BIOGRAPHICAL SKETCH – MIGUEL CANALS

RESUME – MIGUEL F CANALS SILANDER, Ph.D.

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PROFESSIONAL QUALIFICATIONS

Dr. Miguel Canals is an oceanographer and numerical modeler with 13 years of experience in coastal hydrodynamics, numerical ocean modeling and forensic oceanography. He has extensive experience in numerical model implementation and development and has conducted numerical modeling, instrument deployment, data analysis and met-ocean hindcast analyses for projects in Puerto Rico, the US Caribbean and Latin America. He has extensive experience with the following numerical models: BOUSS2D, CMS-FLOW, CMS-WAVE, STWAVE, SWAN, SWASH. Dr. Canals is also professor of physical oceanography and ocean/coastal engineering at the University of Puerto Rico at Mayaguez. His work focuses on coastal hydrodynamics, coastal wave transformation, geophysical fluid dynamics and renewable ocean energy. From 2012 to 2017 he served as the Technical Director of the Caribbean Coastal Ocean Observing System (CARICOOS; https://www.caricoos.org) and co-led the design and implementation of the observational and numerical modeling components of CARICOOS. He is the Director of the UPRM Center for Applied Ocean Science and Engineering and leads a portfolio of externally funded research projects focusing on nearshore wave modeling, coral reef restoration, coastal circulation and hydrodynamics, numerical marine connectivity studies, and ocean energy resource characterization projects. He is also directly involved in several projects related to coastal hazards and shoreline protection led by the USACE in Puerto Rico.

Memberships: American Shoreline Beach Preservation Association, American Society of Limnology and Oceanography

Training: USACE Surface Modeling System (CMS FLOW, CMS WAVE, BOUSS2D, STWAVE)

PROFESSIONAL PREPARATION

University of Hawaii at Manoa Ph.D. in Ocean (Coastal) Engineering, 2008

Dissertation: *Three-dimensional vortex dynamics in oscillating flows*

University of Puerto Rico at Mayagüez M.Sc. in Oceanography, 2005

Thesis: *On the three-dimensional structure of Caribbean mesoscale vortices*

University of Puerto Rico at Mayagüez B.Sc. in Biology, 2003

Biographical Sketch – Miguel Canals

Professional Experience

December 2017 - Present: Full Professor of Physical Oceanography (Joint Appointment), Department of Marine Sciences, University of Puerto Rico at Mayagüez

December 2017 - Present: Full Professor, Department of Engineering Science and Materials, University of Puerto Rico at Mayagüez

January 2015 - 2017: Associate Professor of Physical Oceanography (Joint Appointment), Department of Marine Sciences, University of Puerto Rico at Mayagüez

July 2014 - 2017: Associate Professor, Department of Engineering Science and Materials, University of Puerto Rico at Mayagüez

January 2012 – December 2017: Technical Director, Caribbean Coastal Ocean Observing System

January 2011 - Present: Founder & Director, UPRM Center for Applied Ocean Science and Engineering, Department of Engineering Science and Materials, University of Puerto Rico at Mayagüez

January 2009 – December 2014: Director, Fluid Mechanics Laboratory, Department of Engineering Science and Materials, University of Puerto Rico at Mayagüez

January 2009 – July 2014: Assistant Professor, Department of Engineering Science and Materials, University of Puerto Rico at Mayagüez

Awards / Recognitions

- 2007 American Physical Society Gallery of Fluid Motion Award
- Cover of Physics of Fluids Journal (http://pof.aip.org/pof/covers/20_9.jsp)
- Cover of Journal of Fluid Mechanics, May 2011
- 2011 Distinguished Professor Award, Department of Engineering Science and Materials, College of Engineering, UPRM
- US Coral Reef Task Force Research Award, 2015

Biographical Sketch – Miguel Canals

Recent Peer-reviewed Publications

Solano, M., Canals, M. and Leonardi, S. Barotropic boundary conditions and tide forcing in split-explicit high resolution coastal ocean models. Journal of Ocean Engineering and Science, Volume 5, Issue 3, 2020. Pages 249-260,

Hernandez, E., Toledo-Hernandez, C., Ruiz-Diaz, C., Gomez-Andujar, N., Medina-Muñiz, J., and Canals, M. Hurricane Impacts and the Resilience of the Invasive Sea Vine, Halophila stipulacea: a Case Study from Puerto Rico. Estuaries and Coasts (2020). https://doi.org/10.1007/s12237-019-00673-4

Browning, T., Sawyer, D., Brooks, G., Larson, R., Ramos-Scharron, C., and Canals, M. Widespread Deposition in a Coastal Bay Following Three Major 2017 Hurricanes (Irma, Jose, and Maria). Scientific Reports, Vol 9, Article number: 7101, 2019. (https://www.nature.com/articles/s41598-019-43062-4)

Canals, M. and C. García. On the spatial distribution of the wave energy resource in Puerto Rico and the United States Virgin Islands, Journal of Renewable Energy, Volume 136, Pages 442-451, 2019.

Solano, M., Canals, M. and Leonardi, S. Development and validation of a coastal ocean forecast system for Puerto Rico and the U.S. Virgin Islands. Journal of Ocean Engineering and Science, Volume 3, Issue 3, Pages 223-236, 2018.

Loeffler, C. R., A. Robertson, H. A. Flores Quintana, M. Canals, T. B. Smith, and D. Olsen. Ciguatoxin prevalence in four commercial fish species along an oceanic exposure gradient in the U.S. Virgin Islands. Environmental Toxicology and Chemistry, Vol 37(7):1852-1863. doi: 10.1002/etc.4137, 2018

Smith TB, Brandtneris VW, Canals MC, Brandt ME, Martens J, Brewer R, Kadison E, Kammann M, Keller J and DM Holstein. Potential structuring forces on a shelf edge upper mesophotic coral ecosystem in the US Virgin Islands. Frontiers in Marine Science, 3:115 DOI: 10.3389/fmars.2016.00115, 2016.

Amador, A. and Canals. M., Design and development of an instrumented drifter for Lagrangian measurements of inertial particle dynamics in breaking waves, IEEE Journal of Oceanic Engineering,, vol.PP, no.99, pp.1-1, 2015.

Anselmi, C., Canals, M., Morell, J., Gonzalez, J., Capella, J., and Mercado, A. Development of a nearshore wave forecasting system for Puerto Rico, Journal of Coastal Research: Volume 28, Issue 5: 1049-1056. 2012

Corredor, J. Amador, A., Canals, M., Rivera, S., Capella, J., Morell, J., Glenn, S., Roarty, H., Handel, E., Lemus, E. Optimizing and Validating High-Frequency Radar Surface Current Measurements in the Mona Passage, Marine Technology Society Journal, Vol. 45, No. 3, pp. 49-58, 2011

Canals, M. and Pawlak, G. Three-dimensional vortex dynamics in oscillatory flow separation. Journal of Fluid Mechanics, Vol. 674, pp. 408-432, 2011.

Biographical Sketch – Miguel Canals

Canals, M., Pawlak, G. and MacCready, P. Tilted baroclinic tidal vortices. Journal of Physical Oceanography, Vol. 39, No. 2, pp. 333-350, 2009.

Canals, M. and Pawlak, G. Topology and breakdown of Görtler vortices on an oscillating cylinder. Physics of Fluids, Vol. 20, No. 9, pp 091102, 2008.

Synergistic Activities

- Member of the Puerto Rico Government's Interagency Beach Management Board (2017-present)
- Member of the Puerto Rico Climate Change Council (2016-Present)
- Member of the Puerto Rico Conservation Trust Advisory Council (Appointed April 2021 by UPR President)
- Coordinator of the Fluid Mechanics Teaching Committee, Department of General Engineering, January 2009-Fall 2012
- Developed the Vortex Visualization Facility at the Environmental Fluid Dynamics Laboratory of the University of Hawaii at Manoa. Developed novel flow visualization techniques to capture complex time-dependent fluid-structure interactions. The resulting flow visualization images have been used by the American Institute of Physics, the American Physical Society's Holiday Card, the cover of the Physics of Fluids journal and several University of Hawaii brochures. This research earned Dr. Canals the American Physical Society Gallery of Fluid Motion Award (2007).
- Referee for Journal of Engineering for the Marine Environment, Limnology and Oceanography, Marine Technology Society Journal
- Invited proposal reviewer for the National Science Foundation (NSF) and the National Oceanographic and Atmospheric Administration
- Active in management activities of several marine reserves in the Caribbean, including the Desecheo Island Marine Natural Reserve (member of Pilot Committee) and the Tres Palmas Marine Natural Reserve (elected member of Management Committee). Responsible for integration of coastal hydrodynamics into management plans and research activities in sensitive coral reef areas.
- Have served as expert witness in forensic oceanography in several court cases
- Have provided several continued education courses and workshops to the Puerto Rico College of Architects and Engineers in the field of coastal hydrodynamics and oceanography

Biographical Sketch – Miguel Canals

Teaching Experience

- INGE 4015 - Fluid Mechanics for Civil Engineering
- INGE 4010 - Fluid Mechanics for Mechanical Engineering
- INGE 3016 - Algorithms and MATLAB Programming
- INGE 5185 - Introduction to Coastal Engineering
- INGE 5996 - Special Topics: Advanced Coastal Hydrodynamics
- INGE 5027 - Ocean Wave Dynamics for Engineers
- CMOF 6631 – Geophysical Fluid Dynamics I
- CMOF 6632 – Geophysical Fluid Dynamics II

Thesis advisor and post-graduate scholars

Graduate:

- Colin Evans, Biological Oceanography, UPRM - now Auxiliary Researcher at CAOSE, UPRM
- Estefania Quiñones, Physical Oceanography, UPRM - now PhD student in College of Earth, Ocean & Atmospheric Sciences, Oregon State University
- Gabriela Salgado, Civil Engineering, UPRM - now engineer at USACE Engineering Research and Development Center
- Carlos García, Electrical Engineering, UPRM - now Systems Engineer at CORDC, Scripps Institute of Oceanography
- Andre Amador, Mechanical Engineering, UPRM - received PhD (2020) in Applied Ocean Science and Mechanical Engineering at UC San Diego
- Patricia Chardon, Civil Engineering, UPRM - received PhD (2016) in Coastal Engineering at University of Delaware
- Christian Rojas, Civil Engineering, UPRM - now PhD student in CoastalEngineering at University of Florida

- Francisco Velez, Civil Engineering, UPRM - now engineer at CH2MHILL.
- Carlos Anselmi, Marine Sciences, UPRM - now meteorologist at NWS San Juan. (Co-advised with Prof. Aurelio Mercado)

Undergraduate:

- Omar Lopez, Civil Engineering, UPRM - now PhD student in Coastal Engineering at Stevens Institute of Technology, coastal engineer at Taylor Engineering
- Daniel Martinez, Mechanical Engineering, UPRM - now engineer at USACE Engineering Research and Development Center
- Fabian Garcia, Mechanical Engineering, UPRM - now engineer at USACE Engineering Research and Development Center

EXTERNALLY FUNDED RESEARCH GRANTS (UPRM)

Enhancing Coastal Intelligence in the US Caribbean Archipelago: the Caribbean Coastal Ocean Observing System

- Funding: $1.7M / yr, 2016 - 2021, NOAA
- Investigators: PI: Julio Morell, Co-PIs: Miguel Canals, Sylvia Rodriguez, Patricia Chardón
- Description: This project seeks to maintain and expand the Caribbean Coastal Ocean Observing System

Low Tech Rehabilitation of Coral Reef Ecosystem Services: An Alternative Test Bed to Reduce Coastal Vulnerability

- Funding: $200k, Oct 2017 - Nov 2019, NOAA
- Investigators: PI Edwin Hernandez, Co-PIs: Miguel Canals, Elvira Cuevas
- Description: This project seeks to evaluate, through computational fluid dynamics and detailed field observations, the feasibility of restoring coral reefs to enhance wave dissipation and enhance coastal resilience

Oceanographic Pathways and Hydrodynamic Connectivity Between Marine Protected Areas in the US Virgin Islands and Eastern Puerto Rico

- Funding: $247k, March 2018 - March 2020, NOAA (through Caribbean Fishery Management Council)

- Investigators: PI Miguel Canals
- Description: This project will analyze the hydrodynamic connectivity of fish eggs and larvae between MPAs in the US Virgin Islands and Eastern Puerto Rico

The Puerto Rico very high-resolution wave energy atlas: A 40-year wave hindcast simulation and analysis in support of coastal zone management, engineering, design and conservation

- Funding: $85k, August 2019 - July 2020, Puerto Rico Department of Natural and Environmental Resources
- Investigators: PI Miguel Canals

Development of the Puerto Rico Digital Ocean Energy Atlas: Unlocking Puerto Rico's Marine Renewable Energy Potential

- Funding: $150k, August 2019 - July 2021, Puerto Rico Science and Technology Research Trust
- Investigators: PI Miguel Canals

A wave modeling test bed for Puerto Rico

- Funding: $271k, August 2019 - July 2022, United States Geological Survey
- Investigators: PI Miguel Canals, Co-PI Patricia Chardon

Puerto Rico Beach Recovery Post-María 2017: Phase 1 - Erosion Assessment, Control and Management

- Funding: $78k, April 2018 - July 2018, FEMA
- Investigators: PI Luis Aponte, Co-PIs: Miguel Canals, Jonathan Muñoz, Patricia Chardón
- Description: This rapid response project will evaluate the status of several beaches in Puerto Rico after Hurricane María using field observations and numerical modeling

NSF RAPID: Hurricane Maria Rapid Response: Field Observations of Post-storm Beach Recovery Dynamics in Rincón, Puerto Rico

- Funding: $94k, November 2017 - October 2018, NSF
- Investigators: PI Patricia Chardon, Co-PIs Miguel Canals, Sylvia Rodriguez
- Description: This rapid response project will analyze in detail the beach recovery and sediment transport mechanisms in Rincón, Puerto Rico after Hurricane María

Enhancing coastal intelligence in the US Caribbean: The Caribbean Coastal Ocean Observing System

Schedule: July 2017 - June 2022

Researchers: Julio Morell (PI), Miguel Canals (Co-PI & Technical Director), Sylvia Rodriguez (Co-PI)

Funding: NOAA, ~$18,000,000, 5 years

Model and data based hydrodynamic connectivity study for the marine protected area network off western Puerto Rico

Researchers: *Miguel Canals* (PI), Jorge Capella, & Julio Morell (Co-PI)
Funding: NOAA, $140,774

Towards potential beach nourishment in Rincón: Developing RTK beach mapping capabilities, sediment compatibility and an online sediments database
Researchers: *Miguel Canals (PI), Sylvia Rodriguez (Co-PI)*
Funding: NOAA, $41,600

Life-cycle analysis of beach nourishment
Researchers: Luis Aponte (PI), *Miguel Canals* (Co-PI)
Funding: NOAA, $41,500

Advancing the Caribbean Coastal Ocean Observing System
Schedule: July 2011 - June 2016
Researchers: Julio Morell (PI), Jorge Corredor, Miguel Canals (Associate Director), Aurelio Mercado, Luis Aponte
Funding: NOAA, FY 2011: $1,367,000, FY 2012-2016: ~$1,500,000 per year

Lagrangian observations of turbulence in breaking surface waves
Schedule: September 2011 - August 2013
Researchers: Miguel Canals (PI)
Funding: NSF, $227,000

Development of the Puerto Rico beach and surfzone currents warning system
Schedule: February 2012 – January 2014
Researchers: Miguel Canals (PI), Julio Morell
Funding: NSF, $84,586

MRI: Acquisition of a Particle Image Velocimetry (PIV) system to promote state-of-the-art experimental techniques for fluid dynamics research and education at UPRM
Schedule: November 2010 - October 2013
Researchers: Silvina Cancelos (PI), Stefano Leonardi (Co-PI), Ubaldo Cordova (Co-PI), Miguel Canals (Co-PI), Luis Aponte (Co-PI)
Funding: NSF, $184,979

Center for Secure and Resilient Maritime Commerce
Schedule: April 2011 - March 2014
Researchers: Jorge Corredor (PI), Julio Morell (Co-PI), Miguel Canals (Co-PI),
Funding: DHS, $250,000

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Education and training of students on port security at UPRM

Schedule: April 2011 - March 2014
Researchers: Vidya Manian (PI), Miguel Canals (Co-PI), Hector Carlo (Co-PI),
Funding: DHS, $400,000

The hydrodynamics of Guánica Bay

Schedule: November 2011 - October 2012
Researchers: Miguel Canals (PI)
Funding: NFWF / NOAA, $16,432

Implementing the Caribbean Coastal Ocean Observing System

Schedule: July 2008 - June 2011
Researchers: Julio Morell (PI), Jorge Corredor, Miguel Canals, Aurelio Mercado, Luis Aponte
Funding: NOAA, ~$4,000,000

The Caribbean Ocean Data Distribution and Visualization Laboratory

Schedule: August 2009 - July 2010
Researchers: Miguel Canals (PI)
Funding: UNIDATA / NSF, $19,432

Operational models and tools

- The Puerto Rico High-Resolution Wave Climate Atlas
- CARICOOS FVCOM Coastal Circulation Model (A. Rivera and M. Canals): https://www.caricoos.org/currents/forecast/FVCOM/PRVI/Currents
- The CARICOOS Nearshore Wave Model: http://www.caricoos.org/map/swan-point-forecast and http://www.caricoos.org/waves/forecast/SWAN/PRVI/hsig
- The CARICOOS - Sea Grant Breaker Height Prediction System: http://www.caricoos.org/map/nearshore-breaker-model
- The Yabucoa Port Metocean Observation and Prediction System: http://www.caricoos.org/ports/yabucoa/us

Biographical Sketch – Miguel Canals

Other Skills

- AAUS Scientific diver
- NAUI Master Scuba Diver
- NAUI Rescue Diver
- NAUI Nitrox certified
- 15 years of experience as lead scientific diver
- Over 200 hours of research ship time
- USCG & DRNA Licensed Boat Operator

Other

- Member of 2001 Puerto Rico National Surfing Team
- 2008 Hawaii Jiu Jitsu Triple Crown Champion (Amateur no-gi division)