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Nonlinear Processes in Geophysics
Discussions

Interactive comment on "On modulation instability in a system of jets, waves and eddies off California" *by* L. M. Ivanov et al.

Anonymous Referee #1

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Review of "On modulation instability in a system of jets, waves and eddies off California" by Ivanov et al.

One of recent discoveries in oceanography is the presence of quasi-zonal jets (QZJ) in ocean currents. Based on the literature examination, the authors explicitly show that this oceanographic discovery is in fact a branch of broader atmospheric research (including other planets) where QZJ features have been known before. But, I got an impression that Introduction partly misses a throughout review of the ocean QZJ observations.

Explaining how large-scale structures in the World Ocean are formed is very important because it expands our knowledge on energy transitions between different scales and allows estimating characteristic energy-dominant scales in the ocean. Authors sug-

gested an approach to evaluate possible roles of nonlinear self-organization in generation of quasi-zonal jets and bi-annual oscillations in the real ocean. Their technique involves the spatial mode decomposition and wavelet analysis in the time domain.

The central questions of the present paper are: if and how four-wave quasi-resonance interactions form the QZJs. Even though these jets are not intense in the ocean, the authors argue that they contribute to generation of Rossby waves, which are not weak.

I think that the paper is written in a good scientific style. It still needs a MINOR REVISION before publication in Nonlinear Processes Geophysics. Particular questions, I wish they were better discussed, follow.

(1) Improve overview of the ocean QZJ observations and interpretation.

(2) page 3. I would suggest extending discussion of Connaugton et al. (2010)'s results. Although Connaugton et al. (2010) have analyzed an idealized 2D case, many features found by them are present in altimetry observations.

(3) Provide more details on how you analyze altimeter observations, i.e. without any suggestions about its dimensionality etc. Do you transform SSHs into simpler field? How do you separate bi-annual oscillations (BAO), Rossby Waves, QZJs from the mode decomposition employed in the paper?. How these features are distinguished from satellite SSH? Demonstrate quartet by discussion of wave number and frequency of each contributor.

(4) More details should be provided in the Abstract, which should be self-explaining. In particular, the statement ("The total number of quartets induced off California was approximately 10 times larger than the number of existing triads") needs more explanations.

(5) lines 25-26, p.98. Provide reference for each generation mechanism you discussed.

(6) after line 25, p.99. what is q and why it varies upto 2 to 3. Can the wave steepness be ~ 2 for weakly nonlinear waves?

(7) Explain what is meant by ‘faster to slower scales” (after line 10 on p.100). Guess it needs rewording.

(8) Figure 4. Why biannual oscillations in Fig.4 don’t depict biannual periodicity. Visual inspection of Fig. 4b suggest that <\nuˆ2> varies with semi-annual periodicity.

(9) Figure 9 has panels (a) through (h), but only (a) and (b) are mentioned in its legend.

Section 4. Please, give an example for a quartet.

Section 9. Some discussion of how two different types of quartets were identified from the SSH data would be helpful.

Noted typos.

Page 98, Line 16, the “(“ before 2007 should be deleted

Line 10, p.99. Srivistan -> Srinivasan

Line 25, "A number of" should be replaced by "Mechanisms for"

Page 104,Line 4, delete "more"

Page 105, remove the space between the integral signs

Page 107, Line 7 insert an "a" after "in"

Page 108, Line 1/2 "apriori" should be in italics

Interactive comment on Nonlin. Processes Geophys. Discuss., 1, 97, 2014.