

Interactive comment on “Ship-borne measurements of XCO₂, XCH₄, and XCO above the Pacific Ocean and comparison to CAMS atmospheric analyses and S5P/TROPOMI” by Marvin Knapp et al.

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Knapp et al., ESSD, Ship-borne measurements of XCO₂, XCH₄, and XCO above the Pacific Ocean and comparison to CAMS atmospheric analyses and S5P/TROPOMI

This paper describes in detail an east-west transect of atmospheric total column amount measurements of CO₂, CH₄ and CO across the Pacific Ocean near 30°N, from Vancouver to Singapore. The stated purpose of the campaign is to provide an assessment of the potential for ship-borne measurements to validate satellite-based

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measurements of greenhouse gases and CO, such as by GOSAT and OCO series satellites, over the oceans. At present such validation relies entirely on land based networks, such as TCCON, so this is a valuable aim, to develop validation methods over the oceans. Although there are few actual coincidences of these campaign measurements with actual satellite measurements, the measurements are compared to two independent datasets, from Copernicus Atmospheric Monitoring Service (CAMS) which assimilates and interpolates data from several satellites for CO₂ and CH₄, and TROPOMI for CO. The campaign measurements are made by direct solar absorption spectroscopy in the NIR using a Bruker EM27-SUN Fourier Transform spectrometer with custom-built fast response solar tracker suited to shipboard measurements. There is a full description of all components of the measurement system in part referring back to previous work. The instrument, data description and accuracy assessment is quite complete and well suited to ESSD publication. The data are already available in PAN-GAEA. The paper is acceptable for publication with only a few suggestions for minor revisions to clarify some points.

Technical corrections.

L10: “Precision” is a general term which should not be used for quantitative purposes (see BIPM’s Guidelines for Uncertainty in Measurement, GUM). Please specify here in the abstract the measure of precision quoted (0.24 ppm, 1.1 ppb, 0.75 ppb), presumably it is the 1-sigma repeatability of consecutive measurements.

L11: Please add a few words here in the abstract to describe the CAMS product for those readers not familiar with it. In the context it is important to know that this a gridded field of assimilated data from satellites, not a purely model product.

L33: . . . similar column-sensitivity to (not as) the satellites. Also, it appears that there has been no inclusion of averaging kernel information in comparing columns from different instruments and CAMS. This point is not addressed. If the sensitivities are “similar”, can you provide a figure for the potential size of the error in ignoring the averaging

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kernels?

L45: I suggest replacing “disposes of” with “incorporates”

L82: . . . positioned on top OF the box

L109: ratioed not rationed

L111: TCCON consistently uses 0.2095 for the mole fraction of O₂ in air, not the 0.2094 used here. Could you provide a reference to the source of this figure?

L162: Although previously common practice, using the word “calibrated” in comparing TCCON to the SI-traceable scales of the in situ networks is problematic, since many do not consider this to be strictly “calibration”. Better to use “validated”, or “compared and scaled to “ the WMO scales.

L163: the meaning of “background concentration” is not clear here – I think you mean “We determine the SZA dependence for each species from observations over a day in background air when the columns do not vary, and the scaling factors. . .”

Figure 4: It is quite hard to distinguish the blue and green data in these plots, could you choose a more distinct pair, such as blue and magenta?

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