Comments on egusphere – 2025-2072 Anonymour Referee #2

AC : author response

The authors study observed cross-shelf volume transports associated with mode-1 internal tides and high-frequency Nonlinear Internal Waves (NLIWs) in two contrasting mid-shelf locations. The vertical structure of the Stokes drift profiles Qr is a particular focus, with monthly-averaged volume transport estimates of ~0.1-0.2 m2/s in different parts of the water column. Comparison with theoretical predictions for the shape of Qr suggest this is a significant cross-shelf transport mechanism in the Armorican and Aquitaine shelves. Interaction with the wind-driven upwelling/downwelling Eulerian circulation is also discussed.

The text and figures are mostly clear, though figure labels are sometimes hard to read. I appreciate the comparison between the two different regimes and the Stokes volume transport estimates, since this is a difficult process to measure, and is not present in most full-complexity numerical models.

I see some major and minor issues with the manuscript in its present form, which I detail below. Briefly, I feel that a couple of sources of instrumental error (random instrumental noise and the assumption of flow homogeneity across the ADCPs' beam separation) need to be examined to add more confidence to the results.

Thank you for your efforts in reviewing our manuscript. We are also grateful for the discussion you have initiated.

Major

M1: Since the transports Q, QEu and Qr (and other quantitative estimates) are based on measurements which contain random error, it is important to have error bounds derived from the propagation of the instrumental noise. This would add confidence to the results, for example the comparison between experimental and theoretical Stokes drift fluxes in Section 4.1. Figures 1(c,e), 6, 9, and 10 would also benefit from this analysis.

See the “M1.pdf” file linked to the discussion.

M2: The lagged arrival times of short-wavelength signals at different beams of an ADCP can cause substantial differences in measured velocities due to the beam-to-Earth coordinate transformation. In this dataset, the presence of NLIWs and tidal bores can add spurious transport to the raw time series. Scotti et al. (2005, https://doi.org/10.1175/JTECH1731.1) propose a method to correct for these efects, which I think is necessary here. This would eliminate potentially spurious NLIWs and tidal bore signals in the raw velocity records that could affect the total Q estimates (and hence Qr). This could change the interpretation of the Qr profiles' shapes, e.g., the discussion in lines 449-463.

Reconstructing a coherent velocity time series that would be corrected under each appearance of NLIWs is not technically possible (at least with the dataset we are using). This is due to several limitations:

- Only one of the two ADCPs used in this paper is in beam coordinates. The Scotti et al. (2005) correction is not possible for ADCP recording data in Earth coordinates.

- The methodology given in Scotti et al. (2005) requires a strong backscatter signal associated to the NLIW and this is not always the case in our ADCP dataset. Retrieving the propagation speed and direction is therefore not possible for all the NLIW events.

- The methodology was initially developed to correct the velocity under a train of NLIWs with constant propagation speed and direction. When waves superpose the methodology is not applicable. This happens multiple times in our datasets, either with the superposition of elevation and depression waves, or waves propagating independently over a short time period. Correcting the velocity under hundreds of NLIWs with varying propagation speed and direction, and reconstructing a coherent time series (i.e. without adding uncontrolled time dependant errors) seems unrealistic.

We acknowledge that the lagged arrival times of short-wavelength signals at different beams of an ADCP will add uncertainties in the measured velocity. The NLIWs are expected to increase the measurement uncertainty. To better clarify this point we propose to add the following paragraph in the discussion section, line 449-463 :

“The uncertainty in transport is expected to be enhanced by the impact of the NLIW on measurements. The lagged arrival times of short-wavelength signals at different beams of an ADCP can cause substantial differences in measured velocities. This is due to the beam-to-Earth coordinate transformation (Scotti et al. (2005, https://doi.org/10.1175/JTECH1731.1). To correct this effect, the ADCP must be in a specific beam configuration. This was not the case for the ADCP used at the SE-BoB. Furthermore, the velocities must be corrected for each wave, taking into account their specific propagation speed and direction. The correction is not possible when waves superpose. Currently, the effect of NLIW on the different component of the transport cannot be assessed. NLIW generate asymmetrical transport in the water column (Lamb, 1997 — http://doi.wiley.com/10.1029/97JC00441). They can also generate cross-shelf transport equivalent to that on large scales dynamics (Zhang et al., 2015 – https://onlinelibrary.wiley.com/doi/abs/10.1002/2014JC010393). A study focusing on NLIW transport and its contribution to the total Eulerian and residual transport would clarify their impact on cross-shelf transport."

M3 (Line 132): It is worth checking that the 24 h cutoff period effectively filters all major tidal constituents. I wonder if it might leak some M2 variance, as M2 is the most energetic constituent and has a period that is not a multiple of 24 h.

We computed the Eulerian transport using the DEMERLIAC tidal filter, which is effectively used by SHOM. We compared these results with the 24-hour low-pass filter results presented in the referenced paper.

The time-averaged profiles of Eulerian transport are equivalent at both sites using either method (Figure 1). The time series differ. The 24-hour low-pass filter is less effective at removing tidal constituents but The DEMERLIAC filter operates on hourly data which averaged out the contribution long term contribution of the high frequency dynamics such as the NLIW. Additionally, the tidal filter operates on time windows of several days, causing the final results to lack the first and last days of the record (Figures 2 & 3).

The structures described in the paper remain present in both results:

- At N-BoB: The 3-layer structure is observed in both results on 2022-09-07. The destruction of the stratification is observed in both results. (Figure 2)
- At SE-BoB: The DEMERLIAC filter removes the complex 3-layer structure on 2017-07-15 and reduces negative Eulerian transport. However, key structures remain in both results, including large negative transport at the beginning of the record and negative transport near the bottom after 2017-07-21 (Figure 3)

In conclusion we kept the 24h low pass filter after verifying that the monthly averaged profile was equivalent and the main structures in the time series were equivalent to a specific tidal filter DEMERLIAC. The 24h low pass filter was preferred because it can be applied to high-frequency data and it does not remove the first and last day of measurements.

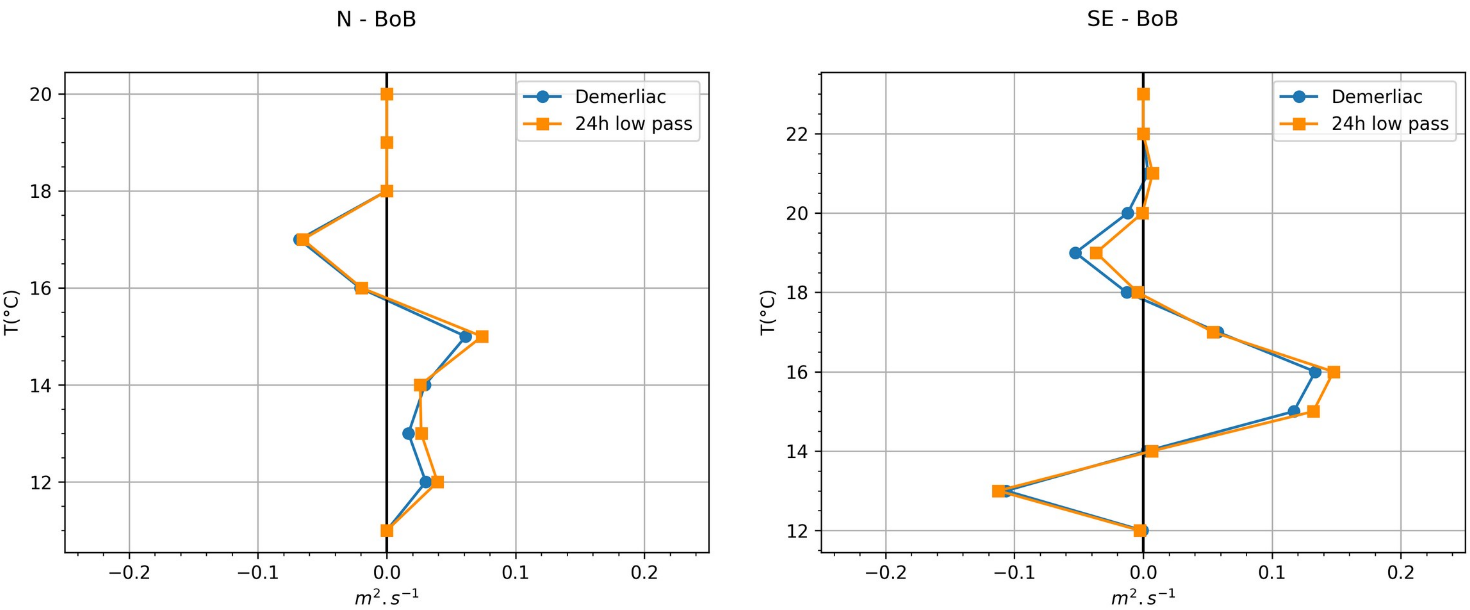


Figure 1 : time averaged eulerian transport Q_Eu using a 24h low pass filter and the tidal filter DEMERLIAC. (N-BoB on the left and SE-BoB on the right.

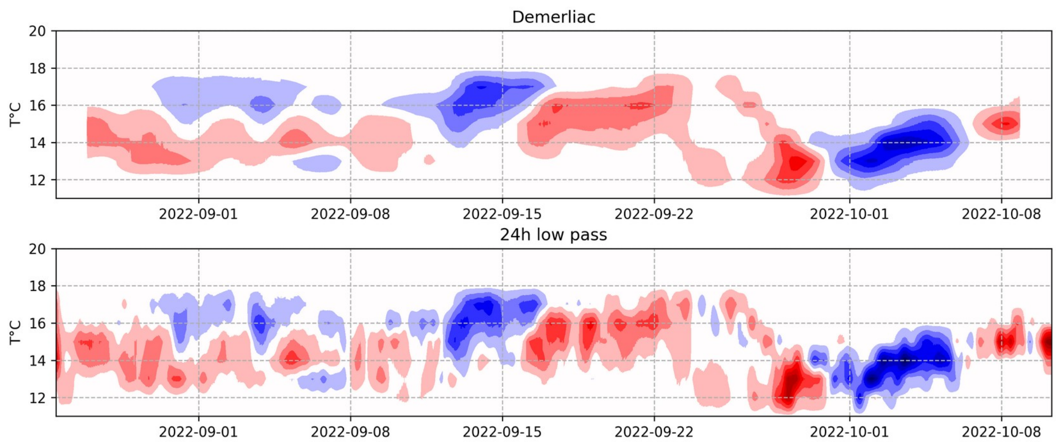


Figure 2 : time series of the eulerian transport Q_Eu using a Demerliac filter (top) and a 24h low pass filter (bottom) at the N-BoB.

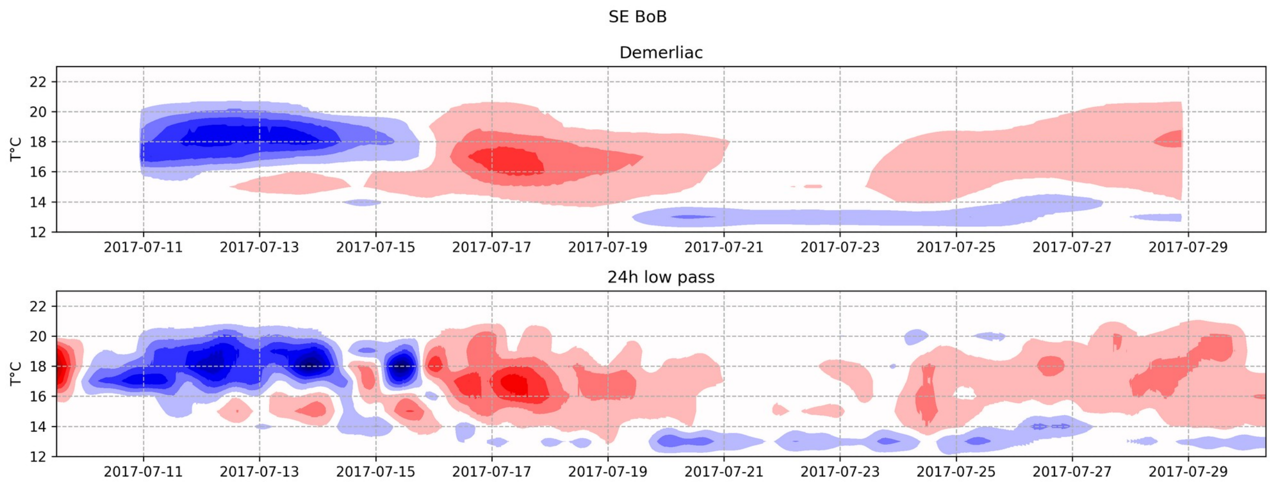


Figure 3 : time series of the eulerian transport Q_Eu using a Demerliac filter (top) and a 24h low pass filter (bottom) at the SE-BoB.

M4 (Lines 192-193, 301): I understand the Stokes drift from the other processes listed, but why would density-driven mean flows have a Stokes component? It is not an oscillatory process.

I would have expect the punctal transport to be filtered out but to contribute to the final amplitude of the signal.

Minor points:

m1 (line 54): "The southern shelf of the BoB presents the smallest barotropic tide of the shelf". This statement could use a reference.

ok

m2 (Line 79): "on average the regional circulation is less than 2.5 cm/s". Is this a typical along-shelf or cross-shelf velocity, or a speed?

Speed - modified

m3 (96-97): It would be helpful to include the temperature and pressure sensors' specifications such as manufacturer and model.

Ok, the sensors specification have been added line 96-97 and line 120.

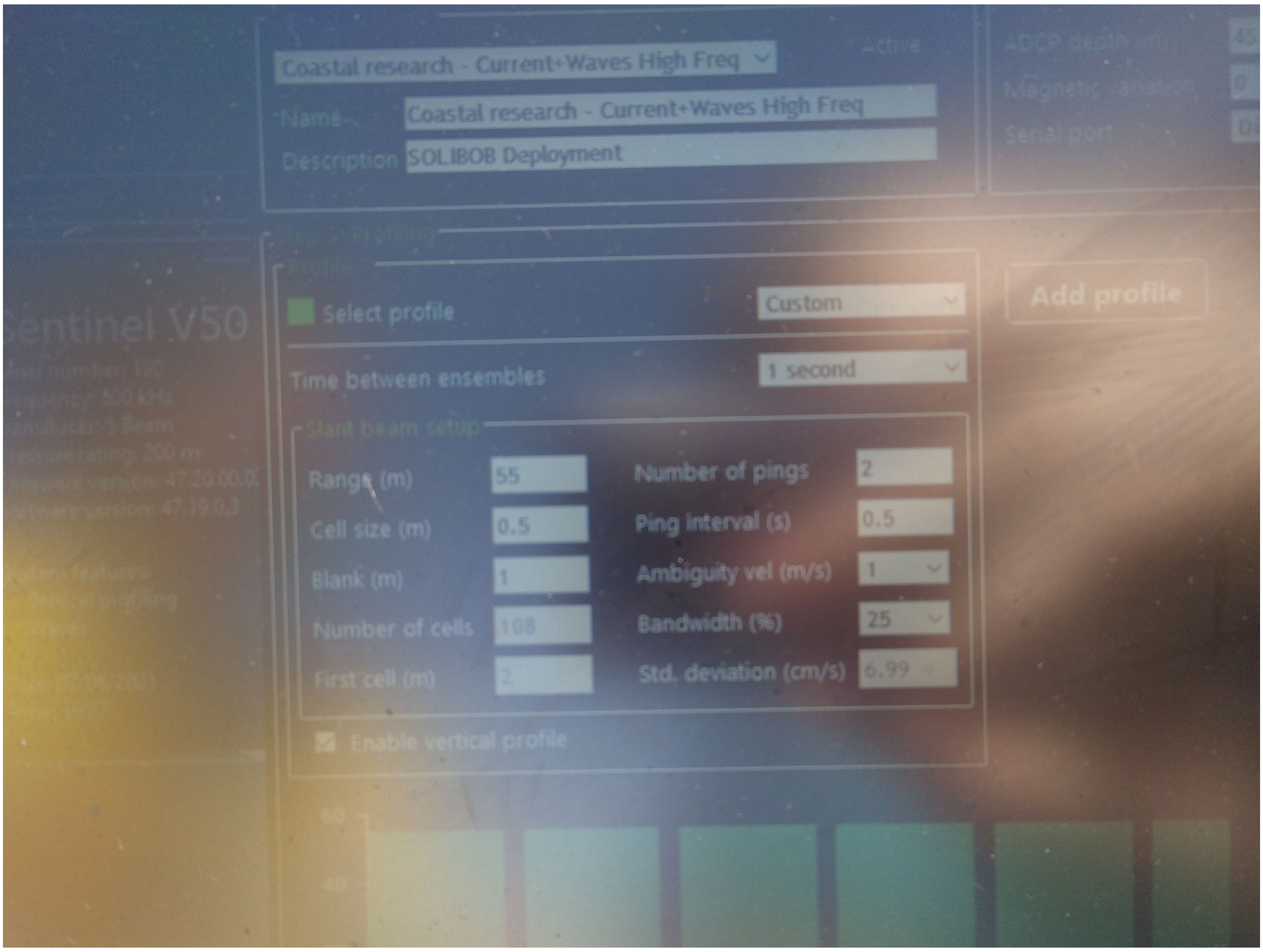
m4 (Line 98-99): What is the source for the 0.15 degrees C accuracy of the temperature sensor?

The temperature sensor calibration were documented in section 3 in (Lazure et al. 2019 https://archimer.ifremer.fr/doc/00630/74245/) . The Mastodon moorings were the one used in both dataset (SE-BoB et N-BoB). The uncertainty of the temperature sensor is actually 0.1°C. We added the refence in line 99 and line 123.

m5 (Line 100-101): Same as in m4, it would be good to include the ADCP's single-ping standard deviation for error propagation.

For S-BoB site : 8cm/s in figure 9 in ADCP coordinate transformation booklet – added in line 100

For N-BoB site : 6.99 cm/s (see picture below) – added in line 120



m6 (Lines 136-137): "We then solved the Sturm-Liouviille equation (4) and... and amplitude." This sentence might read more naturally if it is after equation 4 is introduced.

Yes. The sentence was removed.

m7 (Line 426): "...Peru shelf, a location with a strong internal wave field". A reference for this statement would be helpful. I do not think Lentz and Chapman (2004) mention this.

I added reference to the Jackson 2004 Internal waves atlas that gives pictures and description of internal waves packets on the peruvian shelf. I also modified the sentence in line 425 into :

« Lentz and Chapman (2004) » presented observations made around the world, including negative volume flux near the seabed under upwelling on the Peru shelf — a location characterized by regular internal wave packets « Jackson 2004 ».

m8: The axis labels and some of the annotations in most figures are too small to read without zooming in.

Yes, this will be corrected.

Typos/minor edits

Line 11: an -> a
ok
Line 38: transportation -> transport
ok
Line 89: over -> in
ok
Line 159: of the -> the
ok
Line 189: in the next -> in
ok
Line 197: this -> that
ok
Line 250 isotherms -> isotherm
ok
Line 281: maxima -> maximum
ok
Line 297: dominate -> dominant
ok
Line 301: waves -> wave
ok
Line 306: height -> heights
ok
Line 319: Qr1 -> Qr
ok
Line 321: T > 15°C -> T < 15°C; dominatly -> dominantly
Thank you

Line 352: drove Q_A asymmetry -> caused Q_A's asymmetry
ok
Lines 358, 387, 389, and elsewhere: NLIW -> NLIWs
ok
Line 361: time series -> the time series
ok
Line 387 attributed -> attributed to

ok