** such as NOAA and NSF maintain or fund resources for managing, integrating and disseminating coastal data. NOAA does this under the IOOS program office. The National Science Foundation is focused on research and advancing scientific frontiers via programs such as the Ocean Observatories Initiative (OOI). The OOI Program will conduct transformational ocean science using an integrated ocean observatory with a network of interactive nodes studying interrelated ocean processes on coastal, regional, and global spatial scales and through a continuum of time scales, from microseconds to decades.. SURA can add value to those functions by providing super regional and multi-disciplinary integration capabilities.
- ***Regional Associations (RAs)*****,** are charged with coordinating and managing regionally focused coastal activities under NOAA's IOOS. They possess varying degrees of capability in the area of cyber infrastructure and informatics. "NFRA and the RAs work to increase access to ocean and coastal information." They are currently working toward a super-regional integrative capability. SURA must be both proactive and sensitive in reaching out to RAs and teaming with NFRA to help bring super-regional data integration for the coastal research community.
- ***Private corporations*****,** such as Boeing and Lockheed Martin are proven system integrators and seek to play major roles as data integrators for NOAA's IOOS. An effective partnership between SURA and one or more of these private corporations could yield a synergistic outcome that offers something for everyone and may resonate favorably on Capitol Hill.
- ***Foreign government-run agencies*** such as Australia's CSIRO, New Zealand,s NIWA and Korea's KORDI have missions to provide openly accessible information on coastal processes. The level of their informatics infrastructure is unclear. Although none of these programs should be regarded as a competitor for SURA, any of them could be a viable future partner.

C) How do we presently communicate benefits?

- *Meetings and workshops* with SCOOP partners and members of the Coastal Research Committee have been held for several years. Although we have had limited benefits to offer, this sort of multi-institutional forum and communication capacity is valuable and often underappreciated or underutilized. This is a clear SURA strength that needs to be leveraged.
- *Publications* in the scientific and technical literature have explained the SCOOP architecture and goals. Some of the inundation modeling results have also been published.
- *Presentations at scientific meetings* over the past several years have increased awareness
- of SURA's SCOOP program but have not been particularly effective in recruiting advocates from within the research community.
- *Presentations at IOOS Coordination meetings* at the request of NOAA have helped the IOOS Program Office, RAs and RCOOS understand the SCOOP Program.
- *Interaction with the Technical Developers at IOOS* via OOSTethys and the Oceans IE activities.
- *SURA's Coastal Newsletter* is distributed on a monthly basis to members of the Coastal Research Committee and other stakeholders.
- *The OpenIOOS.org web site* has been the most visible portal for SCOOP Program accomplishments. This site has recently been transferred from GoMOOS to SURA. Much of the site is currently not functioning since the funding for the SCOOP Program ended. The name of the site will be changed in the near future to avoid confusion with NOAA's IOOS site.

D) How can we communicate benefits in the future?

- 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. These workshops should facilitate effective synergies among several sub disciplines including coastal hydrodynamics, biogeochemistry, coastal and wetlands ecology, river hydrology, meteorology, ecosystem modeling and coastal engineering (among other possible specialties).
- Strengthen and make robust the SCOOP/DCL cyber infrastructure, make it visible via sites such as openIOOS.org (and its successor), and provide outreach to the scientific community on how to utilize the capabilities that SURA provides. But it needs to work fluidly.
- 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.
- 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.
- 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. Work with leaders in the Regional Associations and sub-regional associations to maximize effective outreach and community building.
- Open discussions with museums, aquariums and other education venues.
- Publish in the scientific literature. It is important for those who utilize the capabilities that SURA facilitates to make their results visible to the scientific community at large via both technical and non-technical publications.

E) How does technology help?

Information technology/cyberinfrastructure underpins SURA's Coastal Program. Although previous successes have varied, the potential contributions of technology include the following.

- Provision of *trans-disciplinary computational capabilities* and demonstrations that extend beyond traditional discipline-specific approaches.
- *Component–based architectures* to advance community standards and specifications from standards organizations such as: 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.
- Provision of *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.

- Development of *data federation methods* to represent heterogeneous data in a consistent and efficient manner. The Distributed Coastal Laboratory should ultimately support 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.
- Infrastructure to enable real time data integration into forecast models.

F) Anticipated future services

The DCL and its SCOOP infrastructure have the potential to illuminate phenomena that were previously undiscovered, only peripherally understood, or beyond the reach of conventional research approaches. A key emphasis in the future will be on facilitating computation across domains where non-linear interactions are likely. Effective modeling of non-linear processes across different disciplines offers great potential for yielding transformational discoveries. By way of the DCL, coastal science researchers from different sub disciplines can combine their discipline-specific modeling experience and capabilities to develop sets 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 restore healthy ecosystems as in the Florida Everglades and the Mississippi Delta and to forecast ecological responses to climate change. Recently completed SURA-led proposals add the following sub disciplinary foci:

- *Coastal riverine and flood plain hydrologic modeling*- River flows are an important shoreward boundary condition to the coastal ocean and significantly impact many coastal phenomena. For the DCL Modeling Testbed, the modest aim is to couple existing hydrologic models to coastal ocean models,
- *Coastal Mesoscale Atmospheric Modeling*- Surface winds and atmospheric pressure play a dominant role in driving coastal ocean circulation,. A more advanced line of investigation involving the exchange of polluting and nourishing gases and particles between the coastal atmosphere and coastal ocean can be anticipated in the foreseeable future.
- *Baroclinic coastal circulation modeling and assimilation*- Skill assessment for data assimilative models will be conducted with the DCL Modeling Testbed. An effort will be made to assimilate observational data into models wherever this is straightforward. However, model runs and inter-comparisons not involving data assimilation are likely to be more common initially.
- *Ecosystem forecasting*- As with the physical models, skill assessment of the marine ecological forecasting systems is required. Thus, there is a need to establish a sustained test bed process for the marine ecological forecasting systems.
- *Management of Super-regional or Multi-regional Modeling Test Beds* A Senate Committee has included $4.5M within the Ocean Assessment Program for NOAA to initiate and competitively award an extramurally based super regional test bed that enables data integration and dissemination to understand, predict, and mitigate the consequences of both extreme events and chronic conditions in the U.S. Atlantic and Gulf Regions. SURA could coordinate and manage such a program following submission of a successful competitive proposal.

II. Market Analysis Summary

A) Market Segment

- SURA's coastal programs are presently focused on coastal scientists (as our name suggests we should be). However, the tools, infrastructure and managerial structure could, in future, serve the needs of the environmental sciences at large.
- We have not focused on the needs of blue water oceanographers because national programs exist for them such as the University National Oceanographic Laboratory System (UNOLS) and because the majority of the marine science programs at SURA universities have coastal emphases.
- Much of the research done within the coastal science community involves empirical shipboard measurements, field studies, and small-scale laboratory experimentation. These scientists are NOT our primary constituency although many can make effective use of the information that we provide.
- As pointed out in the "Starting Assumptions" section, our special niche has been, and continues to be, coastal informatics and the attendant integration of observed and modeled data. Therefore, the coastal modeling community seems to be our focused research segment.
- Numerical modelers with interests in a broad spectrum of coastal phenomena, including physical, biogeochemical, ecological and engineering, are one segment that should benefit most immediately from SURA's efforts. These scientists have also driven much of our program direction to date.
- Another sub-group that our programs can serve are theoreticians and "big picture" analysts who seek to explain large scale, time varying coastal processes (space and time scales of 100s to 1000s of kilometers and years to decades).
- In the future, a robust and long-lived coastal informatics program such as the DCL will be essential to testing hypotheses concerning the impacts of global climate change and also for enabling adaptive, ecosystem-based management practices.
- Operational agencies, coastal resource managers and emergency managers are, and will eventually be, served by the evolving DCL. Application oriented outcomes that we anticipate in the long-term include: *1. Improved knowledge for utilization by coastal environmental managers; 2. Improved ability to* advise *changes in management practices; and 3. Long-term improvements to environmental and socioeconomic conditions.*
- SURA can provide management and coordination of large multi-institutional initiatives such as the super-regional modeling test bed described above in section I F.

B) Implementation Strategy

Realizing the potential of the DCL will require Leadership, Funding, and Action. In the prospectus and strategic plan that the SURA coastal team prepared in spring of 2008 in response to the request from the Coastal Research Committee, we described distinct categories of strategies that need to be met in order for the DCL to succeed in achieving its goals. Full details are in that document. The most critical strategic challenge categories are:

- *Team building and engaging potential users* includes workshops that enfranchise the participants in formulating specific interdisciplinary questions and establishing a compelling and interactive collaboration environment.
- *Effective coordination and* ***leadership*** *of scientific teams* requires identifying project leaders from

within the broader community and within SURA to lead targeted thrusts and prepare competitive funding proposals. This approach has been followed in recent proposal activities within SURA.

- *Funding the DCL, and other Coastal Programs* at adequate levels for sustained periods of time is undeniably essential to the future of SURA's coastal programs. Over the past year, we have submitted numerous competitive proposals to federal funding agencies, and one private foundation, with only very modest success. We must continue to pursue federal funding from multiple sources. We expect to continue the pursuit of Congressional endorsement of our initiatives with the assistance of Van Scoyoc Associates. In future efforts, we also may consider closer partnering with the private sector and, possibly, the establishment of a SURA Coastal Endowment.

C) Trends

- When SURA began promoting its data integration initiative and the SCOOP program was born in 2003, the challenge was selling the coastal science community on the value of a distributed and shared cyber infrastructure. Today, that initial vision is more widely, though not universally, embraced and has been implemented at several institutions, within NOAA and in some Regional Associations, though with varying degrees of success and sophistication. Our challenge now is not selling the vision but demonstrating that SURA has the leadership and backing of the coastal community and its member universities to develop a useful and non-duplicative informatics system.
- The initial societal applications that the SCOOP program set out to serve, and which justified our prior funding, had to do largely with the safety and security of coastal residents. In particular, until recently, SCOOP was focused on predicting coastal inundation. Secondary reasons for ONR support related to port security. Today, those initial issues remain important, but new additional motivators are also emerging.
- *Climate change* is now accepted as constituting a real threat of global concern. The new US administration is placing a high priority not only on reducing the threat but also on planning for the inevitable. Coastal informatics programs will be needed to provide long time series of decadal changes in storms, inundation, water quality and coastal ecology as well as economic factors such as fisheries. Similarly, a robust cyber infrastructure will be required to enable multi-disciplinary models to be run and coupled to forecast the possible outcomes of alternative climate change scenarios.
- *Renewable energy* is also a priority of the new administration. Coastal informatics will be important to the design and deployment of offshore windmills and to evaluating the potential of coastal currents, tides and waves as energy sources.
- *HR 146 Subtitle C – passed by Congress and enacted on March 30, 2009 – authorizes the Integrated Coastal and Ocean Observation System Act of 2009***.** The coastal informatics program at SURA (with strong leadership, action, and funding) may have the potential to fit the criteria of a super-regional entity consistent with the definition of a "Regional Information Coordination Entity" (*RICE*), as set out in Section 12303 of the new law: *A regional information coordination entity is defined as "an organizational body that … coordinates State, Federal, local, and private interests at a regional level with the responsibility of engaging the private and public sectors in designing, operating, and improving regional coastal and ocean observing systems in order to ensure the provision of data and information that meet the needs of user groups from the respective regions."* This national development is clearly important to the future of SURA's

Coastal Informatics program.

- *Ecosystem-based management* approaches as are emphasized in the September 10, 2009 report by the President's Task Force, must rely heavily on adaptive management strategies. Such strategies must be underpinned by sophisticated and robust data assimilation and model forecasts.
- *Marine Spatial Planning* represents an emerging national thrust, emphasized in the recent report by the President's Task Force, that will clearly require informatics and management capabilities of the sort that SURA can contribute.
- *Coordination and management of a multi-regional modeling testbed* such as that called for in recent Departments of Commerce and Justice, and Science and Related Agencies Appropriations Bill, 2010.

D) Growth

- The SCOOP program experienced *negative growth* from 2007 until its completion in 2009. SURA has completed and will soon submit its final report on SCOOP to NOAA. Other, smaller coastal activities, such as the Marine Metadata Initiative continue though with limited funding. Proposals out for review would return us to 2006 levels of support if successful. But new approaches and funding sources will have to materialize if there is to be real growth on the part of SURA Coastal.
- In recent years, declining federal funding, particularly from ONR and NOAA, along with sharp reductions in state funding for state institutions of higher education have brought about programmatic reductions in many coastal research activities. At the same time, competition for diminishing research funds has intensified. This is one reason why it is imperative that SURA avoid situations where it could be seen more as a competitor than as a benefactor.
- The recent emergence of new stimulus funds distributed among several of the agencies that support coastal science, including NOAA, may herald a new era of growth in coastal research. It is thus far not clear which sectors of the community will benefit and to what degree.

E) Needs

- The coastal research community at large clearly needs new, or renewed, funding support. SURA can help facilitate increased funding via large community programs without detracting from "base" funding to individual institutions.
- For the coastal sciences, large scale, trans-disciplinary and multi-institutional community approaches to complex problems probably represents the wave of the future, at least so far as transformational breakthroughs are concerned. Individual institutions can coordinate and lead projects involving two or three institutions. But for programs involving many institutions and large data sets, which may arouse sentiments of "intellectual property" ownership, an institution-neutral organization like SURA can be very helpful.
- An advanced community-wide cyber infrastructure will almost certainly be required in the future. No agency or organization, including SURA, is providing that infrastructure at present.
- Support from SURA institutions and the community at large is a key element to success. SURA should build upon what it has accomplished with past funding to achieve the goals of the DCL and benefit SURA member institutions and coastal science at large. SURA must enhance its reputation of excellence and prove that it can accomplish the goals we've set out to accomplish through demonstration projects and outreach.

III. Funding Needs and Strategy

A) Overview

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, we must broaden our pursuits to include but also go beyond federal agencies to states, foundations, and the private sector. We should also consider developing and "owning" sets of value-added informatics and management services for which SURA can receive direct compensation. 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.

B) Base Budget requirements

- Operating costs during the SCOOP program were in the range of $1.5-2.0M/yr with the bulk of those costs taking the form of sub awards to program partners.
- The base direct cost for SURA's involvement in these programs in FY 2009 was roughly $400K excluding the subcontract to GoMOOS for Philip Bogden (who has now assumed an IPA at NSF). This amount included salaries and fringe for two full time employees and one part time employee, travel expenses and costs of hosting meetings. Thus, the minimal cost for SURA to continue a minimal coastal activity is expected to be $400K/yr in FY 2010.
- Sub awards to partner institutions have been, and will continue to be, essential to advancing science, particularly in areas of numerical modeling and data integration and analysis across the spectrum of sub disciplines. During SCOOP, sub awards totaled over $1M per year until the declining final phases. Proposals recently submitted to NOAA and NSF contain subaward totals of roughly $2M year. On average, this equates to about $200K to each of 10 partner institutions.
- Full implementation of the DCL as envisioned by the March 2008 prospectus or the operation of a super regional modeling test bed would likely involve 15-20 institutions and extensive development and implementation of infrastructure. Thus, we project budgetary needs on the order $5M/year to fully realize the vision.
- 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.

C) Summary of Potential Strategies for Funding SURA's Coastal Programs

- 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.
- 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. 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.

- 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.
- Pursue partnerships and funding alliances with stakeholder industries, including offshore oil and gas, insurance, sensor manufacturers, systems integrators.
- Seek private foundation support for focused projects that align well with the missions of specific foundations.
- Pursue the creation of a SURA Coastal Endowment to be supported by philanthropists.
- SURA coastal can follow the Linux buss model, in which we create open source code and we provide consulting on implementation and customization.
- SURA coastal can provide metadata expertise to projects funded by NSF. Funded projects will require participants to take a virtual seminar hosted related to process (how, where, when , etc.) NSF expects data to be described and registered. MMI has a set of guides and community built around it, that can be leveraged by SURA for this purpose.
- SURA Coastal can provide the virtual environment to set up test beds for different groups, we could charge a fee for such a service. SURA can coordinate cross institutional projects to set milestones, conduct meetings, and take responsibility for follow up activities.

D) Traditional Federal Agency Sources

NOAA is envisioned to be the lead agency for Congressional appropriations directed to the IOOS. However, other federal agencies, notably NSF through 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), SURA 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. *It must be noted that the SCOOP program began with ONR support. ONR support for future efforts should be seriously explored.*

E) Leading a Super-regional Modeling Test bed

The Senate Appropriations Subcommittee for Commerce, Justice and Science has called for inclusion in the FY 2010 NOAA budget of $4.5M to support a super regional modeling test bed for the US east and Gulf coasts. The language states: *Since the U.S. Atlantic and Gulf Coasts encompass two-thirds of the nation's tidal shores and face multiple economic, human health, public safety and operational conditions, the Committee has included $4,500,000 within the Ocean Assessment Program for NOAA to initiate and competitively award an extramurally based super regional test bed that enables data integration and dissemination to understand, predict, and mitigate the consequences of both extreme events and chronic conditions in the U.S. Atlantic and Gulf Regions. Such a test bed should include no less than 20 academic*

partners and research institutions to guarantee it is multi-disciplinary, and inclusive of community modeling. Should this opportunity become a reality when the budget is passed, SURA should be well positioned to submit a competitive proposal that supports its constituency.

F) 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.

G) 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.

H) A SURA Coastal Endowment?

In an interesting commentary in the December 2007 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.