

Cover letter to the Editor

Dear Editor,

Please consider this as the resubmission of the original manuscript
"The role of vertical shear on the horizontal oceanic dispersion",
by A. S. Lanotte, et al.

We are very happy that Ref. 1 found our paper largely improved and that you agreed to publish our paper, with some minor revisions suggested by Referee 1.

We have implemented all such minor revisions in the revised version, as you can see from our detailed answer and from the manuscript itself.

Please note that Dr. Guglielmo Lacorata is no longer in the author list.

We are happy to contribute with our work to the OS topical issue
"Oceanographic processes on the continental shelf: observations and modeling".

Yours sincerely,
Alessandra S. Lanotte (corresponding author)

Response to the Editor and to Reviewer #1

We are very happy that the Reviewer found the *paper significantly improved* and he/she now thinks that the *main concerns and suggestions have been satisfactorily addressed*. Here below we discuss all the revisions asked by the Reviewer, to be considered by the Editor in his final assessment.

Reviewer criticisms are here marked in green, bold face. Our answers in black. The main changes made in the manuscript in blue. In the manuscript also main changes are in blue.

We start from the general points listed at the end of the report, then we address the minor points.

GENERAL POINTS

Rev: Discuss the fact that the ADCP results on vertical shear are significant with respect to measurement errors

In the revised version, we added the following sentence:

“ADCP results on vertical shear are significant with respect to measurement errors. We note however that the dataset can be considered of good quality, both in terms of the statistical accuracy and of the measurement conditions: only seldom low acoustic backscatter and diurnal migration of the scattering source cause noise in the data. By averaging over a large number of profiles, we can reduce ADCP velocity uncertainties”.

Rev: Clarify in the Introduction that the vertical shear comparison between MFS and ADCP data is performed in one location only, and it does not therefore provide validation or statistical comparison. Rather, it is simply used as a specific example indicating differences between model and data, which in turns motivate the sensitivity study conducted using the results of Series 1,2,3.

In the revised version, we added the following sentence:

“Since the comparison is performed in one location only, its results might not be of general validity. Rather, they point to differences that can arise between model and data, which in turns motivate the sensitivity study presented in Sec. 3,[..]”

Rev: I am not quite sure that the term “mixed layer” is used correctly in the present context.

Mixing layer is now used instead of mixed layer and then we often refer to the upper part of the ocean.

MINOR POINTS

Rev: Title. I suggest “Effects of vertical shear in modeling horizontal oceanic dispersion”

We changed the title accordingly.

Rev: All trough the text rephrase “vertical velocity gradients (profiles)” with “vertical gradients (profiles) of horizontal velocities” to avoid possible misunderstandings

We have changed this wording throughout the paper, we omitted the word “(profiles)” when it was not necessary.

Rev: Line 15 add references.

We added the reference to the book of Kantha and Clayson, 2000: “Small Scale Processes in Geophysical Fluid Flows”, Academic Press.

Rev: Line 42-44 modify the phrase taking into account that recent coastal experiments (Schroeder et al, 2012, GRL) show results conflicting with exponential behavior.

In the revised version, we have changed the paragraph where we discuss coastal pair dispersion experiments as follows:

“Coastal region experiments are puzzling. Some, as e.g., Ohlmann et al. (2012), tend to support the existence of an exponential regime, beside or instead of the power-law one, while others, as Shroeder and et al. (2012), show results conflicting with the exponential behavior” .

Rev:

- **Line 44 “experiment” instead of “measurements”**
- **Line 76: modify “diffusion in the upper ocean”**
- **Line 100 add “(see Fig.1)”**
- **Line 192 modify “gradients in the MFS model, that overrides the small scale fluctuations”**

We have done all these changes.

Rev: Line 194 rephrase, it is not clear

In the revised manuscript we have changed the sentence as follows:

“ii) differently, the horizontal relative separation resulting from the introduction of the 2D KLM is fast enough to become dominant with respect to the anomalous shear effect produced by the MFS solution.”

Rev:

- **Line 201 “following” instead of “sequel”**
- **Line 205, 242 add the references for the KLMs summarized**
- **Line 257 “Numerical experiment set up” instead of “Results from numerical experiment”**
- **Line 275 Modify with something like “In addition, we also compare results from these runs with results obtained in Lacorata et al (2014) considering MFS surface tracked particles (correct??) and drifters.... “**

That was correct.

We have done this last change, and all the others listed corrections as requested.

Rev:

- **Line 310 Modify as “In Figure 5 we compare FSLE results from the 3 Series and results from**
- **Lacorata et al (2014) at the surface”**
- **Line 332 Modify “This suggests that the dominant effect is the one associated with the MFS vertical shear”**
- **Line 336 “overrides” instead of “covers”**

We have done these changes.

Rev: Line 340-345 rephrase, it is not clear

In the revised version we have changed the paragraph as follows:

“A way to solve this mismatch is to add a 3D kinematic model, enabling vertical shear mixing and promoting surface horizontal dispersion also. However, the adoption of the 3D KLM only does not seem an appropriate choice, since vertical gradients of the horizontal velocities have an anomalous temporal persistence, resulting in a spurious shear dispersion. Indeed, such persistence does not seem to have a counterpart in observational data, and we interpret it is an artifact of the poor temporal resolution of MFS model.”

Rev:

- **Line 359 modify as “tracer particles in a Mediterranean Sea model”**
- **Line 367 add “overestimated in the model”**
- **Fig1 add dates corresponding to the 3 examples**

Done.

Rev: Fig2 The ADCP location and the symbol description in not correct.

Thanks for pointing this mistake. We fixed the coordinates of the ADCP locations in the figures and in the figure captions.

A short list of the main changes is the following:

- Title has been changed.
- Introduction: references and related discussions have been added.
- Figures 1 and 2 have been changed to fix some misprints.
- Few clarifying paragraphs have been added
- Two References have been added