The internal waves – an overlooked acoustic signal in PIES

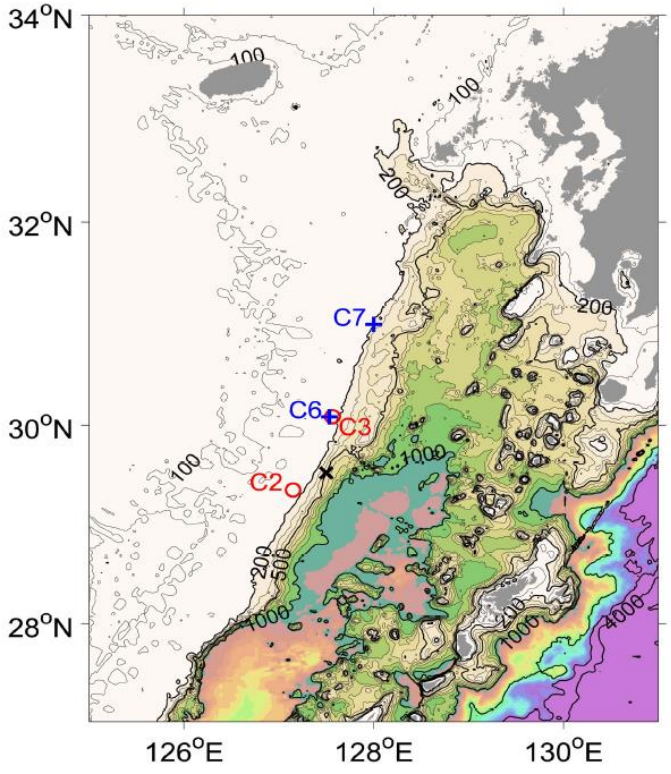
April 10, 2015
Symposium in Honor of Prof. D. R. Watts

Jae-Hun Park
Korea Institute of Ocean Science and Technology

My history with internal waves

- Master thesis work at Seoul National University in 1997

: Observation of semidiurnal internal tides and near-inertial waves at the shelf break of the East China Sea



- Had chances to meet with Randy (3 times in Fukuoka, Kyoto, and Hiroshima) and Mark (1 time on Kakuyo-maru) during my PhD work in Japan

My history with internal waves

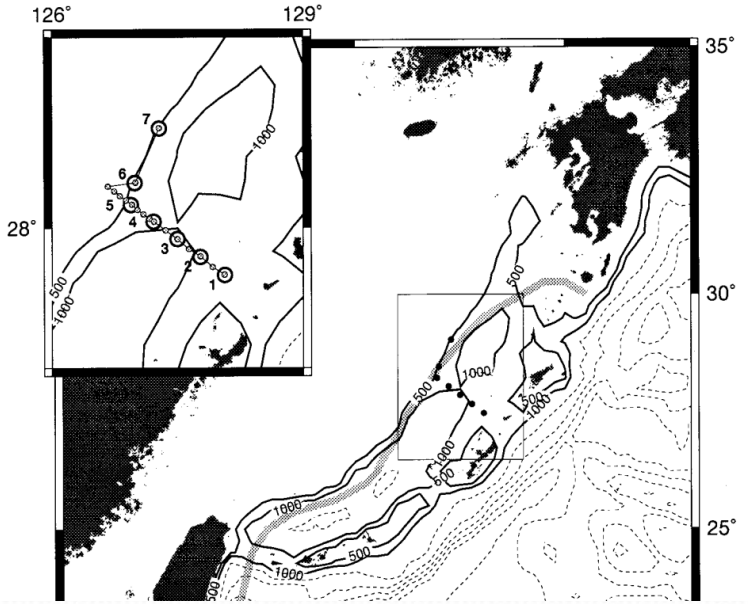
Kuroshio Meanders in the East China Sea

CHARLES JAMES* AND MARK WIMBUSH

Graduate School of Oceanography, University of Rhode Island, Narragansett, Rhode Island

HIROSHI ICHIKAWA

Faculty of Fisheries, Kagoshima University, Kagoshima, Japan



- I made a first try to look at the internal tide signal in PIES acoustic measurements when I started working at JAMSTEC in 2000, but in vain.

My history with internal waves

- Then, I made another try to look at the internal tide signal in PIES acoustic measurements from Hawaiian Ocean Time-series, but in vain again.

JOURNAL OF GEOPHYSICAL RESEARCH, VOL. 105, NO. C12, PAGES 28,653–28,661, DECEMBER 15, 2000

Coherence of internal tide modulations along the Hawaiian Ridge

Gary T. Mitchum
Department of Marine Science, University of South Florida, St. Petersburg, Florida

Stephen M. Chiswell
National Institute of Water and Atmospheric Research, Wellington, New Zealand

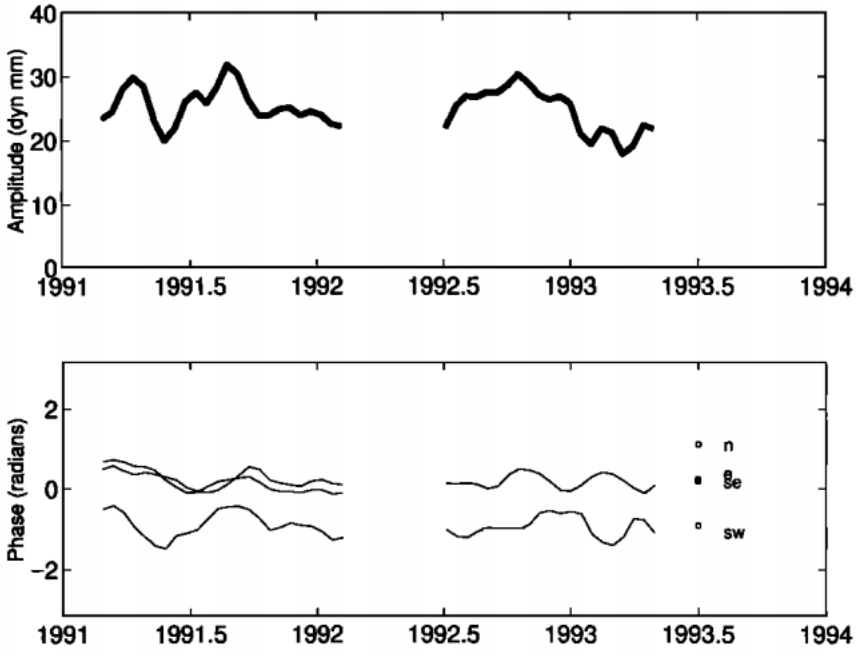


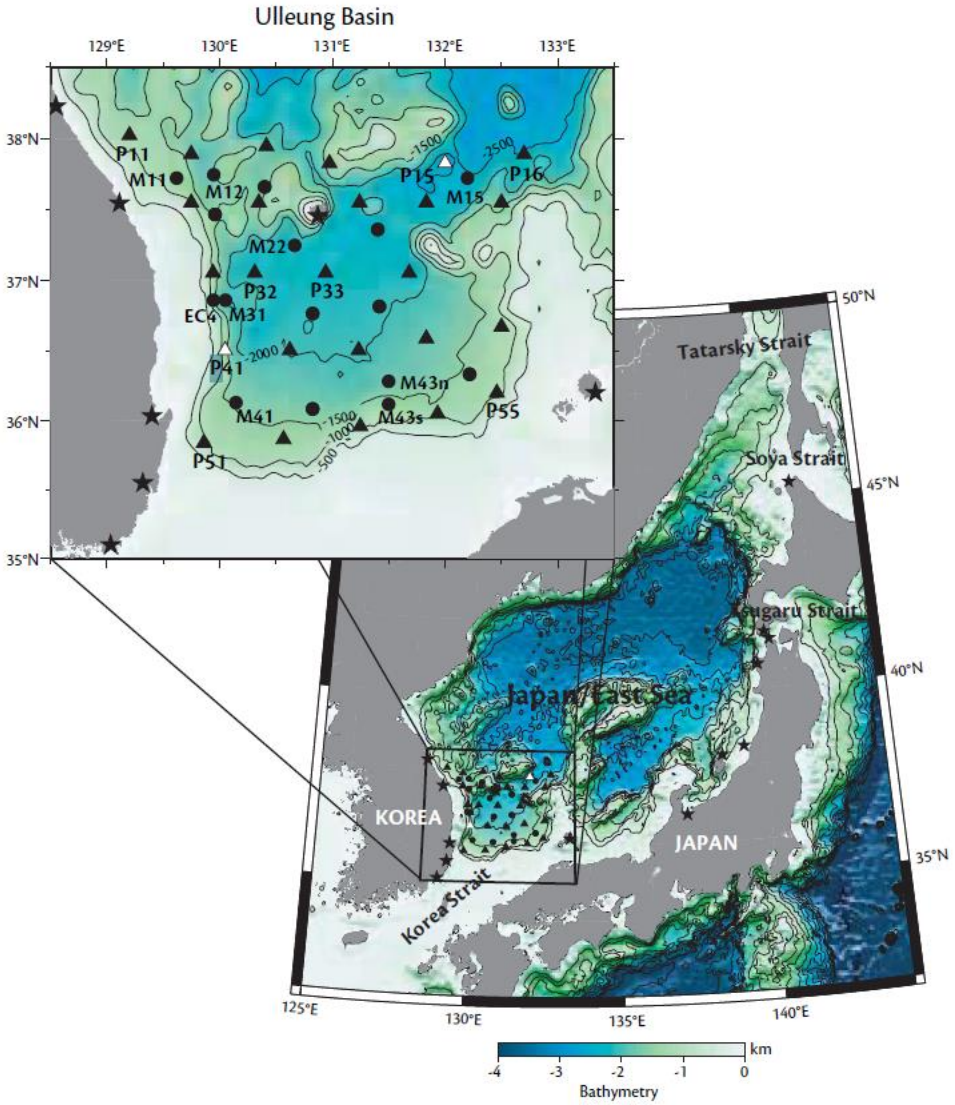
Figure 2. Amplitude and phase of the M_2 internal tide derived from the inverted echo sounders (IES). The amplitude shown is the average amplitude from moorings sw and se.

My history with internal waves

- Then, I forgot about internal waves for a while …

- Joined Watts and Wimbush group in 2002 as a post-doc

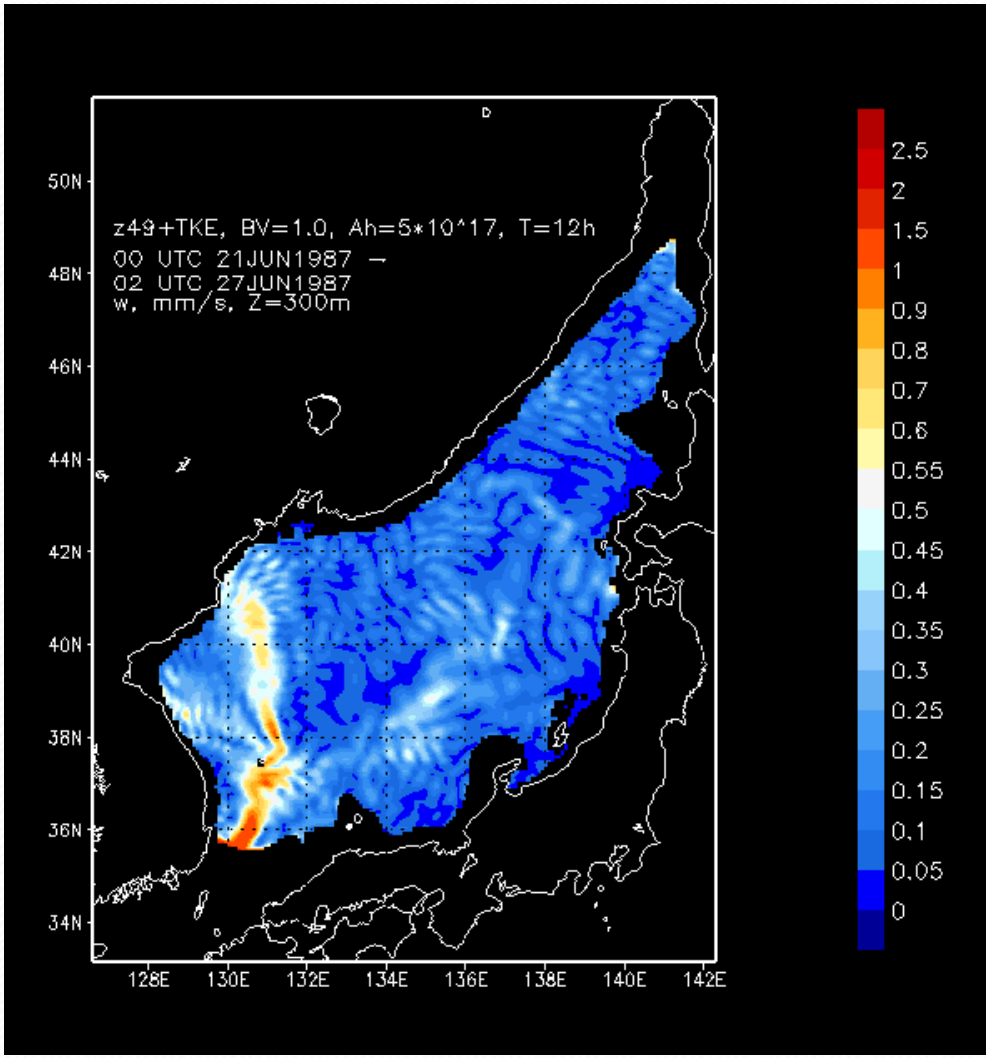
- Firstly worked on PIES data collected from the Japan/East Sea

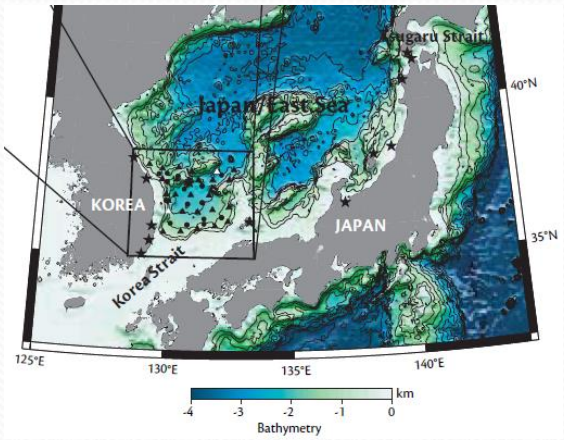


My history with internal waves

- Randy and I attended IUGG 2003 meeting held in Sapporo, Japan

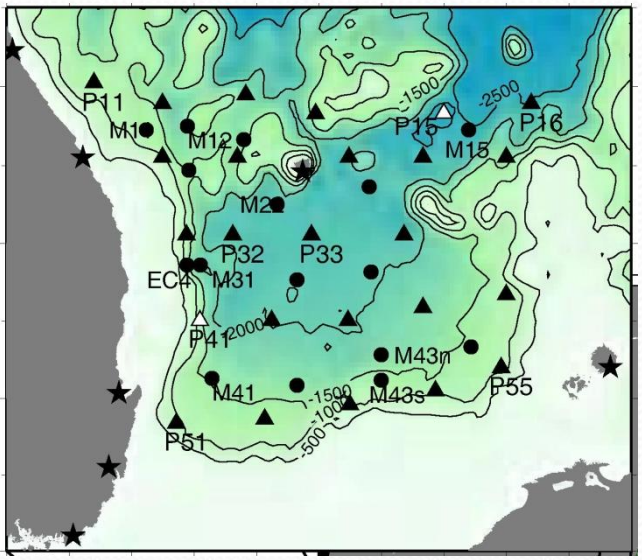
- We saw a talking showing internal tide features in the Japan/East Sea from numerical simulations





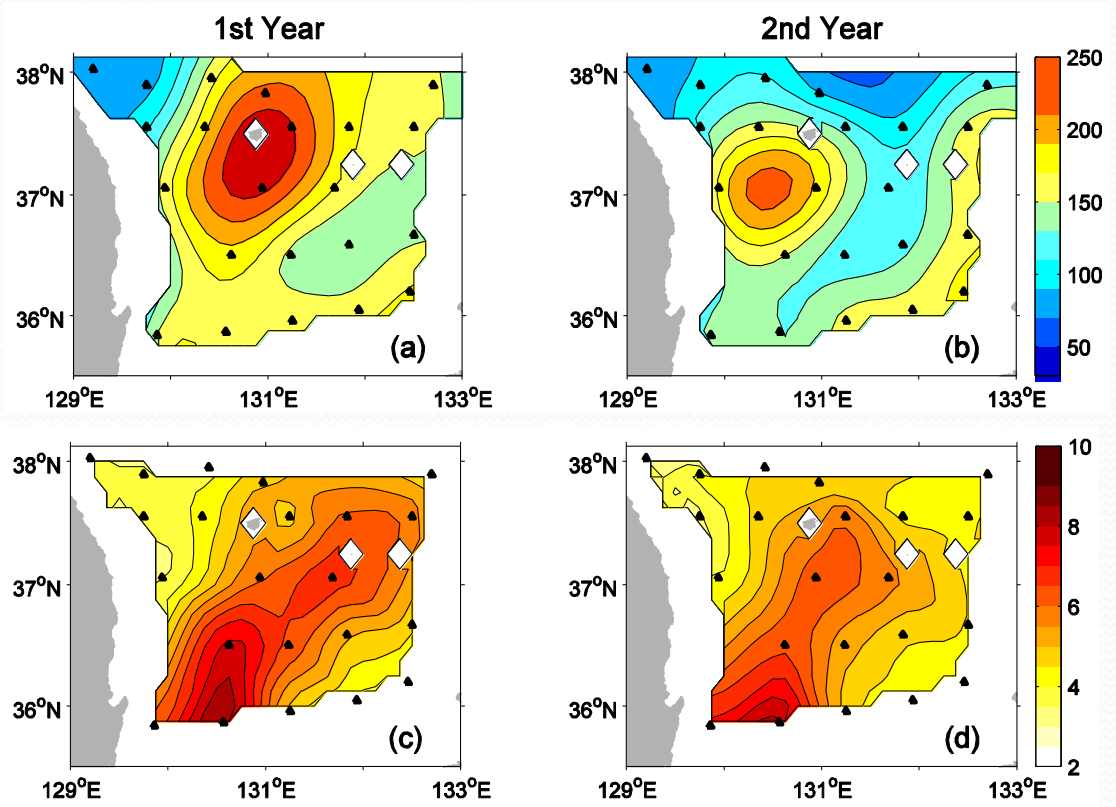
From Varlamov, S. M. & J.-H. Yoon (IUGG 2003, IAPSO)

My history with internal waves



PIES

Current mooring



Z_5

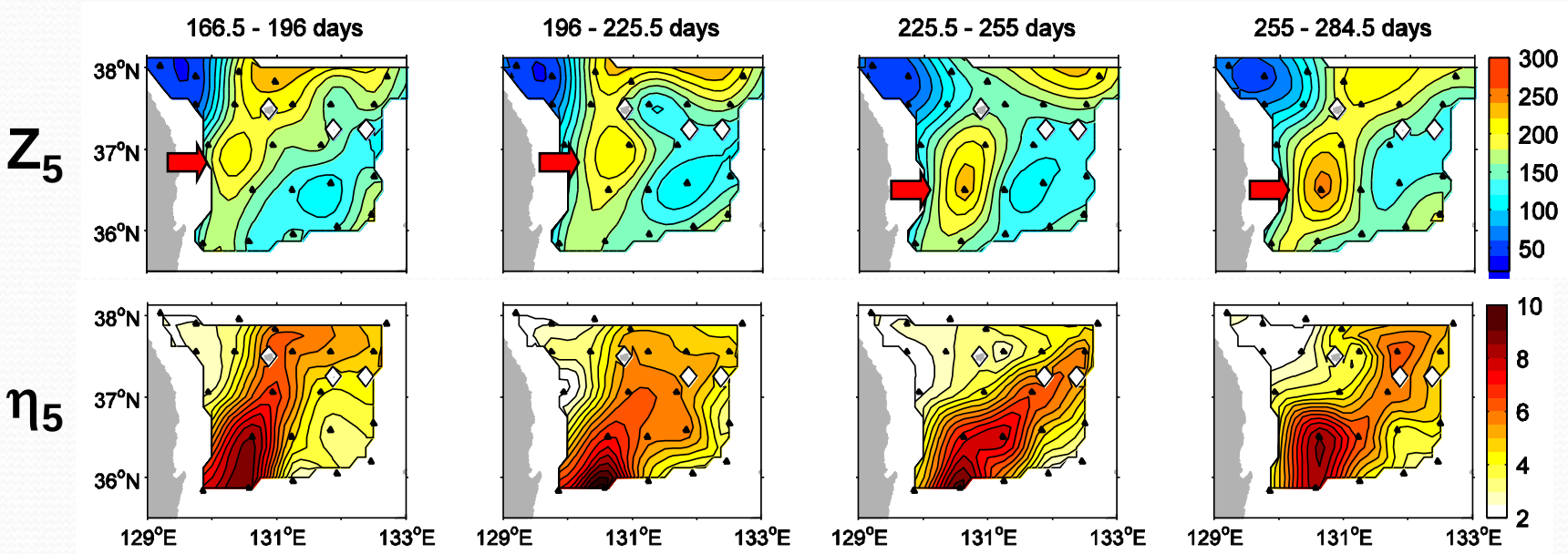
η_5

Park and Watts (2006)

My history with internal waves

Lunar monthly mean (29.5d)

Case I : Beam refracts eastward as warm eddy develops



Park and Watts (2006)

Internal wave study using PIES has provided me good opportunities to get fundings under the nice guidance of Randy

- Internal Tides and Inertial Oscillations: Analysis of Observations in the Gulf Stream South of New England, NSF

- Collaborative Research: Oceanic response to atmospheric forcing in the Kuroshio Extension, NSF

- Internal Waves in Straits (IWISE): Observations of Wave Generation, ONR

- Flow Encountering Abrupt Tomography (FLEAT), ONR (2015-2019)

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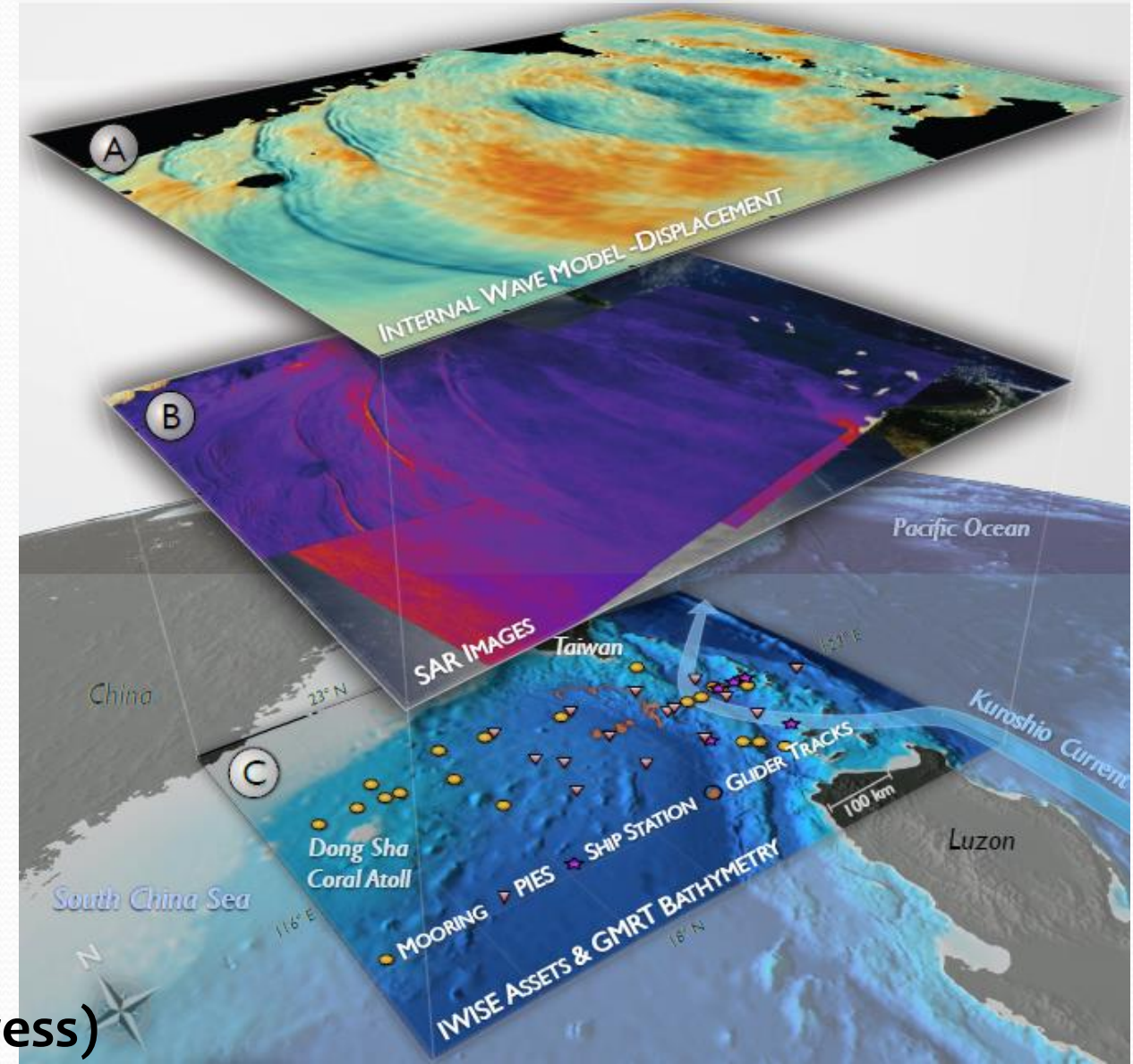
My most recent internal wave story

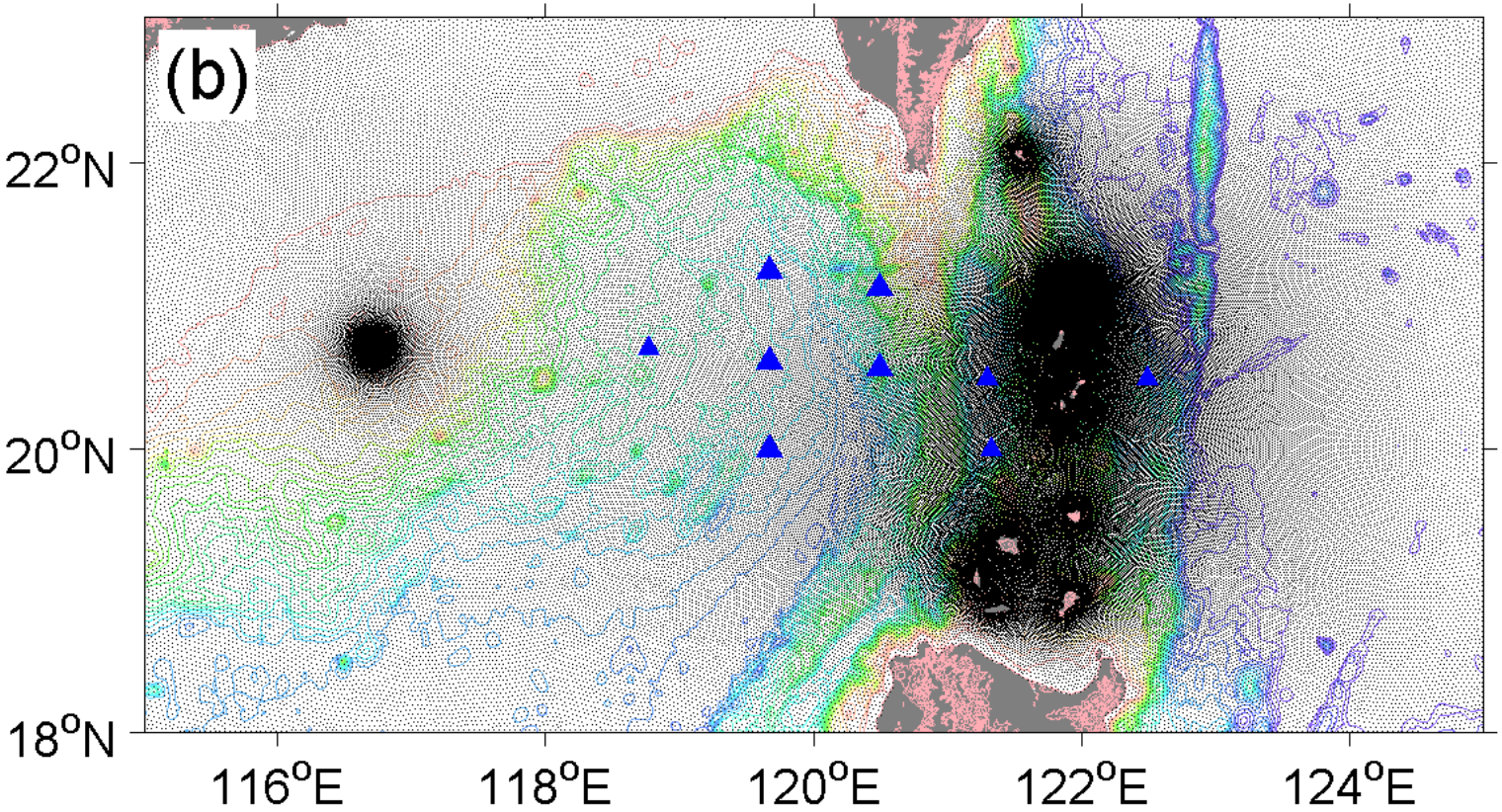
South China Sea



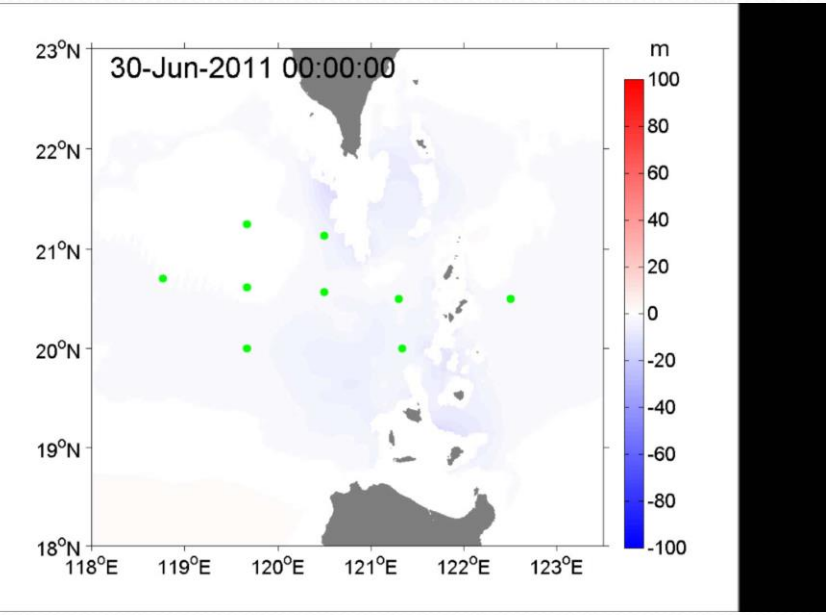
Alford et al. (2015, in press)

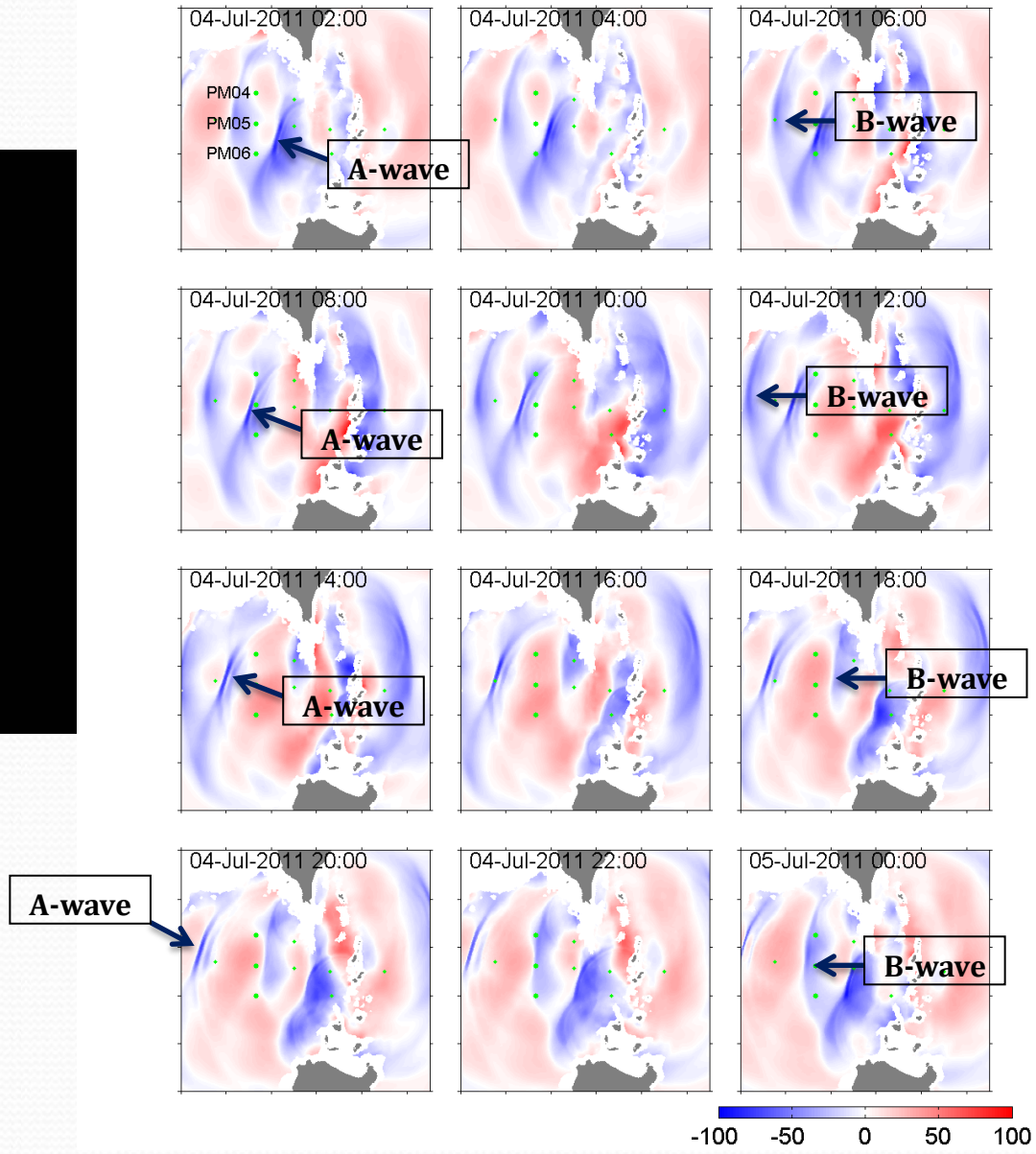
My most recent internal wave story

Numerical simulation for nonlinear internal waves using SUNTANS (non-hydrostatic)



My most recent internal wave story





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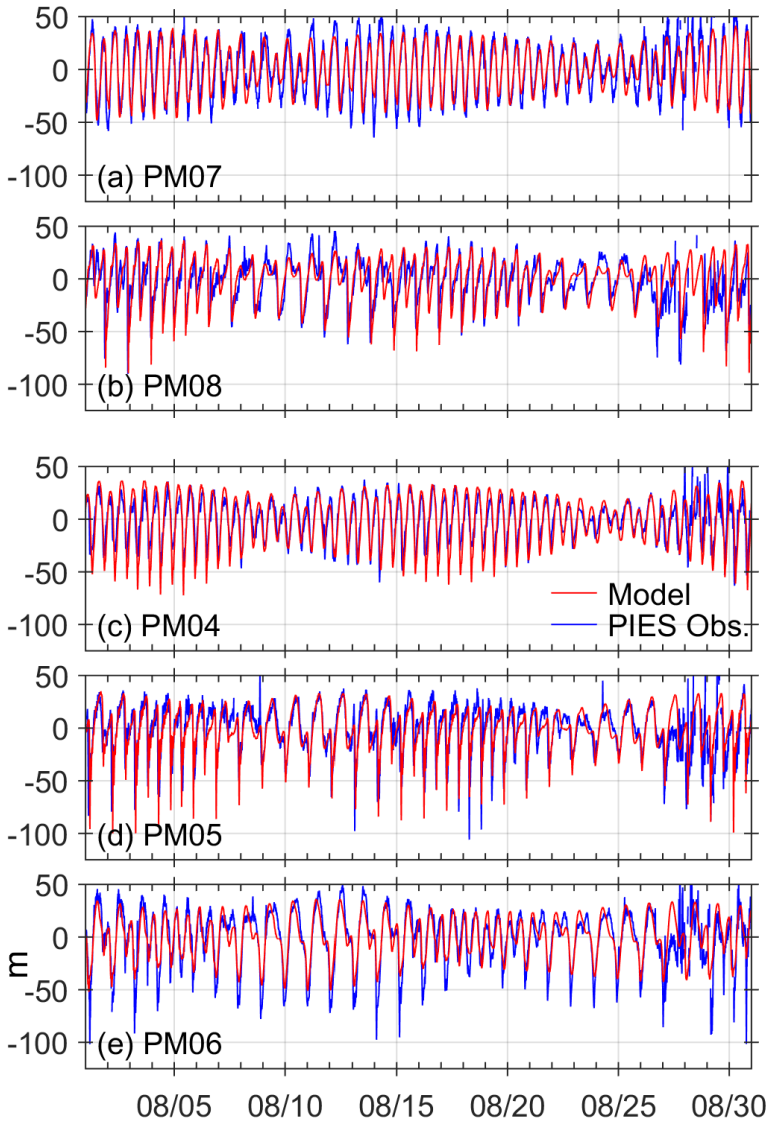

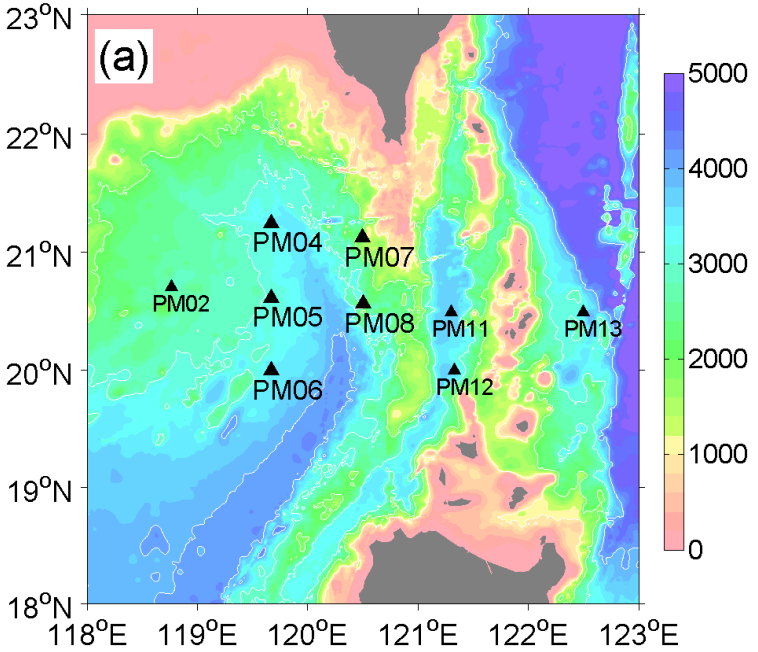

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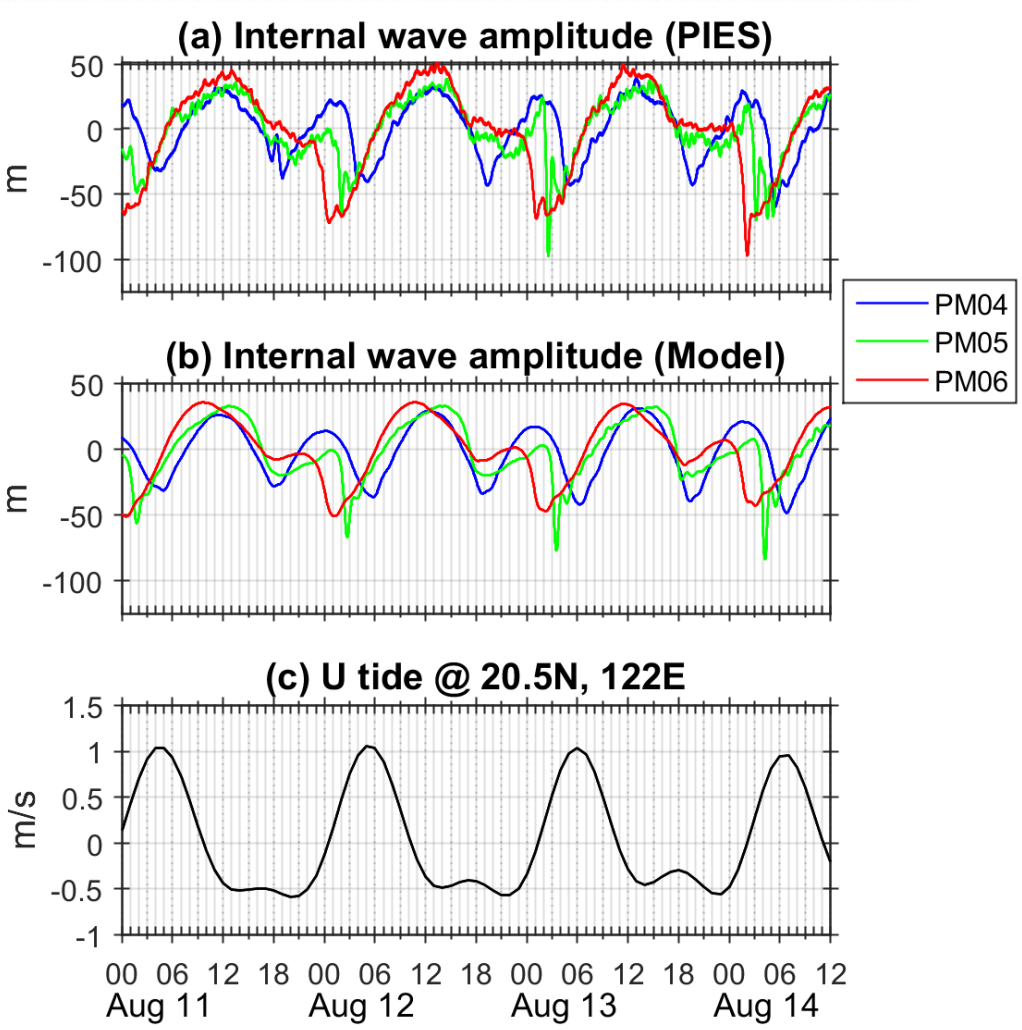
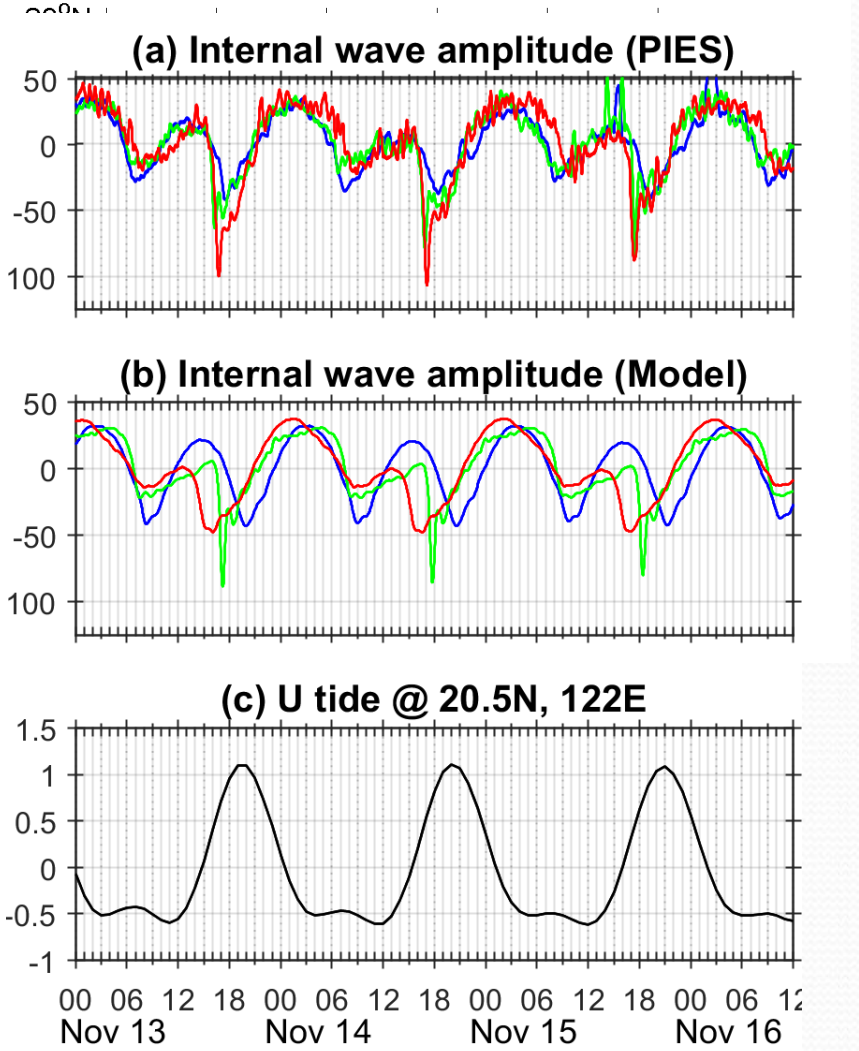
My most recent internal wave story





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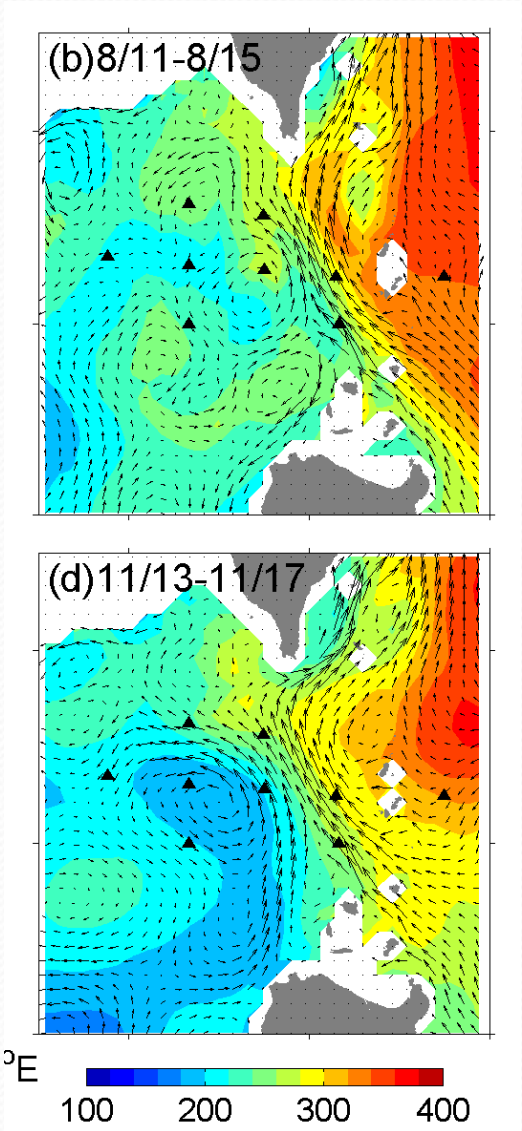

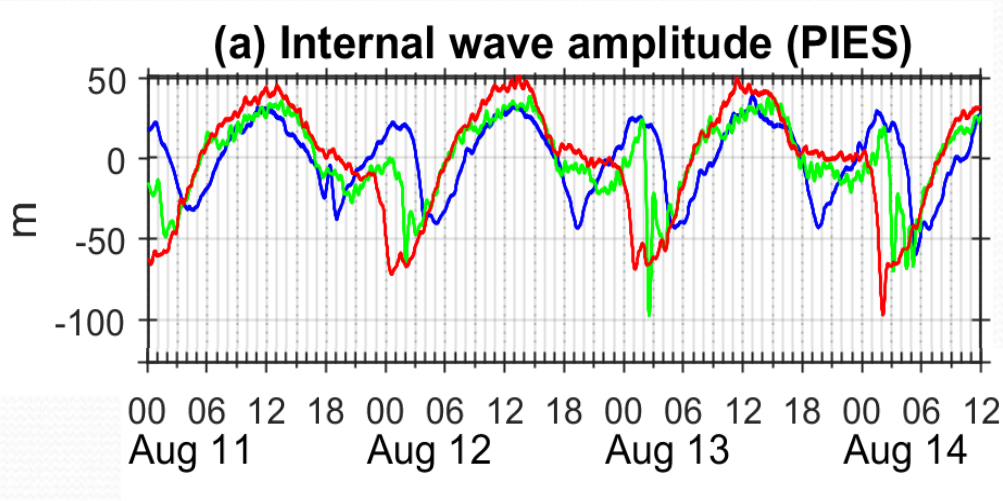

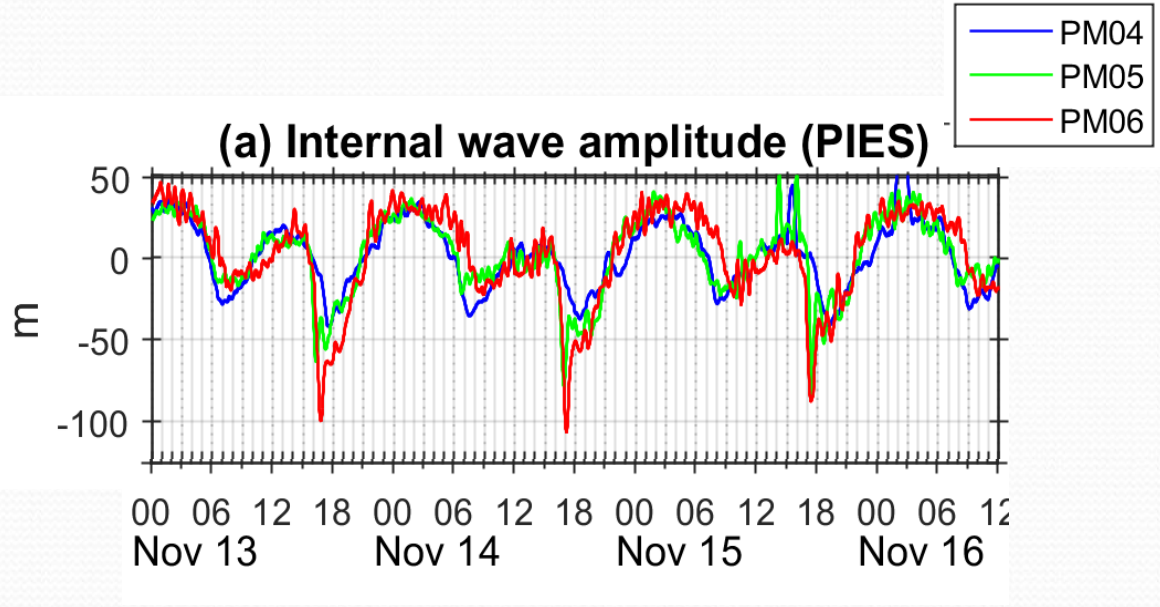

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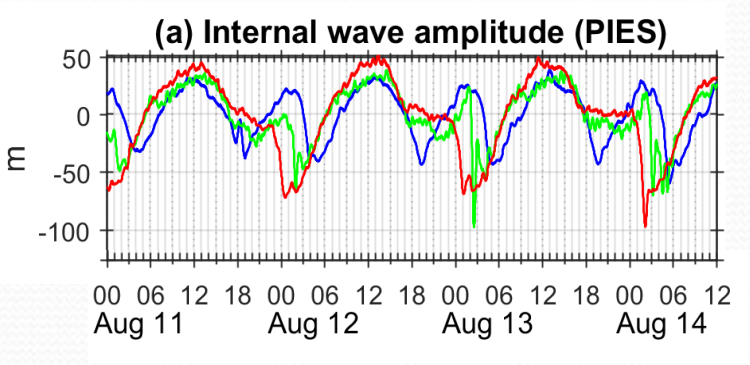
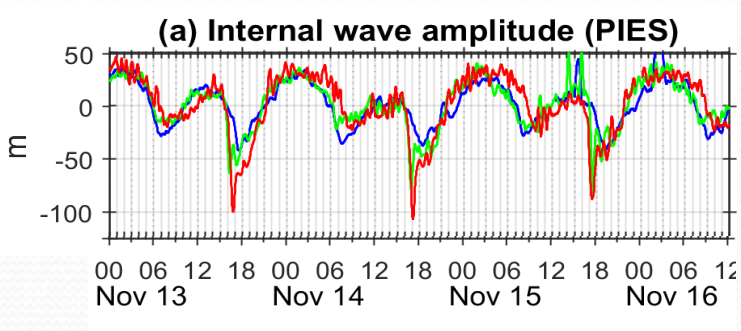
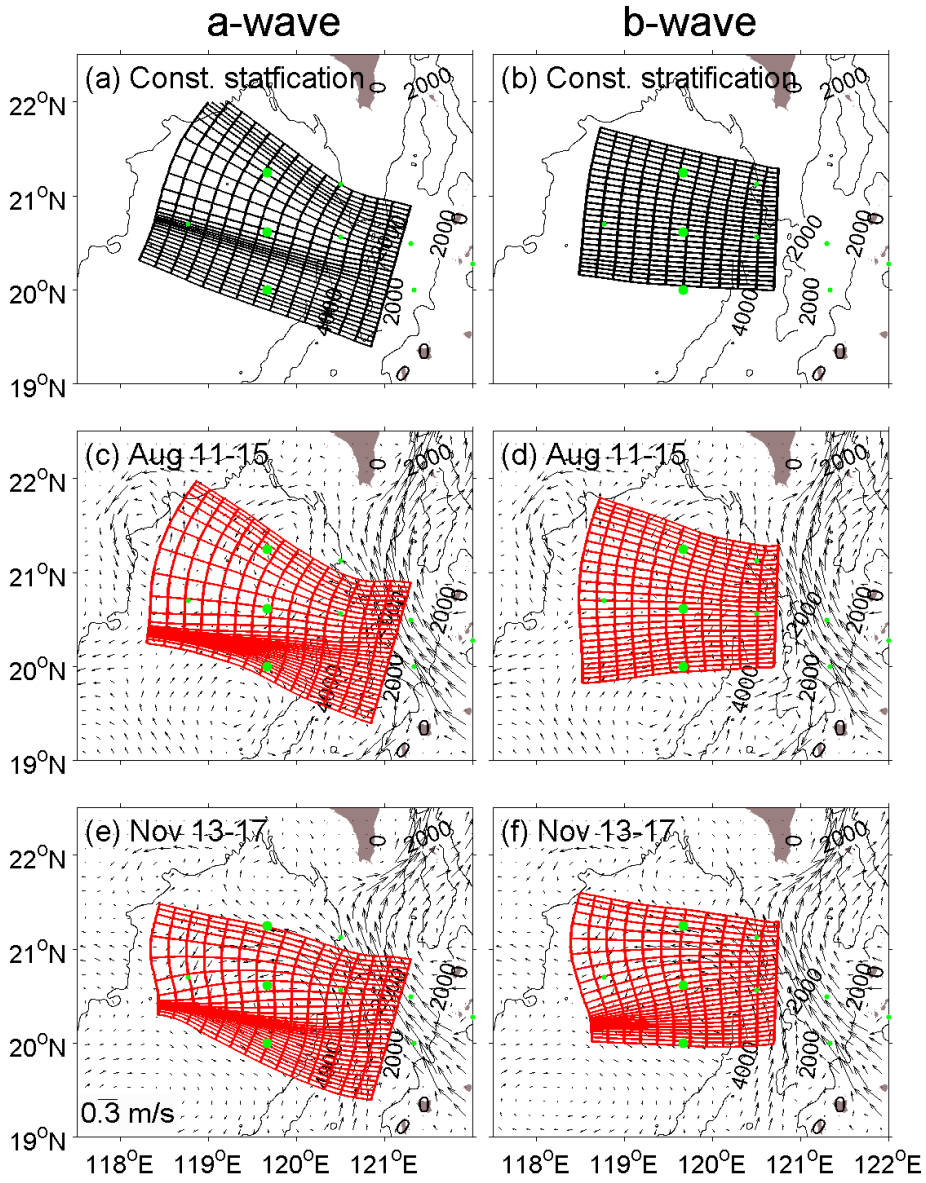






Conclusion

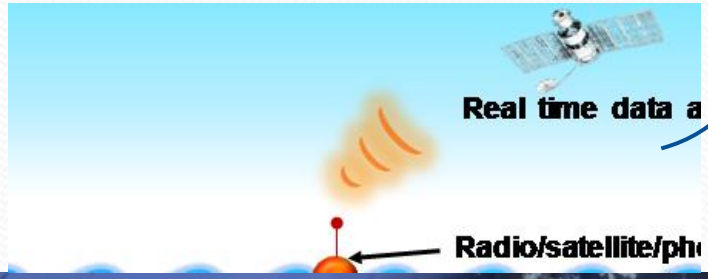
- Detecting the internal wave – an overlooked acoustic signal – using PIES was a sort of 'niche market' at first. But, later to me it became a sort of 'mass market'.

- There can be other signals we might have missed though they have been there from the first …

Who knows?

A new business in Hawaii?

A new business model for Randy: Wave-PIES (this is for the surface waves)



1) Acoustic telemetry
2) Pop-up buoy
3) A new technology

Thanks