



The hydrodynamics of the Tres Palmas Marine Reserve, Rincón, PR

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Objective

- Understand basic hydrodynamics of TPMR and surrounding regions. Important for
 - Larval connectivity
 - Sediment transport and erosion (see next talk by K. Scott)
 - Wave-coral interactions and asexual reproduction of *A. Palmata*

RESERVA MARINA TRES PALMAS

Designada bajo la Ley 17 - 8 de enero de 2004
"Ley de la Reserva Marina Tres Palmas de Rincón"

Actividades Permitidas Activities Allowed



Surfear
Surfing



Buceo/Buceo Libre
Scuba/Snorkeling



Pasada
Picnicking



Caminar
Walking



Observación de la Naturaleza
Nature Watching



Fotografía
Photography

Actividades Prohibidas Prohibited Activities



Pesca
Fishing



Pesca con Figa
Spearguns



Tirar Basura
Littering



Colección de Cualquier Tipo
Collection of any kind



Recursos Naturales Natural Resources



Comunidades de Coral
"Cuerno de Alce"
Elkhorn Coral Communities
Acropora palmata



Ballenas Jorobadas
Humpback Whale
Megaptera novaeangliae



Delfin Hocico De Botella
Bottlenose Dolphin
Tursiops truncatus



Peces Comunes del Arrecife
Common Reef Fishes
Parrot Fish, Blue Tang, Surgeonfish, Sergeant Major, Yellowtail



Carey de Concha
Hawksbill Turtle
Eretmochelys imbricata



Langosta Espinosa
Spiny Lobster
Panulirus argus

Una reserva marina es un área protegida con recursos excepcionales en la cual no se permite daño ni extracción alguna. Esta reserva marina contiene algunas de las comunidades de coral "Cuerno de Alce" mejor conservadas en el Caribe.

A marine reserve is a protected area with exceptional natural resources that are protected and must not be removed or damaged. This marine reserve contains some of the healthiest Elkhorn Coral communities in the Caribbean.

Los corales se dañan al tocarlos, pararse en ellos, removerlos, anclarse y son sofocados por la basura y sedimento. Corals are damaged by touching, standing on them, removing them, anchoring, and can be smothered by trash and sediment.

Por favor, nade horizontalmente al entrar al arrecife y mantenga una distancia razonable entre su cuerpo y los corales, para evitar tocarlos.

Please swim horizontal to the reef and maintain a safe distance to avoid contact with the corals.

Recoja su basura y mantenga la playa limpia para ayudar a proteger la vida marina. Pick up your trash and keep the beach clean to help protect sea life.



Para información o para reportar actividades ilegales, por favor llame al: For information or to report unlawful activity, please call: (787)882-5827 or (787)724-5700

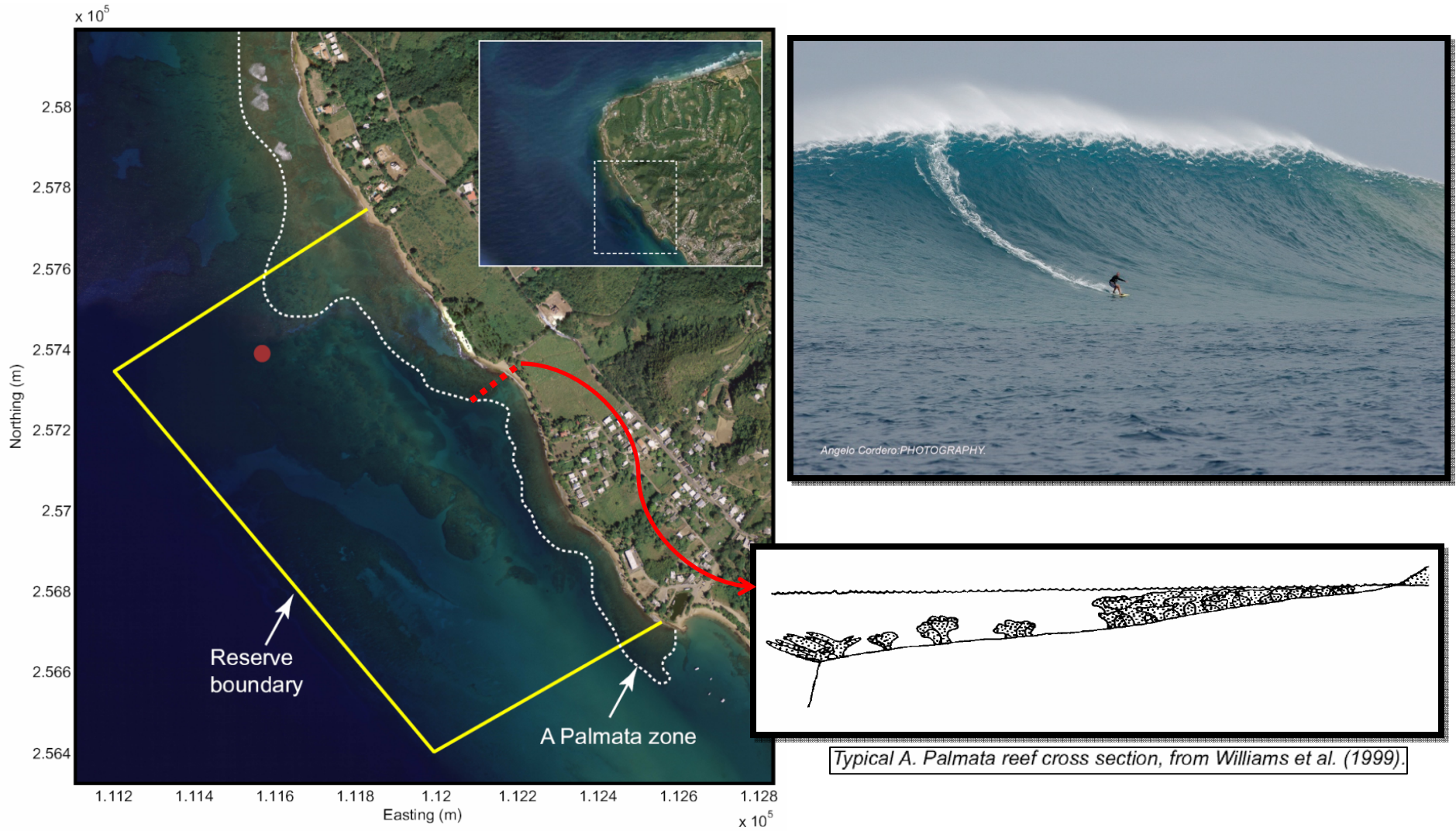
Esta Reserva Marina tiene el respaldo de las comunidades de El Rincón y las siguientes organizaciones y agencias. This Marine Reserve is supported by the community of El Rincón and the following organizations and agencies:



Gracias al patrocinio de:
This sign made possible by a grant from:
SUPYR

Foto: www.fishbase.org

Physical setting



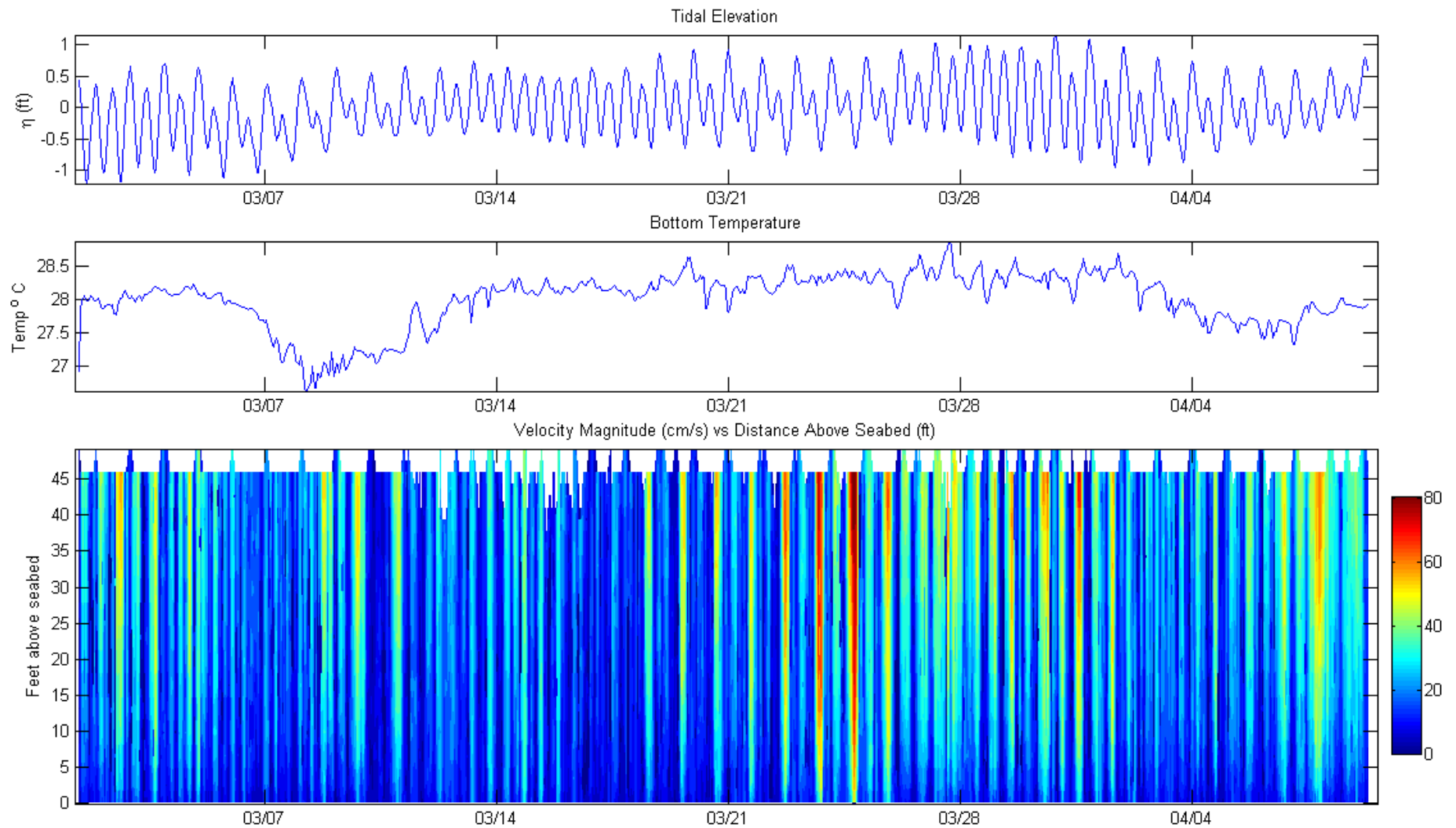
Wave-structure interaction: A. Palmata



(a) Overturned and (b) fractured Elkhorn coral at Tres Palmas (photos by M. Scharer).

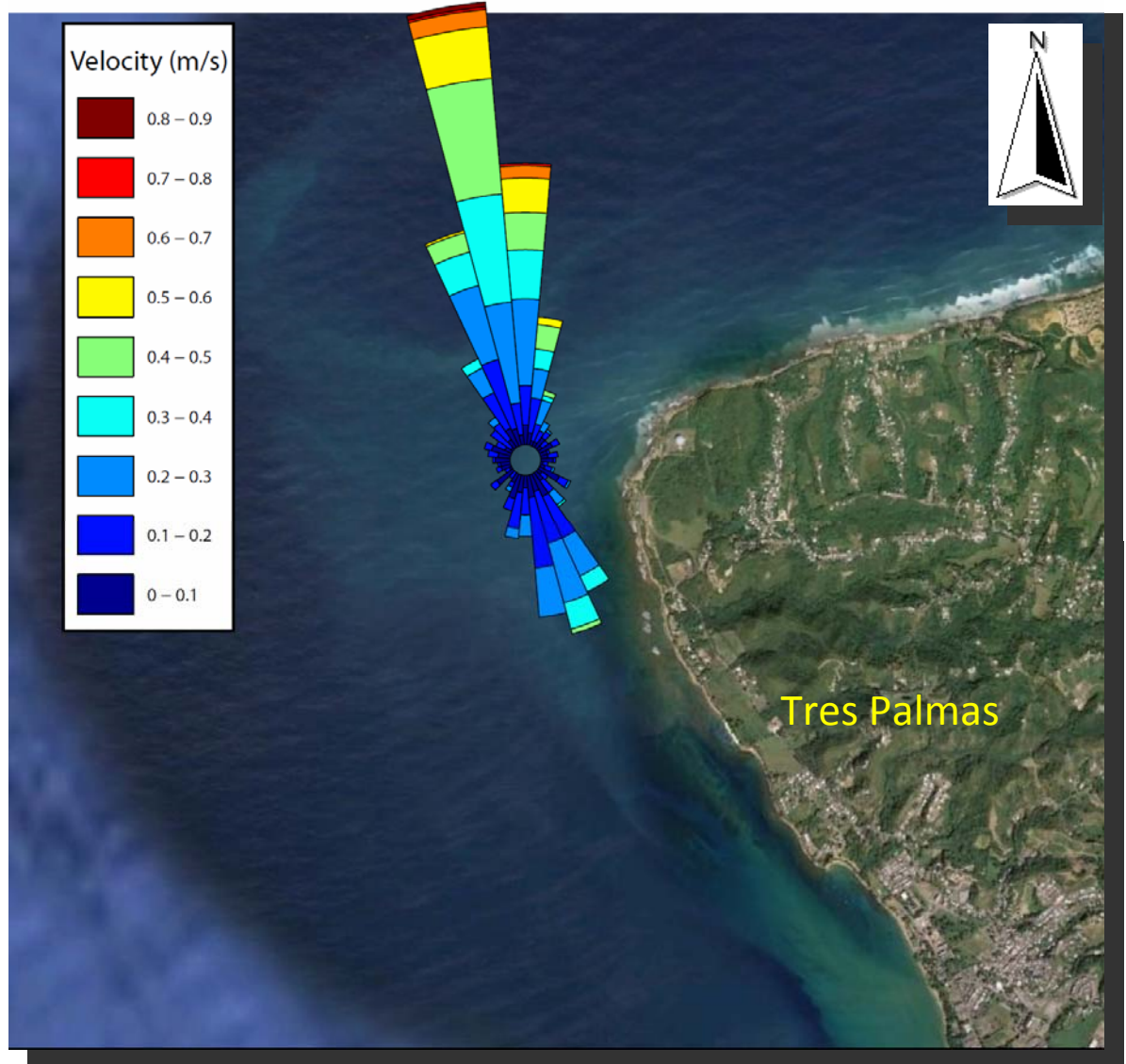
- **Structural failure** occurs when wave-induced bending moment $>$ tensile strength
- Fragmentation part of asexual reproduction
- Damage shown above due to March 2008 swell event

Tidal currents: March-April 2010

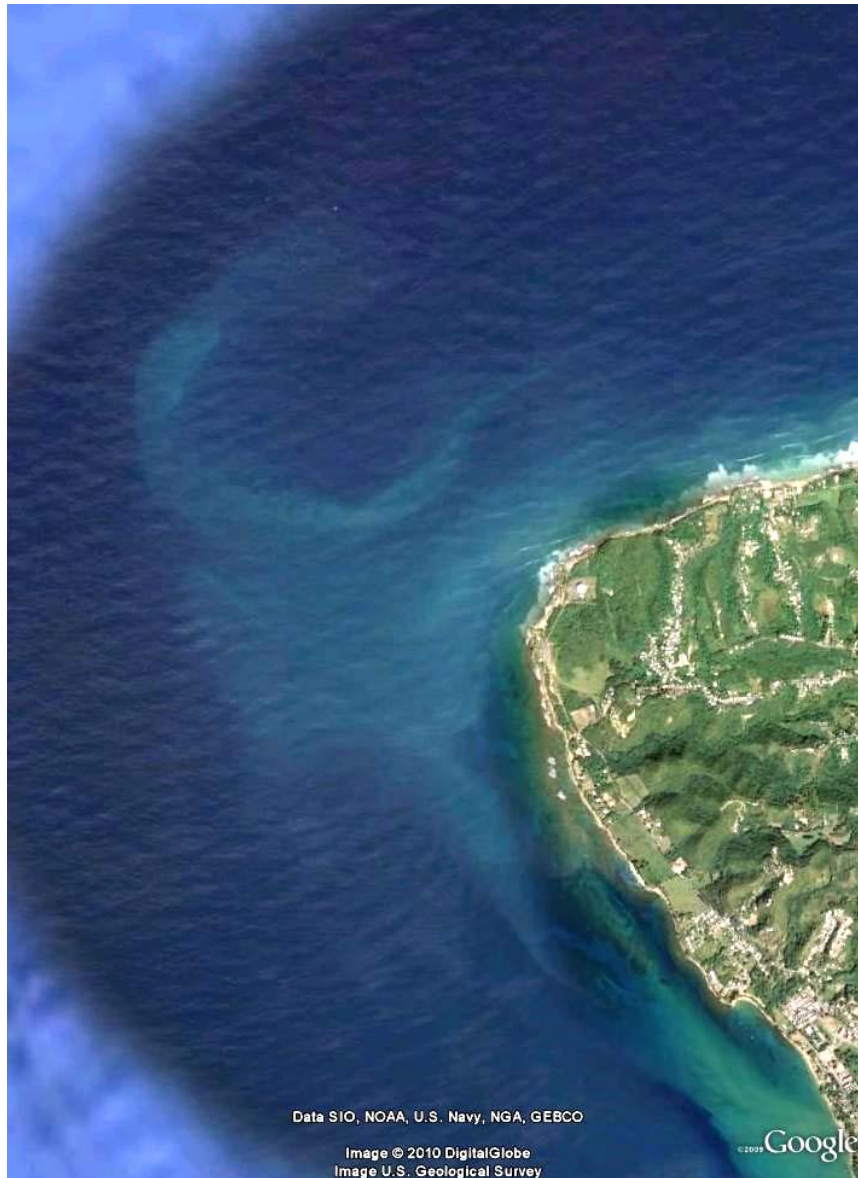


Transport Rose: March-April 2010

- Mean northerly flow
- Velocities as large as to 2 knots
- Data obtained by CariCOOS personnel
- Low correlation between current direction and tidal phase

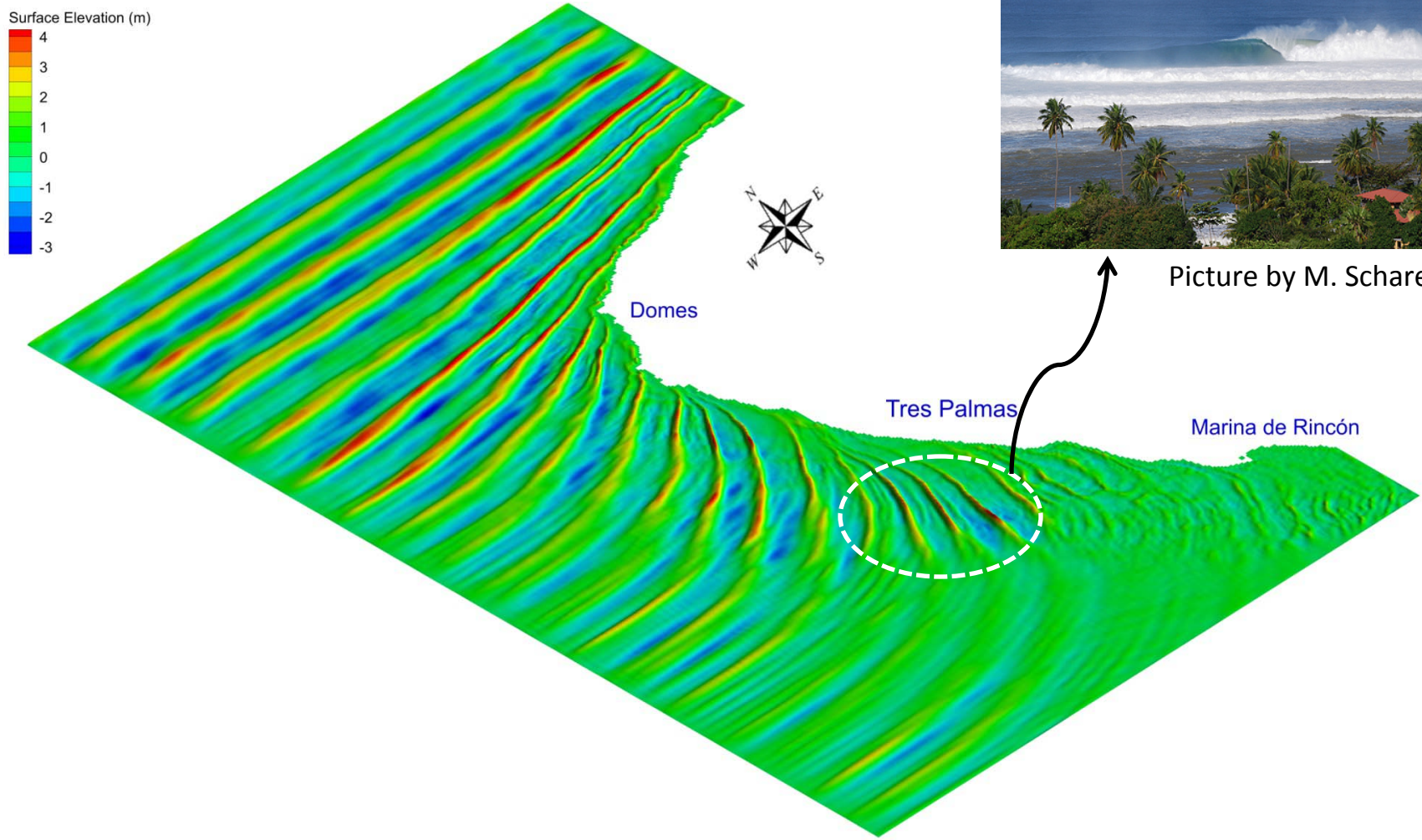


Tidal Vortices



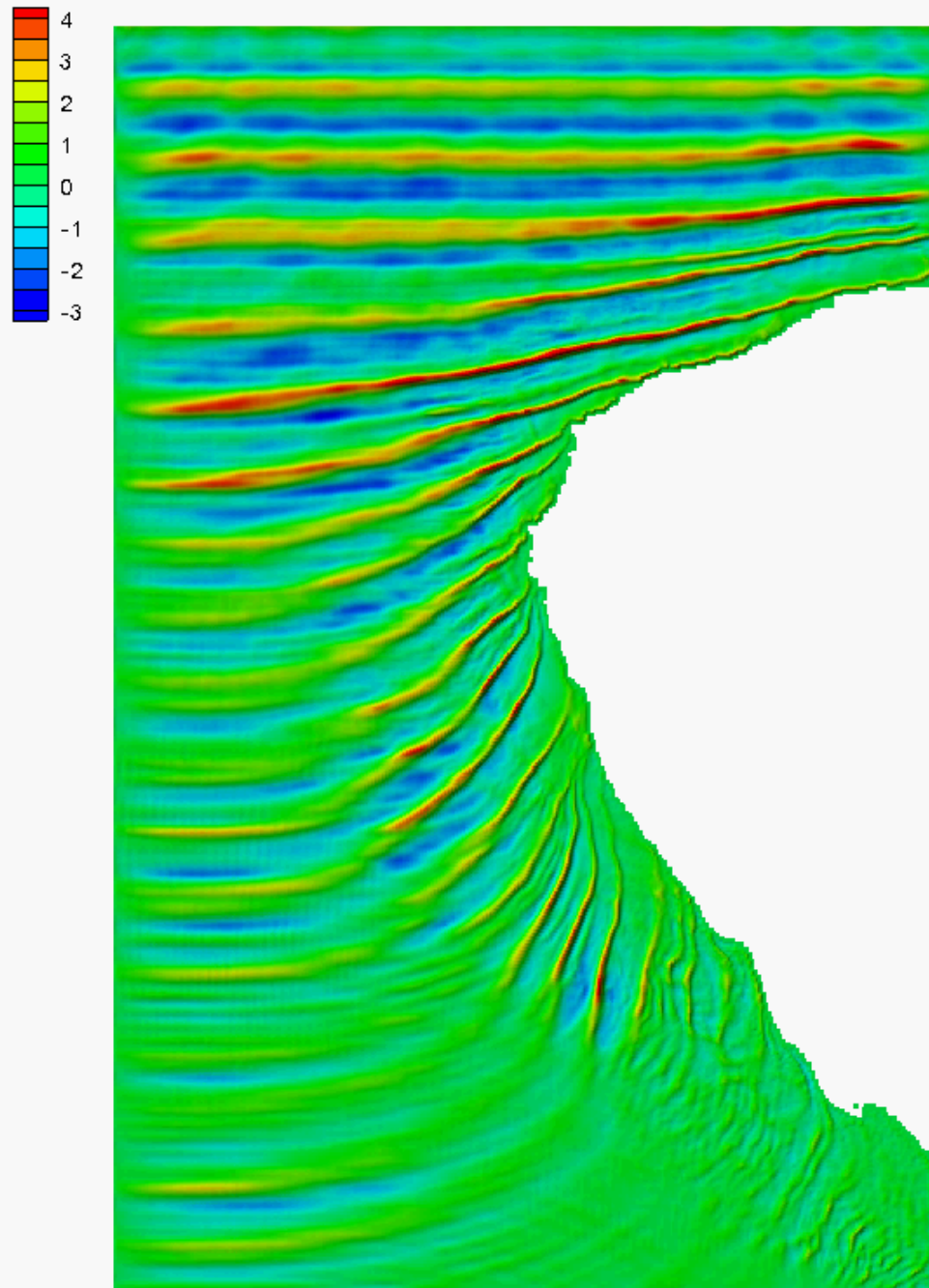
ADCIRC model by J. Gonzalez, CariCOOS

Numerical simulations



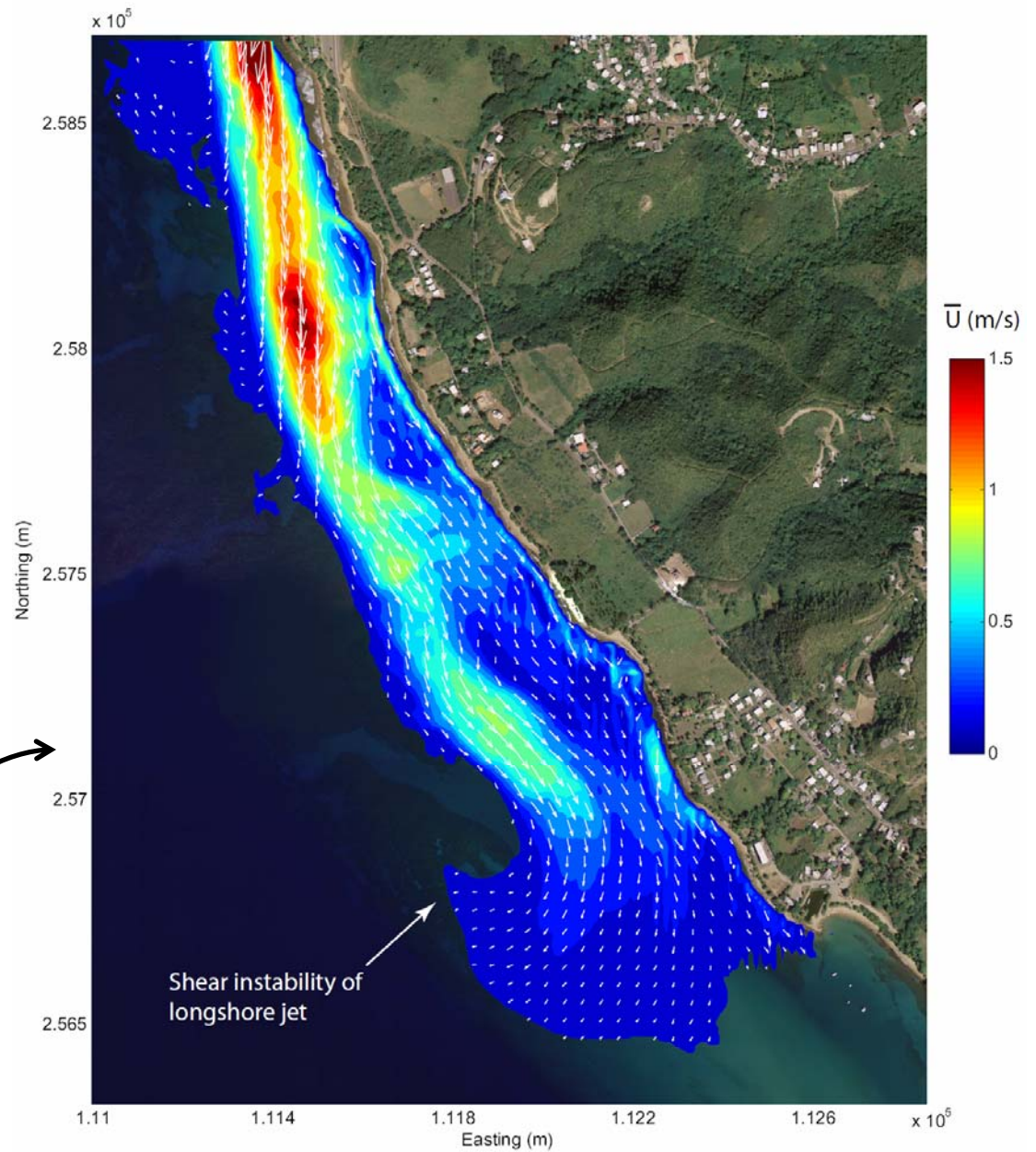
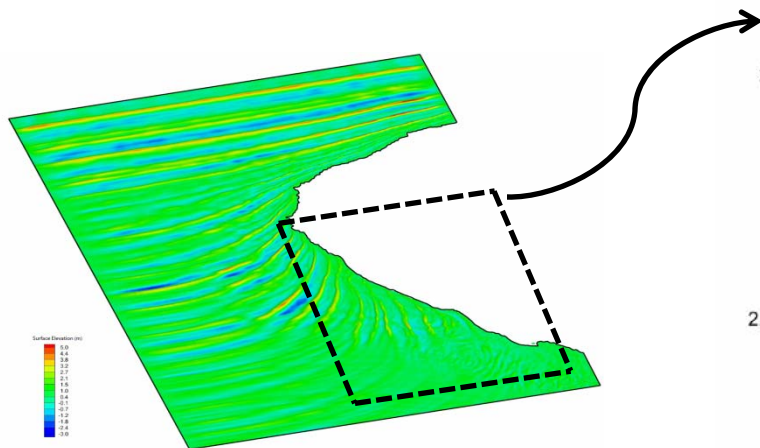
Picture by M. Scharer

Surface Elevation (m)



Wave-induced currents

- Mean wave-induced currents overlaid on USGS DOQ imagery of Rincon
- Note the very strong alongshore jet and the recirculation region near the marina.



Surf-zone turbulence in the A. Palmata zone

- There is evidence of coherent vortices in the surf zone at TPMR
- These vortices may accelerate the mixing of larvae and biogenic material

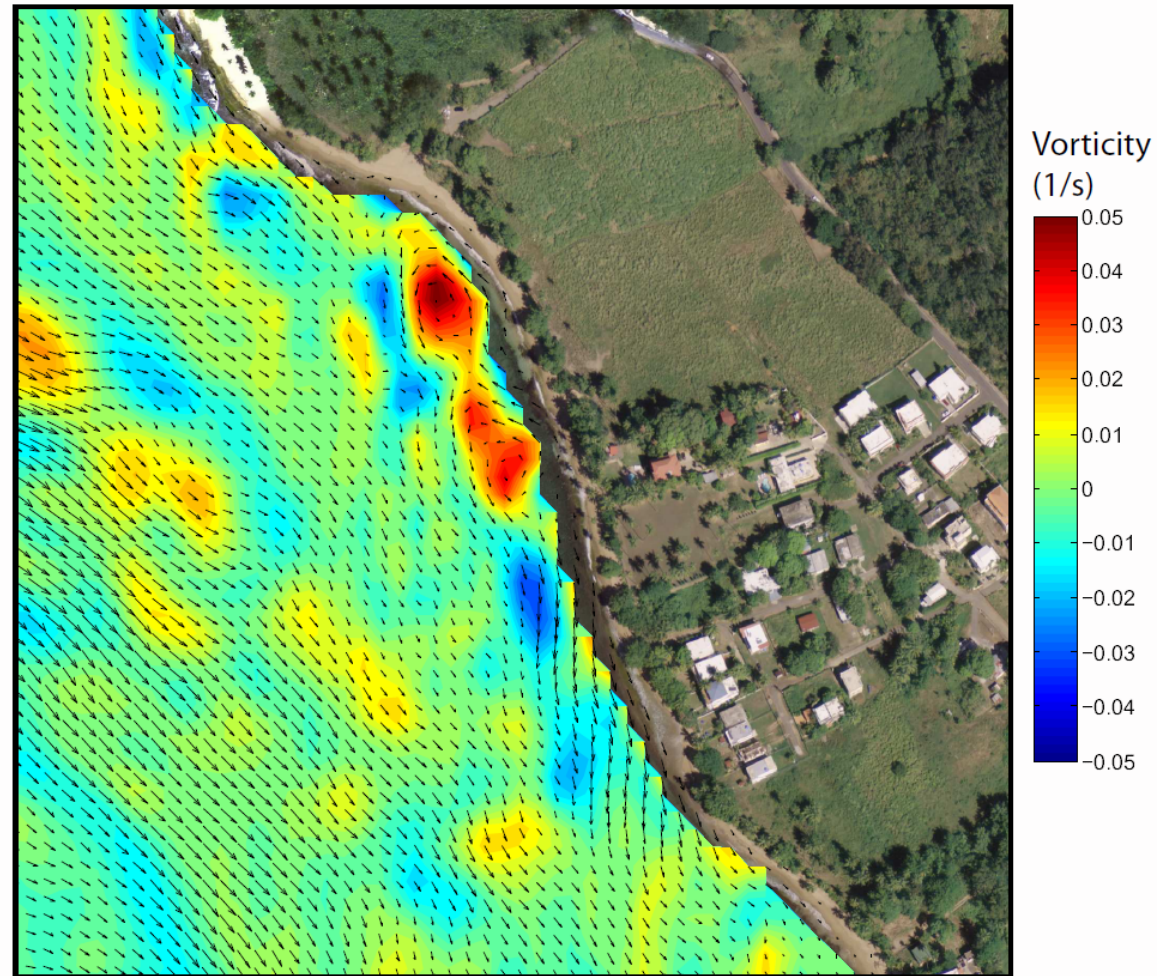


Figure 6. Unsteady vorticity magnitude (colors) and unsteady current direction (arrows).

Origin of Bajo Blanco - speculation

- Strong alongshore jet loses momentum as it goes into stagnant region
- Wave-induced entrained sediment may settle into Bajo Blanco



0 85 170 340 Meters



Acknowledgements

- INGE 5996 students
- Current data and modeling software courtesy of Caribbean Coastal Ocean Observing System
- Junta de Manejo - Tres Palmas