www.JCRonline.org *Just CERFing*, Vol. 7(5), May 2016 www.cerf-jcr.org

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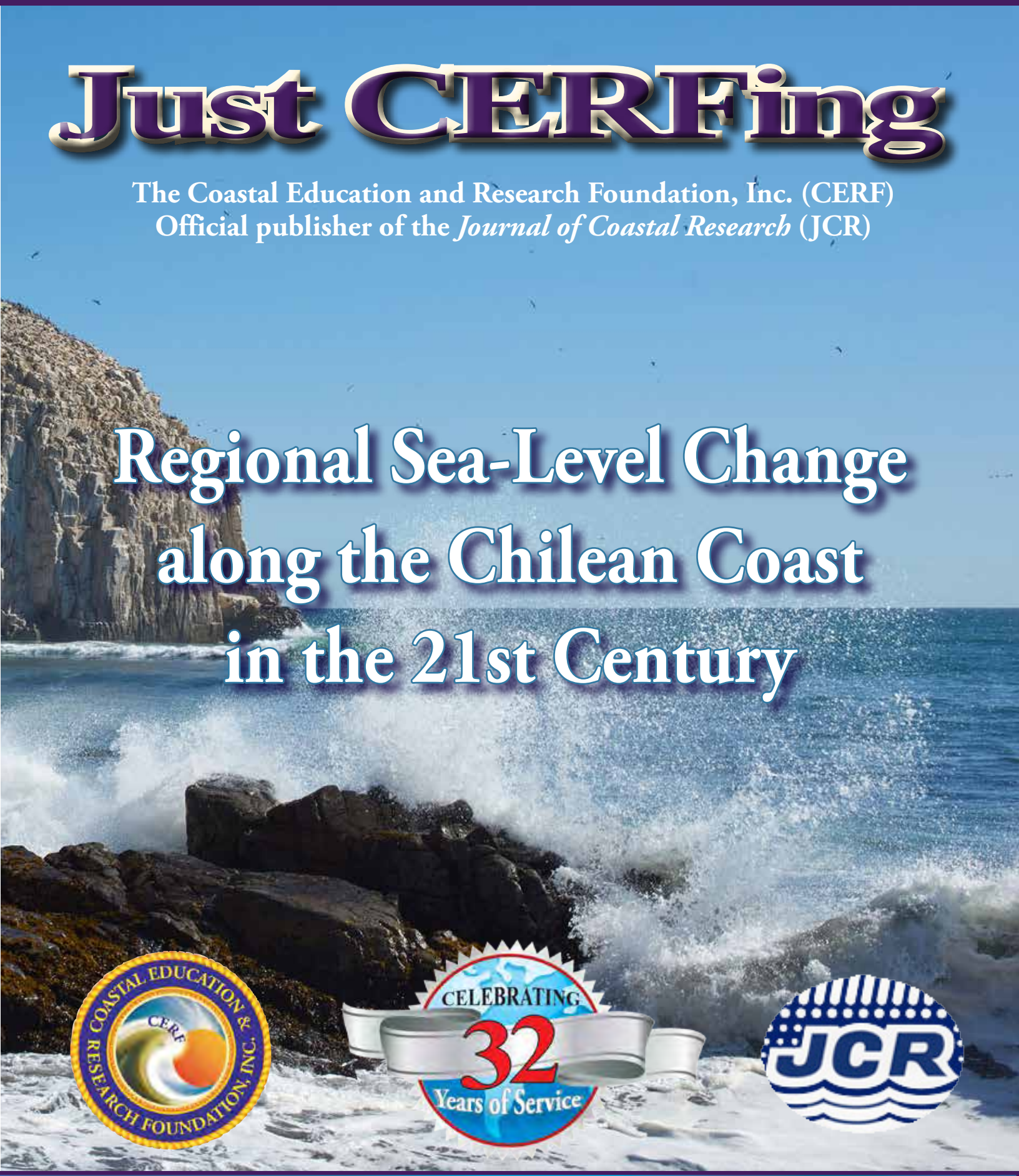

Regional Sea-Level Change along the Chilean Coast in the 21st Century

Dr. Charles W. Finkl
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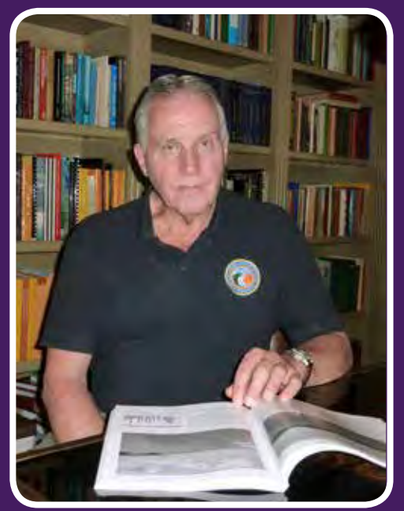

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Coastal Education and Research Foundation *[CERF]* is pleased to announce our newly appointed Regional Vice Presidents (RVP), who throughout the international scientific community continue to provide outstanding representation of our coastal research society. Please join us in honoring the following individuals for their tremendous service and support of CERF and the JCR.

CERF Regional Vice Presidents

Southeast Asia
Nobuo Mimura, D.Eng.

North America
James R. Houston, Ph.D.
Victor V. Klemas, Ph.D.
Orrin H. Pilkey, Jr., Ph.D.

South America
Omar Defeo, D.Sc.

Western Europe
Carlos Pereira da Silva, Ph.D.
Michael Phillips, Ph.D.
Marcel J.F. Stive, Ph.D.

Eastern Europe
Kazimierz K. Furmańczyk, D.Sc.

Oceania
Charles Lemckert, Ph.D.
Vic Semeniuk, Ph.D.
Andrew D. Short, Ph.D.

CERF RVP (Southeast Asia)

Nobuo Mimura, D.Eng.

Nobuo Mimura, D.Eng., is currently serving as the President of Ibaraki University. His academic areas of expertise are global environmental engineering, coastal engineering, and adaptation policy to climate change. Dr. Mimura has also been a member of the advisory committees for Ministry of Foreign Affairs, Ministry of Infrastructure, Land and Transportation, Ministry of the Environment and Ministry of Education, Culture, Sports, and Science and Technology.

CERF RVP (North America)

James R. Houston, Ph.D.

Jim Houston, Ph.D., is Director Emeritus of the U.S. Army Engineer Research and Development Center (ERDC), which includes all the research and development laboratories of the Corps of Engineers. He managed one of the most diverse research organizations in the world – seven laboratories at four geographical sites, with over 2,000 employees and an annual program budget of $1.3 billion. Dr. Houston has published over 130 technical reports and papers and has received several honors and awards including three Presidential Rank Awards and the National Beach Advocacy Award.

Vic Klemas, Ph.D.

Vic Klemas, Ph.D., is Professor Emeritus in the University of Delaware's College of Earth, Ocean, and Environment. He directed UD's Applied Ocean Science Program from 1981-98, and he has co-directed UD's Center for Remote Sensing for more than 30 years. Dr. Klemas has served on six scientific committees of the National Research Council and received a number of awards, including, in November 2010, the Science Prize of the Republic of Lithuania. The honor recognized his lifetime achievements in applying remote sensing and other advanced techniques to study coastal ecosystems.

Orrin H. Pilkey, Jr., Ph.D.

Orrin H. Pilkey, Ph.D., is a James B. Duke Professor Emeritus of Geology within the Division of Earth and Ocean Sciences and Director Emeritus of the Program for the Study of Developed Shorelines (PSDS) in the Nicholas School of the Environment and Earth Sciences at Duke University. Since 1965, Dr. Pilkey has been at Duke University with one-year breaks with the Department of Marine Science at the University of Puerto Rico, Mayaquez, and with the U.S. Geological Survey in Woods Hole, Massachusetts. His research career started with the study of shoreline/continental shelf sedimentation, progressed to the deep sea with emphasis on abyssal plain sediments, and back to the nearshore with emphasis on coastal management. Dr. Pilkey has published more than 250 technical publications and has authored, coauthored, or edited 39 books.

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CERF RVP (South America)

Omar Defeo, D.Sc.

Omar Defeo, D.Sc., is a professor in the Marine Science Unit at the Universidad de la República in Uruguay. He is also among a select group of ecologists worldwide working on sandy beach ecosystems and how they are threatened by climate change. For the past 15 years, Prof. Defeo has also been involved in artisanal shellfisheries, ecology, and conservation of coastal marine invertebrate biodiversity research in Latin America, primarily in Mexico and Chile.

CERF RVP (Western Europe)

Carlos Pereira da Silva, Ph.D.

Carlos Pereira da Silva, Ph.D., is the Director of e-GEO within the Research Centre for Geography and Regional Planning at the Universidade Nova de Lisboa, Portugal. Dr. Pereira da Silva's research interests are mainly focused on coastal zone management, with specific emphasis in beach management, public participation studies, and carrying capacity. A long time supporter of CERF and the JCR, in April 2009, he served as the local Chair and Co-organizer of the 10th International Coastal Symposium (ICS) that took place in Lisbon, Portugal.

Michael Phillips, Ph.D.

Professor Mike R. Phillips (BSc, PGCE, MSc, PhD, MIEnvSc, FRGS) serves as Pro Vice-Chancellor of Research, Innovation, Enterprise, and Commercialization at the University of Wales Trinity Saint David (Swansea Metropolian). Professor Phillips research expertise includes coastal processes, morphological change and adaptation to climate change and sea-level rise. Consultancy includes beach replenishment issues and developing techniques to monitor underwater sediment movement to inform beach management. He is widely published and recently organized a session on Coastal Tourism and Climate Change at UNESCO Headquarters in Paris as part of his role as a member of the Climate Change Working Group of the UNEP Global Forum on Oceans, Coasts, and Islands.

Marcel J.F. Stive, Ph.D.

Until 2010, Marcel Stive, Ph.D., was Scientific Director of the Water Research Centre Delft, which is now embedded in the Delft Research Initiative Environment. He currently holds the positions of: Chair of Coastal Engineering in the Section of Hydraulic Engineering and Department Head of Hydraulic Engineering at Delft University of Technology. Dr. Stive was recently appointed Knight in the Order of the Dutch Lion in theatre the Rijswijkse Schouwburg in Rijswijk. He was presented with this award for his outstanding record as a top researcher, much consulted expert, distinguished engineer, and inspiring teacher.

CERF RVP (Eastern Europe)

Kazimierz K. Furmańczyk, D.Sc.

Kaz Furmańczyk, D.Sc., is currently Full Professor at the University of Szczecin and the Head of the Remote Sensing and Marine Cartography Unit at the Institute of Marine and Coastal Sciences. Author and co-author of over 100 scientific publications including books (2) and chapters, journal articles, abstracts, and conference papers. Contributions are mainly in the disciplines of remote sensing, coastal sciences, hydrology, and oceanography. In May 2011, he served as the local Chair and Co-organizer of the 11th International Coastal Symposium (ICS) that took place in Szczecin, Poland.

CERF RVP (Oceania)

Charles Lemckert, Ph.D.

Charles Lemckert, Ph.D., is the Head of Discipline of Civil Engineering at Griffith University's School of Engineering. He has active research interests in the fields of physical limnology, coastal systems, environmental monitoring techniques, environmental fluid dynamics, coastal zone management, and engineering education. Along with his postgraduate students and research partners, Dr. Lemckert is undertaking research studies on water treatment pond design (for recycling purposes), the dynamics of drinking water reservoirs, the study of whale migration in southeast Queensland waters, and ocean mixing dynamics. In 2007, he served as the local Chair and Co-organizer of the 9th International Coastal Symposium (ICS) along the Gold Coast of Australia.

Vic Semeniuk, Ph.D.

Vic Semeniuk, Ph.D., is a natural history research scientist, specialising in coastal, estuarine and wetland environments, and mangrove and tidal flat environments. He has 45 years experience in scientific research in Australia, Europe, Canada, the USA, Ireland, the United Kingdom, and South Africa. Dr. Semeniuk is currently the Director of the Research & Development Firm, the V & C Semeniuk Research Group, and has over 130 publications in refereed scientific journals. He also has a proactive interest in conservation and coastal management, and has published multiple scientific works directly and indirectly leading to this objective.

Andrew D. Short, Ph.D.

Andy Short, Ph.D., served as the Director of the Coastal Studies Unit at The University of Sydney and has been the National Coordinator of the Australian Beach Safety and Management Program in cooperation with Surf Life Saving Australia. Dr. Short is mainly interested in the processes and morphology of coastal systems. His present research focuses on the beach and barrier systems of Australia, as it relates to the morphodynamics of representative systems in variable wave and tide environments, and in the nature, hazards, and usage of all Australia beach systems.

Regional Sea-Level Change along the Chilean Coast in the 21st Century

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ABSTRACT

Regional sea-level change for Chile is considered until the end of the 21st century for the representative concentration pathway (RCP)4.5 and RCP8.5 scenarios. The main components that contribute to sea-level change are analyzed and summed to achieve a total estimate of sea-level change along the coast of Chile and in the Southeast Pacific. Included are the steric/dynamic component, the contribution from land ice loss, and the sea-level change due to the glacial isostatic adjustment. Regional fingerprints and global means are combined to estimate sea-level change in this area. For the steric/dynamic component two different estimates are considered. The results are compared with those found in the Intergovernmental Panel on Climate Change Fifth Assessment Report. The total mean sea-level rise along the coast lies between 34 cm and 52 cm for the RCP4.5 scenario and between 46 cm and 74 cm for the RCP8.5 scenario, depending on the location and the steric/dynamic component estimate considered. This component is the main contribution in each scenario. All estimates show a modest, relatively constant decrease in sea-level rise along the coast from north to south.

ADDITIONAL INDEX WORDS: *Sea-level contributions, CMIP5, ice loss, GIA.*

INTRODUCTION

Many coastal areas in the world are densely populated and are therefore threatened by the consequences of a possible sea-level rise or a change in the occurrence of floods and storm surges. Approximately 10% of the world's population lives at an elevation of 10 m or less above sea level (Nicholls and Cazenave, 2010). Moreover, coastal areas are often important for tourism and agriculture. Reliable coastal protection is necessary for low-lying areas. The scientific community has become more and more aware of the importance of sea-level rise. The Intergovernmental Panel on Climate Change (IPCC) introduced an entire chapter on this topic in its fifth Assessment Report (AR5). Analysis of past global mean sea-level has shown a rise of about 20 cm during the last century (Bindoff *et al.*, 2007) and future projections lie between 40 and 63 cm for 2081–2100 relative to 1986–2005, depending on the underlying climate scenario (Church *et al.*, 2013).

Observed mean sea-level rise consists of different components. The two most important ones are thermal expansion and land ice loss (Church *et al.*, 2008, 2013). Thermal expansion refers to sea-level rise from ocean water expansion as ocean temperatures increase in response to global warming. Land ice loss adds water to the ocean, leading to sea-level rise. Rignot, Rivera, and Casassa (2003) demonstrated the growing ice loss and its influence to sea-level change for the Patagonian glaciers. However, sea-level change is not uniform over the globe, but varies regionally because of several effects (*e.g.*, Goennert *et al.*, 2009). Thermal expansion is the global mean of thermosteric effects, which are regionally different, and land ice loss changes the global mass distribution, leading to local gravity changes and a nonuniform water distribution (Church *et al.*, 2008; Mitrovica *et al.*, 2001). Changes in ocean salinity also

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lead to changes in the ocean water density, which also affect ocean height (Cazenave and Llovel, 2010). This is the so-called halosteric effect, an effect that may contribute significantly to sea-level change on a regional scale but little to the global mean (Church *et al.*, 2013). Another factor that contributes to sea-level change is the glacial isostatic adjustment (GIA). During the last ice age about 20,000 years ago, large areas of the earth were covered with ice. This ice depressed the earth's crust, changing the form of the ocean basins. When the ice melted, the earth's crust rebounded toward its former position. GIA describes this ongoing process, one that also depends on the region considered (Whitehouse, 2009). An overview about the different contributions to sea-level change is, *e.g.*, given in Milne *et al.* (2009) or Stammer *et al.* (2013).

The IPCC AR5 presents two different approaches to project future sea level. On the one hand, so-called process-based projections consider the sum of the projected components of sea-level change. They are based on climate models that use the physics of the earth system. On the other hand, the so-called semiempirical approach estimates sea-level change using the relationship between past tide-gauge data and, *e.g.*, temperature to derive a simple model. The components that contribute to sea-level change are not regarded separately, but sea level is regarded as an integrated response of the entire climate system (Church *et al.*, 2013). Baker and McGowan (2014) present a third approach. They use tide gauge and paleo sea-level data to detect past sea-level cycles. They argue that these cycles may modulate current sea-level projections. They use a Lotka–Volterra model to develop a climate model that describes a chaotic climate system containing cycles. This model is designed to consider anthropogenic warming and natural variability. Opinions diverge on whether such sea-level cycles exist or not (Baker and McGowan, 2014; Lewis *et al.*, 2013).

From the discussion above it is clear that global mean sea-level change has only limited applicability for specific regions. Regional mean sea-level analyses are therefore important and essential for reliable coastal management. In this study the different sea-level contributions for the Chilean coast and the Southeast Pacific are analyzed and summed to produce local estimates of total sea-level change from the end of the 20th century until the end of the 21st century. Church *et al.* (2013) also consider land water storage as another component for sea-level change. This factor is not included here as its contribution to future sea-level change is poorly studied and generally small compared with the other contributors (Church *et al.*, 2013; Slangen *et al.*, 2014). Chile is a special case because of its extraordinary shape and position, with a N-S coastal orientation that extends for about 4300 km between 17°S and 56°S, spanning different climate zones. Natural hazards like earthquakes or tsunamis increase sea level temporally and may lead to flooding. An increase in sea level means a rise in initial water levels, allowing flooding events to occur more easily. In general, land rises steeply along the Chilean coast, in contrast to many other parts of the world with flatter coastal regions. Thus Chile has natural protection against flooding in many places. However, several important cities lie at the coast and would be affected by sea-level rise. Until now, no detailed analysis of sea-level projections for the Chilean coast has been carried out and this study aims to fill this important gap. In the following section, the data and the methods used in this work are described. Next the results of the work are presented. In the first part of the results section, sea-level change from the different components listed above are analyzed and in the second part the sum over these components to produce projections of total sea-level change is considered.

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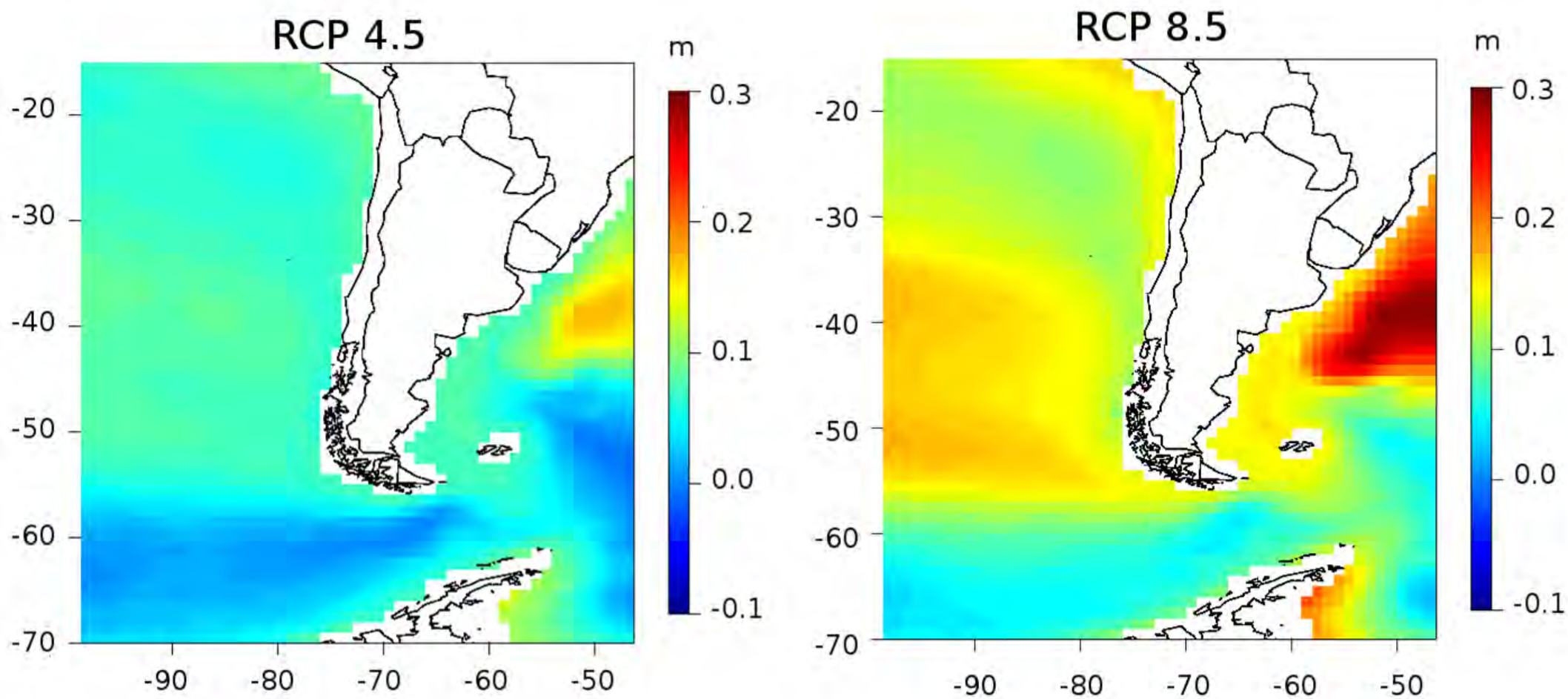

Figure 1. The sum of steric and dynamic sea-level changes shown by the CMIP5 models for the period 2081–2100 with respect to 1986–2005. The left plot shows the RCP 4.5 scenario and the right plot the RCP 8.5 scenario for the multimodel mean of 17 climate models.

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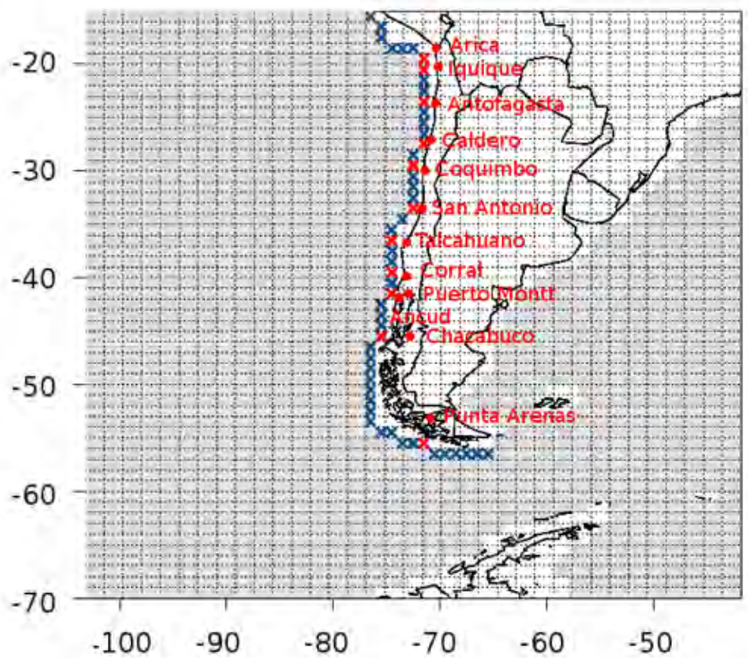

Figure 2. The grid points that are used along the coast are shown with crosses. Also shown are several cities along the coast with their nearest grid points marked in red.

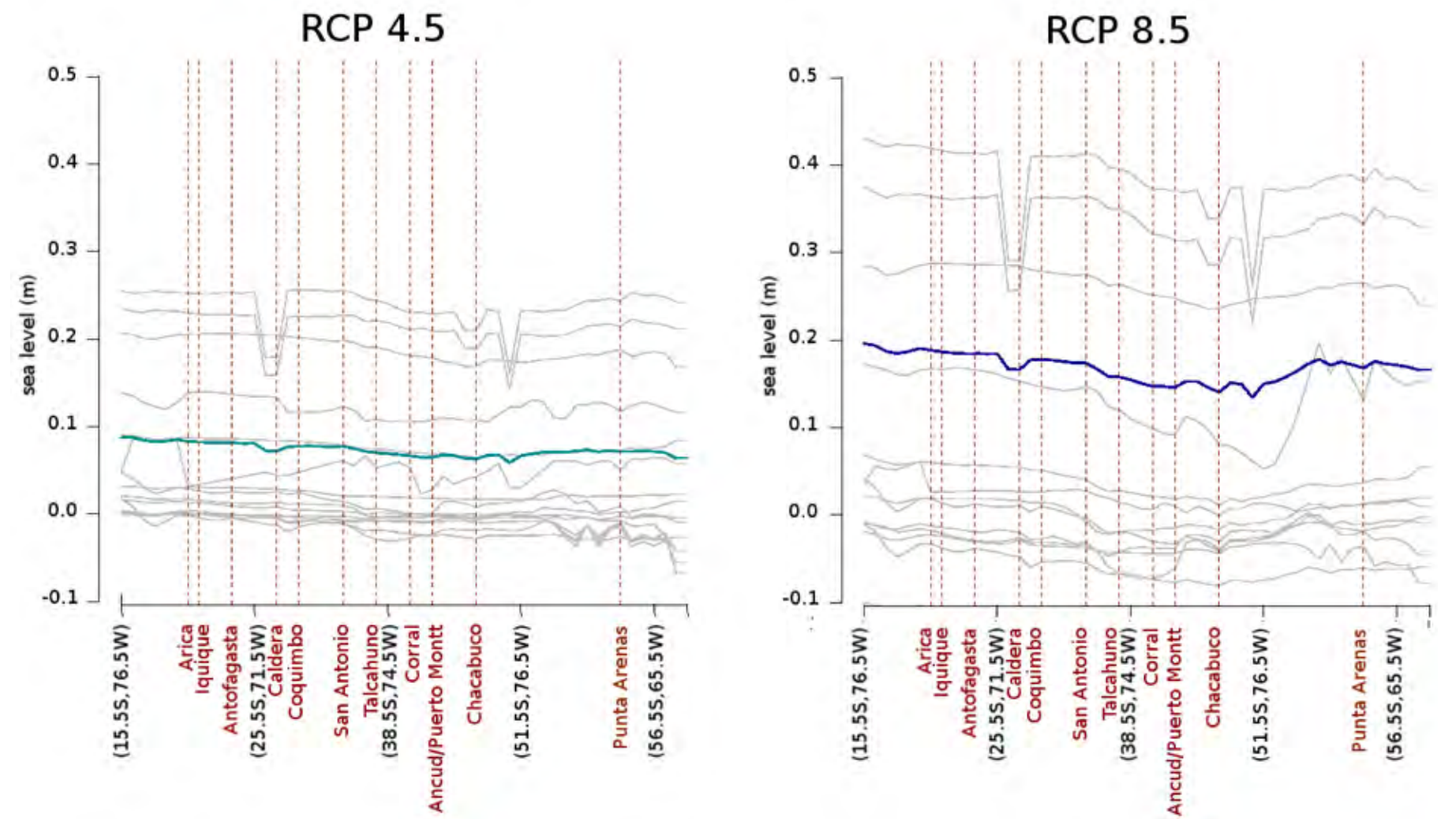

Figure 3. The sum of steric and dynamic sea-level changes along the coast of Chile for the time period 2081–2100 with respect to 1986–2005. Shown are results from 17 climate models for the RCP 4.5 (left) and RCP 8.5 (right) scenarios, shown as individual results (thin curves) and multimodel means (thick curves) The vertical lines mark the positions of some coastal cities.

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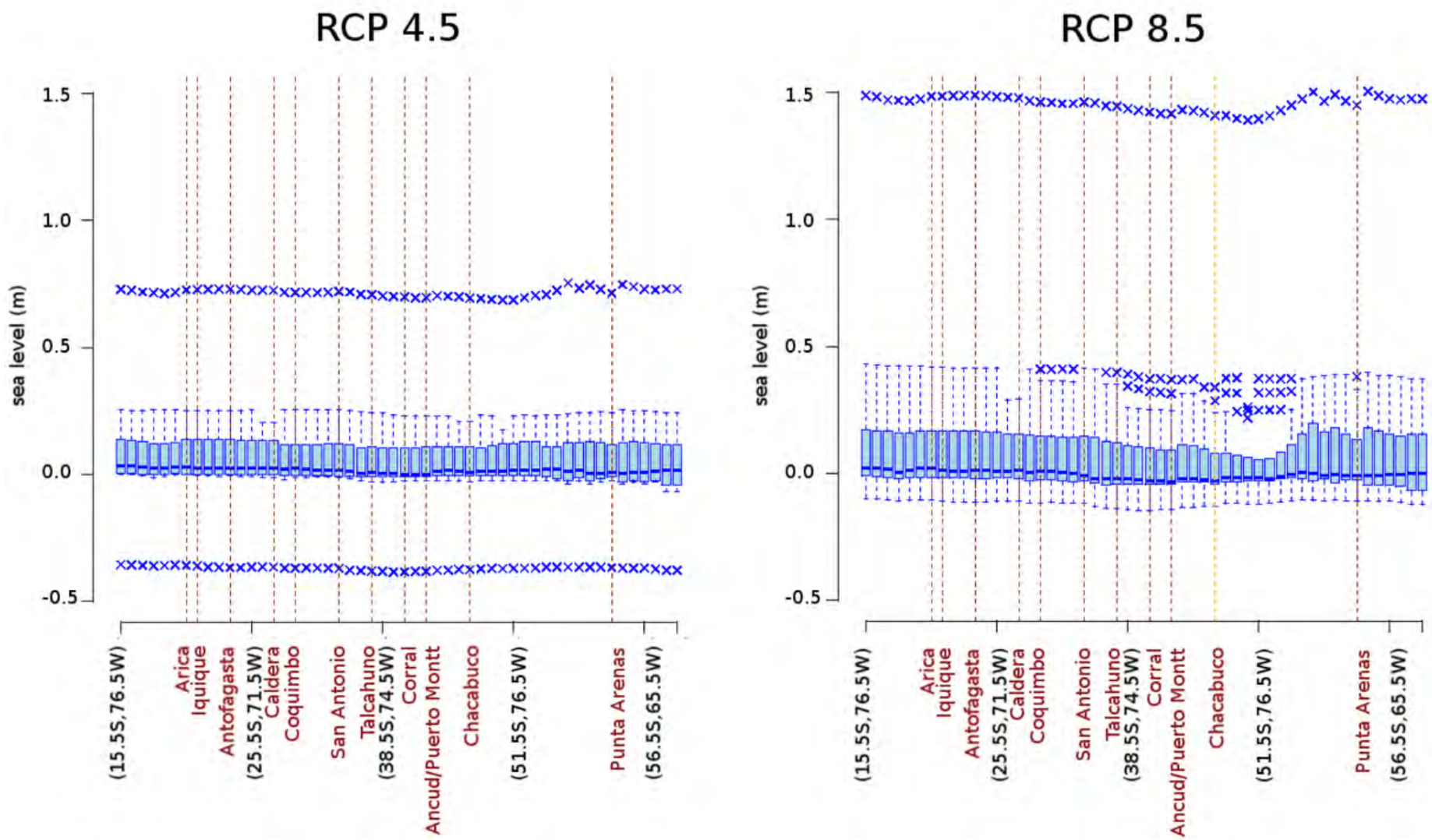

Figure 4. The sum of steric and dynamic sea-level changes along the coast of Chile for the time period 2081–2100 with respect to 1986–2005. The left-hand side shows results for the RCP 4.5 scenario and the right-hand side for the RCP 8.5. The data used are the same as in Figure 3 (17 climate models). The bold line shows the median of the distribution, the boxes show 25th/75th percentiles, and the dashed lines show the entire range of the distribution. Results that have lower/higher values than 1.5 times the 25th/75th percentile interval are regarded as outliers and are plotted as crosses. The vertical lines mark the positions of some coastal cities.

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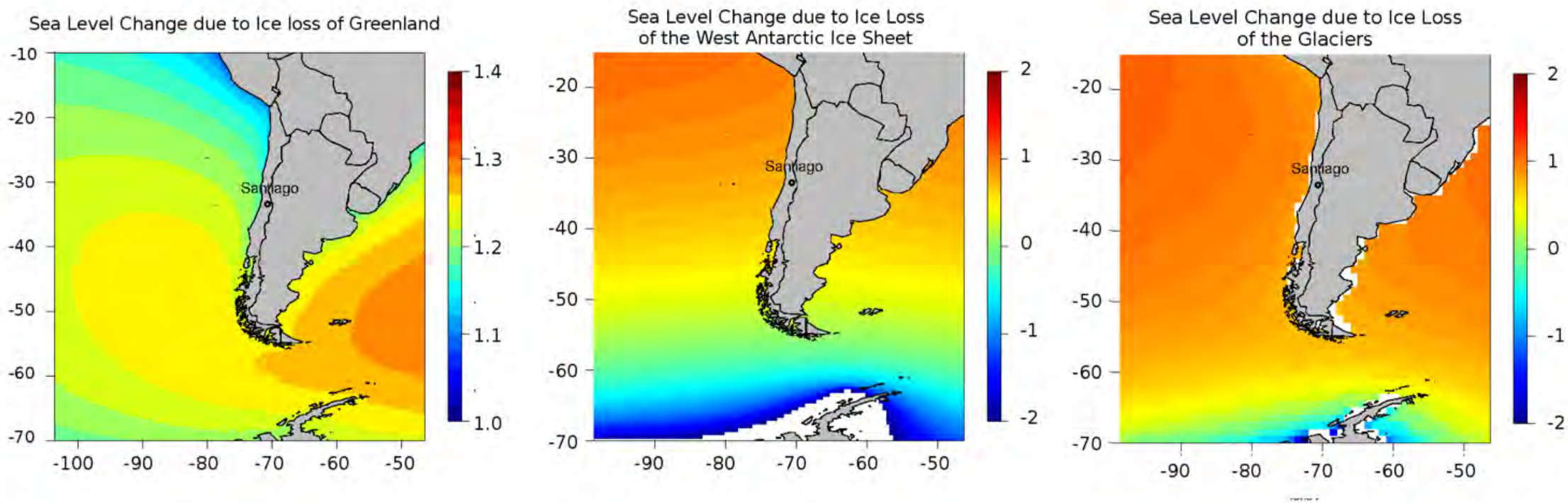

Figure 5. Ratio of local to global mean values of sea-level change due to ice loss from Greenland (left) and West Antarctica (center; data from Milne *et al.*, 2009) and due to ice loss from glaciers (right, data from Slangen *et al.*, 2014). Note that the color scales of the plots differ.

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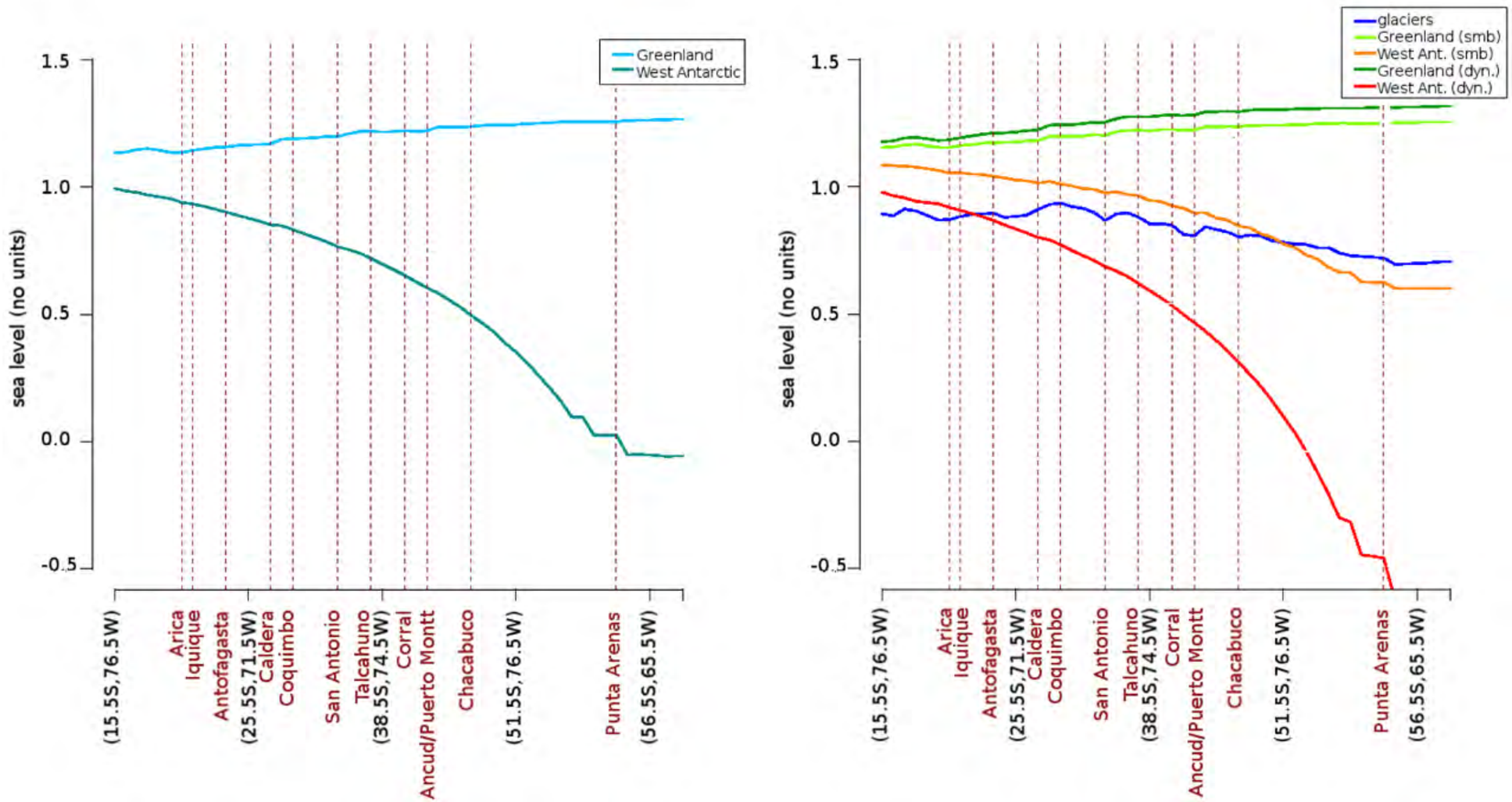

Figure 6. Left, the ratio of local to global mean sea-level change along the coast of Chile due to ice loss from Greenland and West Antarctica (data from Milne *et al.*, 2009). Right, the ratio of local to global mean sea-level change along the coast of Chile due to ice loss from Greenland, West Antarctica, and glaciers (data from Slangen *et al.*, 2014). The Greenland and the West Antarctic contributions are divided into surface mass balance (smb) and dynamic (dyn) parts. The vertical lines mark the positions of some coastal cities.

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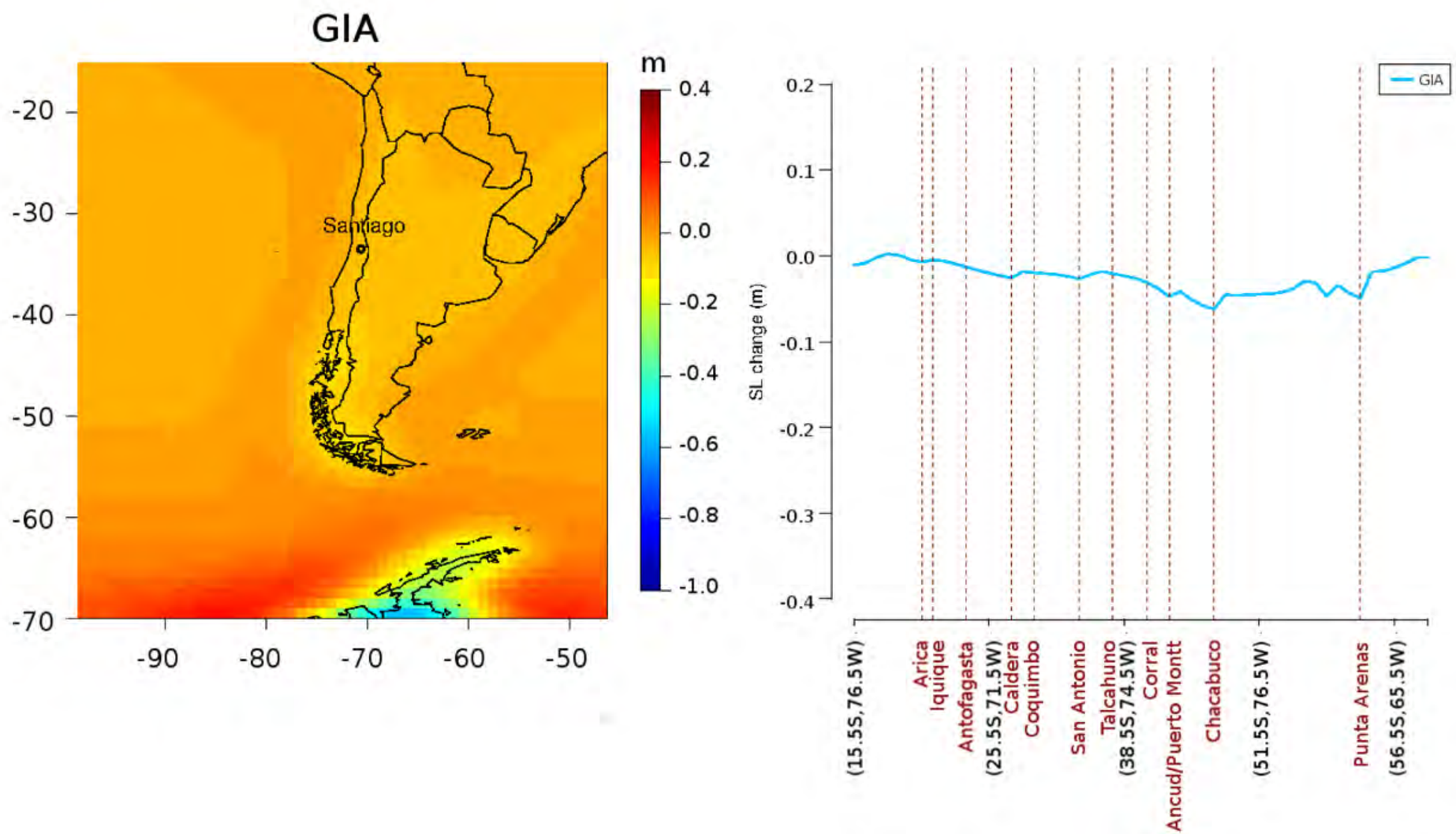

Figure 7. Sea-level change due to the GIA. The right-hand site shows sea-level change along the coast of Chile. The vertical lines in the plots refer to several cities along the coast.

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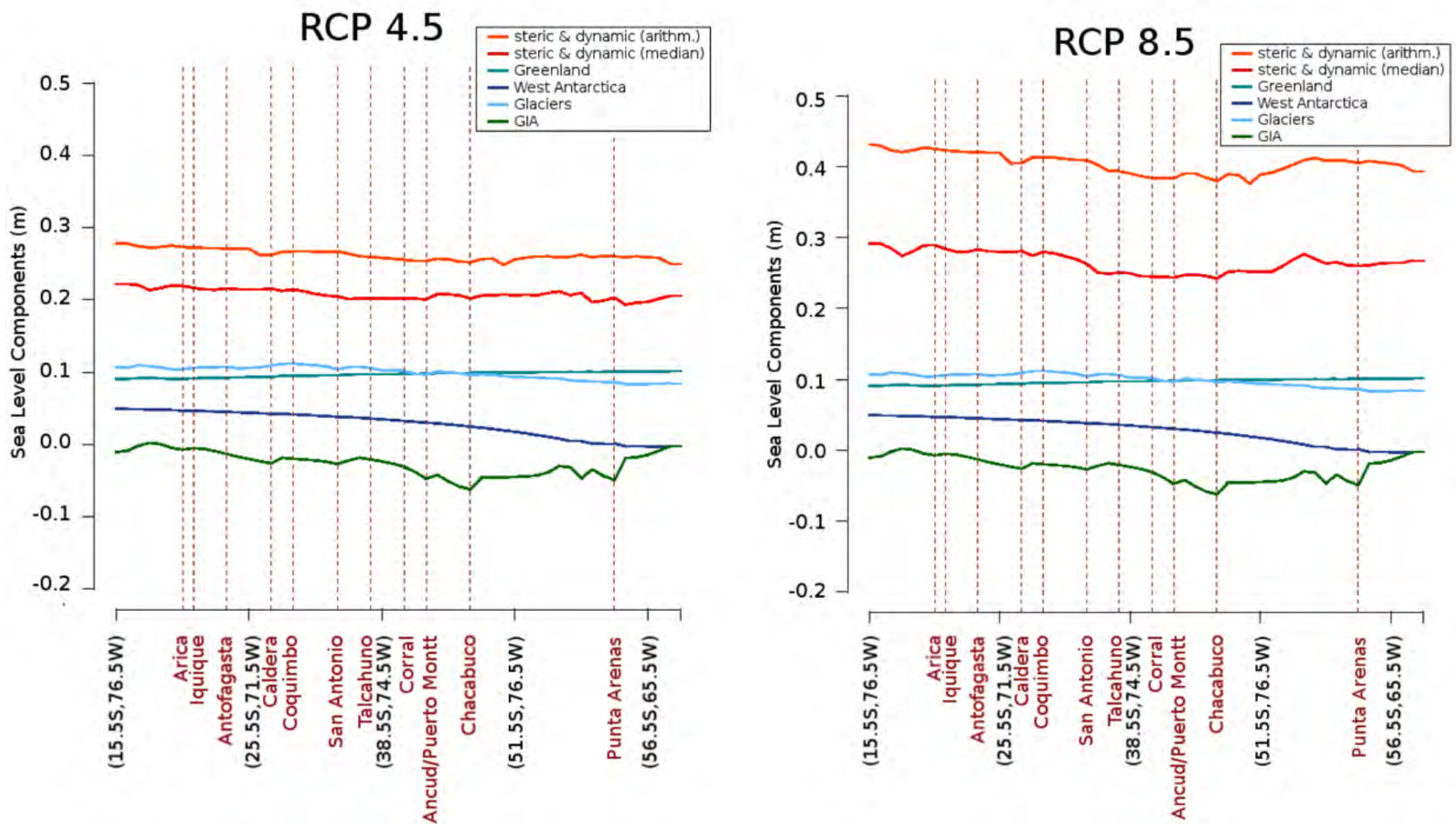

Figure 8. The different components of sea-level change along the coast of Chile for the RCP4.5 (left) and the RCP8.5 (right) scenarios. The Greenland and Antarctic ice sheet components are from Milne *et al.* (2009), the glacier contribution is from Slangen *et al.* (2014), and the GIA contribution is from Peltier (2004). For the steric/dynamic component the arithmetic mean and the median of 17 climate models are shown.

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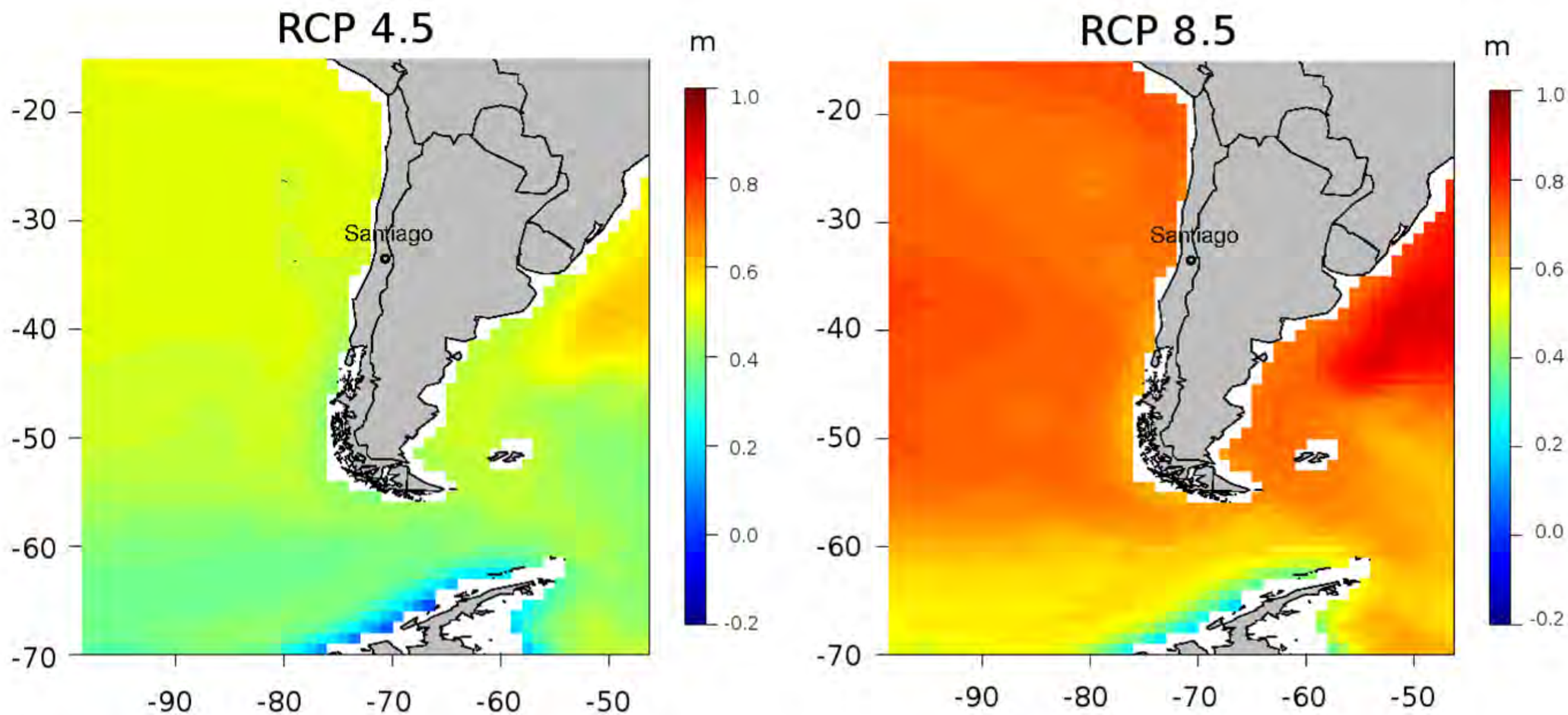

Figure 9. Sea-level change for the period 2081–2100 with respect to 1986–2005 for the RCP4.5 (left) and the RCP8.5 (right) scenarios. The plots show the sum of the steric and dynamic components, the contribution from land ice masses, and the contribution from the GIA. The steric/dynamic fingerprint is calculated from 17 CMIP5 climate models. The fingerprints of the Greenland and Antarctic ice sheets are from Milne *et al.* (2009), the glacier contribution from Slangen *et al.*(2014), and the contribution of the GIA is from Peltier (2004).

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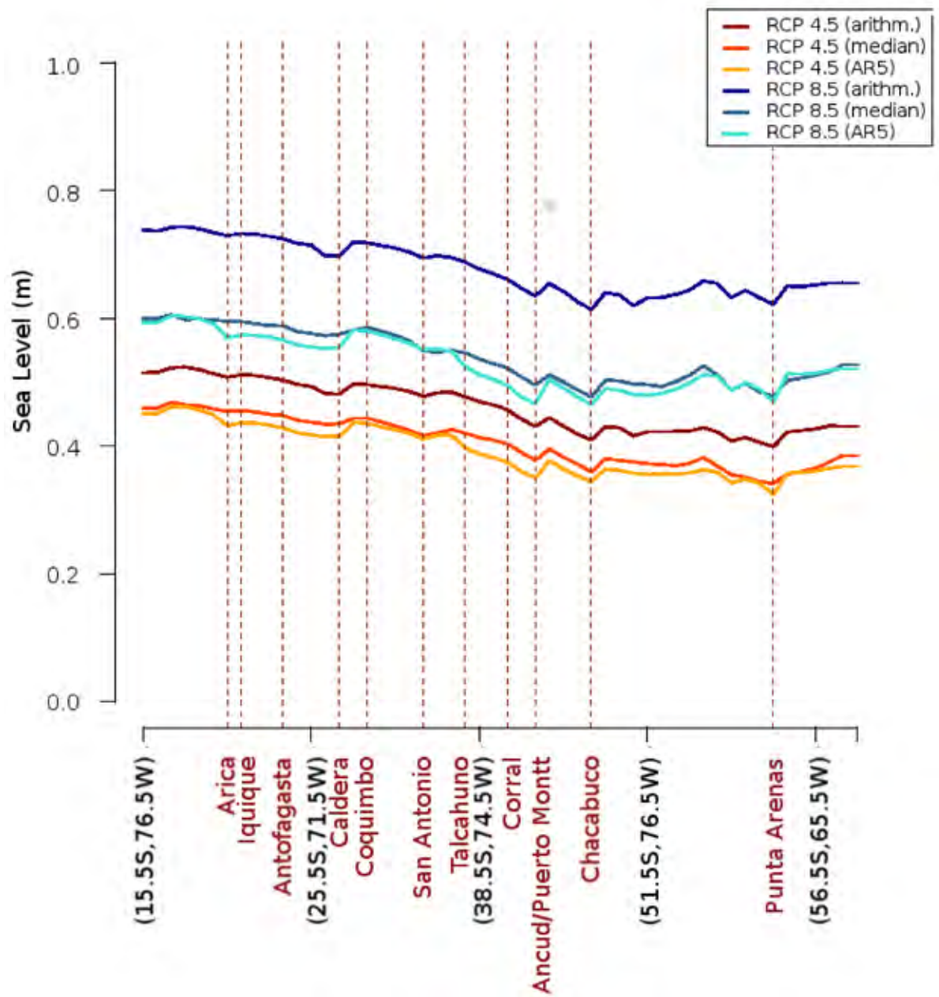

Figure 10. Total sea-level rise along the coast of Chile for the RCP4.5 and the RCP8.5 scenarios. Shown are the results from the IPCC AR5 (Church *et al.*, 2013) and the two estimates of this study that use (1) the arithmetic mean and (2) the median to calculate the steric and dynamic components using projections from 17 climate models.

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In Memoriam

Robert Dolan (1929 –2016)

Bob Dolan while grab sampling in Oregon Inlet, North Carolina. Photo taken May 2003.

Dr. Robert Dolan died on 24 April 2016 in Charlottesville, Virginia, at age 87. He was Professor Emeritus at the University of Virginia (UVA). He will be remembered as a pioneer in the field of coastal geomorphology. After serving in the U.S. Navy, Bob earned his B.S. from Southern Oregon College in 1955, his M.S. from Oregon State University in 1957 and his Ph.D. from the Coastal Studies Institute at Louisiana State University in 1965.

As part of his dissertation, Bob set up instrumentation on a pier he rented at Nags Head, North Carolina to measure the impact of storms. Three weeks into this project, the infamous Ash Wednesday storm of 1962 slammed into the U.S. eastern seaboard. An excellent account of Bob's experience living on the front row of this storm and the impact it had on his life and career can be found in "Ribbon of Sand: The Amazing Convergence of the Ocean and the Outer Banks" by Alexander and Lazell (2000). In short, living and working through that experience shaped his research direction and career for the next nearly 50 years. I had the great pleasure of working with him for a few short years as his post-doc and on several other projects following the post-doc including a technical review of NASA's Wallops Island Flight Facility Shoreline Restoration and Infrastructure Protection Program (with Laura Moore and Bob Dean), the Oregon Inlet jetties Environmental Impact Assessment, and a grain-size analysis of the Virginia barrier islands recently published in Sedimentology.

Bob took his first and only faculty position at UVA in 1965 where he helped to found the Department of Environmental Sciences in the early 1970s during his tenure as Chair. In the years following, Bob worked with the United States Geological Survey (USGS), National Park Service (NPS), U.S. Army Corps of Engineers, and U.S. Fish and Wildlife Service on many projects, but arguably his most noteworthy were those that took place along the Outer Banks of North Carolina. His work with Harry Lins titled, "The Outer Banks of North Carolina" (U.S. Geological Survey Professional Paper 1177-B) is in its fourth printing. During the 1970s, Bob worked to save the Cape Hatteras lighthouse and Hatteras seashore and wrote a landmark paper on the negative impacts of maintaining sand dunes on beaches. This research ultimately led to a reversal of NPS policy along the Cape Hatteras National Seashore to allow the dunes, built in the 1930s by the Civilian Conservation Corps, to erode naturally. He also recommended mining sand from Cape Point at Cape Hatteras to use for nourishing the beach in front of the Cape Hatteras lighthouse. The borrow site has remained to this day and I affectionately refer to this pond as "Dolan's Pond" (Figure 1). While the list of his work in this area is quite extensive, I remember him as a liaison and an expert who, among other things, enabled competing interests to develop mutually satisfactory solutions in the debate regarding construction of the Oregon Inlet jetties.

Bob also worked as a liaison scientist for the Office of Naval Research (ONR) and lived overseas for two stints during the mid-1980s and mid-1990s assessing ONR coastal and marine research and engineering activities.

In the late 1970s and early 1980s, Bob played a major role in advancing the field of shoreline change research with his UVA colleagues Bruce Hayden and Suzette May Kimball among others. He was among the first to develop a shoreline digitizing system when the technology was at its infancy. He then spent many years compiling two large shoreline datasets – COASTS and CEIS – that were used by research groups, coastal land managers, policy makers and local homeowners to assess the vulnerability of coastal properties and use as a land-use decision making tool. Bob and his research team ultimately used those data to provide technical support for the Federal Emergency Management Agency's shoreline mapping program in the late 1980s and early 1990s. A number of publications resulted from this work and provided guidelines on shoreline change analyses for many research groups and government/coastal management agencies (including the USGS's Digital Shoreline Analysis System, DSAS).

Later, he pursued his passion for quantifying northeast storms where he developed the "Dolan/Davis" classification scheme for rating the intensity of northeast storms with his UVA colleague Robert Davis.

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He also worked on a multitude of coastal consulting projects ranging from projects in Dubai to NASA's Wallops Island Flight Facility.

While at UVA, Bob received an award for Significant Contributions to the Science Program from the Department of the Interior (1987) and UVA's Distinguished Professor award (1991). He was also noted for his scientific "flexibility" - contributing literature on topics including "Sinking Cities" and sea-level rise, the "Lost Colony" of Roanoke Island, the origin of Jockey's Ridge, NC and human impacts along the Colorado River. Bob Dolan served as a life mentor to me. He never said a cross word about anyone and turned the other cheek when that gesture was not returned. He had a talent for seeing the big picture and knew how to get things done to see his ideas come to fruition. He could watch a TV show on how potato chip companies know how much salt to put on potato chips and come to work the next day relating those methods to shoreline change analyses. He had a positive outlook on life and a true desire and passion for working with his students, research staff and colleagues. He loved the institution in which he worked his entire professional life as well as good wine, Cajun food, art, gardens, flying small airplanes, exquisite motorcycles and most importantly, his family.

LITERATURE CITED

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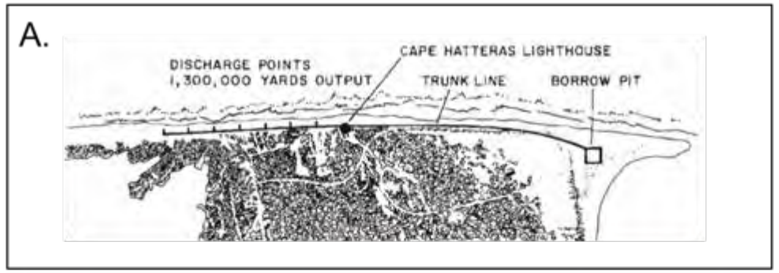

Figure 1. (A) Schematic of 1973 Buxton Beach nourishment project showing borrow pit location as shown in Dolan *et al.* (1974). (B) Google Earth image of same area in July 2014 showing water-filled borrow site and formation of "Dolan's Pond."

For more information, see the UVAToday article at:

https://www.news.virginia.edu/content/memoriam-robert-dolan-pioneering-coastal-geologist?utm_source=DailyReport&utm_medium=email&utm_ampaign=news

Spatial and Temporal Sediment Dynamics in a Subarctic Salt Marsh (Gulf of St. Lawrence, Canada)

Spatial and Temporal Sediment Dynamics in a Subarctic Salt Marsh (Gulf of St. Lawrence, Canada)

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ABSTRACT

Sediment transport in the salt marsh and the lagoon of Penouille is driven by tidal currents, waves, wind, and ice rafting, which interact with topography and vegetation to control the spatial distribution of surface sediments. Multiple linear regressions of 203 samples of marsh surface sediments show that grain size gets finer and organic matter content increases with distance from the lagoon inlet, the sandy peninsula, the closest creek, and the lagoon. The vegetation parameters and surface microtopography have only a minor influence. Locally, grain size can get finer with elevation, while organic matter content increases. However, across the entire marsh, grain size exhibits the opposite trend with elevation, a consequence of aeolian transport and ice rafting. The 94 samples covering the lagoon show a trend of finer grain size with distance from the lagoon inlet and with sea grass cover. Penouille marsh has been relatively stable from 1975 to 2008: analysis of five georeferenced aerial photographs shows that only 3% of the marsh area was lost due to outer marsh edge retreat. Ten sediment cores collected in the marsh show a thickness of 0.14–0.72 m of marsh sediments overlying a sandy substrate. Radiocarbon dates suggest that marsh establishment occurred in the north side of the lagoon around 1000–1200 cal BP. Accretion rates based on radiocarbon dates are 0.4–1 mm/y for several centuries, whereas ^{137}Cs dating indicates rates of 1–3 mm/y since 1963, and accretion plates indicate 2.9 ± 0.9 mm/y between 2010 and 2012. Accretion rates since 1963 are similar to the relative sea-level rise (RSLR) of 1.5 mm/y at Penouille for the 1969–2014 period. However, the accelerated RSLR of 3.7 mm/y observed over the last 20 years and additional RSLR due to climate change may progressively drown the marsh if accretion rate does not substantially increase.

ADDITIONAL INDEX WORDS: *Grain size, organic matter content, accretion rate, sediment transport, ice rafting, aeolian sand.*

INTRODUCTION

Salt marshes are dynamic coastal ecosystems that occupy the upper intertidal zone in relatively sheltered places along the coast, allowing the establishment of fine-grained sedimentation and vegetation (De Groot, Veeneklaas, and Bakker, 2011; Van der Wal, Wielemaker-Van den Dool, and Herman, 2008). Salt marshes represent an important buffer between sea and land that dissipate tide and wave energy, and they form a unique habitat for various plants and animals (Friedrichs and Perry, 2001). In the context of global warming and accelerated eustatic sea-level rise (Church *et al.*, 2013), salt marshes are at risk of coastal squeeze and marsh drowning if their accretion rate is less than the rate of relative sea-level rise (Donnelly and Bertness, 2001; Schwimmer and Pizzuto, 2000; Warren and Niering, 1993).

Variations in accretion rate and sediment grain size across salt marshes are controlled by several environmental factors, such as elevation, proximity to sediment sources (creek, mudflat, *etc.*), vegetation characteristics, and topog-

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raphy (Bartholdy, Bartholdy, and Kroon, 2010; Coulombier, Neumeier, and Bernatchez, 2012; Friedrichs and Perry, 2001). The vegetation favors sedimentation and reduces erosion by slowing currents near the bed, reducing turbulence, dampening waves, and trapping suspended sediment (D'Alpaos *et al.*, 2007; Neumeier and Amos, 2006; Neumeier and Ciavola, 2004). In colder climates, the canopy sheltering effect depends on seasonal vegetation variability (Neumeier, 2005; Van Proosdij, Ollerhead, and Davidson-Arnott, 2006). Typically, sedimentation is higher along tidal creeks or close to marsh edges and tends to decrease with distance from creek or edge and with higher elevation (Bartholdy, Bartholdy, and Kroon, 2010; Détriché *et al.*, 2011; French and Spencer, 1993). Similarly, grain size tends to decrease and organic matter content tends to increase with distance from creeks and marsh edges and with elevation, because the coarsest sediments settle out of suspension rapidly as water moves away from the local sediment source (Christiansen, Wiberg, and Milligan, 2000; Kearney, Stevenson, and Ward, 1994; Yang *et al.*, 2008).

Silt and clay are transported in suspension in marshes by tides and during storms. Sand transport in marshes is more complex; sand movement as bedload is limited by the vegetation canopy, and sand transport in suspension occurs only during storms and close to creeks (De Groot, Veeneklaas, and Bakker, 2011). Extreme storm events deliver pulses of coarser sediments, which contribute significantly to vertical accretion in salt marshes (De Groot, Veeneklaas, and Bakker, 2011; Friedrichs and Perry, 2001; Stumpf, 1983). Aeolian transport can also carry sand from nearby dunes or beaches (French and Spencer, 1993; Rodriguez *et al.*, 2013).

In subarctic regions, ice rafting can redistribute sediments of all sizes across the intertidal zone during winter (Argow, Hughes, and FitzGerald, 2011; Neumeier, 2011). Sediments can freeze to sea ice at low tide in the intertidal zone; then, as the ice moves up with the tide, it tears out a 1–20-mm layer of unconsolidated sediments (Dionne, 1989). For marsh sediments consolidated by rhizomes, the extracted fragment is typically mat-shaped, 5–20 cm thick, and 0.1–2.0 m long (Dionne, 1989). These ice-rafted sediments, or *marsh clumps*, are deposited where ice floes melt in the intertidal zone or in deeper water. Ice floes often get stranded and melt around the mean high water line. Ice rafting creates marsh depressions that may later evolve into salt pans but that also contribute to patchy marsh erosion and accretion (Dionne, 1986, 1989; Pejrup and Andersen, 2000). Sea ice can also mow the aboveground vegetation, leaving the sediment surface unprotected.

Understanding present-day relationships between sediment distributions and environmental factors provides useful information for the reconstruction of past depositional environments based on sediment core records (*e.g.*, Yang *et al.*, 2008). For example, progradation of the outer marsh edge produces an upward fining grain size in a core (Allen, 1996; Singh Chauhan, 2009). The sediment record can also exhibit temporal variations related to extreme storm deposits, shifts in storm frequency, seasonal sediment fluxes, relative sea-level variations, or icerafted deposits (Allen, 1997; Argow, Hughes, and FitzGerald, 2011; Boldt *et al.*, 2010; Wheeler, Orford, and Dardis, 1999; Yang *et al.*, 2008). These variations are often linked with progradation-retrogradation-progradation cycles of the outer marsh edge (Schwimmer and Pizzuto, 2000; Singh Chauhan, 2009).

Recent marsh evolution can be observed by following lateral movements of the marsh limits on historical aerial photographs (Van der Wal, Wielemaker-Van den Dool, and Herman, 2008) and by measuring vertical accretion with accretion pole, sedimentation-erosion table (SET), or marker horizons (Day *et al.*, 1999; Détriché *et al.*, 2011; Nolte *et al.*, 2013). However, sea ice disturbs all aboveground structures, and accretion is best measured with accretion plates in cold climate marshes (Van Proosdij, Ollerhead, and Davidson-Arnott, 2006).

The purpose of the present research is to reconstruct the spatial and temporal sediment dynamics and marsh evolution of a minerogenic, microtidal salt marsh in a subarctic region facing global warming and sea-level rise. The study combines two spatial scales (lateral and vertical marsh evolution) and two temporal scales (recent years and past centuries). First, surface sediment samples from the lagoon and the salt marsh were analyzed to determine the relationships between spatial sediment distributions and environmental parameters. Second, past sediment dynamics and marsh evolution were reconstructed using sediment cores (accretion rates from dating and sediment facies analysis),

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accretion plates (for recent accretion rate), and historical aerial photographs (evolution of marsh surface area from 1975 to 2008).

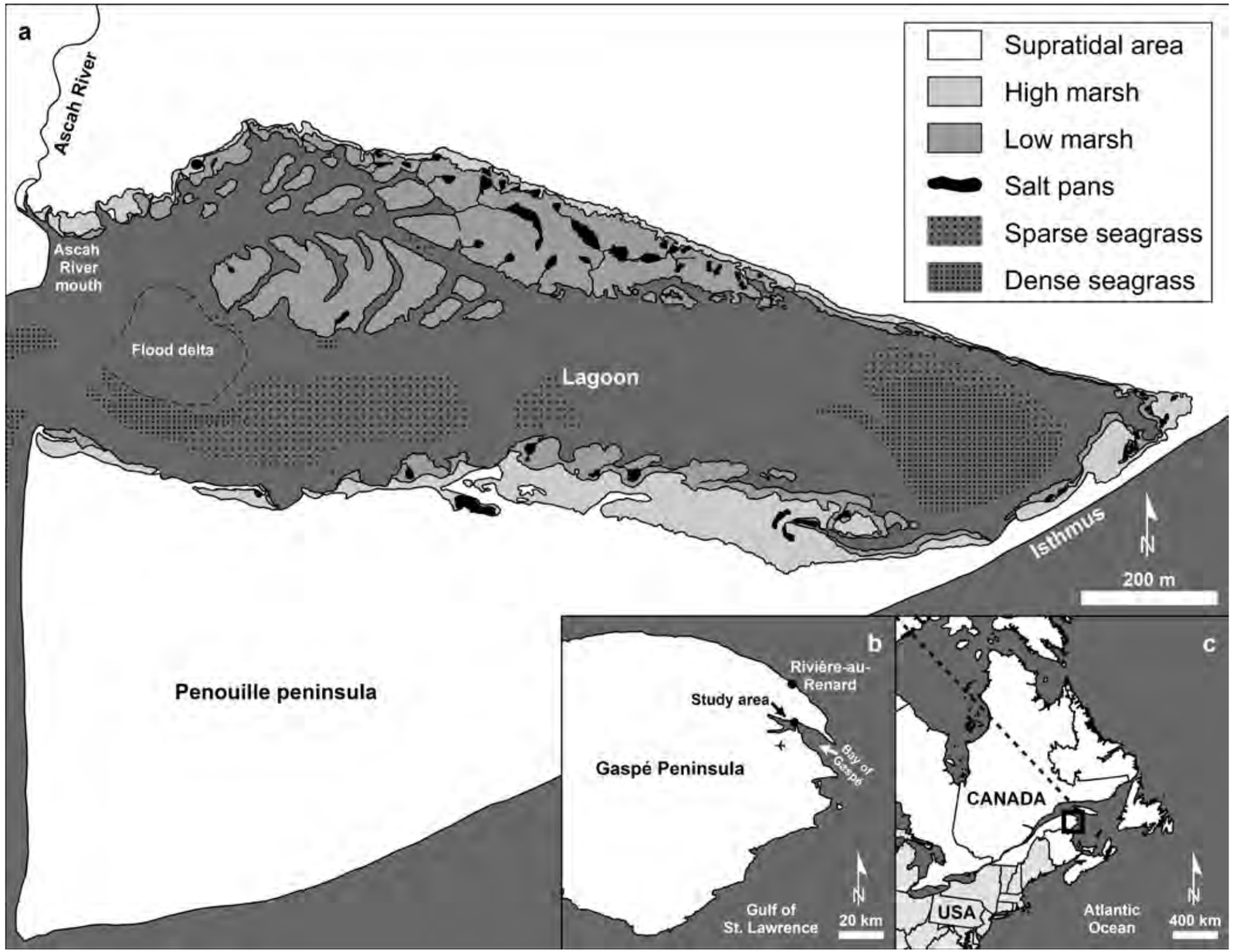

Figure 1. (a) Study area of the Penouille peninsula, lagoon, and salt marsh. (b) Positions of the study area, the Riviére-au-Renard tide gauge, and the weather station at the Gaspé airport. (c) Gaspé Peninsula in eastern Canada.

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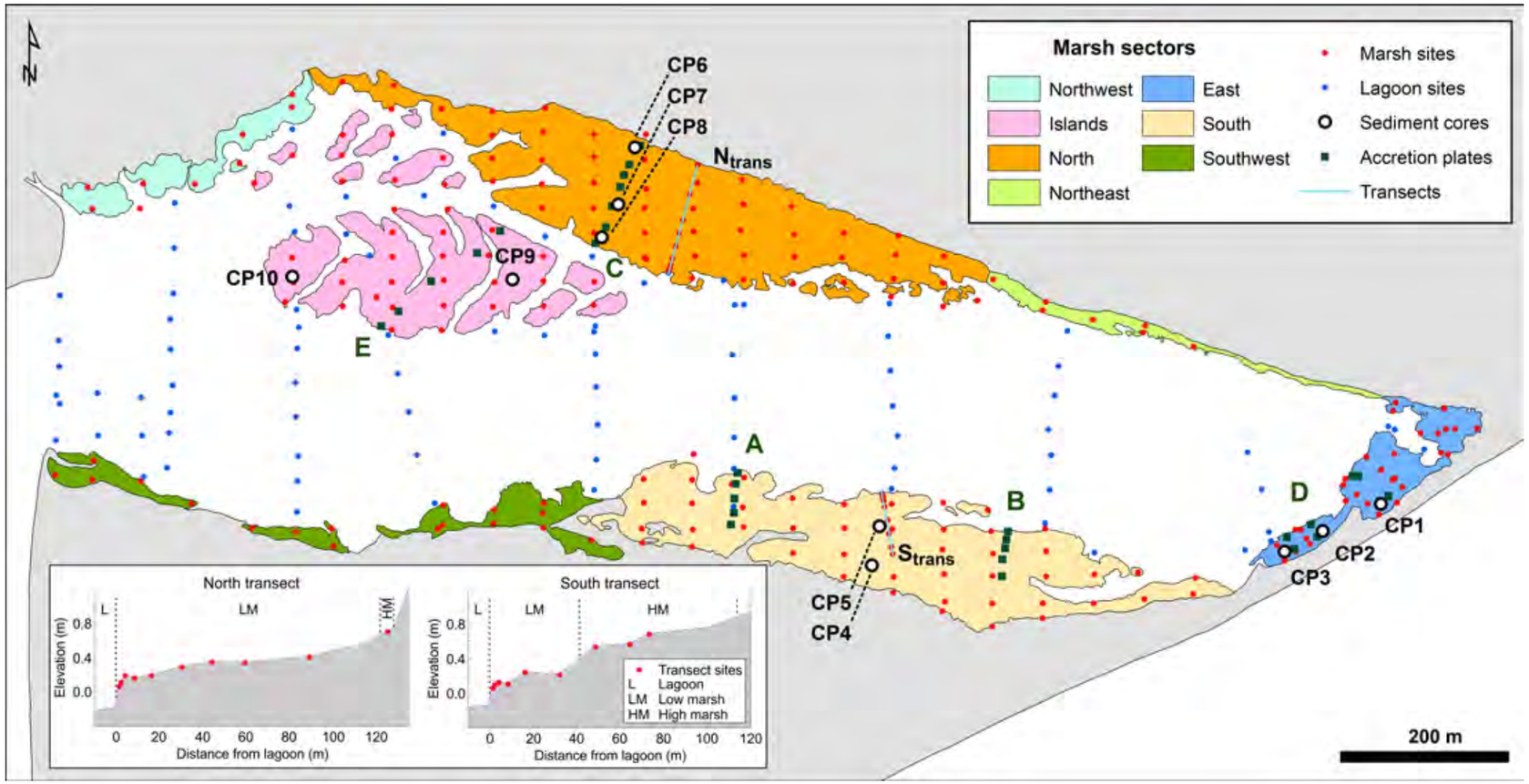

Figure 2. The different marsh sectors with positions of the surface sediment sampling sites (red dots = marsh sites, blue dots = lagoon sites), the sediment core positions (open circles; see Table 1 for core elevations), the accretion plates (dark green squares; letters indicate labels of plate groups on Figure 8), and the two low–high marsh transects (light blue lines, N_{trans} and S_{trans}). The insert shows the topographic profiles of these two marsh transects (elevations are above mean sea level).

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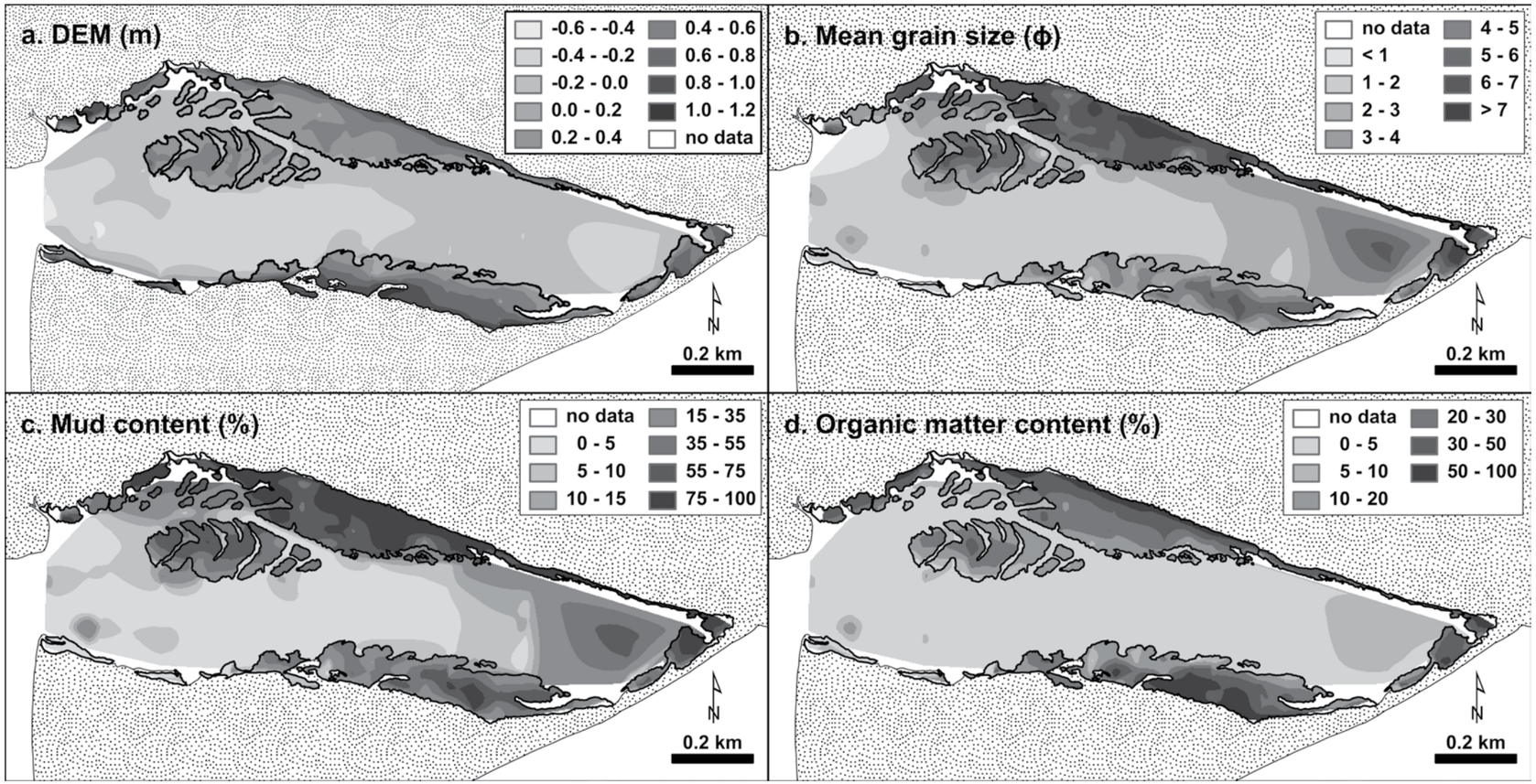

Figure 3. Digital elevation model (DEM) and spatial distribution of the sediment variables: (a) elevation above mean sea level, (b) mean grain size, (c) mud content, and (d) organic matter content.

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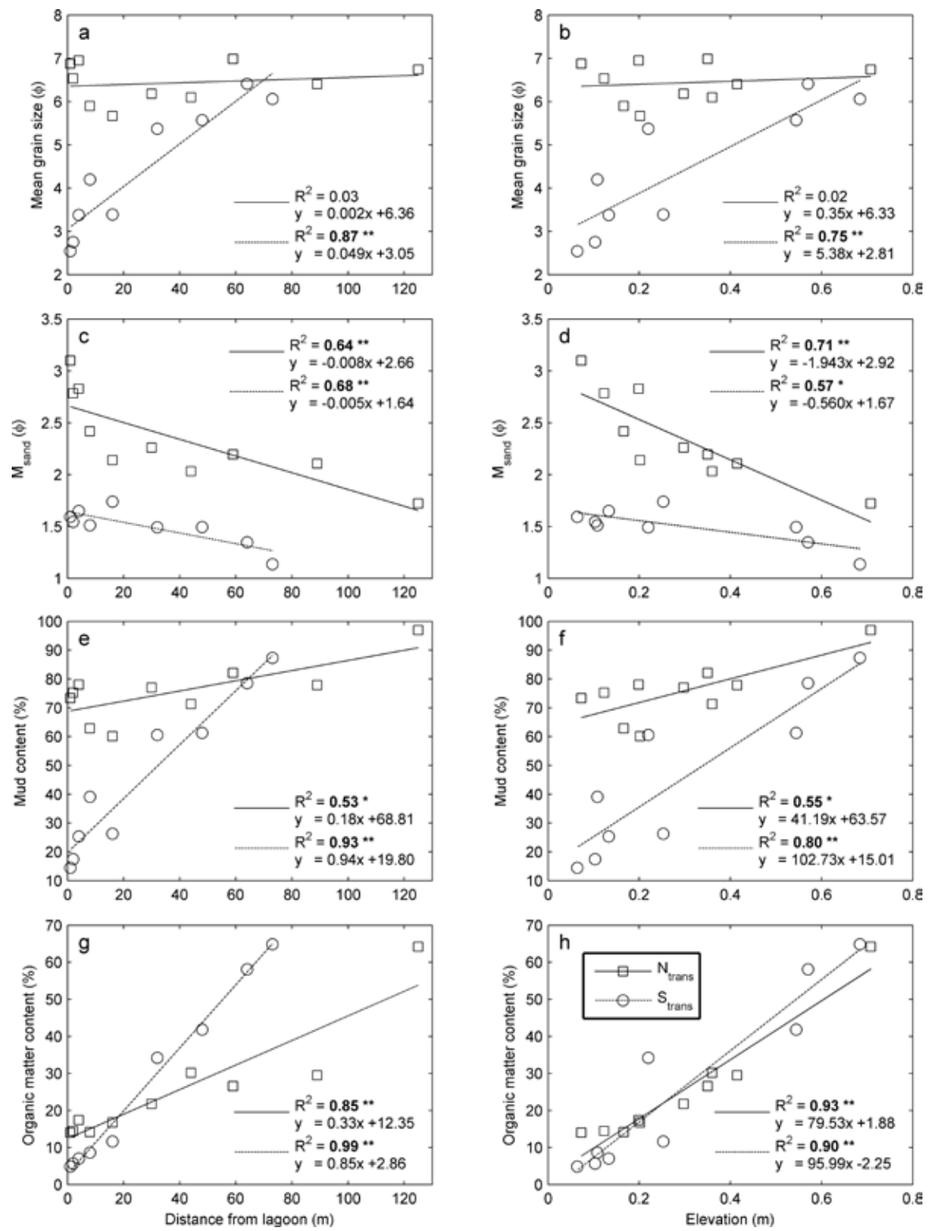

Figure 4. Sediment variables along the two low–high marsh transects (N_{trans} = squares and solid lines; S_{trans} = circles and dashed lines) *vs.* distance from the lagoon (left panels) and *vs.* elevation (right panels): (a, b) mean grain size, (c, d) mean grain size of the sand fraction (M_{sand}), (e, f) mud content, and (g, h) organic matter content. R2 values significant at * $p < 0.05$ or ** $p < 0.01$.

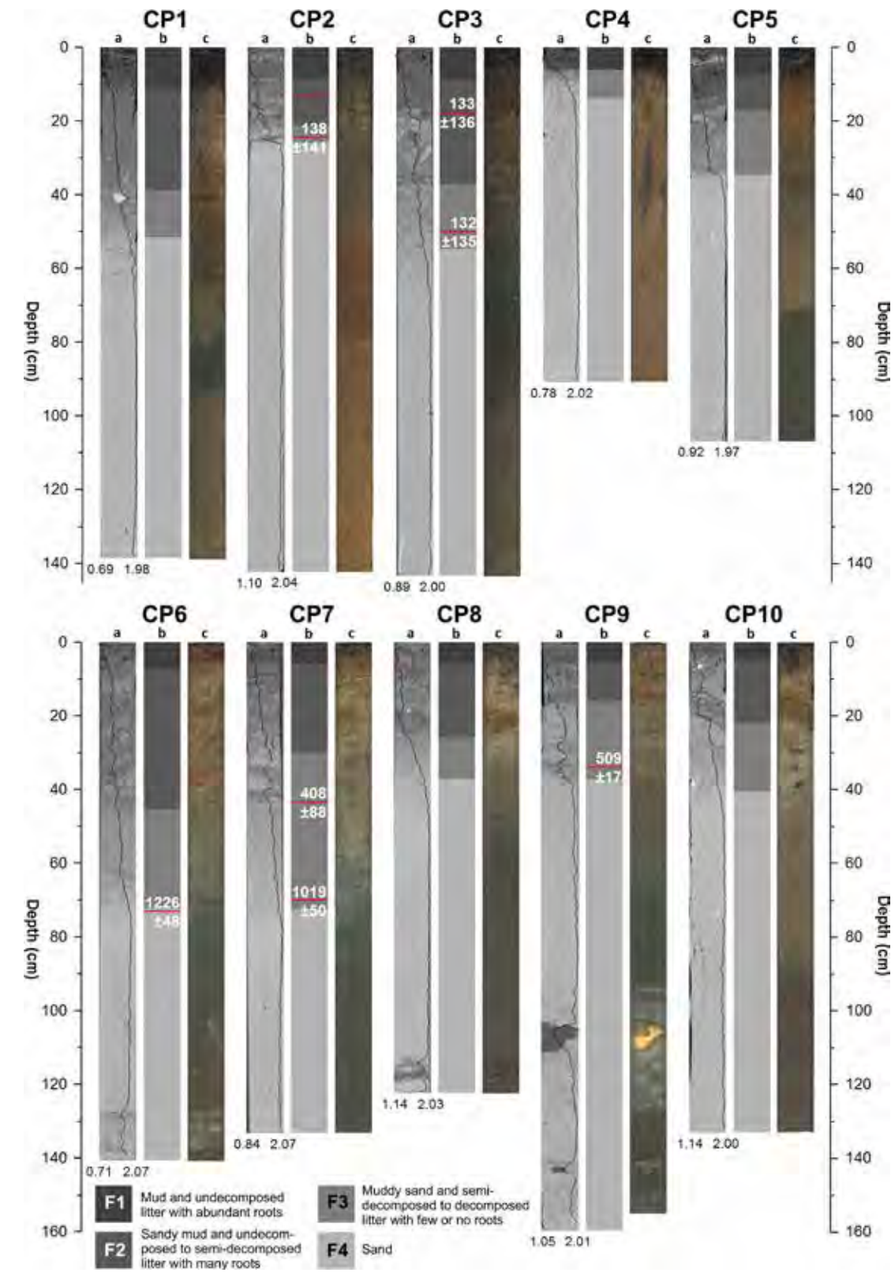

Figure 5. CP1–CP10 cores from the Penouille marsh: (a) sediment core radiograph and superimposed density profile (×1000 kg/m³), (b) F1–F4 facies with depth of AMS ^{14}C age (cal BP, solid red line) and ^{137}Cs peak of 1963 (dashed red line), and (c) sediment core photograph.

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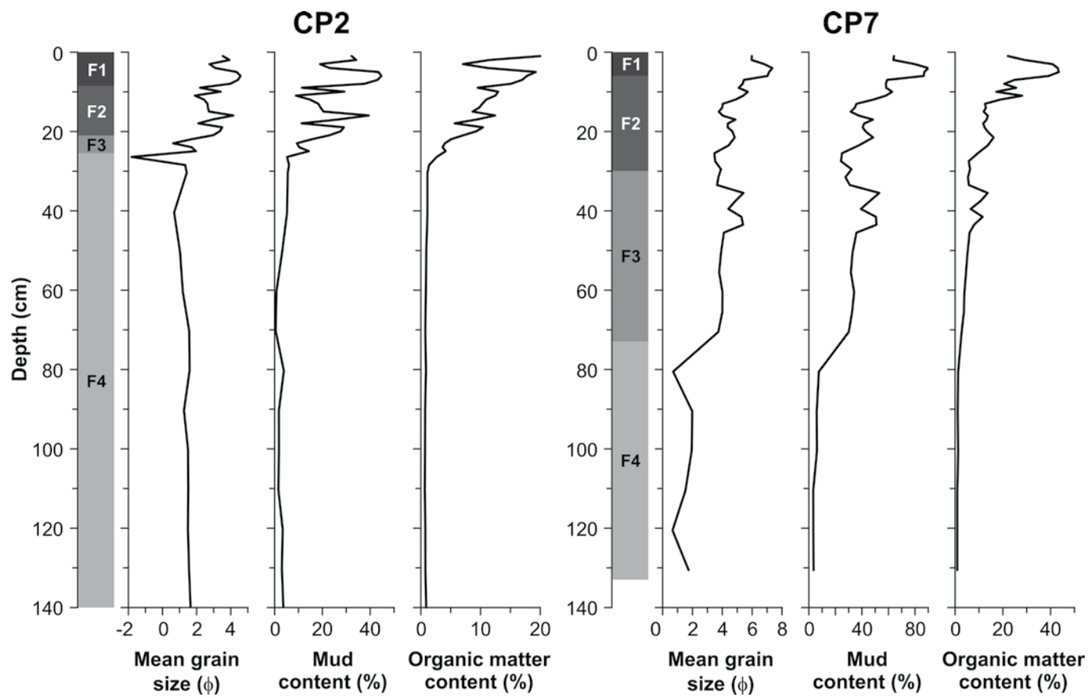

Figure 6. Vertical profiles of mean grain size, mud content, and organic matter content for core CP2 (left plots) and core CP7 (right plots). The F1–F4 facies correspond to different degrees of mud content and organic matter content.

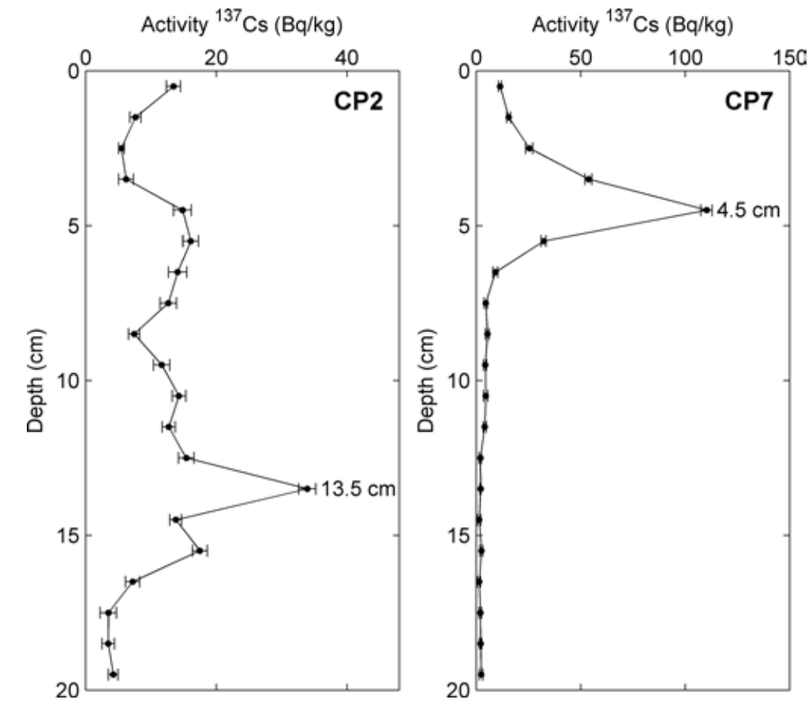

Figure 7. Profiles of ^{137}Cs activity measured in cores CP2 and CP7. The peak corresponds to 1963.

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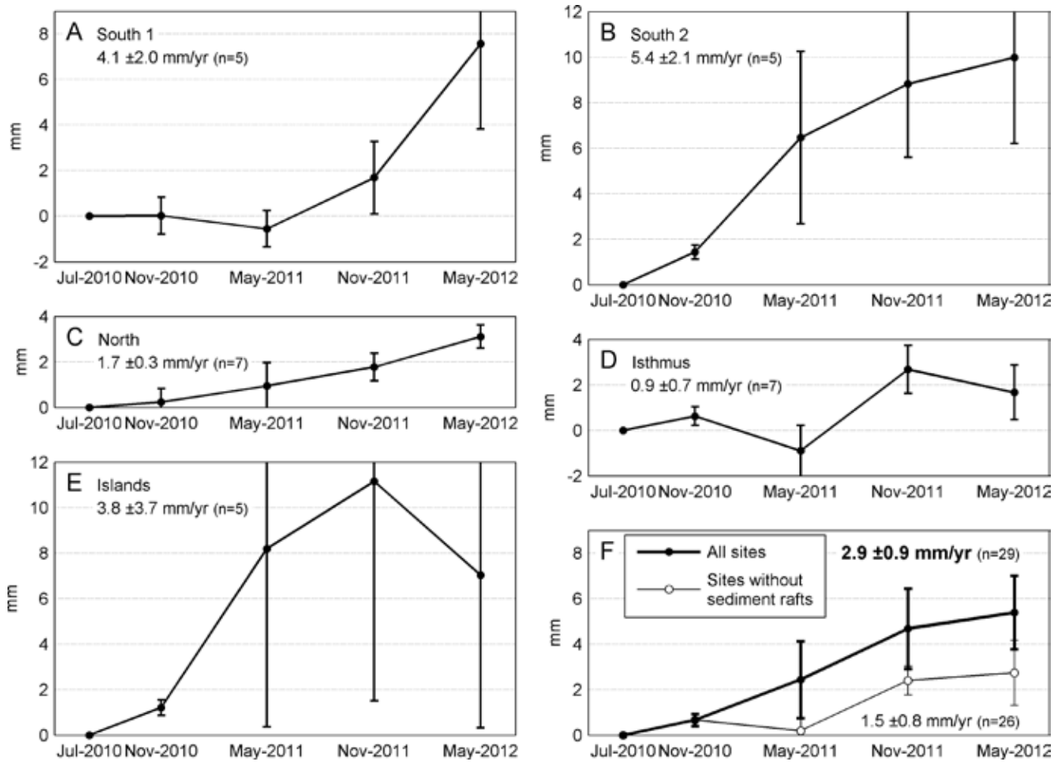

Figure 8. Accretion and erosion measured with accretion plates from July 2010 to May 2012. (A–E) Means (6 SE) for the five groups identified in Figure 2. (F) Means for all 29 sites and means for the sites without arrival of sediment rafts.

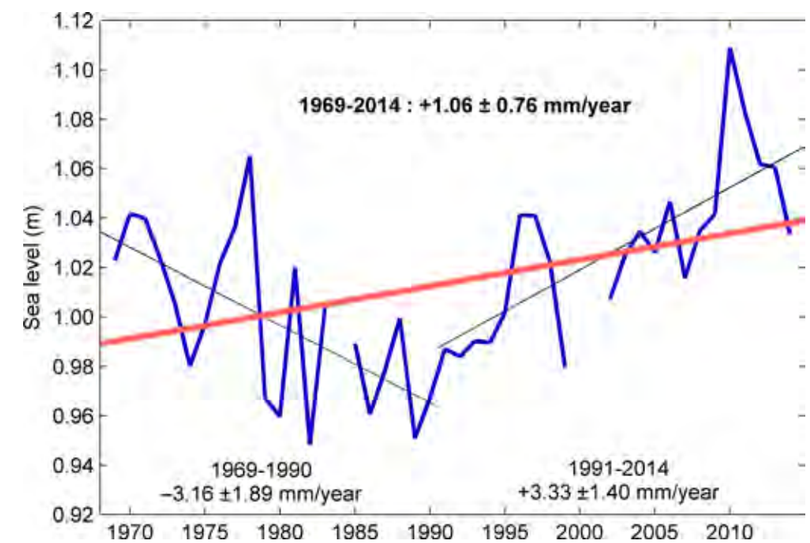

Figure 9. Mean sea level measured at the Riviére-au-Renard tide gauge (yearly means) and relative sea-level rise (RSLR) computed for the periods 1969–2014, 1969–1990, and 1991–2014. RSLR at Penouille is 0.4 mm/y higher because of crustal movements.

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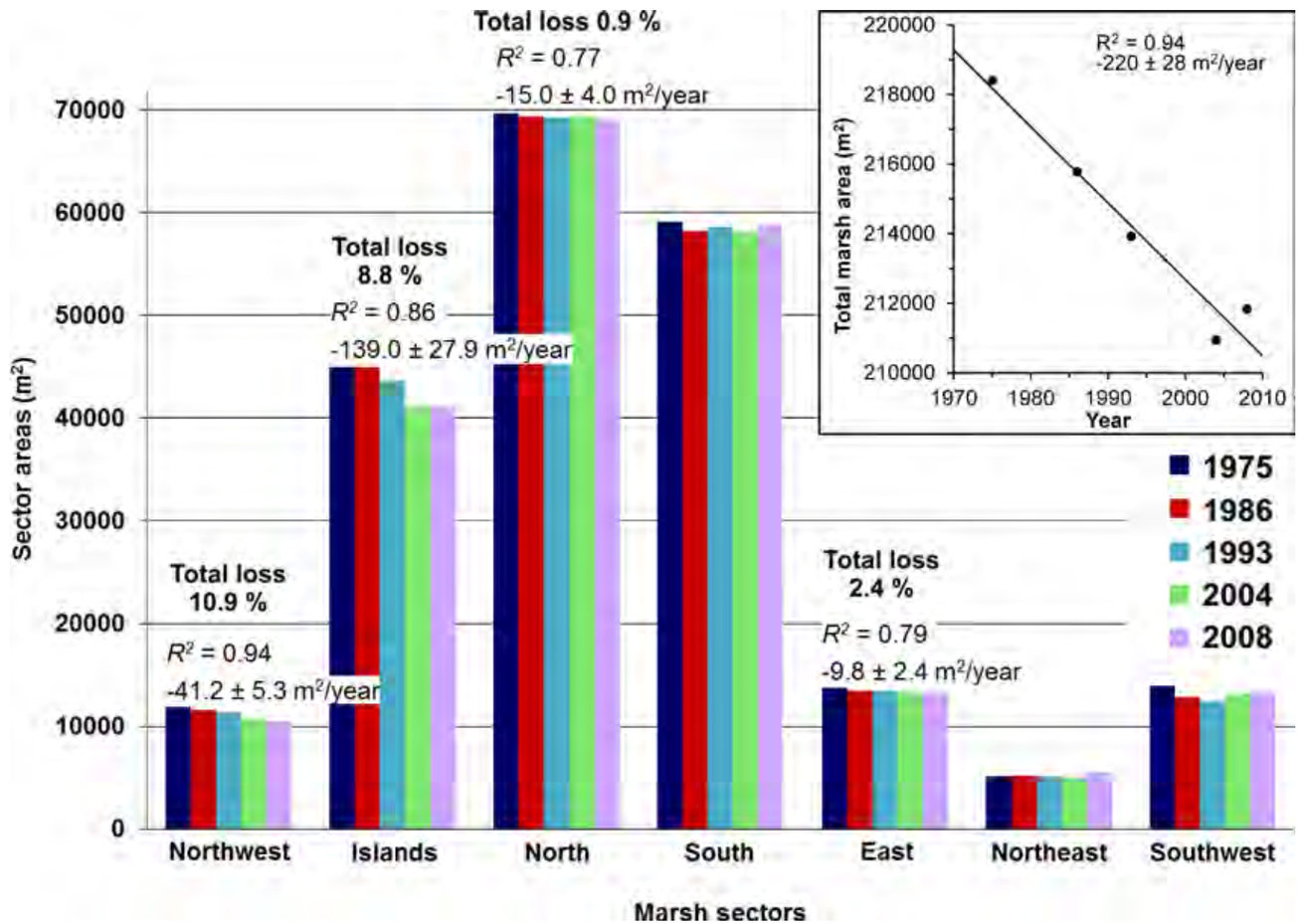

Figure 10. Surface area evolution of marsh sectors from 1975 to 2008. Significant loss ($p<0.05$) occurred in the Northwest, Islands, North, and East sectors. The inset shows the evolution of the total marsh area from 1975 to 2008; the loss of 220 m²/y is significant at $p<0.05$.

To access this full JCR Research Article, please visit:

http://www.jcronline.org/doi/abs/10.2112/JCOASTRES-D-15-00160.1

2nd International Water Safety Symposium (2016 IWSS)

The 2nd International Water Safety Symposium is organized with the legacy of the successful symposium in Busan 2014. The 2nd IWSS brings together leading international researchers and experts to share knowledge of water safety to enhance worldwide understanding of water safety in various approaches. The symposium is organized in Incheon, hub city of Asia from 21st to 24th June, 2016.

The IWSS will integrate the development of related science, public education and training strategies to reduce the risk of accident in water environment such as swimming pool, waterfront and beach.

Key themes include scientific and engineering analysis of water safety, social scientific implementation of water safety and its education, lastly multidisciplinary research for water safety including tourism, emergency response, first aid and environment protection.

There are opportunities to visit unique coastal beaches in Korea and you will witness the beach safety operation system in Korean Coast Guard. Also all participants will have formal and casual social gathering organized by IWSS Local Organization Committee.

Date: 21st to 24th June 2016

Place: Convensia, Songdo, South Korea

Website : http://www.2016iwss.org

Contact : Jong Rae KIM (+82-2-720-7145, jrkim@lskorea.org)

1. Meet the Young Leader

IWSS offers "Meet the Young Leader (MYL)" program to all symposium participants who are undergraduate, graduate school students, young researchers and exhibition visitor. MYL will provide time and place for the leaders in Water Safety in the next generation and let them create international network for the good will. Food and beverage will be served including local beer.

- Date: 22rd June, 2016
- Time: 18:00
- Host: The Local Organization Committee of IWSS
- Sponsor: Aquatic Safety Equipment & Services
- Meeting point: Reception desk of the symposium
- Contact: Jong Rae KIM (+82-2-720-7145, jrkim@lskorea.org)

2. Meet the Experts

"Meet the Experts" is one-hour tea time session with an expert in various themes of water safety. You can directly ask what you have been interested to the experts. You can meet Dr. Tom Griffith, the pioneer of public swim education and scientific facility operation, Dr. Amit Lotan, leading researcher of Jellyfish sting, and Mr. Daniel Schaffer, CEO of Foundation of Environmental Education. The more themes and name of experts will be updated online and message board during the symposium

- Date: 22rd~24th June
- Time: During the symposium session
- Place: ME session room
- Contact: Jong Rae KIM (+82-2-720-7145, jrkim@lskorea.org)

3. Symposium Category

① Engineering and Scientific Approach

- Understanding of Watershed and Coastal Environment
- Water Contamination in Waterfront and Beach
- Disaster Prevention

② Water Safety Education

- Lifeguarding and Lifesaving Training
- Drowning Prevention Education and Public Awareness Program

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- Lifeguarding and Lifesaving Training
- Drowning Prevention Education and Public Awareness Program
- Swim Education and Training (IFSTA Special Session)

③ Other Topics Related with Water Safety

- Tourism and Water Safety
- First Aid and Emergency Response
- Environment Protection around River, Lake and Beach (FEE Special Session)

Abstract Submission & Registration

We would like to announce that the 2rd International Water Safety Symposium(IWSS) final abstract submission is to April 30th.

All paper submissions will be handled electronically through our online web submission system and must be uploaded by April 30th, 2016. http://www.2016iwss.org

Each of the manuscripts for this symposium is being reviewed by several experts in the field. The IWSS will be contacting you shortly as to the Oral or Poster Presentation, date, time, location of your presentation. They will also be giving you instructions.

We look forward to your involvement in the rip current symposium and keeping you updated regarding the conference program, related activities information.

REGISTRATION

Online : www.2016iwss.org

Participant (If Paid Until 30 April, 2016)
Student Rate : USD 500
Standard Rate : USD 600
IFSTA Rate (Double occupancy) : USD 850
IFSTA Rate (Single occupancy) : USD 900

Participant (If Paid After 30 April, 2016)
Student Rate : USD 600
Standard Rate : USD 700
IFSTA Rate (Double occupancy) : USD 900
IFSTA Rate (Single occupancy) : USD 970

COASTAL PHOTOGRAPH

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COASTAL PHOTOGRAPH

Aoraki / Mount Cook, New Zealand. Aoraki / Mount Cook is the highest mountain in New Zealand. Its height since 2014 is listed as 3,724 m (12,218 ft), down from 3,764 m (12,349 ft) before December 1991, due to a rock slide and subsequent erosion. It lies in the Southern Alps, the mountain range which runs the length of the South Island. A popular tourist destination, it is also a favorite challenge for mountain climbers. The summits lie slightly south and east of the main divide of the Southern Alps, with the Tasman Glacier to the east and the Hooker Glacier to the west. The Southern Alps on the South Island in New Zealand were formed by tectonic uplifting and pressure as the Pacific and Indo-Australian Plates collided along the island's western coast. The uplifting continues, raising Aoraki / Mount Cook an average of 7 mm (0.28 in) each year. However, erosive forces are also powerful shapers of the mountains. The severe weather is due to the mountain's jutting into powerful westerly winds of the Roaring Forties which run around approximately 45°S latitude, south of both Africa and Australia. The Southern Alps are the first obstacle the winds encounter after South Africa and Australia, having moved east across the Southern Ocean. (Photograph taken 20 January 2016 by Dr. Jooyong Lee, Sungkyunkwan University [SKKU], Suwon, Republic of Korea)

Genetic Description and Remote Sensing Techniques as Management Tools for *Zostera noltii* Seagrass Populations along the Atlantic Moroccan Coast

Genetic Description and Remote Sensing Techniques as Management Tools for *Zostera noltii* Seagrass Populations along the Atlantic Moroccan Coast

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ABSTRACT

Seagrass meadows provide an essential ecological service in coastal ecosystems worldwide, although they are sensitive to many human factors, as a serious global regression has been documented. During sampling along the Atlantic Moroccan coast, five coastal lagoons were found characterized by the presence of intertidal monospecific seagrass *Zostera noltii* meadows (from south to north, Nayla, Oualidia, Sidi Moussa, Moulay Bousselham, and Larache). Two descriptive methods used to characterize *Z. noltii* populations could be used as management tools for future monitoring implementations: (1) the estimation of surface area covered by *Z. noltii* meadows using remote sensing techniques and *in situ* field surveys, and (2) the genetic characterisation of *Z.* noltii populations using simple sequence repeats (microsatellites) as molecular markers. Results revealed that the Nayla lagoon showed the largest area covered by *Z. noltii* (269,868 m^2) and the highest coverage rate (5.19%), while presenting the lowest genetic/genotypic diversity values ($T = 36$, $\hat{A} = 3.58$, $G = 50$; $R = 0.544$; $H_e = 0.43$). On the other hand, northern populations displayed lower rates of seagrass coverage (-1%) and higher values of genetic/genotypic diversity. Further genetic characterization also revealed that *Z. noltii* populations seem to be highly isolated in three geographically independent regions: northern Morocco (R1, Larache and Moulay Bousselham), central Morocco (R2, Oualidia and Sidi Moussa), and southern Morocco (R3, Nayla), which should be considered independent management units. Both seagrass coverage rate and the genetic description of seagrass populations along the Atlantic Moroccan coast seem to be useful management tools that could be used to evaluate changes in seagrass meadows over time to further establish appropriate conservation strategies.

ADDITIONAL KEY WORDS: *Conservation, microsatellite, satellite images, marine plants.*

INTRODUCTION

The seagrass *Zostera noltii* (Hornemann) is a widely distributed marine plant forming intertidal mudflat prairies along the European and North African Atlantic coasts, from temperate southern Norway to Mauritania, including the Canary Islands, as well as throughout the Mediterranean, Black, Azov, Caspian, and Aral seas (Short *et al.*, 2007). Seagrass beds are known for their essential ecological and economical roles in coastal ecosystems, where they act as nursery habitats and enhance protection from coastal erosion. Moreover, seagrasses feature high rates of primary production and low decomposition rates, playing a significant role in the regulation of the global carbon cycle

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(Fourqurean *et al.*, 2012). However, *Z. noltii*, like other seagrasses, are very sensitive to human impacts, which is the main cause for the regression of seagrass populations worldwide (Orth *et al.*, 2006).

Along the NW Atlantic Moroccan coast, five enclaves of maximum environmental interest in the form of coastal lagoons shelter great biodiversity, including *Z. noltii* meadows: Nayla, Sidi Moussa, Oualidia, Moulay Bousselham, and Larache (Figure 1). The existence of *Z. noltii* no doubt contributes significantly to the biologic, ecological, and environmental values of these lagoons, which, except for Larache, are included in the Ramsar List of Wetlands of International Importance (Hammada, 2007). Additional protection is given to Moulay Bousselham and Nayla, as they were officially classified a permanent biological reserve in 1978 and a national park in 2006, respectively. Despite their protected status, human impacts are evident in the form of growth of human settlements, intensive agriculture, fishing, tourism, and/or oyster farming in the environs, especially in northern (Moulay Bousselham and Larache) and central (Sidi Moussa and Oualidia) populations. All these human activities should certainly have affected *Z. noltii* populations over time, but there is a total lack of knowledge about their current status, not to mention how these *Z. noltii* prairies have evolved or whether their ecological status is declining.

Several authors agreed that, in order to provide appropriate conservation and management tools for seagrass ecosystems, genetic factors should be taken into account (Frankham, 2003; Procaccini, Olsen, and Reusch, 2007), incorporating long-term genetic monitoring that includes a genetic description of the populations and knowledge of the connectivity between them (Evans *et al.*, 2014; Schwartz, Luikart, and Waples, 2007). Moreover, effective conservation and management of natural populations often depend on the identification of management units within species that can be outlined according to the genetic structure and the degree of genetic connectivity between populations (Allendorf, Hohenlohe, and Luikart, 2010; Palsbøll, Berube, and Allendorf, 2007). Additionally, the spatial representation of the distribution of seagrass species can serve as a powerful tool for conservation planning, providing managers and administrators with the best understanding of the extent of the habitat (Johnson, Seip, and Boyce, 2004). Remote sensing techniques combined with field surveys are suitable for monitoring seagrass status and changes in area distributions in large regions and over long time scales (Dingtian and Chaoyu, 2012; Meyer and Pu, 2012; Roelfsema *et al.*, 2009).

The purpose of this work is to provide a first insight about the current status of these five Moroccan Atlantic lagoons, using two different management tools: (1) measuring the extension of *Z. noltii* meadows using remote sensing techniques and *in situ* field surveys and (2) compiling a genetic description of *Z. noltii* populations and the connectivity between them, as well as the genetic structure in the region that enables us to define management units. The results will provide precise parameters for future conservation and management strategies based on the current status of this sensitive species along the Moroccan coast.

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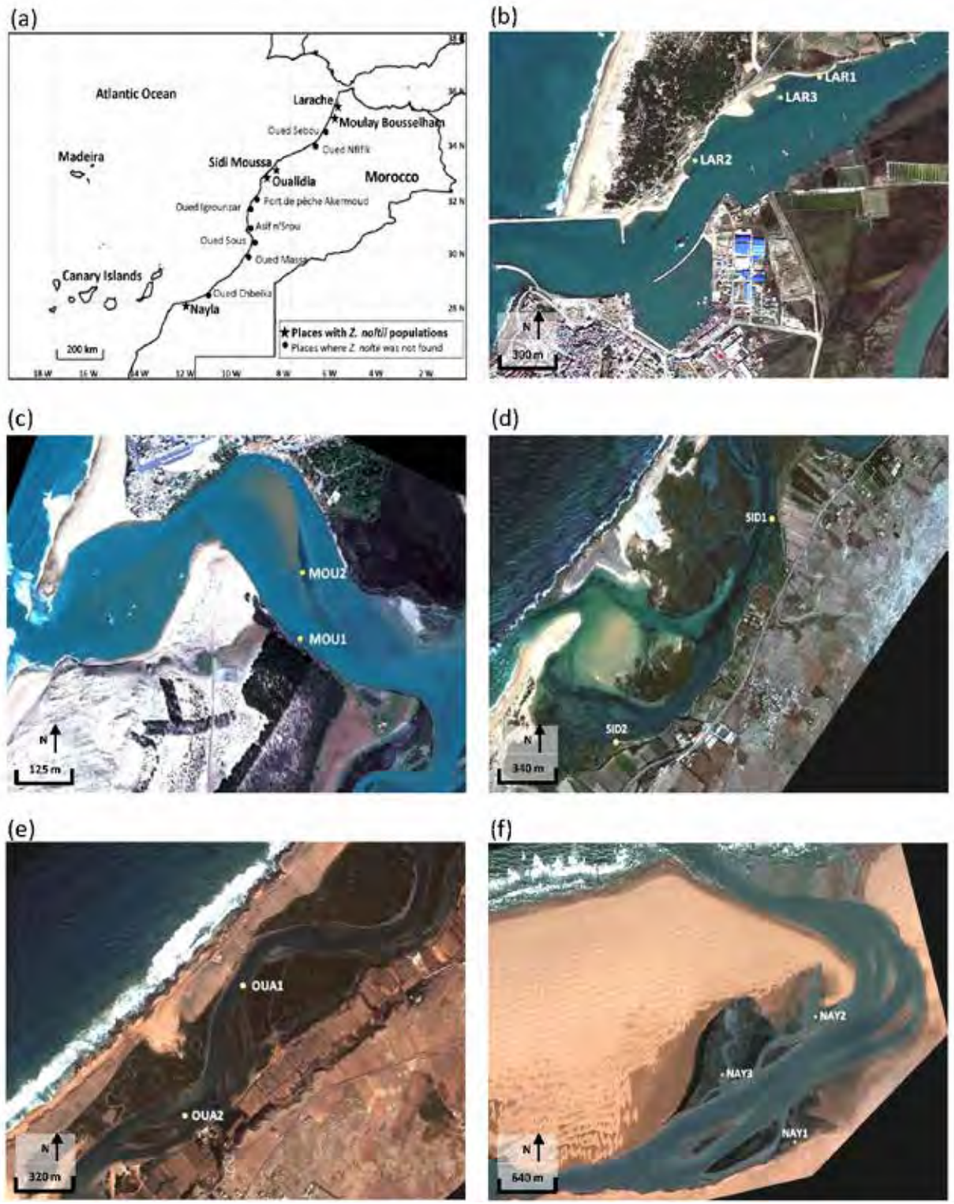

Figure 1. (a) Location of *Z. noltii* populations along the Atlantic Moroccan coast. ★indicates places where *Z. noltii* was found; • indicates sites where Z. noltii was not found. (b) Larache. (c) Moulay Bousselham. (d) Sidi Moussa. (e) Oualidia. (f) Nayla. In Figures 1b–f, • represents sampling areas for the genetic characterisation of *Z. noltii* populations/subpopulations and for *in situ* surveys used to estimate *Z. noltii* distribution using high-resolution satellite images.

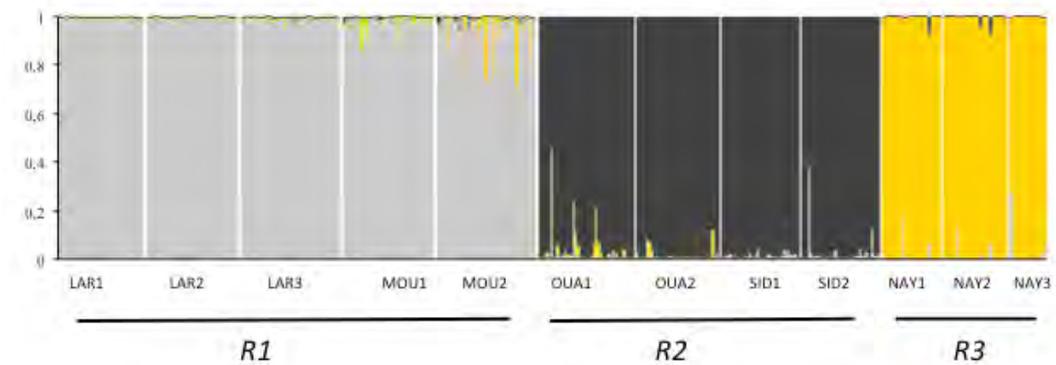

Figure 2. Bayesian assignment of individuals into K-3 genetic clusters using the program STRUCTURE v.2.3.4. Each column corresponds to one individual and each color represents a single cluster. The vertical height of each column denotes the probability of each individual belonging to each of the inferred clusters. Group R1 comprised subpopulations from the northern Moroccan region (LAR1, LAR2, LAR3, MOU1, and MOU2); group R2 included subpopulations from the central Moroccan region (OUA1, OUA2, SID1, and SID2); and group R3 was formed by subpopulations from the south Moroccan region (NAY1, NAY2, and NAY3).

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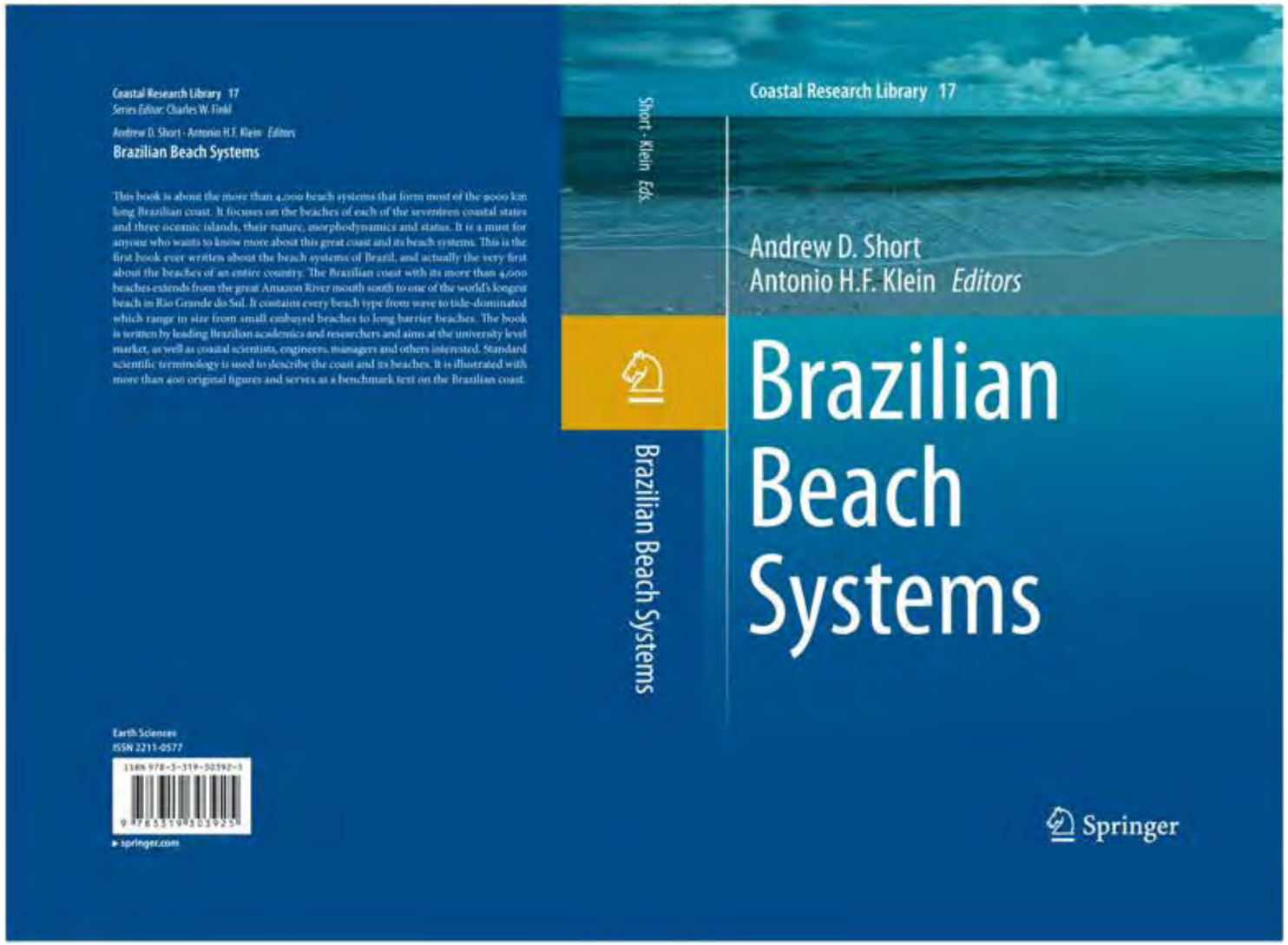

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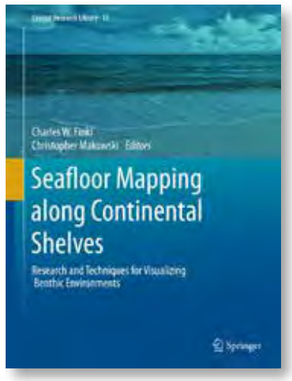

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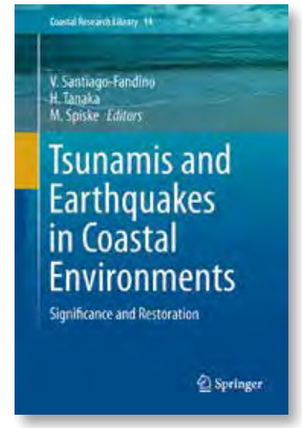

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The Influence of Sea-Level Rise on Wave-Energy Dissipation and Wave-Driven Currents at Buck Island Reef National Monument

The Influence of Sea-Level Rise on Wave-Energy Dissipation and Wave-Driven Currents at Buck Island Reef National Monument

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ABSTRACT

Modern Caribbean reefs have undergone significant degradation in the past century because of various anthropogenic stressors, which include climate-change-related impacts, hurricanes, and, potentially, sea-level rise. Degraded reefs will be unable to maintain sufficient vertical accretion with substantial increases in sea level, which will alter the hydrodynamics of these systems. A reduction in wave dissipation by reefs has the potential to shift the shorelines behind the reefs, potentially resulting in economic and habitat losses for tropical shorelines. This study focused on a barrier reef with low, live coral cover (<10%) and accretion rates comparable to current rates of sea-level rise in the region (~1.7 mm/y). Tides served as a proxy for sea-level rise, with the spring high tide representing a future low tide. These findings indicate that at low tide, infragravity wave frequencies (0.004–0.04 Hz) dominate in the lagoon and are a function of wave breaking on the reef. At high tide, the infragravity waves are less prominent. Current velocities were higher at high tide, averaging 0.14 m s^{-1} *vs.* 0.11 m s^{-1} at low tide. The spectral current characteristics correlate with the infragravity wave frequencies and suggest that these waves are a driving force in lagoon circulation. Wave-energy transmission increased at high tide by 20–30% throughout the sampling period. These results suggest that with sea-level rise, infragravity band waves will be reduced and affect the stresses on the sea bed and sediment-transport processes, also allowing larger and more energetic waves to reach the shoreline.

ADDITIONAL INDEX WORDS: *Infragravity waves, barrier reef, climate change, energy transmission, reef geomorphology, longshore transport.*

INTRODUCTION

In the tropics, coral reefs serve as natural shoreline protective structures, among many other essential ecological roles. The reef's structure forces wave transformation and breaking (Huang *et al.*, 2012; Lugo-Fernandez, Roberts, and Wiseman, 1998; Taebi *et al.*, 2012) because of the abrupt change in the seabed morphology. This process influences energy dissipation, wave-driven flows, bed shear stresses, and boundary-layer conditions (Young, 1989). Energy dissipation by coral reefs is crucial for shaping the reef morphology, shoreline stability, species distribution, and nutrient uptake (Hearn, 1999; Huang *et al.*, 2012; Massel and Gourlay, 2000). Reefs are especially important during storm events, forcing large storm waves to break offshore and preventing or minimizing the shoreline erosion that is often associated with hurricanes, typhoons, tropical storms, or cyclones, which is particularly important along densely populated coastlines (Hubbard *et al.*, 1991; Richmond, 1993).

The complexity of reef slopes and bottom roughness, along with spatial diversity, make hydrodynamic studies difficult using numerical models or field-based approaches (Massel and Gourlay, 2000); however, there are some similarities when comparing the reef bathymetry to that of an offshore bar (Péquignet *et al.*, 2011; Taebi *et al.*, 2012). As a wave approaches shallower water at the reef

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crest and breaks, radiation stresses are generated and impose forces on the water column (Hearn, 1999; Taebi *et al.*, 2012). Most wave-energy dissipation on a steep reef is attributable to wave breaking and bottom friction imposed by the roughness (Massel and Gourlay, 2000) and accounts for a majority of energy dissipation in the 0.06–0.3-Hz frequency band (Péquignet *et al.*, 2011). Wave breaking and subsequent flows tend to be the main driving force for lagoon circulation in barrier reef and atoll environments but in some locations can also be driven by tidal flows, wind, and buoyancy effects (Taebi *et al.*, 2012). Waves breaking on the fore reef generate wave setup on the front of the reef flat that creates a pressure gradient over the reef flat and lagoon that initiates water circulation (Hearn, 1999).

Early studies in coral reef hydrodynamics have shown a tidally dependent reduction in wave energy and current velocities (Lugo-Fernandez, Roberts, and Suhayda, 1998; Lugo-Fernandez, Roberts, and Wiseman, Jr., 1998; Roberts and Suhayda, 1983; Storlazzi *et al.*, 2004). Field-based experiments have also shown that wave breaking strongly influences currents and circulation within reef lagoons (Hearn, 1999; Lugo-Fernandez, Roberts, and Wiseman, Jr., 1998; Roberts and Suhayda, 1983; Roberts, Murray, and Suhayda, 1975). Lugo-Fernandez, Roberts, and Wiseman, Jr., (1998) observed stronger currents at low tide attributed to an increase in wave breaking. The current strength depends on the degree of wave setup, water depth, and friction and is therefore altered by the degree of wave breaking with the tides.

Numerical models have frequently been employed to investigate coral reef hydrodynamics (Mandlier and Kench, 2012; Massel and Gourlay, 2000; Péquignet *et al.*, 2011; Storlazzi *et al.*, 2011; Su, Sheremet, and Smith, 2011; Taebi *et al.*, 2012) and have been used to demonstrate the impact of sea-level rise at coral reefs (Grady *et al.*, 2013; Storlazzi *et al.*, 2011). These models suggest that increasing sea levels will result in the following: (1) decreasing breaking wave heights at the reef crest, (2) a landward migration of the maximum breaking wave, (3) larger wave heights and more energetic waves over the reef flat, (4) an increase in wave-induced shear stresses on the bed, and (5) stronger currents generated as a result of a reduced height in hydrodynamic roughness with greater wave driven flows.

Several of these models and experiments have demonstrated that negative ecological impacts could be associated with reductions in lagoon flushing associated with increasing sea levels (Lugo-Fernandez, Roberts, and Suhayda, 1998; Roberts, Murray, and Suhayda, 1975; Storlazzi *et al.*, 2011; Taebi *et al.*, 2012). The reduction of lagoon flushing influences nutrient availability, water clarity, sediment distribution, and community structure, which all affect overall coral health (Hearn, 1999; Lugo-Fernandez, Roberts, and Suhayda, 1998; Roberts, Murray, and Suhayda, 1975; Storlazzi *et al.*, 2011; Taebi *et al.*, 2012). Additional studies suggest that there would be increased turbidity on exposed reef flats, leading to ecological declines (Grady *et al.*, 2013; Storlazzi *et al.*, 2011).

It is essential to start assessing how reef processes will change if sea-level rise surpasses the rate of vertical reef accretion, which the current trends suggest. The Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report (Rhein *et al.*, 2013) projects a global sea-level rise ranging between 0.26 m and 0.82 m by 2100. Current sea-level rise rates in St. Croix are approximately 2.21 mm y^{-1} (NOAA, 2014), on par with these projections. Average contemporary reef accretion in Caribbean shallow water habitats is approximately 0.68 mm y^{-1} (Perry *et al.*, 2013). At these current rates, sea-level rise could outpace vertical reef accretion.

It is important to note that there is a combination of constructive and destructive processes that contribute to the reef accretion, with coral growth and carbonate production being a constructive process and bioerosion being a destructive process. The combination of these processes produces sediment that is redistributed around the reef, filling voids and channels. The binding of these sediments, taking into account the constant production and destruction, provides the net accretion of the reef itself. Additionally, there are numerous environmental factors (light, depth, *etc.*) that affect the species distribution, and certain coral species respond to various factors. Over time, as these factors change, succession can take place. Shifts from head corals to branching corals can be seen as depth decreases with time (Rogers, 1993). Therefore, it is necessary to consider the timelines of these reef-building processes relative to the rates of sea-level rise in addition to the shorter timescales of coral growth processes.

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Geologic coral reef records have provided insight into adaptations to changes in sea level (Rogers, 1993).Caribbean reefs survived the transition from the Pleistocene to the Holocene in which sea level rose 100 m, including two rapid pulses of increased sea level (Macintyre, 2007). Neumann and Macintyre (1985) coined the terminology of "keep up," "catch up," and "give up" reefs to categorize the relationships between reef growth rates, succession, and sea level. The keep up reefs maintain their previous growth rates under conditions of rapid sea-level rise, including increased turbidity and sedimentation. Catch up reefs lag in growth relative to sea level but are followed by rapid accretion with fast growing branching corals. Give up reefs are not able to maintain growth rates comparable to the rising sea level and drown. Many of these keep up reefs developed the platform for modern reefs in the Caribbean. In addition to sea-level rise, modern day reefs face a combination of stressors that reefs throughout the Holocene did not experience (Tager *et al.*, 2010), including ocean acidification, pollution, overfishing, and bleaching associated with increased sea-surface temperatures. Perry *et al.* (2013) found that modern accretion rates in the Caribbean are lower than rates throughout the Holocene. Additionally, they found that modern reefs require a 10% live coral cover to maintain a positive net accretion. Because of these factors, it is probable that the response and eventual fate of modern Caribbean reefs will be different than their predecessors.

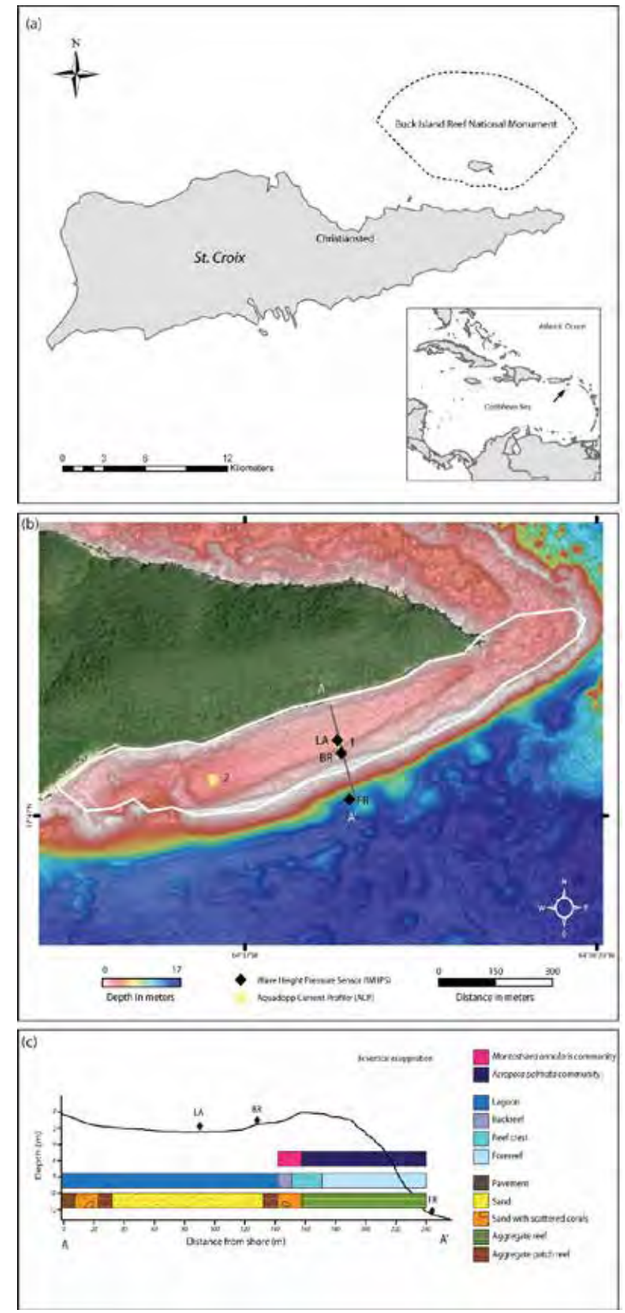

Figure 1. (a) Study site location. Buck Island Reef National Monument is a marine protected area; boundaries are indicated by dashed line. Buck Island is located about 2 km NE of St. Croix in the Caribbean Sea. (b) Bathymetry data derived from a 2011 LIDAR survey by the NOAA (NCCOS, 2013). The WHPSs are shown as black diamonds, and Nortek ACPs are shown as yellow circles. The white border outlines the lagoon area used for flushing analysis. The line labeled A-A' is the reef profile transect. (c) Reef profile extracted from the bathymetry data, A-A'. Color bars were constructed from benthic habitat characterizations derived from the 2011 LIDAR survey (NCCOS, 2013). The color bars only coincide with distance. The top color bar characterizes the predominant coral community and was ground-truthed by visual observations. The middle color bar represents the reef zonation.

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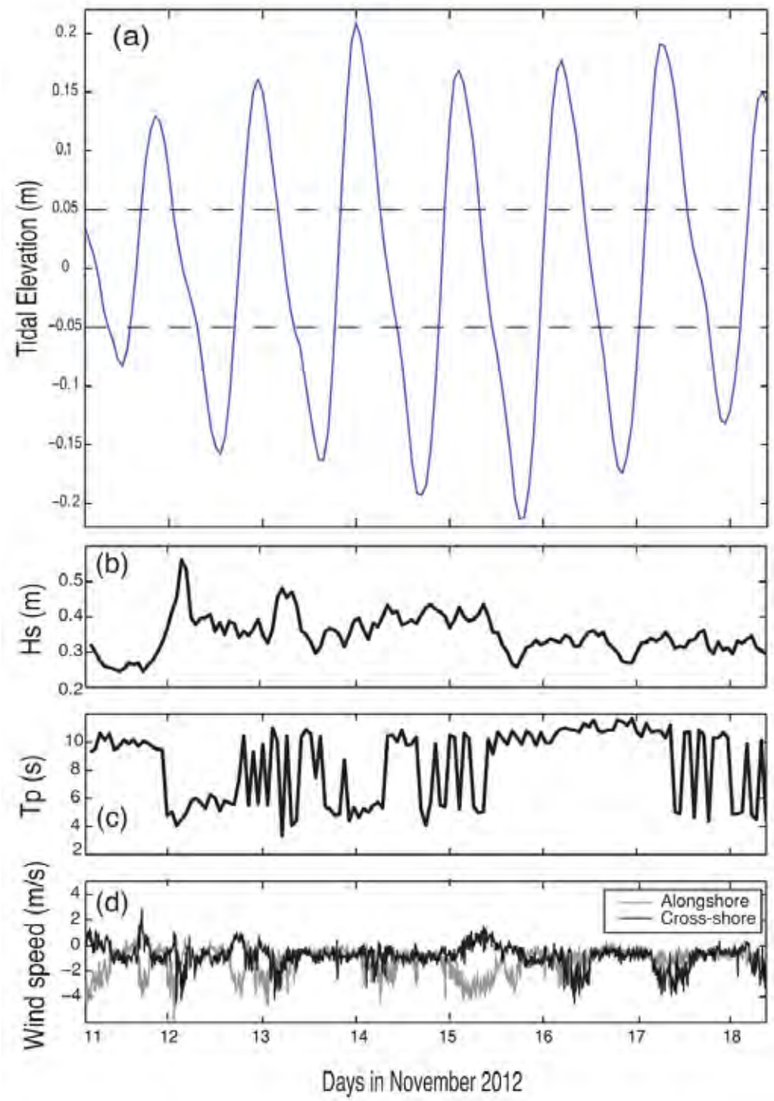

Figure 2. Offshore forcing conditions during the 7-day sampling period: (a) tidal range with the slack tide (±0.5 m) delineated by the dashed lines; (b) significant wave height (H_s); (c) dominant wave period (T_p); and (d) cross-shore and alongshore wind velocities, rotated for correlation analysis with currents.

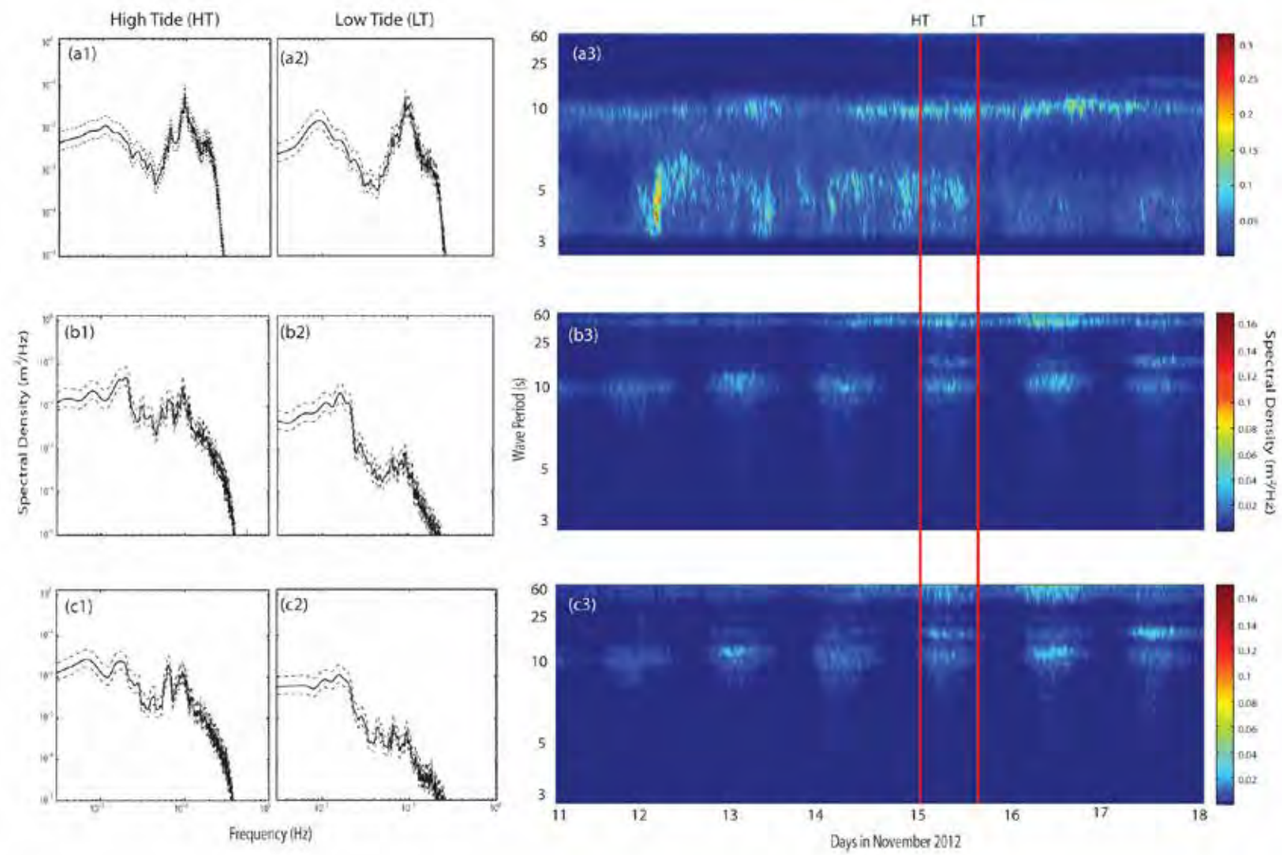

Figure 3. Spectral density plots by location: (a) FR, (b) BR, and (c) LA. High tide (HT) is displayed in the first column (a1)–(c1); low tide (LT) is displayed in the middle column (a2)–(c2), with dotted lines representing a 95% confidence interval. The spectral density for the entire sampling period is shown in the third column (a3)–(c3), with wave period displayed in seconds and $m^2\ Hz^{-1}$. The temporal location of HT and LT are depicted with red lines in the third column. Note that the color scale of (a3) differs from (b3) and (c3) in order to capture the higher densities of shorter period waves.

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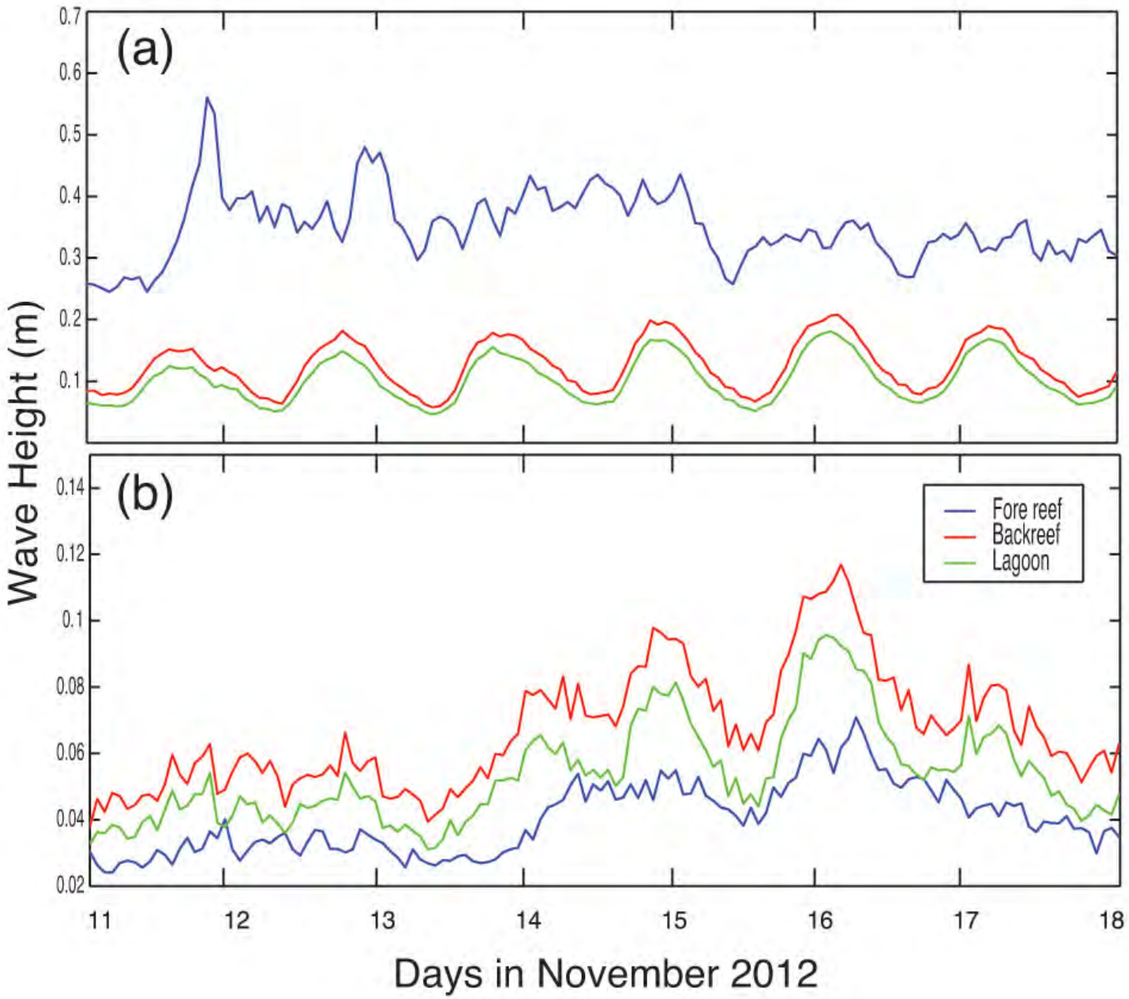

Figure 4. Significant wave heights at each of the WHPS locations (FR, BR, and LA) throughout the sampling period for the wind waves (a) and the infragravity waves (b).

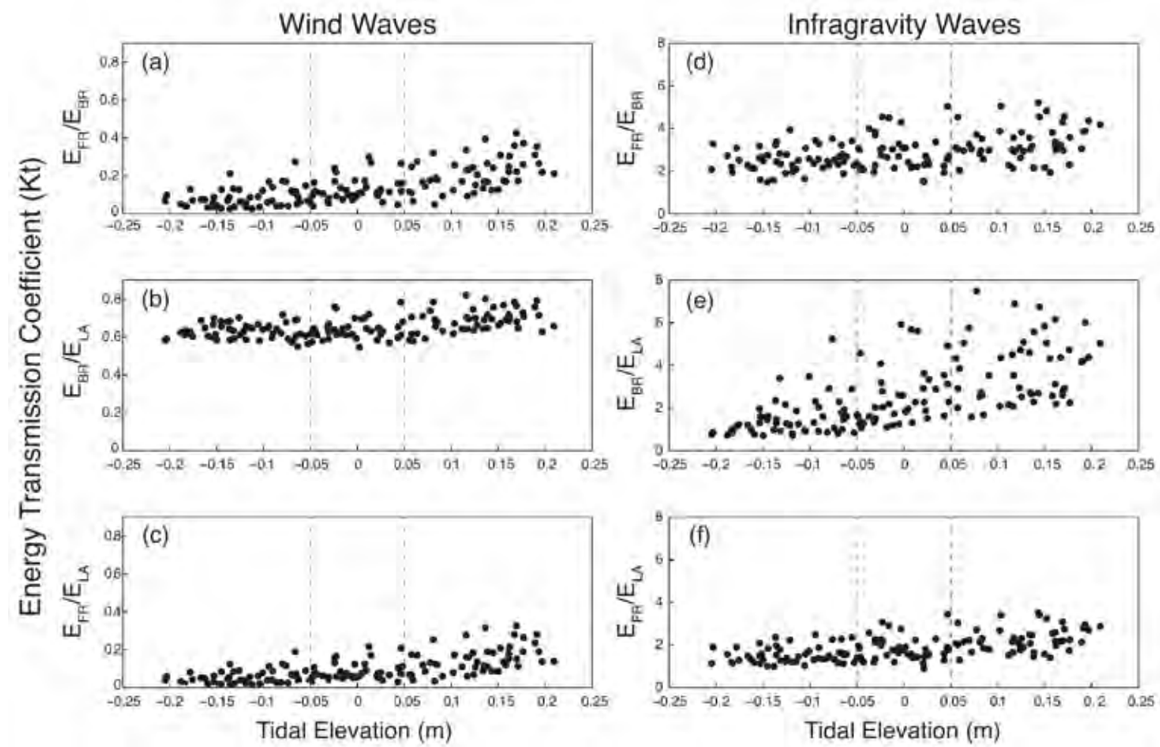

Figure 5. Energy transmission (*Kt*) for wind waves (a)–(c) and infragravity waves (d)–(f) *vs.* tidal elevation. The transect line from FR to BR are shown in (a) and (d), from BR to LA in (b) and (e), and from FR to LA in (c) and (f). The data points within the slack tide, delineated by the dashed lines, were not considered for either high or low tide *Kt* values.

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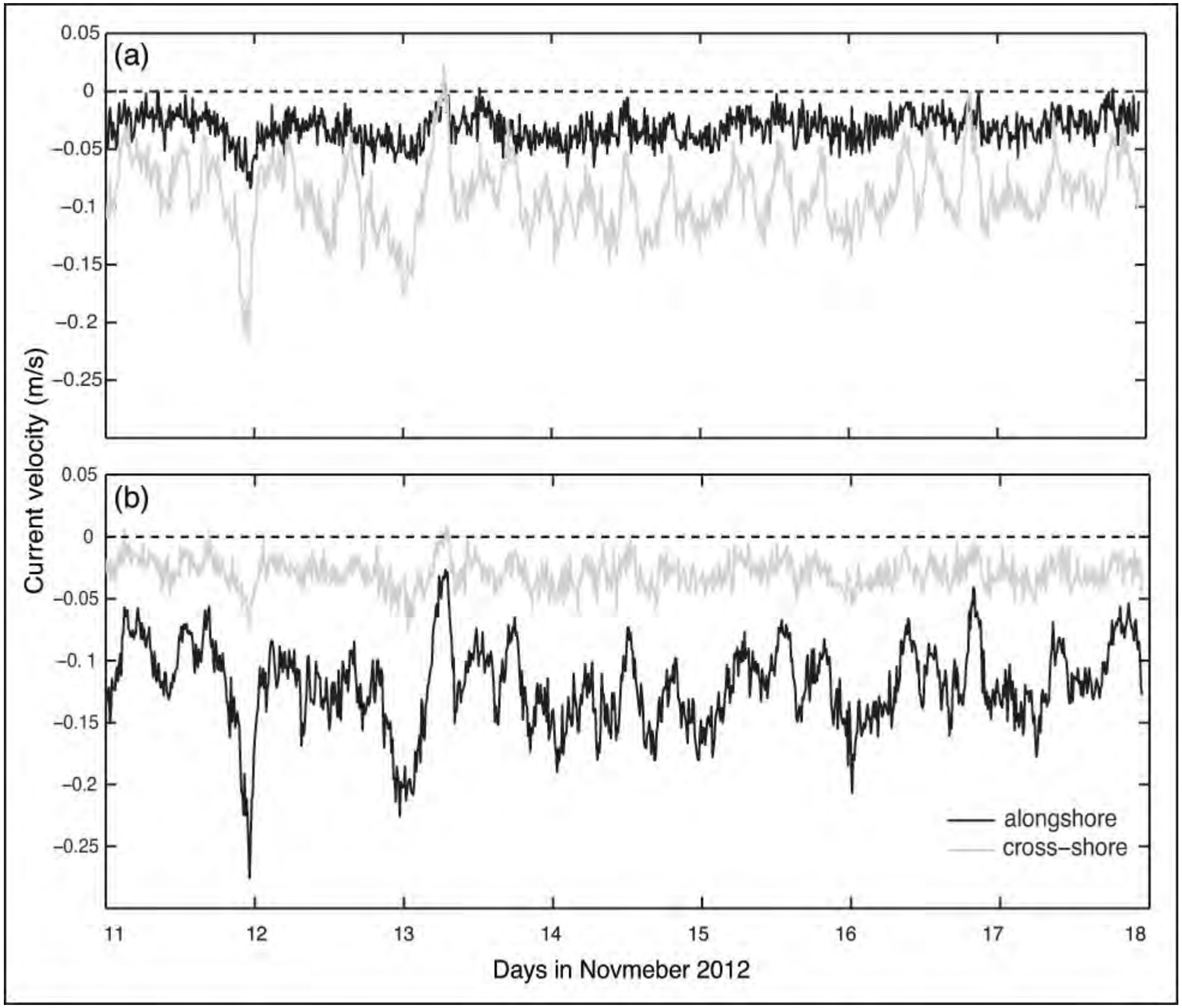

Figure 6. Depth-integrated currents: (a) ACP1 and (b) ACP2. Gray represents cross-shore flows, and black represents alongshore flows.

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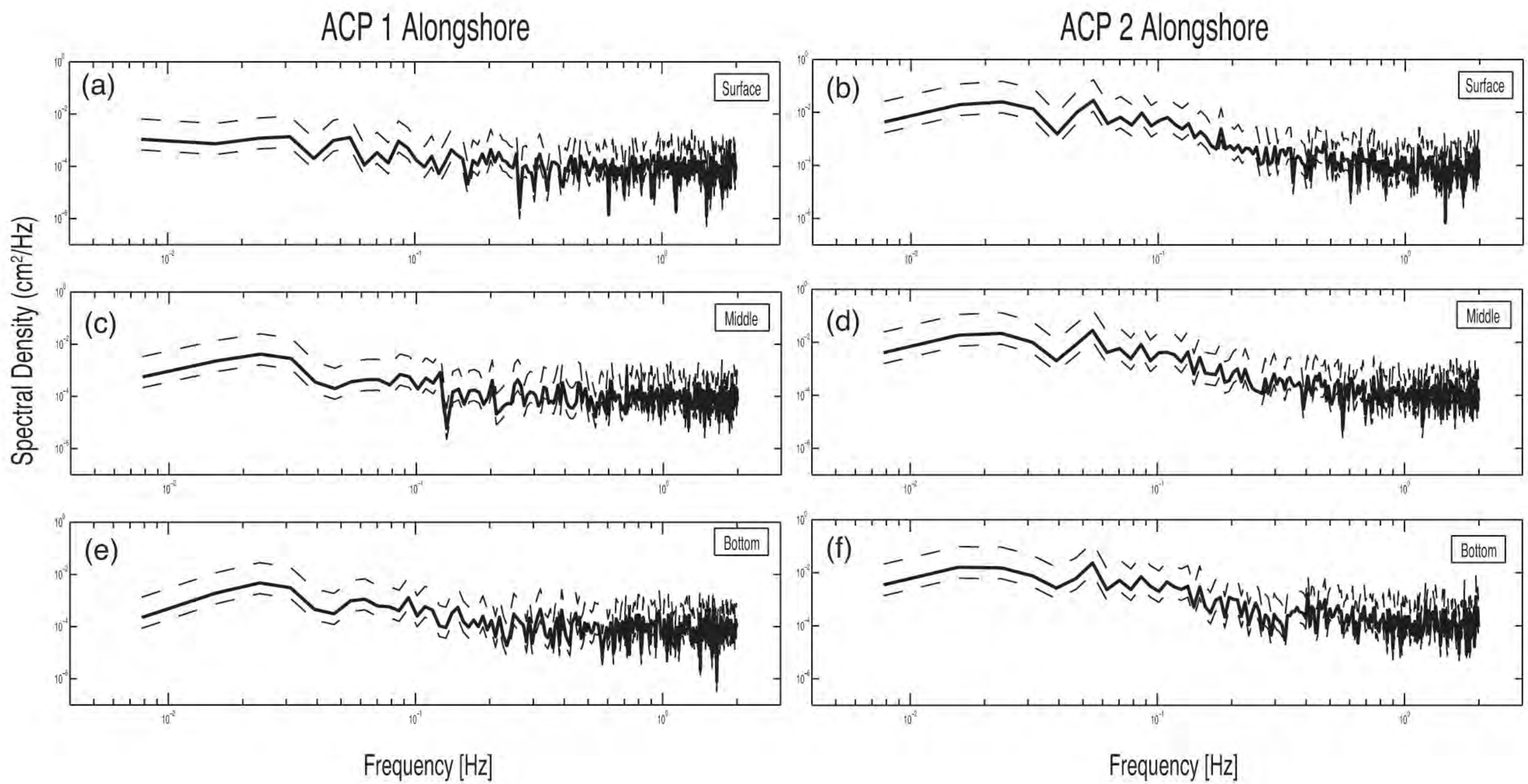

Figure 7. Spectral analysis of the alongshore current profiles for ACP1 (a), (c), and (e), and ACP2 (b), (d), and (f). The surface currents are shown in (a) and (b), mid-depth currents in (c) and (d), and the bottom currents in (e) and (f).

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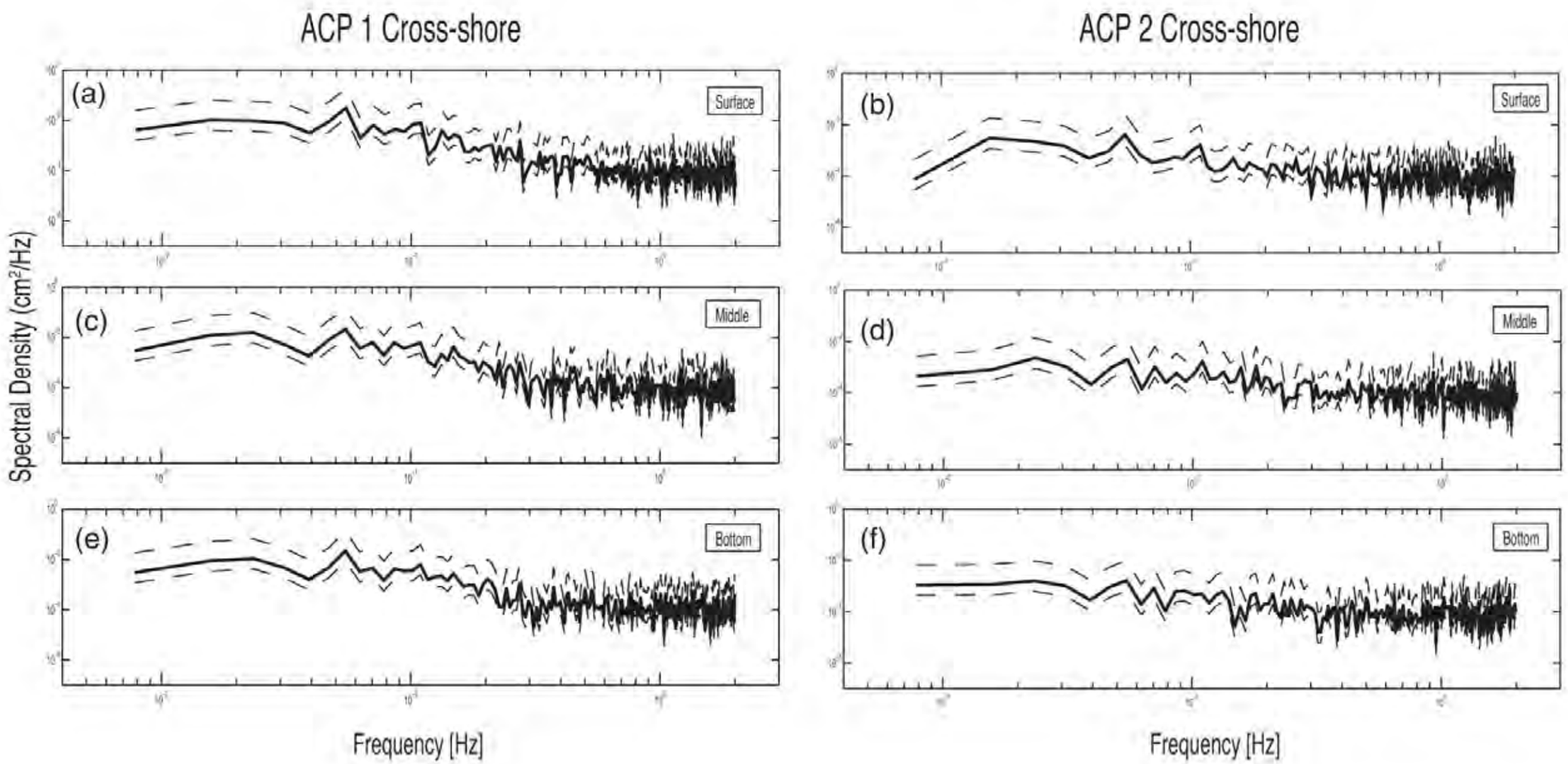

Figure 8. Spectral analysis of the cross-shore current profiles for ACP1 (a), (c), and (e), and ACP2 (b), (d), and (f). The surface currents are shown in (a) and (b), mid-depth currents in (c) and (d), and the bottom currents in (e) and (f).

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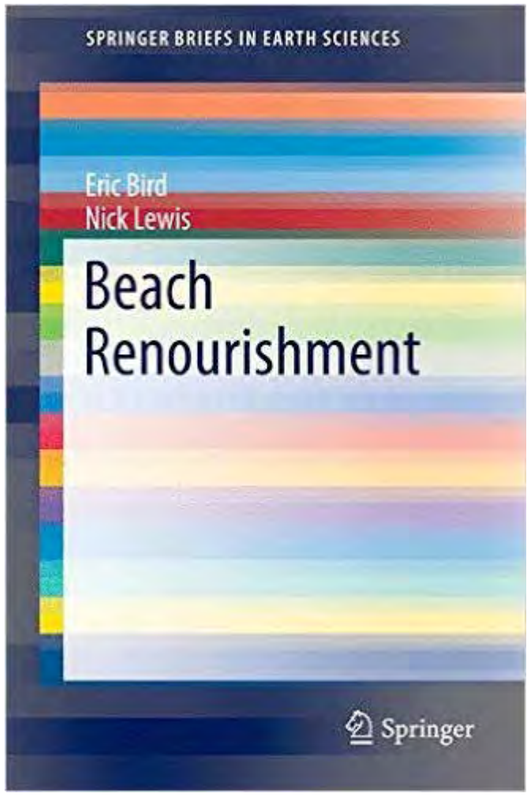
BOOK REVIEW



Bird, E. and Lewis, N., 2015. Beach Renourishment. Dordrecht, The Netherlands: Springer, 135p. Paperback with color illustrations, ISBN: 978-3-319-09727-5.

This is a neat little book by Eric Bird and Nick Lewis, both of whom are experienced coastal researchers. Although the volume is only 135 pages long as part of Springer Briefs in Earth Sciences series, the authors manage to hit most of the highlights and critical issues surrounding beach renourishment. Having said that, it means that no particular topic gets exhaustive treatment, as that is not the point of Springer Briefs. The coverage is, however, sufficient to give the reader a first glimpse of the issues and practices associated with this predominantly shore protection technique that is sometimes referred to as "soft stabilization or engineering." This term is applied in opposition to hard stabilization, which deploys engineering structures such as seawalls, groins, revetments, breakwaters, *etc.* instead of sand. The sand that is applied to eroding shores is regarded as sacrificial in the sense that it needs to be replaced, as it becomes "lost" to the offshore or downdrift coastal segments.

The book starts out by discussing the most commonly encountered cause of beach erosion, which is loss of sediment from the beach to such a degree that the dry beach width is reduced. The process is commonly referred to as shoreline retreat, as this is what most people observe or experience, notwithstanding the fact that beach sand can move offshore to the submerged part of the beach. This is the right place to start the book, as sediment supply is the crux of the matter. The principles of beach renourishment are next briefly discussed to advantage, emphasizing the importance of preliminary investigations, sand searches (sources of sediment for renourishment), methods of emplacement along the shore, and design considerations confronting coastal engineers.

Not to be forgotten is the process of monitoring changes over time after placement of the sand on the shore. This is a critical phase of the process because this is where lessons are learned. That is to say, this phase of renourishment projects attempts to ascertain why projects perform well or poorly. Assessment of project performance is critical to increased understanding of why some projects fail or do not perform as well as intended (as determined from the design life of the beach), and lessons are learned from such analyses to avoid the same pitfalls in future projects. It is a learning experience, and the authors bring out many ancillary aspects of the process that are related to potential environmental impacts of dredging alongshore on the seabed, loading and transport of the sand from offshore to the beach, and impacts associated with emplacement of sand on the shore.

Every beach renourishment project is unique because coastal segments differ from one another and require careful study before, during, and after completion. And many countries approach the process in slightly different ways to match their resources (biophysical and socioeconomic) and needs. Hence, there is discussion of different approaches to beach renourishment in various geographic regions.

In the opinion of the reviewer, who has hands-on experience working on many beach renourishment projects, the authors have done a laudable job of summarizing key points and issues. This book thus may well serve as a primer for those not initiated into the beach renourishment experience. This paperback is handsomely produced, and diagrams and color illustrations support the text. As a quick introduction to a complex process, this book provides effective oversight and relevant perspectives that are not biased pro or con for a process that is not without controversy.

I recommend the book to those researchers and workers who are just starting out in the field and who wish to get an overview of the subject. And for those of us who are or have been involved with aspects of beach renourishment, this handy book will serve as refresher. In many ways, this book is like an apophoreta and is indeed something to be savored before the main course of investigation into the ins and outs of beach renourishment. For coastal managers, this book would seem to be a "must have" because it succinctly presents most aspects of beach renourishment in understandable terms without invoking technical jargon that is so familiar to practitioners. I recommend Beach Renourishment unreservedly to consultants, politicians, managers, students, and members of the academy in professorial ranks.

Charles W. Finkl
Fletcher, North Carolina, U.S.A.

Special Announcement:
REQUEST FOR QUALIFICATIONS

The California State Coastal Conservancy ("Conservancy") anticipates a need for environmental, engineering, architectural, landscape architectural, and construction project management consulting services for Conservancy projects and programs over the next twelve months. The Conservancy seeks to identify individuals and firms providing these services. To submit your qualifications, complete the attached questionnaire, also posted at www.scc.ca.gov, and email it to mary.aledo@scc.ca.gov. The questionnaire is used to identify firms with appropriate qualifications. Specific requests for more detailed submittals will be issued for specific projects over the coming year.

All information received will be kept on file for at least one year from the date of this request. Conservancy staff will use this information in soliciting services, as needed, for upcoming Conservancy projects. Specific project details including contract identification numbers are not available at this point. Any resulting contract will be awarded without discrimination based on race, color, ethnic group identification, religion, age, sex, sexual orientation, disability, or national origin. State certified Small Businesses and Disabled Veteran Business Enterprises are encouraged to submit.

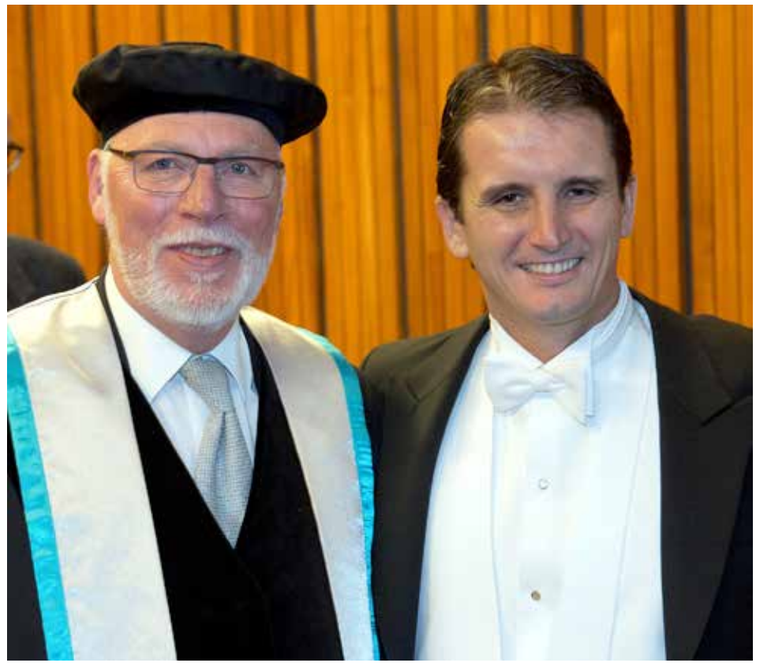
The Conservancy acts to preserve, restore and enhance California's coastal and marine resources and to solve land use problems on the coast and around San Francisco Bay. Conservancy projects fall within the following categories: (1) public access (*e.g.*, trails, bridges, parking, recreational and interpretive facilities); (2) revitalization of urban waterfronts and shoreline facilities; (3) resource conservation and enhancement (*e.g.*, restoration and enhancement of wetlands and endangered species' habitats); (4) coastal preservation (*e.g.*, lot consolidation; transfer of development rights; coastal land acquisition); (5) agricultural land preservation (*e.g.*, acquisition of interests in coastal agricultural land and resolution of land use problems); (6) watershed restoration to improve water quality; (7) marine and coastal resource education; (8) climate change adaptation and mitigation; and (9) urban greening.

In connection with projects in these areas, we are soliciting consultants with experience and expertise in: surveying and mapping; climate change issues; construction project management; civil and hydrological engineering; habitat restoration design; landscape architecture; trail planning and engineering; water quality assessment; geotechnical and geomorphic assessment; structural analyses; pre-project feasibility analyses; economic analyses; hazardous or toxic substance investigations; wetland, watershed, or subtidal assessments; archaeological studies; environmental documentation and assessment under the California Environmental Quality Act and other environmental laws and regulation; botanical studies; agricultural studies; soil analyses; biological investigations; natural resource permitting; site and land use planning; environmental monitoring; and other program-related environmental services, such as appraisals for resource conservation purposes.

Photograph by the California State Coastal Conservancy and AECOM Design + Planning showing the South Bay Salt Pond Restoration Project

Honors and Awards

Professor Marcel Stive and Lindino Benedet at TU Delft, Delft, The Netherlands

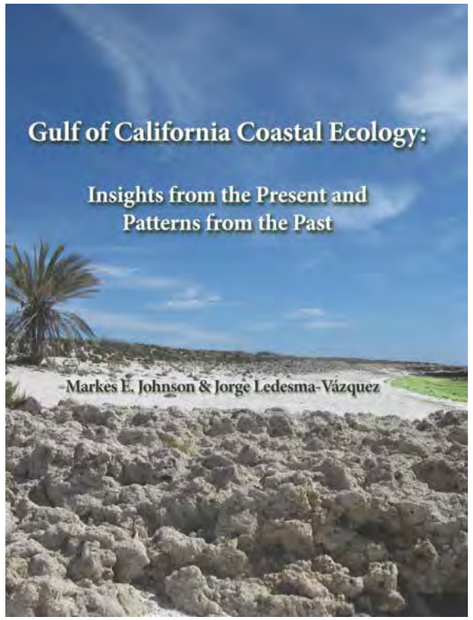


Marcel Stive and Lindino Benedet at the Ph.D. defense ceremony of now Dr. Benedet on April 2016 at TU Delft, Delft, The Netherlands. Professor Stive recently announced his retirement and is stepping down from his position as the Head of the Hydraulic Engineering Department of TU Delft. Prof. Stive, one of the most prominent coastal engineers of our time, is also a JCR Board Member and a Trustee of the Coastal Research and Education Foundation (CERF). Prof. Stive provided invaluable contributions to the field of coastal engineering through his innovative research, education, and mentoring. Recent achievements of Prof. Stive include the 2013 Knighthood in the order of the Durch Lion, Netherlands, the 2015 International Coastal Engineering award by the American Society of Civil Engineers (ASCE), and the 2015 Coastal Award at the Coastal Sediments Conference in Sand Diego. We wish Prof. Stive a plentiful post-retirement life and we hope that he will continue to contribute to the field of Coastal Engineering through selected research projects in this new phase of his career. His work will also continue to be carried on by his many Ph.D. students that now occupy prominent positions in the Academia, Government, and Industry. Dr. Benedet, who is Marcel's 28th Ph.D. student, defended his Ph.D. at TU Delft on April 5th, 2016. His thesis was entitled "Processes Controlling Beach Nourishment Performance at Delray Beach" and it provided many insights into processing beach changes due to abrupt offshore bathymetric anomalies. Dr. Benedet is also a Member of the Editorial Board of the JCR and a former M.Sc. student of JCR Editor-in-Chief and CERF President, Dr. Charles W. Finkl. Dr. Benedet now serves as the Director the Coastal & Maritime Services Business Line for CB&I, where he leads a team of 200+ professionals dedicated to coastal work. Parallel to his career in the consulting arena, Dr. Benedet continues to conduct research through collaborations with his former supervisors, colleagues from academia and consulting, and mentoring of M.Sc. students.

Recently Published

Gulf of California Coastal Ecology: Insights from the Present and Patterns from the Past

by Markes E. Johnson and Jorge Ledesma-Vázquez



Co-authored by geologist Jorge Ledesma-Vázquez, this handbook on ecology and paleoecology is infused with insights on the origins and development of Mexico's Sea of Cortés during a span of more than 12 million years. It makes the connection between a beautiful shell washed onto a beach with the discovery of the same or a similar fossil shell from a nearby limestone cliff. The concept of natural history appears less often in increasingly specialized literature, nowadays, failing to draw a connection between the present and the distant past. This book makes the connection and brings the past alive. It deals with multiple and interlocking ecosystems and their fossil counterparts, providing a holistic overview on geography, ecology, and geology. Students, scholars, and outdoor enthusiasts of all kinds will find this guide an indispensable resource for exploration of virtually any stretch of coastline on the Gulf of California.

Markes E. Johnson is the Charles L. MacMillan Professor of Natural Science, Emeritus, at Williams College in Williamstown, Massachusetts, where he taught courses in historical geology, paleontology, and stratigraphy in the Geosciences Department over a 35-year career. Professor Johnson also currently serves as an Editorial Board Member for the *Journal of Coastal Research* (JCR). His undergraduate education in geology concluded with a BA degree (1971) from the University of Iowa and his advanced training in paleoecology culminated with a Ph.D. degree (1977) through the Department of Geophysical Sciences at the University of Chicago. With 25 years of field experience in Baja California, Johnson has been a semi-annual visitor to the frontier states of Mexico where he habitually led field courses and supervised thesis projects for students from Williams College. He is an authority on the geology of ancient shorelines and the evolution of inter-tidal life through geologic time based on studies conducted around the world from Western Australia to China's Inner Mongolia to the fringe of Arctic lands across Siberia, Norway, and Canada, as well as comparatively young island groups such as the Seychelles in the Indian Ocean and the Cape Verdes in the North Atlantic. Whether on explorations near or far away, this traveler has always been drawn back to the wild islands in the western Gulf of California and their associated peninsular shores. The author lives with his spouse, Gudveig Baarli, in Williamstown, Massachusetts, where they maintain an active and mutually supportive schedule of ongoing research and writing projects.

For more information, please visit:
http://sunbeltpublications.com/shop/gulf-of-california-coastal-ecology/

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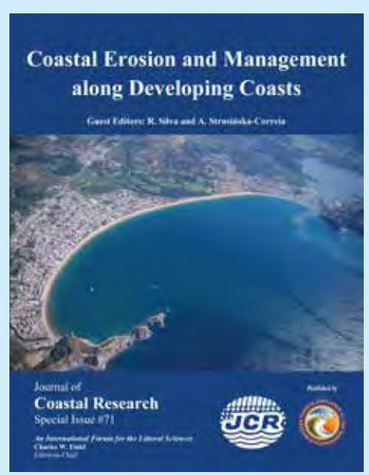

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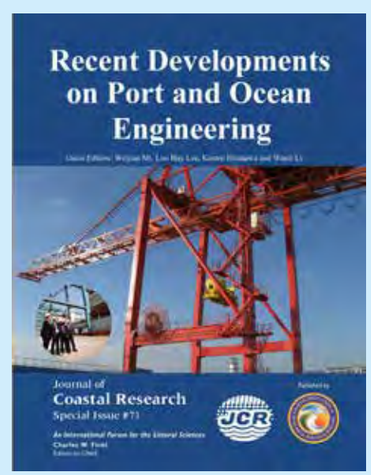

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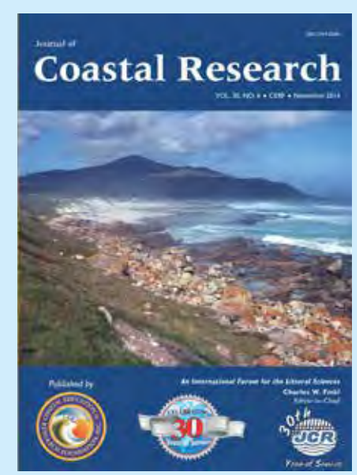

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Toolinna Cove along Baxter Cliffs - member submission

The Coastal Education and Research Foundation (CERF) is a nonprofit scientific society dedicated to the advancement of the coastal sciences and is devoted to the multi-disciplinary study of the complex problems within and around the coastal zone. Our goal is to help translate and interpret coastal issues for the public and to assist in the development of professional coastal research programs. Our Society specifically supports and encourages field and laboratory studies on a local, national, and international basis. Through the mediums of renowned scientific papers, book and encyclopedia series, our monthly society newsletter (*JUST CERFing*), and the world wide web, CERF disseminates the latest research information to professors, specialists, researchers, and the general public in an effort to maintain or improve the quality of our planet's coastal resources.

We encourage you to navigate through our website and explore the many benefits and opportunities that CERF has to offer. One such benefit to CERF members is the internationally acclaimed, *Journal of Coastal Research* (JCR), which offers the most current published research from today's top coastal scientists.

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All possible submissions must depict some coastal or underwater/marine scene and must be high-quality (>300 dpi) image files in either a jpg, tiff, or gif format. In addition, a short caption must accompany the photograph. The caption should include the specific location of the photograph, the date taken, the geological or coastal significance, and your CERF member contact information (full name, title, phone, email, and CERF member number). Example captions can be found on the Gallery page of this website.

While most submissions will be selected for either the CERF website or inside the JCR, a chosen few will actually be selected to be the cover image of a JCR Issue! So dust off those cameras and submit your photos.

Submit your photo and information by email attachment to CMakowski@cerf-jcr.com

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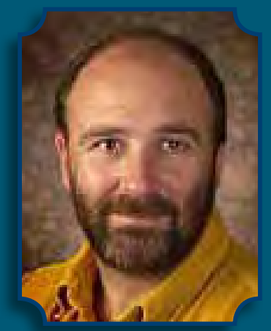

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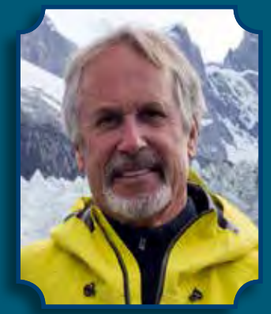

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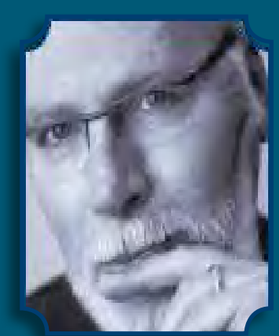

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Dr. Wei Zhang

Mr. Charles Thibault

Dr. Erik van Wellen

Dr. Frédéric Bouchette

A Special Acknowledgement To:
Associate Professor Dr. Charles Lemckert
CERF Lifetime Member

We are proud to acknowledge Associate Professor Dr. Charles Lemckert as the Coastal Education & Research Foundation's first ever Lifetime Member. Dr. Lemckert has always showed great support for CERF and the JCR, and even served as the Chair and Organizer of the 9th International Coastal Symposium (ICS) at Griffith University (Queensland, Australia) in 2007. We are honored to have Dr. Lemckert as a Lifetime Member and warmly recognize his devotion to our coastal research society.

Associate Professor Lemckert has active research interests in the fields of physical limnology, coastal systems, environmental monitoring techniques, environmental fluid dynamics, coastal zone management and engineering education. Along with his postgraduate students and research partners he is undertaking research studies on water treatment pond design (for recycling purposes), the dynamics of drinking water reservoirs, the study of whale migration in South East Queensland Waters, end ocean mixing dynamics.

Selected Publications:

Ali, A.; Lemckert, C.J.; Zhang, H., and Dunn, R.J.K., 2014. Sediment dynamics of a very shallow subtropical estuarine lake. *Journal of Coastal Research*, 30(2), 351-361.

Dunn, R.J.K.; Lemckert, C.J.; Teasdale, P.R., and Welsh, D.T., 2013. Macroinfauna Dynamics and Sediment Parameters of a Subtropical Estuarine Lake—Coombabah Lake (Southern Moreton Bay, Australia). *Journal of Coastal Research*, 29(6A), 156-167.

Ali, A.; Lemckert, C.J., and Dunn, R.J.K., 2010. Salt fluxes within a very shallow subtropical estuary. *Journal of Coastal Research*, 26(3), 436-443.

Brushett, B.A.; King, B., and Lemckert, C.J., 2011. Evaluation of met-ocean forecast data effectiveness for tracking drifters deployed during operational oil spill response in Australian waters. *Journal of Coastal Research*, 64, 991-994.

Lemckert, C.J.; Zier, J., and Gustafson, J., 2009. Tides in Torres Strait. *Journal of Coastal Research*, 56, 524-52.

For a complete list of Dr. Lemckert's publications or
his contact information, please visit:
http://www.griffith.edu.au/engineering-information-technology/griffith-school-engineering/staff/associate-professor-charles-lemckert

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Professor Yong-Sik Cho
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We are proud to acknowledge Professor Yong-Sik Cho as a Lifetime Member of the Coastal Education & Research Foundation. Professor Cho, Yong-Sik received his bachelors and masters degrees from Hanyang University in February 1981 and August 1988 respectively, and his Ph.D. from the School of Civil and Environmental Engineering of Cornell University in January, 1995. The title of the thesis is "Numerical Simulations of Tsunami Propagation and Run-up" (Advisor: Professor Philip L.-F. Liu).

He had continuously worked at Cornell University as a Post-Doctoral Associate after graduation. From March of 1997, he had been employed as an Assistant Professor at the Department of Civil and Environmental Engineering at Sejong University and then moved to Hanyang University in March, 2000. From February 2003 to January 2005, he had served as the Chair of the Department of Civil and Environmental Engineering at Hanyang University. Professor Cho has served as the Director of Innovative Global Construction Leader Education Center, a government enterprises sponsored by the Ministry of Education, Science and Technology, and the Chair of Graduate Studies of the Department of Civil and Environmental Engineering since 2006.

Professor Cho has published 52 journal papers in prominent international journals registered in Science Citation Index such as *Coastal Engineering*, the *Journal of Coastal Research*, the *Journal of Fluid Mechanics*, the *Journal of Hydraulic Research*, *Physics of Fluids*, the *Journal of Geophysical Research*, the *Journal of Engineering Mechanics, and Ocean Engineering*. He has also published 120 papers in domestic journals and about 360 proceedings in international and domestic conferences. Professor Cho has also registered eight patents.

Selected Publications:

Kim, Y.-C.; Choi, M., and Cho, Y.-S., 2012. Tsunami hazard area predicted by probability distribution tendency. *Journal of Coastal Research,* 29(5), 1027-1038.

Cho, Y.-S., 2012. Numerical study for spreading of a pollutant material in coastal environment. *Energy Sources*, Part A, 34(16), 1459-1470.

Cho, Y.-S.; Kim, T.-K.; Jeong, W.-C., and Ha, T.-M., 2012. Numerical simulation of oil spill in ocean. *Journal of Applied Mathematics*, 2012, 1-15.

For a complete list of Professor Cho's publications or his contact information, please visit: http://civil.hanyang.ac.kr/coast/

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DEGREES AND DIPLOMA

July, 2000: Ph.D. (Marine Sediment Dynamics), Institute of Oceanology, Chinese Academy of Sciences (China)

July, 1997: M.Sc. (Coastal Geomorphology and Sedimentology), Department of Geography, Nanjing Normal University (China)

July, 1994: B.Sc. (Geomorphology and Quaternary Geology), Department of Geo-Ocean Sciences, Nanjing University (China)

RESEARCH INTERESTS

Marine Sediment Dynamics; Benthic Boundary Layer Processes; Estuarine and Coastal Morphodynamics

RESEARCH PROGRAMMES (PI)

Monitoring and Development of support system on seabed topographical changes in Pearl River Estuary and Taiwan Shoal. Ocean special funds for scientific research on public causes (No. 201105001-2). 2011-2014. RMB 1,570,000 (about USD240,000).

Simulation on the evolution and realignment of North branch, Changjiang Estuary (No. BK2010050). Jiangsu Key NSF. 2010-2012. RMB 250,000 (about USD38,000).

Physical processes near bottom boundary layer in shallow seas with strong tides and high turbid water. China NSF (No. 40876043). 2009-2011. RMB 500,000 (about USD77,000).

Study and strategy on typical marine hazards of Hainan. Comprehensive Survey and Evaluation Program of Coastal Sea, Hainan Province (No. HN908-02-05). 2008-2011. RMB 250,000 (about USD38,000).

Sediment dynamics and associated environment response in intertidal area and estuary. Program for New Century Excellent Talents in University(No. NCET-06-0446). 2007-2009. RMB 500,000 (about USD77,000).

Wave-current dynamic processes and tidal basin system evolution over tidal flats. China NSF (No. 40576040). 2006-2008. RMB 380,000 (about USD58,000).

The estuary evolution by human activity impacts and associated hazards potential analysis. Jiangsu NSF (No. BK2006131). 2006-2008. RMB 75,000 (about USD12,000).

Siltation hazard and strategy on major embayment and estuary. National Comprehensive Survey and Evaluation Program of China Coastal Ocean (No. 908-02-03-08). 2005-2009. RMB 250,000 (about USD38,000).

Physical oceanography and marine meteorological survey in Jiangsu coastal sea. National Comprehensive Survey and Evaluation Program of China Coastal Ocean (No. JS-908-01-01). 2005-2009. RMB 921,000 (about USD140,000).

SELECT PUBLICATIONS; Refereed Publications (English papers only)

Huang, H; Wang, Y.P.; Gao, S.; Chen, J.; Yang, Y., and Gao J., 2012. Extraction of morphometric bedform characteristics from profiling sonar datasets recorded in shallow coastal waters of China. *China Ocean Engineering*, 26(3), 469-482.

Yunling Liu, Y.; Wang, Y.P.; Li, Y.; Gao, J.; Jia, J.; Xia, X., and Gao, S., 2012. Coastal embayment long-term erosion/siltation associated with P-A relationships: A case study from Jiaozhou Bay, China. *Journal of Coastal Research*, 28(5), 1236-1246.

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A Special Acknowledgement To:

Professor Nicholas K. Coch, Ph.D., C.P.G
CERF Lifetime Member

We are proud to acknowledge Professor Dr. Nicholas K. Coch as a Lifetime Member of the Coastal Education & Research Foundation. Dr. Coch received his Ph.D. in 1965 from Yale University with a specialization in sedimentology and coastal geology. In 1967, he joined the faculty at Queens College of the City University of New York (CUNY). He is now a Professor of Geology in the School of Earth and Environmental Sciences at Queens College of C.U.N.Y. and a member of the Doctoral Faculty of CUNY at the Graduate Center. He has co-authored two college geology textbooks (PHYSICAL GEOLOGY) and is the author of GEOHAZARDS (Pearson). In 2008, he received the President's Award for Teaching Excellence at Queens College and the John Moss Award For Excellence in College Teaching from the National Association of Geology Teachers. His research studies since 1967 have included sedimentation on the Moon, as a Principal Investigator in NASA's Lunar Sample Study Program, and shipboard studies of continental shelf, coastal and estuarine areas in the Northeast, as well as ground and aerial studies of the effects of hurricanes on coasts and urban centers.

His recent research deals with the effects of hurricanes on coasts, urban centers and inland areas, in predicting hurricane damage and in critically analyzing our coastal management policies in a time of sea level rise. He has carried out ground and aerial studies of most recent hurricanes as well as forensic studies of older (16th-20th century) hurricanes.

He is a Fellow of the Geological Society of America and a Member of The American Meteorological Society, Society of Sedimentary Geologists, National Association of Geology Teachers, American Association of Petroleum Geologists and is a Certified Professional Geologist.

Dr. Coch is an expert on Northern Hurricanes and has been a consultant to the N.Y. City Emergency Management Organization and the N.Y.S. Office of Emergency Management. He has presented hurricane seminars to emergency management and government officials in every county in southern New York as well as insurance, reinsurance and risk management groups nationwide. In 2003, he was chosen as a Sigma Xi Distinguished Lecturer for 2004-2007, and presented lectures on his research at educational and research facilities in the U.S. and Canada.

Programs including aspects of his hurricane research have aired on the CNN, PBS, Weather, Discovery, History and National Geographic Channels, and in local, national and international news programs and periodicals.

Selected Publications:

Coch, N.K., 2015. Unique vulnerability of the New York-New Jersey Metropolitan Area to Hurricane Destruction. *Journal of Coastal Research*, 31(1), 196-212.

Coch, N.K., 2013. A field course in tropical coastal geology. *Journal of Coastal Research*, 29(6A), 214-225.

Coch, N.K., 2006. The unique vulnerability of the Northeast U.S. to hurricane damage. Geologic Society of America, Abstract with programs, National G.S.A. Meeting (Philadelphia, Pennsylvania).

For a complete list of Dr. Coch's publications or his contact information, please visit:

http://www.qc.cuny.edu/Academics/Degrees/DMNS/sees/People/Pages/FacultyResearch.aspx?ItemID=23

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We are proud to acknowledge Dr. Hany Elwany as a Lifetime Member of the Coastal Education & Research Foundation. Dr. Elwany received a B.S. degree in Engineering from Alexandria University in 1971. In 1977, he completed his Ph.D. at the University of Dundee, United Kingdom. He obtained an additional B.S. degree in Mathematics and Statistics at Alexandria University in 1980. Dr. Elwany has extensive experience with nearshore oceanography, coastal processes, coastal engineering, and estuarine dynamics. He was the principal investigator for the physical oceanographic program of one of the largest environmental studies ever conducted on the U.S. west coast (at San Onofre). He has conducted in-depth studies of Nile Delta erosion, particularly since the construction of the Aswan Dam. His experience also includes projects involving optimization, numerical modeling, structural dynamic analysis, design of offshore structures, and data analyses, simulation, and dynamic modeling of ocean and coastal conditions. As an educator, both at Liverpool and Alexandria Universities, he taught courses in dynamics, statistics, numerical analysis, computer applications, and maritime engineering.

Dr. Elwany also serves as the President of Coastal Environments, a unique multi-disciplinary oceanographic, coastal engineering, and environmental consulting firm. Coastal Environments, founded in 1988, is comprised of over 30 professional associates, all experts in their respective fields. Technical specialties include coastal and ocean engineering, engineering geology, oceanography, marine biology and geology, environmental analysis, economics, statistics, and computer programming/modeling.

For more information about Dr. Elwany and Coastal Environments, please visit:

http://coastalenvironments.com/

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We are proud to acknowledge Dr. Björn Kjerfve as a Lifetime Member of the Coastal Education & Research Foundation. He is the former Dean of the College of Geosciences and was a Professor of Oceanography at Texas A&M University, 2004-2009. While at Texas A&M, he oversaw four academic departments, the Texas Sea Grant Program, and the Integrated Ocean Drilling Program (IODP), including the 475'ocean sciences drilling vessel, D/V JOIDES Resolution. Kjerfve was previously Professor of Marine and Geological Sciences at the University of South Carolina, 1973-2004, and served as the Director of the Marine Science Program, 2000-2004. He received Ph.D., M.S., and B.A. degrees from Louisiana State University (Marine Sciences), University of Washington (Oceanography), and Georgia Southern University (Mathematics), respectively.

Professor Kjerfve's expertise is coastal and estuarine physical oceanography. He has published some 12 books and 250 scientific journal papers, book chapters, and reports; has supervised 14 Ph.D. dissertations and 24 M.S. theses, and taught more than 6,000 oceanography students. His research includes problem-solving in estuarine and coastal waters as well as climate change and has attracted $20 million in research funding for 90 projects. Dr. Kjerfve's field research has taken place along the East and Gulf coasts of the USA, the Caribbean, Brazil, Mexico, Colombia, Chile, Thailand, Malaysia, the Persian Gulf, Papua New Guinea, and Australia. Dr. Kjerfve was elected as a corresponding member of the Academia Brasileira de Ciências, the Brazilian Academy of Sciences in 2012. Dr. Kjerfve has served as the President of the World Maritime University from 2009 to 2014. He now has the great honor of serving as the fourth Chancellor of the American University of Sharjah in the UAE.

Selected Publications:

Cavalcante, G.H.; Kjerfve, B.; Bauman, A.D., and Usseglio, P., 2011. Water currents and water budget in a costal mega-structure, Palm Jumeirah Lagoon, Dubai, UAE. *Journal of Coastal Research*, 27(2), 384-393.

Cavalcante, G.H.; Kjerfve, B.; Knoppers, B., and Feary, D.A., 2010. Coastal currents adjacent to the Caeté Estuary, Pará Region, North Brazil. *Estuarine Coastal and Shelf Science*, 88(1), 84-90.

Medeiros, C. and Kjerfve, B., 2005. Longitudinal salt and sediment fluxes in a tropical estuary: Itamaracá Brazil. *Journal of Coastal Research*, 21(4), 751-758.

Perillo, G.M.E. and Kjerfve, B., 2005. Regional estuarine and coastal systems of the Americas: An introduction. *Journal of Coastal Research,* 21(4), 729-730.

For a complete list of Dr. Kjerfve's publications or
his contact information, please visit: http://www.aus.edu

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Dr. Wei Zhang works as an associate professor of Harbor, Coastal, and Offshore Engineering in State Key Laboratory of Hydrology-Water Resources and Hydraulic Engineering, Hohai University. He focuses on the tidal current, sediment and salinity movement and transportation laws of estuaries and coasts. Dr. Zhang has published over 20 papers in recent years, including five papers indexed by SCI and EI. He took part in one Key Project of National Nature Science Foundation of China, one 95th Year Key Science and Technology Project for the Ministry of Transport, and two Science and Technology Research Projects of Guangdong Province. He has also led youth projects for the National Nature Science Foundation.

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Chuck Thibault is currently a Ph.D. candidate at the University of Memphis and a Geologist for EarthCon, Inc. Mr. Thibault received his M.S. from the University of Washington (Geology) and a B.S. from the University of Memphis (Geology). His research interests include coastal and environmental hydrogeology and coastal geomorphology. His current research investigates the movement of storm surge generated saline water plumes through coastal surficial aquifers. Mr. Thibault's field research has taken place along the U.S. coasts of Mississippi, Louisiana, and Washington, and on the eastern coast of Kamchatka, Russia.

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We are proud to acknowledge Dr. Erik Van Wellen as a Lifetime Member of the Coastal Education and Research Foundation. Dr. Van Wellen received M.Sc. degrees from both the Artesis Antwerpen (Civil Engineering) and the University of Liverpool (Maritime Civil Engineering). In 1999 he subsequently received his Ph.D. from the University of Plymouth with a specialization in sediment transport modeling. He has authored several papers in prominent international journals and conference proceedings.

He has research interests in the fields of natural marine sediment dynamics and mechanically driven sediment transport, renewable energy, carbon-economics, operational optimization, data analyses and mathematical simulations. During his time on the EuDA (European Dredging Association) Environment Committee he fostered a keen interest in Integrated Coastal Zone Management strategies and how to best balance the competing interests of developments such as harbor facilities, coastal defenses, tourism infrastructures and coastal environment conservation; including how best to strike a balance with mitigation and compensation.

He has previously worked as a commercial diver; and since 1999 has worked for the DEME Group (Dredging, Environmental and Marine Engineering) where he has held several operational, technical and commercial roles in a worldwide setting and is currently employed as an international Project Director.

He is a Fellow of the Institution of Civil Engineers and a Fellow of the Royal Geographical Society, a Member of the Chartered Institute of Arbitrators and a Member of the CEntral Dredging Association. Dr. Van Wellen is a Registered Professional Engineer in continental Europe (EUR ING), the UK (CEng) and internationally IntPE(UK). He is considered an expert in such matters as Civil Engineering, Maritime Construction and Dredging; and has considerable knowledge in the field of contract law and alternative dispute resolution. He also has several patents related to aforementioned technical fields registered to his name.

When not working on engineering or maritime construction projects he can be found teaching diving as a Staff Instructor for the Professional Association of Diving Instructors or actively involved in conservation work such as Dive Against Debris or Project AWARE Shark Conservation. His outstanding underwater photographs have graced the cover of the *Journal of Coastal Research* (JCR) more than once.

For a complete list of publications and more information, please contact Dr. Van Wellen via Skype on: vanwellenerik.

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A Special Acknowledgement To:

Frédéric Bouchette Ph.D.
CERF Lifetime Member

Associate Professor of Littoral Dynamics
Geosciences Montpellier
UMR 5243 – University of Montpellier / CNRS

Following a M.Sc. in physics and mechanics, Fred Bouchette received his Ph.D in March 2001 from the University of Montpellier, South of France. The title of the thesis is "Wave/Seabottom Interaction: The Liquefaction Process" (free translation from French; advisor: Professor M. Séguret). After his Ph.D., Fred had been employed at the University of Montpellier as an associate professor in the department of Geosciences. From 2008 to early 2011, he had moved to the Institute of mathematics and modeling of Montpellier for a three years long stay. Then, until 2012, he has been hosted as an invited professor in the METOS laboratory at the University of Oslo, Norway. He is now back to the University of Montpellier in the same department of Geosciences.

From 2002, Fred was asked to build a scientific staff on littoral hydro-morphodynamics called GLADYS (www.gladys-littoral.org). From that time, the group GLADYS has grown progressively. At now, Fred co-leads the group GLADYS, which rallies most of the scientists working on littoral hydro-morphodynamics along the French Mediterranean Coast, with distinct approaches ranging from applied mathematics to geosciences.

The scientific activity of Fred Bouchette concerns the development of concepts and methods in relation with the dynamics of shallow water environments. He studies the domain that extends from a few tens of meters of water depth at sea to the coastal watershed onshore, with a strong emphasis on the littoral area and the shoreline itself. He has worked in Spain, Taiwan, Canada, Norway, Chad, Italy, Greece, Switzerland, Tunisia, in the French Alps and in the Gulf of Lions (Mediterranean Sea). As testified by his publications, his research combines various points of view from geophysics to geology, including applied mathematics, civil engineering, quantitative geomorphology, with a strong connection to coastal archeology and the analysis of littoral hazards. Nevertheless, his heart's passion still lies with geophysics and applied mathematics.

Presently, Fred Bouchette actively works on the conceptualization of the growth of long term shoreline instabilities such as cuspates or sand spits. On that topic, his last contribution for the *Journal of Coastal Research* (JCR) is the following proceeding:

Bouchette, F.; Manna, M.; Montalvo, P.; Nutz., A.; Schuster, M., and Ghienne, J.-F., 2014. Growth of cuspate spits. *In*: Green, A. and Cooper, J.A.G. (eds.), *Proceedings from the International Coastal Symposium (ICS) 2014 (Durban, South Africa)*. *Journal of Coastal Research*, Special Issue No. 70, pp. 47-52.

Fred Bouchette has published>50 papers and short papers in international journals such as *Coastal Engineering*, *Journal of Coastal Research*, *Discrete and Discontinuous Dynamical Systems*, *Journal of Geophysical Research, Sedimentology, Continental Shelf Research*, *Quaternary Research, Ocean Engineering, Marine Geology, and Climate Research*. Most of his works were performed with and for students. He has contributed to more than 80 proceedings in international or domestic conferences. Fred Bouchette also heads the scientific development of a HPC numerical platform for coastal engineering (www.mirmidon.org).

For a complete list of publications and more information, please visit:
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Current Issue Volume 32, Issue 3 (May 2016)

COVER PHOTOGRAPH:
Interior swale of the slowly-subsiding Cat Island, Mississippi, U.S.A.

Located off the eastern fringe of the subsiding Mississippi delta complex, this slowly-sinking siliciclastic island is the western extent of the Mississippi-Alabama barrier chain. The Cat Island progradational ridge complex is comprised of several exquisite, densely vegetated, strandplain generations welded together throughout the early-late Holocene. This photo displays one of several tidally influenced, medium salinity (10-15 g L^{-1}), east-west trending, dune-swale systems. It depicts the complexity of barrier island ecology, sharp ecotones and zonation, as well as the importance of threshold elevation. In the foreground of the photo, we see the calm interior waters and quick transition from saline tolerant, low-marsh (*Spartina alterniflora*), black needle rush (*Juncus roemerianus*), and high marsh (*Spartina patens*), to the less saline tolerant woody stemmed vegetation consisting of baccharis (*Baccharis halimifolia*), wax myrtle (*Morella cerifera*), yaupon holly (*Ilex vomitoria*), slash pine (*Pinus elliottii* var. *elliottii*), and sand live oak (*Quercus geminata*). The century old climax community stands of sand live oak are located on the highest ridges of the most central portions of the island and theoretically will eventually out-compete and replace the slash pine. The forested portion of the island is a nesting home to a diverse population of migratory and non-migratory birds such as snowy plover (*Charadrius nivosus*), least terns (*Sternula antillarum*), great blue heron (*Ardea herodias*), and osprey (*Pandion haliaetus*). (Photograph taken on 10 September 2014 by William (Bill) Funderburk, Gulf Coast Geospatial Center, University of Southern Mississippi, Long Beach, Mississippi, U.S.A.)

The Coastal Education & Research Foundation *[CERF]* graciously thanks you for your membership and involvement in our international society. We hope that you have enjoyed this latest edition of *Just CERFing*, our society's official newsletter. As mentioned previously, we encourage the worldwide communication of our members through the *Just CERFing* newsletter. If you have any news or announcements that you would like to promote, please send your request or questions directly to Dr. Charles W. Finkl at cfinkl@cerf-jcr.com CERF continues to provide our members with the most up-to-date, professional features of the society. We encourage you to please visit our Foundation's website at http://www.cerf-jcr.org to see all the new content that has been added.

Next Issue of *Just CERFing* coming June 2016.

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