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Coastal Zone Community of Practice
A Proposal to the GEO User Interface Committee

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I. Introduction

The coastal zone encompasses a broad diversity of terrestrial and marine habitats from rivers, wetlands, farms and cities to coral reefs, fishing banks and continental shelf and slope waters. It is an area where inputs from land, sea, air, and people converge; an area of remarkably high productivity; an area where ecosystem goods and services are concentrated; and an area that has been a center of human activity for millennia (Costanza et al., 1997; Cohen and Small, 1998; IOC 2003). Thus, changes in the physical and ecological states of coastal terrestrial and marine systems have disproportional effects on the safety and well being of human populations (Field et al., 2002; GESAMP, 2001; IWCO, 1998; Watson et al., 1998). Coastal ecosystems and human populations are especially vulnerable to the negative impacts of these changes (Jackson et al., 2001; Nicholls and Small, 2002).

In this context, there is a compelling need to ensure that the data and information needs of those that use, depend on, manage and study coastal systems are met in a timely and sustained manner. In particular, informed management for sustainable development and the sustained use of coastal goods and services requires the capacity to assess routinely and rapidly the state of coastal marine and terrestrial systems and provide timely predictions of likely future conditions. Both depend on integrated, sustained, repeated, and routine observations of coastal marine and terrestrial systems across the land-sea interface.

A concerted effort is thereby required to bring together coastal zone data and information providers with users to ensure these needs are met. Toward this goal, the Partners of the Integrated Global Observing Strategy (IGOS) (http://www.igospartners.org/) approved the development of a Coastal Theme in June 2003, and a Coastal Theme Team was established to determine requirements for observations needed to assess interactions among coastal marine and terrestrial systems across the land-sea interface. This effort builds on and complements design and implementation plans of the coastal modules of the Global Ocean Observing System (GOOS) (http://unesdoc.unesco.org/images/0014/001412/141242E.pdf) and the Global Terrestrial Observing System (GTOS) (http://www.fao.org/gtos/gtospub/pub36.html). In so doing, it was recognized that the occurrence of, or changes in, terrestrial and marine phenomena are often related and that interactions among them must be addressed explicitly. The Coastal Theme Team, as articulated in the Team's IGOS-P approved report (IGOS, 2005), has developed a detailed strategy for linking coastal data providers and users with recommended projects and priorities for implementation by the IGOS Partners and the broader community.

Building on the IGOS Coastal Theme and the work of the partnering bodies committed to its implementation, we propose a **Coastal Zone Community of Practice (CP)** that will leverage these ongoing activities. As recommended in the Coastal Theme report, the proposed Coastal Zone CP will address two priority user issue foci: Coastal human populations at risk from natural hazards and impacts from coastal development and urbanization; and coastal ecosystems, including their attendant hydrological and biogeochemical cycles and their changing states of ecosystem health and productivity. With these twin overarching user foci, the Coastal Zone CP addresses all nine GEOSS benefit areas vis-à-vis their manifestation and/or impacts in the coastal zone (Table 1).

Table 1: Linkages between priority user issues of the proposed Coastal Zone Community of Practice and the GEO Societal Benefit Areas.

COASTAL ZONE CP		***GEO***
Priority User Issues		*Societal Benefit Areas*
Coastal Human Populations	1. Coastal Hazards	Disasters, Climate, Health, Water, Energy, Agriculture
	2. Coastal Development & Urbanization	Human Health, Water, Climate, Agriculture, Energy
Coastal Ecosystems	3. Hydrological & Biogeochemical Cycles	Water, Weather, Climate
	4. Ecosystem Health & Productivity	Ecosystems, Biodiversity, Water, Aquaculture (aquatic agriculture) Invasive species

II. Coastal Zone CP Objectives and Linkages with GEO Societal Benefit Areas

The purpose of the Coastal Zone CP is to develop a strategy for engaging user groups across the land-sea interface in the development of those elements of the GEOSS that are required to provide and integrate data on terrestrial, freshwater, marine and atmospheric systems that converge in the coastal zone. The goal is to provide data and information needed to make informed and timely decisions by those that depend on, use, manage, or study coastal systems and components thereof. Its specific objectives are to:

- Engage both data providers and users in the specification of requirements for *in situ* and remote observations needed to provide data and information at rates and in forms needed by decision makers in both private and public sectors;
- Evaluate current and projected observation capabilities in terms of the extent to which they meet these requirements, identifying gaps, redundancies and activities that need to be strengthened;
- Establish a framework to integrate observations, both *in situ* and remote, particularly across boundaries, as time-space scales of variability differ dramatically between the terrestrial side and the marine side of the coastal zone;
- Stimulate collaboration among institutions within and across communities of practice to coordinate the delivery of coastal-related GEOSS targets aimed at realizing societal benefits;
- Liaise with the User Interface Working Group, GEO, and other CPs on matters relating to coastal environmental issues, and on cross-cutting issues of interest to the Coastal CP.

III. Justification

The Coastal Zone CP shall strengthen the linkage between data providers and users across the land-sea interface, enable integration of *in situ* and space-based observations, promote development of coupled climate-hydrological-hydrodynamic-ecological models across the land-sea interface for coastal research, management and other user-driven applications. It shall stimulate building of long-term coastal data sets, as well as assist in the design and implementation of the coastal components of the Global Ocean Observing and the Global Terrestrial Observing Systems. In addition, it shall identify, coordinate and link priorities for research and development efforts to facilitate and improve the operational elements of observing systems and other programs and activities in support of multiple GEOSS targets. Most importantly, the Coastal Zone CP shall stimulate integrated coastal management by coordinating delivery of these key GEOSS targets and thereby enable improved products and services for a broad range of coastal users (see below). Finally, it shall provide cross-cutting links with other CPs and the GEOSS effort to understand the Earth system sufficiently to realize societal benefits.

IV. Membership

The purpose of the Coastal Zone CP is to engage user groups in the design, implementation, operation and improvement of the GEOSS to ensure that data and information (including decision support tools) are provided in forms and at rates needed by groups that use, depend on, manage, and study terrestrial, estuarine and marine ecosystems in the coastal zone. The primary challenge to the Coastal Zone CP will be to effect and sustain this engagement.

The GEO defines five overlapping categories of users (Figure 1):

- Public Information Delivery (Education, Public Awareness, Training);
- Public Emergency & Health Officials (real-time responders; near-term, post event re-builders; and longer-term planners, decision makers, researchers and educators);
- Local and Regional Environmental Managers (real-time responders; near-term, post event re-builders; and longer-term planners, decision makers, researchers and educators);
- Earth Observation Communities (data and information providers and users);
- Operational Modeling and Forecasting Communities (data and information providers and users).

An additional important category of users to consider is:

- Organized grass-roots community based organizations and other non-governmental organizations.

The Coastal Zone CP incorporates all of these users through its heritage within the IGOS Partnership, adapted to the GEO process. In fact, the IGOS Coastal Theme Report (IGOS, 2005) recommends user categories that map to or cross-cut these categories of users (Tables 2 & 3). The report identifies users across the range of scales of interest from local to global. Table 2 focuses on those with local and regional needs. Table 3 recognizes large-scale users. These are conventions and plans that depend upon the products of sustained and functioning observing systems in coastal regions.

Table 2. Issues, representative products and user groups of the IGOS Coastal Theme (IGOS 2005)

CROSS-BOUNDARY ISSUES	REPRESENTATIVE PRODUCTS	USER GROUPS
COASTAL HAZARDS FLOODING EROSION SEA LEVEL RISE	• Assessments & Risk maps: Episodic events Long term trends • Early warnings of where & extent (temporal and spatial) • Risk-based planning: Building codes Transportation	• Coastal Zone Management • Coastal Engineering • Emergency Response Teams • Disaster Planning & Mitigation • Land-Use Planners • Insurance/Re-insurance industries • Non-governmental organizations • Weather forecasters • Water resource managers • Energy industries
COASTAL DEVELOPMENT AND URBANIZATION	• Public health risks and hazards forecasts: Sewage contamination maps Beach closures Harmful algal bloom alert • Water quality classification maps • Air quality classification maps • Siting of energy production facilities • Port development & shipping • Spill contingency plans • Urban planning & zoning • Risk maps of shoreline contamination	• Air-Water Quality Regulators • Sewage Authorities & Sanitary Engineers • Dischargers and Emitters • Port Authorities • Recreational users • Tourist Industries • Public health officials • Energy Industries • NGOs • Coastal Zone Management • Coastal Engineering • Emergency Response Teams • Disaster Planning & Mitigation • Land-Use Planners & Regulators • Insurance/Re-insurance industries • Resource managers
HYDROLOGICAL & BIOGEOCHEMICAL CYCLES	• Land-Sea fresh water flux • Maps of ice volume • Sediment budgets • Nutrient budgets • Eutrophication index • Carbon inventory and flux maps	• Coastal Zone Management • Commerce • Agro-Industries • Living Resource Managers • Sewage Authorities & Sanitary Engineers • Land-Use planners • Water Resource Managers • Energy Industries • Coastal Engineers • Climate forecasters
ECOSYSTEM HEALTH & PRODUCTIVITY	• Habitat/productivity maps terrestrial, marine, polar • Maps of biodiversity across the land- sea interface • Aquaculture siting and permitting • Harmful algal bloom risk maps • Coral reef bleaching hot spots • Land-sea maps of coastal protected areas • Maps of bottom water hypoxia	• Fisheries managers • Fishers • Forest managers • Protected area managers • Coastal Zone Management • Aquaculture industry • Tourist industry • Recreational users • Recreational vendors

Table 3: Conventions Requiring Data and Information on Coastal Marine and Terrestrial Systems: Requires the establishment of an integrated global system of observations.

CONVENTIONS AND ACTION PLANS
• Ramsar Convention on Wetlands
• UN Conference on the Human Environment
• The UN Convention on the Law of the Sea
• The International Convention for the Safety of Life at Sea (SOLAS)
• The UN Framework Convention on Climate Change (UNFCCC)
• The UN Convention on Biological Diversity
• Agenda 21, the Programme of Action for Sustainable Development
• The Implementation Plan of the World Summit on Sustainable Development
• The Convention on the Prevention of Marine Pollution by Dumping of Wastes & Other Matter
• Barbados Action Plan
• Global Programme of Action for the Protection of the Marine Environment from Land Based Activities
• FAO Code of Conduct for responsible Fishery practices
• Agreement for the Implementation of the provision of the UNCLOS relating to the conservation of straddling fish stocks and highly migratory fish stocks
• Regional conventions like Oslo and Paris Conventions and OSPAR and the Convention on the protection of the marine Environment of the Baltic Sea area
• UNEP agreements for examples Convention on International Trade in Endangered Species of wild flora and fauna (CITES), Convention for the Conservation of Migratory Species

Aside from GOOS and GTOS, the IGOS Partnership includes numerous other organizations that will contribute to this community of practice. For example, the Committee on Earth Observation Satellites (CEOS) is composed of national space agencies that are dedicated to Earth observations, as well as the management and dissemination of the data, derived products and information obtained from those observations. As an example, NOAA (the National Oceanic & Atmospheric Administration) is a CEOS member and an agency within the United States that has responsibilities related to all aspects of the Coastal Zone Community's typology. GCOS, GOS/GAW, WCRP and WMO are international programs that involve climate and weather observations and all that is associated with them and their products. Finally, several programs within the United Nations (i.e, IGBP, UNESCO, UNEP, FAO,) have multiple responsibilities within the typology. ICSU, a non-governmental organization is made up of national scientific bodies and international scientific unions.

Many of the above IGOS Partners had representatives directly participating in the development of the Coastal Theme. These included representatives of GOOS, GTOS, UNEP, and CEOS (e.g., NASA, ESA, NOAA, JAXA, CSA, DLR, ISRO), et al. Furthermore, two IGBP programs IMBER and LOICZ were likewise represented, the latter also jointly sponsored by IHDP. Thus, numerous and diverse members of the coastal data provider and user communities were active and directly involved in the development of the Coastal Theme.

In summary, because of the diverse nature of issues within the coastal zone, the Coastal Zone CP has considerable diversity in its user groups, and therefore its potential/likely membership (Tables 2 & 3). Some members may have a stake in all four priority issues (Table 1), whereas some may be interested in only one or two. Thus, membership needs to be flexible and responsive to the eclectic nature of the program. Sections V, VI, and VII describe the activities of the CP and include ways that membership and capacity building will be developed.

V. Working Methods

Requirements for quality data and information in support of decision making in each of the user groups described above fall into two broad categories:

- time-space scales of observations and modelling (resolution and extent for each variable), and,
- time-space scales of applications.

For the most part, required scales of observation and modelling will encompass a hierarchy of scales from the local scale of interest to the next larger scale that must be observed to understand local scales of variability and mitigate their impacts. In contrast, application scales tend to be more local or regional in scope. Important exceptions are ecosystem assessments that often need data on local to global scales, e.g., the recently completed Millennium Assessment. Other exceptions are local sea level rise and sea level hazard assessments: local sea level is the result of a number of processes acting on local, regional and global scales as well as a wide range of temporal scales, and scenarios of future sea level trajectories for any coastal location depend on data from local to global scales. This dichotomy creates challenges to linking the data and information needs of user groups to IOOS development in that the phenomena of interest, the mix of user groups from each of these five categories, and the priorities of these user groups vary from place to place.

Since a "user-driven" system begins with users and their requirements for data and information, the Coastal Zone CP will (among other methods) employ a regional approach to engage users and potential users that take advantage of GOOS Regional Alliances (GRAs) that are being established to design and implement the coastal module of GOOS. The latter consists of a Global Coastal Network (GCN) with Regional Coastal Ocean Observing Systems (RCOOSs) nested in it (a system of systems). The GCN measures and manages a small suite of common variables required by most regions, establishes sentinel stations for early detection of basin scale events (ENSO, PDO, NAO, etc.) and changes in land-based inputs, and implements common standards and protocols required for interoperability. Regional observing systems enhance the GCN based on the priorities of user groups within each region. GRAs have been established to represent user groups within each participating nation in the development of a global system and to engage them in the establishment of regional observing systems that are customized to satisfy their needs in each region. In this model, each GRA provides a forum for international collaboration within each region while a global coalition of GRAs oversees implementation of a GCN that meets their collective needs. Greater regionalization of Coastal GTOS is planned in cooperation with these GRAs.

The Coastal Zone CP will work with each GRA to help identify user groups in their region and to engage them in the process of developing and marketing products and services needed to more effectively manage and mitigate impacts of human development and natural hazards on coastal ecosystems and the susceptibility of coastal human populations to natural disasters. In addition, web-based materials, including survey questionnaires that the user communities can respond to, will also be developed in order to ensure a broad coastal community user base from which to define needs and requirements.

The Coastal Zone CP will be responsive to all procedures and protocols (to be) instituted by the GEO Ad-hoc User Interface Working Group, particularly with regards to reporting and other means of user/member communication. In addition, we will post all relevant documents, reports, and proceeding notices in a well advertised, publicly accessible Coastal Zone CP website, linked with those of GEO and related bodies as appropriate.

As recommended in the IGOS Coastal Theme and endorsed by GOOS and GTOS, a joint GTOS-GOOS Coastal Panel will provide user, scientific and technical guidance for implementing the IGOS Coastal Theme. This panel will be leveraged and expanded for purposes of the Coastal Zone CP. It will commence implementation and organization of the CP with two principal activities (discussed further in section VII). First, a workshop on "Coastal Urbanization, Development, and Hazards: Impacts on Humans and Ecosystem Health and Productivity"" will take place in coordination with CEOS, GOOS, GTOS and IGBP and other interested and appropriate coastal user representatives. This effort will help to identify, address and specifically target the priority coastal user issues identified above. Second, development of regional capacity will begin through a planned conference in South Africa and which will bring together the leadership of each GOOS Regional Alliances and representatives from Large Marine Ecosystem Programmes.

VI. Plan of Activities to Contribute to the GEOSS Implementation

The envisioned implementation of the Coastal Zone CP consists of two parallel phases, the first consisting of a coordination mode whereby there would be facilitation, linkage and coordination of GEOSS target-driven research and development activities towards delivering crucial observation and integration capabilities, with a subsequent transitioning of these capabilities to end users. This effort would be coupled with a parallel capacity building mode to facilitate development of GEOSS-target driven tools and capacity to ensure the timely and effective delivery of the coastal information to users.

Coordination Mode: 2006-2008

Activity 1: Facilitate collection, development and integration of space-based observations, *in situ* measurements and models towards improved coastal environmental assessments, monitoring, and prediction in support of delivery of key GEOSS targets. Among a broad suite of related activities, a focal point would be to promote development of land-sea data assimilation schemes, potentially building to an integrated Coastal Data Assimilation System (CODAS) with operational nowcasting & forecasting (short & long term) capabilities to support users;

Activity 2: Stimulate and coordinate development and implementation of prototype efforts and pilot projects that focus on addressing and mitigating the impacts of coastal development, urbanization and hazards on human and ecosystem health, particularly water quality.

These efforts specifically track with GEO targets #46, 66, 2, 19, 41, 61, 108, 111, 116, 119, 122, 161, 163, 164, 165, 192, 193, 199, 203, 220, 222, 226 & 238 and others.

The envisioned CODAS will bring together the land and sea domains across the coastal interface. An initial demonstration could be the impact of coastal urbanization (e.g., changes in land cover/land use and impacts on runoff/loadings) in the context of climate variability (e.g., ENSO events). Ultimately CODAS would function operationally to provide data and information products (short-term forecasts of coastal states for immediate use in fisheries, hazard management, coastal infrastructure planning, navigation, etc.) in real time to support crucial management decisions for a multi-use domain.

Capacity Building Mode: 2006 and beyond

Activity 3: Facilitate and coordinate development of standardized user interface (e.g, GIS) and decision support tools for coastal management, particularly the development of an Integrated Coastal Decision Support System (ICoDSS).

Activity 4: Facilitate capacity building in developing nations, particularly through partnership pairings with developed nations, towards addressing priority user needs.

These efforts specifically track with GEO targets #5, 10, 15, 17, 19, 24, 51, 56, 62, 76, 85, 86, 97, 101, 102, 103, 105, 117, 157, 181, 183, 194, 204, 216, 222, 223 & 238 et al.

The envisioned ICoDSS would provide coastal users with high resolution, cross-boundary, and easily accessible retrospective and appropriately timed (~near-real-time) data and information, as well as robust short-term and long-term predictions, to support improved coastal understanding and management. The envisioned ICoDSS would be web-based and bring together multi-sensor satellite and *in situ* data streams and coupled models across the coastal interface (e.g., CODAS) with easy to manipulate information query and download capabilities and user-defined scenarios, and support local-scale decision processes as well as large-scale assessments.

VII. Schedule of Proposed Activities for 2006

A number of activities are proposed to foster the development and implementation of the Coastal Zone CP in 2006:

(1) As recommended in the IGOS Coastal Theme and endorsed by GOOS and GTOS, establish a joint GTOS-GOOS Coastal Panel, with other community representatives, to provide user, scientific, and technical guidance for implementing the Coastal Zone CP.

(2) In collaboration with CEOS, GOOS, GTOS and IGBP, the Coastal Zone CP will conduct a workshop on "Coastal Urbanization, Development, and Hazards: Impacts on Humans and Ecosystem Health and Productivity". The workshop (~ 2nd or 3rd quarter 2006) will bring together invited experts and representatives from GRAs worldwide to assess global patterns of human and ecosystem susceptibility to natural

hazards, waterborne pathogens and sea level change. This workshop will provide an end-to-end forum for data providers and data users to interact on coastal urbanization/hazard issues and ensure information needs are met. There will be plenary sessions to provide integration and promote synergies as well several special sessions, including one on the use of space-based observations in support of coastal water quality assessments, including relationships between land-cover/use patterns and coastal water quality. Another special session will focus on information needs and tools in support of coastal decision-making. An additional special session would focus on coastal resource (e.g., wetlands) valuation, including what role satellite observations might play. The resulting findings and assessments will be used during a second workshop that will be held in conjunction with a conference of GRAs in South Africa later in the year.

(3) The aforementioned conference in South Africa will bring together the leadership of each GRA and representatives from Large Marine Ecosystem Programmes to facilitate the development of RCOOSs and to establish a body to oversee development of the GCN. This will be an opportune time for the GTOS-GOOS Coastal Panel to work with the GRAs in the formulation of proposed GEOSS pilot projects that engage the users groups (coastal area management community, resource managers, environmental protection ministries, and land-use planners), GRAs and LMEs.

(4) Other Coastal Zone CP user forums and activity spin-ups will take place on an ad hoc basis leveraging other international, regional, and local meetings and events. As indicated earlier these will be complemented by web-based activities to ensure broad representation and participation in the building of this Coastal Zone CP.

Representative user needs that would be addressed by the above workshops and subsequent pilot activities include:

- Short-term decisions/planning: beach closures, sewage contamination maps, harmful algal bloom alerts, early warnings of hazards;

Primary GEO SBAs and targets include: Health (15, 19, 24, 121, 122, 123, 127); Water (46, 153, 220); Ecosystems (66, 67, 161, 163, 225, 226); Disasters (1,3, 5, 8).

- Long-term decisions/planning: risk-based maps and planning (e.g., for sea level change); sustainable urban planning and zoning; coastal resource valuation.

Primary GEO SBAs and targets include: Climate (31, 37, 139, 145); Disaster (5, 8,108); water (41, 43, 156); health (14, 21, 31); energy (26); ecosystems (165).

Following these workshops, the Coastal Zone CP would help coordinate and facilitate community development of priority prototype efforts and pilot projects for both developed and developing urban coastal regions.

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Figure 1: A Representative GEOSS Users Community of Practice