We thank Referee #1 for their helpful comments and review of our paper; we have responded to all of their comments below.

The reviewer comments are in *black* and the author responses are in blue.

A) Referee #1: This article describes the creation of a sea surface climatology of fCO2 (fugacity of carbon dioxide surface) for the global oceans for the year 2010. The authors argue that in situ sea surface temperature (SSTdepth) as reported in the SOCAT version 1 data base provides a poor estimate for the subskin temperature (Tym,i), required for accurate calculation of surface water fCO2. This is a worthwhile observation, which merits discussion and thought.

Reply: We thank the reviewer for acknowledging the improvement of using subskin SST instead of SST at depth for the calculation of surface water f_{CO2}. However, the effects of the vertical temperature gradient is only one of the three concerns when adjusting the *in situ*, instantaneous f_{CO2} values to a 'true mean' monthly grid-box values for the temperature at which gas transfer occurs. The three steps to fully achieve this are:

1) adjust for errors due to the vertical SST gradient;

2) minimize the bias due to under-sampling;

3) minimize errors due to the different methods and instrumentation used for measuring f_{CO2}.

Revision in paper:

None specific, but we will review our explanation of the "3 steps".

B) Referee #1: Next a calculation is carried out for fCO2 data from SOCAT version 1 and ARC temperature data for the period (1?) August 1991 to 31 December 2007, when both data sets overlap. The authors correct the individual surface water fCO2 values at SSTdepth (as reported in SOCAT) to individual pCO2 and fCO2 values at the subskin temperature.

Reply: We have been misinterpreted here. Applying the three steps described in the previous author response, the individual and instantaneous surface water f_{CO2} values at SSTdepth (as reported in SOCAT) are not re-analysed to individual p_{CO2} and f_{CO2} values at the subskin temperature. The re-analysed values represent the p_{CO2} and f_{CO2} at the *monthly grid-box averaged* satellite derived subskin temperature $T_{ym,i}$. This was done for all data from August 1991 to 31 December 2007.

Revision in paper:

We will clarify the description of the method and clarify the start and end dates.

C) Referee #1: This calculation is complex and involves an inversion. Next, individual climatological pCO2 and fCO2 values are calculated for the year 2010 by applying an increase of a 1.5 µatm/year. Next the individual climatological pCO2 and fCO2 values are grouped by month and put on a 1_ x 1_ grid for the year 2010. Finally the authors proceed to interpolate their fCO2 and pCO2 results by ordinary block Kriging. Unfortunately the text is complex and technical in places. It is a struggle to work out the exact procedure followed. The calculation procedures seem unnecessarily complex. The interpolation method as applied here creates strange looking maps of surface water fCO2 in the global oceans with high standard deviations. Text on SOCAT procedures distracts from the procedures followed by the authors. **My recommendations are:**

1) Simply the calculation procedure by applying the temperature correction directly to fCO2. If pCO2 is needed, use the simplified equation in Landschützer et al. (2013) based on (Körtzinger, 1999), rather than the complex inversion method (equation 10). Avoid using two temperature corrections (equations 12and 13).

2) If the above is deemed unsuitable, make at least a comparison (error analysis) of the final pCO2 and fCO2 values following the above simplified procedure.

Reply: To minimise the errors we have followed the mathematically correct approach of reversing the calculation to return to the original parameter measured before then applying the correction. In Section 5.6 we calculate the potential error introduced by this inversion step. The error turned out to be a very small positive bias. The difference is clearly small, but we stand by using the mathematically correct approach.

Regarding "strange looking maps", we agree that parts look "strange" but that is the honest expression of geospatial interpolation applied to a sparsely sampled population. If an interpolation scheme is used that assumes a relationship to e.g. circulation or temperature, then the maps will certainly look more pleasing to an oceanographer's eye, but that will follow from the assumed relationship rather than direct sampling.

Revision in paper:

None directly, but note proposed alteration of figures described in response to "5".

Referee #1: 3) To centre the climatology on 2000 or 2005, ideally a mid-point for the available fCO2 data in the period 1991-2007, not 3 years after SOCAT version 1 ends.

Reply: We wanted contemporary values of p_{CO2} and f_{CO2}. (As the number of observations in SOCAT increased exponentially during the later years, 2010 seemed a reasonable year).

Revision in Paper:

None.

Referee #1: 4) Check whether the correction of 1.5 µatm/year is appropriate for the later years of the fCO2 data set and for 2008, 2009 and 2010.

Reply: The sensitivity to the assumed trend was addressed in Section 5.5. of the original version. In short, recently Takahashi et al. (2014) presented an updated oceanic pCO2 trend of 1.9 µatm/year. This would result in a difference of 0.8, 0.4 and 0 µatm for 2008, 2009 and 2010.

Revision in Paper:

We will review the explanation given in Section 5.5.

Referee #1: 5) The maps created by Kriging do not show oceanographic features, such as the Antarctic Circumpolar Current. This suggests that something is not quite right in the application of the Kriging or that the interpolation technique is not suitable. The fact that the Kriging provides an unbiased estimate does not make it a good estimator in areas without any data (as the high Kriging variance shows).

Reply: The observation that the resulting maps do not show oceanographic features does not necessarily mean that the interpolation technique is not right, what it shows is that in areas with data shortage the predictions are less accurate. The primary focus of the paper is to create a re-analysed f_{CO2} dataset that is normalised to a reference year. To allow the re-analysed data to be used for global analyses air-sea gas flux studies we apply a simple kriging result to produce spatially complete fields along with an estimate of the error in the kriging. However, this latter stage is not the primary focus of the paper. We will clarify this in the updated paper and we apologise for any confusion. We were not trying to comment on the accuracy of the kriged result when referring to the unbiased estimate, this was simply a comment about the technique.

Revision in paper: We will clarify the statement about the unbiased estimate. We will also improve the presentation of the monthly maps by presenting seasonal maps, rather than monthly ones for all figures (e.g., Fig. R1). To aid the reader we will also only display data that pass a specified variance quality value (this links to comment below), so that regions with large errors are not visible. The actual dataset allows the user to make the choice on the variance value, but we appreciate that showing all values in the paper could mislead the reader to the quality of the outputs.

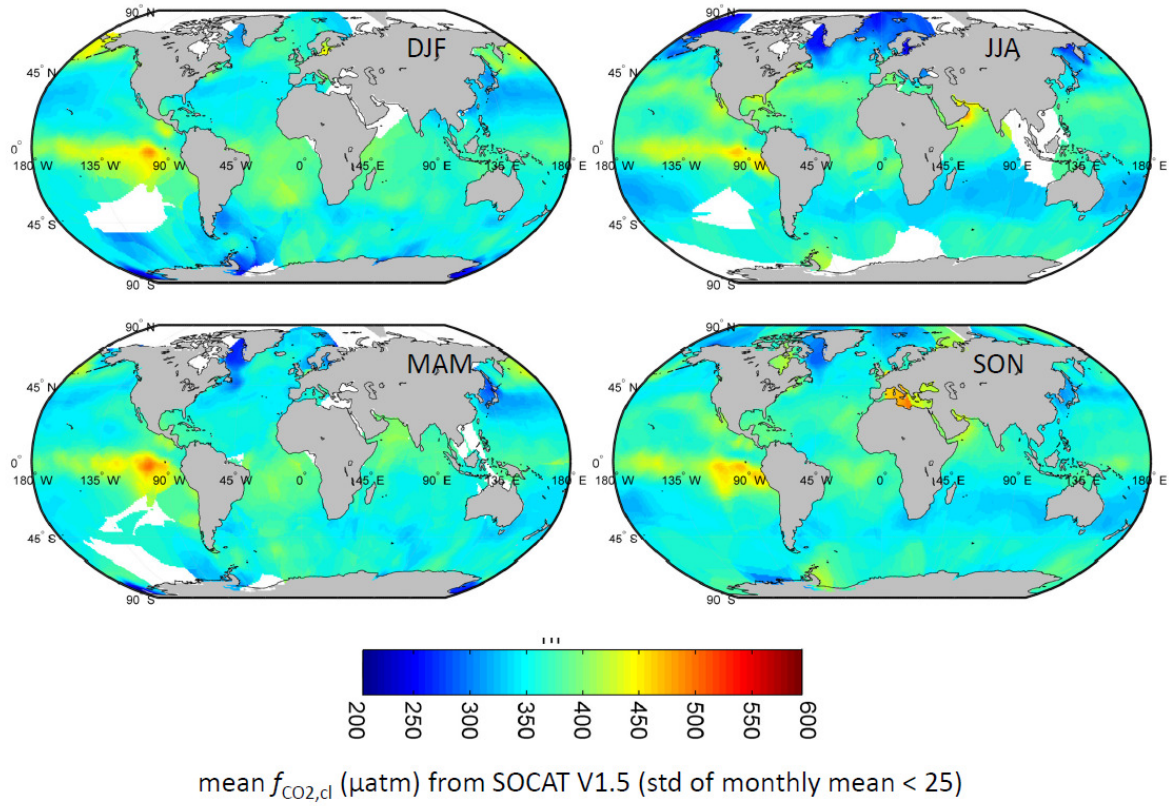

Figure R1. Mean $f_{CO,cl}$ (µatm) of the monthly means, clockwise from top left, December to February, June to August, September to November, and March to May; only monthly mean values with std < 25 µatm were included.

Referee #1: 5a.Does the Kriging procedure stop at land barriers? (It should.)

Reply: We acknowledge that although grid points on land were not included in the kriging procedure the kriging procedure did not necessarily stop at land barriers and that this is a limitation of the spatial interpolation technique. We deliberately kept the interpolation method simple, as much larger international efforts are focussing on the issue of optimal interpolation techniques.

Revision in paper:

This fact will be noted.

Referee #1: 5b.Does the application take into account the reduction in size of a degree of longitude (in kilometres) with latitude?

5c. Have you considered using a dx different from dy? In some ocean regions, fCO2 varies more strongly in e.g. the north-south direction than in the east-west direction (and the other way around) (Jones et al., 2012).

Reply: No, we applied the kriging directly to the 1°x1° grid boxes to keep the interpolation simple.

Revision in paper:

We will check that this is explained clearly. We will refer to Jones et al. (2012).

Referee #1: 5d.Blank any areas on the fCO2 maps with a large Kriging standard deviation (e.g. >25 µatm), i.e. unconstrained by fCO2 data. SOCAT version 1 has no data in the Arctic Ocean, Hudson Bay, the Black Sea, the Caspian Sea, Davis Strait, the Sea of Okotsk and the Gulf of Mexico. The provision of a variance (or standard deviation) is one of the strengths of the Kriging method. Use it!

Reply: We think that this is a good idea. The actual dataset allows the user to make the choice on the variance value, but we agree that showing all values in the paper could mislead the reader to the quality of the outputs.

Revision in paper:

To aid the reader we will only display data that pass a specified variance quality value (this links to comment below), so that regions with large errors are not visible.

Referee #1: Have you tried other methods, such as optimal interpolation or co-Kriging with month of the year as an extra variable? What are the units for the Kriging parameters (Table2)?

Reply: Apologies, we will add the units for Table 2. As previously explained, the main focus of the work is the re-analysis method and so we deliberately kept the interpolation method simple, as much larger international efforts are focussing on the issue of optimal interpolation techniques

Revision in paper:

Units added to Table 2

Referee #1: 6) Add a comparison to a pCO2 climatology (Takahashi et al., 2009) or a mean mapping product (e.g. Landschützer et al., 2013; Rödenbeck et al., 2013).

Reply: A detailed comparision is beyond the scope of this paper, but we agree that some mention of alternative approaches is appropriate.

Revision in paper:

To aid the reader we will mention the work of Landschützer *et al.* (2013), Rödenbeck *et al.* (2013) and others and add a simple comparison to the Takahashi et al 2009 p_{CO2} dataset.

Referee #1: 7) Rewrite the paper and make it easier to understand. Clarify which period you study. Add units.

Reply: Addressing all the points brought up by the referee should improve the paper and we thank them for these useful comments.

Revision in paper:

General rather than specific.

Referee #1: 8) Change scale of figure 5 (fCO2 climatology) to e.g. 280 µatm – 440 µatm. Enlarge the figure for at least one month.

Reply: A scale of 200-600 µatm gives the better looking maps for all months as the suggested scale does not show variation in f_{CO2} over 440 µatm.

Revision in paper:

We will add a figure for the month of January. We will aim to present most of the figures (as suggested by Referee #2) to show seasonal variations, which means that most figures will be reduced to 4 panels. This will allow the figures to be larger.

Referee #1: 9) Shorten sections on SOCAT and move them to an Appendix.

Reply: Thank you. This is an excellent suggestion.

Revision in paper:

We will update the paper to do this.

Referee #1: 10) Consider removing figures 7, 8, 9, 10, 11, 12 and most figures in the appendix.

Reply: The updates described above (changing from monthly to seasonal images) will reduce the number of images within each figure. We agree with the reviewer that currently there are too many figures.

Revision in paper: We propose to keep / remove / add figures as following:

KEEP

Figure 1. Histogram of temperature difference between monthly gridded data of subskin SST derived from ARC, T_{ym}, and in situ SST

Figure 2. Scatter plot of temperature difference between monthly gridded data of subskin SST derived from ARC, T_{ym}, and in situ SST

Figure 3. SOCAT CO_2 fugacity (µatm) data shown in the online Cruise Data Viewer for the month January; all data from 1 August 1991 to 31 December 2007

Figure 4. Revised. Variogram for global $f_{CO2,cl}$ data in 2010 for the month January, derived from $f_{CO2,is}$ shown in Fig.3

Figure 5. Revised. Monthly $f_{CO2,cl}$ values in the global oceans estimated for 2010 grouped in the seasons (as Fig. R1).

Figure 6. Standard deviation in $f_{CO2,cl}$ estimated for January associated with the ordinary block kriging shown in Fig. 5.

Figure 13. $f_{CO2,cl}$ estimated for January associated with high variance blanked out using SOCAT version 2 data

Figure A1. Standard deviation in $f_{CO2,cl}$ estimated for 2010 associated with the ordinary block kriging results shown in Fig. 5

Figure A8. As Fig. 5, but for SOCAT version 2 instead of version 1.5

Figure A9. As Fig. A1, but for SOCAT version 2 instead of version 1.5

REMOVE

Figure 7. Standard deviations of the mean over nine different kriging results of $f_{CO2,cl}$ estimated for January 2010

Figure 8. Standard deviations of the mean over 10 bootstrapped datasets of $f_{CO2,cl}$ estimated for January 2010

Figure 9. Calculated propagation of the 'temporal extrapolation error' in $f_{CO2,cl}$ estimated for January 2010 due to uncertainty in p_{CO2} trend

Figure 10. Calculated 'inversion error' in $f_{CO2,cl}$ estimated for January 2010

Figure 11. Fractions of $f_{CO2,cl}$ estimated for January 2010, calculated with missing value (a) Salinity, (b) Teq ,(c) P, and (d) Peq

Figure 12. As Fig. 5, January, but using only data points with valid T_{eq}

Figure A2. As Fig. 7 for 12 months

Figure A3. As Fig. 8 for 12 months

Figure A4. As Fig. 9 for 12 months

Figure A5. As Fig. 10 for 12 months

Figure A6. As Fig. 5, but for data points with valid T_{eq} values only

Figure A7. As Fig. A1, but for data points with valid T_{eq} values only

NEW

$f_{CO2,cl}$ estimated for January associated with high variance included for SOCAT v1.5

$f_{CO2,cl}$ estimated for January associated with high variance blanked out for SOCAT v1.5

As Fig. 6 but for SOCAT version 2

SST profile (Fig. R2)

Referee #1: 11) Consider carrying out the analysis on SOCAT version 2, rather than version 1.

Reply: We have already done this. The results of applying the method to SOCAT version 2 are detailed in the section 6 of the paper. The method was developed for SOCAT 1.5 and then applied to both versions 1.5 and 2.

Revision in paper:

No specific response

Referee #1: Throughout the manuscript: Add units in the text, tables, figures and figure captions.

Reply: OK. We apologise for the missing units.

Revision in paper:

This will be carefully checked.

Referee #1: P1897 Line 13. Correct to 'Bakker et al. (2014)'.

Reply: OK, thanks for pointing this out.

Revision in paper:

Corrected

Referee #1: P1897 Line 19. Replace 'climatology' by 'data set'. Sabine et al. 2013 do not correct for the gradual surface water fCO2 increase over time. The main output from Sabine et al. are monthly and annual gridded fCO2 data sets.

Reply: OK.

Revision in paper:

Corrected as proposed

Referee #1: P1897 Line 26. Correct 'authors'.

Reply: OK.

Revision in paper:

Corrected as proposed

Referee #1: *P1898 Line 2. Sabine et al. do not 'construct an ocean CO2 flux climatology', as they do not provide fluxes.)*

Reply: OK, that was an error.

Revision in paper:

Corrected as proposed

Referee #1: P1898. Line 25. 'monthly composite SST data provided by SOCAT' is confusing. Clarify that you use SOCAT synthesis products and that you grid these data. For example, P1902 Line 11, 14, P1903 Line 13 and P1904 Line 5-6.

Reply: OK.

Revision in paper:

Corrected as proposed

Referee #1: Sections 1.2-1.4 P1899. How does the depth for air-sea heat exchange compare to that for air-sea CO2 exchange? What are the depths of Tskin, subskin SST relative to (P1900 Line 2) '5 m depth for SST measurement'? A figure demonstrating the various concepts would help. E.g. P1901 line 20 'base of the mass boundary layer', P1901 Line 24 'base of the thermal boundary layer', P1901 Line 12, Line 16 'diffusive sub layer'.

Reply: We agree this is a key area for understanding our processing method and we need to address this.

Revision in paper:

Corrected by including the following figure:

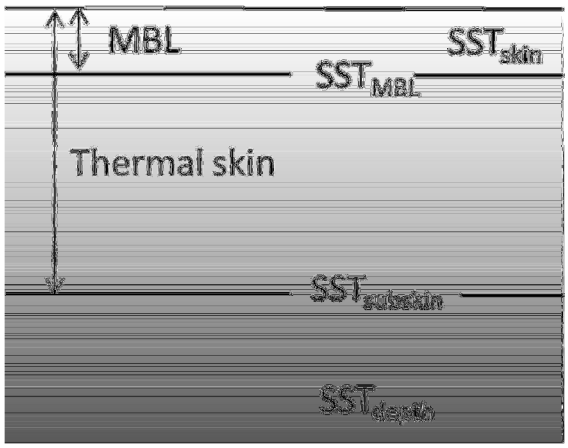

Figure R2. A schematic of the surface ocean, depicting the definition of the molecular boundary layer (MBL), thermal skin and various temperatures at depths.

Referee #1: Section 1.4. Clarify which period you study for SST and fCO2 ((1??) August 1991 to 31 December 2007?). P1902 Line 7: 'from August 1991 to December 2010'. P1904 Line 2-3: '1968 to 2007'. State (more) clearly that you use monthly ARC temperature data for each year on a 1_ x 1_ grid (P1902 Line 8) and in situ (instant) fCO2 and SSTdepth from SOCAT version 1.

Reply: We will clarify the start and end date by adding the days which are 1 August 1991 to 31 December 2007.

Revision in paper:

Corrected as above

Referee #1: P1902. Line 2-4: 'According to Kettle . . .. is negligible'. If this really is the case, there is no point in making the temperature correction for fCO2 in the remainder of the article.

Reply: The reviewer has pointed out a poorly stated and misleading sentence. We should have explained ourselves properly here. The isochemical transition can be applied between in situ fCO2 and fCO2 in the equilibrator, and also between in situ fCO2 and climatological fCO2 since it is reasonable to assume that there will not be systematic changes in total dissolved inorganic carbon and alkalinity in a 1°x 1° grid-box within each month. We have already explained in the comment to the first response that the point of the temperature correction of fCO2 is not to convert from in situ SSTdepth to situ SSTMBL or SSTsubskin, but to convert to a 'monthly composite' value of SST.

Revision in paper:

We propose to change P1901, line 28: 'We used subskin SST…' to P1902, line 5: '…. mass boundary layer.' with the following text.

"The SST difference causes the carbonate system to re-partition during dispersion over the vertical profile. The vertical changes in CO2 parameters will usually be those associated with isochemical repartitioning (Hare et al., 2004; Kettle, Merchant, Jeffery, Filipiak, & Gentemann, 2009). Thus, that assumption is applied to calculate fCO2 for SSTsubskin (to be used in the gas flux calculation with the solubility in the subskin)."

Referee #1: P1902 Lines 7-12 Clearly define the various temperatures, SSTskin, SSTskin,i, Tym,I and Tym. It is a struggle to understand the current explanation. Consider a table (Appendix) with all the symbols used in the text and their definition. Clarify the gridding procedure from ARC SSTskin to Tym,i (e.g. Figure 1).

Reply: A table with all variables is a good suggestion. The procedure from ARC SST skin to $T_{ym,i}$, explained in P1902 lines 10-12, is not a gridding procedure. The gridding is applied to $T_{ym,i}$ resulting in T_{ym} (P1902, Lines 11-12).

Revision in paper:

We will add a table as suggested.

Referee #1: P1902 Line 12 and Line 17. What is the unit for these temperatures?

Reply: The unit can be Kelvin or °C.

Revision in paper:

We will clarify this in the text.

Referee #1: P1903 Line 7. Remove 'SST data from Bakker et al. (2014)'.

Reply: OK.

Revision in paper:

Corrected as proposed

Referee #1: P1904 Line 21 and P1906 Line 13-14. 'Equation (8) was therefore expected to give more accurate pCO2,is estimates' (than equation 1). Takahashi et al. (1993) is the source for both temperature corrections (equation 1 and 8). Takahashi et al. (2009) state the following: 'If Tin situ – Tequ (here SSTdepth and Teq) is less than 2_C, Eq. 2 (here equation 8) yields pCO2 values virtually indistinguishable from the previous ones' (here equation 1). It seems unlikely that the temperature corrections frequently exceed 2°C.

Reply: We agree that this is not usually a large correction, but mathematically Eq. (8) is more accurate than Eq. (1). In a previous paper, we were criticised for stating the approximated version, therefore we have chosen to specify and use the exact version of the equation.

Revision in paper:

None.

Referee #1: P1905. Line 7. Add 'temperature'. (at equilibrator temperature).

Reply: OK.

Revision in paper:

Corrected as proposed

Referee #1: Section 2 P1903-1907. The text on SOCAT procedures (based on Pfeil et al., 2013) distracts from the procedures followed here. Shorten text on SOCAT and move any indispensable text on SOCAT to an appendix. Remove irrelevant comments, e.g. P1906 line 2-6 'they refer to . . .. isochemical conditions'.

Reply: We agree.

Revision in paper:

We will shorten the text as suggested.

Referee #1: Section 2 P1903-1907. Ideally cite the peer-reviewed publication on SOCAT version 1 (Pfeil et al., 2013), rather than Pfeil and Olsen (2009) published online. Use Pfeil and Olsen (2009), when Pfeil et al. (2013) does not contain specific information. By all means mention Pfeil and Olsen (2009), however, this report is more difficult to locate than the published ESSD article. The routines in Pfeil and Olsen (2009) and Pfeil et al.(2013) are based on Pierrot et al. (2009).

Reply: Thankyou for highlighting this.

Revision in paper:

We will edit the paper accordingly.

Referee #1: P1905 Line 23: Correct the statement: 'Pw is set to zero'. Pw is not set to zero. Pw is absent from the equation.

Reply: OK. We apologize for this mistake.

Revision in paper:

Corrected as proposed

Referee #1: P1906. Line 9-10. On '(TCO2 and Talk . . ..may vary)'. Consider removing this, as it distracts. Alternatively explain TCO2, Talk.

Reply: We do not think that this should be removed as understanding what is assumed conservative, and what not, is essential to the philosophy of the processing. T_{CO2} and T_{alk} are explained in pg1906, line 5.

Revision in paper:

None.

Referee #1: P1906. 2nd equation. What is the unit for T ? Degrees Celsius?

Reply: The unit is °C; as stated for the integrated form (Eq. 8). Will add °C.

Revision in paper:

We will add °C.

Referee #1: Section 3 P1907 Line 15-16. Remind the reader of the objective of this section.

Reply: OK.

Revision in paper:

We will explain the context

Referee #1: P1908 Line 18. Correct. Tym,i (equation 13) is not 'a climatological temperature'.

Reply: OK, this was an error.

Revision in paper:

We will replace the phrase with a 'monthly composite'

Referee #1: P1902 Lines 7-12 suggests that Tym,i is the monthly SSTskin at grid points for each year interpolated to the SOCAT measurements plus 0.14K.

Reply: That is correct, $T_{ym,i}$ is the monthly mean of SST_{skin} at grid points for each year interpolated to the SOCAT measurements plus 0.14K.

Revision in paper:

None

Referee #1: P1910 Line 1, P1915 Line 15. Avoid the term: 'missing SOCAT values', when referring to absent measurement salinity, pressure or similar. You might say that certain ancillary parameters are absent in SOCAT.

Reply: OK, we will avoid the term 'missing SOCAT values'

Revision in paper:

Corrected as proposed

Referee #1: P1910 Line 1. Correct the statement: 'We dealt with missing SOCAT variables, following Pfeil and Olsen (2009) etc. . . Pfeil and Olsen (2009) do not 'use SST when Teq is invalid'. The procedures that you follow are very different from those in SOCAT.

Reply: We will clarify this statement. If only surface water f_{CO2} at sea surface temperature were provided (as is the case for CARIOCA data and other spectrophotometric measurements), then no reanalysis was carried out (Pfeil et al., 2013) and the result was the same as using T_{eq} = SST in Eqs. (1)&(8). We will update and change the wording to clarify this.

Revision in paper:

Corrected as proposed

Referee #1: P1911. Line 6-10. Add units for 4, 20, 60, 5x5 sized blocks.

Author Response: OK (4 and 20 are dimensionless).

Revision in paper:

Corrected as proposed

Referee #1: P1915. Line 18. SOCAT used NCEP Pressure and WOA salinity (Table 4 in Pfeil et al.). Not sure if these classify as earth observation (EO). Clarify EO, if you use it.

Reply: We will correct this statement.

Revision in paper:

Replace **'**EO values' with 'values from respectively the World Ocean Atlas 2005 and NCEP).

Referee #1: P1919. Line 19. Correct '(Bakker et al., 2014)'.

Reply: OK.

Revision in paper:

Corrected as proposed

Referee #1: P1918. Line 2. Change to 'SOCAT-based fCO2 (and pCO2) predictions' or similar.

Reply: OK, we will make clear that we do not present SOCAT data, but our calculations are based on SOCAT data.

Revision in paper:

Corrected as proposed

Referee #1: P1919. Acknowledgements. SOCAT has revised its data policy with more text to be added to the acknowledgments (www.socat.info).

Reply: Of course, we will update the acknowledgement (SOCAT revised their data policy after this paper had been submitted).

Revision in paper:

Corrected as proposed

Referee #1: Tables Table 1. Add entry on data source and period covered by data source. What is meant with 'pCO2 (_fCO2)' in column 2?

Reply: OK, We will add the data sources and periods covered for each (Takahashi (2009): 1970 to 2007 and this study 1 August 1991 – 31 December 2007/2011 (SOCAT version 1.5 / 2)).

The p_{CO2} (= f_{CO2}) was meant to highlight that Takahashi did not account for the fact that the gas is not ideal regarding molecular interactions between the gas and the air, so effectively assuming that f_{CO2} = p_{CO2}. We will clarify this in the updated paper.

Revision in paper:

Corrected as proposed

Referee #1: Table 2. Add units for radius, dx, dy. Clarify meaning of min and max.

Reply: OK. Min and max are explained in Section 4 (page 1911, lines 5-9).

Revision in paper:

Corrected as proposed

Referee #1: Table 3. Add units for all parameters. On the footnote: Clarify that not all data in SOCAT meet SOP criteria (Pfeil et al., 2013). Data sets with flags of C and D (59% in version 1; Bakker et al., 2014) do not meet SOP criteria. (N.B. In case of a flag of D the data may meet SOP criteria, but the metadata are incomplete.)

Reply: OK, we will add information detailing this in Section 5.8 (page 1916, lines 11-12)

Revision in paper:

Corrected as proposed

Referee #1: Figure 1: Add a unit for temperature on the x-axis and for average 'dT = -0.09'. Replace 'all available years' by e.g. 'August 1991 to December 2007'. What is the impact of the difference in timing between monthly satellite subskin SST and instant (daily) in situ SST from SOCAT version 1.5? Clarify (or refer to relevant text) how you compare 'monthly gridded data of subskin SST' to 'in situ SST from SOCAT'.

Reply: The impact of differences in timing between monthly satellite subskin SST and instant (daily) in situ SST is that the monthly average of in situ SST is a poor estimate of 'true' monthly average represented by satellite SST. This is the one of the main drivers for the work. The method for comparing the 'monthly gridded data of subskin SST' to 'in situ SST from SOCAT' is described in Section 1.4 (Page 1902, lines 5-16).

Revision in paper:

Temperature units added and period clarified

Referee #1: Figure 2. Add a unit for temperature on the y-axis. Replace 'all available years' by e.g. 'August 1991 to December 2007'.

Reply: OK. This issue is covered by a previous response.

Revision in paper:

None specific to this comment

Referee #1: Figure 3. Replace 'all available data from 1 August 1991 to 31 December 2007' by e.g.'for the months of January from 1992 to 2007'.

Reply: OK. This issue is covered by a previous response.

Revision in paper:

None specific to this comment

Referee #1: Figure 4. What are the units on the axes (distance, semi-variance)? Increase the font size. Is the distance the same in the east-west direction as in the north-south direction?

Reply: OK.

Revision in paper:

Corrected as proposed

Referee #1: Figure 5. Add units for min, max, radius, block size. Reduce the range for the colour scale. Blank areas with a standard deviation (Figure 6) exceeding a certain limit as 'unconstrained' or similar.

Reply: As already discussed, in the revised paper we will only present data with a specified variance. The full dataset will remain in the ancillary data, so users will be able to apply their own chosen quality parameter. This issue is covered by a previous response

Revision in paper:

Units added. None other specific to this comment

Referee #1: Figure 5 versus Figure A8. The fCO2 in Hudson Bay for July changes from _580 µatm (version1) to _220 µatm (version 2). This highlights that areas with a large standard deviation should be blanked and/or that the method should stop at land barriers.

Reply: The user can choose to blank areas over certain standard deviation as they wish.
As already discussed, in the revised paper we will only present data with a specified variance. The full dataset will remain in the ancillary data, so users will be able to apply their own chosen quality parameter. This issue is covered by a previous response.

Revision in paper:

None specific to this comment

Referee #1: Figure A1 versus A9. Why has the standard deviation for November increased from version 1 to 2?

Reply: We can answer that from a technical standpoint only: In Version 2, for the month of November the variograms did not fit the model of a nugget and a spherical model (a Nug(0)+b Sph(c)) very well (See Section 4) and the variograms of the November data fitted a horizontal line

more closely meaning that the variance did not increase much with increasing distance. This implied that the spatial structure of the variable was inconsistent over the entire domain of the dataset, possibly caused by larger trends in the data. Presumably, a change in data content is responsible but we have not investigated further.

Revision in paper:

None

Referee #1: References: Jones et al. (2012) GBC 26 GB2042. doi:10.1029/2010GB004017 Landschützer et al. (2013) BG 10:7793-7815. Pierrot et al. (2009) DSRII 56(8-10):512-522 Rödenbeck et al. (2013) Ocean Science 9: 193-216, doi:10.5194/os-9-193-2013.Takahashi et al., 1993 Takahashi et al., 2009.

Reply: OK, we will add references to the appropriate places in the paper as described throughout the reviewer comments.

Revision in paper:

References

Hare, J. E., Fairall, C. W., McGillis, W. R., Edson, J. B., Ward, B., & Wanninkhof, R. (2004). Evaluation of the national oceanic and atmospheric administrion/coupled-ocean atmospheric response experiment (NOAA/COARE) air-sea gas transfer parameterization using GasEx data. *Journal of Geophysical Research, 109*(C08S11), 1-11. doi:doi:10.1029/2003JC001831

Kettle, H., Merchant, C. J., Jeffery, C. D., Filipiak, M. J., & Gentemann, C. L. (2009). The impact of diurnal variability in sea surface temperature on the central atlantic air-sea CO₂flux. *Atmos. Chem. Phys., 9*, 529-541.

McGillis, W. R., & Wanninkhof, R. (2006). Aqueous CO2 gradients for air-sea flux estimates. *Mar. Chem., 98*, 100-108.