We thank the anonymous reviewer for helpful comments that helped us improve this manuscript. Below the reviewer comments are given in black. Our responses are given in red, and the updated text is given in blue.

General Comments:

This paper presents a comprehensive analysis of uncertainties in eddy covariance flux measurements over the ocean, discussing in detail the separation of systematic from random noise with a thorough overview of different methods for estimating the latter. The authors clearly demonstrate that with current top-end commercial gas analyzers, instrumental noise no longer contributes significantly to the flux uncertainty, this being dominated by variance associated with the nature of turbulent transport. The paper is very well written and structured, and may serve as an excellent reference for researchers looking for a state-of-the-art starting point for uncertainty analysis.

Specific Comments:

Line 40, Eq 1: perhaps briefly explain the "660" for those readers unfamiliar with gas transfer velocity parameterizations

Answer: we added one sentence to explain 660 after the definition of *Sc* (Schmidt number).

Sc is equal to 660 for CO_2 at 20°C and 35‰ salt water (Wanninkhof et al., 2009).

L76: Li-COR Inc. USA

Answer: we added the company information of LI-7500.

After 2000, a commercial open-path infrared gas analyser LI-7500 (Li-COR Inc. USA) became widely used for air-sea CO_2 flux measurements…

L79: expected fluxes

Answer: we replaced 'expected' by 'expected fluxes'.

The LI-7500 generated extremely large and highly variable CO_2 fluxes in comparison to expected fluxes…

L80: … 2011). This problem is generally considered …

Answer: we replaced '…2011), which are generally considered…' by '…2011). This problem is generally considered…'.

… 2011). This problem is generally considered to be an artefact caused by water vapour cross-sensitivity…

L124: Comment on the deflection of the streamlines from horizontal and effects on the

vertical wind component

Answer: CFD modelling suggests that at the location of the sonic anemometer on the JCR, the angle of air flow relative to the horizontal is 3.5 deg for bow on wind. This is consistent with the tilt angle computed from the double rotation as a part of the motion correction. The tilt angle is slightly larger on the Discovery (7.5 deg) for bow on wind. This deflection of the streamline is accounted for by the double rotation prior to the EC flux calculation. Therefore, we add a sentence in the end of this paragraph:

The deflection of the streamline from horizontal and effects on the vertical wind component is accounted for by the double rotation (motion correction processes, see Sect. 2.2.) prior to the EC flux calculation for both ships.

L133: add the Reynolds number for completeness

Answer: the Reynolds numbers are 5957 and 1042 for the air sample tube on JCR and Discovery, respectively. We added this numbers. In addition, the inner diameter of the tube on Discovery is 0.95 cm, we also added this value. We changed the previous sentence 'Air is pulled through a long tube (30 m, 0.95 cm inner diameter) with a dry vane pump at a flow rate of ~40 L min-1 (Gast 1023 133 series).' by:

Air is pulled through a long tube (30 m, 0.95 cm inner diameter, Reynolds number 5957) with a dry vane pump at a flow rate of ~40 L min-1 (Gast 1023 133 series).

We changed the previous sentence 'The LI-7200 gas analyser was mounted within the enclosed staircase, directly underneath the meteorological platform and close to the inlet (inlet length 7.5 m).' by:

The LI-7200 gas analyser was mounted within the enclosed staircase, directly underneath the meteorological platform and close to the inlet (inlet length 7.5 m, inner diameter 0.95 cm, Reynolds number 1042).

Fig. 3: adding a schematic explanation similar to that in Fig. 7a would clarify the method of separating the white noise from the total variance.

Answer: we replaced the previous Fig. 3 and caption by the figure and caption below:

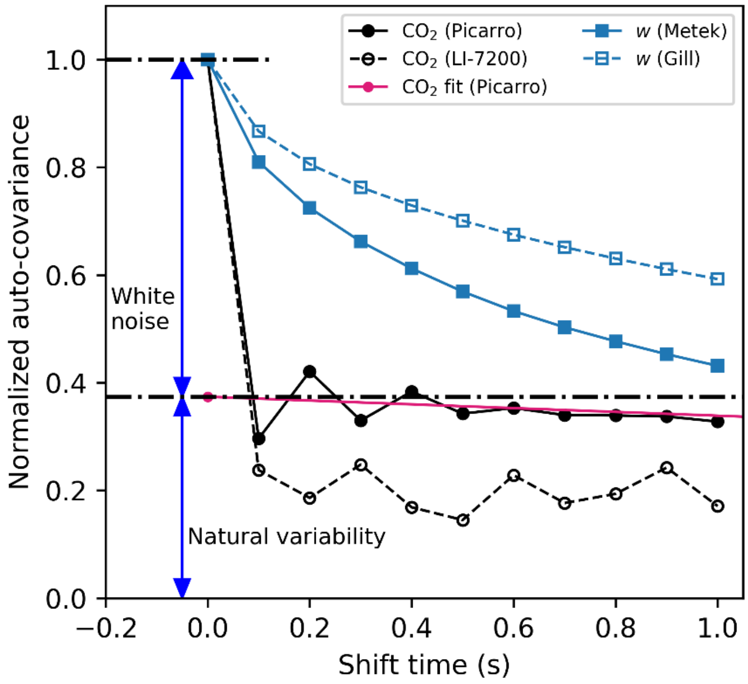


Figure 3. Mean normalised auto-covariance functions of CO_2 and vertical wind velocity (*w*) by four different instruments. The magenta line represents a fit to the noise-free auto-covariance function of CO_2 (measured by Picarro) extrapolated back to a zero time shift. An example of the white noise and natural variability contributions to the total CO_2 (measured by Picarro) variance is indicated by two blue arrows. The sharp decrease of the CO_2 auto-covariance between the zero shift and the initial 0.1 s shift corresponds to the large contribution of white noise from the gas analysers. The LI-7200 is the noisier instrument. The noise contributions from the anemometers are relatively small (< 10%).

L432: should be Eq. 8

Answer: δF_{RV} is calculated by Eq. 7 by setting $\sigma_{c_n}^2 = 0$ and $\sigma_{c_a}^2 = \sigma_{c_{av}}^2$. Here $\sigma_{c_{av}}^2$ is estimated by Eq. 8. We added Eq. 8 as another referred equation for calculating δF_{RV}.

…, vertical flux (δF_{RV}, Eq. 7 and 8) and other atmospheric processes…

L504 etc.: eliminate the space between : and signal; otherwise the colon looks like punctuation.

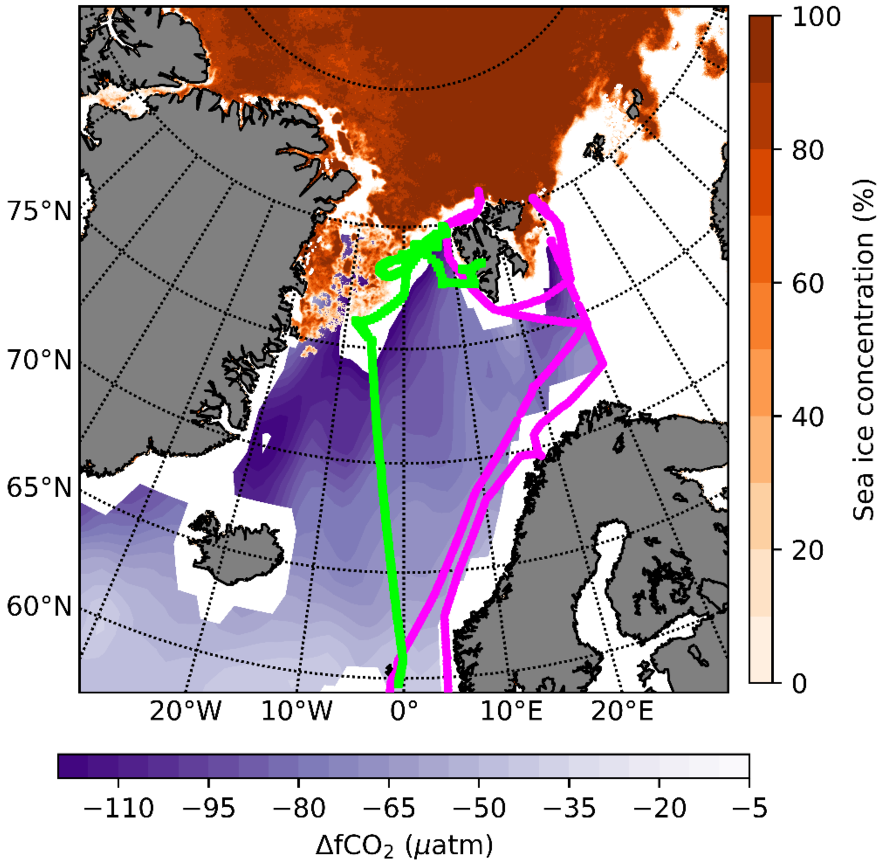
Answer: we eliminated all the space between : and signal (noise: signal) and also eliminated all the space between : and noise (signal: noise) in the manuscript (13 cases).

Signal:noise, noise:signal

Fig. A1: I recommend using color schemes that are more distinguishable from each other

for sea ice and dFCO2 (eg. a grey scale for the sea ice coverage).

Answer: we replaced the previous Fig. A1 by the below one. We tried to use a grey scale for the sea ice coverage, but it is difficult to distinguish the sea ice concentration and the land. Therefore, here we used the orange scale for the sea ice coverage. Seems it is better than the previous one (blue scale for the sea ice coverage).



L942: Chapt. 2

Answer: we corrected the wrong word.

Wyngaard, J. C.: Turbulence in the Atmosphere Part 1, Chapt. 2, Getting to know turbulence, p27-54 Cambridge University Press., 2010.

Reference

Wanninkhof, R., Asher, W. E., Ho, D. T., Sweeney, C., & McGillis, W. R. (2009). Advances in Quantifying Air-Sea Gas Exchange and Environmental Forcing. *Annual Review of Marine Science*, *1*(1), 213–244. https://doi.org/10.1146/annurev.marine.010908.163742