

Global Internal Tides from Multi-Satellite Altimetry

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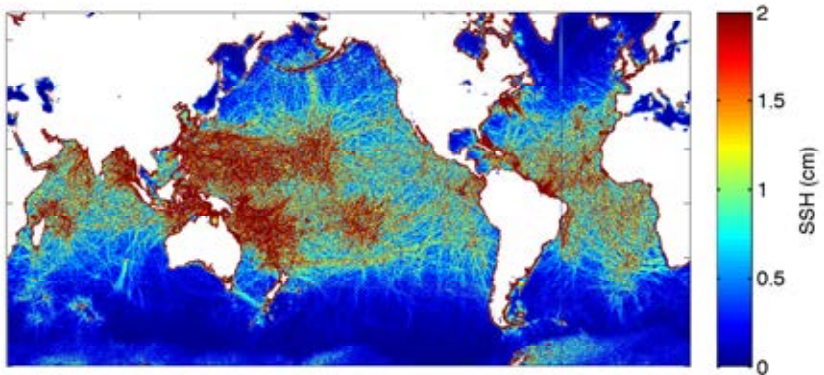
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OSTST meeting 2014

Outline

- 1 **Motivation and challenge**
- 2 **Method and results**
- 3 **Comparisons with models and moorings**
- 4 **Summary**

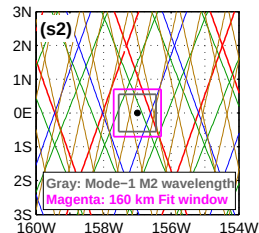
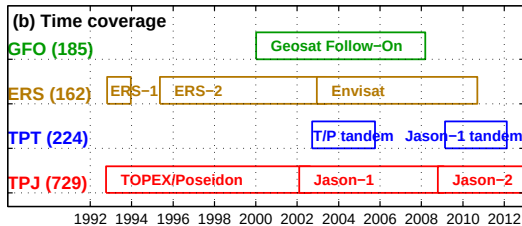
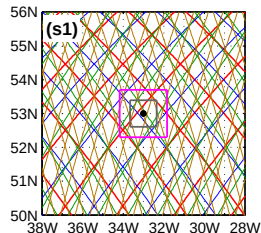
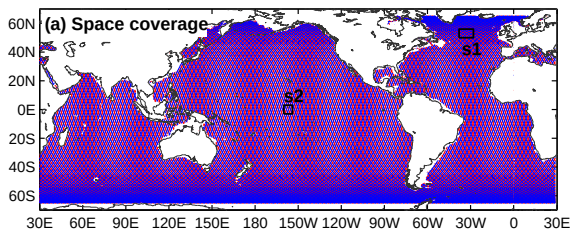
MITgcm Simulated M_2 Internal Tides ($1/48^\circ$)



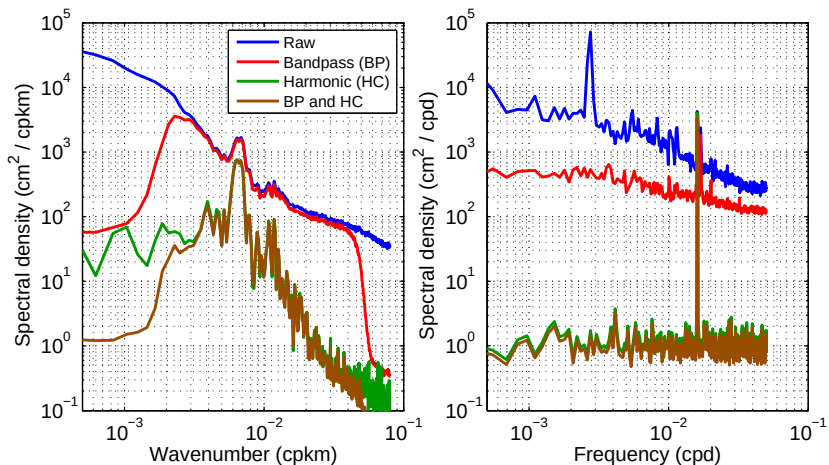
1. Small scale; 2. Multiple waves; 3. Incoherence.

(Data courtesy of D. Menemenlis, C. Uebmann, and L.-L. Fu)

Multiple Satellite Altimeter Data

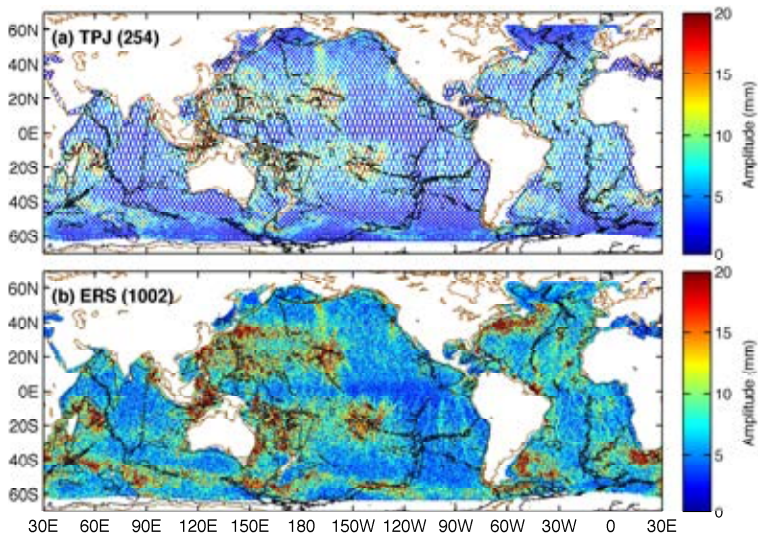


Wavenumber and Frequency Spectra

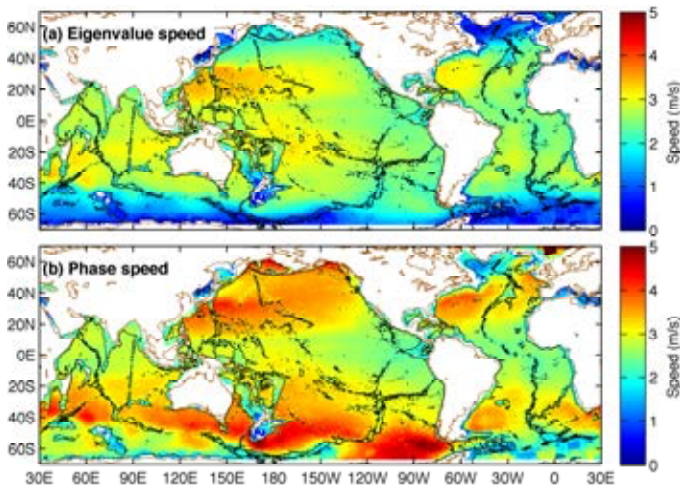


TPJ track #249: 1. BP [20 500] km; 2. HC M_2 (62.1 days)

Along-Track M_2 Internal Tides

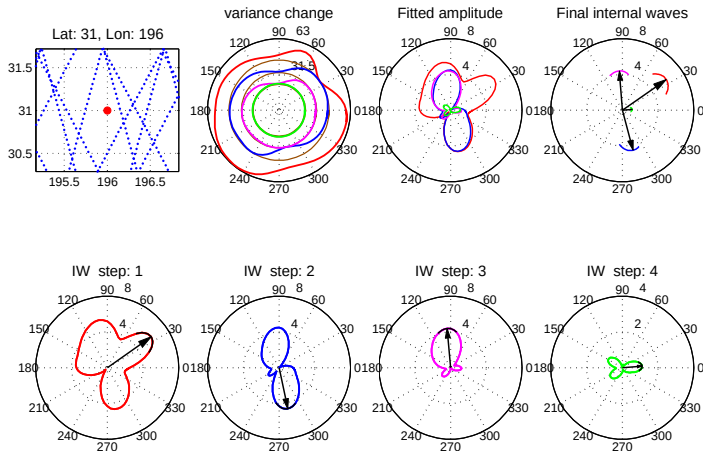


Global Mode-1 M_2 Phase Speed



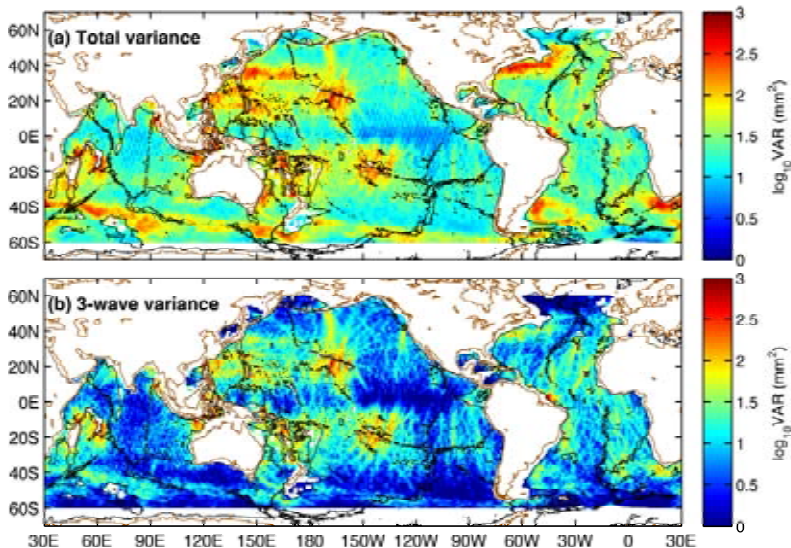
WOA 2005: 1. Stratification profile; 2. Earth's rotation

An Example of Plane-Wave Fit

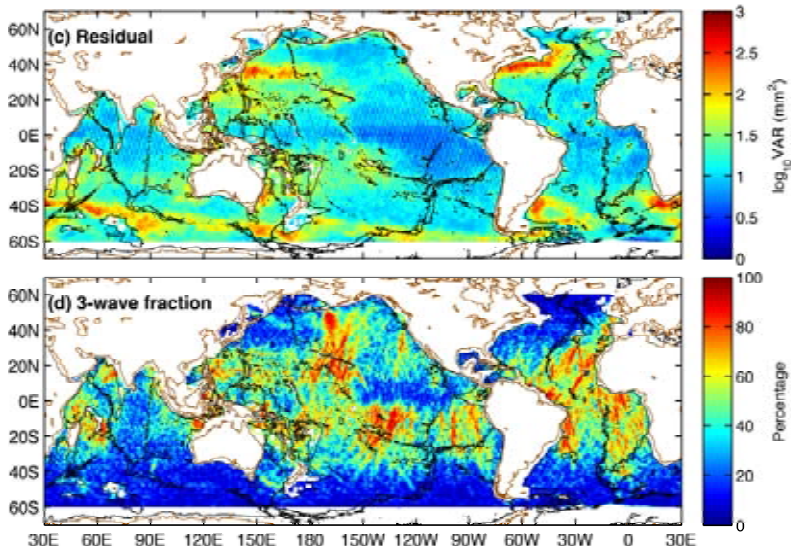


- All tracks in a 160 km window: irregular radar antenna
- Iterative procedure to extract arbitrary number of waves

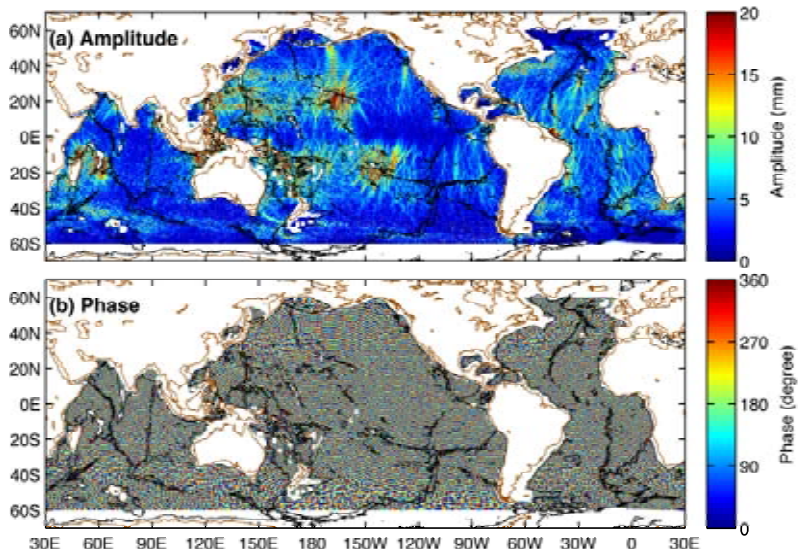
Plane-Wave Fit Variance (I)



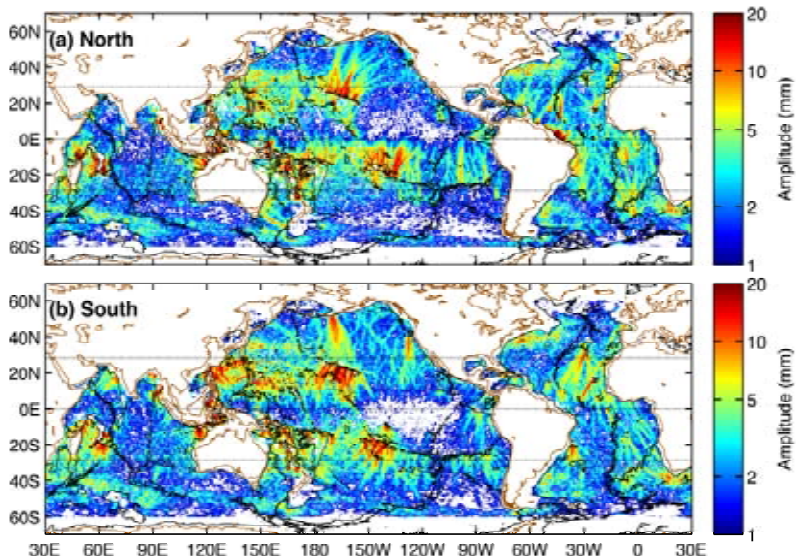
Plane-Wave Fit Variance (II)



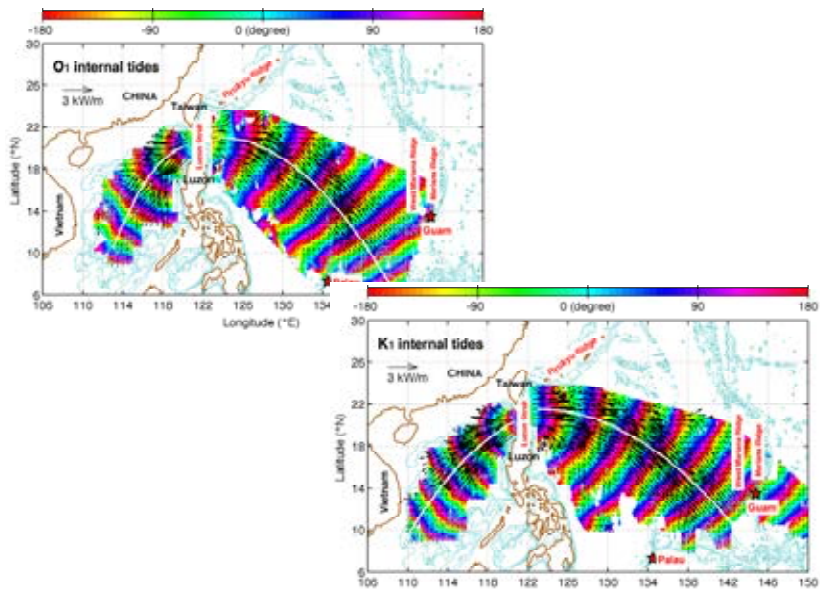
Global Mode-1 M_2 Internal Tides



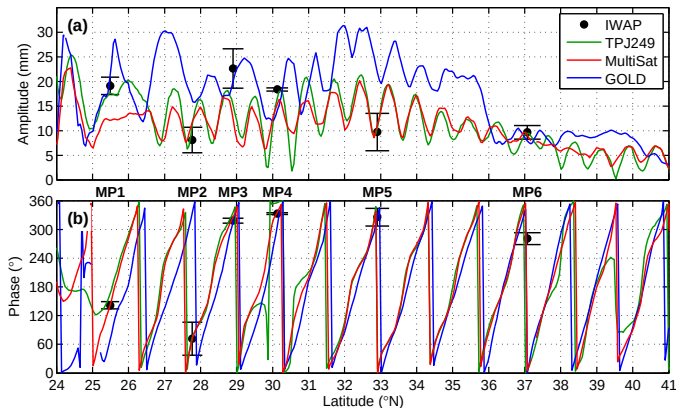
Northbound and Southbound Components



O_1 and K_1 internal tides from the Luzon Strait



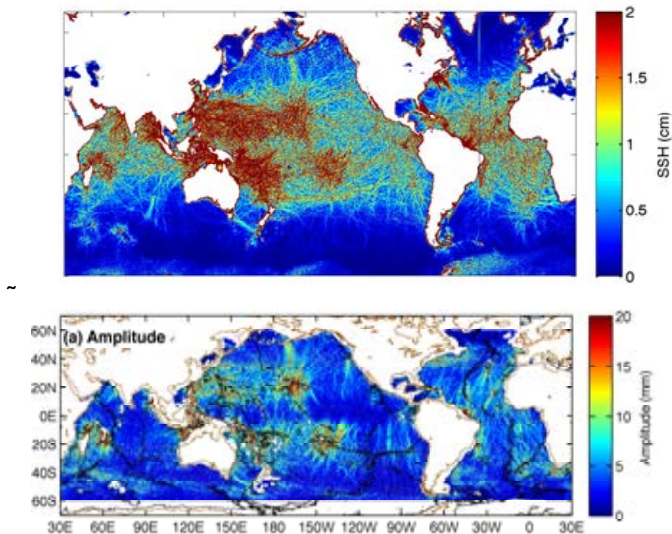
Comparison with IWAP Moorings



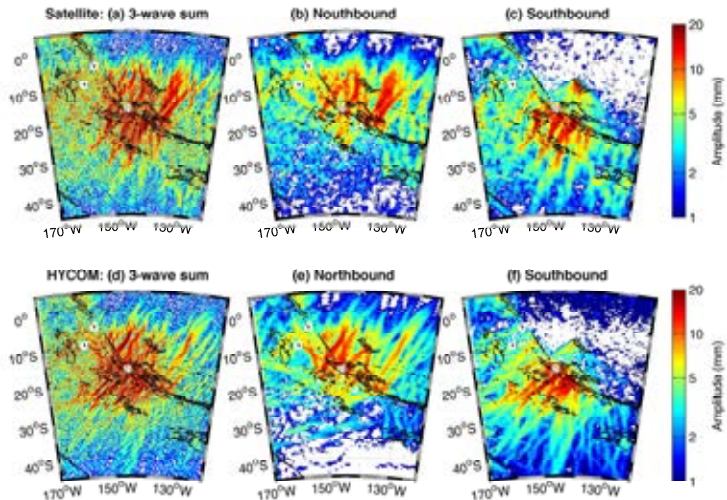
- Six moorings along TPJ #249 [Alford et al. 2007 GRL]
- McLane profilers cover the upper 1500 m.
- Modified to add the MultiSat and GOLD results

(Adapted from Figure 11 in Zhao et al. 2010 JPO)

Altimeter–MITgcm Comparison

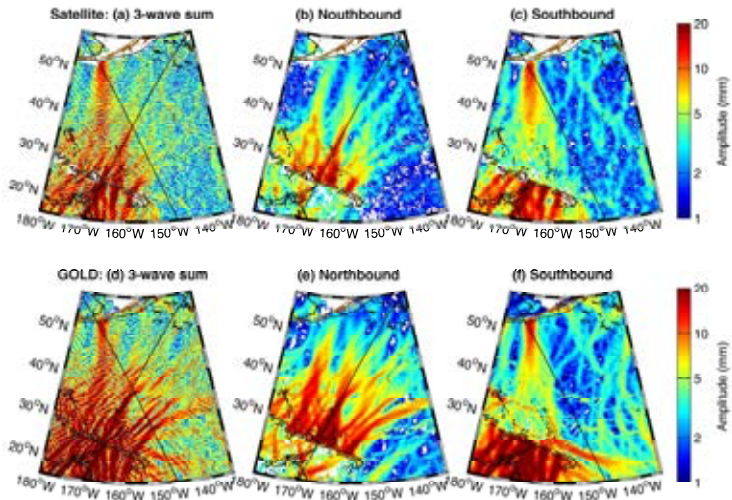


Altimeter–HYCOM Comparison (the Polynesian Islands)



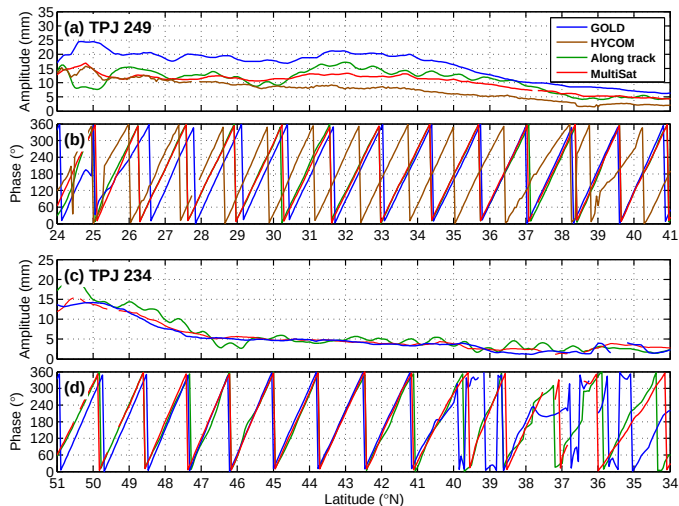
(Data courtesy of B. Arbic, J. Richman, and J. Shriver)

Altimeter–GOLD Comparison in the North Pacific



(Data courtesy of H. Simmons and L. Rainville)

Along-Track Propagation



(a,b) NE beam from Hawaii. (c,d) SE beam from Aleutians.

Summary

Take-home messages

- Global mode-1 M_2 , O_1 and K_1 internal tides
- Uncertainty evaluation (Poster #20 *Girton et al*)
- Positive comparisons with moorings and models

Perspectives

- Refine our method, e.g., bigger window to reduce noise; number of waves; region by region
- Inter-comparison of TPJ, TPT, ERS and GFO (Time length, aliasing period)
- Mode-2/3 component
- Guidance to numerical models