

Rip Current Definition:

– a jet-like seaward flow across the surf zone of a beach.



6 Oct 56

Rips At Rosarita Beach, Baja Calif, MEXICO

REFERENCE: SHORE PROCESSES LAB PHOTO NO
PHOTO TAKEN BY D.L. INMAN

571-11





A Overhead View of a California Mega Rip

July 25, 2009 by Tom Cozad, pilot: Howard Hamlin

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Types of Rip Currents

From United States Lifesaving Association manual:

Fixed: appear over a rip channel.

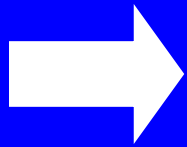
Permanent: stationary near a jetty

Flash: due to sets of waves, bi-modal waves

Traveling or migrating: caused by strong swells which strike the beach obliquely.

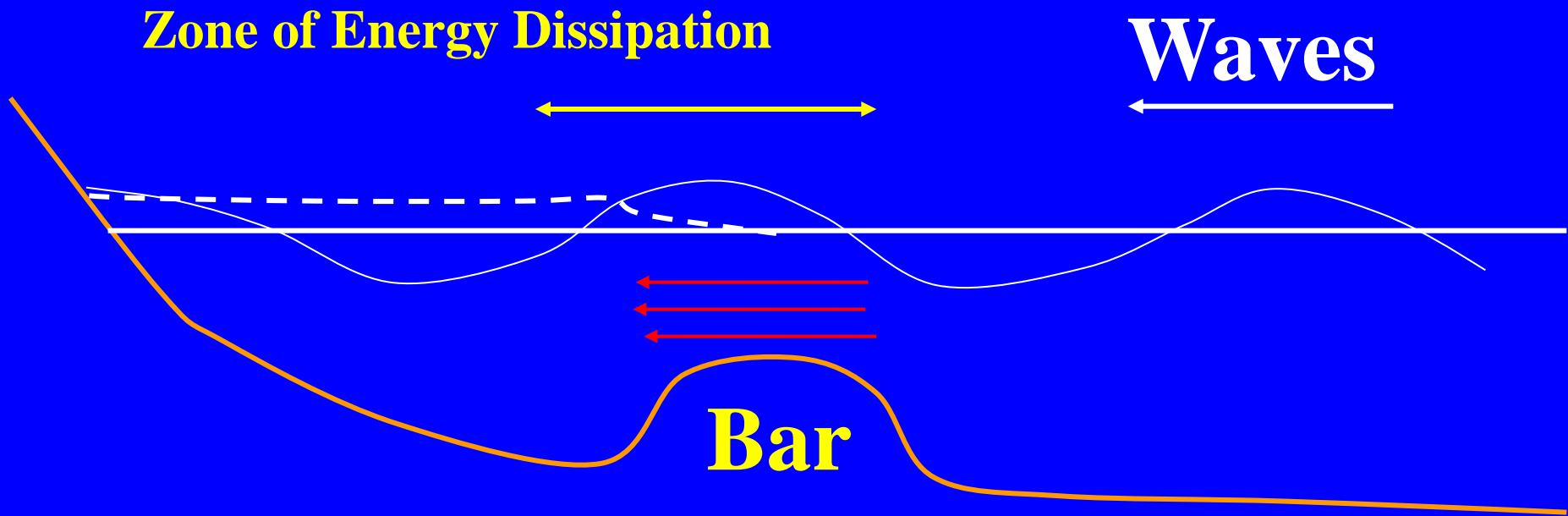
What causes rip currents ?

Major factors



- **Breaking Waves**
- **Water Level**
- **Beach Characteristics**

Consider Surface Wave Energy Dissipation Over a Sand Bar



---- Increase in Water Level over the Bar

Convert momentum flux forces (KE-PE)

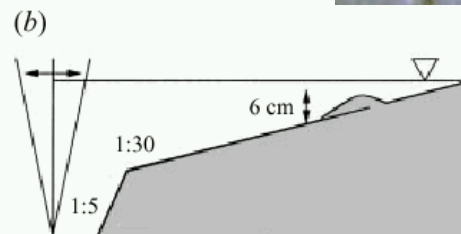
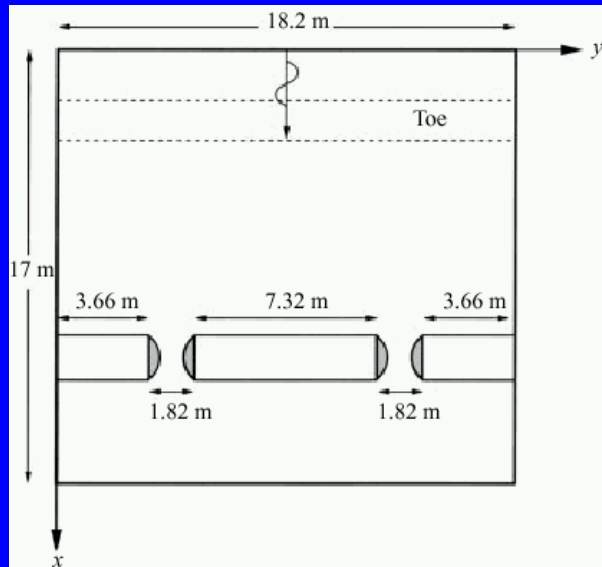
Approaches to Studying Rip Currents

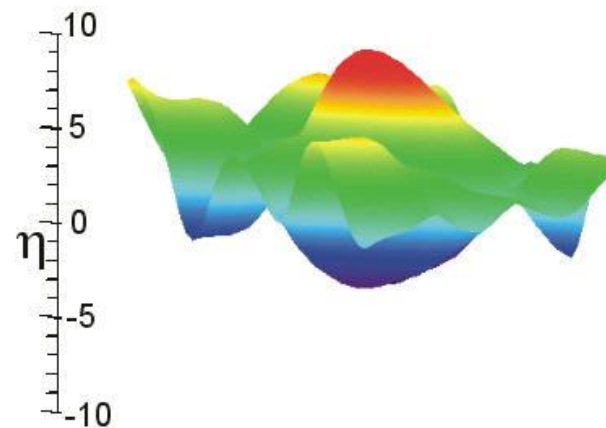
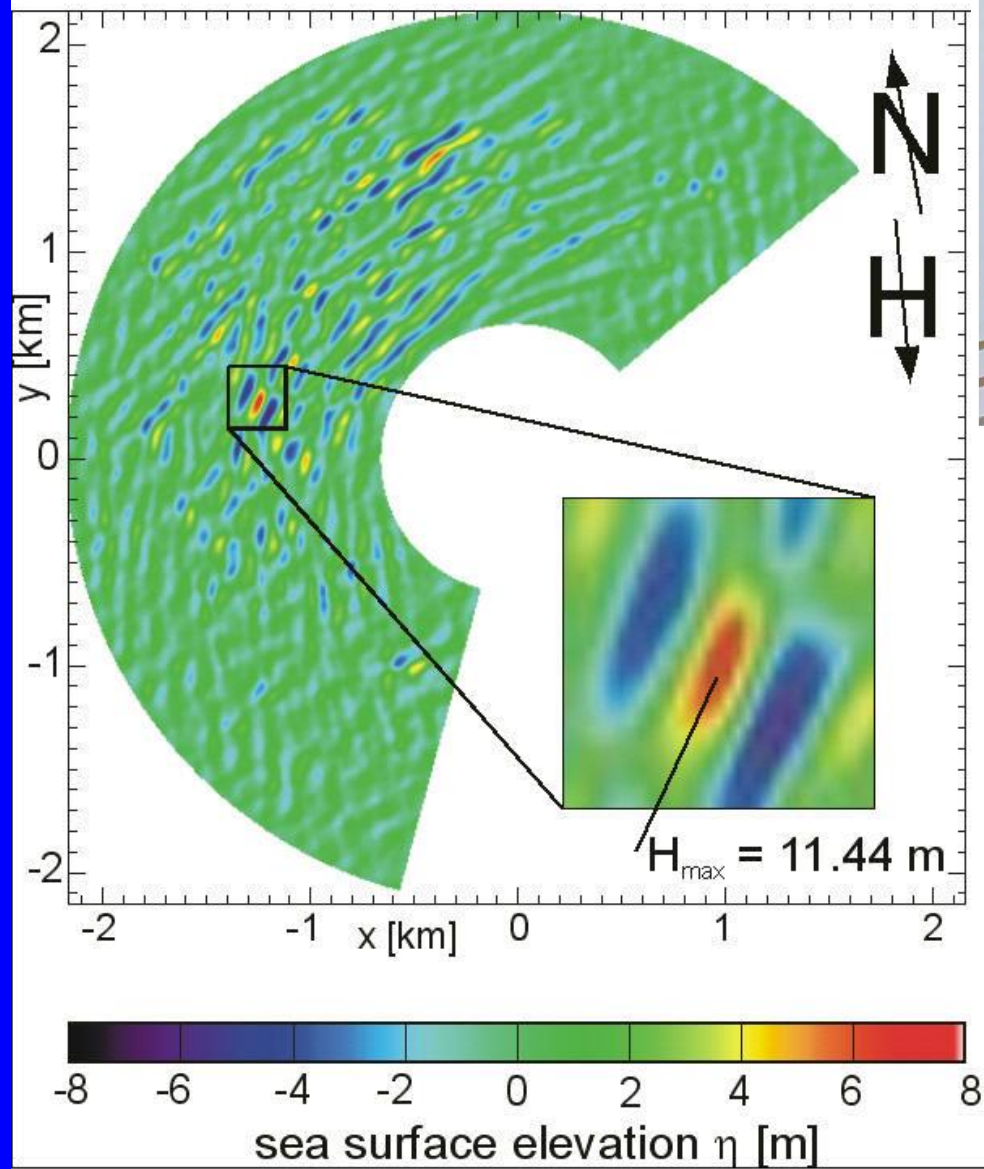
- **Laboratory Experiments:** Qualitative features, scale problem
- **Field Studies:** expensive, not easily repeatable
- **Theory/Computer modeling:** need initial/boundary conditions, CPU intensive
- **Diagnostic Monitoring of surf data:** our approach

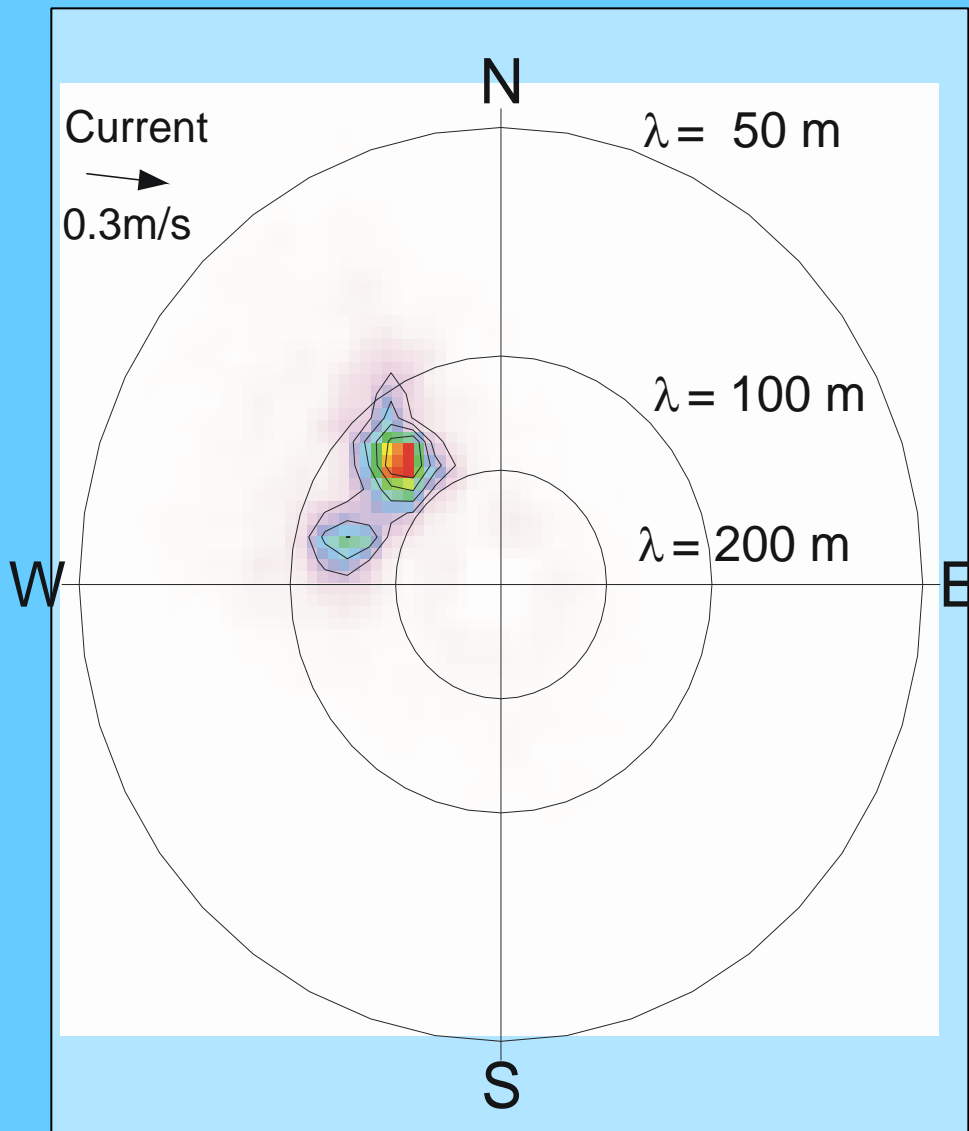
Lab Experiment

Haller *et al.* (2002)

Haller and Dalrymple, 1999







Wave number spectrum observed
using *Marine X-band radar*
May 29, 2001, 15:10 UTC

$$H_s = 4.5 \text{ m}$$

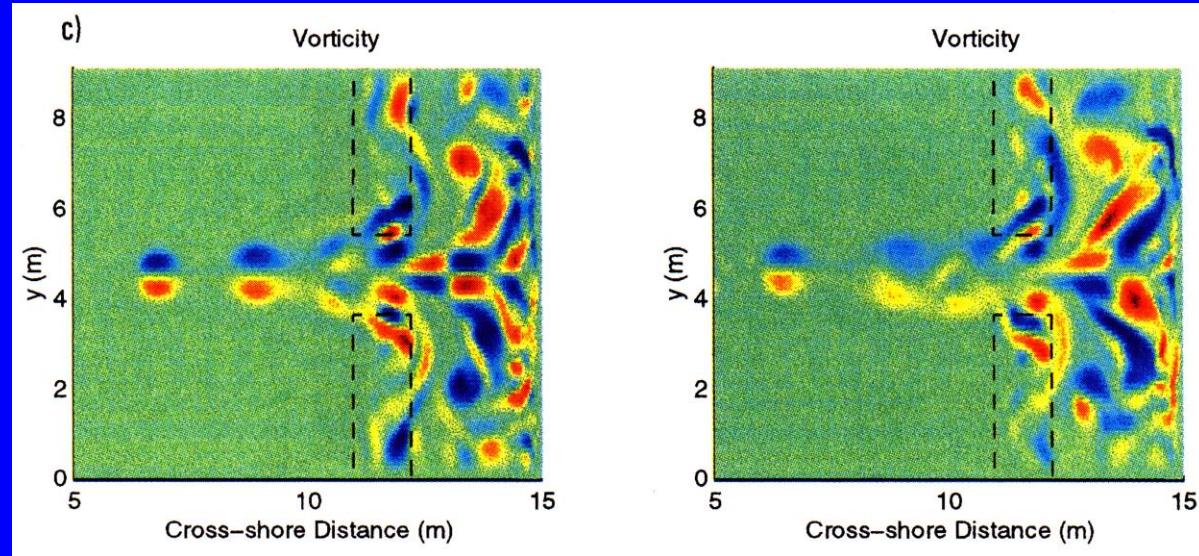
$$T_p = 9.2 \text{ s}$$

$$\lambda_p = 133 \text{ m}$$

Modeling of Nearshore Current Circulations

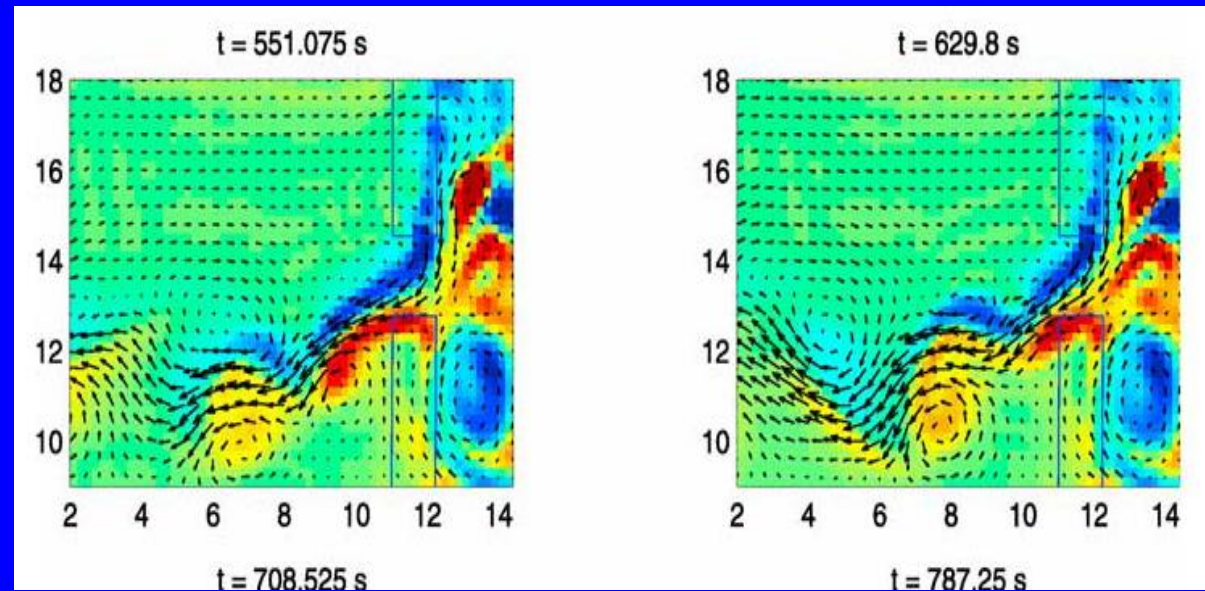
Boussinesq wave/current
model on a sand bar
bathymetry (FUNWAVE)

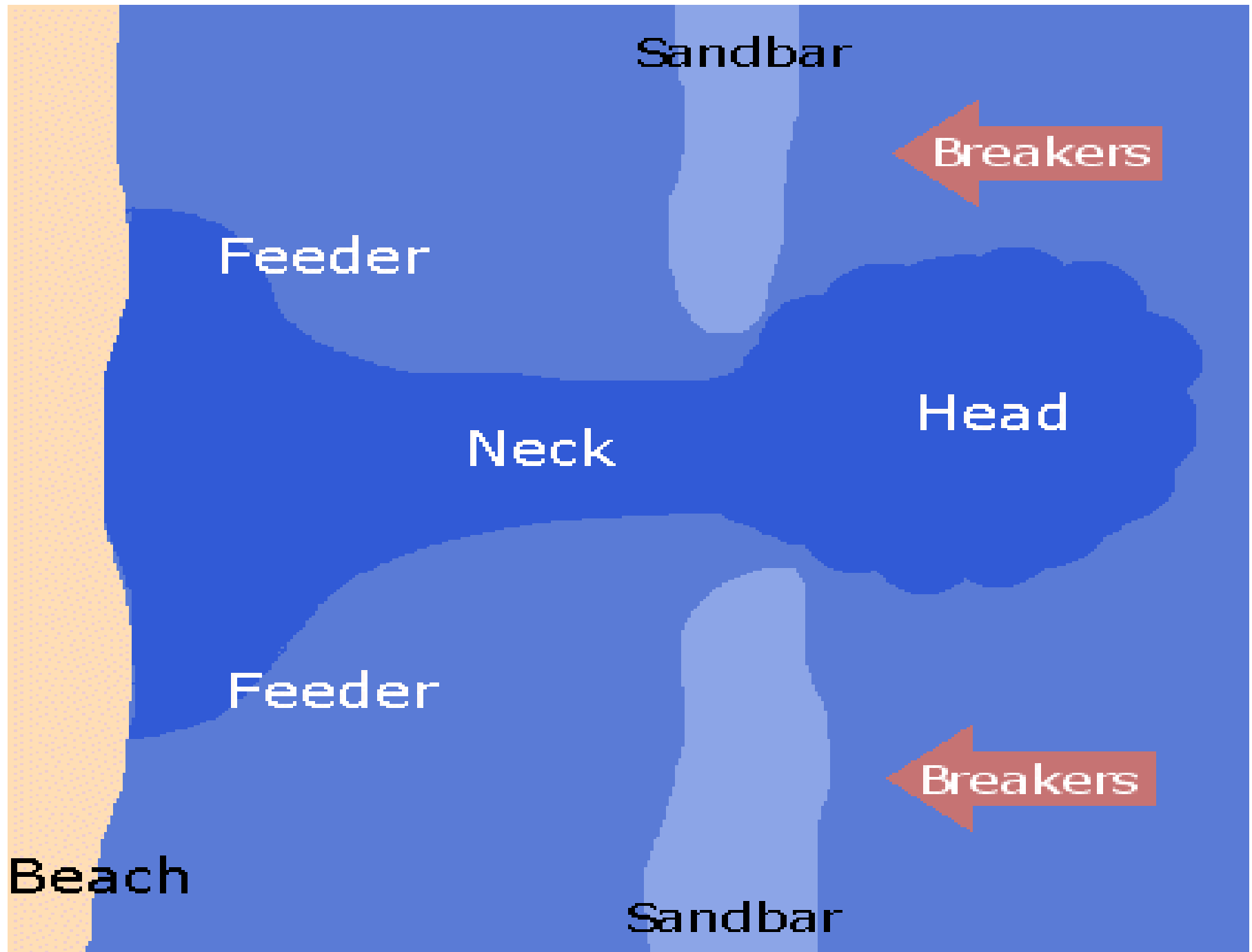
(Chen et al., *J. Geophys. Res.*,
1999)



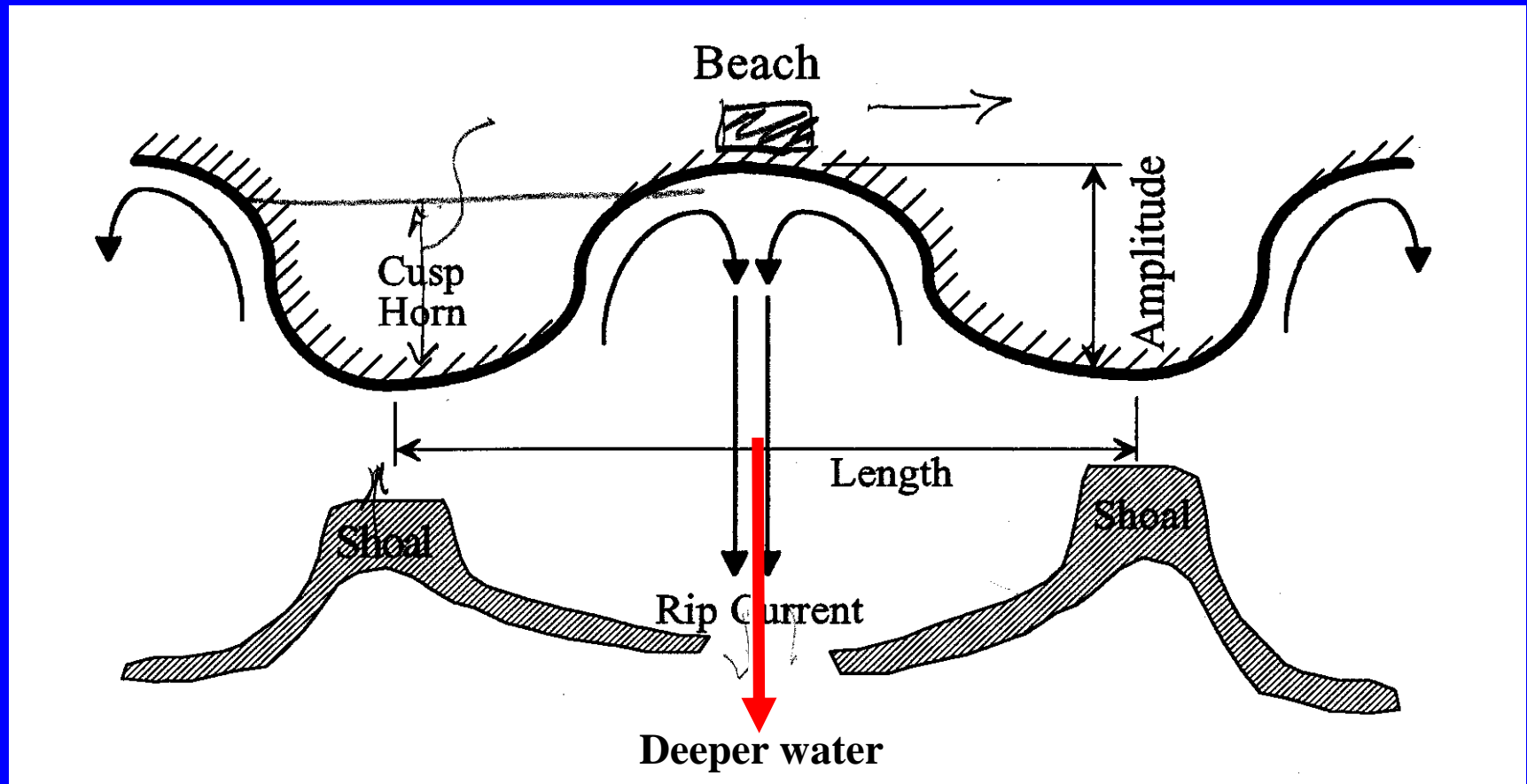
Coupled wave-driver
(REF/DIF) & circulation
model (SHORECIRC)

(Haas et al., *J. Geophys. Res.*,
2003)





Rips over Panama City Beach with bar-trough and protruded shore



Southern California Rip Current Monitoring surf zone data

*Q1: What are the prevailing **conditions** for rip currents ?*

Find a rule of thumb from the data.

*Q2: How to define the **strength** of rip currents ?*

Generalize a description of rip risk levels.

Seasonal Wave Characteristics on Moonlight Beach

Mean Waves	Surf Height (ft)	Wave period (sec)	Surf Zone Width (ft)
Season			
Winter	3.50	10.5	203
Spring	2.89	9.8	280
Summer	2.61	12.6	242
Fall	2.59	11.6	205

Winter: 12/15/08-4/16/09 Spring: 4/16/08-06/10/08 Summer: 6/12/08-10/02/08 Fall: 10/03/08-12/14/08

Seasonal Rip Current Characteristics at Moonlight Beach, CA

Intensity	Weak	Moderate	Strong	No rips
Season				
Winter	50	56	14	22
Spring	33	26	4	8
Summer	51	53	5	20
Fall	37	25	3	14

Winter: 12/15/08-4/16/09 Spring: 4/16-06/10/08 Summer: 6/12-10/02/08 Fall: 10/03-12/14/08

Methods of Prediction

I. Rip prevailing condition:

A. Wave -Sediment (by Short and Wright) or M_2

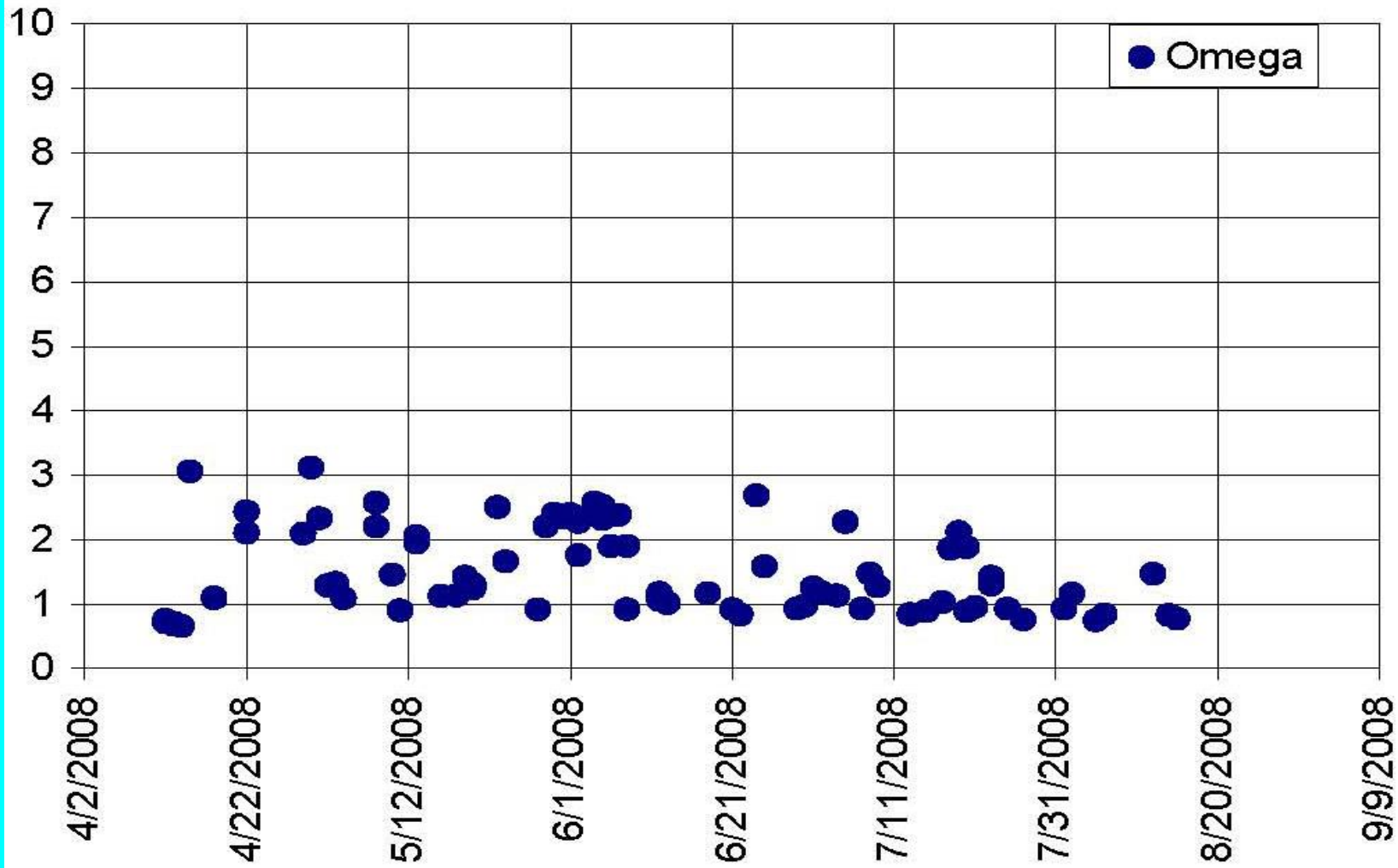
$$\Omega = H_b / T w = \text{wave particle speed/sand falling speed}$$

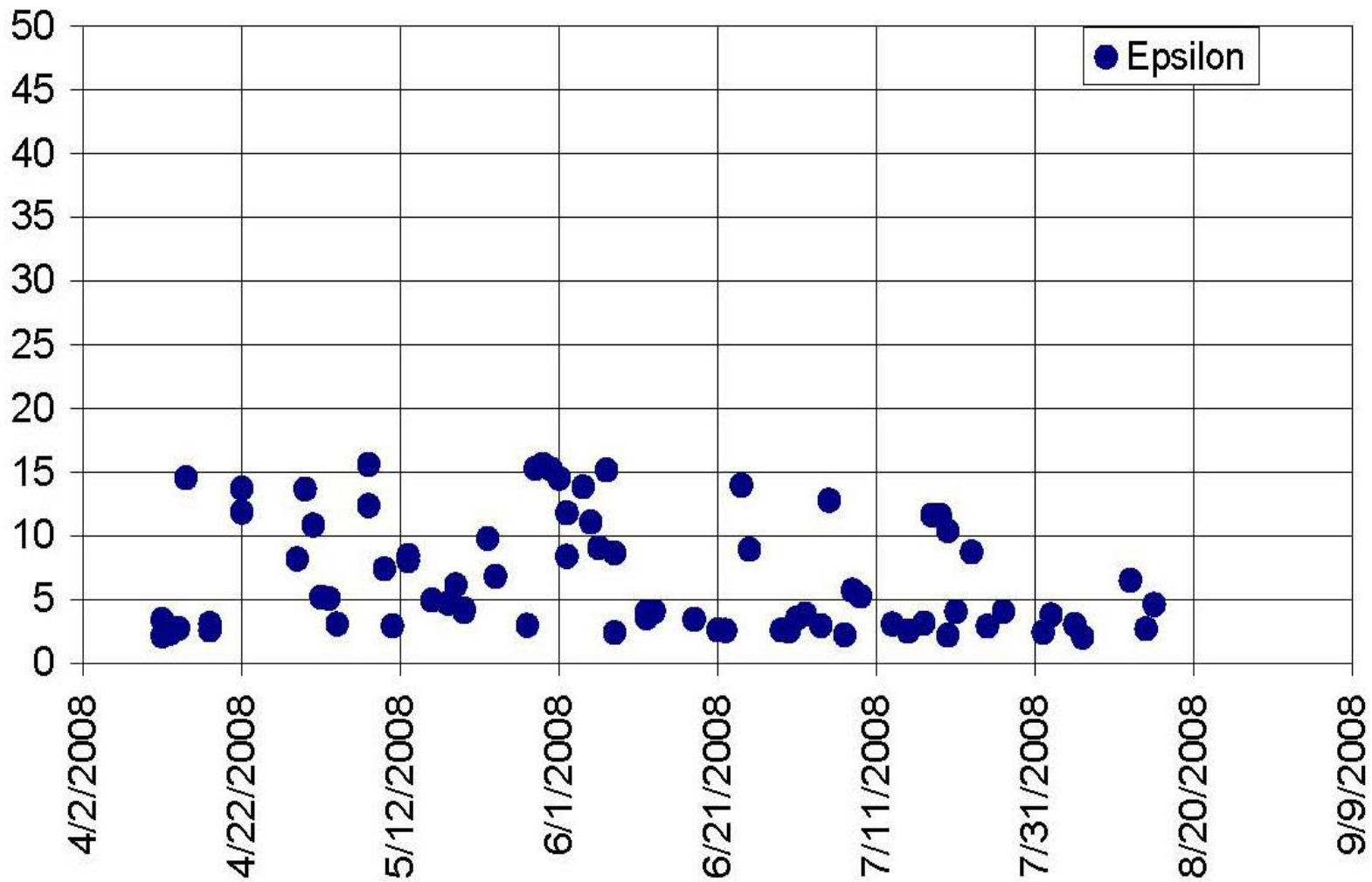
$1 < \Omega < 6$ rips appearing ranges.

B. Surf scale parameter (Wave-Beach) (Guza, Nielsen, etc) or M_3

$$2.0 < \epsilon = a_b \omega^2 / g \tan^2 \beta \Rightarrow \text{wave steepness/beach face slope.}$$

II. Rip strength estimate:





More sensitive to beach face slope, limited

Critical Skill Performance

During 4/15/08 - 8/16/2008

SCORE	POD	FAR	SR	CSI
Methods	Probability of detection	False Alarm rate	Success ratio	Critical success index
Wave-Sand M2	0.81	0.25	0.75	0.631
Wave-beach M3	0.69	0.36	0.64	0.523



(A) Spilling breakers in series with saturated surf zones. Usually can be seen at low tide. Waves are high.



(B) Longshore bar-trough with steeper waves that collapse near the shore. Rip appears at bar breaches.



Beach cusps, $\Omega < 1$ or $\varepsilon < 2.0$, waves are reflected

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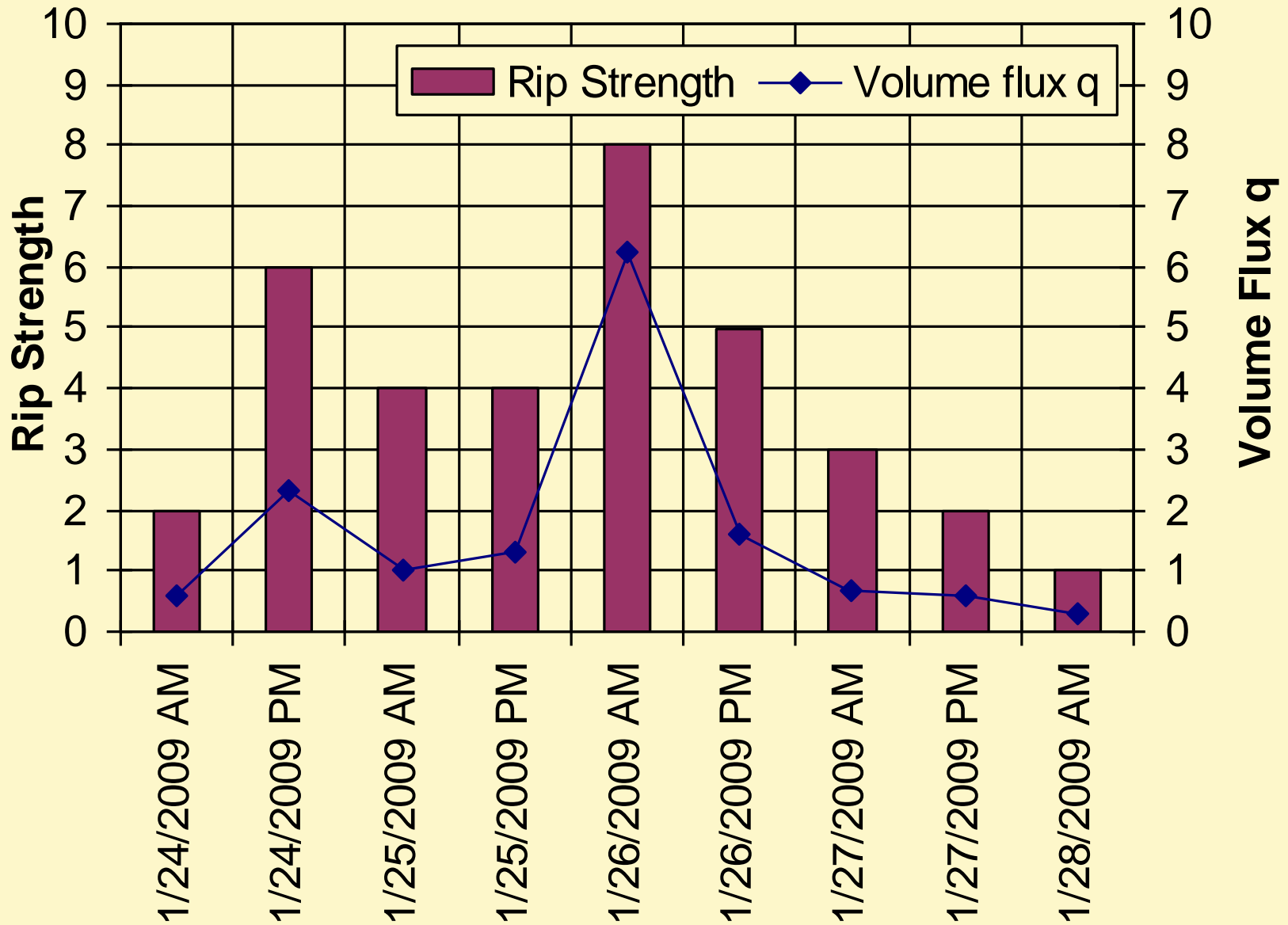
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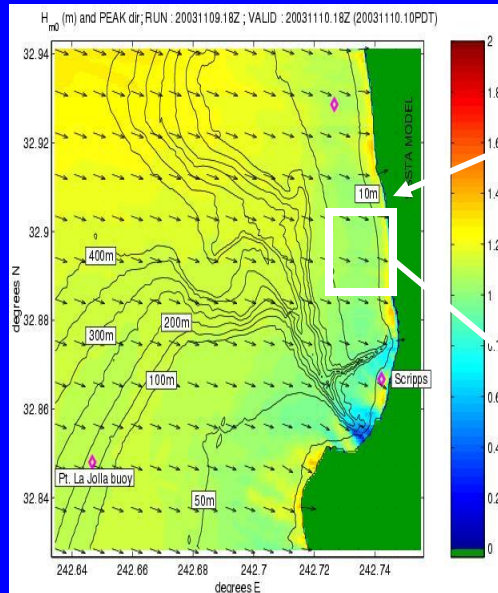
Rip strength versus water volume flux



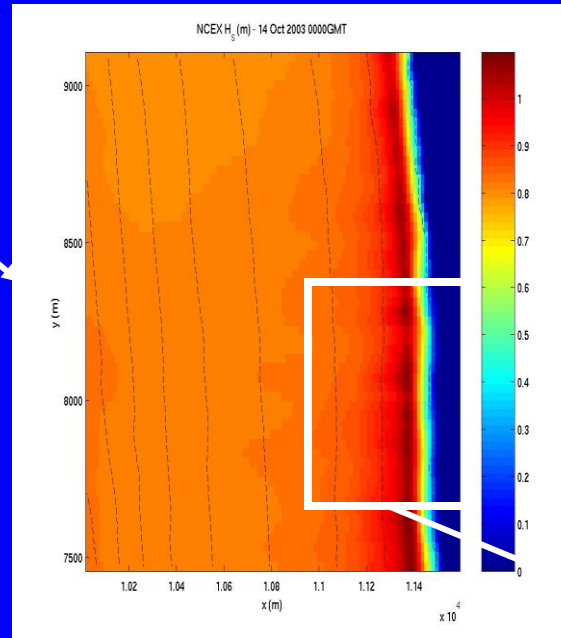
Back-up Slides



Delft 3D Model Setup – Nested Domains



Encircles Area 3

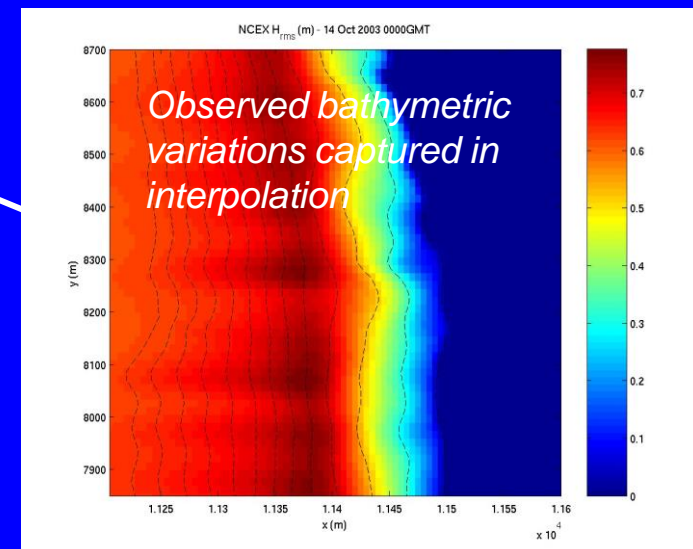


Delft3D SWAN Area

- 15m x 30m resolution
- Boundary information from DIOPS SWAN

Delft3D SWAN/FLOW Area

- 5m x 15m resolution
- Standard boundary conditions
- No roller activated
- 3 hr run (in 1 hr spin up)



CPU used for initialization:
415.210s

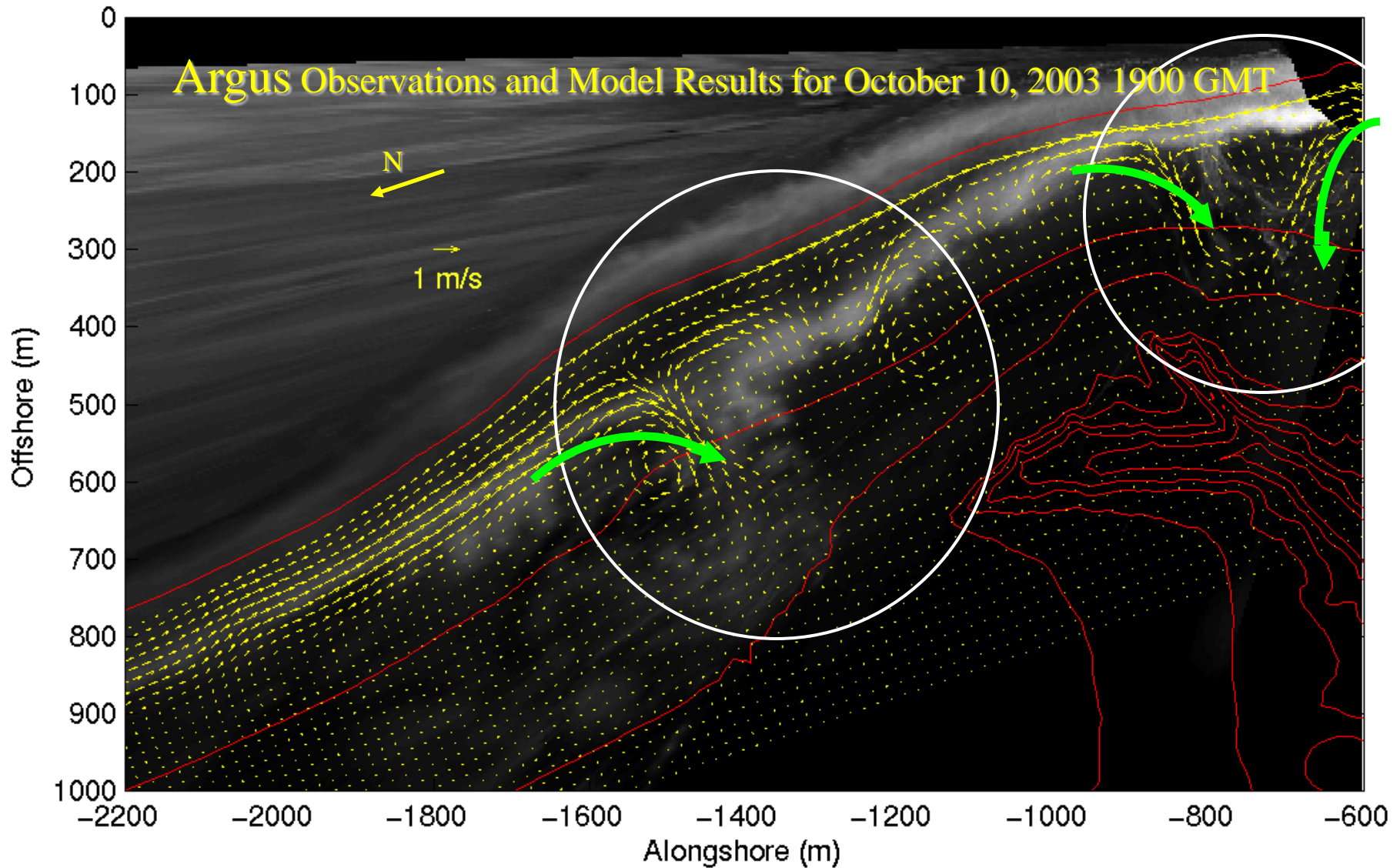
CPU used for simulation:
718.835s

CPU used for close and stop:
0.715s

Total: 1134.92s (~19 min.)

Nearshore Circulation: *Model vs. Visual Signals*

Circulation Results for 10/10/2003 at 1900 GMT



Other factors and Variability of Rip Currents

1. Tide effects: within 12 hours, tide rises from low-high
2. Wave direction: normal wave incidence vs. oblique wave

Different beaches, such as in a bay or semi-protected ?

Uncertainties of prediction lies on:

- * Lifetime of rips vary: 10 sec~3 min ~ weeks.
- * Pulsation of rip: intensities vary with water levels.
Low swell waves (~ 2 ft) at low tide can develop

Tide effects on Rip hazard

Rip current results	Max rip speed (m/sec)	Rescue numbers	Surf Zone Width (yards)
Water levels			
Low tide (0.5 m)	0.60	465	80
High tide (3.0 m)	0.25	3	40

Nile Mile Beach: $H=0.65$ m, $T= 10$ sec and slope = $1/25$

Remarks for Operation

- Lifeguards----NWS can collaborate to provide consistent beach safety operation.
- Getting surf heights are crucial for rip currents.
- The beach sand grain size and beach face slope matters, *IT SHOULD BE RECORDED MONTHLY.*
- In Surf zone forecast, changes in sea states (3 hrs) and the beach states (12 hrs) must be noted during a storm.

Surf zone forecast and **High Surf complements each other.**

