



EGUsphere, referee comment RC1
<https://doi.org/10.5194/egusphere-2022-1397-RC1>, 2023
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Comment on egusphere-2022-1397

Anonymous Referee #1

Referee comment on "Seasonal and El Niño–Southern Oscillation-related ocean variability in the Panama Bight" by Rafael R. Torres et al., EGU Sphere,
<https://doi.org/10.5194/egusphere-2022-1397-RC1>, 2023

General Scientific Comments:

This paper addresses some unresolved issues related to the mean, seasonal and interannual variability in the circulation, SST and SSS in the Panama Bight, also extending the analysis to the larger Eastern Tropical Pacific (ETP) for context. As such, it builds on previously published results, with new results concerning the degree of variability in the circulation caused by ENSO changes (minor). It confirms some previous results, such as the reversing seasonal states of cyclonic (boreal winter) and anticyclonic circulation (June–December); seasonal and interannual changes in SST but only seasonal changes in SSS; seasonal and interannual changes in the Costa Rica Dome and NECC. It finds that during the positive and negative conditions of the ENSO cycle (El Niño and La Niña periods), the circulation in the Panama Bight is not greatly changed. Temperature and sea level means are affected, but the circulation patterns remain largely the same. I believe this is a new finding and may surprise some people

Specific Scientific Comments, Related to the "Principal Criteria"

Scientific Significance: "Good" (2). The paper mostly confirms or clarifies aspects of the circulation that have been discussed by others. This is done using 27 years of altimeter data, a much more comprehensive data set than has been used previously, making this a worthwhile but not astounding contribution. However, two aspects of the Panama Bight circulation that were previously uncertain are not really resolved.

(1) One feature is the flow along the Colombia Coast, which is normally reported as forming the poleward Colombia Current (strongest in boreal winter). Even the more recent references do not show this feature clearly and sometimes lament the lack of data. On Line 75, the authors quote Kessler (2006) as saying that there is no consensus about this phase of the circulation (the anticyclonic phase, which should have an equatorward flow). During the period of anticyclonic flow documented in the present paper, flow along the Colombia coast should be equatorward, rather than poleward. Indeed, from their pictures of the seasonal circulation in Figure 3 and A2, they should conclude that the flow is poleward in boreal winter north of $\sim 1^\circ\text{N}$ and equatorward in boreal summer–Autumn north of $\sim 4^\circ\text{N}$. But they don't really discuss or clarify this previously disputed flow.

(2) The other (more concerning) uncertain aspect is the flow at the northern boundary of the Panama Bight, which is reported in older publications as westward/poleward,

completing the cyclonic circulation, but which should shift from westward during the boreal winter cyclonic circulation to eastward during the boreal summer-autumn anticyclonic circulation. In the text and Figure A1, they show a mean westward current at the top of the Panama Bight (PB) in the 1993-2012 Mean Dynamic Topography (MDT) field produced by CMEMS. But when they form the monthly mean seasonal cycle using the 1993-2019 Absolute Dynamic Topography (ADT) fields, the currents at the top of the PB are eastward during all months. They use the SOM methodology to produce a mean from the ADT data and it also shows eastward velocities at the top of the PB. They could have formed a mean of the ADT monthly means and gotten the same result. They seem to accept the result of eastward flow, perhaps because the SOM analysis is a statistical method and gives this result. What they don't discuss is the difference in the reference periods used in the two products (see below). This is my main complaint about their scientific analysis.

Scientific Quality: Fair (3)

They need to go into more detail about the formation of the MDT, the altimeter sea level anomalies (SLA) and the ADT fields formed from the SLA+MDT.

The ADT fields are formed from the sum of the MDT and SLA, which are formed by subtracting the 1993-2012 mean of the sea surface height fields from each gridded field (including those during 2013-2019, outside the reference period). In principal, the mean of the velocity anomalies derived from the SLA over the period 1993-2012 should be zero and the mean of the ADT velocities over the period 1993-2012 should be the same as those derived from the MDT. But the mean of the ADT velocities over the 1993-2019 period will differ from those from the MDT if the mean of the velocities over the 2013-2019 period are different from those during 1993-2012. This appears to be the case and we can conclude that the mean velocities during the 2013-2019 period at the top of the PB are eastward. The interpretation of this result is made more complicated by the fact that the number of altimeters has increased over time, giving the ADT fields more spatial resolution during the latter years than during much of the 1993-2012 period of the MDT. The CMEMS program produces a "2-Sat" ADT product (using just 2 altimeters during the entire time series) for use in climate studies, to try to eliminate this bias in the number of satellites. I assume that the authors used the "All-Sat" product (using all available altimeters – most people do this to get the greatest spatial resolution).

If the authors want to compare the MDT to the mean from the ADT and to look at the monthly means in comparison to the MDT, they should form the monthly seasonal means from the ADT over the period 1993-2012. They might even do the same thing using the "2-Sat" data set to see if it agrees with the "All-Sat" results. This should clarify whether the mean flow at the top of the Panama Bight is eastward or westward.

Another aspect of the Scientific Quality regards the dynamics. On line 54, the Panama wind jet is described as a continuation of the north trade winds from the Caribbean Sea to the Panama Bight. Kessler cites a number of papers that describe the jet as occurring during the very weak trade winds of boreal winter, driven by an atmospheric pressure difference between the Caribbean Sea and the ETP. In addition, the upwelling and downwelling is attributed by Kessler and others as due to the wind stress curl over the PB, whereas the authors simply attribute the upwelling as due to the wind jet, which could mean divergence at the coast.

Other considerations for Scientific Quality include the methods and appropriate references. I'm not sure how much additional information is gained from the use of the SOM methodology. The mean from the SOM analysis should be similar to a simple mean of all of the 12 mean calendar months. Perhaps the SOM analysis discards any extreme outliers. I suggest a paragraph in the Introduction that could state the benefit of using the SOM

analysis, i.e., what additional information is provided by its use. In the discussion on lines 395-415, if the pairs of the spatial neurons show the circulation in winter, then transitional months and then summer-autumn, those could be produced again by simple averages over those months.

Regarding references, it's a matter of style, but other papers (Rodriguez-Rubio et al., 2003; Kessler, 2006; Devis-Marales et al., 2008) give credit to early papers, such as by Wooster, 1959; Wyrski, 1965,1966; Stevenson, 1970.

Presentation Quality: Excellent (1)

My main comment regarding the figures is to wonder why Figure A1 (the MDT results) is not included in the main body of the paper? These results are compared to those of the ADT, which are in the main body of the paper. Placing the MDT results elsewhere favors the depiction of the eastward velocities at the top of the Panama Bight, which may be an artifact of the ADT reference period (see above).

A complaint that is not the authors' fault is that the figures in the preprint that we are supposed to review are way too small to see clearly on a printed version (even with my magnifying glass). The obvious solution is to only look at the figures by displaying the pdf on a large screen and enlarging the figures greatly. This is what I did but it meant that I couldn't review the paper anywhere except in my office.

Specific Language/Grammar/Typos:

1) Everywhere, starting on page 1: The authors use two language conventions to indicate the direction that winds and currents are moving: XXXXly and XXXXward. So currents moving toward the east are called both "easterly" and "eastward". The XXXXly form is confusing, since in the meteorological literature "easterly" means "from the east". I suggest using only the XXXXward (eastward), since that is not ambiguous. This occurs throughout the text.

2) Line 26: Perhaps change "limited" to "bordered".

3) Line 30: "reverse oceanic gyre" is unclear. "reversing oceanic gyre" would be more understandable.

4) Line 57: should be "as **a** response to"... Add the word "a".

5) Line 71: Eliminate the word "most". It should be "...one of the rainiest locations..."

6) Line 83: The wording is awkward. I suggest this wording or something like it: "as well as temporal sea level variability, **as represented by altimeter-derived** Sea Level Anomalies (SLA). Besides..."

7) Line 86: I suggest adding the word "determine: "...and **determine** if this forcing..."

8) Line 114: Eliminate the word "First" and the sentence starts: "Comparisons between ..."

9) Line 131, 134: Awkward wording. The wording from line 134 would be better: "Anomalies are computed by subtracting **the 1993-2019 spatial mean from the individual monthly data** using all data..." On line 134, you do not need the word "respectively". Note that you are creating a different type of anomaly than the type of "Sea Level Anomaly" people think of with respect to altimeter data.

- 10) Line 151) Do you mean "**somewhat** subjective" ?
- 11) Line 171: Change "to" to "with". "Associated **with** ..."
- 12) Line 185: Add the word "**The**" at the beginning of the sentence.
- 13) Line 188 and others: Continue to change all of the XXXXly to XXXXward – here change "northerly" to "northward"...etc.
- 14) Line 190: Add the word "gyre" after "rotational". "...cyclonic rotational **gyre** closes..."
- 15) Line 192-3: The phrase "The mean temporal SOM..." is confusing. It might be better described as "The **temporal** mean of the SOM circulation ..." And at the end of the sentence, add the figure reference (**Figure A1c**).
- 16) Line 197: Change "to" to "of" "... east **of** 100..."
- 17) Line 2019: "strength" should be "**strengthen**"
- 18) Many places (lines 207, 210, 237, 241, 279, etc.) The repeated use of the word "Besides" at the beginning of sentences is distracting and unneeded. In most of these sentences, the word "Besides" can simply be eliminated with no change in meaning. Sometimes, the word "also" can be added later in the sentence, as is done in line 279. If a connecting word is absolutely needed, other words might be better ("In addition", "Moreover", ..).
- 19) Line 237: "increase" should be "increases"
- 20) Line 239: Replace "by" with "of". "...is composed **of** the..."
- 21) Line 241: "eastern" should be "**eastward**"
- 22) Line 247: "reverse" could be "**reversing**"
- 23) Line 256: change tense from past to present, change "compared" to "**compare**"
- 24) Lines 267-268: Perhaps a minor point, but if "the first quarter of the year" is January-March, I believe there are only 7 months with El Niño positive conditions. There are 12 such months during January-April.
- 25) Line 287: The phrase "geostrophic currents seasonality" is awkward and could be replaced with "**the seasonality of the geostrophic currents**". If you keep the present wording, the word "**currents**" needs an apostrophe.
- 26) Line 289: The use of the word "outlined" is unusual but probably can be understood. Perhaps the phrase "underscored the fact that" is what is meant. Or just use the word "demonstrated".
- 27) Lines 314-315: I do not understand the sentence that begins, "On the contrary,..". What is higher and less variable? The June-December ADT shown by the red line in Figure 5a seems more variable than the black line (normal) or the blue line (Niña)
- 27) Lines 375-376: I believe you have "eastward" and "westward" reversed. "The former" should be the SEC and that flow is "westward" at -34 cm/s. "the latter" should be the

NECC and that flow is "eastward" with a value of +18.8 cm/s.

28) Line 461: There is a typo: "ENOS" should be "ENSO"