Reviewer #3: Review for BAMS-D-20-0105

*We thank you very much for your review. Our responses to your suggestions and questions are noted below.*

General remarks: Throughout the text some of the references to figures and tables are presented in red, I assume that will be changed in the final editing step. I also assume that you will unify the literature section a bit in the final steps.

*It is our understanding that this will be done during typesetting, but all red references have been changed to black for this revision.*

a) Overview:  
It is a concise summary of the findings presented in the individual chapters. In line 135 the new record high in global mean sea level is quoted from section f. It is my impression that the decline from end of 2019 into 2020 is optically dominant in fig. 3.14a and maybe that should be addressed somewhere in the text.

*We have added the highlighted text: “The year 2019 marks the eighth consecutive year that global mean sea level increased relative to the previous year, reaching a new record: 87.6 mm above the 1993 average (Fig. 3.14a)* ***and peaking in the middle of the year****.”*

Line 154: It is hard to read a maximum of geostrophic currents of ~40 cm/s from figure 3.18 if the scale is +-25 cm/s.

*We agree, but if the color scale ranged from +-40 cm/s then most other significant features in the figure would be barely visible or lost. Alternatively, a nonlinear color scale could have been used, for example with the scale saturating past +-25 cm/s, but this is implicitly the case with the existing figure. We prefer to use a color scale that emphasizes weaker yet significant features while noting extreme values in the text.*

Line 164: the persistent tripole pattern in SST in figure 3.1.a is a bit hard to identify since the negative patch in the middle of the NA is not very pronounced.

*This text was changed from “persistent SSTA tripole pattern” to “tripole-like SSTA pattern” to match the verbiage used in Section e.*

b) Sea surface temperature:  
Line 171: please add 'three' in front of updated SST

*done*

Line 172: 'uncertainty product' sounds a bit odd. If possible, rephrase.  
  
Line 185-189: the sentence is much too long and should better start with the fact that uncertainties are smaller in ERSTTv5 than in ERSST v4, before giving details of the computations.

Line 191: I would suggest replacing 'below' by 'between 0.5 to 1.0'

Line 193: Please change 'SSTAs were' to 'SSTAs were between'

*The current text reads that SSTAs “were −0.2°C to +0.2°C”, which should be clear.*

Line 195: Please end sentence after 30°W (0.0°C). Start a new sentence for the high positive anomalies in the Labrador Sea.

*This sentence is noting the three regions of unusual SST anomaly in the Atlantic: “In the Atlantic, SSTAs were +0.2°C to +0.5°C except for the tropical North Atlantic and near the coast of Africa (−0.2°C to 0°C), central North Atlantic near 45°N and 30°W (0.0°C), and the Labrador Sea (+1.5°C).” We believe that it would be odd to isolate the Labrador Sea anomaly from the previous two, given this construction.*

Line: 217: the reference to Fig. 3.11a seems wrong or the note to the strong P-E signals in Fig. 3.11 needs a better phrasing.

*Clarified by adding “precipitation patterns over” the Maritime Continent.*

Lines 228-232: the connection of this paragraph to the above is a bit unclear.

*This paragraph is discussing regional SST anomaly patterns in the Tasman Sea of the southwest South Pacific, while the previous paragraph was discussion broader patterns in the Pacific Ocean.*

Line 240-243: I do see strong positive signals in the Labrador Sea in all seasons and not only in JJA and SON; please check.

Line 245: defining subtropical North Atlantic as between 30-60N seems a bit too wide, normally 20-45 N would distinction to the subpolar gyre further north.

*“Subtropical” removed, as the latitude band is sufficient to define the region.*

Line 258: there seem to be numbers missing in the parenthesis for the temperature gradients.

*The parentheses are indicating the units of the SST trends shown in Fig. 3.4 and tabulated for regions in Table 3.1.*

Line 263: please add 'Fig. 3.3h' after Southern Ocean.

*Done*.

Line 273-278: the sentence is completely unreadable with all the acronyms.

Line 278: The text indicates that in previous studies differences in SSTAs from the different data sets were attributed to different bias corrections, but does not note if that is still true or has changed with the updates.

C: Ocean heat content:  
Line 316: It sounds a bit as a contradiction that a 'near zonal band' should tilt

*This band is not perfectly zonal, which we believe the text makes clear: “a near zonal band that again tilts equatorward to the west, starting at about 12°S well off the west coast of Australia and ending at about 6°S near Africa.”*

Line 341: wouldn't it be better to address the negative trends south of Greenland as 'Gulf Stream extension area' ?

*The Gulf Stream extension area cuts across the southern part of this region, but the trends are also seen in the Irminger Sea, not typically considered part of the Gulf Stream extension.*

Line 380-381: is there a reason why the analysis with the notably different trend is not addressed by name?

D: Salinity:  
2) Sea surface salinity:  
Line 472-475: the conclusion that the BASS data confirm the salty anomalies in the Brazil Current and Gulf Stream extension compared to in-situ data is not easy to make comparing fig. 3.7 and 3.8 since 3.8 is a blended product and only giving seasonal means. An annual map of 3.8 might make an easier comparison.

3) Subsurface salinity:  
Line 478: One introductory sentence as for the other paragraphs would be nice.

Line 495: 5-40°N does not seem to be correct, maybe 35-40 °N

E: Global Ocean heat, freshwater and momentum fluxes  
Line 591: The sentence Qnet appears to be a forcing for ENSO SSTA sounds a bit odd and could be rephrased.

2) Surface fresh water fluxes:  
Line 620: the areas noted as subpolar North Atlantic looks like the Nordic Seas to me.

*Agreed; changed to Nordic Seas.*

3) Wind stress:  
Line 631-632: I would suggest changing the sentence to: 'Marked increase of easterly winds is noted along the ACC (40°-60°S) in the Indian…

*The sentence correctly states “increase of westerly winds” (e.g., from the west, or eastward).*

Line 638: The first sentence could be deleted.

F: Sea level variability and change  
Line 682: Could you also give a trend for the period 2005-2019 since the other components (line 689, 693) are given for that period.

Line 712: please add reference to Fig. 3.14b after (e.g. Merrifield 2011).

*Done.*

Line 732: 'above and below normal sea levels' sounds a bit odd

*We could change this to “anomalously high and low sea levels”, but we believe that the meaning is clear.*

Line 745: should 'especially near the date line' be better called 'especially east of the date line' if it covers the range from Fiji to Samoa?

Line 762: Maybe exchange 'minor high tide flooding' by nuisance floods

*“High tide flooding” is more specifically associated with the tides, while “nuisance floods” are more broad and can also include flooding from, e.g., heavy rain events.*

Line 776-777 : I am wondering why there is so little information from tide gauges in the Atlantic in Fig. 3.16. Is there really no information available from GLOSS and the Hawaii data base or was the focus on the Pacific?

G: Surface currents:  
Line 786: Why was the climatological reference period selected as 1993-2007?

Line 804: 0°-110°W can be right, please check

Line 806: the eastward anomalies centred on 10°N are hard to see.

Line 812-820: the paragraph about EKE in the Kuroshio only seems loosely connected to the rest since no figure is given and no reference to the patterns in figures 3.17 or 3.18 is made.

Line 856-857: could you please specify what you call large number of rings and increased ring size

H: Atlantic meridional overturning circulation and associated heat transport:  
Line 976-978: are these findings from Meinen et al. 2018? Or from another reference?

*Yes; reference added here.*

Line 999: (OSNAP East; Fig. 3.22a) gives the impression as if figure 3.22a is only for OSNAP East.

*Parentheses now separated: “(OSNAP East) (Fig. 3.22a)”*

Line 1001: it is a bit unfortunate that the OSNAP transports are only given for 2014-2016, are not there some draft versions up to 2018 available which could be included as preliminary. Otherwise this timeseries stands out in Fig. 3.22 as being a fragment.

Line 1018-1029: I would suggest moving the part about the XBT estimates for SAMBA further up in the section where the SAMBA results are discussed. It makes a better connection there. I would also suggest adding some explanation for the very different levels of variability that are seen from the direct mooring data versus the XBT data.

I: Global ocean phytoplankton:  
Line 1093: I not sure what is addressed as western North Pacific.

Line 1098: 'nutrient replete conditions' sounds odd

Line 1114: the description of the two pronounced peaks sounds a bit misleading. There are not two peaks in the time series but instead there is one spring peak in each hemisphere. I would suggest reordering the sentence and starting with 'Vernal increases in the NH and SH….

*We believe that the description notes very clearly that the two peaks per year in the time series are due to springtime blooms in the NH and the SH: “Seasonal changes in phytoplankton biomass in the PSO typically display two pronounced peaks, reflecting vernal increases in biomass in the NH and SH”. Due to this, when averaged over the world, there are two peaks in the time series. This is also clear from the other subpanels, which separately show NH and SH.*

J: Global ocean carbon cycle:  
Please check the font style of this section. Random words seem to be shifted upward

*Formats including font style has been made consistent.*

Line 1183: The abbreviation OBGCM only appears once and is not even useful in the context of the sentence on lines 1182-1187. I would suggest eliminating it.

Line 1210: here it is stated that for the computations the monthly wind fields from 2018 have been used, please explain why no update was made.

*As noted in the text, “changes in winds over time have a small effect on annual global air–sea CO2 fluxes (Wanninkhof and Triñanes 2017)” and thus recalculation would not produce a significantly different result.*

Sidebar 3.1 Biogeochemical Argo  
Lines 1388-1396: the whole paragraph remains vague and does not offer any conclusions.

References:  
Line 1670-1675: Only the names for this reference are given but not title and journal

*Reference fixed.*

Figures:  
Fig. 3.1, line 2093, shouldn't that be SST instead of SSTA

*The difference between SSTAs is the same as the difference between SSTs; we choose to consistently use “SSTA” in the caption.*

Fig.3.2, line 2098-2099: the dashed white and solid white lines are difficult to see and distinguish

Fig. 3.7, line 2144: the lines appear black to me not grey

*They should be grey in high resolution, as opposed to the low-resolution jpeg image in the draft document.*

Fig. 3.8: it would be nice to have an additional panel with the annual mean of the blended product to better compare to fig. 3.7a

Fig. 3.9: the fonts on the color bars are too small and there are too many labels on the depth axis

*This will be corrected in typesetting at BAMS.*

Fig. 3.12: the fonts on the color bars are too small and blurred. The minus signs for the wind stress are nearly invisible.

*This will be corrected in typesetting at BAMS.*

Fig. 3.14; Would it be possible to add trend lines to the timeseries in a) and also quoted the trends next to these lines?

Fig. 3.16: Why are there so few tide gauges in Atlantic (especially Europe)?

Fig. 3.17: the font used for the titles seems a bit large

*This will be corrected in typesetting at BAMS.*

Fig. 3.19: Would it be possible to add the 1993-2019 mean values?

Fig. 3.22: Legends in the figure panels would be nicer than the lengthy figure caption

Fig.3.25: please increase fonts, the entire figure looks blurry. The green diamonds for the MEI time series really do not show up.

*This will be corrected in typesetting at BAMS.*

Fig. SB3.1: it would be good to have another panel to this figure which shows the data distribution for this analysis. Profile positions from the argo locations could be color coded to give an impression how many data are available for each time step in the Hovmoeller diagram.

Fig. SB3.2: the whole figure appears blurry, the light green and bue dots do not show up well. The 'gamma' in front of the density ranges nearly disappears.

*This will be corrected in typesetting at BAMS.*