International Conference on Sea Level Rise in the Gulf of Mexico: Impacts, Adaptations, and Management

Program Book

Corpus Christi, Texas
March 1-3, 2010

Organized by
Harte Research Institute for Gulf of Mexico Studies,
Texas A&M University-Corpus Christi

Event Sponsor:

SLR Program at a Glance

Sunday, February 28	7:00 - 9:00 pm	Welcome Reception, Omni Bayfront Hotel Foyer	
Monday, March 1	7:00 - 8:00 am	Breakfast, Omni Bayfront Hotel Foyer	
		Corpus Christi Ballroom A/B	
	8:00 - 8:15 am	Introduction - Larry McKinney, Flavius Killebrew, and Joe Adame	
	8:15 - 9:50 am	Response of Coastal Geologic Systems to Sea-Level Change - Richard Davis, Antonio Rodriguez, and Harry Roberts	
	9:50 - 11:40 am	Measuring Sea-Level Change and Current Trends - Gary Mitchum, Jorge Zavala Hidalgo, Stephen Gill, and David Vaughan	
		Nueces Ballroom A/B	
	12:00 - 1:30 pm	Luncheon Talk - Margaret Davidson	
		Corpus Christi Ballroom A/B	
	1:30 - 3:05 pm	Modeling and Assessing Impacts of Sea-Level Rise I - Virginia Burkett, James Morris, and Jennifer Irish	
	3:05 - 4:30 pm	Modeling and Assessing Impacts of Sea-Level Rise II - Nathaniel Plant, Pamela Hallock-Muller, and Jorge Euan-Avila	
		Aransas Room	**Corpus Christi Ballroom C**
	5:30 - 7:00 pm	Educator Workshop	Poster Session and Reception
		Corpus Christi Ballroom A/B	
	7:00 - 8:30 pm	Evening Public Session Speaker: David Vaughan	
Tuesday, March 2	7:30 - 8:30 am	Breakfast, Omni Bayfront Hotel Foyer	
		Corpus Christi Ballroom A/B	
	8:30 - 9:00 am	Welcome and Introduction - David Yoskowitz and John Dunnigan	
	9:00 - 10:35 am	Sea-Level Rise Impacts on Ecosystems and Human Well-Being - Roger Zimmerman, Porfirio Alvarez Torres, and Mark Maslin	
	10:35 am - 12:00 pm	Infrastructure and Resilience I - Roberto Padilla Hernández, John Jacob, and Eddie Fisher	
	12:00 - 1:30 pm	Lunch	
	1:30 - 3:00 pm	Infrastructure and Resilience II - Austin Becker and Rob Kafalenos	
	3:00 - 4:20 pm	Economic and Policy Impacts - David Yoskowitz, Hipolito Rodriguez, and Jim Titus	
		Aransas Room	**Corpus Christi Ballroom C**
	5:30 - 7:00 pm	Educator Workshop	Poster Session and Reception
		Corpus Christi Ballroom A/B	
	7:00 - 8:30 pm	Evening Public Session Speaker: Michael Orbach	
Wednesday, March 3		**Corpus Christi Ballroom A/B**	
	8:00 - 10:15 am	Legal Implications of Innovative Planning Strategies for Sea Level Rise in the Gulf of Mexico - Margaret Peloso, Timothy Mulvaney, James Wilkins, and Thomas Ruppert	
	10:15 am - 12:15 pm	International Sea-Level Rise Policies and Comparative Case Studies - Tim Reeder, Carlos Welsh Rodriguez, Subandono Diptosaptono, and Dan Whittle	
	12:30 - 2:00 pm	Special Gulf of Mexico Alliance Session on Sea Level Rise Lunch - RSVP Required	
	2:15 - 4:30 pm	Management Strategies for Sea-Level Rise in the Gulf Region - Special Gulf of Mexico Alliance Session on Sea Level Rise	
	4:30 pm	Adjourn Conference	
	6:00 - 8:00 pm	Farewell Social Event (South Texas Museum of Art)	

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International Conference on Sea Level Rise in the Gulf of Mexico

Organizing Committee

CHAIRS

James Gibeaut

Richard McLaughlin

David Yoskowitz

MEMBERS

May Akrawi
John Anderson
Jorge Brenner
Richard Davis
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Larry McKinney
Julie Rosati
Robert Stickney
Ethan Thompson
Wes Tunnell
Jeffress Williams
Woody Woodrow
Jorge Zavala Hidalgo

Welcome to Corpus Christi

Welcome to Corpus Christi, Texas and the *International Conference on Sea-level Rise in the Gulf of Mexico: Impacts, Adaptations, and Management.* When we first started discussing the idea of holding a conference that examined the physical, biological, human and policy dimensions of sea-level rise we were afraid that the scope of such a meeting may be too ambitious and unfocused to generate interest. We were wrong. More than 200 participants from dozens of different academic disciplines and a number of countries have traveled to South Texas to participate. We are thrilled to be able to bring such a diverse and distinguished group together to share knowledge and discuss management options on the phenomenon of sea-level rise, one of the most important topics of our time.

One of the goals of the conference is to offer significant outreach and educational opportunities to the public. To further this effort, all of the presentations will be recorded and uploaded so that people across the globe have access to them on the web. In addition, special workshops have been scheduled to provide school teachers with information about sea-level rise and to support curriculum development. We have also invited the public to attend two free evening lectures that will explore both the physical and human dimensions of the issue.

Many of you may be visiting Corpus Christi for the first time. There are a wide variety of interesting things to do in the Coastal Bend. Many of these opportunities and attractions are described on the conference website. However, plenty of great things to do are located less than a mile from the conference venue. Several excellent museums such as the Corpus Christi Museum of Science and History, Asian Cultures Museum and Educational Center, and Texas Surf Museum are located a few blocks away from the Omni Hotel. If you take a short walk along the seawall you will find a memorial to the famous Tejano singer Selena as well as a floating replica of Columbus' ship *Nina*. Just across the harbor bridge is the historic USS Lexington and Texas State Aquarium. No need to visit the beautiful Art Museum of South Texas as this is the site of our farewell social event on March 3rd. Additionally, the downtown area has many restaurants and pubs within walking distance of the hotel, so go out and explore.

Finally, we would like to thank all of the members of the conference organizing committee for their guidance and hard work as well as the staff and students at the Harte Research Institute, who are too great in number to individually recognize, for shouldering the heavy load that is involved in hosting a conference of this size.

We hope you all have a productive conference and enjoyable stay in Corpus Christi.

-Richard McLaughlin; Jim Gibeaut; and David Yoskowitz

Conference Co-Chairs

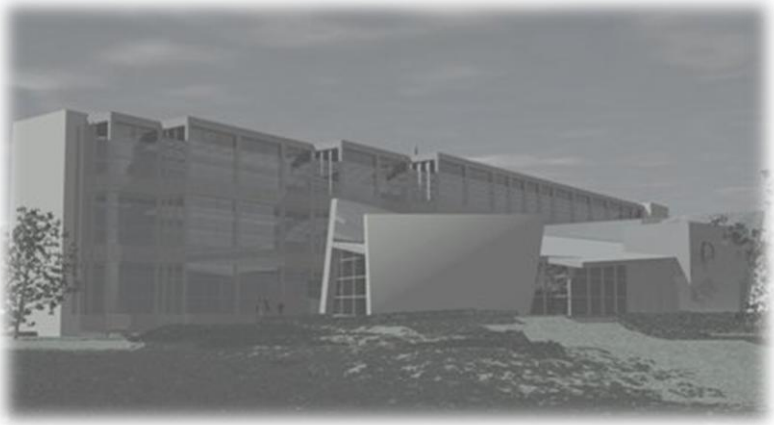
Harte Research Institute for Gulf of Mexico Studies

On September 19, 2000, Mr. Edward H. Harte donated $46 million to establish the new research institute to focus on the Gulf of Mexico. Mr. Harte, philanthropist and former owner of the Corpus Christi Caller-Times newspaper, worked with Dr. Robert R. Furgason, former President of TAMU-CC, to establish the endowment to include endowed research chairs, endowed graduate research fellowships and an endowed operating budget. Mr. Ed Harte was inspired by the book Sea Change written by the renowned oceanographic explorer Dr. Sylvia Earle (1995) in deciding to endow and establish the research institute. Dr. Earle agreed to become Chair of the Advisory Council, whose members represent academia, industry, and conservation, as well as all three countries surrounding the Gulf of Mexico, the United States, Mexico, and Cuba.

The Harte Research Institute (HRI) for Gulf of Mexico Studies at Texas A&M University-Corpus Christi uses a multi-disciplinary approach to promote an ecologically and economically healthy Gulf of Mexico. The *Harte Model* is an integration of science, economic and policy expertise with the unique ability to process complex issues about the health and sustainability of the incredible resource that is the Gulf of Mexico. The institute is built around the synergy created by the focus of the six endowed chairs: coastal and marine geospatial sciences; ecosystems and modeling; biodiversity and conservation; ocean health; marine policy and law; and, socio-economics. It is the interdisciplinary collaboration between the chairs to address ecosystem scale problems and the understanding that people and the environment are inexorably linked in their solution, which makes HRI unique in the community of marine science institutes.

Our objective is to think deeper and build on that basic foundation to address the pressing conservation issues of today. It requires us at HRI to think broadly and pursue partnerships with other like minded organizations, both private and public, where we can most effectively focus our expertise and resources to realize our vision. Our scientific research must, wherever possible, advance sustainability and conservation efforts on a gulf-wide scale and in support of the governance frameworks that build upon and apply sound science to decision-making.

For more information, please visit our website at http://www.harteresearchinstitute.org



General Information

EVENTS

Welcome Social Event (7:00-9:00 pm Sunday)
Check in, pick up your conference materials, and join us in the Omni Bayfront Hotel foyer for a welcome social. Drinks and a light reception will be available. You will be provided two complimentary drink tickets at registration. Event is open to all conference participants.

Oral Sessions
All oral presentations should be made using Microsoft PowerPoint files. Presentations must be provided on a CD or USB memory stick to conference organizers in the Partnership Boardroom prior to your session so we can pre-load your presentation onto conference equipment. The use of personal laptops will not be allowed.

Poster Sessions and Receptions (5:30-7:00 pm Monday and Tuesday)
Poster sessions and receptions will be held on Monday and Tuesday evenings from 5:30-7:00 pm in Corpus Christi Ballroom C. Posters are to be no larger than 40 inches high x 48 inches wide (100 cm high x 120 cm wide). Presenters will be provided materials to secure posters to the panels. Presenters for the Monday and Tuesday poster sessions should have their posters in place by 3:00 pm on Monday and removed by 8:30 am on Wednesday morning. Appetizers and a cash bar will be available. Event is open to all conference participants.

Educator Workshops (5:30-7:00 pm Monday and Tuesday)
Two educator workshops will be held on Monday evening and Tuesday evening from 5:30-7:00 pm in the Aransas Room. Sessions are available by invitation only for teacher participants. Refreshments will be served.

Evening Public Sessions (7:00-8:30 pm Monday and Tuesday)
Two evening public sessions will be held on Monday and Tuesday evening from 7:00-8:30 pm in Corpus Christi Ballroom A/B. Monday's session is entitled "Melting Ice and Rising Seas: Perceptions, Risk, and Reality", given by David Vaughan, Ph.D. from the British Antarctic Survey. Tuesday's speaker will be Michael Orbach, Ph.D. from Duke University presenting on "Cultural and Historical Perspectives on Sea Level Rise: Our Migrating Coasts and Human Communities". Both sessions are open to the public at no charge.

Farewell Social Event (6:00-8:00 pm Wednesday)
A farewell social will be held on Wednesday, March 3rd at the Art Museum of South Texas, a popular attraction on the Corpus Christi Bay designed by Philip Johnson in 1972. The museum serves as the cultural center for fine art in Corpus Christi. Hors D' Oeuvres and refreshments will be catered by the Corpus Christi Town Club, a private membership club highly rated in Corpus Christi. You will be provided two complimentary drink tickets at registration. Entertainment will be provided by Latin Talk, a live band performing Latin, jazz, and salsa music. The Museum is a 5 minute walk from the hotel, however vans will be available. Vans will pick up guests at the Omni Bayfront Hotel entrance facing the bay. Vans will start departing at 5:30 pm, the last shuttle leaving at 6:00 pm. Vans will be available for transport back to the hotel beginning at 7:30 pm. Valet parking is also available.

Conference Hotel and Tourist Information

OMNI BAYFRONT HOTEL

Located in the lively downtown Marina District, the four-diamond Omni Bayfront Hotel offers spectacular views of Corpus Christi Bay. Treat yourself and enjoy a meal and the view from its award-winning rooftop restaurant, ***The Republic of Texas Bar & Grill***. The hotel is located 15 minutes from Corpus Christi International Airport, and operates a complimentary airport shuttle. The hotel also features high speed wireless internet access in the guest rooms, and an outdoor heated swimming pool.

CULTURE AND ENTERTAINMENT (within walking distance or a quick taxi ride)

Art Center of Corpus Christi
Art Museum of South Texas
Asian Cultures Museum & Educational Center
Corpus Christi Museum of Science & History
Texas Surf Museum & Walk of Fame
Texas State Aquarium
USS Lexington

OUTDOORS

Grab a pair of binoculars and enjoy "America's Birdiest City"
Walk along the seawall (directly in front of the Omni Bayfront Hotel)

RESTAURANTS (within walking distance or a quick taxi ride)

Seafood

Joe's Crab Shack (seafood, oysters), 10 min walk - R on Shoreline Dr, L on Lawrence St.
Landry's Seafood House (seafood), 10 min walk - R on Shoreline Dr, L on Peoples St.
Water Street Seafood Company & Oyster Bar (seafood, steaks, oysters), 10 min walk - R on Shoreline Dr, R on Peoples St, L on Water St.

Fine Dining

Katz 21 Steak & Spirits, 15 min walk - R on Shoreline Dr, R on Peoples St, L on Mesquite St
Republic of Texas Bar & Grill, rooftop of Omni Bayfront Hotel
Glass Pavilion, 2nd floor of Omni Bayfront Hotel
Vietnam Restaurant, 5 min walk - R on Shoreline, R on Taylor, L on Water St

International

Aka Sushi (Japanese), 10 min walk - R on Shoreline Dr, R on Peoples St, L on Water St
La Bahia Restaurant (Mexican), 15 min walk - R on Shoreline, R on Peoples St, L on Mesquite
Mama Mia's (Italian), 15 min walk - R on Shoreline, R on Peoples St, L on Mesquite
Ophraka's (Laotian / Thai), 10 min walk - R on Shoreline, R on Peoples St, L on Chaparral, R on Schatzel
Thai Spice (Thai), 5 min walk - R on Shoreline

American & Continental

Burger King, 5 min walk - L on Shoreline, L on Mann, R on Chaparral

City Diner (continental fare of the 50's), 5 min walk - R on Shoreline, R on Taylor, L on Water St
Executive Surf Club (nachos, burgers), 10 min walk - R on Shoreline, R on Peoples St, L on Water St
Desiree's (gourmet sandwiches, soups, salads), 15 min walk - R on Shoreline, inside the Art Center
Subway, 10 min walk - R on Shoreline Dr
Whataburger, 10 min walk - R on Shoreline Dr

If you have a car
B&J's Pizza (pizza, calzones), 15 min drive - L on Shoreline, L onto I-37, exit 1C to Crosstown Expy, exit onto Hwy 358 E, exit Rodd Field Rd and do u-turn at Rodd Field
Blackbeard's (seafood, burgers)***,*** 5 min drive - L on Shoreline, L onto I-37, merge onto US 181 N to Portland, exit Timon Blvd, R on Timon Blvd, L on Elm St, R on Surfside Blvd
La Playa (Tex-Mex), 15 min drive - L on Shoreline, L onto I-37, exit 1C to Crosstown Expy, exit onto Hwy 358 E, exit Weber Rd
Taqueria Jalisco (Tex-Mex), 10 min drive - R on Shoreline, R on Doddridge, L on Staples
Thai Cottage (Thai), 15 min drive - R on Shoreline, R on Airline
Yardarm (seafood)***,*** 15 min drive - R on Shoreline, just past Robert St on L

BARS & NIGHTLIFE (within walking distance or a quick taxi ride)
Katz 21 Steak & Spirits (live music; Thursday jazz), 15 min walk - R on Shoreline Dr, R on Peoples St, L on Mesquite St
Cassidy's Irish Pub (live music), 10 min walk - R on Shoreline, R on Taylor, L on Water St
Dr. Rockits Blues Bar (live music), 10 min walk - R on Shoreline, R on Taylor, L on Chaparral
Executive Surf Club (live music), 10 min walk - R on Shoreline, R on Peoples St, L on Water St
Havana Club (live music, tapas), 10 min walk - R on Shoreline
House of Rock (live music), 10 min walk - R on Shoreline, R on Starr St
Mulligan's Pub, 10 min walk - R on Shoreline, R on Starr, L on Chaparral

MORE INFORMATION
Visit the Corpus Christi Convention and Visitors Bureau website at http://www.visitcorpuschristitx.org/, or the Corpus Christi Chamber of Commerce website at www.corpuschristichamber.org

Oral Presenters

Porfirio Alvarez Torres is the Chief technical advisor of the Gulf of Mexico Large Marine Ecosystem Project (MEX-US), United Nations for Industrial Development Organization (UNIDO). He is a biology graduate from the Metropolitan Autonomous University of Mexico and has a Master of Science and Doctorate in Fisheries Science at the Tokyo University of Marine Science and Technology (former Tokyo University of Fisheries, Japan). Regional coordinator for inland waters and aquaculture projects at the Ministry of Fisheries. Assistant professor and researcher at the Autonomous Metropolitan University, working in coastal lagoons of the Veracruz State in the Gulf of Mexico. As the Director General for Research in Aquaculture at the National Fisheries Institute of Mexico, he lead the development of the national fisheries chart of Mexico and enhanced the promotion of sustainable aquaculture. He is the deputy director for regional integration at the Ministry of Environment and Natural Resources (SEMARNAT) of Mexico, among the main duties and activities has been acting as a leader of the team that designed and implemented management strategies and public policies oriented to the conservation of marine resources and integrated management of coastal areas of Mexico. Leader of SEMARNAT´s task force to develop the national policy for oceans and coasts and the national strategy for the sea and land use planning of Mexico launched by President Calderón in year 2007. Leader of the marine planning process for the Gulf of Mexico and Caribbean Sea region. Leader of Mexico´s ocean policy development and the construction of the National Inter-ministerial Commission for the Sustainable Development of Oceans and Coasts (CIMARES). He has participated in the construction of GEF funded Binational (Mex-US) Project "Gulf of Mexico Large Marine Ecosystem", and has represented Mexico in several UN forums and other international conventions related to ocean and coastal affairs.

Anantha Babbili became the Provost and Vice President for Academic Affairs at Texas A&M University-Corpus Christi on October 1, 2007. He served as the Dean of the College of Mass Communication at Middle Tennessee State University for five years before assuming his current role. Reporting to the President, Babbili serves as the Chief Academic Officer for a vibrant University responsible for academic affairs relating to faculty members and students. Prior to his tenure as a dean and a provost, Babbili spent 21 years at Texas Christian University in Fort Worth as a professor of journalism and media studies, later as the Chairman of the journalism department and as the director of the international/intercultural communication program. He has won several national awards of distinction for academic and teaching excellence. The Carnegie Foundation and the Council for Advancement and Support of Education (CASE) selected him for the U.S. Professor of the Year program listing him as one of the best college professors in the U.S. and designated him as the Texas Professor of the Year. Known for his passion for excellence and for commitment to diversity, Babbili is internationally recognized for research and teaching of international and intercultural communication and global media studies. He is a published author and was a consultant to the United Nations on communication technologies and international law. Babbili held the inaugural Rogers' Chair in New Communication and Information Technology at the University of Western Ontario in Canada (2000-2001). He was also the John F. Murray Visiting Professor at the University of Iowa. He was also a visiting distinguished professor in India, Slovakia, the U.K. and Mexico's Universidad de las Americas (Puebla). Babbili was the editor of a major research journal in mass communication and served on editorial boards of several research journals from around the world, including the International Bibliography of Social Sciences Advisory Committee at the London School of Economics (UK). Babbili received several national and international awards for designing programs and strategies that advance underprivileged students past graduation. He is the recipient of the prestigious Barry Bingham Fellowship from the National Conference of Editorial Writers Foundation for assisting students of color succeed in higher education and in the marketplace. Babbili earned a Ph.D. from the University of Iowa and M.A. from the University of Oklahoma. He also received the B.S. in Biological Sciences and B.J. (Bachelors of Journalism) from India's famed Osmania University. He speaks several languages and has extensive background in developing graduate and undergraduate courses and research opportunities in intercultural settings.

Austin Becker is a Ph.D. student in the Emmett Interdisciplinary Program for Environment and Resources at Stanford University where he researches the potential impacts of climate change on seaports around the world. He focuses on the adaptation side of climate change and works across the disciplines of policy, economics, engineering and climate-change science to quantify the risks and vulnerabilities faced by ports and the economies that depend upon them. He is also exploring potential adaptation strategies that ports, policy makers, and the insurance industry may employ to build resiliency in the face of climate change. Before coming to Stanford, Austin worked for Rhode Island Sea Grant and the Coastal Resources Center as a Marine Research Associate. He earned his Master of Marine

Affairs (2005) and Master of Environmental Science and Management (2006) at the University of Rhode Island. He also holds a 500-Ton U.S. Coast Guard captain's license for ocean-going vessels.

Virginia Burkett is the Chief Scientist for Global Change Research at the U.S. Geological Survey. She was formerly Chief of the Forest Ecology Branch at the USGS National Wetlands Research Center in Lafayette, Louisiana. Burkett has served as Secretary/Director of the Louisiana Department of Wildlife and Fisheries, Director of the Louisiana Coastal Zone Management Program, and Assistant Director of the Louisiana Geological Survey. She has published extensively on the topics of global change and low-lying coastal zones. She was a Lead Author of the United Nation's Intergovernmental Panel on Climate Change (IPCC) Third and Fourth Assessment Reports (2001 and 2007) and the IPCC Technical Paper on Water (2008). She was an author of the 2001 and 2009 national assessments of climate change impacts produced by the U.S. Global Change Research Program. She has co-authored reports for The Wildlife Society (2004), the United Nations Convention on Biodiversity (2005), the Everglades Task Force (2007), and the U.S. Department of Transportation (2008) that address climate change impacts and potential adaptation strategies. Burkett has been appointed to over 40 Commissions, Committees, Science Panels and Boards during her career. She received her doctoral degree in forestry from Stephen F. Austin State University in Nacogdoches, Texas in 1996.

Margaret Davidson has been an active participant in coastal resource management issues since 1978, when she earned her juris doctorate in natural resources law from Louisiana State University. She later earned a master's degree in marine policy and resource economics from the University of Rhode Island. Davidson served as special counsel and assistant attorney general for the Louisiana Department of Justice, and was the executive director of the South Carolina Sea Grant Consortium. She joined NOAA as the director of the NOAA Coastal Services Center in 1995, a position she continues to hold. During this time she also served as the acting assistant administrator for NOAA's National Ocean Service from 2000 to 2002. She holds a faculty appointment at the University of Charleston and serves on the adjunct faculties of Clemson University and the University of South Carolina. Davidson has served on numerous local, state, and federal committees and has provided leadership for national professional societies. She has focused her professional work on environmentally sustainable aquaculture, mitigation of coastal hazards, and impacts of climate variability on coastal resources.

Richard A. Davis, Jr. is a research associate at the Harte Research Institute at Texas A&M University-Corpus Christi. He received his B.S. at Beloit College, his M.S. at the University of Texas-Austin and his Ph.D. at the University of Illinois. He has spent the past 40 years teaching at a university, 32 of those years at the University of South Florida where he is a Distinguished University Professor Emeritus. He was a Senior Fulbright Scholar for the University of Melbourne (Australia) (1976) and was awarded the F.P. Shepard Medal for Excellence in Marine Geology by SEPM in 1999. He has written/edited 15 books on geology, oceanography and coastal systems. He was the visiting professor at the University of Melbourne, University of Sydney, University of Copenhagen, University of Utrecht, Duke University, and the University of North Carolina.

John H. Dunnigan is Senior Policy Advisor to Dr. Jane Lubchenco, the Under Secretary of Commerce for Oceans and Atmosphere and NOAA Administrator. Before assuming his new position in December, Mr. Dunnigan served as NOAA's Assistant Administrator for Ocean Services and Coastal Zone Management, and was responsible for the overall execution of activities in NOAA's National Ocean Service (NOS). NOS is one of the Nation's premier institutions in marine navigation, operational oceanography and geopositioning, and marine and coastal management and science. Mr. Dunnigan serves as the U.S. Representative to the Intergovernmental Oceanographic Commission (IOC), a flag-ship program of UNESCO. The IOC is the United Nations' focal point for ocean sciences and services in collaboration with 136 member countries. Through the IOC and its programs, the U.S. plays an essential role in advancing U.S. ocean interests in global ocean observing system as a component of the Global Earth Observation System, including those for sea levels, tsunami warnings, harmful algal blooms, and coastal management. Mr. Dunnigan previously served as NOAA's Ecosystem Goal Team Lead, responsible for planning, programming and overall coordination across NOAA of its nine ecosystem goal programs. He led NOAA's efforts to move forward in the utilization of ecosystem approaches to management of ocean and coastal resources. In addition to these responsibilities, Mr. Dunnigan served as Director of NOAA's Office of Sustainable Fisheries, providing national coordination and oversight of the agency's fisheries conservation and management policy and activities. In total Mr. Dunnigan has over 20 years of service within NOAA. Mr. Dunnigan served for 11 years as the Executive Director of the Atlantic States Marine Fisheries Commission, building coalitions among member

states to develop and implement mutual conservation programs for shared coastal and marine fishery resources. He has served in a leadership role on the staff of the NOAA Office of General Counsel and the New England Fishery Management Council.

Jorge I. Euan-Avila is a Researcher and Associate Professor 3A for the Department of Marine Resources at the Center for Research and Advanced Studies at IPN. Campus Mérida Activities: 1) Coastal Management; production and integration of bio-physical, economic and socio-cultural data; selection of critical factors for the purposes of planning, action, monitoring and influencing human behaviors for the purpose of sustainable use and conservation of tropical coastal environments; 2) teaching in the area geographic information systems and remote sensing with emphasis in coastal process, environmental impact and change detection analysis ; 3) project and thesis director; and 4) member of graduate student examination committees.

Eddie R. Fisher is the director of Technical Integration of Coastal Planning & Policy Coastal Protection Division for the Texas General Land Office. In this position he and his team work to align all grant funding programs and coastal policy positions to achieve the strategic priorities for the Coastal Resources Program of the Texas General Land Office and the Texas Coastal Management Program. Mr. Fisher has been at the GLO for nine years and formerly served as Director of Coastal Protection managing the GLO's Coastal Erosion Planning & Response Act (CEPRA), the Beach/Dune Program, and the Natural Resource Damage Assessment (NRDA) program. He served as lead on the GLO's 2003 strategic plan entitled Coastal Texas 2020 and the GLO's Coastal Protection Plan in 2008. He worked with coastal stakeholders in Louisiana and Texas to help garner support for passage of the Energy Security Act of 2005, which created the Coastal Impact Assistance Program, and again on the Gulf of Mexico Energy Security Act of 2006, which created the GoMESA grant program for oil producing Gulf states. He is a Governor appointed delegate to the Coastal States Organization, for which he serves as a member of the Executive Committee for Gulf Coast States, and as a member of the Climate Change Workgroup. He has a degree in Communications from the University of Texas at Austin and is a fourth generation native of the Texas coast, born in Port Lavaca, Texas.

Stephen K. Gill is the Chief Scientist with the NOAA/NOS Center for Operational Oceanographic Products and Services in Silver Spring, Maryland. Mr. Gill has served in the federal government and with NOAA's Tides and Currents Program since 1975. He specializes in tidal analysis, determination if tidal datums, and in the application of water level measurements and derived products to the needs coastal communities. Most recently, he was the NOAA Lead Author on the interagency author team for the U.S. Climate Change Science Program Synthesis and Assessment Product 4.1, Coastal Sensitivity to Sea-Level Rise: A focus on the Mid-Atlantic Region.

Pamela Hallock-Muller is a professor at the College of Marine Science at the University of South Florida. Her research interests include: studying the geologic record, as well as modern coral reefs and other carbonate depositional systems to gain insight not only into environments of the past and present, but also the potential effects of human activities on the future of Earth's ecosystems. Her work has implications for coral reef and shelf ecology, environmental management including understanding and predicting impacts of global environmental changes on reefs and carbonate shelves, evolution, paleoceanography, paleoecology, sedimentology including carbonate-facies analyses, and hydrocarbon exploration. She is the author of more than 100 scholarly papers published in scientific journals and books. She has been the thesis/dissertation advisor to around 50 students and has been a committee member for over 50 others.

Jennifer L. Irish is an assistant professor of coastal engineering at Texas A&M University with expertise in physical response at the coast due to extreme weather events like hurricanes. Dr. Irish is a licensed professional engineer with 15 years of experience in coastal engineering, and prior to starting a faculty position in 2006, she was a regional technical specialist and research engineer with the U.S. Army Corps of Engineers. Dr. Irish has expertise in storm surge dynamics, storm morphodynamics, vegetative effects, coastal hazard risk assessment, and general coastal engineering. Dr. Irish has had 19 papers accepted for publication in peer-reviewed journals and has had more than 20 papers appear in professional conference proceedings. In 2008, Dr. Irish received the Superior Civilian Service Award from the Department of the Army in recognition of her scientific contributions to determining hydrodynamic response and flood risk in the New Orleans region as part of the Interagency Performance Evaluation Taskforce. She is Secretary of the Coasts, Oceans, Ports, and Rivers Institute Governing

Board of the American Society of Civil Engineers. At Texas A&M, Dr. Irish teaches coastal engineering, estuarine hydrodynamics, fluid dynamics, and laboratory and field methods in coastal engineering. Dr. Irish currently leads research on hurricane surge parameterization, hurricane extreme-value and forecast statistics, vegetated wave dynamics, levee design, beach and barrier island response to hurricanes, and impacts of climate change and sea level rise on coastal flooding and damages.

John Jacob is the director of the Texas Coastal Watershed Program, and holds a joint appointment with the Texas A&M Sea Grant Program and with Texas AgriLife Extension Service through the Department of Recreation, Parks, and Tourism Science. He has coastwide responsibility for inland environmental problems that have a direct impact on the quality of our bays, estuaries, and coastal waters. Preeminent among these issues are the mitigation and abatement of runoff pollution from both rural and urban sources, and the preservation and restoration of valuable natural habitats such as wetlands. His current project, Coastal CHARM (Community Health and Resource Management), focuses on enabling coastal communities in Texas to improve quality of life in cities and towns while preserving and enhancing the natural coastal environment. Jacob holds B.S. and M.S. degrees from Texas Tech University, and a Ph.D. from Texas A&M University, all in soils and natural resources. He is registered as a Professional Geoscientist with the State of Texas and is a Professional Wetland Scientist. Jacob is a recognized expert on Texas wetlands, having been active in consulting and research aspects of wetlands for more than 20 years. Jacob is coauthor of Texas Sea Grant *Resilient Coast* series on the built environment and wetlands. The Texas Coastal Watershed Program provides education and outreach to local governments and citizens about the impact of land use on watershed health and water quality. The TCWP currently has 7 staff members with programs in sustainable urban planning, watershed management, habitat restoration, sustainable landscapes, and water quality issues.

Rob Kafalenos is an Environmental Protection Specialist in the Office of Natural and Human Environment at the Federal Highway Administration, part of U.S. DOT. He works on policy and research related to adapting transportation to the impacts of climate change, and reducing greenhouse gas emissions from transportation sources. Mr. Kafalenos was a lead author of a chapter in *Impacts of Climate Change and Variability on Transportation Systems and Infrastructure: Gulf Coast Study, Phase 1*. He holds a Master's in Environmental Management from Duke University.

Mark Maslin FRGS, FRSA is the Director of the UCL Environment Institute and Head of the Department of Geography. He is an Executive Director of Carbon Auditors Ltd/Inc. and science advisor to the Global Cool Foundation and Carbon Sense Ltd. Maslin is a leading climatologist with particular expertise in past global and regional climatic change and has publish over 95 papers in journals such as *Science, Nature, and Geology*. He has been awarded grants of over £22 million, twenty-five of which have been awarded by NERC. His areas of scientific expertise include causes of past and future global climate change, ocean circulation, monitoring land carbon sinks, and international and national climate change policies. He has also have written 7 popular books, over 25 popular articles (e.g., for *New Scientist*, Independent and *Guardian*), appeared on radio, television and been consulted regularly by the BBC, Channel 4, Channel 5 and Sky News. His latest popular book is the high successful Oxford University Press "Global Warming: A Very Short Introduction" the second edition was published late last year and has sold over 40,000 copies. He was the lead author of the first UCL Environment Institute Policy Report, which was the basis of the Channel 4 'Dispatches' program Greenwash (5/3/07). Maslin was also a co-author of the recent Lancet-UCL 'Managing the health effects of climate change' commissioned report. He is also currently working on the DIFD Report on Population, Climate Change and the Millennium Development Goals.

Gary Mitchum is a Professor of Physical Oceanography in the College of Marine Science at the University of South Florida, where he has been since 1996. After receiving his PhD from the Department of Oceanography at the Florida State University in 1985, he spent 11 years in the Department of Oceanography at the University of Hawaii, first as a postdoctoral researcher and then as a member of the research faculty and as the Director of the University of Hawaii Sea Level Center. His research interests emphasize short-term climate changes, ranging from interannual variations such as ENSO, to decadal processes, to the long-term sea level rise problem. He has also done work on continental shelf dynamics, mesoscale eddy interactions with mean flows, internal tide generation and propagation, and physical controls on fisheries variables. Although he has used many types of data in his research, he is especially interested in analyses of tide gauge and satellite altimetric data, and notably proposed and developed the presently accepted method of calibrating altimeters via comparisons with the global tide gauge network.

James Morris is the Director of the Belle Baruch Institute for Marine and Coastal Sciences, Professor of Biological Sciences, Distinguished Professor of Marine Studies at the University of South Carolina, and AAAS Fellow. He served as a Program Officer at the National Science Foundation from 2003-2005 and was a visiting professor at Aarhus University, Denmark in 1990. His academic background includes degrees in environmental sciences, (BA, Univ. Virginia), biology (MA, Yale) and forestry and environmental studies (PhD, Yale). He held a postdoctoral fellowship at the Marine Biological Laboratory, Woods Hole before moving to South Carolina. Morris has authored about 80 peer-reviewed publications, largely focused on coastal wetlands. He has served on numerous committees and panels for various agencies, including the US National Science Foundation, the Irish National Science Foundation, the National Research Council, and the IndoFlux committee of India. Dr. Morris has had a history of funding from NSF for research at North Inlet, SC on effects of sea level change on coastal wetlands. He was principal investigator of a NOAA project focused on the effects of sea-level rise in Pamlico Sound, NC and continuing work at Camp Lejeune, NC is supported by DCERP. Morris is also working on marshes in Massachusetts as co-principal investigator of the NSF, Plum Island Long Term Ecological Research site.

Timothy Mulvaney joined the Texas Wesleyan School of Law as a Visiting Associate Professor of Law in 2009. He will assume the rank of Associate Professor of Law in the summer of 2010. Professor Mulvaney teaches Property Law, Land Use Law, a seminar in Constitutional Issues in Environmental Law Seminar, and related courses. Prior to joining the Texas Wesleyan law faculty, Professor Mulvaney worked with the Mississippi-Alabama Sea Grant Legal Program at the University of Mississippi School of Law. At the University of Mississippi, he also taught Land Use Law and select lectures in Constitutional Law. Before entering academia, Professor Mulvaney served as a Deputy Attorney General in the environmental and land use practice group of the New Jersey Attorney General's Office. Drawing on these experiences, Professor Mulvaney's scholarship explores the many conflicts at the intersection of property, land use and environmental law, with a particular focus on constitutional takings jurisprudence and the public trust doctrine. He has published articles on these topics in the primary or environmental law journals of U.C. Berkeley, Tulane University, U.C. Davis, and the University of Richmond, among others. Professor Mulvaney is a co-principal investigator on a team that recently has been awarded a Sea Grant to conduct a two-year interdisciplinary and cooperative research project on regulatory takings, environmental law and land use issues related to natural hazard and climate change resiliency.

Mike Orbach is Professor of Marine Affairs and Policy and Director of the Coastal Environmental Management Program in the Nicholas School of the Environment at Duke University. He has worked as Social Anthropologist and Social Science Advisor with the National Oceanic and Atmospheric Administration; Associate Director of the Center for Coastal Marine Studies at the University of California at Santa Cruz; and Professor of Anthropology in the Department of Sociology and Anthropology and Senior Scientist with the Institute for Coastal and Marine Resources at East Carolina University. He joined the Duke Marine Laboratory in 1993, and was Director of the Marine Laboratory from 1998 to 2006. Mike has performed research and has been involved in coastal and marine policy on all coasts of the U.S. and in Mexico, Central America, the Caribbean, Southeast Asia, Europe, Alaska and the Pacific, and has published widely on social science and policy in coastal and marine environments. He was a formal advisor to both the U.S. Commission on Ocean Policy and the Pew Ocean Commission, has served on the Ocean Studies Board of the National Research Council, is a National Associate of the National Academies of Science and Engineering, and has held numerous other appointments to Boards and Commissions, both public and private. He is currently a member of the Board of Directors of the Ocean Conservancy and the National Sea Grant Advisory Board.

Roberto Padilla Hernández is a Researcher at the Universidad Autónoma de Tamaulipas, Faculty of Civil Engineering. In 2002, he received his PhD at the Institution Faculty of Science, Katholieke Universiteit Leuven in Leuven, Belgium. He earned his M.S. in Physical Oceanography at the Institution Centro de Investigaci´on Cient´ıfica y de Educaci´on Superior de Ensenada and his B.S. at the Institution Universidad Aut´onoma de Baja California, Facultad de Ciencias. As a researcher at the Universidad Autónoma de Tamaulipas, his projects include: wave climatology in the Mexican Seas, energy wave dissipation through withecapping and its numerical modeling, extreme waves and wave climatology in the Gulf of Mexico, wave climatology in the coastal zone of Tamaulipas State, and the implementation of an Operational Wind–Wave Forecast System (MM5–WAM and SWAN).

Margaret E. Peloso is an Associate at Vinson and Elkins LLP, where her principal areas of practice are environmental law and climate change. She received her J.D. with distinction from Stanford Law School in 2009.

While there she was the Editor in Chief for the Stanford Journal of Law and served as an Article Review Board Chair for the Stanford Environmental Law Journal. She is currently working on obtaining her PhD from Duke University where she also received her Master's and Bachelor's Degrees.

Nathaniel Plant is an oceanographer at the U.S. Geological Survey in St. Petersburg FL. His research focuses on predicting coastal storm and sea-level rise impacts and using these predictions to improve coastal management decision-making. Prior to joining the USGS, he earned a PhD in Marine Geology at Oregon State University in 1998 studying the long-term response of coastal sandbars. Since then, he was a postdoctoral fellow at the University of Twente, The Netherlands and then joined the Naval Research Laboratory in Mississippi where his work focused on providing environmental decision support capabilities to the U.S. Navy.

Tim Reeder is the Regional Climate Change Programme Manager in the Thames Region of the Environment Agency. He has over thirty years experience in the environmental field, for much of that working to monitor and improve the quality of the Thames. He has been involved in climate change issues for over fifteen years and is a contributing author to the IPCC 4th assessment report. He represents the Agency on the London Climate Change partnership, which he helped initiate, and is involved in many other climate related issues. He is Project Scientist for the Thames Estuary 2100 project, which is looking at the future of the Thames Barrier and flood risk management in the Thames Estuary.

Harry H. Roberts is the former director of Coastal Studies Institute (for 10 years) in the School of the Coast and Environment at LSU where he is a Boyd Professor emeritus. He has had a career in marine geology and sedimentology that spans more than 40 years and has worked in many foreign countries as well as in the United States. Recently, he has focused his research on two areas: (a) deltaic sedimentation and processes, and (b) surficial geology of the northern Gulf's continental slope. The former research area is directly related to the fundamental science questions that relate to Louisiana's substantial land loss problem. The latter research thrust has concentrated on building an understanding of the impacts of fluid and gas expulsion on the surficial geology of the slope.

Antonio B. Rodriguez graduated from Hamilton College (Clinton, NY) in 1994 with a BA in Geology and Rice University in May 1999 with a Ph.D. in Geology and Geophysics. He stayed at Rice for the next year as a Postdoctoral Research Associate (from May 1999 to January 2000) and as a Lecturer (from January to July 2000). In August 2000, he accepted a job at the University of Alabama, Department of Geological Sciences as an Assistant Professor. There, he pursued his research in coastal geology, taught at the undergraduate and graduate levels, and advised graduate students through their MS and Ph.D. degrees. He left the University of Alabama in August, 2005 as a College of Arts and Sciences Leadership Board Faculty Fellow, and the George Lindahl Fellow, and is currently an Associate Professor at the University of North Carolina at Chapel Hill, Institute of Marine Sciences and Department of Marine Sciences. He spent the last year editing and writing papers for a book entitled "Response of Upper Gulf Coast Estuaries to Holocene Climate Change and Sea-Level Rise". His current research projects focus on the North Carolina coast. Tony lives in Morehead City, NC with his wife and two sons.

Hipólito Rodriguez is an economist and anthropologist at the *Centro de Investigaciones y Estudios Superiores en Antropologia Social* (CIESAS). His main researches analyze urban and environmental history in Veracruz. Recently, he has published *El Istmo en el contexto contemporáneo del desarrollo, Programa de Ordenamiento Territorial de Veracruz, Los barrios pobres de las ciudades de México*. In 2009, his contribution to *Adaptación a los impactos del cambio climático en los humedales costeros del Golfo de México* (INE-SEMARNAT) examined the water uses in the Gulf of México region.

Thomas Ruppert is the assistant in environmental law and holds a cooperative position created by the Levin College of Law's Conservation Clinic and the University of Florida's Institute for Food and Agriculture's (IFAS) extension service. Mr. Ruppert provides legal expertise in the context of IFAS extension projects. Mr. Ruppert's areas of expertise include beach and coastal policy in Florida, sea turtle habitat protection, the Endangered Species Act, Florida's coastal construction control line permitting, comprehensive planning law, and 5th amendment takings law. Additional conservation and environmental issues with which Mr. Ruppert has worked include the Clean Water Act's total maximum daily load program, water quality trading, low-impact development stormwater, homeowners' associations, and boating/marine issues. Mr. Ruppert is currently consulting with a project of the SE Florida Coral Reef Initiative to examine gaps in local, state, and federal permitting processes as well as identify potential areas of

synergy and inter-agency cooperation in compliance and enforcement of permit conditions related to corals. Mr. Ruppert speaks fluent Spanish. He has worked on projects in several Central American countries and with the UF Conservation Clinic's Costa Rica summer program in San José where he has worked on human rights, water, land use planning, and property issues.

James G. Titus has been the project manager for sea level rise at the US Environmental Protection Agency since 1982, with the continuing mission of identifying opportunities to prepare for the consequences of risings sea level. Throughout this period, he has advocated the widespread application of rolling easements to allow ecosystems to migrate inland, either by legislation (as in Texas) or acquisition of rolling easements as a type of conservation easement. He also has advocated that developed barrier islands should be elevated until economics dictates a landward migration, and elevated the family cottage and yard on Long Beach Island, NJ.

David Vaughan is a Science Leader for the British Antarctic Survey. He first went to Antarctica in 1985 as a surveyor's assistant, and since has led seven scientific field campaigns, including a major UK/US collaboration to survey one of the most remote part of the continent. He now leads the British Antarctic Survey's research program into ice sheets and their past and future changes, and a major European-funded program which will, within 3 years, deliver global sea-level rise projections for the next 200 years. He was a coordinating lead author for the last report from the Intergovernmental Panel on Climate Change.

Carlos M. Welsh Rodriguez is a full time research scientist at Earth Science Center at Veracruz University and a faculty member since 1996. His research is accredited by the Mexican Science and Technology Council as a National Scientist Researcher. He received his Postdoc at the National Center for Atmospheric Research at Boulder, CO and his PhD on Sustainability from Technological University of Catalunya. He received his Master's Degree in Environmental Management from Technological University of Madrid and Bachelor's Degree in physics with specialty on Climatology. He is the co-coodinator of the Veracruz Action Plan on Climate Change and a member of the Network of Greenhouse Gases Experts, the American Geophysical Union, the Scientist Committee from renewable Mexican Energy Association, and the International Sustainability Indicators Network. He was the Deputy Director of research at Veracruz University from 2006-2008 and the Deputy Director of Veracruz Science and Technology Council from 2005-2006. His research focus is on Sustainability and Climate Change.

Dan Whittle is senior attorney with the Environmental Defense Fund and is director of its Cuba Program. Over the last decade Dan has worked on the ground in Cuba with environmental officials, scientists, and resource managers on a variety of projects relating to coastal zone management, environmental law and policy development, ocean energy, and sustainable fisheries management.

James G. Wilkins is the Professor/Director of the Louisiana Sea Grant Law and Policy Program at Louisiana State University. He is the lead author of "Louisiana Coastal Hazard Mitigation Guidebook" and teaches a "Coastal Zone Management" course.

David Yoskowitz is the Endowed Chair for Socio-Economics at the Harte Research Institute for Gulf of Mexico Studies and Professor of Economics in the College of Business at Texas A&M University-Corpus Christi. His work focuses on valuation of ecosystem services, freshwater inflow, and water marketing.

Jorge Zavala Hidalgo is a Professor at Universidad Nacional Autónoma de México He received his PhD from CICESE, Mexico. He makes many contributions to the knowledge of Gulf of Mexico dynamics and the Climate of Mexico.

Roger J. Zimmerman is Laboratory Director at the NOAA Fisheries Service (NMFS), facility in Galveston, Texas. The Laboratory specializes in fisheries science and ecological research on living marine resources in the Gulf of Mexico. Dr. Zimmerman's specialties are crustacean biology, estuarine and marine benthic ecology. He is a native of south Texas, receiving a Master's degree in Biology and Geology from Texas A&I University in 1969 and earning a Ph.D. in Biological Marine Sciences from the University of Puerto Rico in 1979. In 1981, Dr. Zimmerman was hired as a NMFS Fisheries Biologist in Galveston and for the past 25 years has served in research, teaching and consultation while addressing issues of sea level rise in estuaries, restoration of coastal wetlands, characterization of

essential fish habitats and management of estuarine systems. He is especially recognized for his work on the ecology of penaeid shrimps and on functions of intertidal wetlands as habitat for fishery species. Dr. Zimmerman's regional service includes: (1) the Council for Agricultural Science and Technology, "Gulf of Mexico Hypoxia: Land and Sea Interactions, (2) the Union of Concerned Scientists and Ecological Society of America, "Confronting Climate Change in the Gulf Coast Region, (3) the NOAA Fisheries Service, "Planning for Ecosystem-Based Fisheries Management", (4) America's Wetland Campaign to Save Coastal Louisiana, "Envisioning the Future of the Gulf Coast" and (5) the NOAA Gulf of Mexico Regional Collaboration Team. Dr. Zimmerman's publications and those of staff under his direction can be viewed on the Galveston Laboratory's web site at http://galveston.ssp.nmfs.gov/.

Conference Schedule

Sunday February 28, 2010	Welcome Reception, Omni Bayfront Hotel Foyer, 7:00 - 9:00 pm	
Monday March 1, 2010	**Natural Sciences: Physical and Biological Dimensions of the Problem**	
7:00 - 8:00	Breakfast, Omni Bayfront Hotel Foyer	
ROOM	**CORPUS CHRISTI BALLROOM A/B**	
8:00 - 8:15	Welcome - Larry McKinney, Director, Harte Research Institute; Flavius Killebrew, President, Texas A&M University-Corpus Christi; Joe Adame, Mayor, Corpus Christi, Texas	
Technical Session	**Response of Coastal Geologic Systems to Sea-Level Change, Moderator: James Gibeaut**	
8:15 - 8:35	**Geologic History of Sea Level Change in the Gulf of Mexico; Past, Present and Future -** Richard (Skip) A. Davis, Harte Research Institute, Texas A&M University-Corpus Christi	
8:35 - 8:55	**Holocene Sea-Level Change and the Evolution of Coastal Depositional Systems: Implications for the Future -** Antonio B. Rodriguez, University of North Carolina, Chapel Hill	
8:55 - 9:15	**Impact of Rising Sea Level and Reduced Sediment Supply on Deltas: The Mississippi River Delta Case -** Harry H. Roberts, Coastal Studies Institute, School of the Coast and Environment, Louisiana State University	
9:15 - 9:35	Panel Discussion	
9:35 - 9:50	Break	
Technical Session	**Measuring Sea-Level Change and Current Trends, Moderator: Jim Titus**	
9:50 - 10:10	**Sea-Level Rise in the Gulf of Mexico -** Gary T. Mitchum, University of South Florida	
10:10 - 10:30	**Sea-Level Trends Along Mexico's Coast** - Jorge Zavala Hidalgo, Universidad Nacional Autónoma de México	
10:30 - 10:50	**Sea-Level Measurement, Determination, and Application in the Gulf of Mexico -** Stephen Gill, NOAA/NOS Center for Operational Oceanographic Products and Services	
10:50 - 11:10	**Update on Global Sea-Level Projections Since IPCC Fourth Assessment** - David Vaughan, British Antarctic Survey	
11:10 - 11:40	Panel Discussion	
ROOM	**NUECES BALLROOM A/B**	
12:00 - 1:30	Luncheon Talk –**Today's Flood is Tomorrow's High Tide. Are you Ready? - Margaret Davidson, Director, NOAA Coastal Services Center**	
ROOM	**CORPUS CHRISTI BALLROOM A/B**	
Technical Session	**Modeling and Assessing Impacts of Sea-Level Rise I, Moderator: Michael Orbach**	
1:30 -1:50	**Causes, Rates, and Regional Variability of Sea-Level Rise -** Virginia Burkett, National Wetlands Research Center, U.S. Geological Survey	
1:50 - 2:10	**The Limits of Salt Marsh Adaptation to Rising Sea Level** - James T. Morris, Belle W Baruch Institute for Marine and Coastal Sciences, University of South Carolina	
2:10 -2:30	**Integrating Sea Level Rise with Hurricane Flood Level Statistics** - Jennifer L. Irish, Texas A&M University	
2:30 - 2:50	Panel Discussion	
2:50 - 3:05	Break	
Technical Session	**Modeling and Assessing Impacts of Sea-Level Rise II, Moderator: John Jacob**	
3:05 - 3:25	**The Impact of Sea-Level Rise on Changing Coastlines** - Nathaniel Plant, Center for Coastal and Watershed Studies, U.S. Geological Survey	
3:25 - 3:45	**Sea Level Rise and Coral Reefs: Predicting Responses** - Pamela Hallock-Muller, University of South Florida	
3:45 - 4:05	**Impacts of Sea-Level Rise on the Yucatan Peninsula, Mexico** - Jorge I. Euan-Avila, Department of Marine Resources at CINVESTAV IPN, Merida, Yucatan, Mexico	
4:05 - 4:30	Panel Discussion	
4:30	Adjourn	
ROOM	**ARANSAS ROOM**	**CORPUS CHRISTI BALLROOM C**
5:30 - 7:00	Educator Workshop - **RSVP Required**	Poster Session and Reception
ROOM	**CORPUS CHRISTI BALLROOM A/B**	
7:00 - 8:30	**Evening Public Session: Melting Ice and Rising Seas: Perceptions, Risk, and Reality** - David Vaughan, British Antarctic Survey	

Conference Schedule Continued

Tuesday March 2, 2010	Human Dimensions	
7:30 -8:30	Breakfast, Omni Bayfront Hotel Foyer	
ROOM	**CORPUS CHRISTI BALLROOM A/B**	
8:30 - 8:40	Welcome - David Yoskowitz - Harte Research Institute, Texas A&M University-Corpus Christi	
8:40 - 9:00	**NOAA's Role in Helping Coastal Communities Address the Impacts of Sea-Level Rise** - John H. Dunnigan, Senior Policy Advisor to the Under Secretary of Commerce for Oceans and Atmosphere	
Technical Session	**Sea-Level Rise Impacts on Ecosystems and Human Well-Being, Moderator: Gary Mitchum**	
9:00 - 9:20	**Sea Level Rise Impact on Ecosystems and Fisheries** - Roger Zimmerman, NOAA/NMFS	
9:20 - 9:40	**Incorporating Risk and Vulnerability Factors in the Development of Models Used in the Sea and Land Use Planning of the Gulf of Mexico and Caribbean Sea** - Porfirio Alvarez Torres, United Nations for Industrial Development Organization (UNIDO)	
9:40 - 10:00	**Climate Change and Human Health** - Mark Maslin, University College London	
10:00 - 10:20	Panel Discussion	
10:20 - 10:35	Break	
Technical Session	**Infrastructure and Resilience I, Moderator: Nikki Pace**	
10:35 - 10:55	**Early Warning Systems to Extreme Hydro-Meteorological Events for the South Coast of Tamaulipas, Mexico** - Roberto Padilla Hernández, Universidad Autonoma de Tamaulipas	
10:55 - 11:15	**Wetland Transgressions and Human Misdeeds: Topography, Development, and Sea Level Rise on the Gulf Coast** - John Jacob, Texas A&M University, Sea Grant	
11:15 - 11:35	**Coastal States Organization Climate Change Workgroup - Findings and Purpose for Coastal Climate Change Adaptation Legislation** - Eddie Fisher, Texas General Land Office	
11:35 - 12:00	Panel Discussion	
12:00 - 1:30	Lunch	
Technical Session	**Infrastructure and Resilience II, Moderator: Cuauhtemoc Leon**	
1:30 - 2:00	**Climate Change Impacts on Seaports: A Global Survey of Port Administrators' Perceptions and Plans** - Austin Becker, Stanford University	
2:00 - 2:30	**Impacts of Climate Change and Variability on Transportation Systems and Infrastructure in the Gulf Coast** - Rob Kafalenos, Department of Transportation	
2:30 - 2:45	Panel Discussion	
2:45 - 3:00	Break	
Technical Session	**Economic and Policy Impacts, Moderator: Richard (Skip) Davis**	
3:00 - 3:20	**The Socio-Economic Impacts of Sea Level Rise in Galveston Bay** - David Yoskowitz, Harte Research Institute, Texas A&M University-Corpus Christi	
3:20 - 3:40	**Human, Economic, and Policy Impacts of Sea Level Rise in Mexico** - Hipolito Rodriguez, CIESAS-Golfo	
3:40 - 4:00	**Pick the Response Pathway Now** - Jim Titus, U.S. Environmental Protection Agency	
4:00 - 4:20	Panel Discussion	
4:20	Adjourn	
ROOM	**ARANSAS ROOM**	**CORPUS CHRISTI BALLROOM C**
5:30 - 7:00	Educator Workshop 2 - **RSVP Required**	Poster Session and Reception
ROOM	**CORPUS CHRISTI BALLROOM A/B**	
7:00 - 8:30	**Evening Public Session**: **Cultural and Historical Perspectives on Sea Level Rise: Our Migrating Coasts and Human Communities** - Michael Orbach, Duke University	

Conference Schedule Continued

Wednesday March 3, 2010	Law, Policy and Comparative Studies
7:00 - 8:00	Breakfast, Omni Bayfront Hotel Foyer
ROOM	**CORPUS CHRISTI BALLROOM A/B**
Technical Session	**Legal Implications of Innovative Planning Strategies for Sea Level Rise in the Gulf of Mexico**
8:00 - 8:10	Moderator - Richard McLaughlin, Harte Research Institute, Texas A&M University-Corpus Christi
8:10 - 8:30	**Introduction to Legal and Policy Issues Associated With Promoting Coastal Resiliency -** Margaret Peloso, Vinson & Elkins
8:30 - 8:50	**Municipal Exactions at the Water's Edge** - Timothy Mulvaney, Texas Wesleyan University Law School
8:50 - 9:10	**Governmental Liability for Failing to Protect Citizens from Known or Impending Hazards** - James Wilkins, Louisiana Sea Grant Law and Policy Program, Louisiana State University
9:10 - 9:30	**Reducing "Investment-backed Expectations" in Coastal Areas** - Thomas Ruppert, University of Florida Levin College of Law and Program for Resource Efficient Communities
9:30 - 10:00	Panel Discussion
10:00 - 10:15	Break
Technical Session	**International Sea-Level Rise Policies and Comparative Case Studies**
10:15 - 10:35	Moderator - Anantha Babbili, Provost, Texas A&M University-Corpus Christi
10:35 - 10:55	**Flood Risk and Sea Level Rise in London and the UK -** Tim Reeder, U.K. Environmental Agency
10:55 - 11:15	**Sea-Level Rise Planning in the State of Veracruz, Mexico -** Carlos Welsh Rodriguez, University of Veracruz
11:15 - 11:35	**Sea-Level Rise Policies in Indonesia and the Coral Triangle -** Subandono Diptosaptono, Indonesian Department of Marine Resources
11:35 - 11:55	**Sea-Level Rise Policies in Cuba -** Dan Whittle, Environmental Defense
11:55 - 12:15	Panel Discussion
12:30 - 2:00	Special Gulf of Mexico Alliance Session on Sea Level Rise Lunch - **RSVP Required**
Technical Session	**Management Strategies for Sea-Level Rise in the Gulf Region**
2:15 - 4:30	**Special Gulf of Mexico Alliance Session on Sea Level Rise**
4:30	Adjourn Conference
6:00 - 8:00 pm	Farewell Social Event (South Texas Museum of Art)

Oral Presentation Abstracts

Climate Change Impacts on Seaports: A Global Survey of Port Administrators' Perceptions and Plans

Austin Becker, Ph.D. student, Emmett Interdisciplinary Program for Environment and Resources, Stanford University

We surveyed port authorities from around the world to ascertain how administrators feel that climate change might impact their operations, what level of sea level change would create operational problems, and how they plan to adapt to new environmental conditions. The survey was distributed to 350 major ports through two leading international port organizations, the International Association of Ports and Harbors and the American Association of Port Authorities. Climate change will disproportionately affect ports and port-based economies, depending on their geographic location and the institutional capacities of the ports themselves and the communities in which they are located. Ports in a hurricane belt will face different challenges than those on emergent coastlines far removed from storm-impacts. Ports in developing nations will have a different suite of options available to them than those in developed nations. Ports located in estuaries that provide nursery environments for marine life have an even greater responsibility to protect coastal waters. A recent EPA report on climate impacts on seaports states, "most ports do not appear to be thinking about, let alone actively preparing to address, the effects of climate change." Decision makers must understand the nature of the problem and what options may be considered. This survey serves as an important first step in understanding and addressing these challenges.

Causes, Rates, and Regional Variability of Sea-Level Rise

Virginia Burkett, U.S. Geological Survey

Since the peak of the last glacial period about 21,000 years ago, global mean sea level has risen more than 120 meters. Between 15,000 and 6,000 years BP the rate of sea level rise was approximately 10 mm/year, punctuated by meltwater events, and followed by a period of relatively stable sea level (less than 0.2 mm/yr of rise over the last 3,000 years). The average rate of sea level rise during the 20th century was 1.7 mm/year with considerable interannual, decadal, and spatial variability. Global mean sea-level rise is expected to accelerate over the coming decades due to human-induced warming of the atmosphere and the resultant increase in global ocean heat content and the decline of land-based ice, both of which contribute to an increase in ocean volume. The Intergovernmental Panel on Climate Change's estimates of sea level rise for this century suggest an acceleration of up to 2.4 times compared to the 20th Century, with contributions from the major ice sheets (Antarctica and Greenland) being a major uncertainty. Several recent studies support the view that a 1-2 m rise in global mean sea level is plausible over the remainder of this century. Regional trends in sea level rise depart from the global-mean trend because of variations in surface atmospheric pressure, wind stress, and oceanographic factors such as ocean surface circulation and density. Vertical land movements caused by natural geological processes, such as tectonic displacements and glacial isostatic adjustment, can have effects on local sea level that are comparable to climate-related sea level change. In addition, many of the world's populated coasts are subsiding due to human activities, such as groundwater withdrawals, and will therefore experience higher rates of "relative" sea level rise. Increases of extreme sea levels due to changes in storm characteristics are also of special concern in developed coastal regions. It is the relative change in sea level, coupled with the extreme events and antecedent conditions that determine how coastal systems will be impacted by an acceleration of sea level rise at a given location.

Today's Flood is Tomorrow's High Tide. Are you Ready?

Margaret Davidson, NOAA Coastal Services Center

As a greater percentage of the U.S. population moves into our coastal counties, more people, businesses, and infrastructure will become vulnerable to the impacts of sea-level rise. Portions of the Gulf of Mexico are particularly vulnerable to the combined effects of sea-level rise and subsidence. To mitigate these impacts and adapt to rising seas, affected coastal communities, states, and regional organizations must orient and harmonize their planning and implementation activities to address both planning and implementation efforts to address problems at the local level. In the Gulf of Mexico, as in other regions of the country, this type of integrated planning and implementation has begun, while other regions lag behind for a variety of reasons. In some cases, the stumbling block may simply be

the perceived enormity of the task of planning for sea-level rise based on estimates that can range from a few tens of centimeters to meters over the next century. Such impediments to integrated sea-level rise adaptation planning and action can be overcome by approaching the task differently – by breaking the problem into more relatable and manageable components. Instead of trying to tackle "the sea-level rise problem," plan for a series of flooding events or seasonal storms that will progressively worsen in magnitude over time. With this approach, adaptation planning can move from the insurmountable to the legacy-worthy. Private-public-academic partnerships can be struck to assess and fill information gaps for sea-level rise adaption planning. In addition, incorporating the benefits of ecosystem services provided by each community's physical and biological assets into the planning effort will greatly enhance the community's ability to successfully evaluate and address the scope and scale of projected sea-level rise impacts.

Geologic History of Sea Level Change in the Gulf of Mexico; Past, Present and Future

Richard A. Davis, Jr., Harte Research Institute, Texas A&M University –Corpus Christi

The Gulf of Mexico had its origin with the breakup of the supercontinent Pangea in the Triassic Period about 150 million years ago. It began as a shallow evaporate basin and soon became rimmed by reefs. The carbonate platforms of Florida and the Yucatan persisted while land derived sediment began to be deposited in deltaic complexes in other parts of the Gulf Coast throughout the Cenozoic Era. Extensive glaciation that began about 2.5 million years ago caused numerous rises and falls of sea level; about 50 of these cycles during this time period. We know a fair amount about the most recent few of these cycles. Sea level ranged from about 40 m above its present position to 130 m below it. Lowering of sea level was associated with the development and growth of extensive ice sheets in both the northern and southern hemispheres. During this circumstance what is now the continental shelf was a coastal plain with most of the same characteristics of the present coastal plain; river systems, estuaries, and deltas. Melting of these ice sheets caused sea level to rise; initially rather rapidly and slowing over the past few thousand years. Virtually all of what we see along the present Gulf of Mexico coast has developed in the past 7,000 years when sea level was within a few meters of its present position; deltas, estuaries, and barrier islands. Until the past few decades sea level had been rising very slowly; about 1.5 mm/yr. More recently, tide gauges have shown rates of rise to be about twice that amount. In addition there are several areas where both natural and anthropogenic factors have caused rates of sea level rise to be up to 10 mm/yr. Many coastal areas are in jeopardy with projections of 0.7-1.0 m rise in sea level by the end of the century.

NOAA's Role in Helping Coastal Communities Address the Impacts of Sea-Level Rise

John H. Dunnigan, Senior Policy Advisor to the Under Secretary of Commerce for Oceans and Atmosphere, National Oceanic and Atmospheric Administration

The National Oceanic and Atmospheric Administration (NOAA) seeks to understand and predict changes in the Earth's environment and conserve and manage coastal and marine resources to meet the nation's economic, social and environmental needs. Mr. Dunnigan, who served as the Assistant Administrator for Ocean Services and Coastal Zone Management and head of the National Ocean Service, will provide a broad overview of how NOAA is working to support sustainable coastal communities and economies by helping coastal communities address the impacts of sea-level rise.

Impacts of Sea-Level Rise on the Yucatan Peninsula, Mexico

Jorge I. Euan-Avila, Centro de Investigación y Estudios Avanzados del Instituto Politécnico Nacional Merida

The cross section geo-morphology of the coastal zone in the Yucatán peninsula is mainly characterized by slight gentle slope of the beach (.0001) with elevations in the barrier islands and wetlands less than 2m. These characteristics suggest that the area is very susceptible to storm surge flooding and by the SLR in the long run. Several large beach profiles (km) from SRTM+ were used to estimate the slope of selected areas. SLR data from the TOPEX/POSEIDON and JASON in the Gulf of Mexico were used to estimate barrier coast line retreat using the Broom rule. In addition a flooding area is estimated with a simple model for hurricane storm surge.

Coastal States Organization Climate Change Workgroup - Findings and Purpose for Coastal Climate Change Adaptation Legislation.

Eddie R. Fisher, Director of Technical Integration of Coastal Planning & Policy, Texas General Land Office

The Coastal States Organization (CSO) was established in 1970 to represent the Governors of the nation's thirty-five coastal states, commonwealths and territories on legislative and policy issues relating to the sound management of coastal, Great Lakes and ocean resources. Since 2006 CSO has been working with coastal states Congress and NOAA, through its Climate Change Workgroup, on issues related to climate change impacts to coastal areas. Members of the workgroup have testified before Congress on the immediate needs of states to begin climate change adaptation strategies. Eddie Fisher has been a member of the workgroup since its inception and is a former co-chair of the group.

Sea-Level Measurement, Determination, and Application in the Gulf of Mexico

Stephen K. Gill, NOAA/NOS Center for Operational Oceanographic Products and Services

The process of determining sea level trends and variations from tide gauges is reviewed. Using a cross-section of long-term NOAA tide stations in the Gulf of Mexico, variations and uncertainties in relative trends in sea level, variations in decadal mean sea level, and monthly mean sea level anomalies are discussed. Temporal and spatial variations in sea level in the Gulf of Mexico are also reviewed. Finally, the relationship of relative sea level trends to land elevations and coastal structures and the impact of these trends at the local level are presented.

Sea Level Rise and Coral Reefs: Predicting Responses

Pamela Hallock, College of Marine Science, University of South Florida

Coral reefs are under stress from a diverse range of anthropogenic stressors including sedimentation, declining water quality, overfishing, mass-bleaching events, ocean acidification, and the proliferation of new diseases and invasive species. Given the worldwide decline of reefs caused by these and other impacts, models of light requirements of reef communities indicate that the direct effect of sea level rise at rates predicted for the 21st Century is a minor factor from an ecological perspective. More ecologically significant will be the impacts of sea level rise into polluted terrestrial environments, as this will increase sedimentation and diminish water quality, at least temporarily. However, the consequences of sea level rise on low-lying coastal zones currently protected by offshore reefs, including the Florida Keys, coastal Yucatan and Belize, and atolls in the Indo-Pacific, will inevitably be mass displacement of coastal human communities. In the short term, declining reefs are becoming less effective barriers to storm waves. In the longer term, the consequences will be the loss of traditional ways of life for these human populations, with some entire atoll-based countries, including the Maldives, Tuvalu and the Marshall Islands facing displacement. Planning for such inevitabilities has begun in Tuvalu, which has a treaty with New Zealand to take their entire population, and in the Maldives, which is building upward. Will the political leaders in low-lying communities around the Gulf of Mexico be comparably far-sighted?

Integrating Sea Level Rise with Hurricane Flood Level Statistics

Jennifer L. Irish, Zachry Department of Civil Engineering, Texas A&M University

Reliable extreme-value hurricane flooding estimates are essential for effective risk assessment, management, and engineering at the coast. However, limited historical flood observations and uncertainty in future sea level conditions present a challenge for assessing future hurricane flooding probability. Historical water level observations indicate that sea level is rising in most hurricane-prone regions throughout the US. Recent studies, including those by the Intergovernmental Panel on Climate Change, also suggest that in the future SLR may accelerate. In this paper, methods will be presented for incorporating sea level rise (SLR) into extreme-value flood statistics. Adopting a joint-probability approach, surge-response-functions (SRF), developed from a limited set of hydrodynamic simulations, are used to define time-varying continuous probability mass functions. Here, it will be demonstrated that dimensionless SRFs can account for the dynamic coupling between surge generation and changes in mean estuary or bay depth with SLR without loss in surge-prediction accuracy. Finally, methods for accounting for uncertainty in future SLR projections within the joint-probability framework will be discussed.

Wetland transgressions and human misdeeds: Topography, development, and sea level rise on the Gulf Coast

John Jacob, Texas A&M University Sea Grant

Given the geomorphic realities of the Texas coast, the only way that most of our estuarine wetlands can keep up with accelerated sea level rise will be through wetland transgression to higher ground. The ability of coastal wetlands to migrate inland will depend on coastal topography and development. In many areas along the coast relatively steep slopes or bluffs that formed during downcutting associated with the last glacial highstand will result in drowned wetlands with little inland migration, at least until sea level rises above about 5 m, a level contemplated only in the most extreme predictions for the next hundred years or so. In other areas existing and future coastal development will also block wetland transgression. In this paper I explore the pattern of development along the Texas coast, and how that pattern might be modified to enable more wetland migration. I also review data gaps in our understanding of susceptibility of coastal wetlands to drowning by SLR.

Impacts of Climate Change and Variability on Transportation Systems and Infrastructure in the Gulf Coast

Robert Kafalenos, Department of Transportation

The changing climate raises critical questions for the transportation sector, built and maintained through substantial public and private investment. The prospect of changes in temperature, precipitation, sea levels and storm events warrants consideration of how climate change could affect the country's roads, airports, rail, transit systems, and ports. This presentation focuses on the results of a case study focused on the Gulf Coast region: *Impacts of Climate Change and Variability on Transportation Systems and Infrastructure: Gulf Coast Study, Phase 1*. In addition, ongoing efforts related to Phase 2 of the Gulf Coast Study and other FHWA efforts tied to climate change adaptation will be discussed.

Climate Change and Human Health

Mark Maslin, University College London

The UCL-Lancet commission published their report in 2009 and declared that Climate change is the biggest global health threat of the 21st century. In this talk Mark Maslin one of the authors of the reports examines why the commission came to this stark conclusion. They found that the effects of climate change on health will affect most populations in the next decades and put the lives and wellbeing of billions of people at increased risk. During this century, earth's average surface temperature rises are likely to exceed the safe threshold of 2°C above preindustrial average temperature. Rises could be as high a 6°C 2100 and 12°C in the high latitudes. The Lancet report, outlined the major threats—both direct and indirect—to global health from climate change through changing patterns of disease, water and food insecurity, vulnerable shelter and human settlements, extreme climatic events, and population growth and migration. Although vector-borne diseases will expand their reach and death tolls. It is the increase in heatwaves, floods, drought, sea level and other extreme climate events which will affect water and food security, which are likely to have the biggest effect on global health.

Sea Level Rise in the Gulf of Mexico

Gary T. Mitchum, College of Marine Science, University of South Florida

We will begin by reviewing the state of our knowledge concerning global sea level rise estimates and projections, and the challenges of down-scaling the global estimates to regional and local scales. The sources of relative sea level change (i.e., the difference between land and ocean levels) will be defined and estimates will be given for the GOM region along with our best derivations of the reliability of these on time scales varying from annual to multi-decadal. Finally, we will briefly discuss the politically sensitive issue of planning for the future given the unavoidable uncertainties in our projections.

The Limits of Salt Marsh Adaptation to Rising Sea Level

James Morris, Director, Belle Baruch Institute, University of South Carolina

The current distribution of coastal wetlands is the product of 4,000 years of near static sea level and progradation. The rise in sea level that we see today began several centuries ago. Consequently, today's coastal wetlands are transgressing and may not be equilibrium with sea level. Salt marsh plant biomass and sediment accretion rates are influenced by the relative elevation of the marsh surface. There is an optimum elevation for plant productivity, and there are upper and lower limits of relative elevation determined by hypoxia at one extreme and osmotic stress at the other. Provided that marsh elevation is super-optimal for plant growth, a rise in relative sea level will stimulate primary production and sedimentation, thereby raising marsh elevation. Relative marsh surface elevation will decline as the rate of SLR increases. When the surface falls to a relative elevation that is suboptimal for the vegetation, a further increase in relative sea level depress primary production and sedimentation, leading to the conversion of vegetated marsh to open water. This transition is a tipping point. New data suggest that some of our marshes are already past or are nearing this tipping point.

Municipal Exactions at the Water's Edge

Timothy M. Mulvaney, Texas Wesleyan University School of Law

This presentation will address the ability of local governments to impose discretionary permit conditions to offset the burdens that new development places upon existing infrastructure and the environment. Over fifteen years ago, a deeply divided U.S. Supreme Court ruled that the Takings Clause of the U.S. Constitution significantly restricts this governmental authority, for the clause requires the judiciary to apply a more stringent level of scrutiny in reviewing permit conditions than is accorded outright permit denials. This presentation will explain how these decisions provide land use regulators with some incentives to circumvent the more stringent standard for permit conditions by under-regulating, over-regulating, or engaging in unwelcome conduct associated with a repeat-player theory. However, dicta in a recent Supreme Court opinion could be interpreted as limiting the application of stringent scrutiny to a small subset of exactions, and thus leave local governments with increased flexibility to impose conditions to deal with complicated modern environmental, natural resource and land use challenges on U.S. coastlines. Professor Mulvaney will conclude the presentation by explaining the possibility of conducting a multi-state empirical study on local coastal permitting conditions, and he looks forward to your participation therein.

Cultural and Historical Perspectives on Sea Level Rise: Our Migrating Coasts and Human Communities

Michael K. Orbach, Professor of Marine Affairs and Policy, Nicholas School of the Environment, Duke University

Sea level is projected to rise worldwide between one and two meters in the next century. By that time, over half of the world's population will live within 100 miles of an ocean coast. Already, 20 of the 30 largest cities in the world are located in vulnerable coastal areas. The effects of sea level rise are already being felt in many locations around the world. Human civilization – since the time of significant build infrastructure – has never experienced this situation of rising sea levels. Given the potential magnitude of the effects of sea level rise, there are several questions that should begin to be addressed immediately. First, which areas will human attempt to "defend" from inundation? It is almost certain that because of practical engineering and economic challenges, most coastal areas will not be defended, but rather abandoned to inundation. Second, to what upland locations will human populations and human infrastructure such as building, roads and sewer systems move? Third, to what upland locations will our "natural infrastructure" such as mangrove forests and fringe marshes move? Finally, what will we do about the considerable human infrastructure – perhaps the City of Houston -- that will eventually be abandoned? These issues will be discussed in the context of different cultural and historical perspectives on coastal management from around the world.

Early Warning Systems to Extreme Hydro-Meteorological Events for the South Coast of Tamaulipas, Mexico (SATEME, Spanish acronym)

Roberto Padilla Hernández (Speaker), Sergio Jiménez Hernández, Gerardo Quiroga Goode, Julio Cesar Barrientos Cisneros, Felipe Sosa Pérez, Gabriela Hernández Mendoza, Francisco Alcocer, Dulce Piñeiro Hernández, Jorge Reynoso Martinez, Felix Gutierrez, Luis Alvaro Zavala Guerrero, Roberto Pichardo Ramirez, Marcos Azuara Hernández, Universidad Autónoma de Tamaulipas

Introduction of prevention systems of natural disasters, such as catastrophic floods caused by hurricanes in Mexican seaside municipalities is a new reality nowadays. Their appearance is explained in the Mexican urban context, where over 80% of the population lives in urban areas. This effect has caused in certain coastal areas of the country, some overcrowding and impact to the beaches, lakes and river mouths. In Mexico the untenable human sprawl of the coastal zones, like the Gulf of Mexico, has favored that the consequences of a hurricane's passage, generating higher disasters and important human and material loss. Within this context, it's necessary the organization of the coastal urban zones and the promotion of the culture of prevention in view of the possibility of natural disasters -- like hurricanes and floods, in those coastal municipalities. This study deals with the impact that disasters caused by floods have in the world and mainly in Mexico. It also focuses in the importance of prevention in view of natural disasters (hurricanes) in the municipalities by means of the Early Warning Systems to Extreme hydro-meteorological Events for the South Coast of Tamaulipas, Mexico (SATEME) for the Coast of Tamaulipas, this system is a set of tools for hydrometeorological simulation and forecasting that determine the risk conditions by heavy seas and extreme floods of the low basin of the Panuco river for the South coast of the State of Tamaulipas. It determines specifically for a tropical cyclone event the floodplains in the Coastal Metropolitan Area of the municipalities of Tampico, Madero and Altamira in Tamaulipas (ZMCTMA, Spanish acronym) and partially in Pueblo Viejo and Pánuco in Veracruz. The goal pursued by this research is to provide an effective forecasting tool that alerts with enough time to the population of Tampico, Madero and Altamira considering the effects of a flood due to heavy seas and extreme floods in the low basin of the Panuco River. In this sense, the purpose is to become a basic element for the authorities of Civil Defense in preventing and attending contingencies due to Extreme Meteorological Events in the Coast of Tamaulipas.

Introduction to Legal and Policy Issues Associated with Promoting Coastal Resiliency

Margaret E. Peloso, Vinson & Elkins LLP

All coastal states will face a number of important policy challenges with respect to sea level rise. In the Gulf States, the challenges will be particularly acute, as climate change produces not only gradual inundation due to rising seas but may also lead to stronger and more frequent storms and associated coastal flooding. Over time, such impacts will place more people, property, and fragile coastal ecosystems at risk, and without a comprehensive policy response, societal vulnerability to the impacts of sea level rise will certainly increase. This presentation will explain the concept of coastal resiliency and the legal and policy responses that can reduce vulnerability to climate change. Drawing on case study research, I will outline the key legal factors that make some states better positioned than others in responding to sea level rise. Recognizing the important role of the courts, I also review the potential implications of the recent Supreme Court arguments in *Stop the Beach Renourishment v. Florida Department of Environment* and the Texas Supreme Court arguments in *Severance v. Patterson*. Finally, I conclude with a set of recommended actions that coastal governments can take to promote coastal resiliency and reduce vulnerability to climate change.

The Impact of Sea-Level Rise on Changing Coastlines

Nathaniel G. Plant, U.S. Geological Survey, St. Petersburg FL

Sea-level rise will not simply flood the coastline like a filling bathtub. Instead, the coupled processes of sea-level rise, storm-driven waves and surge, and coastal erosion mean that that there will be a dynamic coastal response to all of these factors. The problem of predicting the future form and function of the coast is exacerbated by uncertainties in forecasts of climate-driven changes in sea level and storminess, not to mention fundamental limitations in our ability to forecast erosion and deposition processes. Therefore, a probabilistic approach is required that can cope with uncertain knowledge about both the driving forces and the coastal response. Here, I present a an overview of the existing predictive capabilities that span the relatively short temporal scales of coastal response to storms through to the longer time scales that include significant changes in sea-level rise. Conclusions from this analysis

are that (1) we have sufficient understanding of the processes contributing to coastal topographic changes to make useful predictions and (2) future scenarios that include high rates of sea-level rise will take us beyond the parameter space that has been used to develop and test these predictions.

Flood Risk and Sea Level Rise in London and the UK

Tim Reeder, Environment Agency UK

The presentation will cover the approach to assessing sea level rise and how to adapt to this. The main emphasis will be on the work carried out in the Thames Estuary 2100 Project to develop a plan for Flood risk for London and the estuary management for the 21st Century. London has always had to manage flood risk from the sea and climate change will make this more challenging. The advantages of an adaptive flexible approach will be outlined. Overarching policy for the UK will be covered; the UK is taking a proactive approach to climate change adaptation. Addressing sea level rise and associated flood risk will be central to this.

Impact of Rising Sea Level and Reduced Sediment Supply on Deltas: The Mississippi River Delta Case

Harry Roberts (speaker)[1], Mike Blum[2]
[1] Coastal Studies Institute, School of the Coast & Environment, Louisiana State University
[2] Process Sedimentology Group, Clastic Reservoir Performance Prediction, Exxon Mobil Upstream Research Co.

Following the last glacial maximum (LGM) at about 20 kyr BP, global sea level (SL) rose rapidly across continental shelves, backstepping fluvial deposition into entrenched alluvial valleys formed during the falling limb of SL. Coincident with the late phase of SL rise, the rate slowed dramatically (starting at about 7-8 kyrBP) allowing the world's great rivers to build today's deltas. However, in the last two centuries boundary conditions for delta-building have changed, sediment supply has been altered by human intervention and more recently, the rate of Holocene sea level rise has significantly increased. Coastal plain submergence and land loss are now common to many of the world's deltas. The Mississippi River delta is a dramatic case of submergence and land loss. Over 25% of the delta plain wetlands have been lost in historical times. The sediment load of the river has been reduced > 50% over the last century by dam construction in the drainage basin (> 4000 dams) and river engineering projects (e.g. bank revetments, meander cutoffs, and river-training structures). Calculations of sediment stored on the delta plain over the last 12 kyrs indicate that a mean storage rate necessary to construct the flood plain and deltas exceeds the modern sediment loads of the Mississippi and Atchafalaya Rivers combined. Also, the rate of sea level rise during construction of the delta plain was ~ 1mm/yr. Now it is ~ 3 mm/yr and predicted to rise in the future. Using averaged subsidence values that increase from inland to the coast and the accepted current rate of sea level rise, resulting accommodation by the end of this century would require 18-24 billion of sediment to sustain the present coastal plain configuration. In the absence of sediment input, 10,000 – 13,500 km^2 of the delta plain will be submerged by 2100. Under conditions of lowered sediment supply and increasing sea level rise, drowning of a large part of the Mississippi River delta plain is inevitable. Many of the world's great river deltas will share the Mississippi's fate.

Holocene Sea-Level Change and the Evolution of Coastal Depositional Systems: Implications for the Future

Antonio B. Rodriguez (speaker)[1], John B. Anderson[2], Alexander R. Simms[3], and Kristy T. Milliken[2]
[1]University of North Carolina at Chapel Hill, Institute of Marine Science
[2]Rice University, Department of Earth Science
[3]Oklahoma State University, T. Boone Pickens School of Geology

One of the main impacts of Global Warming is accelerated sea-level rise, which will eventually result in the drowning of low-lying coastal areas. The current rate of sea-level rise (average 3.1 mm/yr) is more than four times the rate for the past 4000 years (0.7 mm/yr) and it now seems likely that the rate will at least double by the end of this century, exceeding the average rate for the past 8500 years. During the overall rise of the past 8500 years, estuaries in Texas, western Louisiana, and Alabama experienced episodes of stability that were punctuated by widespread flooding and re-organization of environments that lasted for only a few centuries. The largest flooding events resulted in landward shifts in bay-head deltas of a few tens of kilometers at a rate that is unprecedented in modern times (<150 m/yr) and increases in open-water area >30% in two to three centuries. These changes

occurred when the average rate of sea-level rise in the Gulf of Mexico was ~5.2 mm/yr. Based on our results, it seems reasonable to predict that a modest increase in the rate of sea level rise (5 mm/yr) by the end of this century will result in significant impact to low gradient coasts, like those in North Carolina, Louisiana, and Texas; however, our examples from the geologic record ignore the impacts of humans, despite the continuing global coastal population boom. Changing sediment sources and the modification and/or disruption of established sediment-transfer routes throughout the coastal zone has a strong impact on sediment fluxes to estuarine systems (including barrier islands) through rivers, creeks, and man-made canals and channels. Human modifications have the potential to dramatically change the evolution of estuarine shorelines, which should be fringed by salt marsh but are rapidly being replaced by bulkheads, riprap, and rock sills. The impact of Global Warming and associated accelerated sea-level rise on low elevation and low gradient coasts is underestimated by simple inundation models, which focus on magnitudes of sea-level rise and not rates, and the impacts of human modifications to the coast must be taken into account when projecting future shoreline positions.

Human, Economic, and Policy Impacts of Sea Level Rise in Mexico

Hipólito Rodriguez, CIESAS-Golfo

During the last fifteen years, the Mexican economy has suffered the impacts of different events associated to the climate change. The Mexican states situated in the east, with sea littoral, has been particularly vulnerable to these impacts. There are six states in this geographic area where the economy has been touched by these events. Two of them, have a strategic importance because their contribution to the petroleum supply. Another two have also strategic ports in the new economic model oriented to the exportation. And finally, two have a considerable weight in the tourism sector, from whom the regional economy obtains many resources. Some of the major disastrous consequences of the climate change in the last two decades have occurred in Veracruz, Tabasco and Yucatan, where the poor population experienced a high vulnerability index. Considering this history, in this paper we discuss the trends that will affect the economy and the social policy in the next years.

Reducing "Investment-backed Expectations" in Coastal Areas

Thomas Ruppert, University of Florida Levin College of Law and Program for Resource Efficient Communities

Sea-level rise without human interference results in landward migration of shorelines. Both this migration and vertical rise of sea level on "hardened" shorelines present unprecedented policy challenges for planning. Part of this challenge resides in the legal concept of "takings," which prohibits government use of private property without compensation. This presentation will sketch the legal history of takings in the U.S. Constitution and through statute in Florida. The presentation will then examine the role that "reasonable investment-backed expectations" play in these analyses and how changing understandings and new legal arguments could alter reasonable investment-backed expectations.

Pick the Response Pathway Now

Jim Titus, U.S. Environmental Protection Agency

Land use, infrastructure, and legal decisions made today can have consequences for centuries. Therefore, planning for sea level rise now is justified even though the greatest impacts are likely to be decades in the future. Three fundamental response pathways are (1) retreat and shore protection through either (2) elevating land surfaces or (3) shoreline armoring. Preparing for sea level rise requires choosing between these pathways because the appropriate preparation usually depends on whether the land will be given up to the sea, elevated, or maintained in its current location. A recent sea level rise planning study concluded that along the Atlantic Coast, 60% of the land vulnerable to rising sea level is likely or certain to be developed and protected, 10% is part of a conservation area where shores would retreat, and 30% is undeveloped and unlikely to be protected—unless it becomes developed in the future; similar unpublished studies have been conducted along the Gulf Coasts of Florida and Texas. Because protecting most coastal areas is economically and environmentally infeasible, the background principals of property law should be clarified to remove any expectation of a right to hold back the sea (i.e. rolling easement) in those areas where such a wholesale reclassification involves minimal takings, such as lands where shore protection and development are unlikely. In undeveloped areas where development and shore protection are expected, rolling easements should sometimes be acquired as part of the planning process. http://papers.risingsea.net/ERL

Melting Ice and Rising Seas: Perceptions, Risk, and Reality

David G. Vaughan, British Antarctic Survey

A variety of sea-level measurements indicate that global sea-level rise is now approaching 4 mm per year, and contributions from ocean expansion, glacier retreat and ice-sheet loss, are all expected to rise in the coming hundred years. While these rates make the most dramatic projections to have appeared in recent years look unrealistic, projections of sea-level rise still contain substantial uncertainty and there is strong possibility that coastal communities and individuals will begin to see noticeable impacts in coming decades, as a rise in global sea level dramatically changes the statistics and economics of storm risk. These are issues that policy-makers from local to national cannot afford to ignore, but for policies to make sense they must be underpinned by a sound understanding of the science. I will discuss the current state of sea-level rise projection, and where the uncertainties lie, and how this impacts the wider debate around climate change. I'll share some of my experiences of trying to communicate science through the media, and to policy-makers, and discuss the role of scientists within that debate. Within the climate change debate, however, sea-level rise is an issue that is frequently used a centerpiece by campaigners and lobbyists. This focus probably arises because the risk associated with sea-level rise is easier to communicate in graphic terms than other more subtle climate changes which have the potential to be even more deadly. But sea-level rise, which is essentially a complex response to climate change, has several attributes that should set it apart from the rest of the climate change debate. On one hand, whereas atmospheric climate change can occur abruptly, the processes leading to sea-level rise mean it must change smoothly, and the degree to which its rate of rise can contain significant surprises is actually rather limited. Indeed, it is unclear that reductions of the emissions of greenhouse gases would have any effect on the sea-level rise for the next 100 years – although at present we cannot be confident in predicting its magnitude, the sea-level rise for this period is already fixed in the system. For the developed world, this means that a planned response of adaptation to sea-level rise, although this may be costly and may have to include "managed retreat" from some vulnerable areas, may be sufficient to maintain risk at acceptable levels. For the developing world there are undoubtedly fewer options and increasing risks are likely to be unavoidable. On the other hand, the likelihood that some vulnerable parts of the world's remaining ice sheets will, in decades to centuries, enter a phase of essentially irreversible retreat, leading to eventual sea-level rise of several metres over coming centuries remains a strong possibility. Whether the continued sea-level rise this will create is an acceptable legacy for future generations is a wholly moral debate, about which science can have little to contribute, beyond establishing the thresholds of climate change at which such events become more likely.

Sea-level Rise planning in the State of Veracruz, Mexico

Carlos M. Welsh Rodríguez, University of Veracruz

The state of Veracruz represents one of the most vulnerable places in the Gulf of Mexico. Because of that, the University of Veracruz with funds from the U.K. (Global Opportunities Fund) developed the Veracruz Action Plan on Climate Change, with the strong alliance of the National Autonomous University of Mexico (UNAM) and the Ecology Institute (INECOL). This plan includes selected studies to show vulnerability of the biophysical systems and impacts on the economy and society. As a result of the studies and with the public's participation, the University of Veracruz delivered a strategic plan to the Veracruz Government in order to establish a state public policy on adaptation and mitigation for Veracruz. In that strategic plan, the sea level rise was included from a broad perspective, as a regional impact on the productive system and society, as a risk factor to the power industry and as change driving factor on biodiversity. However, the planning process models in Veracruz were far away from an ideal model. The public, government, industry, producers and all the stakeholders did not share concerns or an objective that helps to build an accurate action plan to adapt Veracruz to the new reality of Climate Change.

Adapting to Sea-Level Rise: A Look at Laws, Policies, and Institutions in Cuba

Dan Whittle, Environmental Defense

This presentation will summarize actions and efforts the Cuban government is taking to address the current and future environmental and economic impacts associated with sea level rise (SLR). This will include a summary of potential impacts and an examination of those coastal areas considered to be the most vulnerable to rising sea levels. The principal focus of this presentation will be on environmental and planning laws, policies and institutions, and will also include information on civil defense programs and hurricane forecasting and preparedness. With respect to

environmental planning and management, this talk will explore principle environmental laws, policies, and strategies relating to SLR and provide an in-depth look at the ministries, agencies and institutions involved.

Governmental Liability for Failing to Protect Citizens from Known or Impending Hazards

James G. Wilkins, Professor/Director Louisiana Sea Grant Law and Policy Program, Louisiana State University

Worldwide communication has made us more aware than ever of the constant threat natural hazards pose to human life and property. Coastal areas are particularly vulnerable especially in light of current climate science's predictions for accelerated sea level rise in coming decades. Some state and local governments are attempting to prepare for sea level rise by instituting hazard mitigation measures that restrict where and how development may occur. These measures can raise legal issues such as takings challenges from property owners. However, governmental entities may, in the long run, incur more liability when their actions, or failure to act, increase their citizens' exposure to natural hazards resulting in injury. Government's duty to protect people from known or foreseeable hazards is likely to increase with the advance in accuracy of technology used to predict hazardous events and vulnerable areas.

The Socio-Economic Impacts of Sea Level Rise in Galveston Bay

David Yoskowitz (Speaker), Ali McKenzie, James Gibeaut, Harte Research Institute for Gulf of Mexico Studies

This project is part of a larger effort that seeks to illustrate, at a local level, the impact that climate change can have on communities. The science and impacts of climate change do little to motivate action if individuals cannot relate to them on a personal level. One of the more important changes taking place along the Texas coast is sea level rise and more specifically, relative sea level rise in the Galveston Bay region. Sea level rise is not a hypothetical phenomenon, it is happening. The instrumental record for Galveston's Pier 21 has recorded a 0.60 meter increase in relative sea level over the last 100 years. To assess the potential impact that sea level rise may have on the region, we focus on two scenarios of sea level rise and the associated socio-economic impact for the next 100 years. We model two scenarios of relative sea level rise for 100 years: 1) 0.69 meters and, 2) 1.5 meters. For the region, almost 99,000 households would be displaced under the 1.5m scenario. For Galveston County alone, 78% of the current number of total households would be displaced under the 0.69m scenario and 93% under the 1.5m scenario households with an Ike level storm on top of the sea level rise. This would equate to about 1.3% of all the households in Texas and equivalent to the entire city of Corpus Christi (year 2000). An Ike type storm with sea level rise of 0.69 meters would also create an additional $1.7 billion in property losses. With a 1.5 meter rise it would jump to $3.8 billion.

Sea Level Trends Along Mexico's Coasts

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The annual cycle and the long term trends on sea level for seven sites in the Mexico's Gulf of Mexico coast are analyzed seven in the Gulf of Mexico. For this analysis the monthly means of the largest series in Mexico from the Mexican Sea Level Service, operated by the Instituto de Geofísica of the Universidad Nacional Autónoma de México. The series have different length, from 16 to 50 years. For each site the annual cycle is obtained, computing the long term monthly means and the standard deviation. For the computation of the long term trends, only years with the twelve months are considered to prevent bias due to the seasonal variability. The sites studied show a maximum sea level during September-October and minimums in different months of the year. The trends are positive, being Cd. Madero the site that has the largest increase with 9.2 ± 5.1 mm year-1, and Alvarado the smallest with 1.8 ± 2.3 mm year-1. Veracruz is the longest series and a trend of 1.9 ± 0.6 mm year-1. Trends and sea level variability are different for each region due to oceanographic processes and vertical land motion showing that it is necessary to realize regional studies. The ongoing program for the rehabilitation of the network, the database and the website is shown.

Sea Level Rise Impact on Ecosystems and Fisheries

Roger J. Zimmerman (Speaker) and Thomas J. Minello, NOAA Fisheries

Fisheries production in the Gulf of Mexico is largely estuarine dependent and includes shrimp and menhaden fisheries that are among the most valuable in the United States. In 2008, dock side landings of Gulf shrimp were 256.6 million pounds valued at $441.8 million, the nation's second most valuable fishery. Catch of Gulf menhaden

in 2008 amounted to 1.3 billion pounds, surpassed only by Alaskan Pollock. These two species and others representing major commercial and recreational fisheries in the Gulf such as blue crab, red drum, southern flounder and spotted sea trout depend upon estuarine wetlands to complete their life cycles. Correspondingly, more estuarine wetlands occur in the Gulf of Mexico than elsewhere in the nation. But current high loss rates of wetland habitats in the Gulf due to the combination of sea level rise and subsidence threaten to diminish historical levels of productivity. Predicted increases in sea level rise will accelerate estuarine habitat losses that support the Gulf of Mexico Large Marine Ecosystem (LME) and fishing cultures. The magnitude and complexity of cascading effects of estuarine habitat changes on the Gulf LME due to sea level rise may not be fully appreciated nor understood. Gulf shrimp and menhaden are lower level consumers whose populations support robust food chains of higher trophic consumers. Reduction in the productivity and biomass available from these two abundant species alone could restrict biological energy available to higher trophic levels and change the food web dynamics in the Gulf LME. Reduced populations of intermediate consumers would affect higher consumers and disrupt or truncate food chains in ways not yet foreseen. Unfortunately, the details of connectivity and dependency of energy transfer within food webs in the Gulf are, for the most part, neither delineated nor quantified. Secondary production benefiting fisheries and ecosystems has been shown to be proportional to area of estuarine wetlands. A combination of sea level rise and subsidence in Louisiana provides a model for examining effects of accelerated sea level rise on estuarine dependent secondary production. Estuarine wetlands in Louisiana are being converted to open water at a rate faster that they are being replaced. Drowning of these emergent marshes results in an "edge effect' that temporarily increases the marsh-open water interface which in turn benefits secondary productivity. Louisiana is experiencing this phenomenon at present. But as emergent marshes are not replaced, the total area diminishes and production of estuarine dependent species also diminishes. Reductions in long established coastal fisheries in the Gulf are inevitable due to sea level rise. Since prominent Gulf fisheries rely upon biomass surpluses, SL rise induced habitat losses are certain to impact the productivity of estuarine dependent species. Initial predictions for the next century suggest losses that could lead to the extinction of some commercial and recreational fisheries. For shrimp alone, the loss could be on the order 40% or more in production. The impact of these losses to Gulf fisheries affects human dependency through reduced employment, vanishing cultures and reductions in domestic seafood products. The goods and services provided by the Gulf's estuarine ecosystems have sustained unique fishing communities since our nation's beginning. Mitigation against SL level rise impacts must insure that estuarine wetlands be replaced at the rate they are lost. Actions need to taken to accelerate preservation, restoration and creation of estuarine wetlands.

Poster Presentation Abstracts

Joint Archive for Sea Level: A Resource for Sea Level Rise Research

Pat Caldwell, Regional Science Officer, Honolulu, Hawa
Dr. Mark Merrifield, Sea Level Center (UHSLC), University of Hawai'
Russ Beard, Director, NCDDC

The Joint Archive for Sea Level (JASL) is a collaborative effort between the University of Hawaii Sea Level Center (UHSLC) and the NOAA Data Centers (NODC and NCDDC), with the objective of making high quality, international, long-term time series of sea level data available for scientific research, education, and commerce. The UHSLC provides scientific guidance while the NOAA data centers lend expertise in data management. The JASL is designated as an archive center of the Global Sea Level Observing System (GLOSS), which is conducted under the auspices of the Joint Technical Commission for Oceanography and Marine Meteorology (JCOMM) of the World Meteorological Organization (WMO) and the Intergovernmental Oceanographic Commission (IOC). The JASL solicits contributions of recent and historic hourly sea level data from over 60 agencies representing over 70 countries. Hourly intervals allow a fine resolution in quality control. The JASL is the largest international archive of research quality hourly sea level data. From the hourly data, daily and monthly means are computed. The hourly, daily, and monthly values are submitted annually to the Word Data Center for Oceanography-Silver Spring, co-located with the NODC, and the Permanent Service for Mean Sea Level (PSMSL) in the United Kingdom. The JASL is a valuable resource for investigations of long-term, large scale, sea level variations such as global sea level rise.

Implications of Black Mangrove (*Avicennia sp.)* Colony Expansion in the Gulf of Mexico with Climate Change: Wetland Health and Resistance to Rising Sea Levels

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Populations of black mangroves (*Avicennia sp.)* are hypothesized to expand their latitudinal range because of a reduction in the frequency of coastal freezes, which limit mangrove colonies and individual tree size, and an overall warmer climate. The Gulf of Mexico is located at the northward limit of black mangrove habitat and is therefore a prime candidate for population expansion to occur. This colonization would replace *Spartina ssp*. marsh. We hypothesize that mangrove root systems raise soil elevations (by rooting and increased sediment trapping) and increase resistance to land loss and edge erosion from storm waves, due to elevation and increased soil strength. In addition to elevation changes, mangrove expansion may alter organic carbon sequestration and change estuarine productivity in adjacent water bodies. The focus of this study is not to validate the expansion of mangrove populations in the Gulf of Mexico, but to examine the regional and global implications of this expansion with respect to predicted rises in sea level, cyclonic storms, and global carbon storage. Field sites of adjacent and intergrown *Avicennia* mangrove and *Spartina* marsh populations in similar geomorphological setting were selected in backbarrier areas near Port Aransas and Galveston, TX (two sites each). High-accuracy (±1 cm) elevation maps over ~5,000 m^2 areas were created using a GPS base station and transit topographic mapping. Peat auger (no compaction) cores from marsh and mangrove areas were collected for sampling of organic matter content, pore water chemistry, Pb/Cs sediment accumulation rates, sediment grain size, and pigment and lignin-phenol biomarkers of organic matter source(s). Elevation surveys to date indicate mangrove areas are a few centimeters higher in elevation than surrounding marsh at the patch and individual mangrove scale, with less of an elevation offset in clayey versus sandy soils. Preliminary results of core sediments indicate porosity is lower in mangrove rooted horizons (upper ~20 cm), with a corresponding increase in sediment strength. No consistent variation in grain size has been observed on sites thus far, suggesting little evidence for increased trapping of suspended particulates in the mangrove areas, although data on sediment accumulation rates is still being processed. Our reconnaissance for site surveys to date, ultimately designed to cover the full latitudinal range of the western Gulf of Mexico, suggests that black mangrove populations are clustered near inlet areas, indicating seed transport pathways are a major control on colony establishment, and likely, the rapidity of habitat replacement.

Modeling Considerations for Estimating Coastal Inundation Risk in the Gulf of Mexico and Consequences of Sea Level Rise

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The vulnerability to Sea Level Rise for the Gulf of Mexico coast varies significantly because of spatial differences in: the coastline geometry, tides, beach slope, and frequency of hurricane impacts. For example, Hurricane Dennis (2005) caused extreme flooding along the coastal zone of the northeastern Gulf of Mexico, even though local winds were relatively weak. A modeling study presented here shows that this region is particularly susceptible to intense flooding during storms due to its coastline geometry in relation to storm tracks, even though this region is less frequently directly impacted by hurricanes compared to other places in the Gulf. Improvements in storm surge modeling methodologies are being applied to assess the geographic differences in flooding risks from storm surges and waves compared to risk of loss due to high winds. One of the likely impacts of Sea Level Rise on the region is higher vulnerability to coastal inundation and flooding. Predicting the change in inundation risk due to sea level rise along the Gulf of Mexico coast over extended temporal scales is important for assessing potential future economic, social, and environmental transformations of the region.

Height and Sediment Grain-Size Distribution of Beach Ridge Dunes on North Padre Island, Western Gulf of Mexico: Implications for Estimating Regional Centennial to Millennial Sea-Level Fluctuations and Paleo-Storm Intensity

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Beach dune ridge height and grain-size distributions are, in part, controlled by sea level and wave intensity and can be used as proxies for evaluating the magnitude and periodicity of meter-scale-sea-level fluctuations and paleo-storm intensities. Low dune ridges, formed during periods of sea-level lowstand and low storm intensity, are characterized by grain-size distributions exhibiting high kurtosis. High dune ridges, formed during periods of sea-level highstands and high storm intensity, are characterized by grain-size distributions with low kurtosis. On North Padre Island low dune ridges exhibit grain-size distributions with high kurtosis and a low abundance of storm-induced sand. High dune ridges exhibit poly-modal grain-size distributions with low kurtosis suggesting that dune sand is a mixture of poly-modal storm-induced shoreface sand. An analysis of shoreface grain-size distributions has resulted in a mixing model that suggests storm-induced sand is sourced from different water depths along the shoreface profile. The grain-size distribution of storm sand is controlled by the depth of storm wave base, which is positively correlated with storm intensity. The dune sand grain-size mixing model and dune elevation data suggest climate-induced-sea-level fluctuations in the Gulf of Mexico with periods of 200-250, 400-500, and 900-1,000 years, consistent with the periodicities observed in published Late Holocene sea-level curves and climate-change proxy curves. These changes are consistent with centennial- and millennial-scale changes over the North Atlantic Ocean.

Developing a Barrier Island Geohazards Map: Galveston Island, Texas

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The entire 48-km long Galveston Island is highly vulnerable to sea-level rise and tropical storms, but simply categorizing the entire island as a risky place to live would not help guide the ongoing development. The *Galveston Island Geohazards Map* shows areas that vary in their susceptibility to, and function for, mitigating the effects of geological processes. These processes include sea-level rise, land subsidence, erosion, and storm-surge flooding and washover. Areas mapped as having imminent hazard potential include the presently existing critical environments of estuarine wetlands, freshwater wetlands, and the beach/foredune system. Areas of future critical environments are designated as having a high hazard potential and include areas of uplands projected to become critical environments

in 60 years. Moderate hazard areas are uplands that are neither currently, nor are expected to become, critical environments during the next 60 years but may be inundated during a category-one hurricane. The island core unit has a low-hazard potential because it is relatively high in elevation and interior to the island, making it overall less susceptible to geohazards than other parts of the island. A beach/dune ridge generally more than 2-meters high and set in a seaward position extends along about half the length of the island. This ridge forms a natural barrier to cross-island washover, making it an important feature to preserve. The western 10 km of the island, however, is not well protected by natural features or seawalls, making it an area with enhanced potential for washover.

Responsiveness of Large Scale Habitat Restoration Projects to Sea Level Rise

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One of the most important factors for consideration in design of coastal restoration projects is sea level rise. With funding through the American Recovery and Reinvestment Act (ARRA), NOAA Restoration Center (RC) has funded large-scale restoration projects designed to produce significant ecological habitat features to create buffers, which protect coastal communities from sea level rise, coastal storms, and flooding. In the Gulf of Mexico (TX, LA and AL), ARRA projects are being implemented using innovative adaptive management restoration techniques that are designed to be long-lasting in the face of rising sea levels. Salt marsh restoration/creation projects have specific elevation designs to allow for the migration of intertidal marsh to higher elevations as relative sea level rises, potentially three feet over the next 100 years. Oyster reef restoration projects, besides serving as shoreline stabilizers, are self-maintaining and self-sustaining, resulting in continuous building of the reef that can potentially keep up with effects of sea level rise. Three different types of reefs (ReefBlk, Reef Ball and oyster bags) are being trialed to learn which will lessen increased wave action and allow for accretion and migration of habitat behind the reef. There are many assumptions and hypotheses behind the use of these types of restoration techniques. The results from these projects should help us to further elucidate valid techniques that will be responsive to sea level rise and will make these Gulf shorelines more resilient to a changing climate.

Gulf of Mexico Climate Outreach – Building a Community of Practice (CoP) for Long-Term Engagement with Coastal Communities

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The potential economic, social, and ecological impacts of sea level rise (SLR) around the Gulf of Mexico (GOM) are tremendous. They compel us to provide decision makers with reliable information and science-based guidance regarding both the level of risk to their coastal communities and strategies they can promote to effectively adapt to rising SL. We will address these needs through a collaborative project involving the four GOM Sea Grant Programs, NOAA capabilities, and other federal, state and local partners. The project will bring together extension, outreach and education (EOE) experts from around the Gulf who we expect to be conducting EOE related to SLR in their respective communities. In a facilitated workshop, we will provide them with the latest information from technical experts on projected rate of SLR, anticipated impacts to coastal natural and built resources, adaptation strategies, and practical tools for communicating risk and using community based social marketing. The EOE experts also will interact with local planners who will present case studies from around the Gulf related to SLR adaptation planning, and collectively they will develop an outreach strategy for providing guidance to local communities regarding SLR adaptation options. This project also will establish a long-term community of practice among EOE professionals in the Gulf region that will ensure continued dialogue and information exchange on SLR and other climate-change and coastal hazard related issues.

Simulating Mississippi River Conditions after Future Perturbations

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Approximately 1500-1900 mi^2 of land, primarily low-lying coastal marshes on Louisiana's delta plain, have become submerged since the 1930s. The deterioration of the LA coastal marshes, which are of major ecological, recreational

and economical importance, is alarming and of national concern because it represents approximately 90 percent of the total coastal marsh loss occurring in the United States. In most of the Louisiana coastal area, relative sea level rise, that controls total land loss, is approximately one order of magnitude greater than the global sea level rise rate and has caused large increases in the amount of coastal land which is submerged and subjected to erosion pressures together with the duration of flooding. Even though factors such as hydrologic isolation of the wetlands and geological subsidence may be more relevant for the land loss problem than global sea level rise, increases in the eustatic sea level will have an important impact on the dynamics of the lower River system. A two-dimensional hydrodynamic finite element adaptive model for the Lower Mississippi River Delta (from River Mile 105 to Gulf of Mexico) that includes all of the lower River passes and openings together with many of the dynamic forcings from the Gulf has been calibrated and validated. In this presentation, model results will show the impact of future sea level rise on flow distribution through the various passes and general sediment transport behavior of the river system. We will also discuss potential implications for management of the lower River.

Dynamical and Climatic Forcings of Tide Gauge Variability

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Rates of global sea-level rise calculated for the last century and recent decades range from about 1.1 mm yr^{-1} to 3.1 mm yr^{-1}, with the higher values found for the more recent episodes. However, these sea level changes are occurring against a backdrop in which season and annual variability in sea level is orders of magnitude greater than the long-term trend. This variability makes it difficult to calculate long-term trends. Many investigators cope with the confounding effects caused by this variability by averaging large and long-term data sets. An alternative approach is to understand the causes of this variability and to use this understanding as a means to better elucidate patterns in the tide gauge records. Here we present data seasonal and interannual sea-level data from a suite of tide gauges on the Gulf Coast and both coasts of the Atlantic Ocean. After adjusting for glacial isostatic adjustments, sea-level variability at these sites can be understood in terms of seasonal meteorological processes, shifts in global wind and pressure fields, changes in the position on atmospheric centers of action, and global climate change. This work provides key insights into the relative importance between climate variability and climate trends.

Interannual Variability of Extreme Sea Level Anomalies along the U.S. Gulf of Mexico Coastline

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Coastal sea level anomalies responsible for flooding and extreme low water conditions are driven by extra-tropical and tropical storms in the Gulf of Mexico. This study examines daily sea level records over the past fifty years to identify trends and modes of variability in the coastal sea level. A strong seasonal signal is evident in the sea level variability, with maximum variability in the winter months. Interannual variability in the frequency of occurrence of the extreme sea level anomalies is associated with El Niño-Southern Oscillation (ENSO) during the fall and winter. This is consistent with ENSO-related changes in the genesis location of extratropical atmospheric low pressure systems and in the tracks of these weather systems. The impacts of tropical systems in the summer through early fall months on coastal sea level in the GOM are shown by infrequent extreme high and low anomalies coinciding with individual storms. However, the number of storms affecting the data record from a particular sea level station is too small to confirm ENSO related variability. Statistical methods are employed to demonstrate a significant link between extreme sea-level anomalies in the GOM and ENSO during the October to March period.

Human Dimension Information Resources for Community Resilience and Sea Level Rise Planning: NOAA County Snapshots and Spatial Trends in Coastal Socioeconomics Web Site

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Two new NOAA products provide coastal and ocean managers with human dimension information for community resilience and sea level rise planning. First, the County Snapshots provides local officials with a summary look at demographic, infrastructure, and land use information within the FEMA 100-year flood zone for the Nation's coastal counties. Second, the Spatial Trends in Coastal Socioeconomics – or STICS – Web site allows users to dig deeper into the demographic and economic status and trends within this same flood zone area. STICS recompiles several national demographic and economic datasets into a variety of geographic units that coastal and ocean managers must work with on a daily basis: (1) placed-based management programs, for example, the NOAA National Estuarine Research Reserves and the USEPA National Estuary Programs; coastal floodplains, for example, FEMA 100-year flood hazard areas; coastal watersheds, for example, NOAA estuaries and USGS hydrologic units; and political areas, for example, counties, states, and Coastal Zone Management Act (CZMA) state coastal zone management program boundaries. STICS currently offers the following national datasets: (1) demographic information from the U.S. Census Bureau; (2) personal income and employment information from the Bureau of Economic Analysis; (3) demographic projections developed by Woods and Poole Economics, Inc.; and (4) participation in coastal recreational activities from the National Survey on Recreation in the Environment. The STICS Quick Report Tool provides a map-based interface to easily discover demographic and economic characteristics of the 100-year flood zone for the Nation's coastal counties.

Vertical Accretion in Estuarine Wetlands of Mustang Island, TX as Determined by Cs-137 Gamma Spectroscopy

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Estuarine wetlands of Mustang Island are limited by the narrow tidal range to elevations below 0.5 m above MSL. A change in sea level of just 0.1 m, therefore, can significantly affect wetland distribution. Other studies concluded that the fate of estuarine wetlands depends to a large part on the balance of vertical accretion (mineral and organic matter accumulation) and the rate of sea-level rise. Herein we present the preliminary results of an ongoing study to determine vertical accretion rates in the fringing wetland environments of Mustang Island, TX. Accretion rates were determined using the 1963 peak in Cs-137 as a marker horizon as located by HPGe gamma spectroscopy. For purposes of this study, high marsh, high-tidal flat, low marsh and low-tidal flat environments are targeted in three areas along the island. Data on the organic contribution to the vertical accretion rate is obtained by loss on ignition. In addition, bulk density and grain size distributions are also determined. Our results indicate that accretion rates decrease with increasing elevation - consistent with studies in similar settings elsewhere. The highest accretion rate was obtained from a low marsh core (4.22 mm/yr); a core from a high tidal flat yielded an accretion rate of 1.7 mm/yr. High marsh environments have the lowest accretion rates 1.01-1.12 mm/yr. Interestingly, accretion rates for low tidal flats could not be determined because a Cs-137 peak is absent. Organic content in all the cores is generally below 10%, therefore, it is a relatively minor contributor to vertical accretion. Lastly, the published rate of sea-level rise at the nearby Rockport tide gauge is 5.17 +/- 0.67 mm/yr. As this rate exceeds the accretion rates obtained in this study, significant changes in the distribution of intertidal environments on Mustang Island can be expected in the future.

Past and Future Impacts of Sea Level Rise on Coastal Habitats and Species in the Greater Everglades

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This USGS Integrated Modeling Project, established in March 2009, merges biologic and hydrologic models to develop tools and products to help resource managers anticipate the projected ecological consequences of rising sea level in coastal south Florida. The project builds on prior USGS models and research in support of the Comprehensive Everglades Restoration Plan (CERP). To develop a realistic suite of predictive models, we are (1) Enhancing an existing hydrologic model to reliably hindcast multi-decadal observed sea level rise (SLR) phenomena; (2) Developing mechanistic models of coastal vegetation change, which help explain how hydrologic changes associated with SLR induces vegetation regime change; (3) Incorporating episodic disturbance events, particularly hurricanes, and estimating their impact on hydrologic and vegetation change models; (4) Integrating vegetation change and hydrologic models to simulate variables for both spatially-explicit population models and models of habitat suitability indices for focal species; and (5) Developing predictive capability for the integrated ecologic-hydrologic models, which incorporates comparative assessments of effects to floral and faunal species under projected restoration, management, and SLR scenarios.

Mean Sea Level – What are the Recent Changes Along the Texas Gulf Coast?

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Mean Sea Level is defined By NOAA's National Ocean Service (NOS) as "The arithmetic mean of hourly heights observed over the National Tidal Datum Epoch (the latest being 1983-2001). Shorter series are specified in the name; e.g. monthly mean sea level and yearly mean sea level." Where sea level is changing, NOS now computes updated tidal datums, including Mean Sea Level, when a five-year mean varies from the published Epoch value by more than 3 centimeters. Data of monthly mean sea levels provided by 11 Texas Coastal Ocean Observation Network (TCOON) stations have been used to find running averages for 5 years and compare these data to the published Mean Sea Level for each station. Data was also subjected to factor analysis (main components), which demonstrated that there are two main factors explaining variations of the sea levels: one could be interpreted as regional and a second factor with significantly less weight could be interpreted as local. The first factor is showing increases with most recent data for 5-year running averages, while the input of the second factor is somewhat steady. Using 4 factors allows consideration of local causes in Mean Sea Level change; the land subsiding at differing rates along the Texas coast may be one explanation of local variations of the mean sea level.

Sea Level Rise in the Gulf of Mexico: What Can the Gulf of Mexico Coastal Ocean Observing System (GCOOS) Do for You?

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The phenomenon of sea-level rise in the Gulf of Mexico is of special concern because many coastal residents live at, or in some cases below, sea level. With high end estimates into 2100 on the order of 1.5 m, many coastal communities would be inundated. What, if anything, can be done to mitigate how people and the environment respond? There are many dimensions to the issue, ranging from historical trends in sea level change to new technologies to drive models that assess the impacts of future change. Presented here are examples of projected changes in coastal communities based on current estimates of sea-level rise, and the technologies being applied to generate the forecasts. These include output from numerical models driven by data-rich observation programs, cutting edge data visualization methods, and global ocean estimates from satellite altimetry. A challenge to implementing innovative management strategies for the Gulf region is aggregating and disseminating information in

a way that is meaningful and easily accessible to a variety of stakeholders. The developing Gulf of Mexico Coastal Ocean Observing System Regional Association (GCOOS RA), one of eleven RAs of the U.S. Integrated Ocean Observing System (IOOS), can be instrumental in promoting the use of these data. With 13 IOOS-DMAC-compliant parameters currently available via the GCOOS data portal, the diverse data streams provide the tool with which we can integrate and manage the data and products.

Sea Level Rise and the Redevelopment of Galveston Island State Park Following Hurricane Ike

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The beachside infrastructure and dune field at Galveston Island State Park; Galveston, Texas, were destroyed by Hurricane Ike on September 13, 2008. The remains of this infrastructure including most paved surfaces have been removed. High rates of relative sea level rise and subsequent inland migration of the Park's beach prior to Hurricane Ike had narrowed the dune field to 30' or less with either hard infrastructure or a natural wetland swale preventing inland dune development. A park redevelopment goal is to facilitate sand dune recovery both for protection of future park facilities and conservation of the active dune field's native plant community. New beach access and camping facilities will therefore need to anticipate sea level rise induced beach and dune migration over an appropriate planning horizon. Historic aerial photography and elevation survey were used to determine the past extent of active dune fields at the State Park under relatively stable sea level conditions. Current beach migration rates inland were estimated as well as the expected width of the future dune field at the Park. These were used to project the beach and active dune field location 50 years from the present.

Predicting Habitat Change on Ingleside Barrier Strandplains using Available Data: Lamar Peninsula

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The Ingleside barrier strandplain is located in the Texas Coastal Bend. The peninsulas are connected to the mainland and separated by shallow bays and barrier islands from the Gulf of Mexico. The peninsulas share a common geologic past and formation, but may exhibit biologic gradients as a result of environmental gradients along the coast (i.e., higher temperatures, lower rainfall, higher evaporation from north to south). The increase in sea level rise from both eustatic and local subsidence will affect land cover proportions in the upland and aquatic zones. This study focused on developing a spatial model in GIS that can address those changes in relation to soils and land cover data using Lamar Peninsula, which encompassed all habitat types representative of the barrier strandplain. By increasing sea level one meter, upland coverage decreased from 72.5% to 35.1%, with a concomitant increase in aquatic habitats. The peninsula connection to the mainland became inundated, and exhibited the most increase in wetland habitats. Unvegetated flats and intertidal marshes predominated the landscape. The palustrine wetlands currently occurring in this area provided the marsh mosaic with areas of lower elevations, which shifted to subtidal submerged vegetation and connective tidal channels. The upland habitat also shifted from 76% coastal oak woodland to <30%, potentially as a result of reduced upland area, as well as higher storm surge and saltwater intrusion impacts. These changes will have pronounced impacts on upland and aquatic wildlife, as well as future development on the peninsula.

A Case Study of Galveston, Texas: Measuring, Deciphering and Presenting Information Regarding Local Sea Level Variability

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The U.S. National Oceanic and Atmospheric Administration (NOAA) and its predecessor organization have been measuring sea level (SL) since the mid-19th century. Originally in support of charting and marine boundary delineation, long-term data sets, like those recorded since 1908 on Pier 21 and 1957 on Pleasure Pier in Galveston, now quantify SL variability that directly impacts coastal communities. Observations from the NOAA Galveston stations 1) capture event-driven storm surges and determine their reoccurrence frequencies. 2) The observations define a >0.25 m mean seasonal cycle, highest in September and October coincident to hurricane season, which

results from fluctuations in the regional wind field, coastal currents, and water densities. 3) The observations isolate the frequency and magnitude of SL anomalies driven by irregular ocean-atmosphere interactions forcing SL above/below seasonal predictions. 4) The observations track long-term relative SL trends, 6.39 ±0.28 mm/yr at Pier 21 and 6.84 ±0.81 mm/yr at Pleasure Pier, and include a local land subsidence rate. The backbone of each system is a network of benchmarks that monitor the vertical stability of the observation platform and provide user access to the vertical tidal datums. The centimeter-level accuracy of the SL measurements transferred onto the benchmarks via geodetic surveys facilitates a local vertical reference frame. A localized informational picture of inundation related to the SL variability can be construed using the highly accurate (~20 cm) LIDAR topographic data that exists for the Galveston area. In the face of climate change, deciphering and presenting data concerning local SL variability is imperative for coastal restoration initiatives, emergency preparedness, habitat management and planning of coastal infrastructure.

Sea Level Rise Visualization on the Alabama-Mississippi and Delaware Coastlines

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Coastal communities throughout the U.S. are in the initial stages of thinking about, planning, and/or creating climate adaptation plans. Emergency managers, developers, and the general public need to know the potential impact of a rising sea level and how that phenomenon may influence plans for developing future critical infrastructure and for habitat restoration and conservation. In late 2008, in response to these critical needs, the U.S. Geological Survey and the National Oceanic and Atmospheric Administration in concert with the Mississippi-Alabama Sea Grant Consortium, the Delaware Department of Natural Resources and Environmental Control and several other Federal, State, and local stakeholders formed a team to create two pilot internet map applications that could effectively project various sea level rise scenarios on the Alabama-Mississippi Gulf of Mexico Coast and the mouth of the Christina River on and Upper Delaware Bay. The Alabama-Mississippi Gulf of Mexico Coastal pilot Internet Map Server (http://gom.usgs.gov/slr/index.html) was developed from an existing server which was built principally to display the maximum storm tide crest resulting from Hurricane Katrina (2005). This server quickly and easily projects 1-, 3-, 6-ft sea level rises onto a 3-meter digital elevation model constructed from Light Detection and Ranging (LiDAR) data procured before Hurricane Katrina. The Delaware River pilot (http://csc-s-web-q.csc.noaa.gov/de_slr/index.html), developed with a similar concept, used a 2-meter horizontal Digital Elevation Model created from State of Delaware LiDAR data to illustrate a hypothetical 4ft. rise in sea level. Flood frequency estimates were computed based on National Weather Service coastal flood warning criteria to show how these increases in sea level could make daily tidal flooding worse.

Response of Coastal Systems to Accelerated Sea-Level Rise

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Sea-level rise rates are predicted to exceed 4 mm/yr by the year 2100. Many sea-level rise models rely on inundation scenarios for areas within 1-2 meters elevation (i.e. areas expected to be affected in the next century). However, these models do not take into account complex barrier island dynamics. We argue that these models are not an accurate representation of shoreline response, and should not be used for coastal planning scenarios. Rather, the geologic record coupled with data for the last century can aide in understanding and developing planning strategies. In order to understand how coastal systems will respond to sea level rise (SLR) rates greater than 4 mm/yr, we must go back several millennia. Previous studies have determined that shoreline retreat rates were as high as 60 m/yr from ~10,000-6,000 yr B.P. During this time period, SLR rates ranged from 5-9 mm/yr, and many bays along the Texas coast back-stepped rapidly. Most of the barrier islands along the Texas coast appear to have formed ~5,000 yrs B.P., when the rate of SLR slowed to ~2 mm/yr. However, after their formation, some barriers have remained stable during the same time that others were retreating. Therefore, during rapid SLR scenarios, coastal systems respond

quite differently than passively being flooded in place. By understanding how each system has responded in the past during similar sea-level rise rates, we can better plan and predict future coastal change.

Comparison of Extreme Value Statistical Distributions and Implications for Galveston Pier 21

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Floods are the most common natural disasters affecting societies around the world. The confluence of sea level rise and population growth in coastal regions makes it essential to continue improving flood management strategies. For an efficient planning it is essential to develop accurate flooding estimates which take into account both local effects such as vertical land motion and global effects such as estimated rates of sea level rise linked to climate change. Several extreme value distributions are compared using multiple statistical measures for the modeling of maximum yearly surges. Vertical land motion, broader sea level rise, tidal and atmospheric forcings are considered separately. The surge distribution models are based on the 105 years record of Galveston Pier 21, Texas. A different statistical distribution than presently used by most researchers and FEMA is selected to estimate flood risk. Exceedance probabilities of past storms are compared after including the influence of past sea level rise. The extreme surge distributions are then combined with sea level rise projections to estimate future water level exceedance probabilities. The research shows that by year 2100 and using the past rate of sea level rise exceedance probabilities could double for large storms such as Hurricane Ike but increase by 5 or even 6 times for smaller storms such as Hurricanes Alicia and Rita. While individually not as devastating or costly as large hurricanes, the cumulative and regular cost of smaller events could well be a bigger threat to coastal communities as sea level rises.

Aquatecture-Architectural Adaptation to Rising Sea Levels

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University of South Florida, Ecosystems Technology Group- College of Marine Science

Our world is drastically changing. Temperatures are rising, skies over cities are blanketed with smoke, and melting glaciers are raising sea levels at alarming rates. Although the destruction we face is already threatening the quality of life for billions around the world, it could just be the beginning. What is projected to come in the future could be catastrophic. It is crucial to realize that climate change is already happening. One of the main concerns stemming from climate change is that as the polar ice caps continue to melt, rising water will invade our coastal cities around the world. In accordance with sea level projection maps, sea levels will rise 15 feet in some areas, and major cities like Miami, Galveston, Shanghai, Calcutta, and Manhattan will be completely submerged. We must ask ourselves: How can we avoid a mass migration as water levels invade our homes and cities? Instead of retreating inland, adaptation strategies should be devised. This proposal will explore how homes, buildings, and cities should respond to sea level increase through the implementation of a new architectural typology—Aquatecture. Aquatecture is defined as an architectural adaptation typology used to mitigate and manage flooding (long and short term). With this typology, water and architectural design can unite to produce dynamic and reliable mitigation solutions. The main course of action involves redefining three main living systems: a home, a neighborhood, and a residential tower to resist destruction of rising water levels and to continue city-town-home inhabitation. For example, a home that rises along pilings as water levels increase, forming self-sustaining communities with these adaptable homes, and adaptive reuse strategies for existing infrastructures are some adaption strategies to be explored. In addition to adaptable building design, supporting systems will be integrated throughout affected areas. Systems such as alternative energy production (wind turbines, hydro-electric, photovoltaics), alternative farming, mixed-used industry, alternative transportation, and water filtration zones will be incorporated. With the help of Aquatecture, alternatives to abandoning our coastal cities are provided. Due to the flexibility of site location that Aquatecture allows, this intervention can serve as a long-term solution and standard of living within current and projected flood prone areas around the world. ecwilli2@mail.usf.edu

Hydrodynamic Simulation of Sabine Lake and the Surrounding Wetlands – Transient Response to the Changing Sea Level

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Sabine Lake is a 90,000 acre (364 km²) salt water estuary formed by the confluence of the Sabine River and the Neches River. It drains through Sabine Pass into the Gulf of Mexico. The lake borders Jefferson Country, Texas, Orange Country, Texas, and Cameron Parish, Louisiana. The nearby city of Port Arthur is located on the northwest side of the lake. Numerical simulation and analysis of the hydrodynamics and water-component transports in the Sabine Lake and surrounding wetlands is very important for assessing impacts of sea-level rise. The analysis of the results will assist in the development of preservation plans for the wetlands and coastal areas. The simulation software was successfully developed, debugged and tested. The unsteady two-dimensional shallow water equations are the governing equations in this study. The flow, circulation and water surface elevation were investigated in this study. The flooding of the wetlands near the lake due the sea-level rise was also simulated, thanks to the available land elevation data. Since the ocean surface level changes with time, the hydrodynamics of the lake water also changes accordingly. Therefore, fully unsteady simulations are required. From the transient response of water surface elevations in the lake area to the transient tidal conditions of the Gulf of Mexico, we can determine when and where will be flooded, thus the impacts of the sea-level rise on the Sabine Lake and the surrounding coastal wetlands.

Mangrove ecosystem vulnerability to climate chance effect in Yucatan Peninsula (carbonate settings), SE Mexico

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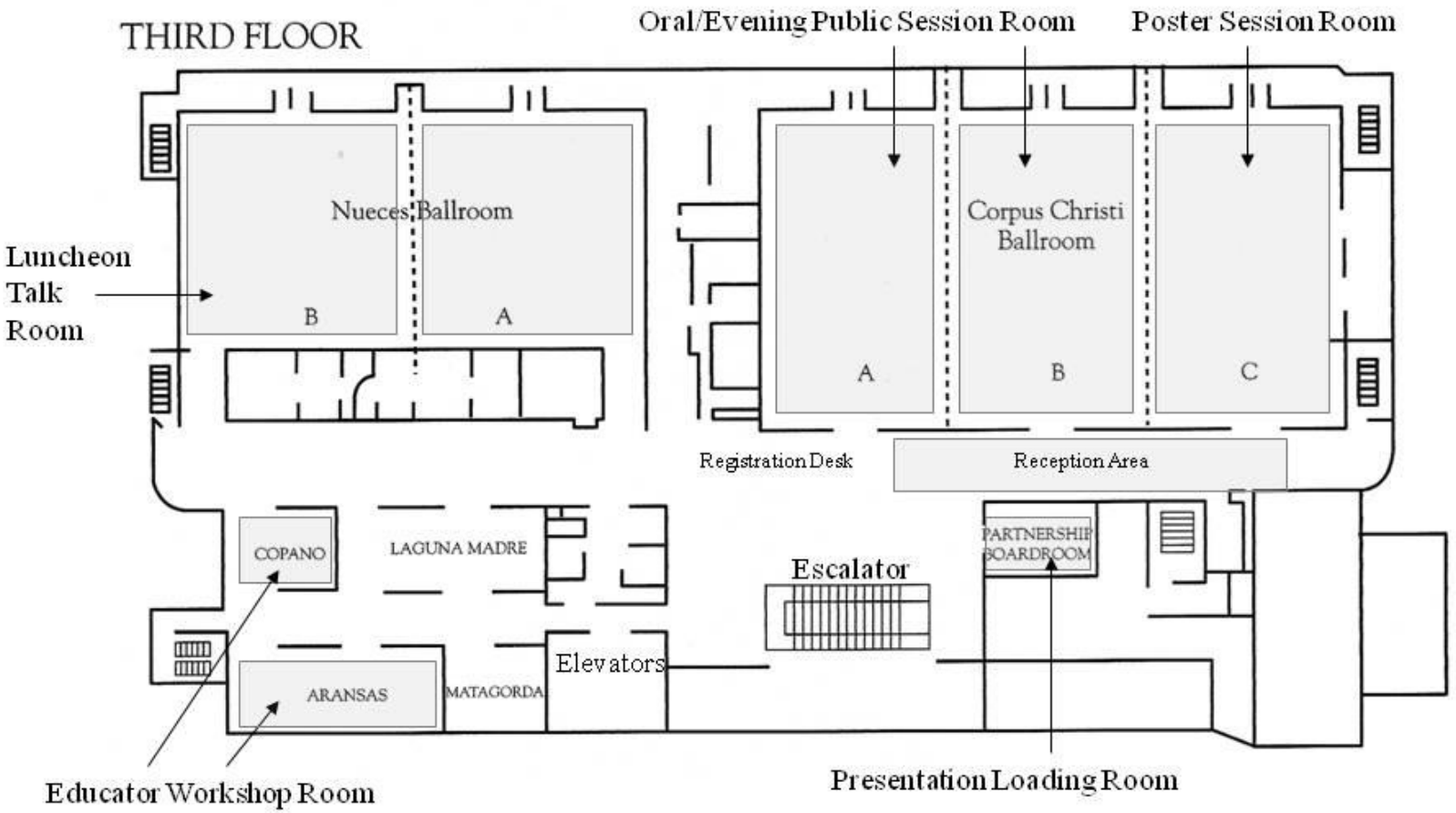
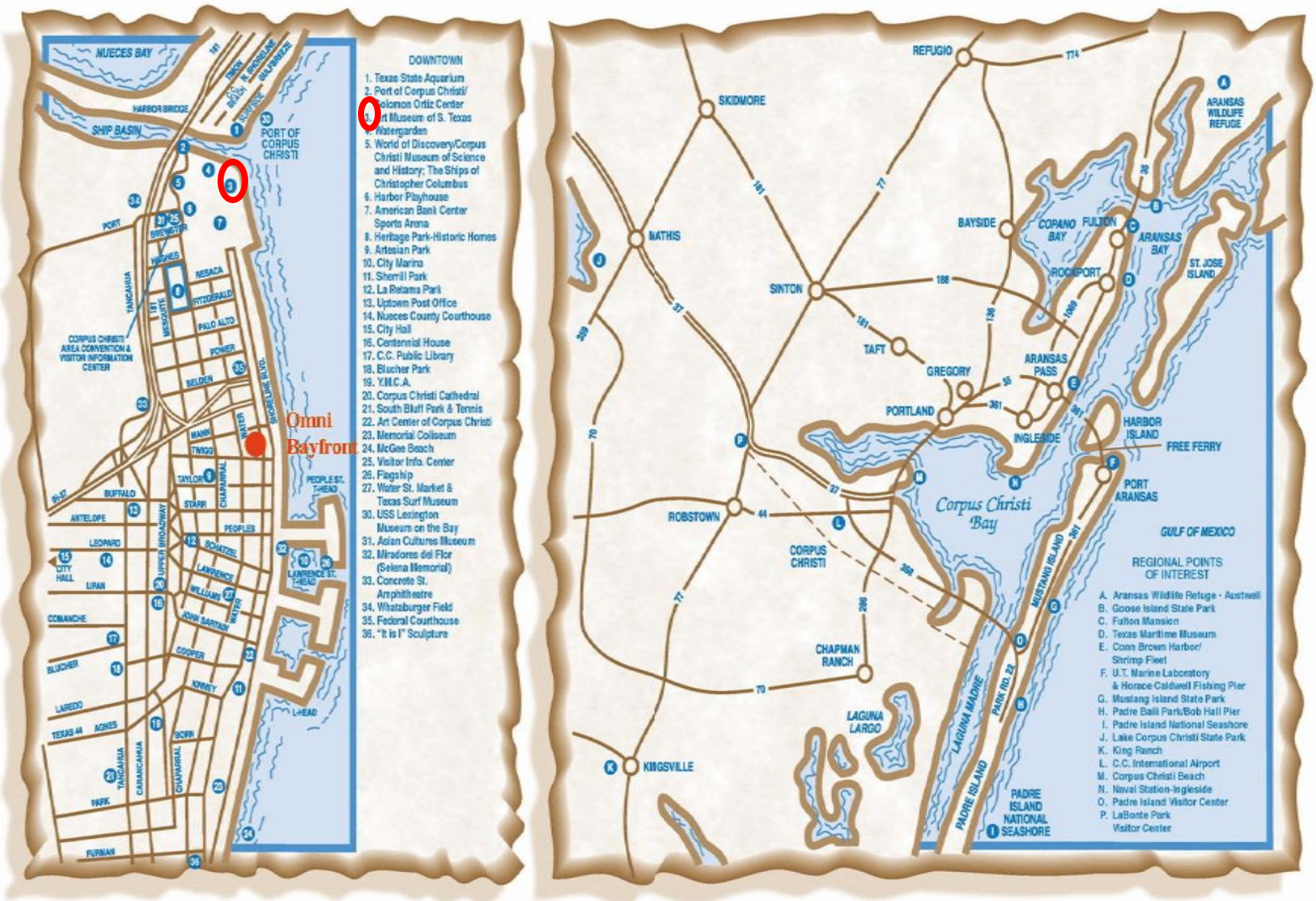
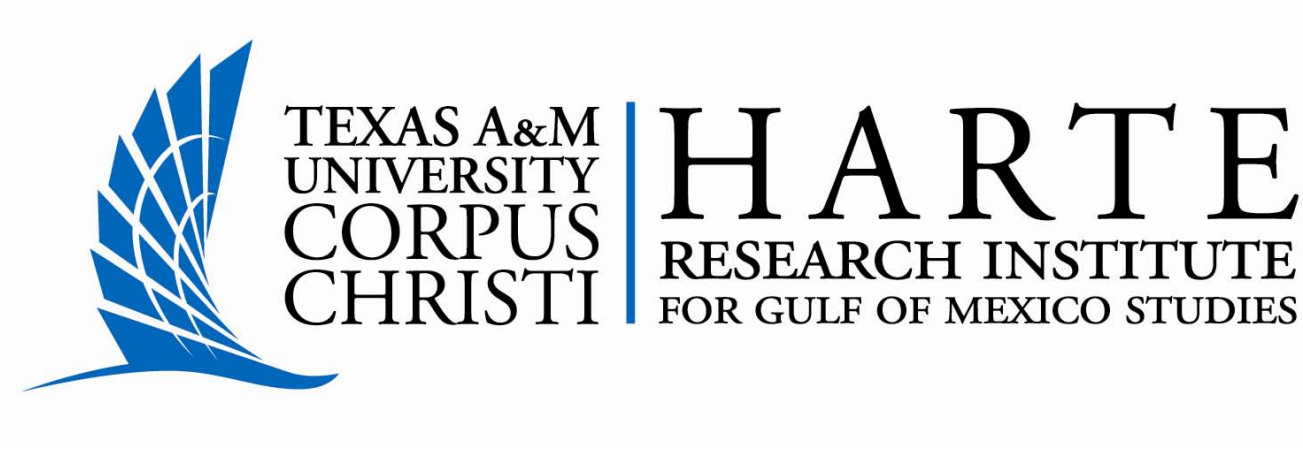
The coast of Yucatan Peninsula is characterized by semi-arid climate, hurricanes impacts, low tide, groundwater discharges and carbonate soil. This last condition limits the sediments source to mangrove forest and increases their vulnerability to the sea level rise. Permanent forest plot, SET bases and press level logger were installing in several sites in Yucatan Peninsula as part a long-term monitoring program. Our research is focused in the analysis of the potential effects of climate change on the Yucatan mangroves in relation with the environmental and hydrogeological characteristics of these region and the anthropic factors that impact these coastal ecosystems. Results showed in site with strong influence of groundwater discharges (springs), the mangrove forest had the highest structure value (complexity index =17) and litterfall production (16 t ha/yr). Vertical accretions show spatial pattern from 3.9 mm/yr to 1.0 mm/yr while the elevation varied from 5.3 mm/yr to -2.8 mm/yr according to wet or dry scenarios. The spatial differences are related with local forcing function as organic matter production, porewater storage and sediment type, as well as regional variables as erosion/deposition by storms and hurricanes.


THIRD FLOOR
Oral/Evening Public Session Room
Poster Session Room
Nueces Ballroom
B
A
Corpus Christi Ballroom
A
B
C
Luncheon Talk Room
Registration Desk
Reception Area
COPANO
LAGUNA MADRE
PARTNERSHIP BOARDROOM
Escalator
Elevators
ARANSAS
MATAGORDA
Educator Workshop Room
Presentation Loading Room


NUECES BAY
HARBOR BRIDGE
SHIP BASIN
PORT OF CORPUS CHRISTI
CORPUS CHRISTI AREA CONVENTION & VISITOR INFORMATION CENTER
Omni Bayfront
SHORELINE BLVD.
PEOPLE ST. T-HEAD
LAWRENCE ST. T-HEAD
L-HEAD
DOWNTOWN
1. Texas State Aquarium
2. Port of Corpus Christi/ Solomon Ortiz Center
3. Art Museum of S. Texas
4. Watergarden
5. World of Discovery/Corpus Christi Museum of Science and History; The Ships of Christopher Columbus
6. Harbor Playhouse
7. American Bank Center Sports Arena
8. Heritage Park-Historic Homes
9. Artesian Park
10. City Marina
11. Sherrill Park
12. La Retama Park
13. Uptown Post Office
14. Nueces County Courthouse
15. City Hall
16. Centennial House
17. C.C. Public Library
18. Blucher Park
19. Y.M.C.A.
20. Corpus Christi Cathedral
21. South Bluff Park & Tennis
22. Art Center of Corpus Christi
23. Memorial Coliseum
24. McGee Beach
25. Visitor Info. Center
26. Flagship
27. Water St. Market & Texas Surf Museum
30. USS Lexington Museum on the Bay
31. Asian Cultures Museum
32. Miradores del Flor (Selena Memorial)
33. Concrete St. Amphitheatre
34. Whataburger Field
35. Federal Courthouse
36. "It is I" Sculpture
REFUGIO
SKIDMORE
MATHIS
SINTON
TAFT
GREGORY
PORTLAND
BAYSIDE
COPANO BAY
FULTON
ROCKPORT
ARANSAS BAY
ARANSAS WILDLIFE REFUGE
ST. JOSE ISLAND
ARANSAS PASS
INGLESIDE
HARBOR ISLAND
FREE FERRY
PORT ARANSAS
ROBSTOWN
CORPUS CHRISTI
Corpus Christi Bay
GULF OF MEXICO
CHAPMAN RANCH
LAGUNA LARGO
KINGSVILLE
LAGUNA MADRE
PADRE ISLAND
PADRE ISLAND NATIONAL SEASHORE
MUSTANG ISLAND
PARK RD. 22
REGIONAL POINTS OF INTEREST
A. Aransas Wildlife Refuge - Austwell
B. Goose Island State Park
C. Fulton Mansion
D. Texas Maritime Museum
E. Conn Brown Harbor/ Shrimp Fleet
F. U.T. Marine Laboratory & Horace Caldwell Fishing Pier
G. Mustang Island State Park
H. Padre Balli Park/Bob Hall Pier
I. Padre Island National Seashore
J. Lake Corpus Christi State Park
K. King Ranch
L. C.C. International Airport
M. Corpus Christi Beach
N. Naval Station-Ingleside
O. Padre Island Visitor Center
P. LaBonte Park Visitor Center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