

The manuscript is refined compared to the original version and all of my comments were properly addressed. This work is a useful contribution to the field because this is the first time I have seen the regional importance of predictors addressed in a rigorous way.

The text could still use some minor improvements, mainly in the introduction. I have provided some detailed suggestions below. Once the text has been modified, then I think the manuscript is ready for publication

Suggestions:

Line 36: consider removing “have been thought to”.

Line 38-44: Please rewrite this sentence for clarity. Maybe something like this: “However, the air-sea CO₂ flux averaged between 2001-2015 varies from -1.55 and -1.74 PgC/yr, depending on the pCO₂ product. These differences largely stem from differences in pCO₂ estimates across the products.”

Line 45-47: Consider changing sentence to: “Surface water pCO₂ greater than the overlying air indicates CO₂ is released from the ocean to the air. Conversely, absorption of CO₂ by oceans happened when the pCO₂ of the surface water is lower than the overlying air”

Line 48: need a comma after “sink”.

Line 48: sentence starting with “Sparse and uneven...” could be a new paragraph.

Line 56: Consider changing “Recent researches on” to “Advances in”

Line 62: consider removing “methods such as” and changing “and other” to “with”

Line 68 “ were considered as” to “are considered”

Line 74: “appeared” to “appears”

Line 77: Consider writing sentence as “In addition, sampling information, such as latitude and longitude, has been used as a predictor.” Also, consider referencing Gregor et al. 2019

Lines 111-137: I would consider removing this text and moving Table S1 to the main text. Tables are much easier to read.

Line 145: Landschützer et al. (2020)

Line 148: consider rephrasing “Provinces with connected pixels less than 10 and provinces with SOCAT observation less than 1000...” to “Provinces with less than 10 pixels and less than 1000 SOCAT observations...”

Line 153: "The" needs to be lower case

Line 156: "200 m"

Line 167: comma after "summation".

Line 170: "a tan-sigmoid"

Line 173: Maybe remove "pure" from "pure linear function", I am not sure what that means.

Line 177: Please state how sensitive the model is to the choice of random number. That random number defines where the NN starts "searching" in errors space. I understand the random number was fixed for reproducibility purposes. However, my understanding of best practice is to either run the model many times with different random numbers and take the average or "tune" the random number to find the one that gives best results. Please mention if this was explored or if the random number was simply chosen randomly.

Line 224: "after that,"

Line 226: "Then,"

Line 231-235: Please consider rephrasing, this sentence is hard to understand.

Line 236: "At this time, part 1 ... finished and ..."

Line 259: In what increments where neurons increased by?

Line 290: It is also worth noting pCO₂ at BATS and HOT are estimated from TA and DIC (I am not sure if ESTOC is estimated or directly measured). I think it's important for the reader to know these estimates are derived and not directly measured like SOCAT observations.

Line 505: Wouldn't modifying the structure of the FFNN be considered making a "better network"? By better network do you mean more sophisticated architectures? I would also add that different learning algorithms could be considered.

Table 4: Please state what the bold values indicate. Also a comma is needed before respectively: "...Landschützer et al., 2014 and Denvil-Sommer et al., 2019, respectively" This typo is repeated throughout the article

Figure 3: Make it clear these provinces are from a SOM. This is just a suggestion, but it would be great to get some of the information in Table 4 into this map. Maybe putting the leading predictor in parentheses in the colorbar? This might look too messy, it's just a suggestion.

Figure 6: Comma before “respectively”

Figure 7: Comma needed: “...Landschützer et al., 2014 and Denvil-Sommer et al., 2019, respectively

Figure 8: please put units on the colorbar.