KORESPONDENSI PAPER

Judul : Ekman dynamics variability along the southern coast of Java revealed by satellite data

Jurnal : International Journal of Remote Sensing / Taylor and Francis (Q1)

No	Aktivitas	Tanggal	Keterangan	Lamp.
1	Submission	27/09/2019	Manuscript submission to the International Journal of Remote Sensing - Manuscript ID TRES-PAP-2019-1169	1
2	Hasil review ronde 1	14/11/2019	IJRS - Decision on Manuscript ID TRES-PAP-2019-1169 Major revision dengan 3 reviewer	2
3	Revision round 1 submitted	19/02/2020	Revised IJRS Research Paper submission to the International Journal of Remote Sensing - TRES-PAP-2019-1169.R1 Balasan komentar reviewer terlampir	3
4	Hasil review ronde 2	19/03/2020	IJRS - Decision on revised manuscript ID TRES-PAP-2019-1169.R1 Minor revision	4
5	Revision round 2 submitted	29/03/2020	Revised IJRS Research Paper submission to the International Journal of Remote Sensing - TRES-PAP-2019-1169.R2 Balasan komentar reviewer terlampir	5
6	Accepted	24/04/2020	IJRS - Decision on Revised Manuscript ID TRES-PAP-2019-1169.R2	6
7	Published	21/09/2020	Taylor & Francis Author Survey	7

Catatan : Semua proses submission sampai publish melalui system, email terlampir hanya merupakan report dari system tersebut

Manuscript submission to the International Journal of Remote Sensing - Manuscript ID TRES-PAP-2019-1169

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Date: Friday, September 27, 2019, 01:07 PM GMT+7

27-Sep-2019

Dear Dr. Anindya Wirasatriya
(cc'd to co-authors, if any)

Your manuscript entitled "Ekman dynamics variability along the southern coast of Java revealed by satellite data" has been successfully submitted online and is presently being given full consideration for publication in International Journal of Remote Sensing.

Your manuscript ID is TRES-PAP-2019-1169.

Please mention the above manuscript ID in all future correspondence. If there are any changes in your contact details, please log in to the International Journal of Remote Sensing - ScholarOne Manuscripts site at https://mc.manuscriptcentral.com/tres and edit your user account information as appropriate.

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The journal to which you are have submitted to is participating in the PEER project. This project, which is supported by the European Union EC eContentplus programme(http://ec.europa.eu/information_society/activities/econtentplus/index_en.htm), aims to monitor the effects of systematic self-archiving (author deposit in repositories) over time. If your submission is accepted, and you are based in the EU, you may be invited to deposit your accepted manuscript in a repository as part of this project. The project will develop models to illustrate how traditional publishing systems may coexist with self-archiving For further information please visit the PEER project website at http://www.peerproject.eu.

Thank you for submitting your manuscript to the International Journal of Remote Sensing.

Yours sincerely

Mrs Catherine Murray
Administrator, International Journal of Remote Sensing
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Lampiran 2

IJRS - Decision on Manuscript ID TRES-PAP-2019-1169

From: International Journal of Remote Sensing (onbehalfof@manuscriptcentral.com)

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Date: Friday, November 15, 2019, 08:13 AM GMT+7

14-Nov-2019

Dear Dr. Wirasatriya

Manuscript ID TRES-PAP-2019-1169 entitled "Ekman dynamics variability along the southern coast of Java revealed by satellite data" which you submitted to the International Journal of Remote Sensing, has been reviewed.

The comments of the referee(s) are included at the bottom of this email.

The referee(s) suggest that the submission may be publishable, but only after some major revisions have been made to your manuscript. Therefore, I invite you to respond to their comments and revise your manuscript.

IMPORTANT: In order to avoid delays, if your paper is finally accepted for publication, I would earnestly encourage you to make absolutely sure that your have fully complied with the Instructions for Authors and the Further Notes on Style that apply to this Journal. PLEASE SEE THE ATTACHED FILE which contains a summary of these Instructions.

You will be unable to make your revisions on the originally submitted version of the manuscript. Instead, revise your manuscript using a word processing program and save it on your computer.

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IMPORTANT: Your original files are available to you when you upload your revised manuscript. Please delete any redundant files before completing the submission.

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Once again, thank you for submitting your manuscript to the International Journal of Remote Sensing and I look forward to receiving your revision.

Yours sincerely

Dr. Weigen Huang
Editor, International Journal of Remote Sensing
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ATTACHMENT: "Summary of Instructions to IJRS Authors".

Referee(s)' Comments to Author:

Referee: 1

Comments to the Author
Please see the review in the attached file.

Referee: 2

Comments to the Author
Review of "Ekman dynamics variability along the southern coast of Java revealed by satellite data" by WIRASATRIYA et al.
Reviewed by: Takanori Horii, JAMSTEC, Japan

This study examined Ekman mass transport (EMT) and Ekman pumping velocity (EPV) related to seasonal coastal upwelling along the southern coast of Java. The authors presented distinguished dynamic process of the EMT and EPV at two different sites south of Java: one is western part around 8S-107E and another is around central part around (9S-100E). Stronger (weaker) EMT and Ekman pumping (Ekman suction) were estimated at the western part (central part). The results imply that there would be zonally different mass balance in the coastal upwelling system. They also investigated interannual variation of the EMT and EPV south of Java associated with ENSO and IOD.

Overall, the analysis procedures are sound and the results are interesting. I think this knowledge will contribute to understanding coastal upwelling system there. However, I also found that several major concerns/problems and quite a few minor points to be revised for publication. In particular, it is a must to consider the spatial scale of coastal upwelling estimated by the internal radius of deformation (Yoshida 1955; Gill 1982) to justify the main results. Specific comments are given below.

Major comments
1) As is well known, coastal upwelling is confined in narrow area along the coast. In our recent work, we estimated the spatial scale of the upwelling south of Java as 30-70 km (Horii et al. 2018). Because the results presented in this manuscript were based on satellite dataset with the resolution (0.25*0.25 degree), it is essential to check the results (Figures 2-9) can be interpreted as the signal within the range of the coastal upwelling. Otherwise, their discussion on the balance between EMT and EPV (Page 11 around L. 17-22; Page 12 around L. 24-27) would not be valid.
Reference:
Yoshida K (1955) Coastal upwelling off the California coast, Rec Oceanogr Works, Japan, 15, 1-13
Gill (1982) Atmosphere-ocean dynamics. Academic Press. 662pp.
Horii, T., I. Ueki, and K. Ando (2018) Coastal upwelling events along the southern coast of Java during the 2008 positive Indian Ocean Dipole. J. Oceanography 74(5), 499-508, doi:https://doi.org/10.1007/s10872-018-0475-z

2) Related to the above comment (1), estimated Ekman pumping at the western side (Figure 4: July-August) looks more than 50 km away from the coast. If this is the case, the Ekman pumping cannot directly inhibit coastal upwelling occurred near the coast; the downwelling would just push down the subsurface layer at the area away from the upwelling region. Please consider the regional difference and discuss this point.

3) The zonal difference in EMT and EPV (Figures 2-5) is interesting. However, the domains of two boxes are too small to justify the conclusion. I would suggest estimating EMT and EPV for wider domains: for example, (106-108.5E, 8.5S-7.5S) and (108.5-112E, 9.0S-8.0S).

Minor comments
4) Abstract: "southeasterly wind burst" is not an appropriate terminology. Simply "southeasterly wind" would be better.

5) 4th paragraph of Introduction "Nevertheless, the physical processes…was never been described in the previous studies" seems exaggerating sentence. Actually, based on observational data, Horii et al. (2018) showed that the coastal upwelling signal south of Java can be explained by the local southeasterly wind.

6) Page 8 around L. 44: Fig. 2a, not Fig. 1a

7) Page 10 around L. 8 "offshore EMT dominates throughout the year": " offshore EMT dominates for all other season from April to November" would be better.

8) Page 11 around L. 7: "…is also attained in July-August" would be better.

9) Page 11 around L. 45-60: The part "To investigate…in Susanto, Moore, and Marra (2006)" should be placed before the paragraph "Similar pattern of the zonal propagation…" (Page 12 around L. 38).

10) As above comment (9), the content of the part "During the peak of southeast monsoon season…by their EPV distribution" overlaps with the previous part "To examine the relationship among EMT…in the previous subsection (Pages 10-11)". Please reorganize the paragraphs.

11) Page 12 around L. 41: a typo: Varela et al. (2016)

12) Page 14 around L. 11: There was no positive IOD observed in 2009.

13) Page 14 around L. 36-39 "Nevertheless, we cannot find the significant intensified wind": I think we can see the intensified signal in the Hovmoller diagram of EPV (Figure 8b).

14) Page 14 around L. 58-60 "ITF induces baroclinic instability that accelerates upwelling": Please show citation(s) on baroclinic instability there.

15) Page 15 around L. 60: Please delete "throughout the year"

16) Figure 10: Which year is the salinity anomaly? In August 2006?

Referee: 3

Comments to the Author
This paper try to understand the seasonal and inter-seasonal dynamics of Java Upwelling. The effort if constructed carefully will be a good output that can contribute to new knowledge in the area. There are very few studies in the region, and the additional part of IOD and ENSO has certainly increase the value of the research output. Nevertheless, there are a lot of shortcomings that need to be addressed by the author before the paper can be consider for publications.

Major comments
1. The direct comparison between EPV and EMT by authors are inappropriate. For the direct comparison between EMT (units: m3 s-1 per meter of coast) and EPV (m s -1), the EPV must be converted to vertical transport by integrating vertical velocity out to the distance where the positive wind stress curl remains. After the EPV was converted to vertical transport, we had two independent upwelling estimates; that due to EMT and integrated EPV which are having the same unit of m3 s-1 per meter of coast, and thus, comparison can be done. In addition, I have noticed EPV has a wrong unit (m3 s-1) where is should be (m s-1). Please refer to Pickett & Paduan (2003) https://doi.org/10.1029/2003JC001902; Kok et al. (2017) https://doi.org/10.1371/journal.pone.0171979; Castelao & Barth (2006) https://doi.org/10.1029/2005GL025182 for better clarification.
2. The authors were using different wind data sources, i.e QuickSCAT and ASCAT to calculate monthly climatology of EMT and EPV from 2003 – 2016. This practise is unsuitable since both satellites may use different sensitivity/algorithm to obtain wind data. Merging these datasets to obtain monthly climatology data may lead to the deviation of result. Hence, I suggest authors to use continuous dataset either obtain from the same satellite or use the reanalysis wind data, e.g. ERA5. Otherwise, separate the current dataset according to monthly climatology, 2003 – 2009 (QuikSCAT) & 2010 – 2016 (ASCAT).
3. Section 3.1: I don't quite agree with the usage of wind speed to correlate with SST directly which may lead to an inaccuracy of correlation coefficient. The wind speed is a combination of both zonal and meridional components. Since the coast of southern Java is east-west orientated, the wind component responsible for upwelling must be zonal component (alongshore wind) and it might correlate well with SST. The author should correlate the SST with zonal and meridional wind components separately and determine which of the wind component is correlated well/ not well correlated with SST.
4. Page 14, Line 8 – 20: The author did not emphasis on why there is no significant change of the chl-a and SST during 2009 & 2015 although the characteristic is similar with 1997 which have positive IOD and strong El Nino (chl-blooming). In addition, I noticed that SST and chl-a in both 2009 and 2015 showing different characteristic where in 2009 the SST is warmer, and chl-a are lower if compared to that in 2015 and in 2015 itself, the SST and chl-a are rather similar with normal years but not in 2009. In addition, further analysis should be done to emphasis either IOD or El Nino have left a comparative larger impact on the upwelling system in the southern Java since IOD and ENSO might produce different impacts on upwelling along southern Java.

Minor Comments
Page 3, Line 11-34: This paragraph might not be necessary since it does not quite relate to your research topic.

Page 3, Line 37 – 58: This paragraph should be combined with the first paragraph, and then summarize. Besides, the authors should emphasis when is the period of monsoon season, i.e. southeast/northwest monsoon as well as to inform the wind orientations within these periods.
Page 4, Line 3 – 8: Some researches proposed several factors that…These sentences are too general, the authors should explain the influences of ITF and Kelvin wave towards upwelling in concise.
Page 4, Line 17 – 18: Nevertheless, the physical processes on how… This sentence is not true. As according to your paper, Varela et al. (2016) have conducted the upwelling study of southern Java through the analysis of EMT.
Page 4, Line 31 – 54: For example, in the South China Sea… The author should be careful in emphasising the upwelling in the South China Sea or Vietnamese coast. The given example is only referred to the Vietnamese coast but not represent the SCS as the SCS itself is represented by numerous coasts, i.e. Vietnamese coast, Taiwanese coast, Malaysian coast etc. You should also refer to this paper;
Kok PH, Mohd Akhir MF, Tangang F, Husain ML (2017) Spatiotemporal trends in the southwest monsoon wind driven upwelling in the southwestern part of the South China Sea. PLoS ONE 12(2): e0171979.https://doi.org/10.1371/journal.pone.0171979

Page 6, Line 17 – 22: In addition, bathymetry was… This is not the main data source and should be included in the caption of figure 1.
Page 7, Line 4 – 9: The equation 4 must come before equation 3.
Page 7, Line 42 – 49: Should be changed to - To investigate interannual variability… and Dipole Mode Index (DMI), respectively.
Page 8, Line 27: surface winds blow northeastward change to southeasterly (the meteorological term used to refer wind direction).
Page 8, Line 28 – 30: along northern coast of Java change to along southern coast of Java.
Page 8, Line 36: coast of Java. Many studies showed that change to coast of Java where many studies showed that
Page 9, Line 26 – 50: Based on the region … this paragraph should be in introduction
Page 9, Line 52, Page 10, Line 27 – 31: Since this study is only focusing on the upwelling, therefore the information other than upwelling months in not necessary, and so, the map of EMT (Fig. 3) and EPV (Fig. 4) other than upwelling months is also unnecessary.
Page 15, Line 47: Please refer to major comment item 3.
Page 15 Line 55 – Page 16, Line 23: Please refer to major comment item 1.
Figure 2a) It should not only show the SST during the peak month of upwelling (August), whereas it should show all of SST map during the entire upwelling months in order to give a clearer picture of the evolution of SST spatially and temporally. In addition, the thin and thick box should be placed in figure 1. Moreover, the author should use western/eastern box rather than using thin/thick box for better clarification throughout the manuscript.
Figure 6: 20 sample areas in 0.5 x 0.5 bins should be placed inside figure 1. Therefore, this figure might not necessary.

* Summary-of-Instructions-to-IJRS-Authors.pdf
18.8kB

Wirasatriya et al 2019 review.pdf
91.1kB

Wirasatriya et al 2019 review.pdf
91.1kB

Revised IJRS Research Paper submission to the International Journal of Remote Sensing - TRES-PAP-2019-1169.R1

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Date: Thursday, February 20, 2020, 11:03 AM GMT+7

19-Feb-2020

Dear Dr. Anindya Wirasatriya
(cc'd to co-authors, if any)

Your revised IJRS Research Paper entitled "Ekman dynamics variability along the southern coast of Java revealed by satellite data" has been successfully submitted online and is presently being given full consideration for publication in our journal, the International Journal of Remote Sensing.

Your manuscript ID is TRES-PAP-2019-1169.R1.

This reference number is the same as the orginal one, but with .R1 or .R2 etc added, signifying that it is a 1st revision, 2nd revison etc. Please note that the Editor may choose to assign it to referees again, even though it is a revision.

Please mention the above manuscript ID in all future correspondence. If there are any changes in your contact details, please log in to the International Journal of Remote Sensing - ScholarOne Manuscripts site at https://mc.manuscriptcentral.com/tres and edit your user account information as appropriate.

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Thank you for submitting your manuscript to the International Journal of Remote Sensing.

Yours sincerely

Mrs Catherine Murray
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General Response

We would like to thank to all reviewers for the comments, criticisms, suggestions and questions that can improve the quality of this manuscript. We conducted fundamental changes based on the comments from reviewers. First, we change the wind data from QuikSCAT and ASCAT 0.25° into ASCAT 0.125°. Since the starting observation period of ASCAT is 2007, we exclude the analysis in 2006 as a consequence. The observation period becomes 2007-2018. We also fix the units of EMT and EPV based on the literature review suggested by reviewers. Thus, we reanalyzed all dataset for imroving this manuscript. For the texts, we have rearranged the story of the paper to be more understandable. We also checked the English and typos carefully. The revised parts are in red fonts. Our responses are denoted in "**R:**" and P…L.. means Page …. Line ….

<u>Referee 1</u>

Summary of review:

The manuscript uses primarily satellite data (wind, SST, and chlorophyll) to study the seasonal cycle and interannual variability of Ekman offshore transport and Ekman pumping south of the coast of Java. The authors are focused on the difference in alongshore wind stress (and therefore Ekman transport) between the coast of western vs. eastern Java, and explaining why SST during the upwelling season is fairly uniform along the coast despite the greater offshore Ekman transport near western Java. The paper focuses on the hypothesis that Ekman pumping suppresses upwelling near western Java while enhancing it near eastern Java. This is an interesting idea, but unfortunately there is little compelling support for it in the manuscript presently. I am concerned that the Ekman pumping calculations are influenced by potentially error-prone wind data near the coastline, and also that the authors do not seem to have considered the influence of coastal Kelvin or other coastally-trapped waves as a possible explanation. Earlier literature in this region, as well as in other regions dating back at least to Clarke (1979) have suggested that coastal anomalies in upwelling & SST occur down the waveguide (in this case east) from where the maximum wind forcing occurs. Lastly, there is a brief attempt at an analysis of salinity, which is definitely another factor to consider when explaining SST variability in the region, but it is not well developed and outside the main focus of the paper. Hence, I can not recommend acceptance of this manuscript to the journal without **major revisions**. At this time, the results supporting the authors' conclusions are not robust; however, if the manuscript is revised as suggested in the comments below, they may still find novel contributions to our knowledge of the Java coastal upwelling.

R: Thank you very much for your comments. ASCAT product has been tasted and validated both for open seas and coastal areas and it show good accuracy for both areas (Verhoef and Stoffelen 2014). Moreover, our curl calculation has already exclude the closest pixels to the land to avoid the land error. We have also added more explanation about Kelvin wave in the discussion which may can answer, why the effect positive IOD is not robust to both EPV and EMT. The references that you suggested truly increase our understanding about the mechanisms of coastal upwelling in the southern coast of Java.

Major comments:

1. In Figure 7, the alongshore variations in EMT and EPV during the upwelling season (approx. June-September) appear to be negatively correlated. For example, negative EPV is observed in bins 8-10 throughout the upwelling season, even as it is positive elsewhere. In these bins the EMT is also weaker than areas to the west and east. Since EPV is likely mostly a function of $\partial\tau x/\partial y$, this suggests to me that the alongshore EPV variations are mostly determined by the alongshore wind closest to the coast. Where the alongshore wind adjacent to the coast is strongest, the EPV is positive (downward); where coastal alongshore wind is weaker, EPV is negative (upward). This concerns me because it is closest to the coast where measurements from QuikSCAT and ASCAT are likely to have the largest errors (from land influencing the backscatter). Therefore, one of the authors' key conclusions from the paper (that Ekman pumping intensifies upwelling near eastern Java and suppresses it near western Java) is dependent on measurements that may be subject to large errors. In order to increase confidence that these analyses are based on robust data, the manuscript needs to do the following:

- Plot the seasonal cycle of alongshore wind at progressively larger distances south of the coastline; this could be done using plots with axes of y (distance from coast) and month, and averaged for boxes south of western Java and eastern Java. The idea is to clarify how the wind climatology (plotted indirectly in Figure 3) influences $\partial\tau x/\partial y$ and therefore EPV.

R: Fig. A show the Monthly Climatology of he Zonal component of wind to represent $\partial\tau x/\partial y$ in the changing time. However, we cannot see the how wind climatology influences EPV. This is because EPV is not only influenced by $\partial\tau x/\partial y$ but also $\partial\tau y/\partial x$ as a manifestation of curl.

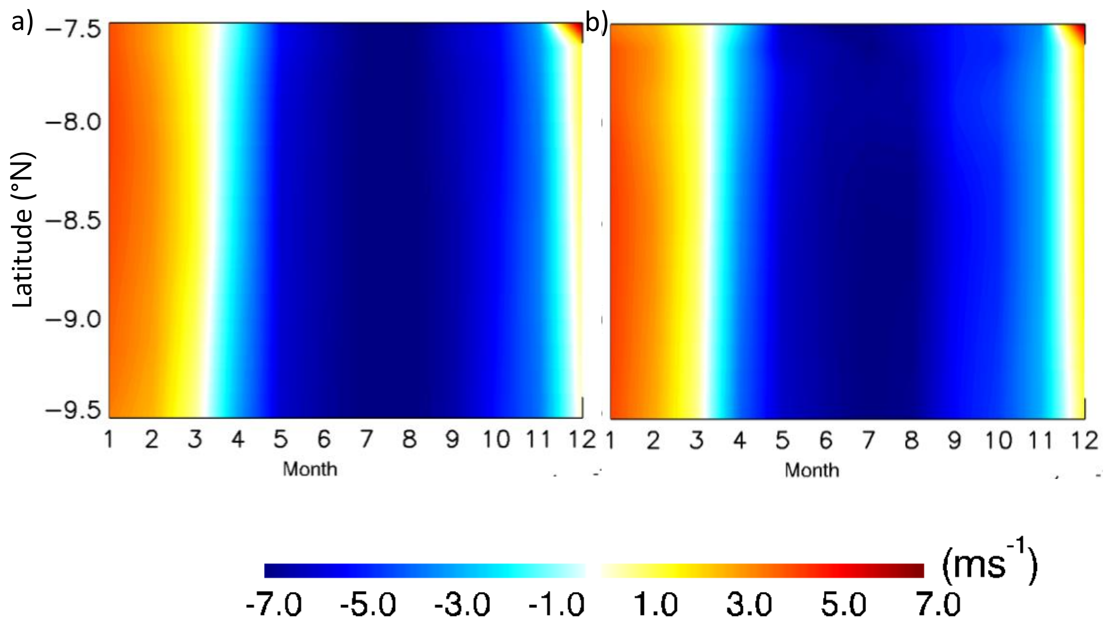

Fig. A. Monthly Climatology of he Zonal component of wind at a) 106.5-107.5°E and b) 110.5-111.5°E.

- The manuscript should show how the magnitude of the calculated EPV compares to typical isopycnal vertical displacement rates (perhaps the reanalysis could be used to quantify isopycnal variability, and/or in-situ measurements such as the IX1 XBT line). Is the magnitude of EPV strong enough to explain observed or modeled isopycnal displacements?

R: Thank you very much for your suggestion we plot the the variation of density vertical profiles from reanalysis data (http://marine.copernicus.eu/) as shown in Fig. 5a,b. as a representation of the upwelling/downwelling processes in both boxes. The lifting of denser water masses which indicate upwelling occur during southeast monsoon season for both boxes. However, it is clearly seen that the upwelling in the eastern box is stronger than in the western box as denoted by the higher surface density in the eastern box (i.e., more than 22.4 kg m^{-3}) from August to September. This result indicates that during southeast monsoon season, the resultant of weak offshore EMT and strong negative EPV in the eastern box generates stronger upwelling than the resultant of strong offshore EMT and positive EPV in the western box. As a result, SSTs in the eastern box are lower than those in the western box. This analysis indicates that magnitude of EPV strong enough to explain modeled isopycnal displacements. The more explanation can be obtained in P13L41-P14L13

- Temporal correlations would also enhance the argument for EPV having an influence on SST in this area. If EPV in each bin is correlated with SST in the same bin (during the upwelling season, with seasonal averages removed), is there a relationship robust enough to suggest a causal influence? This may be a challenge to show, since EPV is already correlated with EMT and EMT appears to be the dominant signal. But if the influence of EMT adjacent to the coast can be removed (using a linear regression for example) and the EPV variability itself is shown to influence SST, this would be a novel and significant result.

R: we conducted a statistical analysis to obtain the relationship among SST, EMT and EPV for both boxes as shown in Table 1. In the western box, the correlation between SST and meridional EMT is higher than the correlation between SST and EPV. This indicates that the influence of meridional EMT to SST variation is stronger than EPV. Conversely, the influence of EPV to SST variation is stronger than meridional EMT in the eastern box. However, the multiple correlation analysis between the meridional component of EMT and EPV as the independent variable and SST as the dependent variable are stronger than the single correlation analysis for both boxes. These correlation values imply that the effects of both wind speed (represented by EMT) and wind curl (represented by EPV), combine to influence SST variation along the southern coast of Java. The more explanation can be obtained in P14L15-37.

2. Section 3.3, page 14: After a sentence in the introduction (page 3), there is no mention of coastal Kelvin wave activity along the coast of Java. Yet previous studies (Chen et al. 2015, 2016; Delman et al. 2016, 2018; Horii et al. 2018) have found that coastal Kelvin waves generated by remote wind anomalies (either along the equator in the Indian Ocean, or along the coast of Sumatra) are a dominant contributor to the interannual variability of upwelling and negative SST anomalies during positive IOD and El Niño years. Any study of interannual variability in this region needs to address their influence. In the case of 2006, alongshore wind anomalies near the coast of Java were neutral to slightly downwelling-favorable through much of the May-October upwelling season (e.g., Figure 8c, Delman et al. 2016). But there were upwelling-favorable winds along the equator and Sumatra coast in June 2016, preceding the development of negative SST anomalies. Horii et al. (2018) also found evidence for coastal Kelvin wave activity, as Argo float data showed upward movement of isotherms that was not supported by local wind anomalies in July 2008 (Figure 6a, Horii et al. 2018). Upwelling coastal Kelvin waves may affect surface chlorophyll as well; like upwelling-favorable Ekman transport and Ekman pumping from local wind forcing, Kelvin waves can bring deeper nutrient-rich waters close to the surface where they are entrained into the mixed layer. Some (though not all) of this Kelvin wave variability (in particular equatorially-generated Kelvin waves) is related to the IOD DMI. Hence, strong positive Chl-a and negative SST anomalies can occur during the upwelling season when the DMI is negative, even when local EMT and EPV are not significantly different from their seasonal averages.

R: Thank you very much for your suggestion. After adding more explanation about Kelvin wave in the discussion of the interannual variation, the story on how positive IOD amplify the Chl-a blooming and SST cooling along the southern coast of Java during south east monsoon becomes more understandable. Although the increasing EMT and EPV during positive IOD is not too robust compared to the decreasing EMT and EPV during negative IOD, Kelvin wave may contribute to the increasing Chl-a and reducing SST during positive IOD. The more explanation can be obtained in P17L50-P18L59.

3. Lower page 14 and upper page 15: The salinity analysis here is very thin and does not show an understanding of the subsurface structure in the area. Why choose 200 m depth? The vertical salinity gradients are most pronounced at ~50-100 m depth, just below the base of the mixed layer. Differences in salinity between the mixed layer and the thermocline near Java typically exceed 1 g/kg or ppt (Figure 7b, Delman et al. 2016), so it is unlikely that an anomaly of 0.1 ppt well below the mixed layer would significantly affect vertical mixing and entrainment into the mixed layer. There may in fact be a convincing argument to make that the salinity stratification impacts SST; while EMT is weaker near eastern Java compared to western Java, the vertical salinity stratification is also weaker, and this could be a compensating factor that allows for more SST cooling further east. There are not many in-situ observations to study time series of subsurface salinity, but sea surface salinity (SSS) observations are available from SMOS starting in 2010. If the authors substantially revise this paper, they may want to consider including satellite SSS observations along with the reanalysis. Otherwise, a salinity analysis is probably beyond the scope of this paper, and I would recommend removing this section to keep the focus on studying Ekman dynamics by looking at wind, SST, and chlorophyll data.

R: Thank you very much for your suggestion. Since now we use ASCAT data only, the observation period is from 2007 to 2018 which makes case 2006 automatically excluded. Therefore, the analysis of salinity for the case of 2006 is also automatically removed.

Other comments/edits:

General comment: There are a number of errors in English grammar that need to be corrected; I understand that English is not the first language of many of the authors, so this is understandable, but the text should be checked by a good-quality English-language word processing program before submitting. Additionally, there are some typos and inconsistencies in notation, figure captions, and website URLs that need to be corrected. I have highlighted specific cases below, but please look carefully at these items before resubmission.

R: Thank you very much for your comments. We have carefully check the English, typos, figure captions and website. Hopefully this revised manuscript is much better than the previous one.

Abstract and elsewhere in paper: It seems that the authors use Ekman pumping to refer specifically to downwelling/downward velocity, and Ekman suction to refer to upwelling/upward velocity. But as generally used, Ekman pumping can refer to either downwelling or upwelling. I would suggest clarifying this language to refer to “downwelling Ekman pumping” or “upwelling Ekman pumping”. Once the acronym

EPV is introduced, the terms "downwelling EPV" and "upwelling EPV" could also be used.

R: Thank you very much for your suggestion. Now we use upwelling/downwelling EPV or simply negative/positive EPV in the revised manuscript.

Lower page 4: Since the paper is focusing on Java, there is no need to write in detail about the case of the South China Sea near Vietnam. It is sufficient to mention that Ekman pumping is influential in other parts of the ocean such as the South China Sea near the coast of Vietnam, and cite some relevant references.

R: Thank you very much for your suggestion. Now we simplify the introduction of South China Sea case and add more cases to enrich the background of the different contribution of EMT and EPV for the upwelling generation in an area. (P5L13-34)

Equation (6): In standard notation, the *i* in *xi* would be a subscript: *xi*.

R: It is done. (P8L48)

Section 2.1, lower page 5: The analysis of QuikSCAT and ASCAT wind data in this manuscript assumes that these data are accurate close to the coast, as derivatives are taken in areas within 100 km of the coast to compute the wind stress curl. The authors should mention how close to the coast they consider the wind data to be unaffected by interference from land, and give a reference to support their claim.

R: ASCAT product has been tasted and validated both for open seas and coastal areas and it show good accuracy for both areas (Verhoef and Stoffelen 2014). (P6L30-35)

End of section 2.1, page 6: What source is responsible for the generation and distribution of GLOBAL-REANALYSIS-PHY-001-025? I assume this is the ocean physics reanalysis distributed through the Copernicus Marine Environment Monitoring Service (CMEMS). The model used to generate the reanalysis (NEMO) should be mentioned, and the model resolution (1/4°), as well as the distributor (CMEMS).

R: Thank you very much. It is done. (P7L8-16)

Acknowledgement section: The website URL for the SeaWiFS data is no longer active. Please include an updated URL to access this data so that readers can find the dataset that was used.

R: We have provided PO.DAAC Drive url to download the data. (P20L36-39)

Figures 2, 5: Why are the thick and thin boxes chosen for the SST and wind speed comparison so small in area? There is a definite large-scale gradient in wind speed (e.g., Figures 2a, 3 between the areas south of western and eastern Java); this would be more convincingly demonstrated if the boxes used for the comparison included a larger area.

R: Thank you very much for your suggestion. We expand the areal size becomes twice larger.

Figures 3, 4, 6-8: The units of EMT and EPV in these figures are specified as m3 /s or /m3 , which is incorrect. EMT should have units of m2 /s, and EPV should have units of m/s. Please also check the scaling factors; I do not think that the scaling factor is 10-4 for all of these figures.

R: Thank you very much for your correction. The unit of EMT is m^2/s and EPV is m/s. These have already adapted from references (e.g., Pickett and Paduan 2003; Kok et al., 2017).

Figure 9 caption: There is no "meridional component" of Chl-a; I assume that this is a typographical error. Please correct this.

R: Thank you very much. Yes this is typographical error.

Figure 10: Salinity anomaly when, relative to what? Given the text, it seems like the anomaly being plotted is during August 2006, relative to the 2003-2015 August climatology. But the figure caption needs to specify this.

R: Salinity analysis for 2006 has been removed.

References:

Chen, G., Han, W., Li, Y., Wang, D., & Shinoda, T. (2015), Intraseasonal variability of upwelling in the equatorial Eastern Indian Ocean. *Journal of Geophysical Research: Oceans*, 120. https://doi.org/10.1002/2015JC011223.

Chen, G., Han, W., Li, Y., & Wang, D. (2016), Interannual variability of equatorial eastern Indian Ocean upwelling: local versus remote forcing. *Journal of Physical Oceanography*, 46, 789-807. https://doi.org/10.1175/JPO-D-15-0117.1.

Clarke, A. J. (1979), On the generation of the seasonal coastal upwelling in the Gulf of Guinea. *Journal of Geophysical Research*, 84 (C7), 3743-3751.

Delman, A. S., Sprintall, J., McClean, J. L., & Talley, L. D. (2016), Anomalous Java cooling at the initiation of positive Indian Ocean Dipole events. *Journal of Geophysical Research: Oceans*, 121, 5805-5824. https://doi.org/10.1002/2016JC011635.

Delman, A. S., McClean, J. L., Sprintall, J., Talley, L. D., & Bryan, F. O. (2018), Processspecific contributions to anomalous Java mixed layer cooling during positive IOD events. *Journal of Geophysical Research: Oceans*, 123. https://doi.org/10.1029/2017JC013749.

Horii, T., Ueki, I., & Ando, K. (2018), Coastal upwelling events along the southern coast of Java during the 2008 positive Indian Ocean Dipole. *Journal of Oceanography*, 74 (5), 499-508.

https://doi.org/10.1007/s10872-018-0475-z.

Referee: 2

Comments to the Author

Review of "Ekman dynamics variability along the southern coast of Java revealed by satellite data" by WIRASATRIYA et al.

Reviewed by: Takanori Horii, JAMSTEC, Japan

This study examined Ekman mass transport (EMT) and Ekman pumping velocity (EPV) related to seasonal coastal upwelling along the southern coast of Java. The authors presented distinguished dynamic process of the EMT and EPV at two different sites south of Java: one is western part around 8S-107E and another is around central part around (9S-100E). Stronger (weaker) EMT and Ekman pumping (Ekman suction) were estimated at the western part (central part). The results imply that there would be zonally different mass balance in the coastal upwelling system. They also investigated interannual variation of the EMT and EPV south of Java associated with ENSO and IOD.

Overall, the analysis procedures are sound and the results are interesting. I think this knowledge will contribute to understanding coastal upwelling system there. However, I also found that several major concerns/problems and quite a few minor points to be revised for publication. In particular, it is a must to consider the spatial scale of coastal upwelling estimated by the internal radius of deformation (Yoshida 1955; Gill 1982) to justify the main results. Specific comments are given below.

R: Thank you very much for your motivating comments. To avoid the miss interpretation due to the coastal upwelling radius, we have changed our wind data from 0.25° resolution into 0.125° resolution which make our analysis can be closer to the land.

Major comments

1) As is well known, coastal upwelling is confined in narrow area along the coast. In our recent work, we estimated the spatial scale of the upwelling south of Java as 30-70 km (Horii et al. 2018). Because the results presented in this manuscript were based on satellite dataset with the resolution (0.25*0.25 degree), it is essential to check the results (Figures 2-9) can be interpreted as the signal within the range of the coastal upwelling. Otherwise, their discussion on the balance between EMT and EPV (Page 11 around L. 17-22; Page 12 around L. 24-27) would not be valid.

Reference:

Yoshida K (1955) Coastal upwelling off the California coast, Rec Oceanogr Works, Japan, 15, 1-13

Gill (1982) Atmosphere-ocean dynamics. Academic Press. 662pp.

Horii, T., I. Ueki, and K. Ando (2018) Coastal upwelling events along the southern coast of Java during the 2008 positive Indian Ocean Dipole. J. Oceanography 74(5), 499-508, doi:https://doi.org/10.1007/s10872-018-0475-z

R: Thank you very much for your concern. Since now we now use ASCAT 12.5 km, the surface wind data can be closer to the land and and then we can keep the analysis for EMT and EPV within 70 km band along the coastal line.

2) Related to the above comment (1), estimated Ekman pumping at the western side (Figure 4: July-August) looks more than 50 km away from the coast. If this is the case, the Ekman pumping cannot directly inhibit coastal upwelling occurred near the coast; the downwelling would just push down the subsurface layer at the area away from the upwelling region. Please consider the regional difference and discuss this point.

R: Thank you very much for your concern. Since now we now use ASCAT 12.5 km, the surface wind data can be closer to the land and and then we can keep the analysis for EMT and EPV within 70 km band along the coastal line.

3) The zonal difference in EMT and EPV (Figures 2-5) is interesting. However, the domains of two boxes are too small to justify the conclusion. I would suggest estimating EMT and EPV for wider domains: for example, (106-108.5E, 8.5S-7.5S) and (108.5-112E, 9.0S-8.0S).

R: Thank you very much for your suggestion. We have enlarged the areal size becomes twice larger but we still keep the area not too far from the coast due to the concern about the radius of coastal upwelling. (P17L39-47)

Minor comments

4) Abstract: "southeasterly wind burst" is not an appropriate terminology. Simply "southeasterly wind" would be better.

R: It is done. (P2-L16)

5) 4th paragraph of Introduction "Nevertheless, the physical processes…was never been described in the previous studies" seems exaggerating sentence. Actually, based on observational data, Horii et al. (2018) showed that the coastal upwelling signal south of Java can be explained by the local southeasterly wind.

R: Thank you very much… we have add more references for the previous study of upwelling along the southern coast of Java, and highlighted the left problems. The more explanation can be obtained at (P3L13-43)

6) Page 8 around L. 44: Fig. 2a, not Fig. 1a

R: Thank you very much for your correction. It is done. (P10L52)

7) Page 10 around L. 8 "offshore EMT dominates throughout the year": " offshore EMT dominates for all other season from April to November" would be better.

R: It is done. (P11L52)

8) Page 11 around L. 7: "…is also attained in July-August" would be better.

R: The new analysis shows that the maximum difference of V EMT is in August. (P12L56)

9) Page 11 around L. 45-60: The part "To investigate…in Susanto, Moore, and Marra (2006)" should be placed before the paragraph "Similar pattern of the zonal propagation…" (Page 12 around L. 38).

R: It is done. (P15L8-25)

9) As above comment (9), the content of the part "During the peak of southeast monsoon season…by their EPV distribution" overlaps with the previous part "To examine the relationship among EMT…in the previous subsection (Pages 10-11)". Please reorganize the paragraphs.

R: It is done. "During the peak of southeast…." becomes new paragraph. (P15L30)

10) Page 12 around L. 41: a typo: Varela et al. (2016)

R : It is done. (P15L10)

12) Page 14 around L. 11: There was no positive IOD observed in 2009.

R: 2009 is positive IOD. Now we made IOD and ONI indices in the hovmoller plot become more understandable (Fig. 7and 8).

13) Page 14 around L. 36-39 "Nevertheless, we cannot find the significant intensified wind": I think we can see the intensified signal in the Hovmoller diagram of EPV (Figure 8b).

R: We have improved the quality of Hovmoller diagram in Fig. 7 and 8. Now the the influence of ENSO and IOD to the variability of EMT and EPV are more distinguishable. Therefore, the intensified signal of EPV is observed.

14) Page 14 around L. 58-60 "ITF induces baroclinic instability that accelerates upwelling": Please show citation(s) on baroclinic instability there.

R: We have removed the discussion about case 2006.

15) Page 15 around L. 60: Please delete "throughout the year"

R: It is done. (P19L39)

15) Figure 10: Which year is the salinity anomaly? In August 2006?

R: We have removed the discussion about case 2006.

Referee: 3

Comments to the Author

This paper try to understand the seasonal and inter-seasonal dynamics of Java Upwelling. The effort if constructed carefully will be a good output that can contribute to new knowledge in the area. There are very few studies in the region, and the additional part of IOD and ENSO has certainly increase the value of the research output. Nevertheless, there are a lot of shortcomings that need to be addressed by the author before the paper can be consider for publications.

R: Thank you very much for your comment. In the revised manuscript, we have improve many parts coming from the reviewers. We also have improved the figure for IOD and ENSO analysis which becomes more understandable and informative.

Major comments

1. The direct comparison between EPV and EMT by authors are inappropriate. For the direct comparison between EMT (units: m3 s-1 per meter of coast) and EPV (m s -1), the EPV must be converted to vertical transport by integrating vertical velocity out to the distance where the positive wind stress curl remains. After the EPV was converted to vertical transport, we had two independent upwelling estimates; that due to EMT and integrated EPV which are having the same unit of m3 s-1 per meter of coast, and thus, comparison can be done. In addition, I have noticed EPV has a wrong unit (m3 s-1) where is should be (m s-1). Please refer to Pickett & Paduan (2003) https://doi.org/10.1029/2003JC001902; Kok et al. (2017) https://doi.org/10.1371/journal.pone.0171979; Castelao & Barth (2006) https://doi.org/10.1029/2005GL025182 for better clarification.

R: Thank you very much for your correction. The unit of EMT is m^2/s and EPV is m/s. These have already adapted from references (e.g., Pickett and Paduan 2003; Kok et al., 2017). The previous studies (e.g., Pickett and Paduan 2003; Castelao and Barth 2006; Kok et al. 2017) converted the unit of EPV into vertical transport in order to compare the water mass transport brought by EMT and EPV in the same units (i.e., m^2s^{-1}). They estimated vertical transport by integrating vertical velocity out to the distance where the positive wind stress curl remains. Since the present study is not only considering the positive wind curl stress but also negative wind curl stress, we did not convert into vertical transport. Helpern (2002) simply compared EPV and EMT which is represented by alongshore wind stress to examine the variability of Ekman dynamics off Peru during 1997-1998 El Niño. In the present study, we performed correlation analysis to determine the dominant role of the Ekman dynamics that influence upwelling along the southern coast of Java. To determine the dominant role of the Ekman dynamics that influence upwelling along the southern coast of Java, we performed correlation analysis. (P8L13-39)

2. The authors were using different wind data sources, i.e QuickSCAT and ASCAT to calculate monthly climatology of EMT and EPV from 2003 – 2016. This practise is unsuitable since both satellites may use different sensitivity/algorithm to obtain wind data. Merging these datasets to obtain monthly climatology data may lead to the deviation of result. Hence, I suggest authors to use continuous dataset either obtain from the same satellite or use the reanalysis wind data, e.g. ERA5. Otherwise, separate the current dataset according to monthly climatology, 2003 – 2009 (QuikSCAT) & 2010 – 2016 (ASCAT).

R: Thank you very much for your suggestion. To solve this problem, we removed QuikSCAT and use only ASCAT 12.5 km. We did not choose ERA5 data since ERA5 data also provide data over the land which causes large error on the curl calculation along the border between land and ocean. ERA5 is also categorized as reanalysis data, so this is not suitable with the title of this manuscript that uses satellite data.

3. Section 3.1: I don't quite agree with the usage of wind speed to correlate with SST directly which may lead to an inaccuracy of correlation coefficient. The wind speed is a combination of both zonal and meridional components. Since the coast of southern Java is east-west orientated, the wind component responsible for upwelling must be zonal component (alongshore wind) and it might correlate well with SST. The author should correlate the SST with zonal and meridional wind components separately and determine which of the wind component is correlated well/ not well correlated with SST.

R: Thank you very much for you comment. Actually we also agree with you. Here we would like to clarify that actually section 3.1. is not the main result. It was made not to examine which wind component is dominant for the variability of SST along the southern coast of Java. It was made to introduce the problem of the relationship between wind speed and SST or Chl-a missed by the previous studies (e.g. Qu et al. 2005; Iskandar et al. 2009). To answer this problem we provide the Ekman dynamics analysis explained in section 3.2. and 3.3 which become the main result of this study.

4. Page 14, Line 8 – 20: The author did not emphasis on why there is no significant change of the chl-a and SST during 2009 & 2015 although the characteristic is similar with 1997 which have positive IOD and strong El Nino (chl-blooming). In addition, I noticed that SST and chl-a in both 2009 and 2015 showing different characteristic where in 2009 the SST is warmer, and chl-a are lower if compared to that in 2015 and in 2015 itself, the SST and Chl-a are rather similar with normal years but not in 2009. In addition, further analysis should be done to emphasis either IOD or El Nino have left a comparative larger impact on the upwelling system in the southern Java since IOD and ENSO might produce different impacts on upwelling along southern Java.

R: Thank you very much for your comment. To sharpen the interannual variation of Ekman dynamics, the ENSO and IOD conditions have been highlighted every year in

Fig. 7 and 8. The quality of Fig. 7 and 8 were also been improved by adding contour lines, so that the variations of EMT, EPV, SST and Chl-a in the different ENSO and IOD condition are more distinguishable. Case 2009 is different with 2015. 2009 is positive IOD and Normal ENSO, while 2015 is positive IOD and El Nino. However, The SST and Chl-a are similarly low and high, respectively. This is because IOD has more effect to the variability of SST and Chl-a in the southern coast of Java than ENSO (Chen et al. 2016). The more explanation can be obtained in P17L50-P18L59.

Minor Comments

Page 3, Line 11-34: This paragraph might not be necessary since it does not quite relate to your research topic.

R: Thank you very much for your suggestion. It is deleted.

Page 3, Line 37 – 58: This paragraph should be combined with the first paragraph, and then summarize. Besides, the authors should emphasis when is the period of monsoon season, i.e. southeast/northwest monsoon as well as to inform the wind orientations within these periods.

R: It is done. We reorganized the paragraph in introduction in order to achieve more flowing story. We added the background of monsoon period in introduction. (P3L38-P4L9)

Page 4, Line 3 – 8: Some researches proposed several factors that…These sentences are too general, the authors should explain the influences of ITF and Kelvin wave towards upwelling in concise.

R: Thank you very much for your comment. We have already provide comprehensive previous study related to the mechanisms of upwelling along the southern coast of Java. (P4L13-43)

Page 4, Line 17 – 18: Nevertheless, the physical processes on how… This sentence is not true. As according to your paper, Varela et al. (2016) have conducted the upwelling study of southern Java through the analysis of EMT.

R: Thank you very much for your correction. We have rearranged the story in Introduction section to avoid miss-understanding about the previous Ekman Dynamics study in the southern coast of Java. Although Varela et al. (2016) showed the role of EMT on the variability of upwelling along the southern coast of Java, they neglected EPV in their analysis which may play important role in the upwelling processes.

Page 4, Line 31 – 54: For example, in the South China Sea… The author should be careful in emphasising the upwelling in the South China Sea or Vietnamese coast. The given example is only referred to the Vietnamese coast but not represent the SCS as the SCS itself is represented by numerous coasts, i.e. Vietnamese coast, Taiwanese coast, Malaysian coast etc. You should also refer to this paper;

Kok PH, Mohd Akhir MF, Tangang F, Husain ML (2017) Spatiotemporal trends in the southwest monsoon wind driven upwelling in the southwestern part of the South China Sea. PLoS ONE 12(2): e0171979.https://doi.org/10.1371/journal.pone.0171979

R: thank you very much for your suggestion. We have changed into Vietnamese coast (P5L13) and add Kok et al. (2017) (P5L30) to enrich the background of this study.

Page 6, Line 17 – 22: In addition, bathymetry was… This is not the main data source and should be included in the caption of figure 1.

R: We have removed bathymetry since it has no correlation with the present analysis.

Page 7, Line 4 – 9: The equation 4 must come before equation 3.

R: It is done

Page 7, Line 42 – 49: Should be changed to - To investigate interannual variability… and Dipole Mode Index (DMI), respectively.

R: It is done. (P9L18)

Page 8, Line 27: surface winds blow northeastward change to southeasterly (the meteorological term used to refer wind direction).

R: It is done.

Page 8, Line 28 – 30: along northern coast of Java change to along southern coast of Java.

R: Thank you very much for your correction. It is done. (P10L37)

Page 8, Line 36: coast of Java. Many studies showed that change to coast of Java where many studies showed that

R: It is done. (P10L44)

Page 9, Line 26 – 50: Based on the region … this paragraph should be in introduction

R: Thank you very much for your suggestion. It moves to introduction. I think the story in the Introduction now becomes better. (P3L38-P4L8-10)

Page 9, Line 52, Page 10, Line 27 – 31: Since this study is only focusing on the upwelling, therefore the information other than upwelling months in not necessary, and so, the map of EMT (Fig. 3) and EPV (Fig. 4) other than upwelling months is also unnecessary.

R: Thank you very much for your comment. The purpose of this research is to investigate the variability of Ekman dynamics along the southern coast of Java. Thus, we provide the analysis for whole months to obtain their seasonal variability. However, to emphasize the incongruity between the distribution of surface wind and SST along the southern coast of Java during upwelling season which was missed by the previous studies the upwelling season becomes the main focus of our analysis.

Page 15, Line 47: Please refer to major comment item 3.

R: Thank you very much for your comment. We keep this conclusion as explained in the answer to major comment item 3.

Page 15 Line 55 – Page 16, Line 23: Please refer to major comment item 1.

R: Thank you very much for your comment. We keep this conclusion. As explained in the answer to major comment item 1, to determine the dominant role of the Ekman dynamics that influence upwelling along the southern coast of Java, we performed correlation analysis.

Figure 2a) It should not only show the SST during the peak month of upwelling (August), whereas it should show all of SST map during the entire upwelling months in order to give a clearer picture of the evolution of SST spatially and temporally. In addition, the thin and thick box should be placed in figure 1.

R: Thank you very much for your comment. The evolution of SST distribution is not the concern of this study since it has already describe in the previous studies (e.g., Susanto et al. 2001; Qu et al. 2005). As explained in the response of Major comment item 3, the reason to show the SST and surface wind map in the peak of upwelling season (August) is to emphasize the incongruity between the distribution of surface wind and SST along the southern coast of Java which was missed by the previous studies. And this analysis becomes the entrance for Ekman Dynamics analysis which becomes the answer of this incongruity.

Moreover, the author should use western/eastern box rather than using thin/thick box for better clarification throughout the manuscript.

R: It is done

Figure 6: 20 sample areas in 0.5 x 0.5 bins should be placed inside figure 1. Therefore, this figure might not necessary.

R: Fig. 6 is moved to Fig. 1.

IJRS - Decision on revised manuscript ID TRES-PAP-2019-1169.R1

From: International Journal of Remote Sensing (onbehalfof@manuscriptcentral.com)

To: aninosi@yahoo.co.id

Date: Thursday, March 19, 2020, 12:49 PM GMT+7

19-Mar-2020

Dear Dr. Wirasatriya

Revised manuscript ID TRES-PAP-2019-1169.R1 entitled "Ekman dynamics variability along the southern coast of Java revealed by satellite data" which you submitted to the International Journal of Remote Sensing, has been reviewed.

The comments of the referee(s) are included at the bottom of this email.

The referee(s) suggest that the submission may be publishable, but only after some major revisions have been made to your manuscript. Therefore, I invite you to respond to their comments and revise your manuscript again.

IMPORTANT: In order to avoid delays, if your paper is finally accepted for publication, I would earnestly encourage you to make absolutely sure that your have fully complied with the Instructions for Authors and the Further Notes on Style that apply to this Journal. PLEASE SEE THE ATTACHED FILE which contains a summary of these Instructions.

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Yours sincerely

Dr. Weigen Huang
Editor, International Journal of Remote Sensing
wghuang163@163.com

ATTACHMENT: "Summary of Instructions to IJRS Authors"

Referee(s)' Comments to Author:

Referee: 1

Comments to the Author
Summary:
The main hypothesis of this paper is that Ekman pumping velocity (EPV) explains why SSTs are cooler near the coast of eastern Java compared to western Java. Previously the authors used QuikSCAT wind data that made me skeptical they could resolve EPV near the coast, but by focusing on ASCAT wind data the odds of resolving the EPV accurately are improved. Along with an expanded discussion of the role of coastal Kelvin waves, some changes to figures and the addition of a table, the manuscript is substantially improved. However, this is still a challenging hypothesis to prove, as coastal Kelvin waves and local stratification (not to mention the possible role of the Indonesian Throughflow) are also known to influence upwelling and SSTs, and there is not sufficient subsurface data near the coast to discount their effects on the west-east Java SST gradient. I do think there are some more analyses that the authors should try before attributing the west-east differences in seasonal or interannual SST variability to EPV, which I have described under "major comments". Given this assessment, I still find the manuscript in need of major revisions, but I commend the authors for making good progress and think that the manuscript should be ready for publication after the issues below are resolved.

Major comments:
1. The most significant challenge to testing the main hypothesis of this paper is showing that factors other than EPV (e.g., coastal Kelvin waves, local stratification) are not the primary reason for the SST difference between western and eastern Java. The authors have already shown (with the helpful changes to Figure 5 and the addition of Table 1) that EPV is a possible explanation for the SST difference. But can we differentiate the influence of locally-forced EPV from that of isopycnal displacements due to remotely-forced Kelvin waves?
One way to try and investigate this is to compute profiles of horizontal divergence in the upper ocean in the two boxes with the ~0.08° resolution CMEMS reanalysis used in Figures 5b,c. (If vertical velocity is available from the reanalysis, the authors could look at this directly, but it does not seem like this is an available variable from the reanalysis product.) If the divergence peaks near the surface, then locally-forced EPV is likely responsible. If the divergence is more evenly spread through the upper 100 meters (i.e., above the thermocline), this suggests the influence of coastal Kelvin waves. The vertically-integrated divergence in the upper ocean can also be compared with the EPV (according to continuity for an incompressible fluid $\partial u/\partial x + \partial v/\partial y + \partial w/\partial z = 0$, so given that w is relatively small near the surface, vertical integration downward from the surface can approximate w). It is necessary to keep in mind that the atmospheric forcing of the reanalysis product (ERA-Interim, ~80 km resolution) is not as high-resolution as ASCAT, so Ekman pumping near the coast may be underrepresented in the analysis. Nonetheless, it would be useful to see how the high-resolution reanalysis represents the vertical profile of horizontal divergence, and whether there are differences between the western and eastern boxes; it would complement the isopycnal plots in Figures 5b,c.

2. There needs to be more information provided about the correlations in Table 1. Over what time range are the correlations in Table 1 computed; is it 2007-2018? Were seasonal averages removed from EPV, EMT, and SST prior to computing the correlations? Since Table 1 is cited in the section on seasonal variation (and not interannual variation), it seems like the seasonal averages were not removed. Retaining the seasonal cycle makes it difficult to show that EPV or EMT causes changes in SST, since the seasonal cycle of SST is influenced by many factors other than EPV and EMT (e.g., radiative and latent heat fluxes, coastal Kelvin wave propagation). Correlations of variables in the seasonal cycle are often not associated with causation, at least not directly, since the seasonal signal is dominant in nearly all physical variables in the upper ocean. By removing the SST seasonal cycle, most of the radiative flux influence at least should be removed, allowing for more focus on the effect of wind forcing. So I would recommend that this analysis be carried out with seasonal averages removed, and discussed in the interannual variation section (3.3).
Also, how are EPV & meridional EMT combined to compute these correlations? Is the EPV multiplied by the meridional length of the box Δy to obtain the vertical flux into the box (in the same units as EMT?). In any case, it is not clear what the physical meaning of the combined EPV and EMT is. It could be more useful to show the correlations of SST with the individual components of the wind stress curl ($\partial \tau y/\partial x$ and $\partial \tau x/dy$), since as the authors noted, both can contribute to EPV.
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Minor comments/edits:
Please also see the edits and comments in the "annotated" PDF of your manuscript that has been attached.

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4. It would be helpful to see a combination of Figures 7a,b and 8b, where the seasonal averages are removed, so that only the seasonal anomalies are shown. Then the interannual variation of SST can be seen alongside EMT and EPV, and the alongshore structure can also be studied.

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Referee: 2

Comments to the Author
The 2nd-round review of "Ekman dynamics variability along the southern coast of Java revealed by satellite data"
By Wirasatriya et al.

I have reviewed the revised manuscript and found that the authors have addressed all of my major concerns: (1) Analyses with consideration on the spatial scale of coastal upwelling is appropriate; Therefore, (2) The Ekman mass transport and Ekman pumping velocity are more apparent than previous version; and (3) The domains of two boxes are reasonable.

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Revised IJRS Research Paper submission to the International Journal of Remote Sensing - TRES-PAP-2019-1169.R2

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Date: Monday, March 30, 2020, 07:08 AM GMT+7

29-Mar-2020

Dear Dr. Anindya Wirasatriya
(cc'd to co-authors, if any)

Your revised IJRS Research Paper entitled "Ekman dynamics variability along the southern coast of Java revealed by satellite data" has been successfully submitted online and is presently being given full consideration for publication in our journal, the International Journal of Remote Sensing.

Your manuscript ID is TRES-PAP-2019-1169.R2.

This reference number is the same as the orginal one, but with .R1 or .R2 etc added, signifying that it is a 1st revision, 2nd revison etc. Please note that the Editor may choose to assign it to referees again, even though it is a revision.

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Thank you for submitting your manuscript to the International Journal of Remote Sensing.

Yours sincerely

Mrs Catherine Murray
Administrator, International Journal of Remote Sensing
IJRS-Administrator@Dundee.ac.uk

Referee(s)' Comments to Author:

Referee: 1

Comments to the Author

Summary:

The main hypothesis of this paper is that Ekman pumping velocity (EPV) explains why SSTs are cooler near the coast of eastern Java compared to western Java. Previously the authors used QuikSCAT wind data that made me skeptical they could resolve EPV near the coast, but by focusing on ASCAT wind data the odds of resolving the EPV accurately are improved. Along with an expanded discussion of the role of coastal Kelvin waves, some changes to figures and the addition of a table, the manuscript is substantially improved. However, this is still a challenging hypothesis to prove, as coastal Kelvin waves and local stratification (not to mention the possible role of the Indonesian Throughflow) are also known to influence upwelling and SSTs, and there is not sufficient subsurface data near the coast to discount their effects on the west-east Java SST gradient. I do think there are some more analyses that the authors should try before attributing the west-east differences in seasonal or interannual SST variability to EPV, which I have described under "major comments". Given this assessment, I still find the manuscript in need of major revisions, but I commend the authors for making good progress and think that the manuscript should be ready for publication after the issues below are resolved.

R: Thank you very much for your motivating comments. Your suggestions during the first revision were very helpful to improve this manuscript. In this revised version we add one more figure related to the vertical density profile from Argo float data, to support the analysis by using reanalysis data shown in Fig. 5b,c. However, the calculation of ocean current divergence from reanalysis data was failed. This may be related to accuracy of the ocean current reanalysis data.

Kelvin wave does not become the focus of our study. Further investigation about Kelvin wave is beyond the scope of our study. Thus in the present study the role of Kelvin wave to the variability of SST along the southern coast of Java is only discussed in the result section.

Major comments:

1. The most significant challenge to testing the main hypothesis of this paper is showing that factors other than EPV (e.g., coastal Kelvin waves, local stratification) are not the primary reason for the SST difference between western and eastern Java. The authors have already shown (with the helpful changes to Figure 5 and the addition of Table 1) that EPV is a possible explanation for the SST difference. But can we differentiate the influence of locally-forced EPV from that of isopycnal displacements due to remotely-forced Kelvin waves?

One way to try and investigate this is to compute profiles of horizontal divergence in the upper ocean in the two boxes with the ~0.08° resolution CMEMS reanalysis used in Figures 5b,c. (If vertical velocity is available from the reanalysis, the authors could look at this directly, but it does not seem like this is an available variable from the reanalysis product.) If the divergence peaks near the surface, then locally-forced EPV is likely responsible. If the divergence is more evenly spread through the upper 100 meters (i.e., above the thermocline), this suggests the influence of coastal Kelvin waves. The vertically-integrated divergence in the upper ocean can also be compared with the EPV (according to continuity for an incompressible fluid $\partial u/\partial x + \partial v/\partial y + \partial w/\partial z = 0$, so given that w is relatively small near the surface, vertical integration downward from the surface can approximate w). It is necessary to keep in mind that the atmospheric forcing of the reanalysis product (ERA-Interim, ~80 km resolution) is not as high-resolution as ASCAT, so Ekman pumping near the coast may be underrepresented in the analysis. Nonetheless, it would be useful to see how the high-resolution reanalysis represents the vertical profile of horizontal divergence, and whether there are differences between the western and eastern boxes; it would complement the isopycnal plots in Figures 5b,c.

R: Thank you very much for your suggestions and comments. We have plotted the time series of horizontal divergence profiles in the 2 boxes as shown in Fig. I.

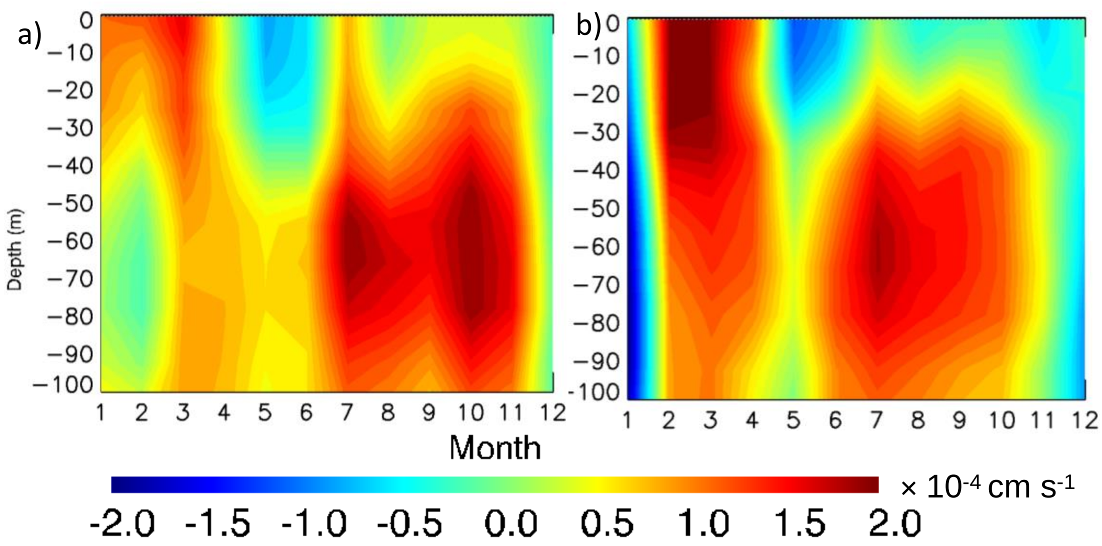

Fig. I a) and b) are monthly climatology of the vertical profile of horizontal divergence inside the thin and thick boxes in Fig. 2.a, respectively.

However, the result is quite strange, the divergence occurred twice a year during northwest monsoon and south east monsoon. According to the density profile data, downwelling should occur during northwest monsoon. This may relate to the accuracy of the ocean current data from Marine Copernicus. The RMSE of current data is quite large; generally is 0.25 m/s (http://resources.marine.copernicus.eu/documents/QUID/CMEMS-GLO-QUID-001-030.pdf). *Thus, we decide to stop and exclude this analysis from the manuscript.*

To support the analysis of the role of EMT and EPV to the upwelling variability through density profile (Fig. 5b,c), we provide the analysis of observational density data obtained from Argo float (Fig. 6). The mixed layers depths during northwest monsoon season at the western and eastern area along the southern coast of Java are deeper than those during southeast monsoon season. Furthermore, it can be seen that during southeast monsoon season, the mixed layer depths at the eastern part are shallower than those at the western part. This indicates that the upwelling in the eastern part of the southern coast of Java is stronger than the western part. (P13L51-P14L13)

We agree that analyzing the vertical movement of water mass is very important to further strengthen this indication. Since reanalysis data failed to perform this analysis, the vertical current data obtained from ADCP may help to reveal this problem. However, this is beyond the scope of the present study and would be potential for future works.

One of the important findings in this study is that Ekman dynamics strongly control the seasonal variation of SST and also Chl-a along the southern coast of Java but not for interannual variation which is dominantly controlled by IOD. How IOD influences SST and Chl-a in the interannual time scale may be through the propagation of Kelvin wave which is already discussed in the present study (P17L52-P19L10).

2. There needs to be more information provided about the correlations in Table 1. Over what time range are the correlations in Table 1 computed; is it 2007-2018? Were seasonal averages removed from EPV, EMT, and SST prior to computing the correlations? Since Table 1 is cited in the section on seasonal variation (and not interannual variation), it seems like the seasonal averages were not removed. Retaining the seasonal cycle makes it difficult to show that EPV or EMT causes changes in SST, since the seasonal cycle of SST is influenced by many factors other than EPV and EMT (e.g., radiative and latent heat fluxes, coastal Kelvin wave propagation). Correlations of variables in the seasonal cycle are often not associated with causation, at least not directly, since the seasonal signal is dominant in nearly all physical variables in the upper ocean. By removing the SST seasonal cycle, most of the radiative flux influence at least should be removed, allowing for more focus on the effect of wind forcing. So I would recommend that this analysis be carried out with seasonal averages removed, and discussed in the interannual variation section (3.3).

Also, how are EPV & meridional EMT combined to compute these correlations? Is the EPV multiplied by the meridional length of the box Δy to obtain the vertical flux into the box (in the same units as EMT?). In any case, it is not clear what the physical meaning of the combined EPV and EMT is. It could be more useful to show the correlations of SST with the individual components of the wind stress curl ($\partial \tau y/\partial x$ and $\partial \tau x/dy$), since as the authors noted, both can contribute to EPV.

Lastly, the significance and/or uncertainty of the correlations should be assessed, by calculating degrees of freedom present in the time series; see a data analysis textbook (e.g., Emery and Thomson; Bendat and Piersol) for a description of the method for this.

R: Thank you very much for your comments. We use monthly data from 2007 to 2018 to calculate correlation. Thus, there are 144 data. (P8L36). The correlation coefficient is highly significant with $p < 0.01$ and this has already put at the caption of Table 1. We are sorry for putting the wrong value of correlation for the eastern box. We have put the correct correlation value in this revised manuscript.

We do not remove the seasonal signal since our story was build based on the fact that surface wind plays the most important factor that forms the seasonal pattern of coastal upwelling along the southern coast of Java Island (Susanto et al. 2001; Susanto and Marra 2005; Iskandar et al. 2009, Wirasatriya et al. 2018a) (P4L45-50). One of the upwelling indicators used in the present study is SST. Of course the mechanisms on how surface wind influences SST is not only through Ekman dynamics but also latent heat release. Our previous study in Sulawesi Sea and Maluku Sea (Wirasatriya et al. 2019a) has shown that the effect of latent heat flux in influencing the SST variability is small and it is not comparable with how EMT influence SST. Thus, in the favorable coastal upwelling area, Ekman dynamics play dominant role in influencing SST. The role of solar radiation is not dominant in influencing SST in the southern coast of Java. Fig. II show the time series of monthly climatology solar radiation in the boxes shown in Fig. 2a.

It can be seen that the increase of solar radiation in both areas are not followed by the increase of SSTs as shown in Fig. 2b. Surface wind has stronger influence to the variability of SST as shown in Fig. 2b. However, the problem is, we found incongruity for the influence of wind speed to SST variation between the western part and eastern part of the southern coast of Java. The answer to this question is by analyzing the Ekman dynamics as presented in this study.

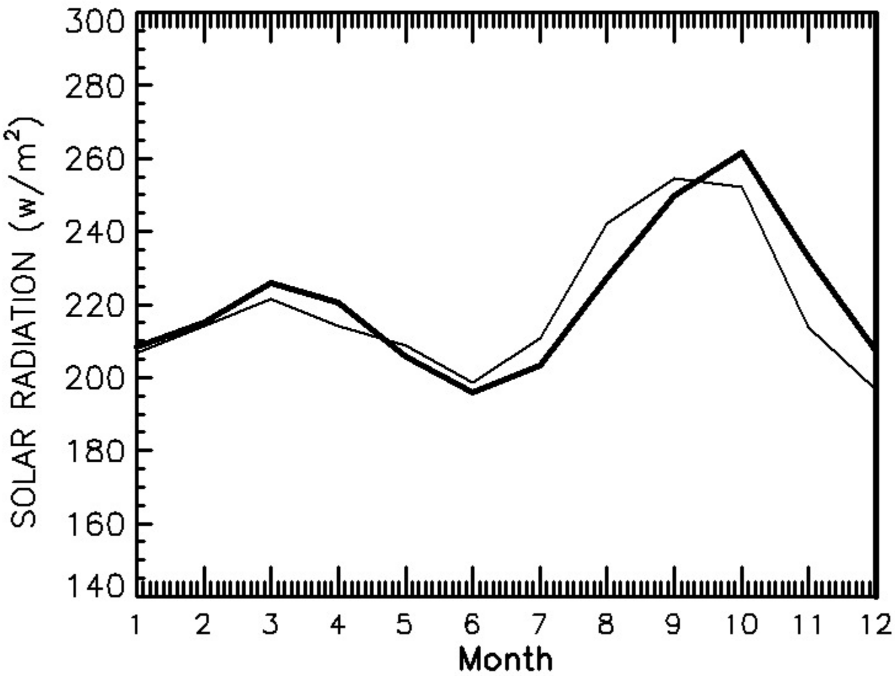

Fig. II The time series of monthly climatology solar radiation (2007-2018) from ERA5 data. Thin and thick lines denote thin and thick boxes shown in Fig. 2a.

We did try removed the seasonal mean, however, the results is small (see table I), this is because the upwelling is strongly induced by seasonal monsoon winds.

Table I. The correlation analysis between the monthly anomaly SST and monthly anomaly of Ekman dynamics from its climatology.

		EPV	meridional EMT
Western Box	SST	-0.06	0.06
		p=0.42	p=0.46
Eastern Box	SST	0.03	-0.2
		p= 0.67	p=0.01

We think that correlation between SST and wind stress curl is not necessary since directly it has represented by the correlation between SST and EPV.

How EPV & meridional EMT are combined to compute the correlation with SST is by using m_correlate function in IDL program (https://www.harrisgeospatial.com/docs/m_correlate.html). This function computes the multiple correlation coefficient of a dependent variable i.e., SST and two or more independent variables i.e., EPV & meridional EMT. The more information about this method can be found in book "APPLIED STATISTICS (third edition), J. Neter, W. Wasserman, G.A. Whitmore; ISBN 0-205-10328-6

Minor comments/edits:

Please also see the edits and comments in the "annotated" PDF of your manuscript that has been attached.

R: Thank you very much. We have revised based on the "annotated" PDF.

1. General comment: when listing units such as m s-1 and m2 s-1, make sure there is a space between m and s. Otherwise ms-1 reads as "inverse milliseconds", rather than "meters per second". I noted this in the annotated PDF on page 11, line 22, but there are many instances that need to be edited.

R: Thank you very much for your corrections. It is done.

2. Equation (6): If I understand this correctly, the equation just describes a temporal average. It would be enough to just state that monthly climatologies are monthly means for all years; if the equation is retained, it seems like the i before the summation sign should actually be a 1.

R: We delete the equation (6).

3. Figure 6a title: "Meredional" is misspelled; should be "Meridional".

R: It is done.

4. It would be helpful to see a combination of Figures 7a,b and 8b, where the seasonal averages are removed, so that only the seasonal anomalies are shown. Then the interannual variation of SST can be seen alongside EMT and EPV, and the alongshore structure can also be studied.

R: Since the correlation analysis of removing seasonal signal shows weak correlation, we do not continue to modify Fig. 8 and 9 by removing seasonal signal.

5. Figure 8 caption: Not clear why EPV and EMT are mentioned in this caption, since they are not plotted in Figure 8, only in Figure 7.

R: We delete EPV and EMT in the caption of Fig. 9.

Referee: 2

Comments to the Author

The 2nd-round review of "Ekman dynamics variability along the southern coast of Java revealed by satellite data"

By Wirasatriya et al.

I have reviewed the revised manuscript and found that the authors have addressed all of my major concerns: (1) Analyses with consideration on the spatial scale of coastal upwelling is appropriate; Therefore, (2) The Ekman mass transport and Ekman pumping velocity are more apparent than previous version; and (3) The domains of two boxes are reasonable.

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Last line of Page 5: The authors have changed the period from 2007. Is "i.e., from 2003 to 2016" correct?

R: Thank you very much for your correction. We change into from 2007 to 2018. (P5L56)

Page 9: "smoothed by 3 months to..." -> "smoothed it with 3-month running mean filter to..." if my understanding is correct.

R: It is done. Thank you. (P9L34-37)

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R: It is done. Thank you. (P13L27)

Page 14: On the statistical analysis (Table 1), how did the author calculate the correlation? I suppose they have used monthly data during 2007-2018, so the sampling number would be 12 months * 12 years = 144. Please add the detail of procedure in the manuscript.

R: It is done. Thank you. (P8L36)

IJRS - Decision on Revised Manuscript ID TRES-PAP-2019-1169.R2

From: International Journal of Remote Sensing (onbehalfof@manuscriptcentral.com)

To: aninosi@yahoo.co.id

Date: Friday, April 24, 2020, 02:04 PM GMT+7

24-Apr-2020

Dear Dr. Wirasatriya

It is a pleasure to inform you that your revised manuscript entitled "Ekman dynamics variability along the southern coast of Java revealed by satellite data" has been provisionally recommended for acceptance, for publication in the International Journal of Remote Sensing.

This recommendation is provisional, pending technical review and approval by the Editor in Chief. The technical edit is to assure general scientific clarity and consistency of language, style, and format in conformity with the Journal's style. Papers that are not correctly formatted or not sufficiently clearly written may be returned to authors or declined after technical review.

The comments of the referee(s) who reviewed your manuscript are included at the bottom of this email.

As part of the technical review, the manuscript will be checked for style, completeness of references and the quality of the figures by one of our Technical Editors. Although we try to do the technical review as rapidly as possible, this process can take about a month or more. Once the review is complete, if there are any problems, you will be contacted to provide clarification or revisions to the manuscript. The 'final form' date will be the date we receive the final corrections, and/or when the manuscript is determined to be acceptable within our style standards and approved by the Editor in Chief. It is at this point that your manuscript will be considered finally accepted for publication. Please be aware that, if any problems with your article cannot be resolved in a timely manner, it may be treated as having been withdrawn from publication.

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Thank you for your contribution. On behalf of the Editors of the International Journal of Remote Sensing, we look forward to your continued contributions to our journal.

Yours sincerely

Dr. Weigen Huang
Associate Editor, International Journal of Remote Sensing
wghuang163@163.com

Referee(s)' Comments to Author:
Referee: 1

Comments to the Author
Please see the attached PDF for comments

Referee: 2

Comments to the Author
Review of "Ekman dynamics variability along the southern coast of Java revealed by satellite data"

By Wirasatriya et al.

The authors have addressed all my comments. I have no further comments. I recommend that it will be acceptable.

****
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Taylor & Francis Author Survey

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Date: Monday, September 21, 2020, 12:20 PM GMT+7

Dear Anindya Wirasatriya,

Your article '*Ekman dynamics variability along the southern coast of Java revealed by satellite data*' has recently been published online in *International Journal of Remote Sensing*.

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