Integrating long-term transport observations from end-point moorings and bottom pressure sensors

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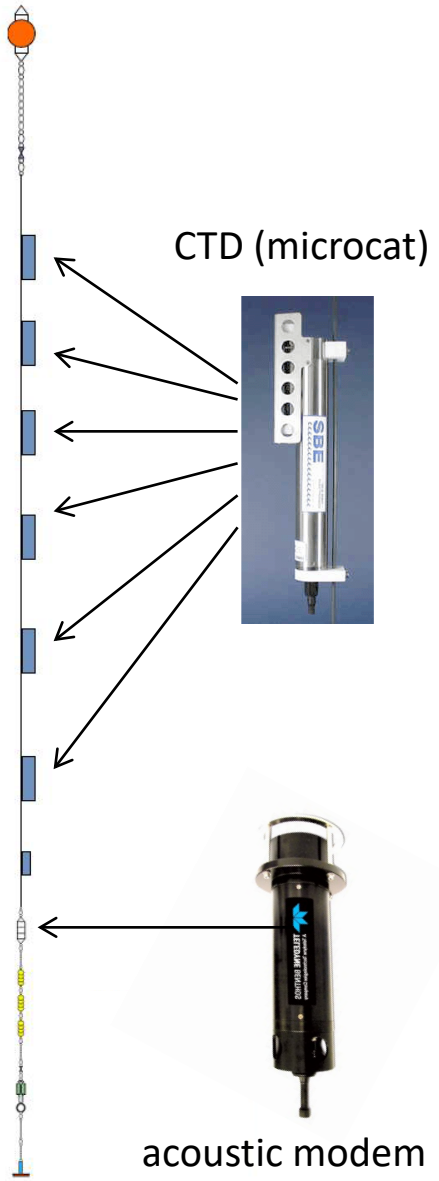
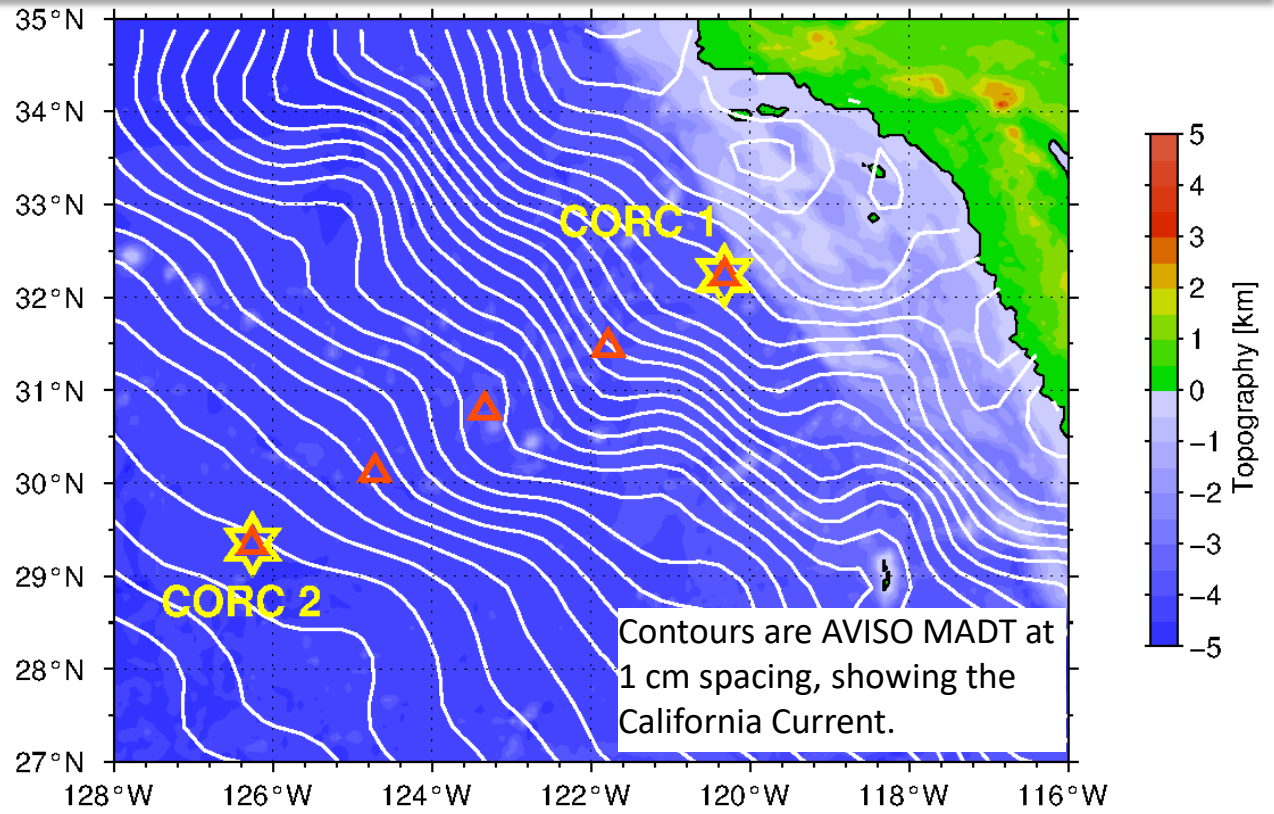
Main points:

- Dynamic height profiles plus bottom-p at two locations gives transport (and SSH)
- Complementarity with altimetry is being used routinely, need more resolution/accuracy
- Up to 17-year long programs, sustained: open-ocean, boundary currents, coastal (potential benchmarks or anchor points for SWOT, accumulated know-how)

California Current (CORC project)

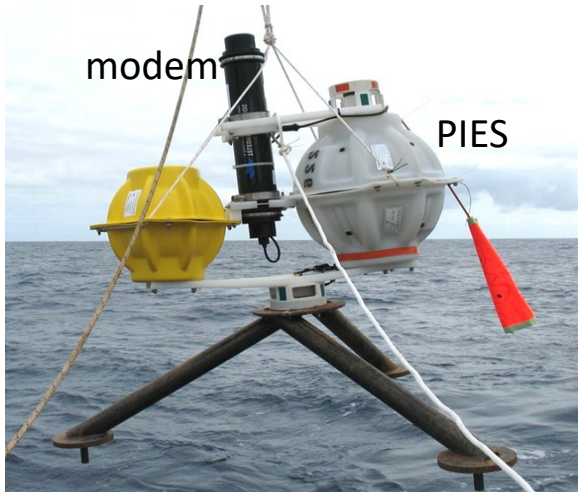




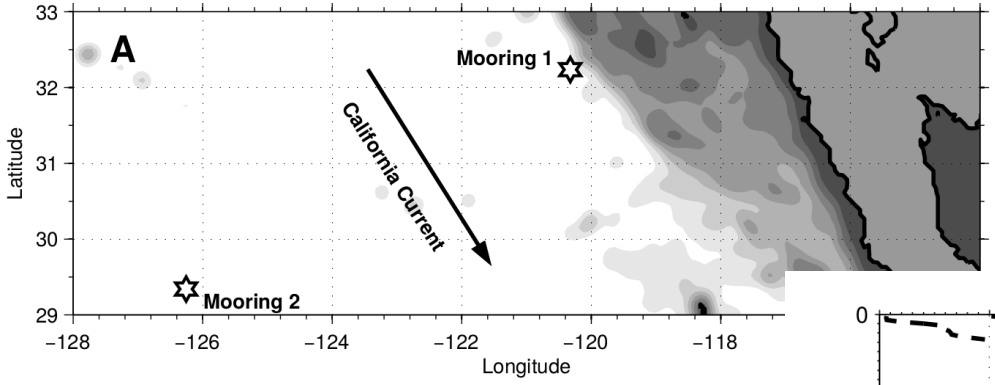
$$dynamic\ height = \frac{1}{g}\int_{p_{ref}}^{p} \alpha\, dp'$$

Transport from difference between 2 locations

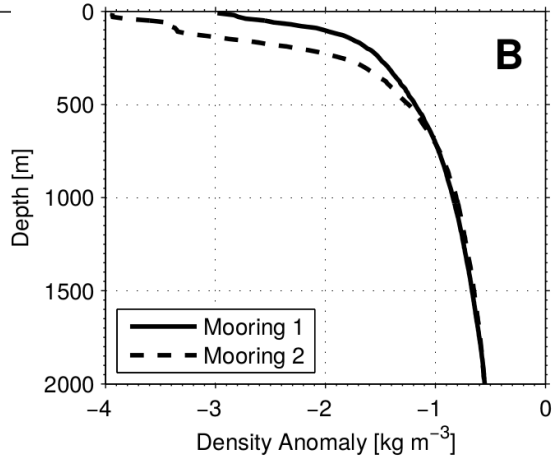
(only use bottom pressure from PIES)

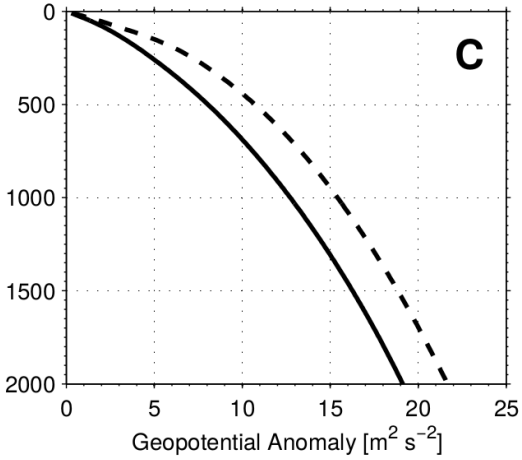


Steps to merge mooring and altimeter data

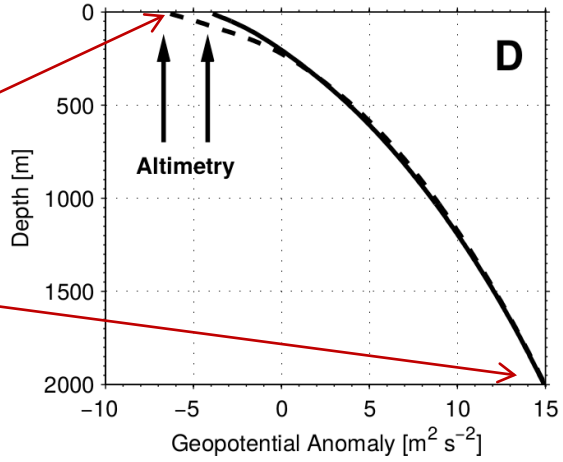


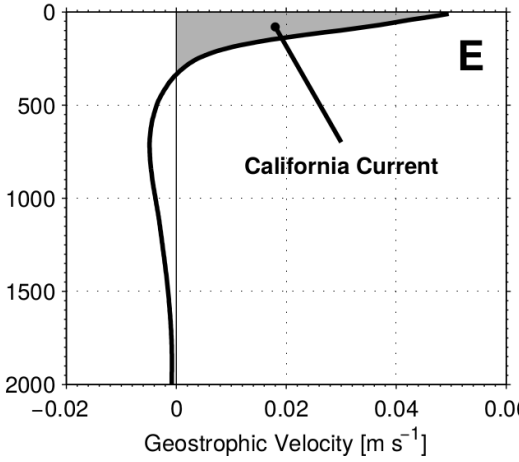
(Figures from new Altimetry book)





Reference to
1) altimetry at surface
or
2) PIES pressure at bottom

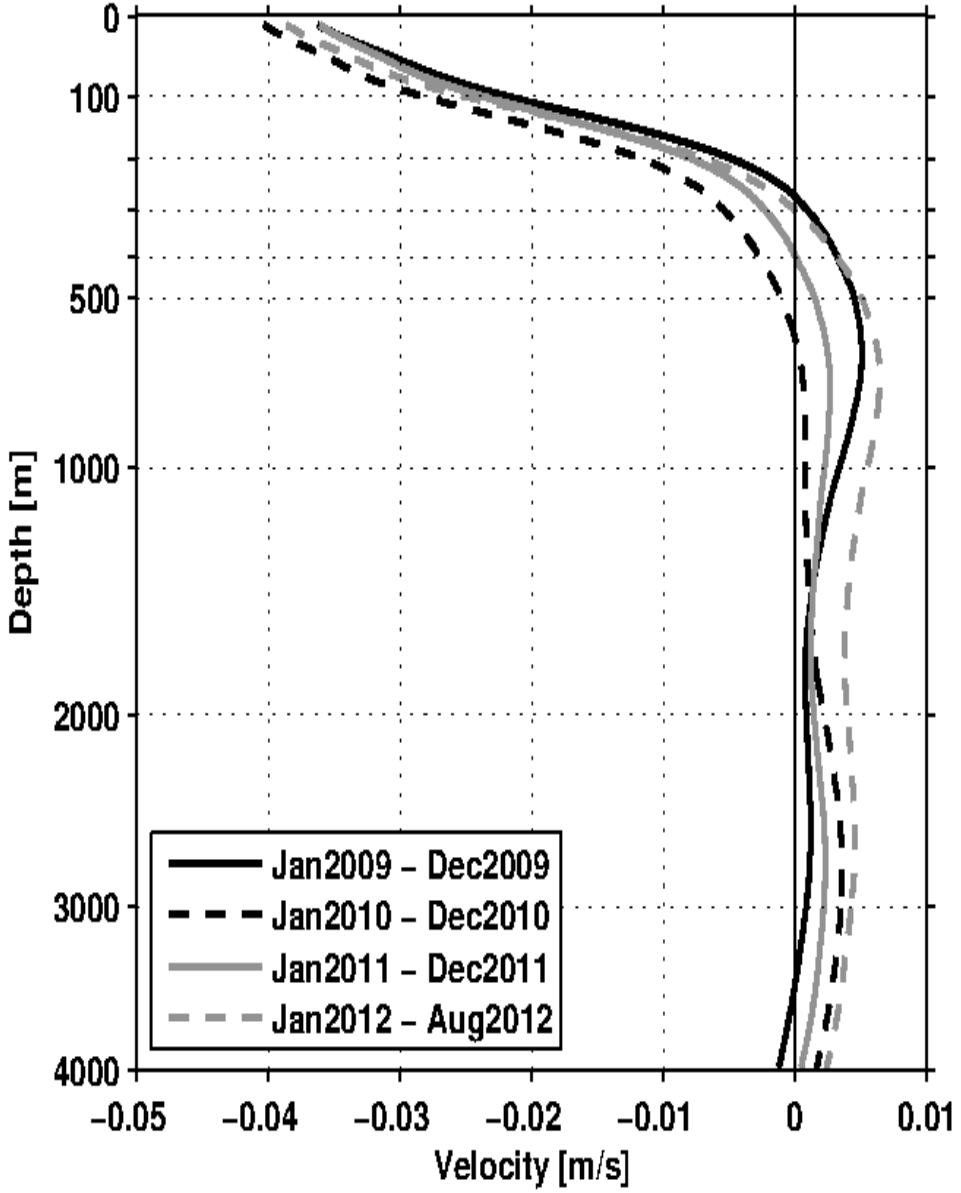




1-year average profiles

Referenced to PIES (short timescales) and AVISO (long timescales).

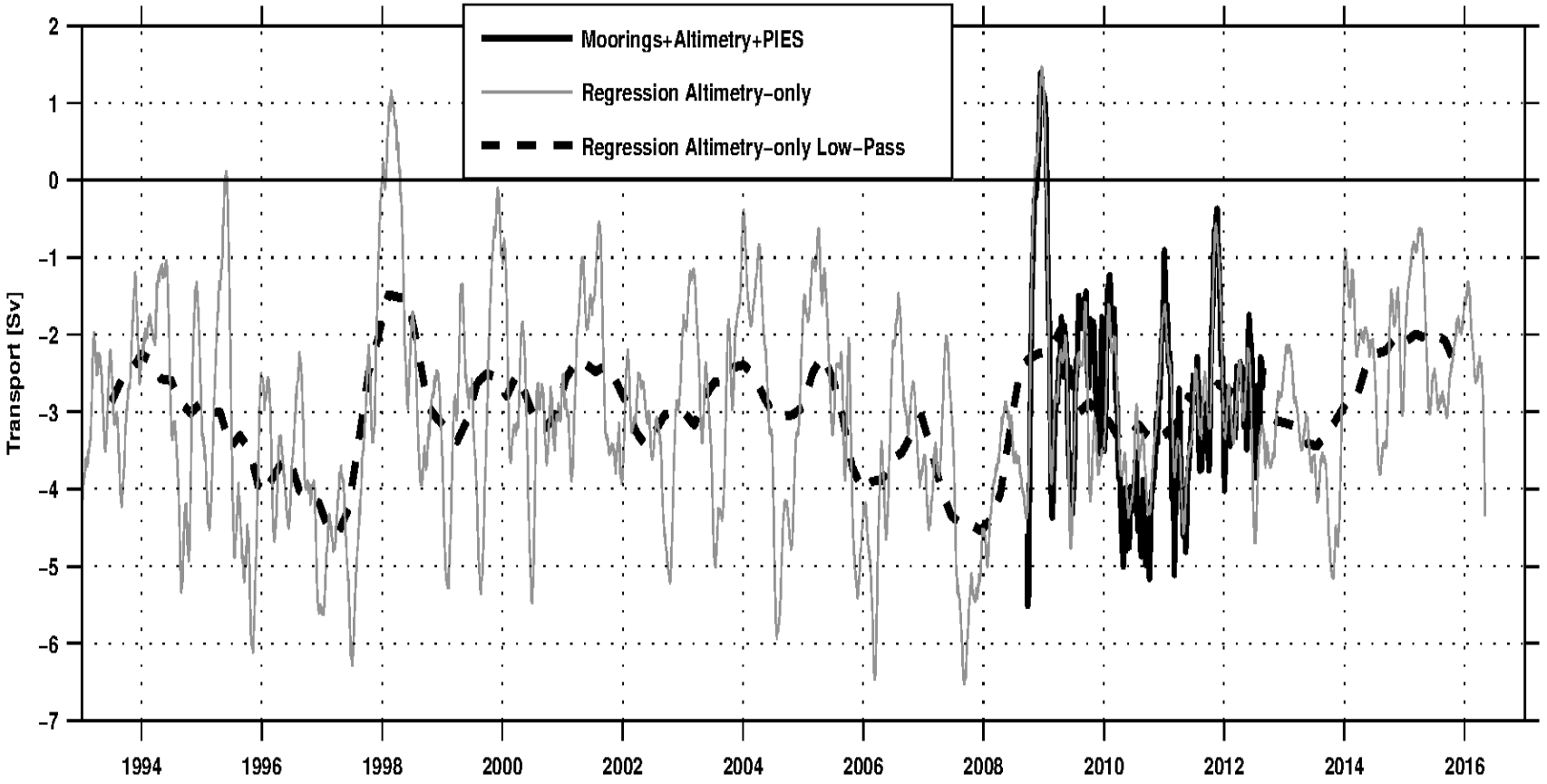
Shows interannual variability, e.g. in the Californua Undercurrent.



Altimetry alone can reproduce total transport

CORC California Current Volume Transport:

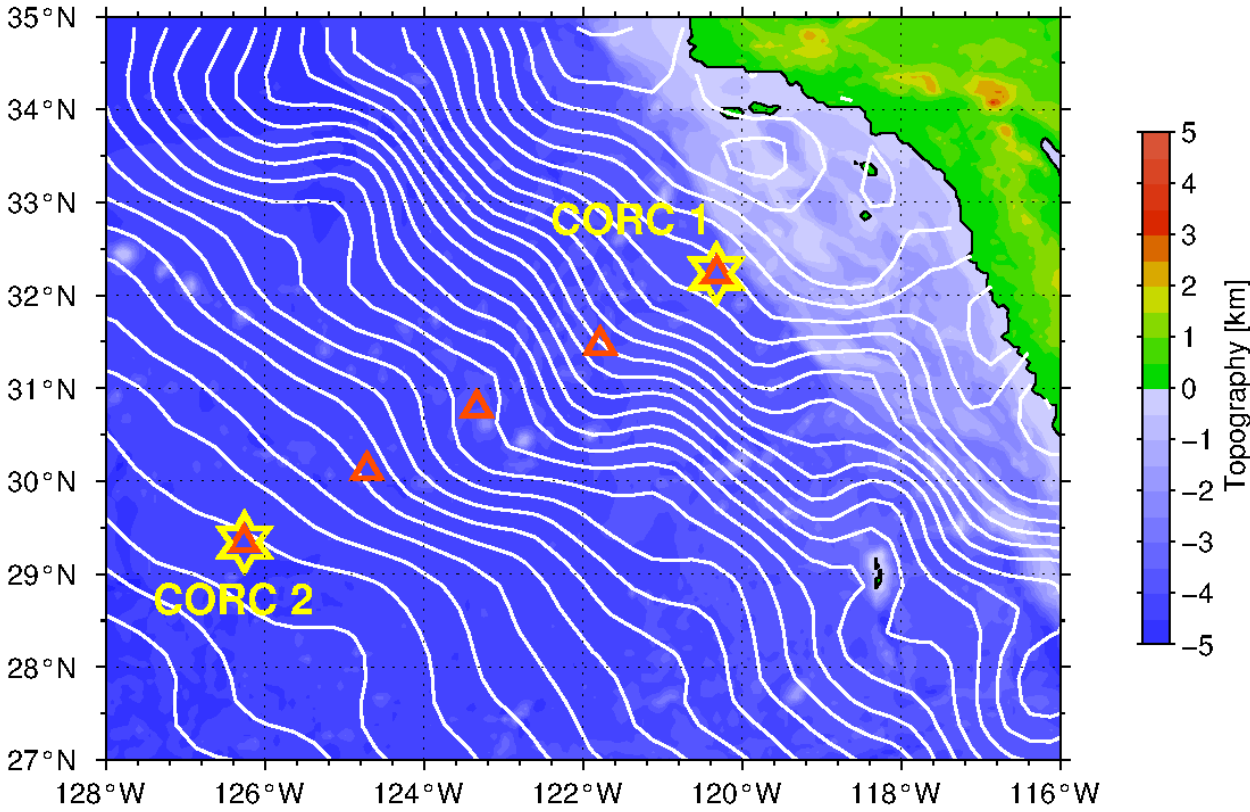
- Moorings+PIES 2008-2012, showed high correlation with altimeter SSH difference
- Regression on altimetry alone gives timeseries 1993-2016



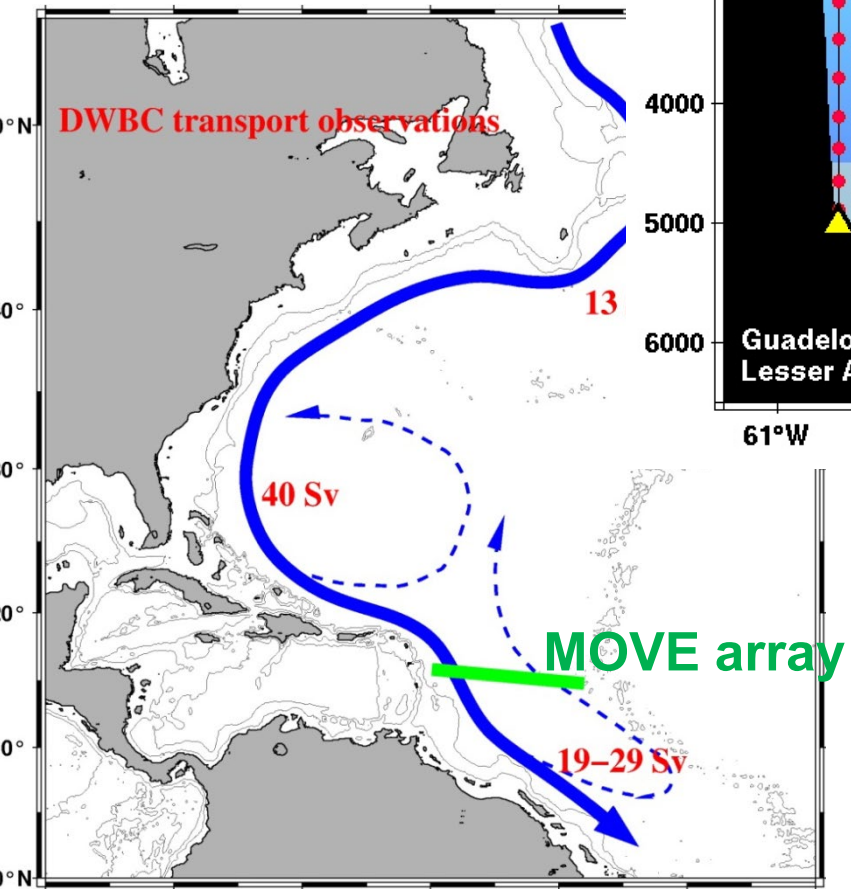
SWOT applications

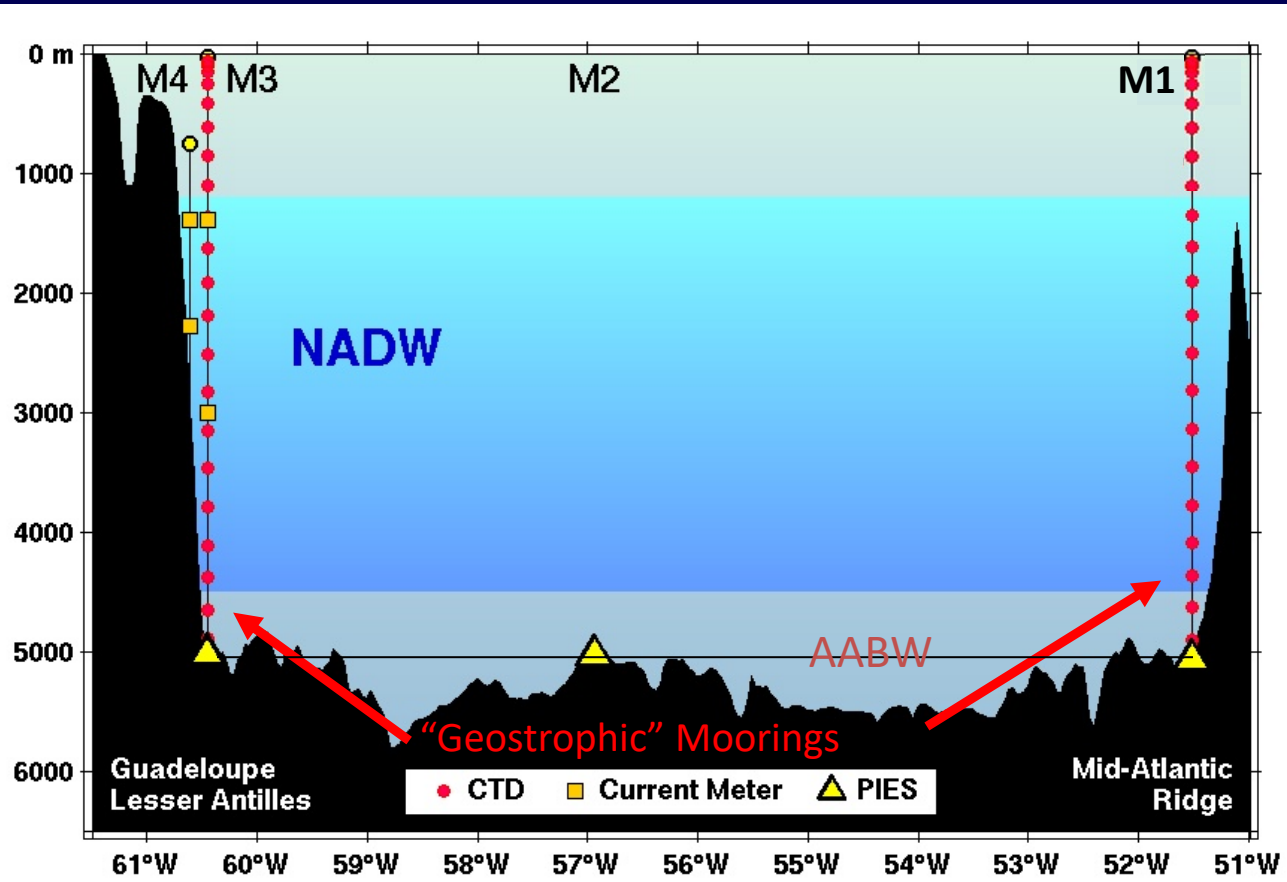
- resolve meanders and fronts of the California Current

- extend method inshore onto slope and complicated shelf regions (moorings are in place)



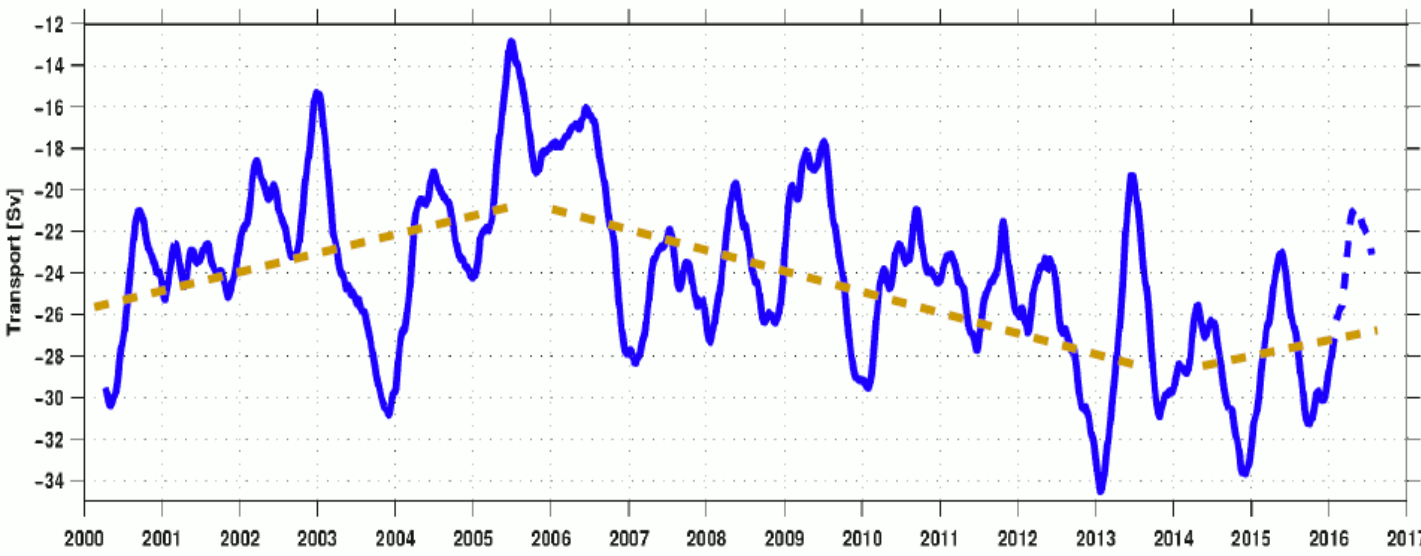
MOVE project





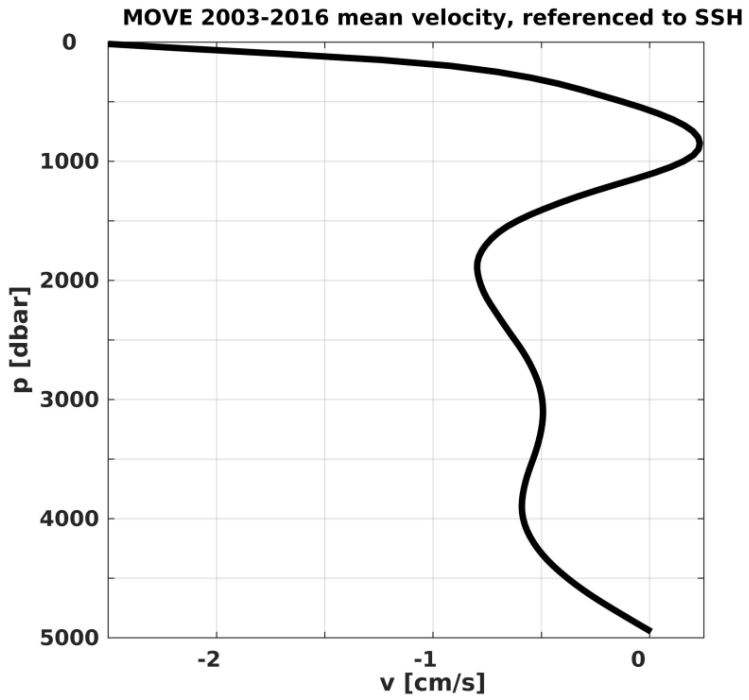
Transport timeseries and profile

On long timescales, don't know drift of pressure sensor – assume no flow between NADW and AABW.



Possible approaches being pursued:

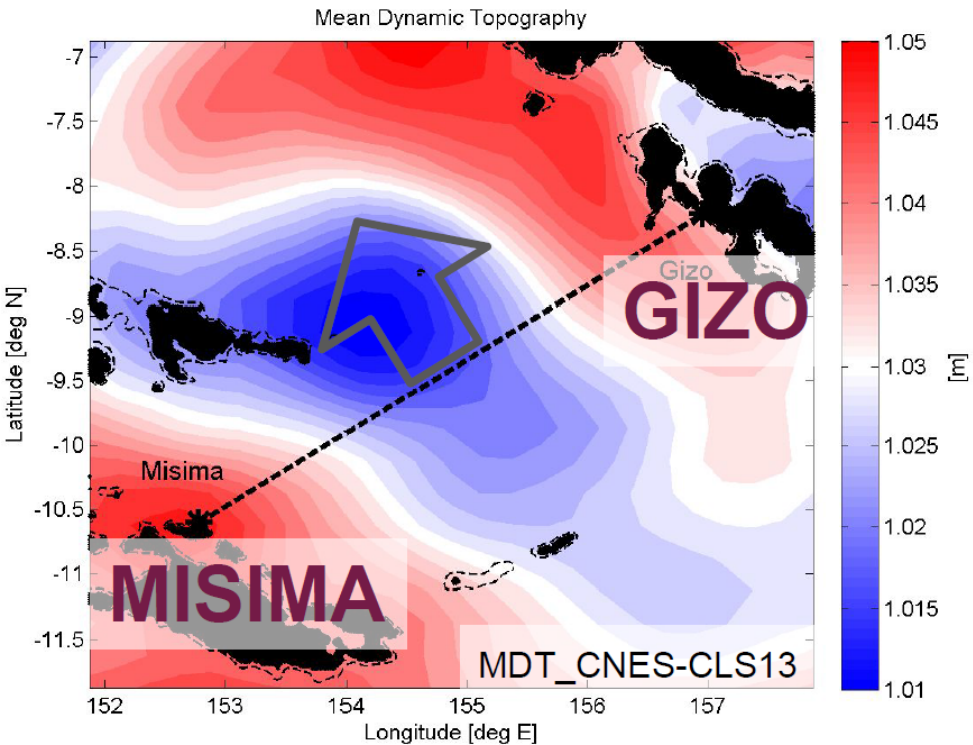
1. **use GRACE to determine long-term changes in bottom pressure**
2. **use SSH from altimetry as a reference**

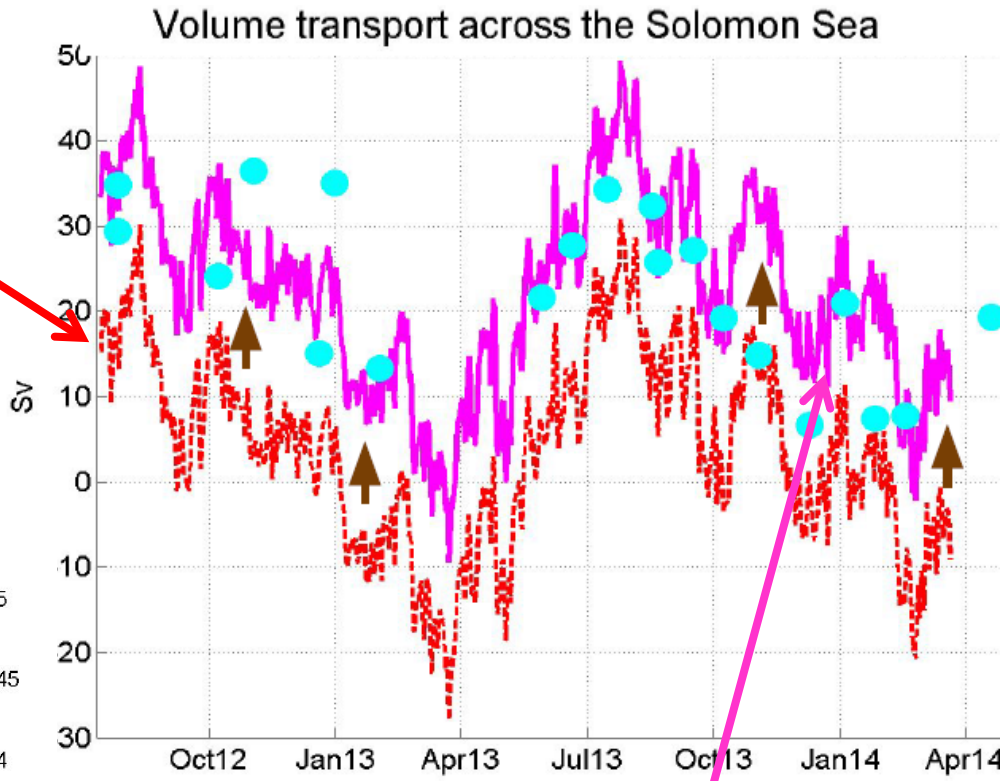


Need more accuracy in altimeter on shorter time and space scales to reference the time-variable part

Western boundary current flow through Solomon Sea

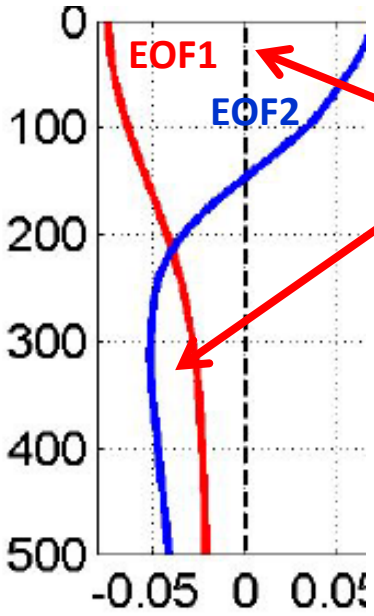
End-point moorings (CTD) and PIES (bottom pressure) give transport, but one constant unknown remains.





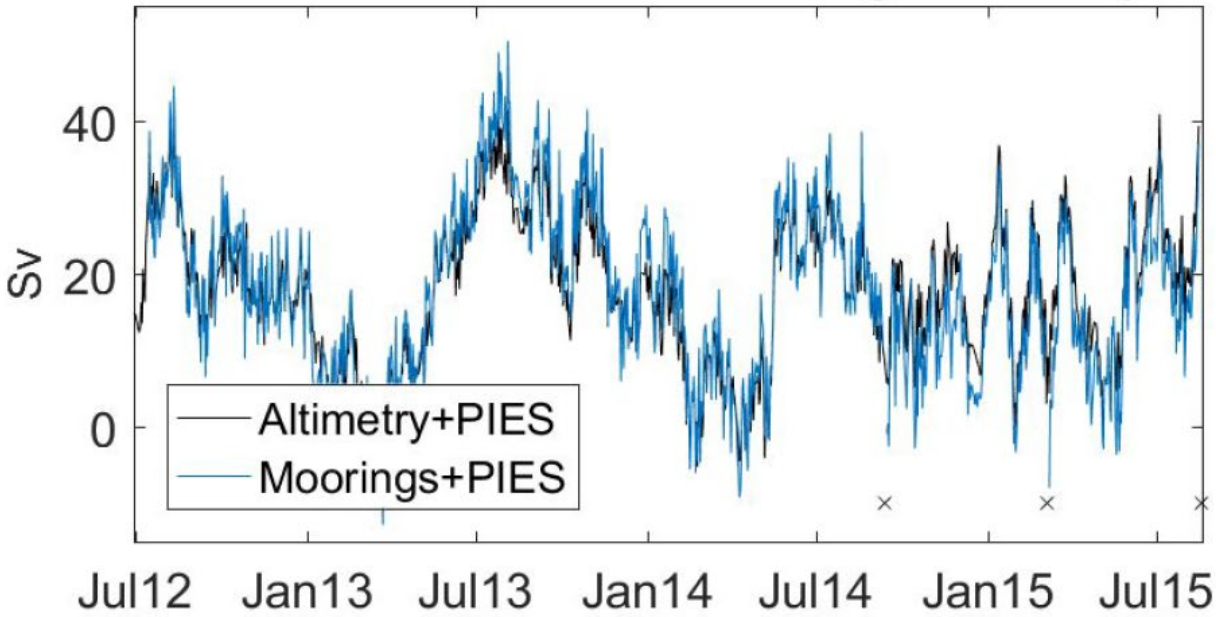
Offset be determined from mean SSH gradient, then transport agrees well with sporadic glider estimates.

Reconstruction of profiles of tranport (per unit depth)



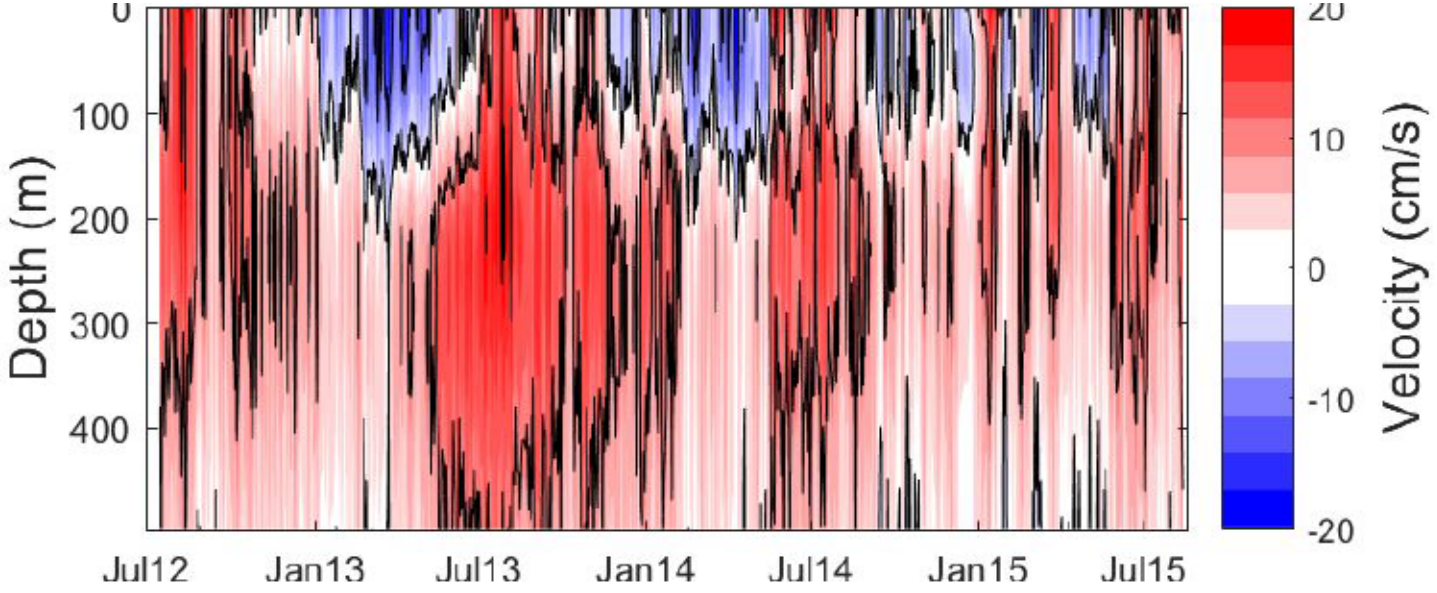
Surface flow from altimetry and flow at 320m from PIES are good constraints for both EOFs and thus total flow…

Total Transport from Moorings/PIES and Reconstruction with EOFs using Altimetry/PIES

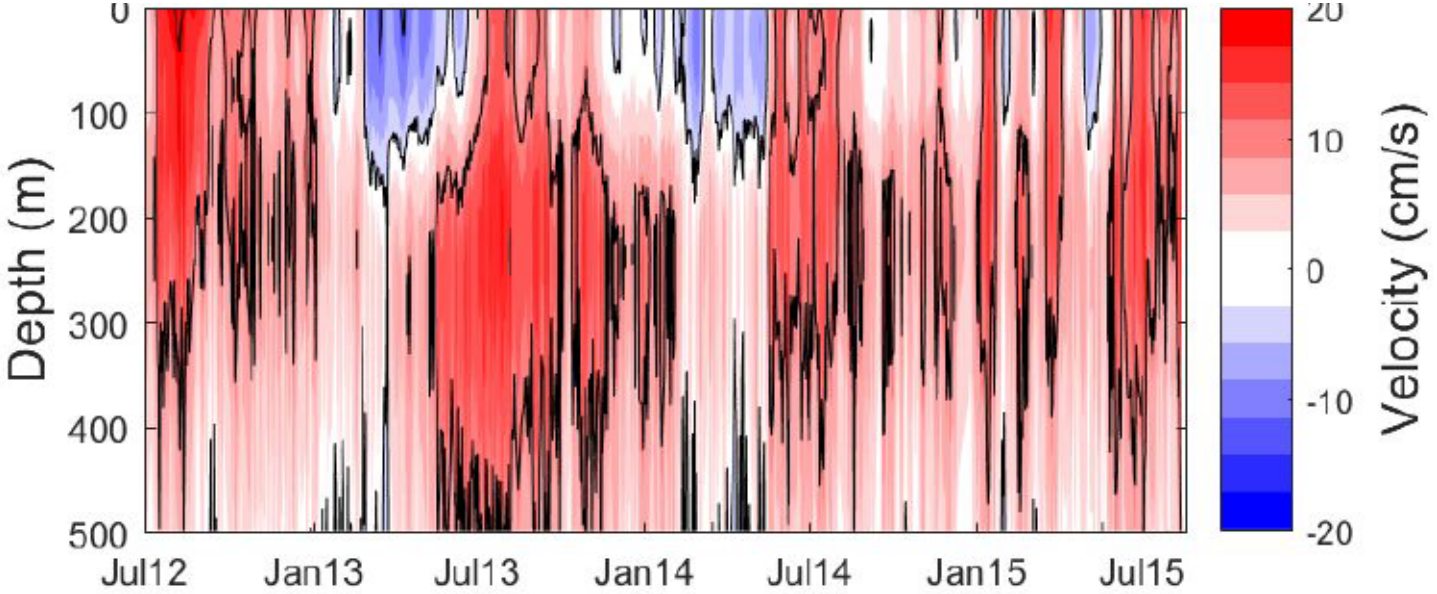


1-day resolution, x represents the time when either the mooring or PIES is swapped out. R = 0.9426. PIES at MS was swapped out on Sep 13, 2014, mooring at GZ was swapped out on Mar 6, 2015, mooring at MS was swapped out on Aug 18, 2015.

Total horizontally averaged flow

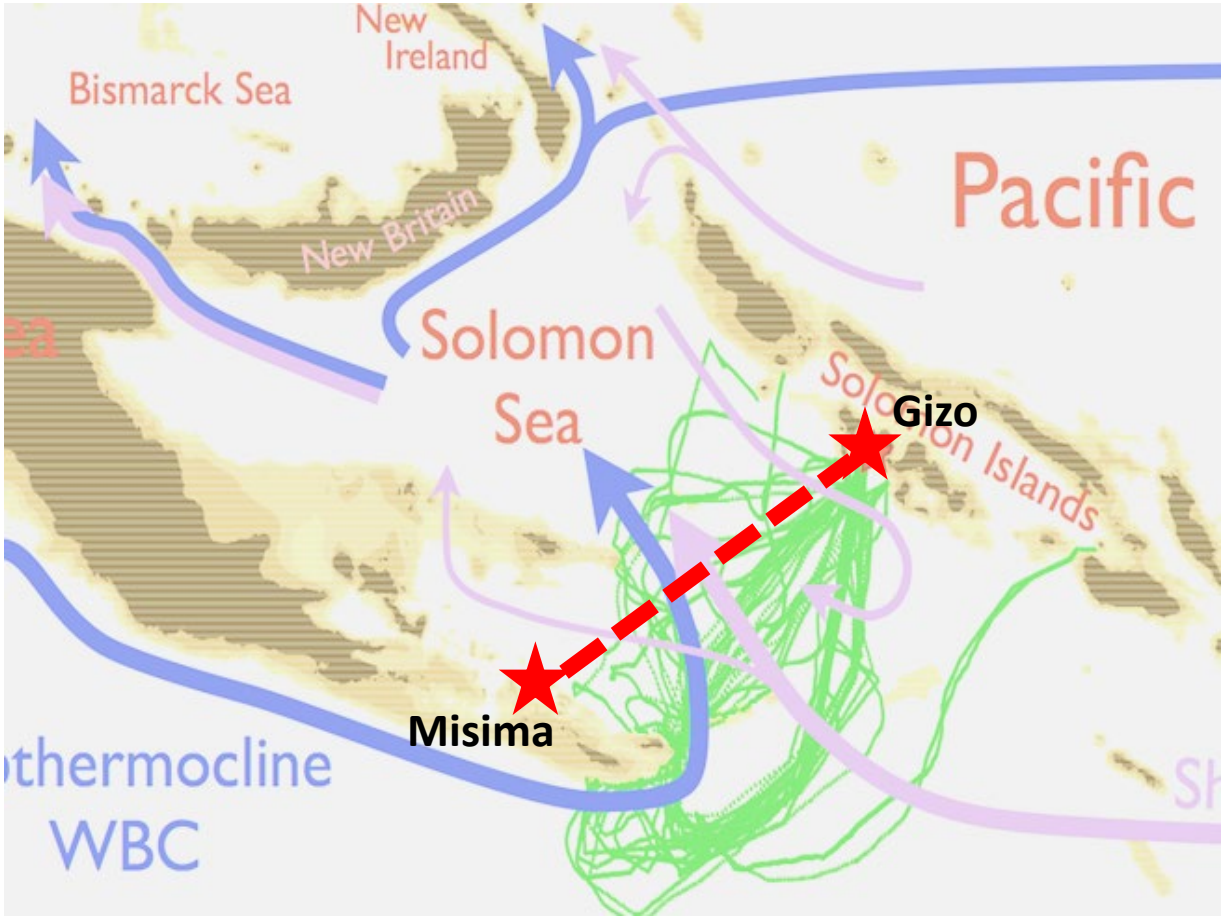


From microcats and PIES



Reconstructed from PIES and altimetry

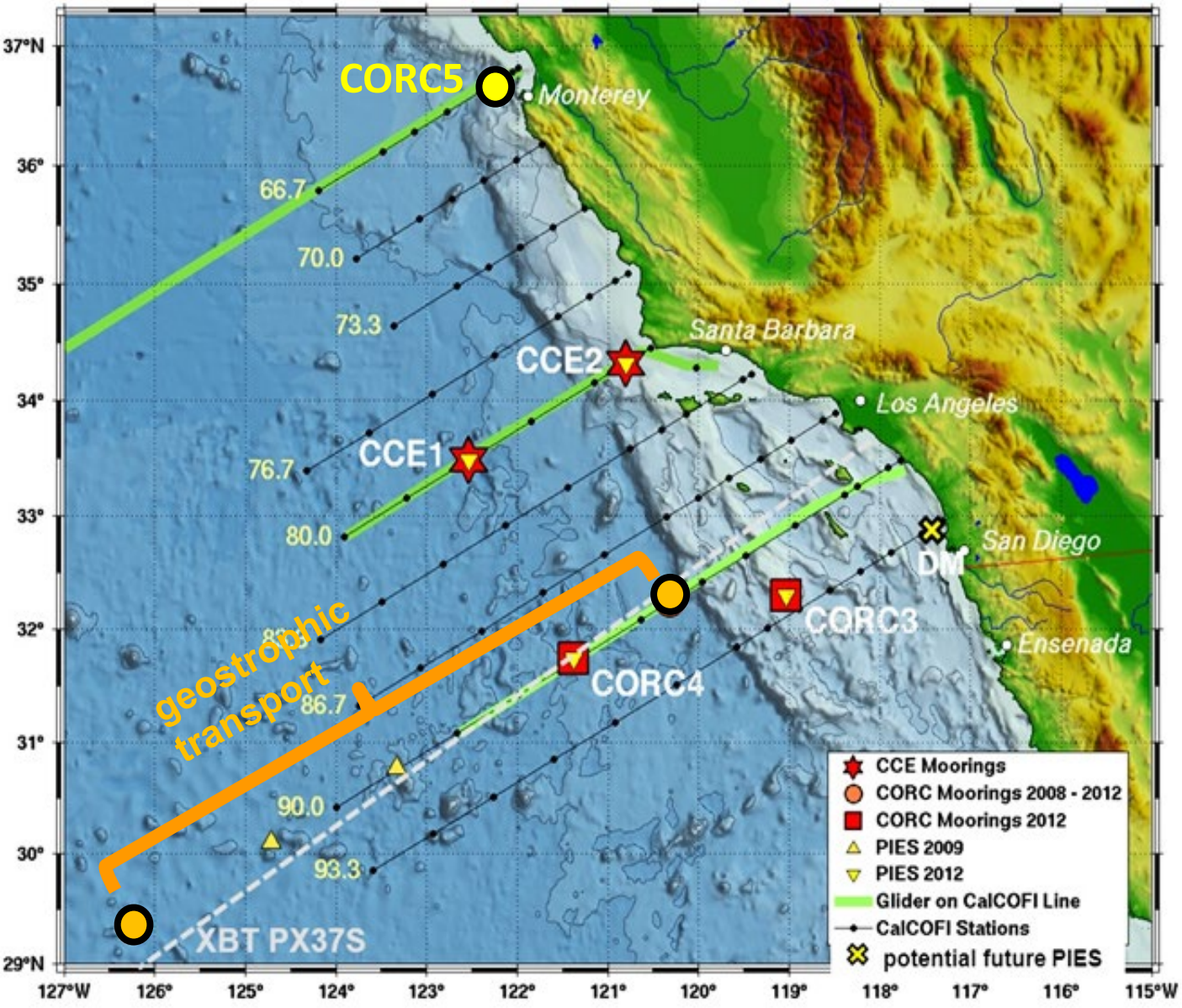
SWOT application



Need to resolve mesoscale:

- strong eddies/fronts may bias geostrophic transports
- Coherent eddies may advect water properties

Coastal moorings where altimetry/SWOT will help, and v.v.



Dynamic height now measured over slope in 800m for upwelling transport budgets. CORC5 is new and coincides with other SWOT efforts.

Many of these moorings will be sustained.

Thank you

(more about the technology and accuracies in CalVal session tomorrow)