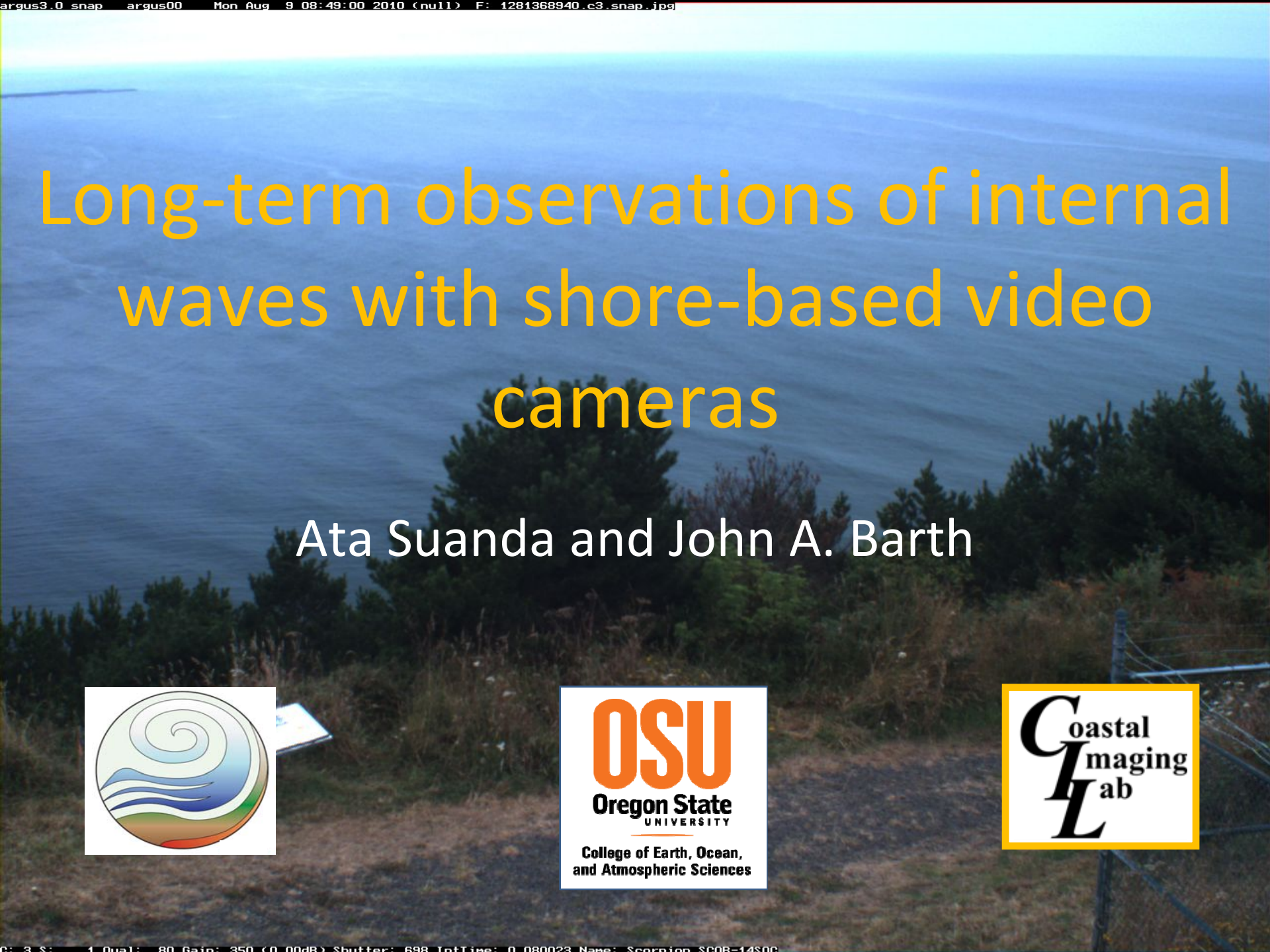
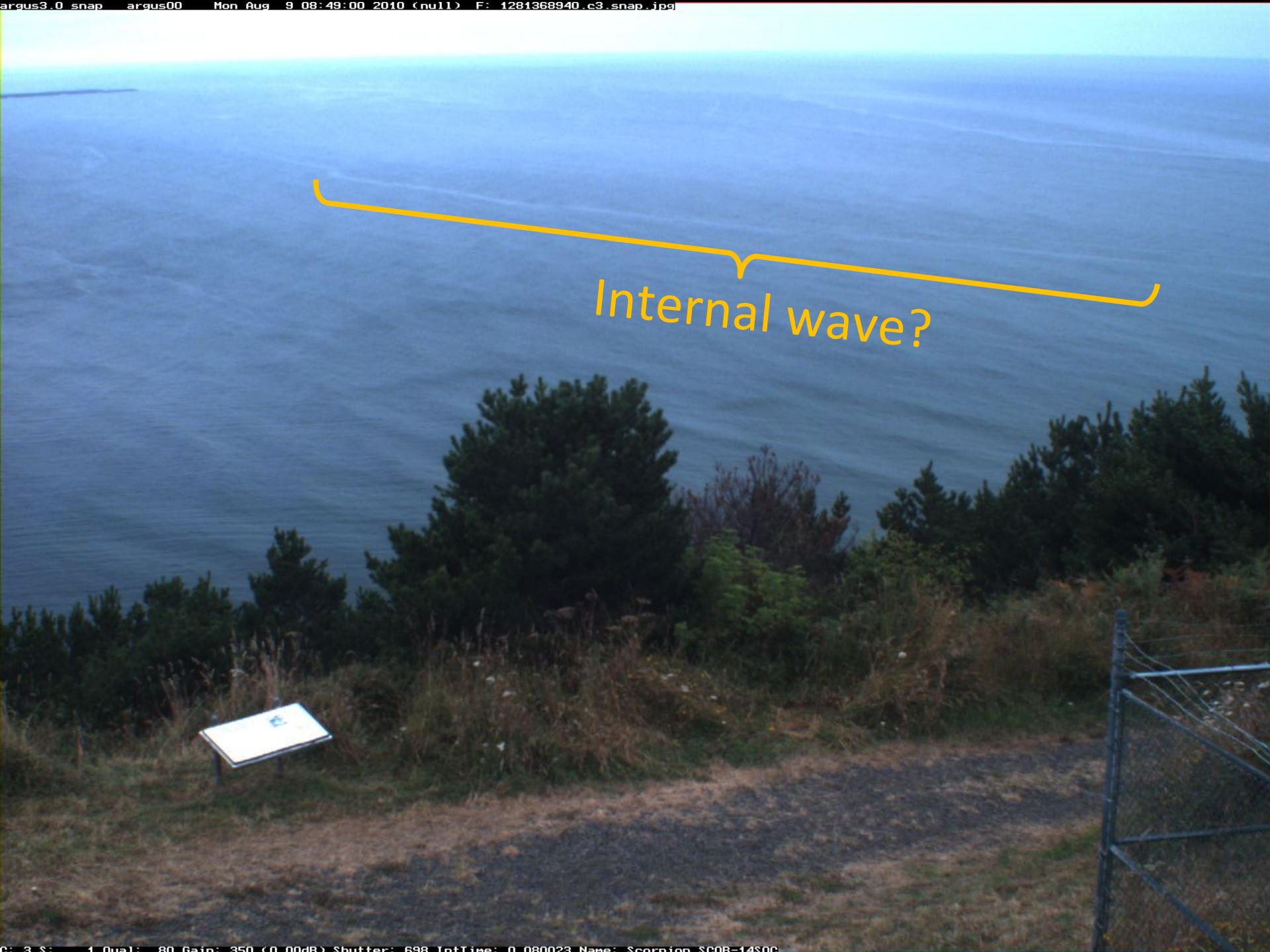


Long-term observations of internal waves with shore-based video cameras

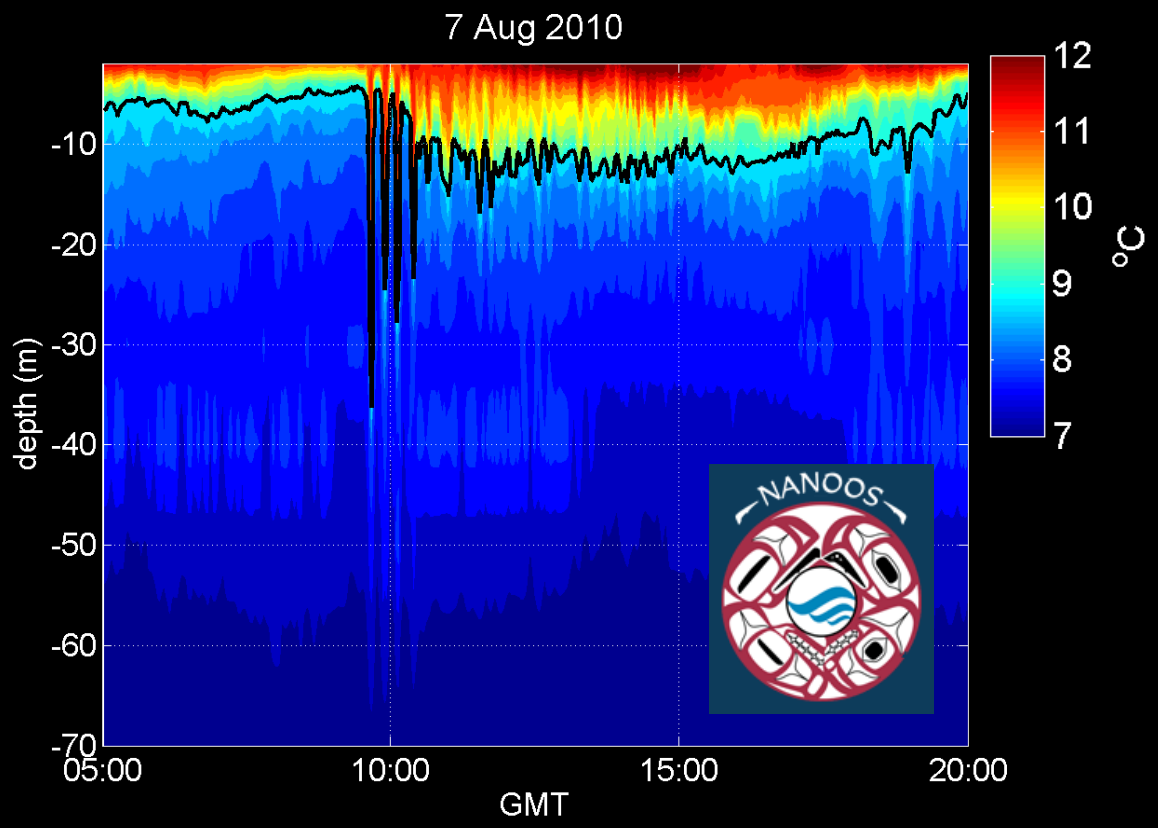
Ata Suanda and John A. Barth

OSU Oregon State University College of Earth, Ocean, and Atmospheric Sciences

Coastal Imaging Lab

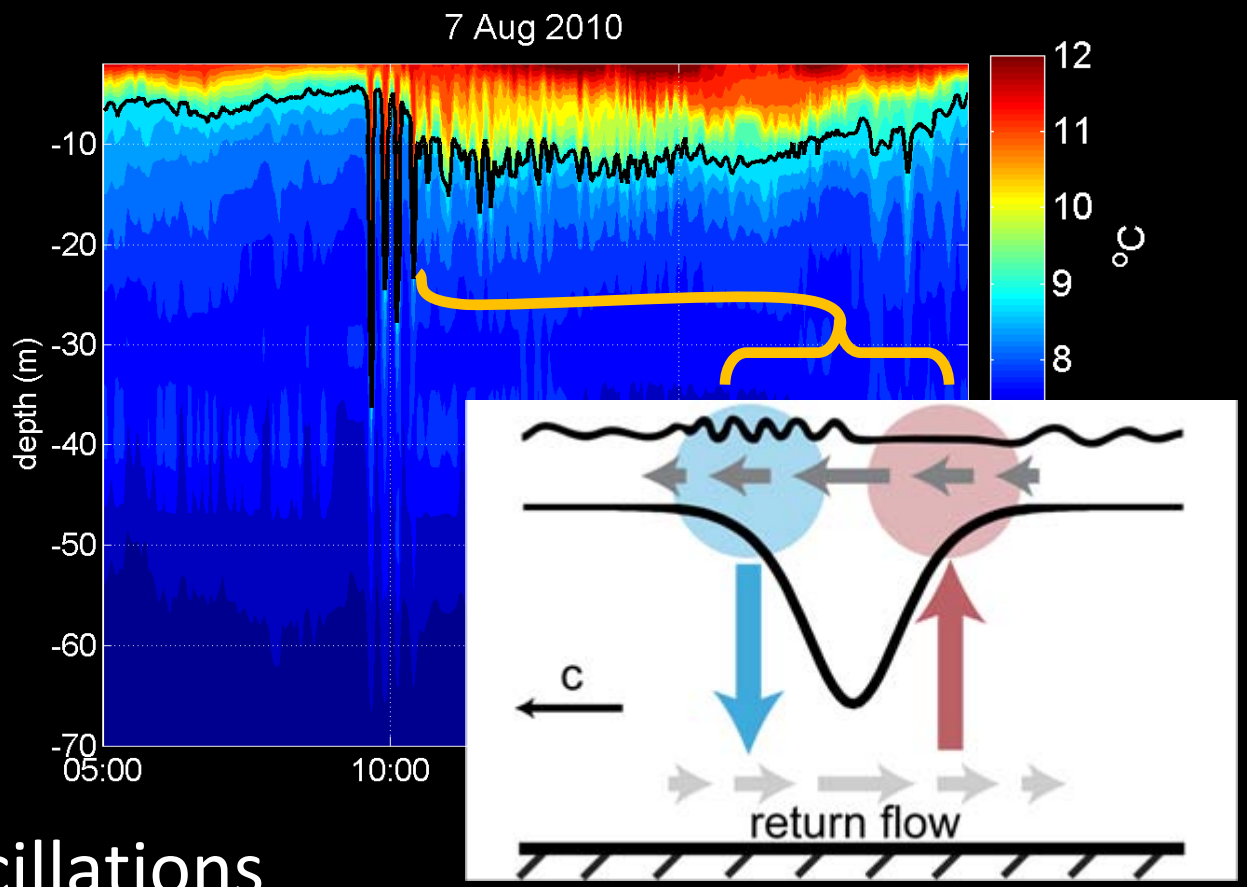

argus3.0 snap argus00 Mon Aug 9 08:49:00 2010 (null) F: 1281368940.c3.snap.jpg
Internal wave?

What is an internal wave?



Interior oscillations

What is an internal wave?



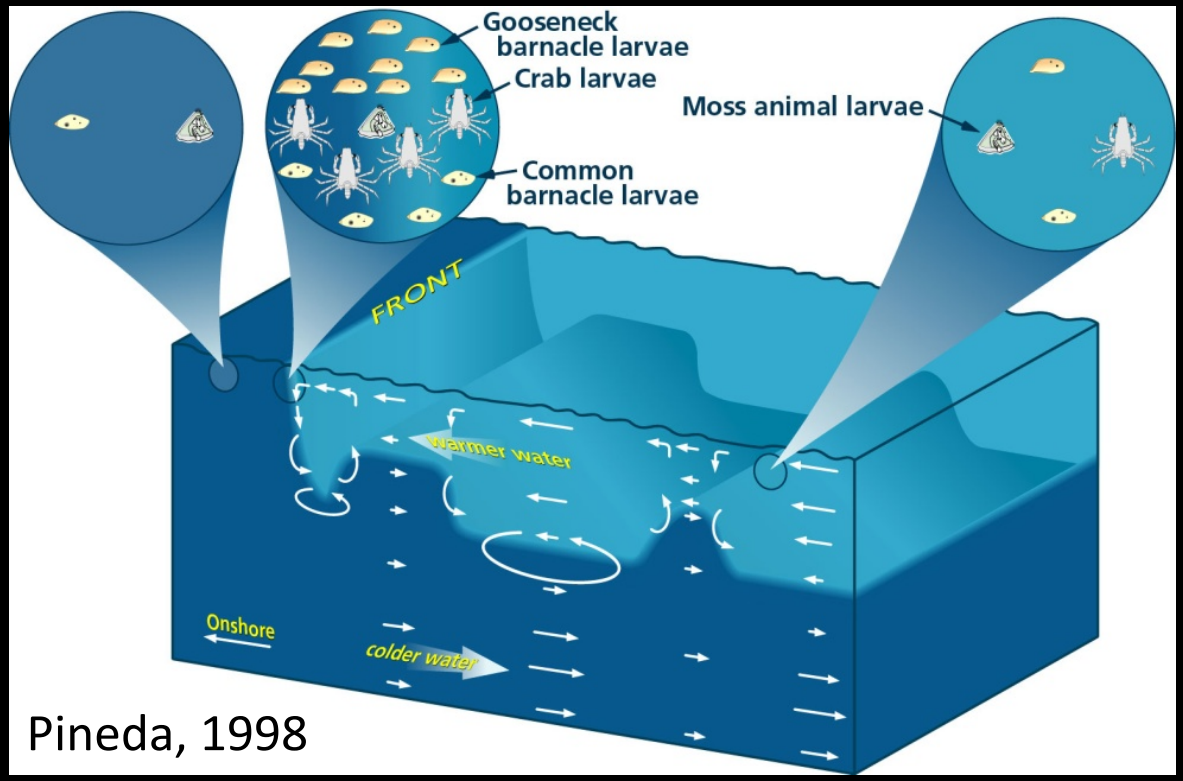
Shroyer, 2010

Interior oscillations

Alternating currents

Large vertical velocity

The need for monitoring

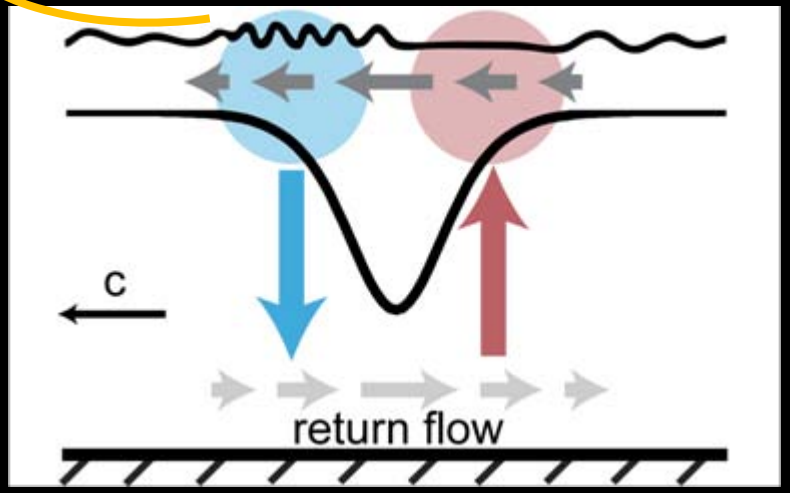


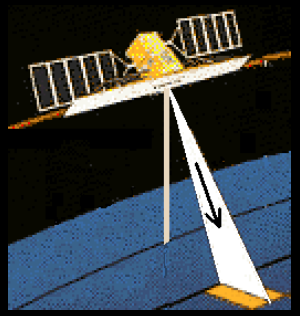
Pineda, 1998

- Important for mixing and transports
- Understanding the fate of tracers (larvae, nutrients, etc.)
- Internal waves are *intermittent* and affected by *many* oceanographic processes.

Surface expression of IWs

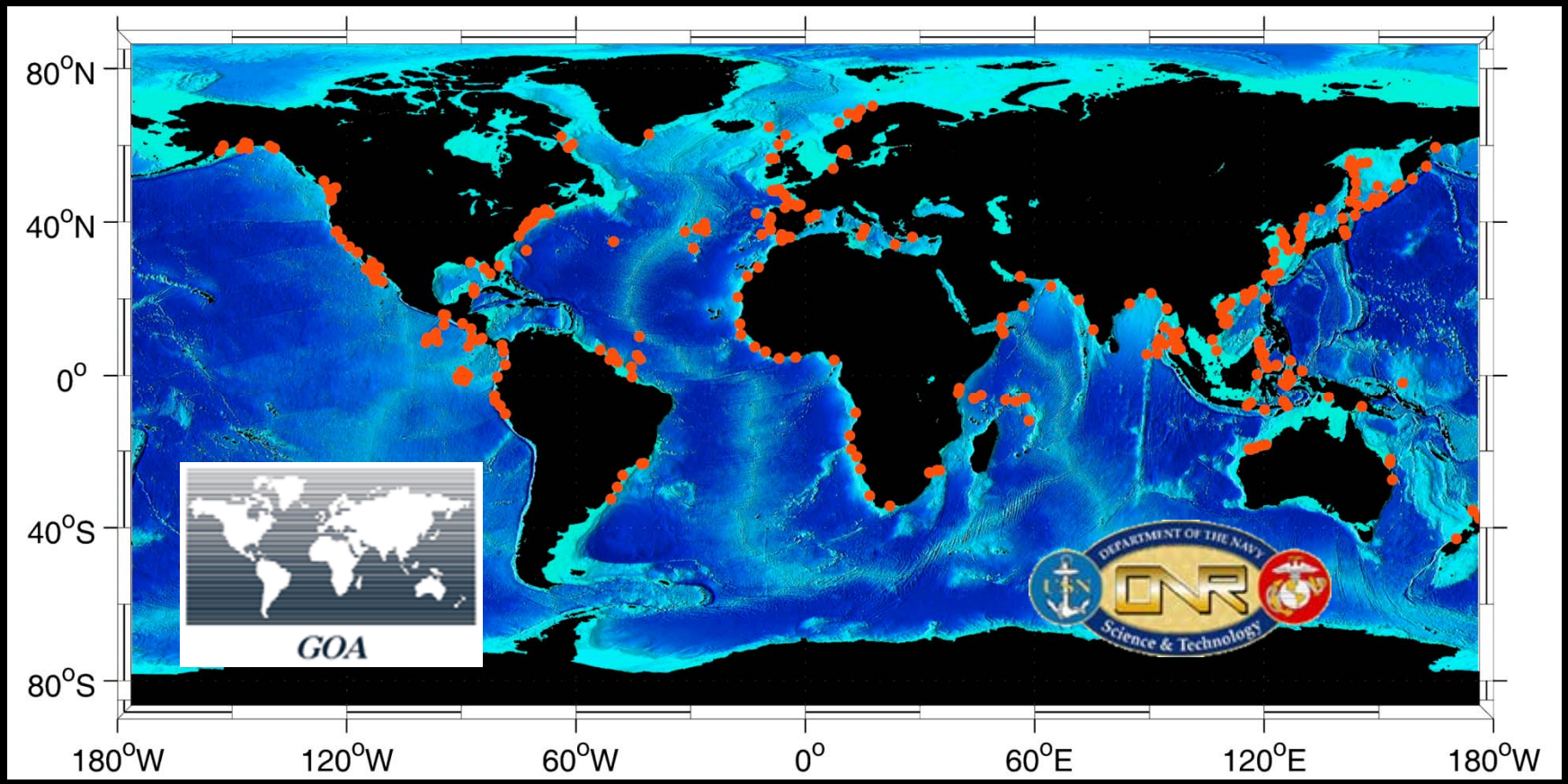
Surface currents create convergences and divergence.





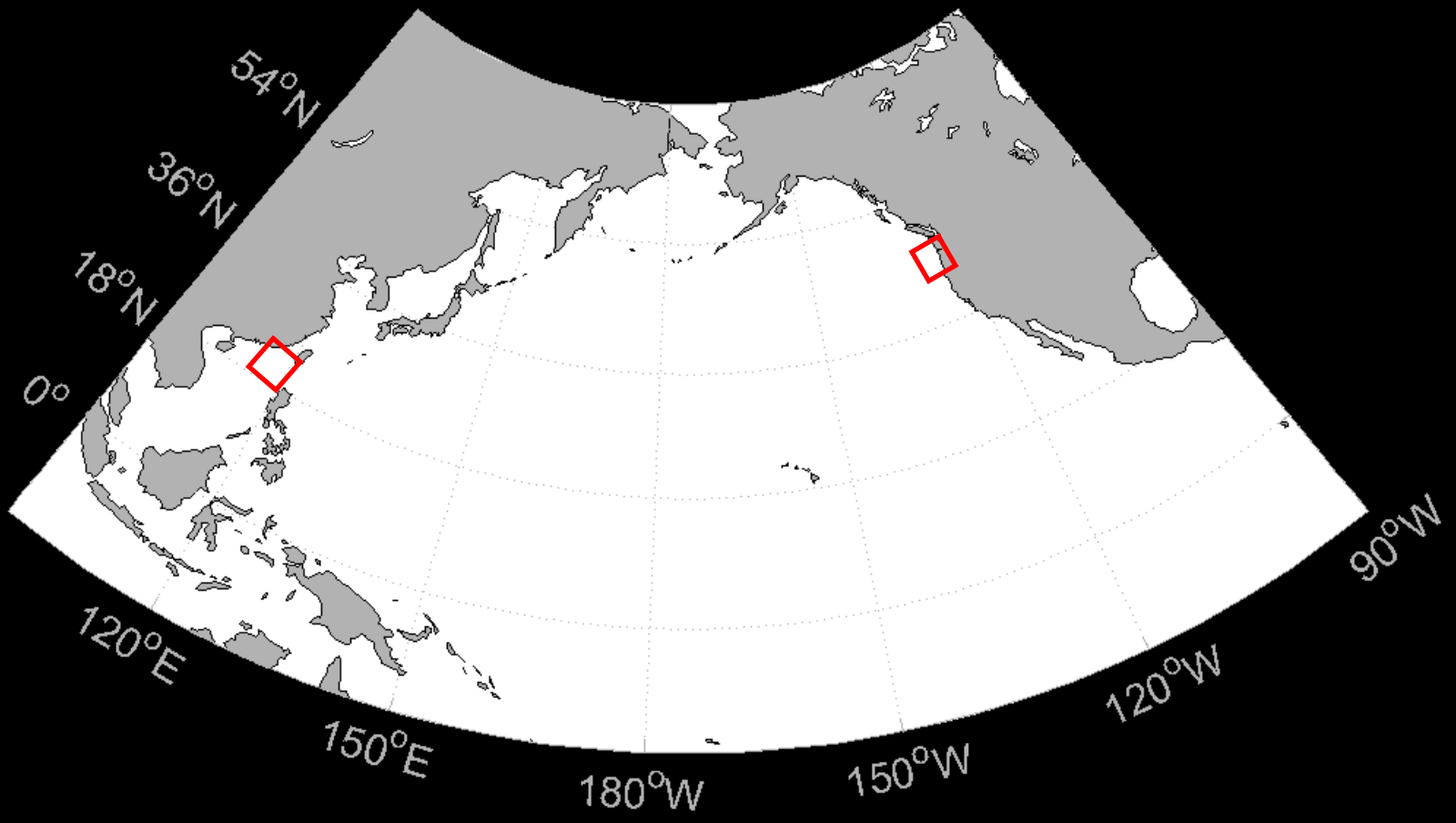
Visible in remote sensing

Internal wave observations are everywhere!



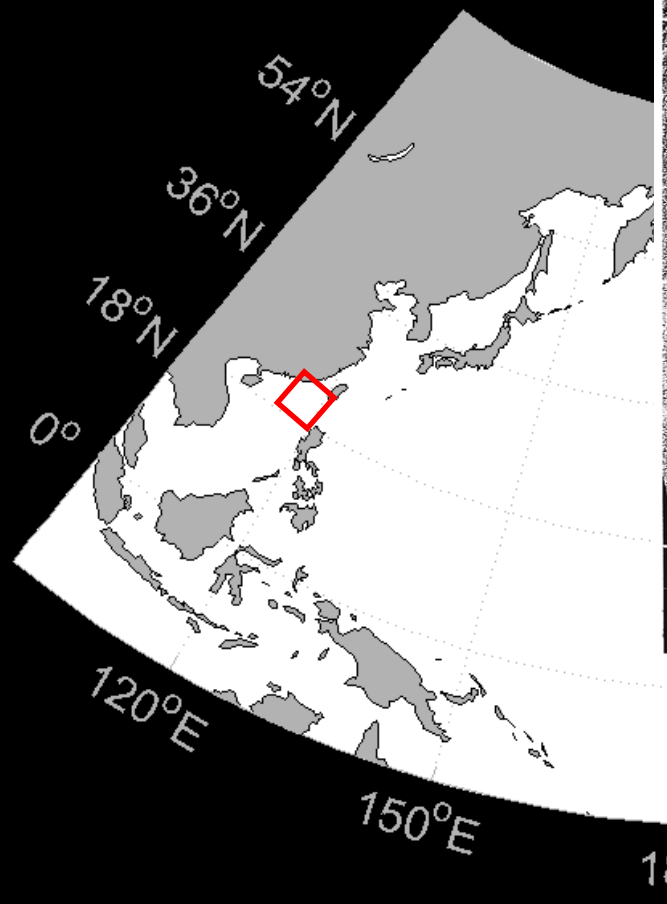
Atlas of Oceanic Internal Solitary Waves (http://www.internalwaveatlas.com)

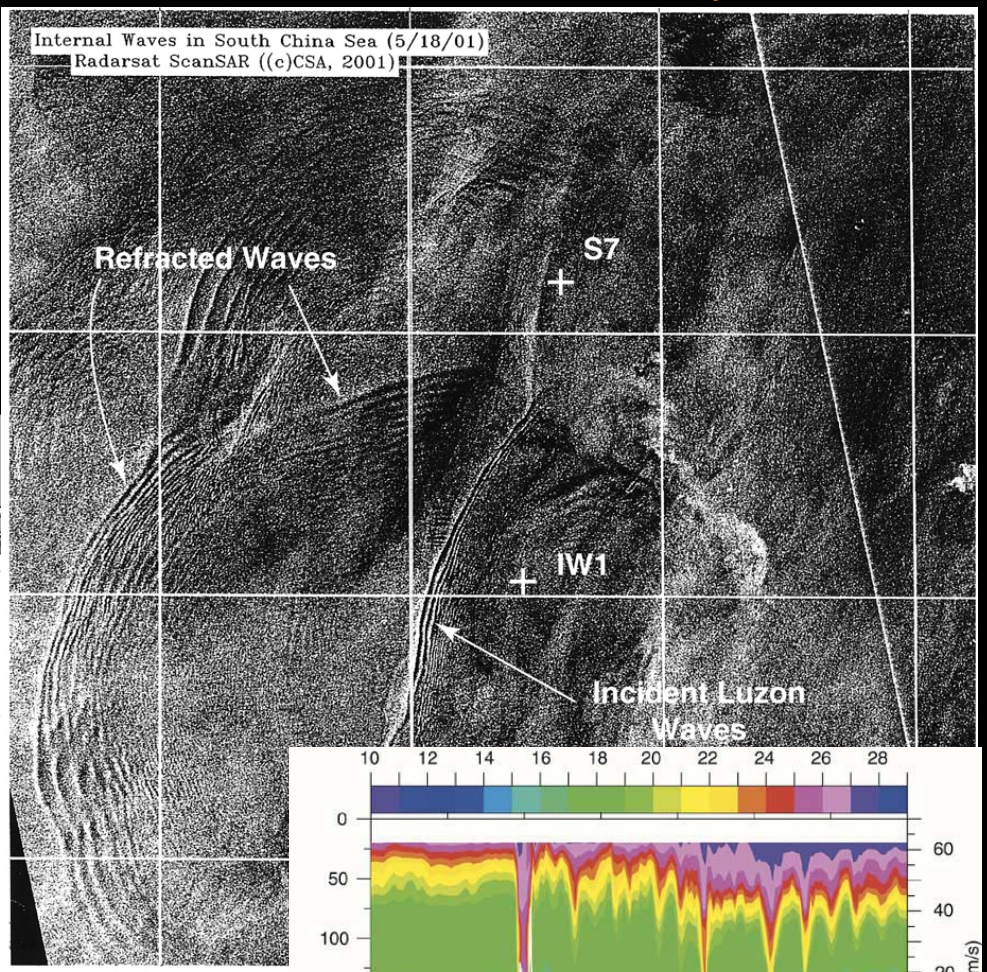
North Pacific Ocean examples

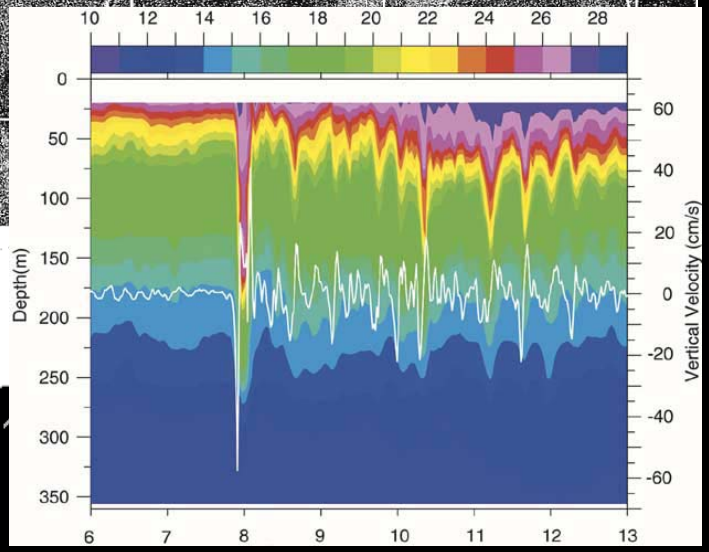


Tide-bathymetry interaction

Ramp et al., 2004

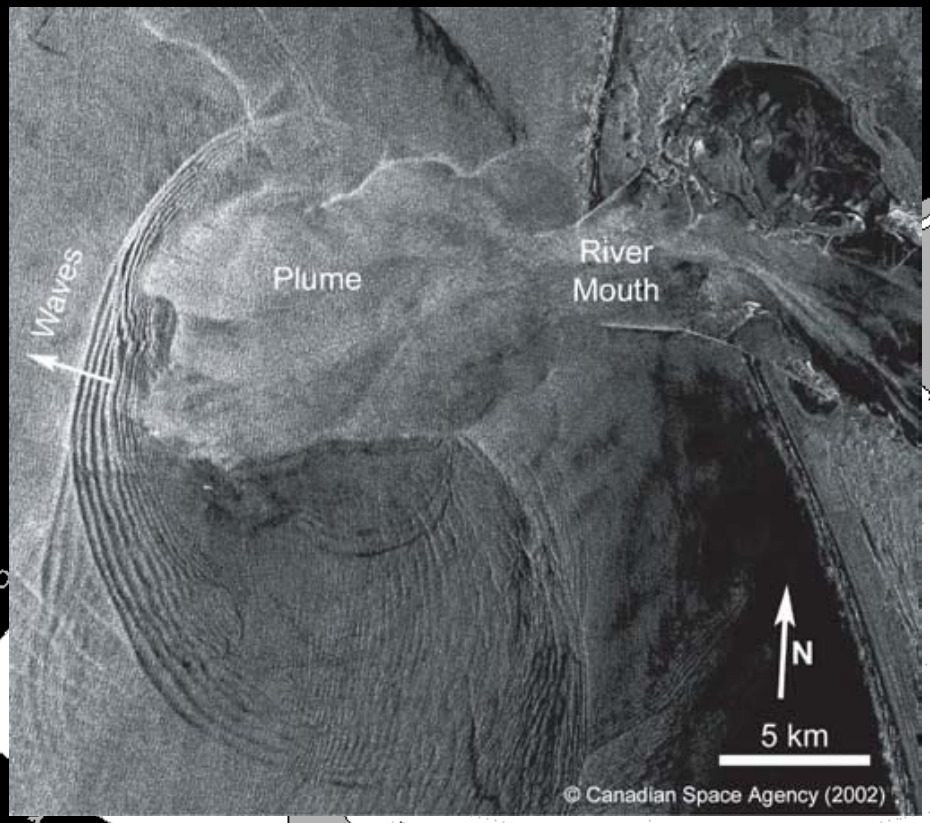


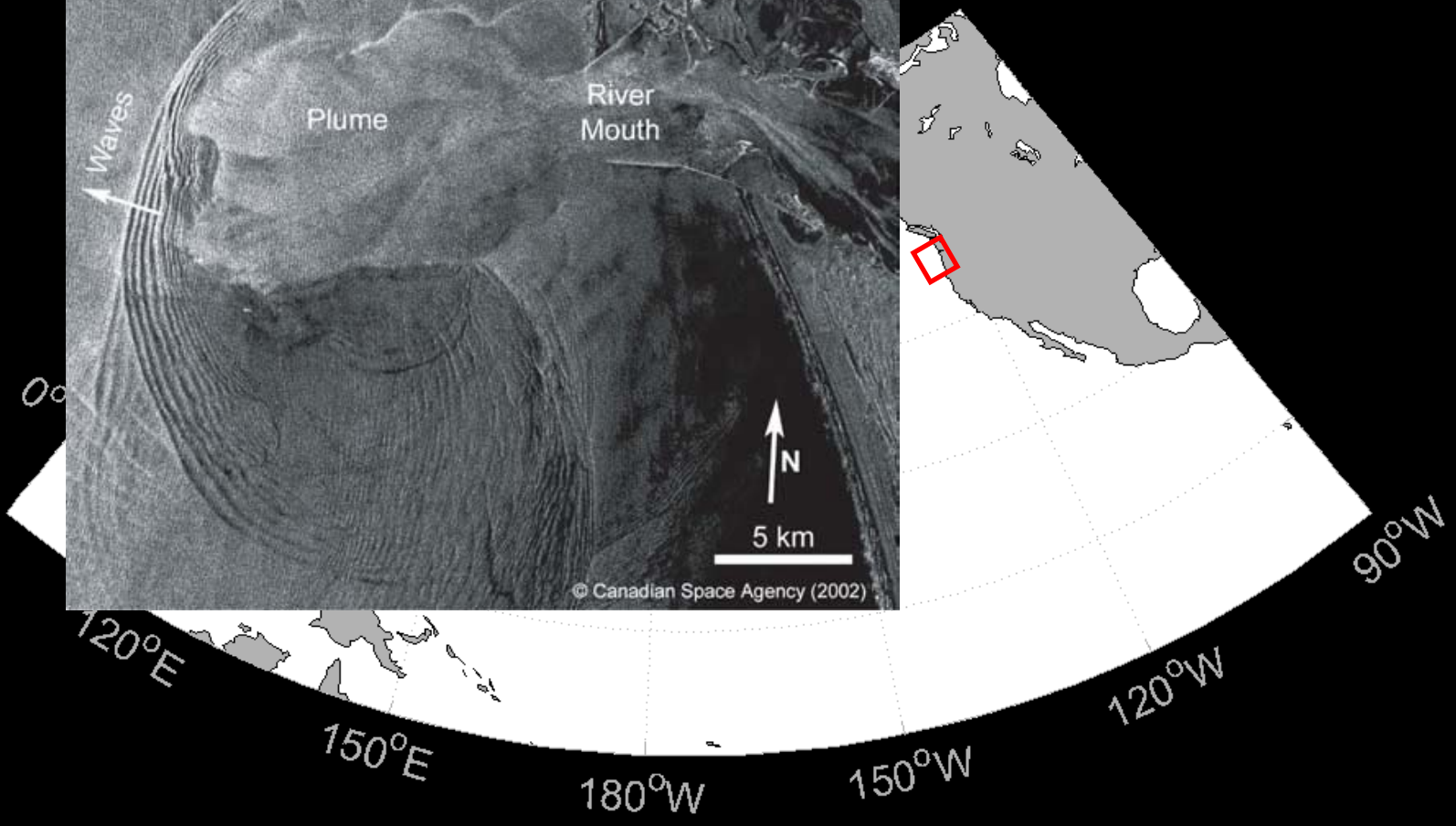




Tide-river plume interaction

Nash and Moum, 2005





The difficulty in monitoring

- Satellite pass infrequent
- Rough environment
- Biological growth

Video remote sensing is an alternative…

Single camera view point

Use shore-based video cameras

Pawlowicz, 2003

Propagates onshore ~15 cm/s

Potential for monitoring?

Single camera view point

Use shore-based video cameras

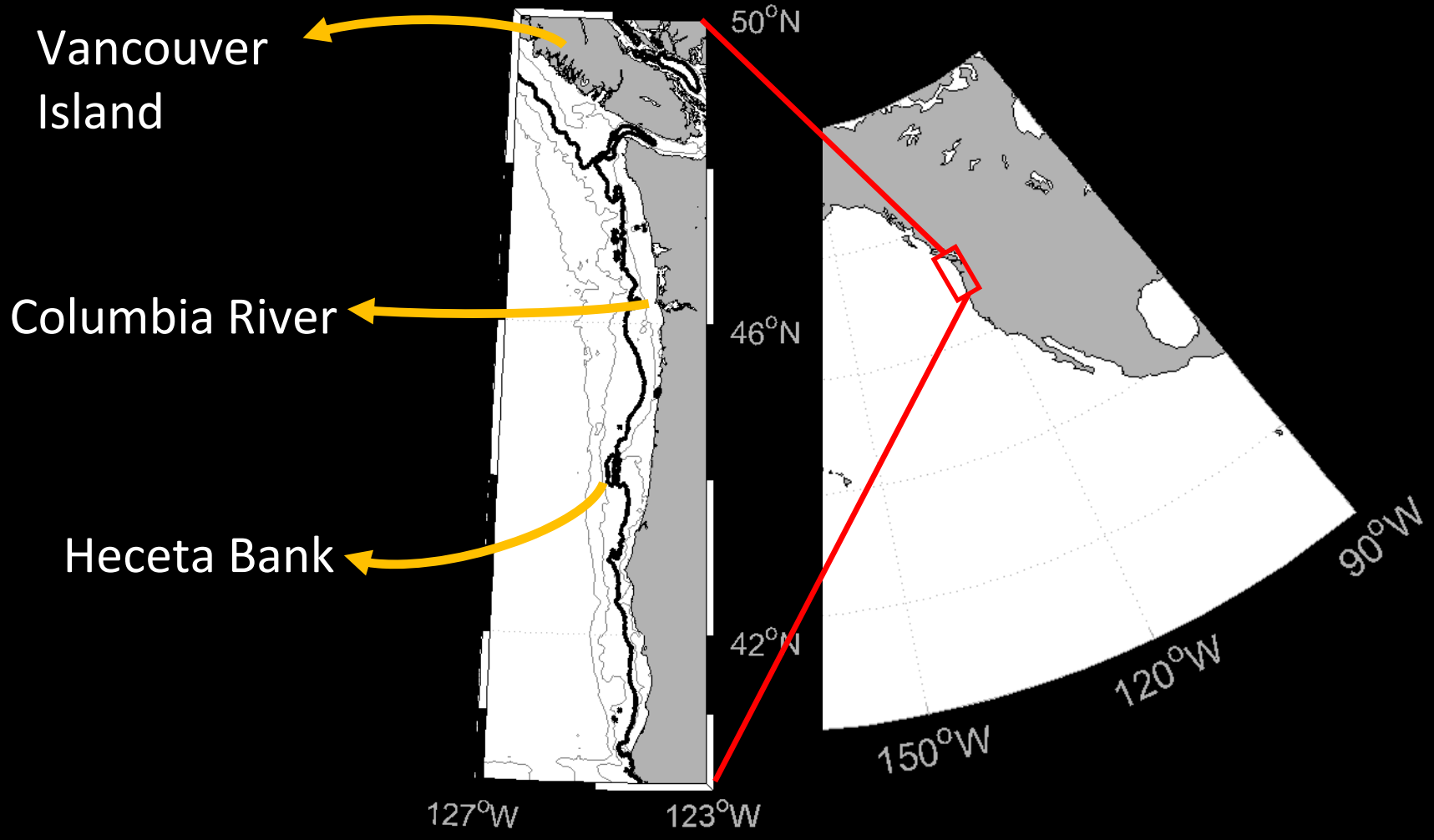
Pawlowicz, 2003

Propagates onshore ~15 cm/s

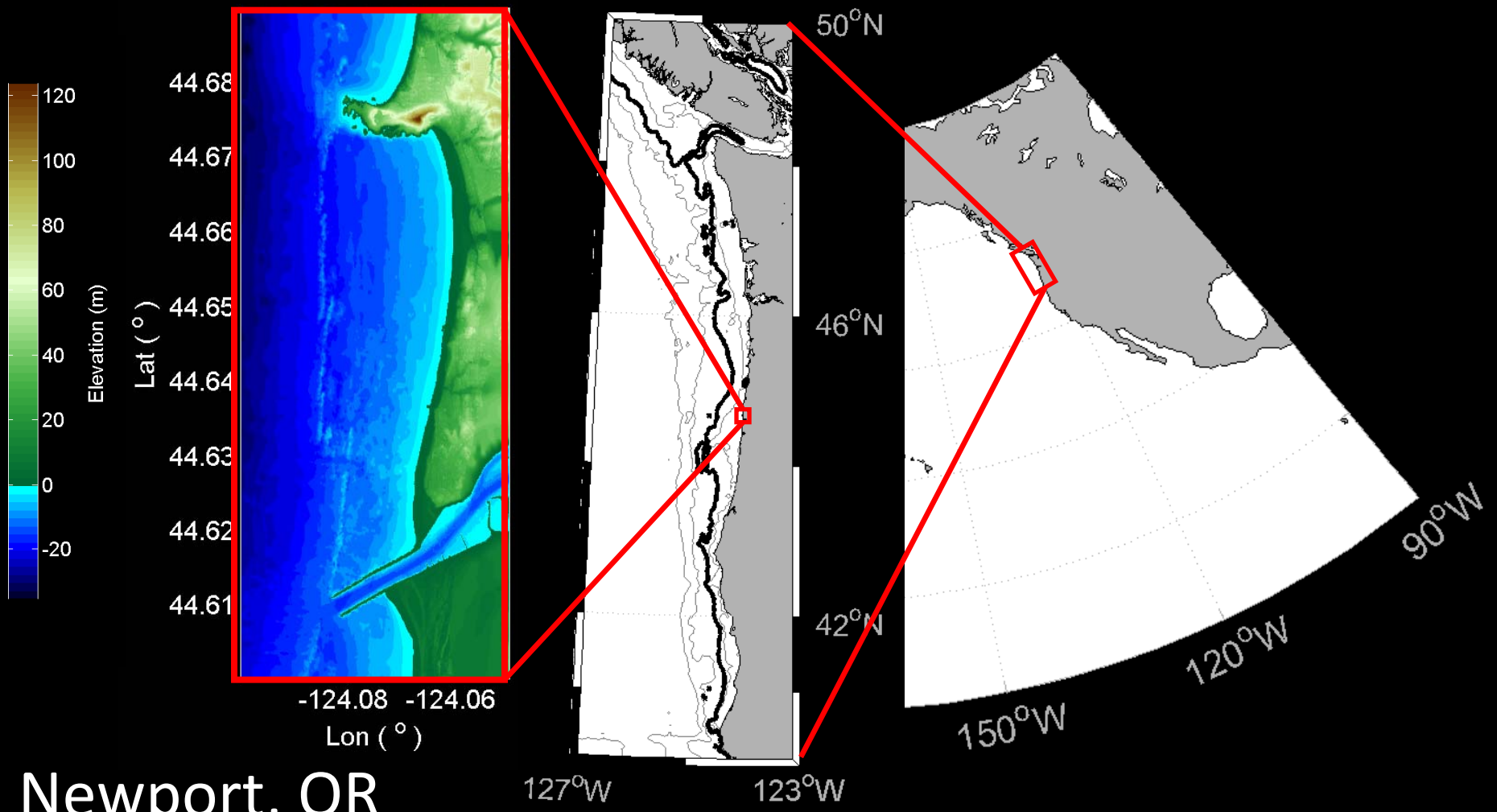
Potential for monitoring?

Collaborative in-situ + video sensing experiment

Collaborative experiment

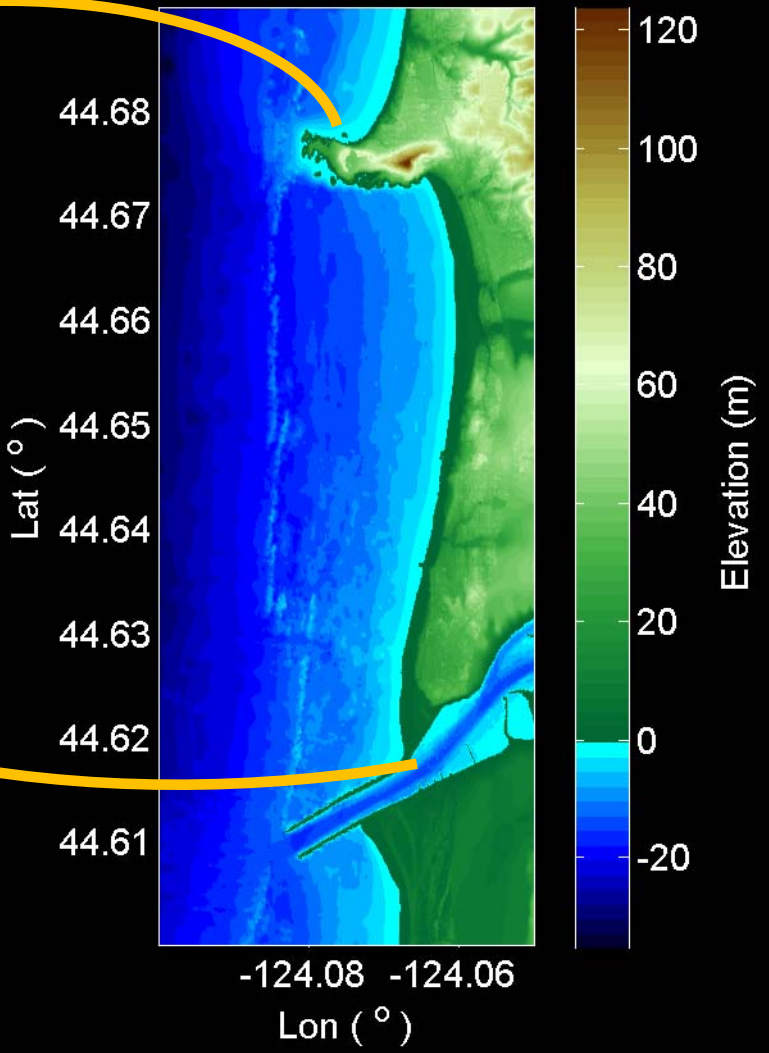


Collaborative experiment



Newport, OR

Collaborative experiment



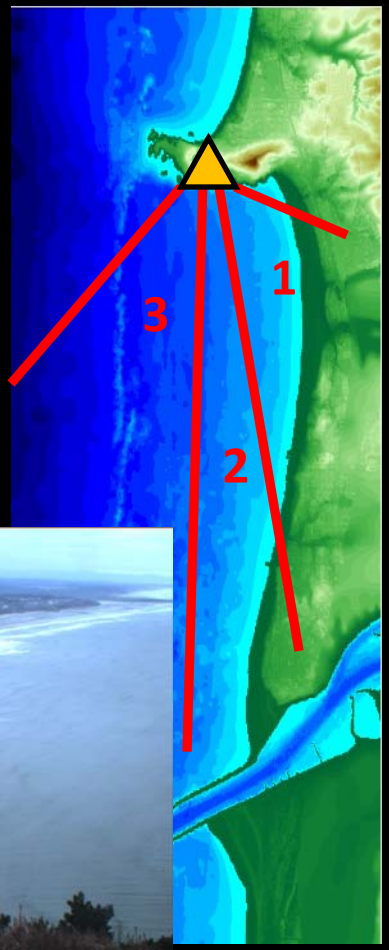
Elevated vantage point

Argus system

- Multiple cameras
- Permanent installation (‘92 - present)
- Beach processes
- Added offshore camera (2010)

http://cil-www.coas.oregonstate.edu/

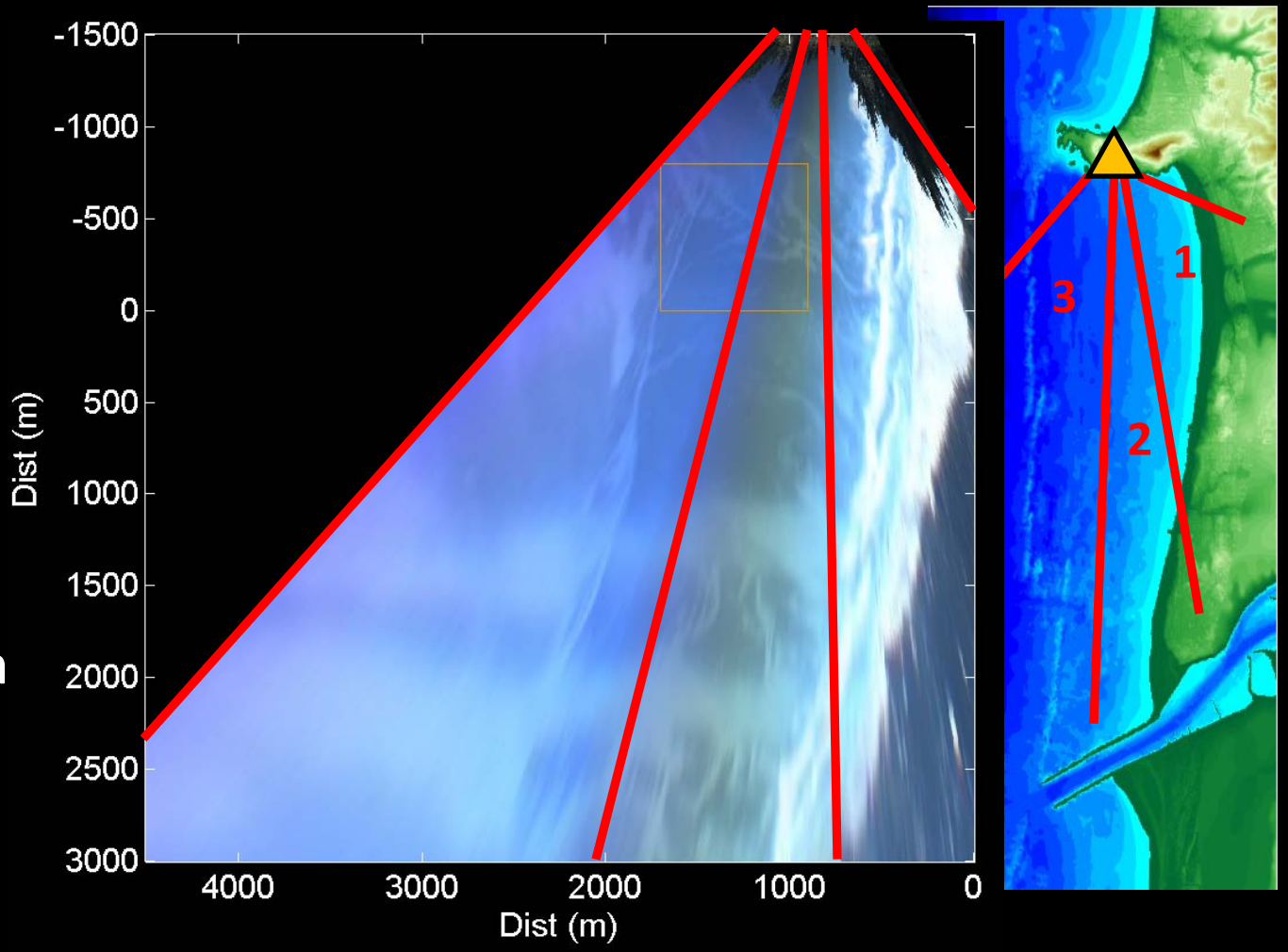
Argus system



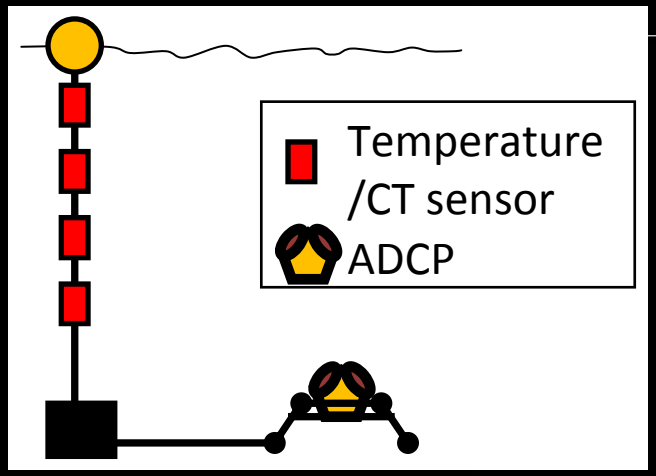
- 3 separate images
- Increases field of view
- Camera orientation

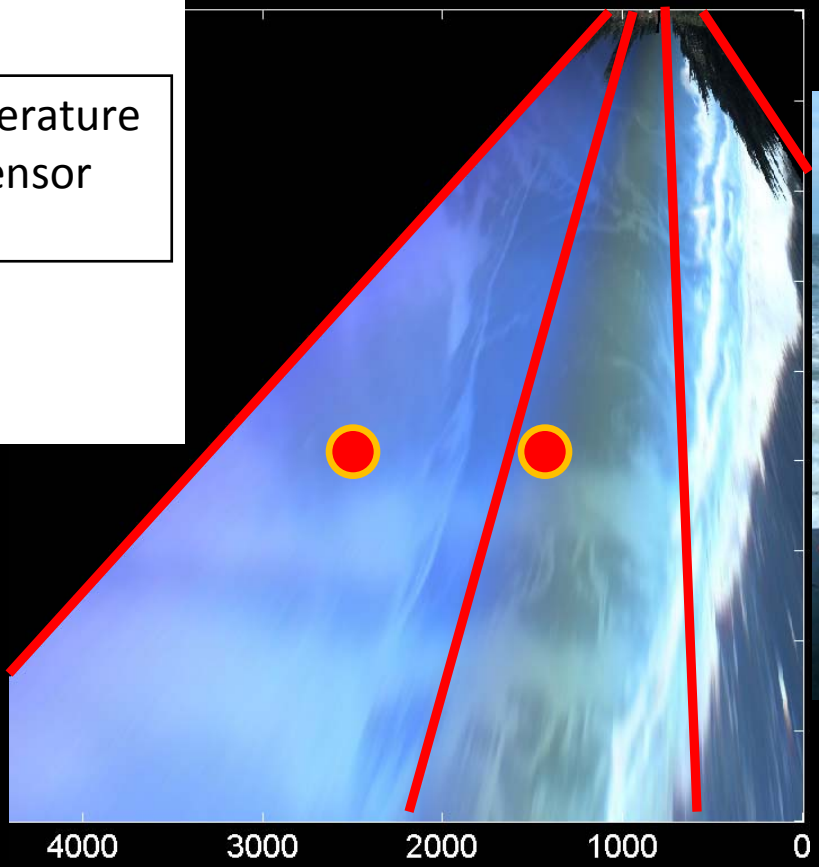
Argus system

- Geo-rectification



In-situ measurements

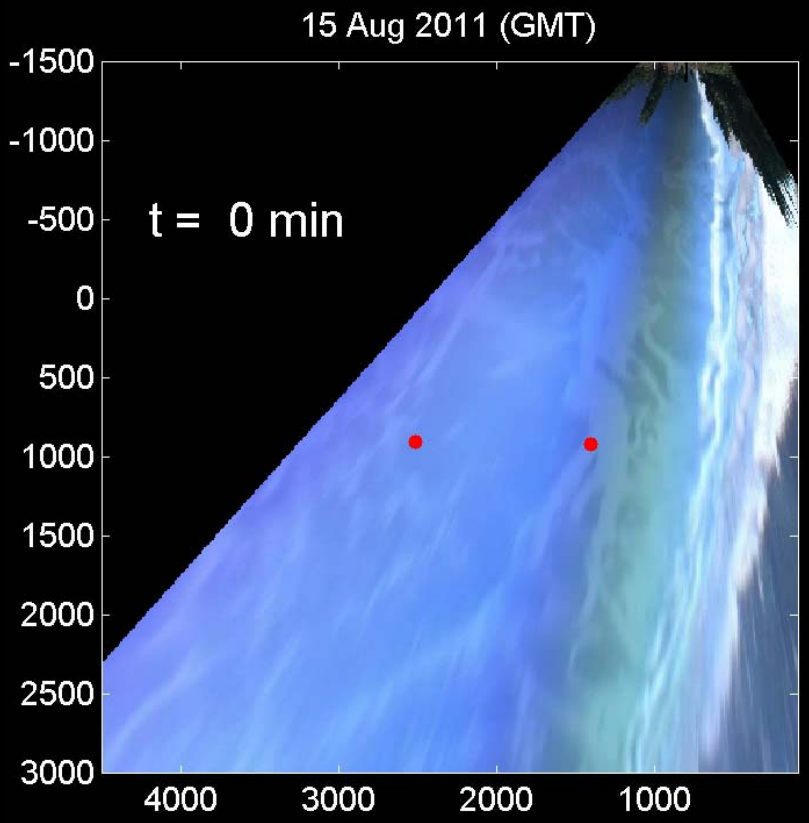


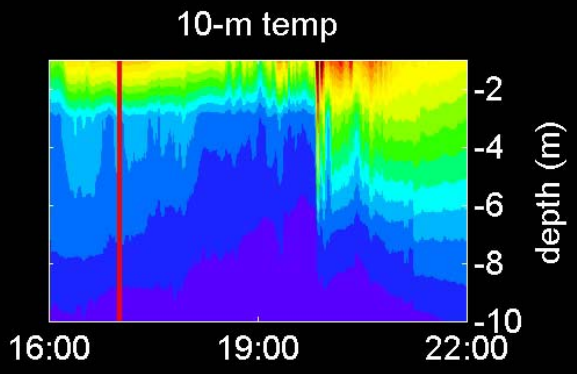


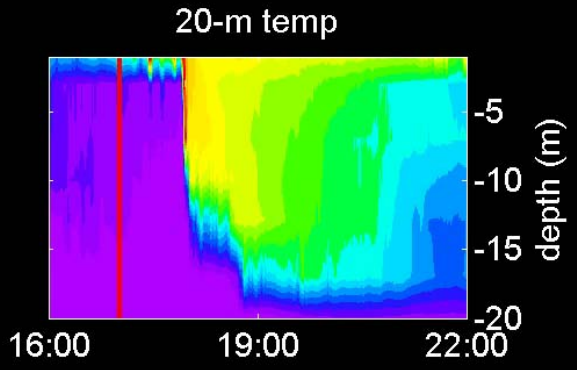
- August, 2011
- 20 and 10-m moorings
- 5 s sampling

Combined picture

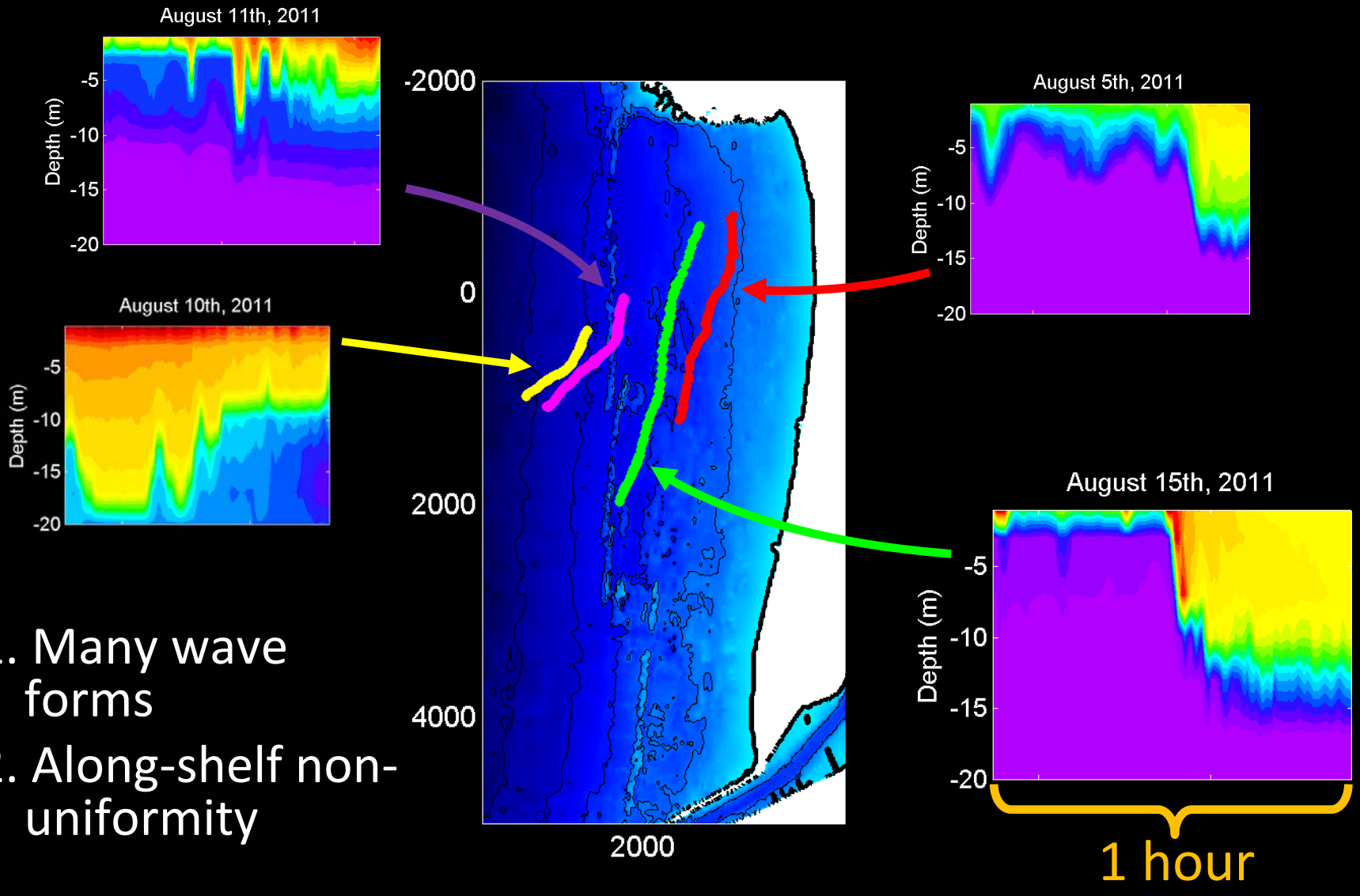
- Identify fronts in image sequences
- Wave propagates through both moorings





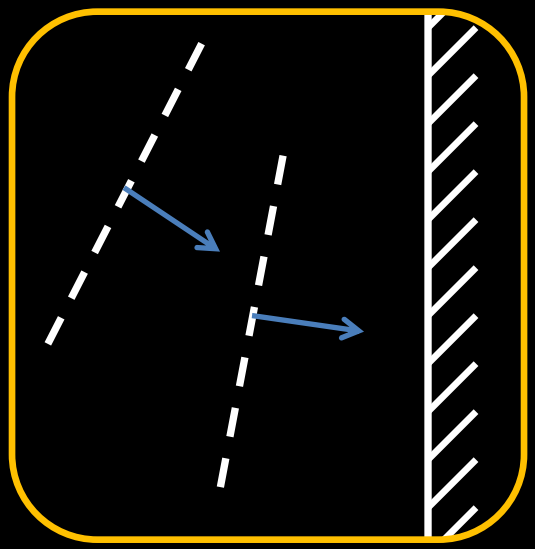


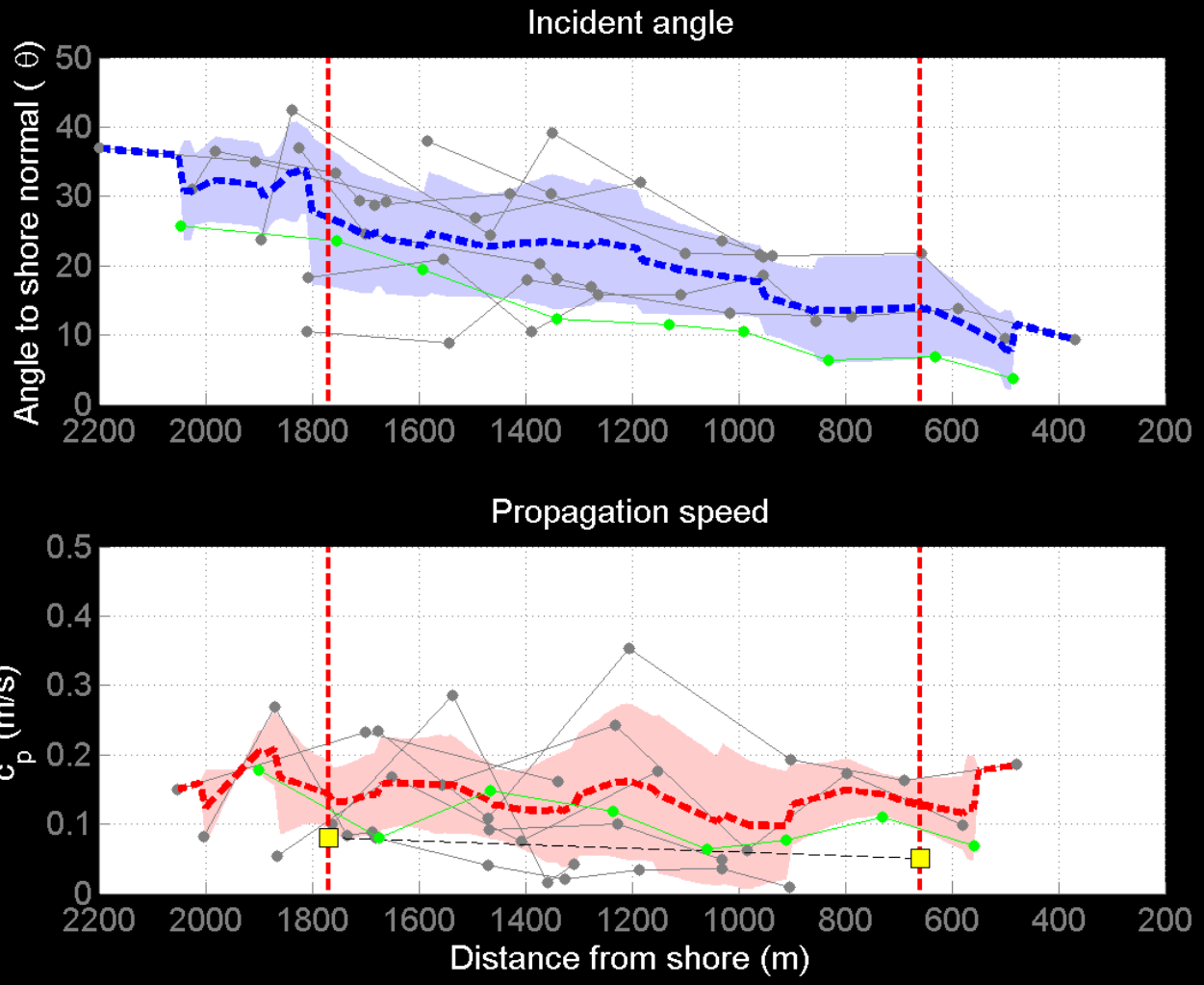
Science perspective: 3D views of IWs



1. Many wave forms
2. Along-shelf non-uniformity

Science perspective: Streak propagation

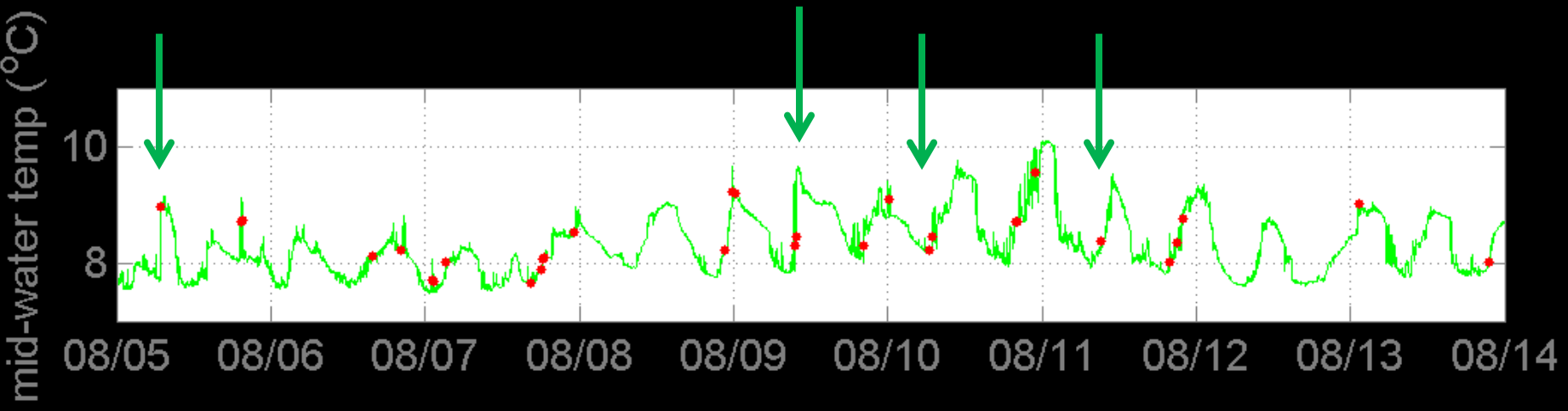




3. Refraction
4. Waves are faster than linear speeds

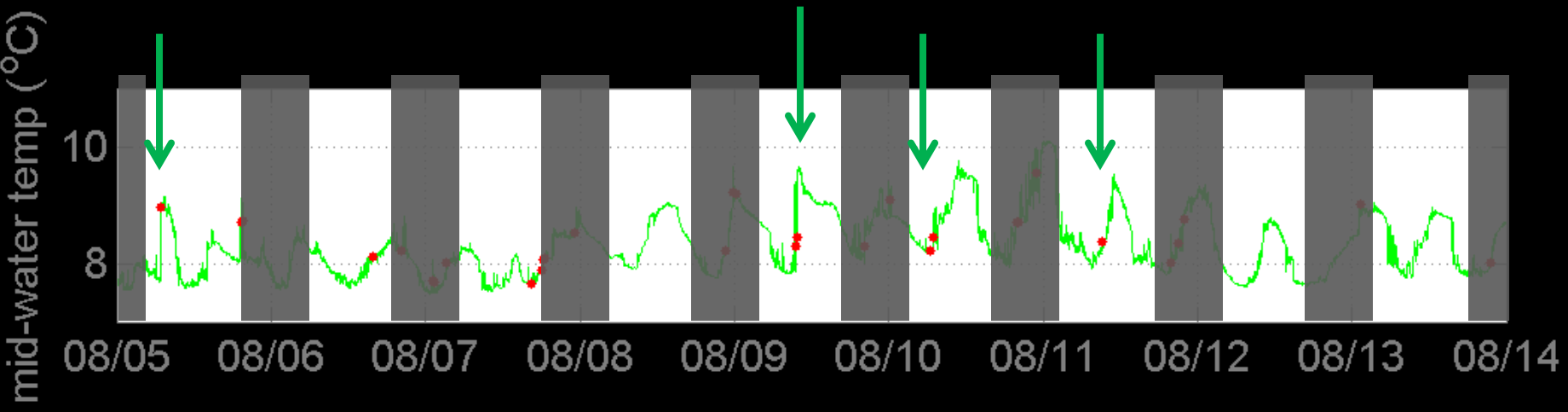
Properties help differentiate streaks

Potential for monitoring



- Many other observed waves

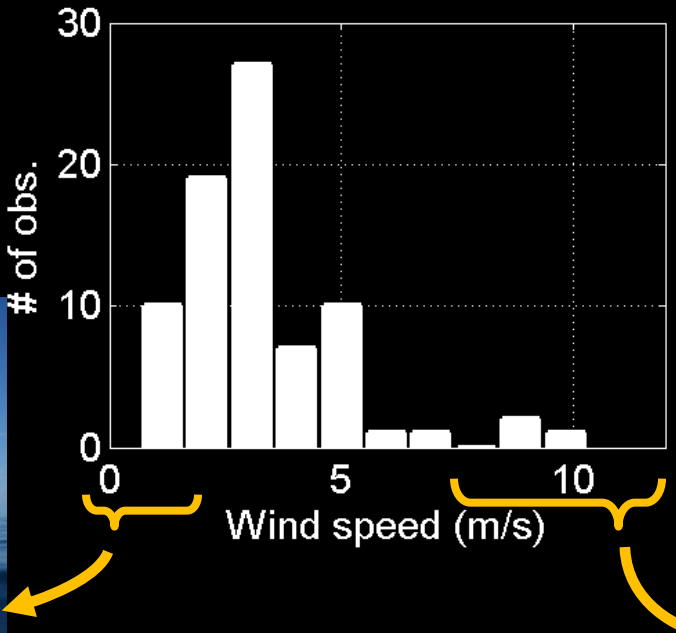
Potential for monitoring

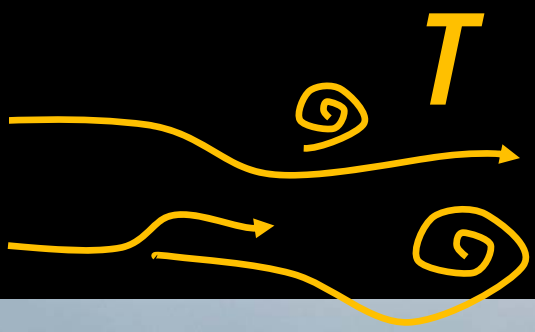


- Many other observed waves
- Cannot see through darkness or fog
- Extend observation period:

  in-situ (4 weeks) ⟶ camera (14 weeks)

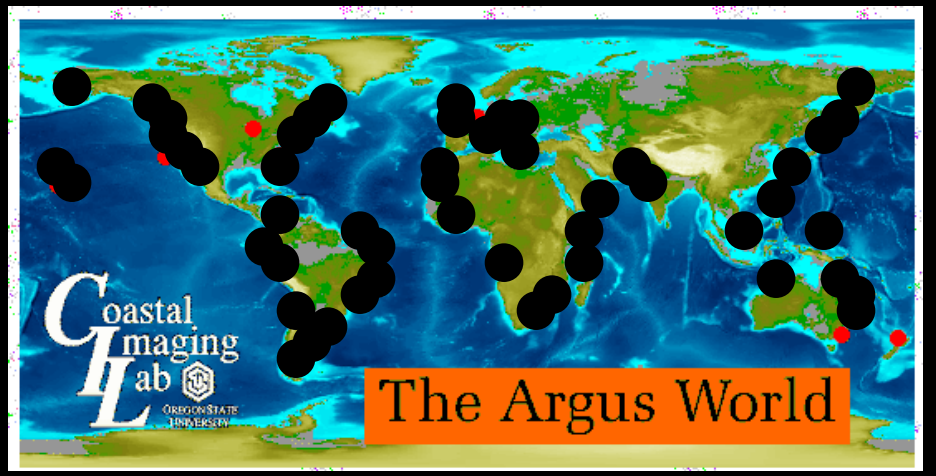
Sea state determines success remote sensing





Wind speed is also important!

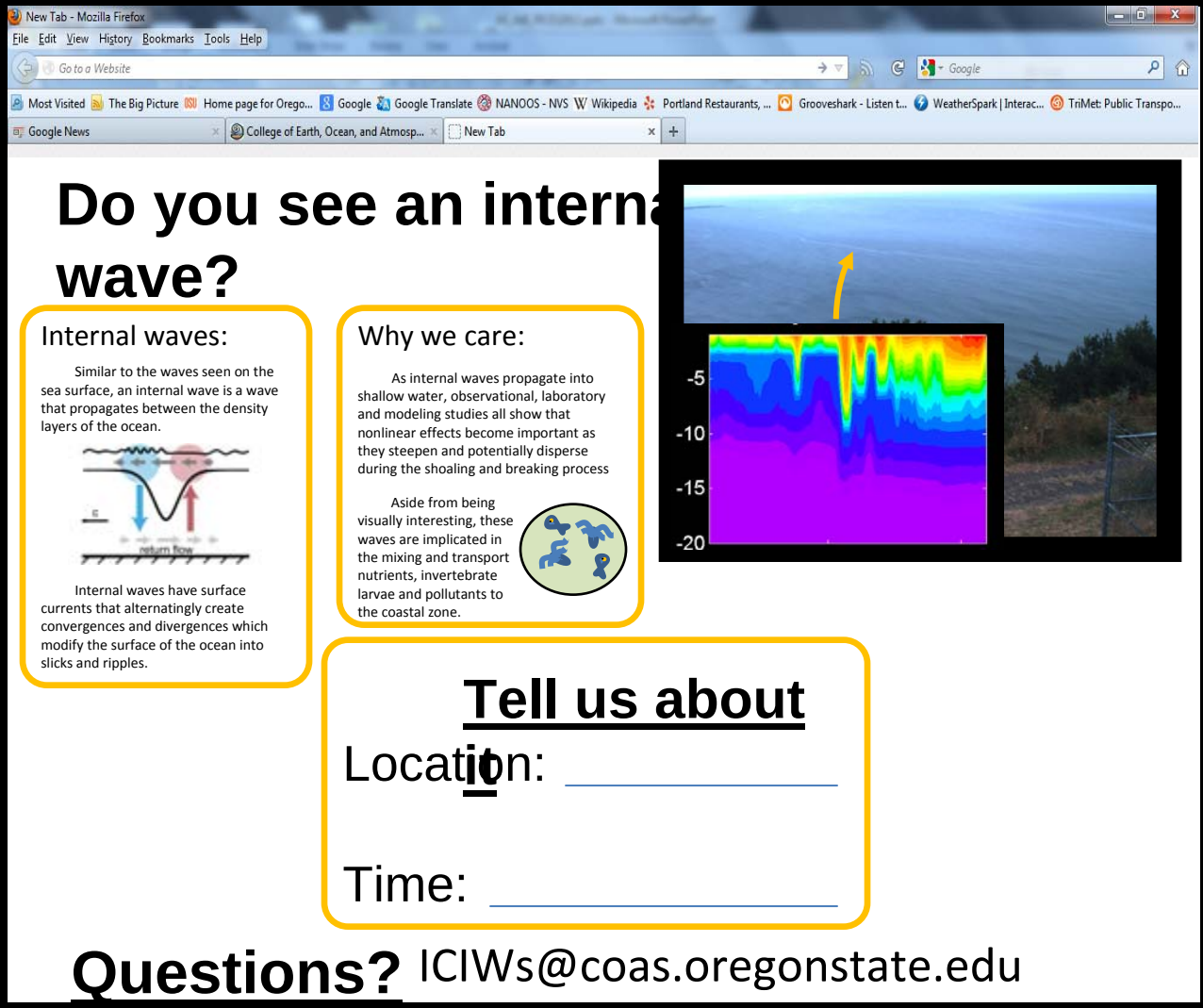
Toward the use of webcams

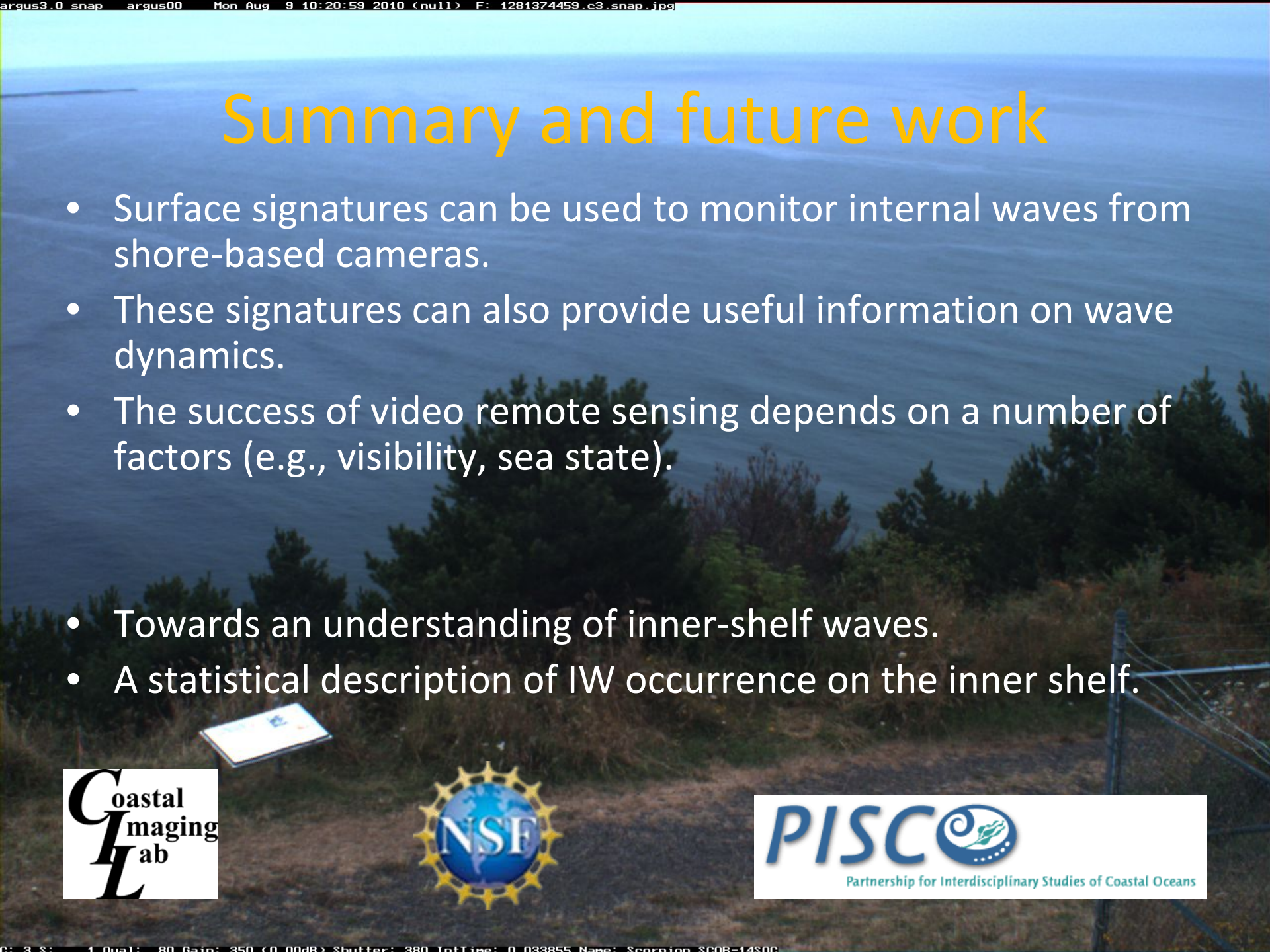


- Collaboration with others
- Short in-situ deployments decipher types of waves
- Add data acquisition systems

Toward the use of webcams

…or cloud sourcing!





Summary and future work

- Surface signatures can be used to monitor internal waves from shore-based cameras.
- These signatures can also provide useful information on wave dynamics.
- The success of video remote sensing depends on a number of factors (e.g., visibility, sea state).

- Towards an understanding of inner-shelf waves.
- A statistical description of IW occurrence on the inner shelf.

Coastal Imaging Lab

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Partnership for Interdisciplinary Studies of Coastal Oceans