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# Land–Ocean Interactions in the Coastal Zone: Past, present & future☆

R. Ramesh[a,*], Z. Chen[b], V. Cummins[c], J. Day[d], C. D'Elia[d], B. Dennison[e], D.L. Forbes[f], B. Glaeser[g], M. Glaser[h], B. Glavovic[i], H. Kremer[j], M. Lange[c], J.N. Larsen[k], M.Le Tissier[c], A. Newton[l], M. Pelling[m], R. Purvaja[a], E. Wolanski[n]

[a] National Centre for Sustainable Coastal Management, Ministry of Environment, Forest and Climate Change, Anna University Campus, Chennai 600 025, India
[b] East China Normal University, State Key Laboratory for Estuarine and Coastal Research, People's Republic of China
[c] MaREI Centre, University College Cork, Beaufort Building, Ringaskiddy, Cork, Ireland
[d] Department of Oceanography and Coastal Sciences, Louisiana State University, Louisiana, United States
[e] University of Maryland Center for Environmental Science, 2020 Horns Point Rd., Cambridge, MD 21613, USA
[f] Geological Survey of Canada, Natural Resources Canada, Bedford Institute of Oceanography, Dartmouth, Nova Scotia B2Y 4A2, Canada
[g] Deutsche Gesellschaft für Humanökologie, Clayallee 271, 14169 Berlin, Germany
[h] Leibniz-Zentrum für Marine Tropenökologie (ZMT) GmbH, Fahrenheitstr. 6, 28359 Bremen, Germany
[i] School of People, Environment and Planning, Massey University, Palmerston North 4442, New Zealand
[j] Scientific Assessment Branch, Division of Early Warning and Assessment, Nairobi, Kenya
[k] University of Akureyri, Stefansson Arctic Institute, Iceland
[l] NILU, IMPEC-Department of Environmental Impacts and Economics, 2027 Kjeller, Norway
[m] King's College London, Department of Geography, UK, United Kingdom
[n] TropWATER and College of Marine and Environmental Science, James Cook University, Townsville Q. 4811, Australia

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ABSTRACT

The Land–ocean Interactions in the Coastal Zone (LOICZ) project was established in 1993 as a core project of the International Geosphere–Biosphere Programme (IGBP) to provide the science knowledge to answer "How will changes in land use, sea level and climate alter coastal systems, and what are the wider consequences?" In its first phase of operation (1993–2003) LOICZ began a fundamental investigation focused on biophysical dimensions, including seminal assessments of coastal seas as net sources or sinks of atmospheric $CO_2$, river discharge to the oceans, and biogeochemical modelling. In the second generation of LOICZ (2004–2014), increased attention was paid to the human dimensions of the coast, involving the inclusion of cross-cutting themes such as coastal governance, social-ecological systems, ecological economics and activities around capacity building and the promotion of early career scientists. This paper provides a synthesis of this work and looks forward to the future challenges for the project. With the transition to Future Earth, there is a paradigm shift emerging. The new vision is to support transformation to a sustainable and resilient future for society and nature on the coast, by facilitating innovative, integrated and solutions-oriented science. Realising this vision takes LOICZ into a third generation: to be at the forefront of co-designing, co-producing and co-implementing knowledge for coastal resilience and sustainability. LOICZ as Future Earth Coasts will continue to address 'hotspots' of coastal vulnerability, focusing on themes of dynamic coasts, human development and the coast, and pathways to global coastal sustainability and constraints thereof.



## 1. Introduction

The coasts of the world form a narrow interface zone between marine and terrestrial areas in which large and growing proportions of the human population and global economic activity are located. The low-elevation coastal zone (LECZ) encompassing 2% of the earth's land area (McGranahan et al., 2007) is home to 600 million people (10% of the total population), of whom 360 million are urban (13% of the world's total urban population)

☆ Except the first author, names of all authors are arranged in alphabetic order and their contribution is equal. All authors are present or past members of the LOICZ Scientific Steering Committee and/or Regional Nodes and the IPO.

* Corresponding author. Fax: +91 4422200158.
*E-mail addresses:* rramesh_au@yahoo.com, purvaja.ramachandran@gmail.com (R. Ramesh).

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as of year 2000 (CIESIN, 2009). The coastal zone sustains sensitive ecosystems providing critical habitat for many endangered species, and highly important ecosystem services in the form of coastal protection, fisheries and other living resources, rich agricultural lands, areas of high aesthetic value, and is typically held as public heritage and connects land and sea. Eight of the top ten largest cities in the world and much of the world's tourism, which are increasingly important in national economies, are situated at the coast.

Coastal regions and populations are exposed to pressures and hazards from both land and sea making the coastal zone "Arguably the most transformed and imperilled social-ecological system on earth, [which] are characterized by pervasive unsustainable practices" (Cummins et al., 2014). To address these issues, the international research consortium LOICZ (Land–Ocean Interactions in the Coastal Zone) was initiated as a core project of IGBP (the International Geosphere–Biosphere Programme) in 1993 to answer the core question "How will changes in land use, sea level and climate alter coastal systems, and what are the wider consequences?" (Crossland et al., 2005). A fundamental approach that LOICZ has taken to address this question is recognition that that the coastal zone is not a geographic boundary of interaction between the land and the sea but a global compartment of special significance for biogeochemical cycling and processes and ever increasingly for human habitation and economies. The primary objective of LOICZ was "to provide the knowledge, understanding, global vision, and predictive capacity to enable coastal communities to assess, anticipate and respond to the interaction of global change and local pressures which determine coastal change" (Kremer et al., 2005). At its core, LOICZ is a network and community of scientists from all disciplines and across 80 countries from all regions of the world who contribute their work and expertise to collectively address an overarching goal to 'to develop the capacity to assess, model and predict (i) change in the global coastal zone under multiple forcings (including human activity), and (ii) the consequences for human welfare' (Kremer et al., 2005). Through its activities LOICZ has served as a catalyst for methodological development, strategic research coordination, science communication, capacity building, and applications to enhance coastal sustainability at a global scale.

LOICZ has been managed through an International Project Office (IPO) supporting the strategic direction provided by a Scientific Steering Committee. The IPO was first located at the Netherlands Institute for Sea Research in Texel and financially supported by the Dutch Government. In 2006, it moved to the Institute for Coastal Research at the GKSS Research Centre (later Helmholtz Zentrum Geesthacht Centre for Materials and Coastal Research (HZG)) in Geesthacht, Germany, which supported the IPO until 2014. As of January 2015, the IPO is hosted at the MaREI Centre of University College Cork (UCC), in Ireland. The global reach of LOICZ was enhanced by a network of regional node engagement partners in East Asia, Southeast Asia, South Asia, South America and North America, with emerging regional centres in Taiwan, the Caribbean, West Africa, and the Arctic.

The history of LOICZ can be clearly demarcated into three phases, 1993–2003, 2004–2014, and from 2015 to a new third phase having transitioned to Future Earth Coasts as part of the new Future Earth programme (Fig. 1). Fig. 1 shows the research foci in each phase along with the major outputs. A Web of Science search using LOICZ as the search term results in a total of 1189 publications with average citations per year of 66. In addition to peer reviewed journals outputs of LOICZ have been published in the LOICZ

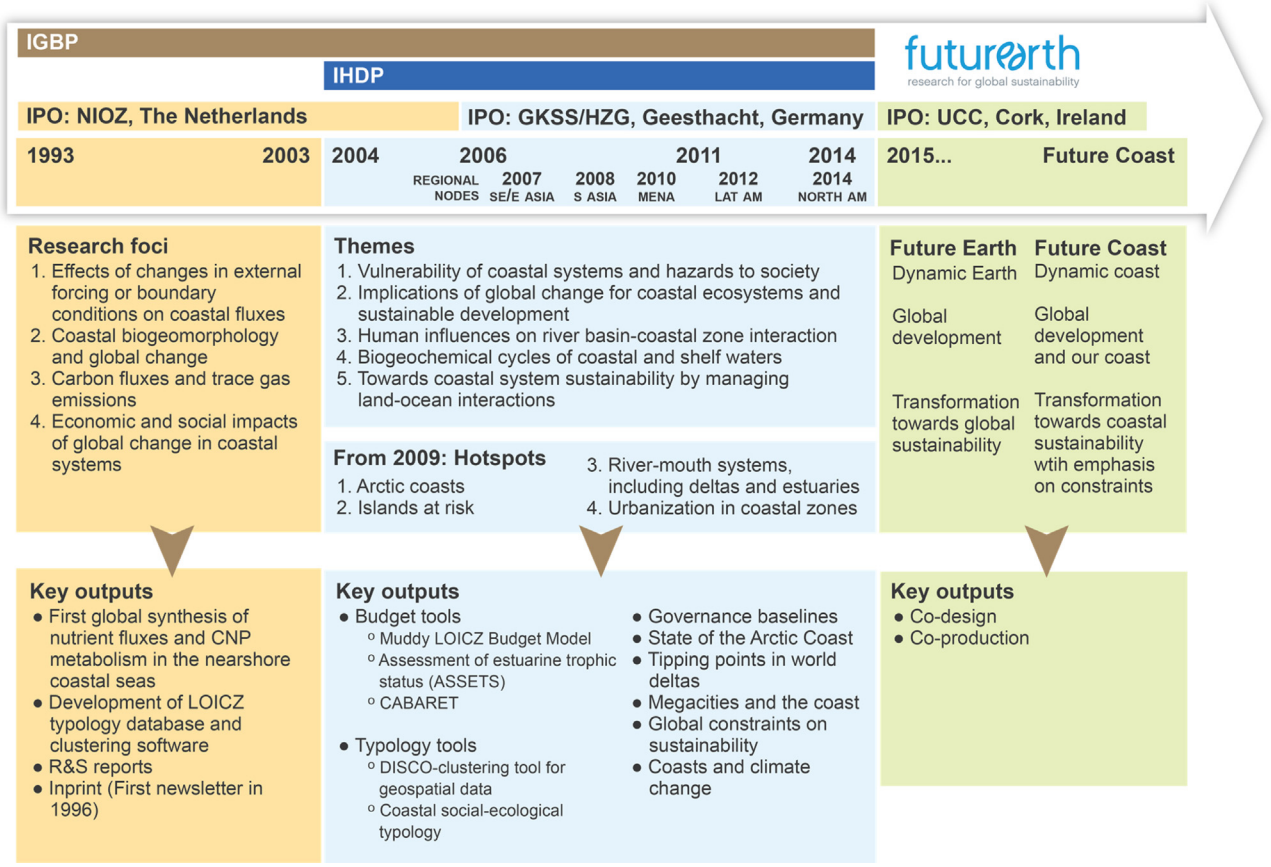


**Fig. 1.** Timeline of activities and achievements of LOICZ (1993–2015).

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