



Supplement of

Investigation of spaceborne trace gas products over St Petersburg and Yekaterinburg, Russia, by using COllaborative Column Carbon Observing Network (COCCON) observations

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Supplement

Correlation between COCCON and satellite products

Figure S1, Figure S2 and Figure S3 shows the comparison between the original COCCON and Satellite products without applying the smoothing corrections.

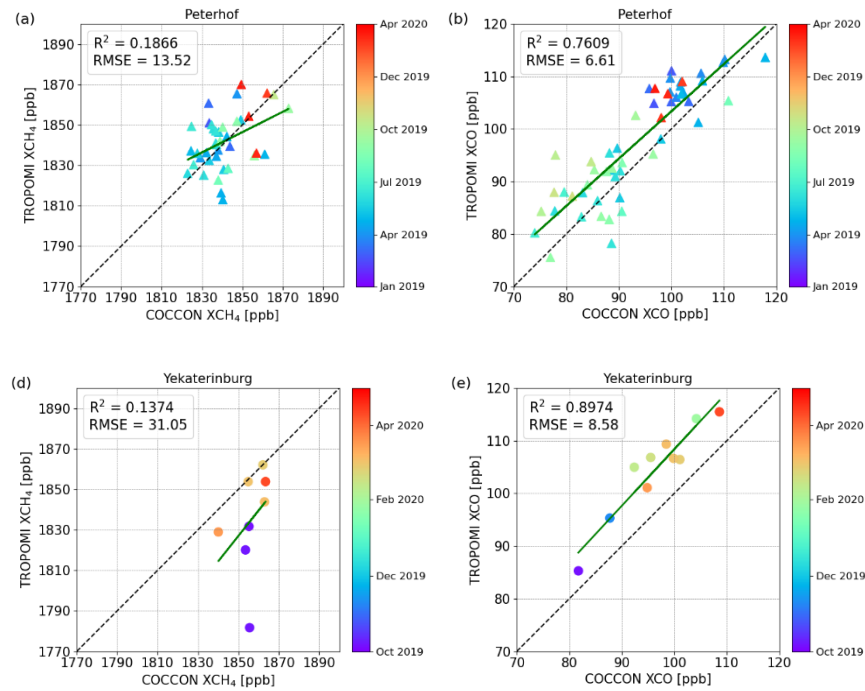


Figure S1 Correlation plots between TROPOMI and COCCON for XCH₄ and XCO at Peterhof (a-b) and at Yekaterinburg (d-e).

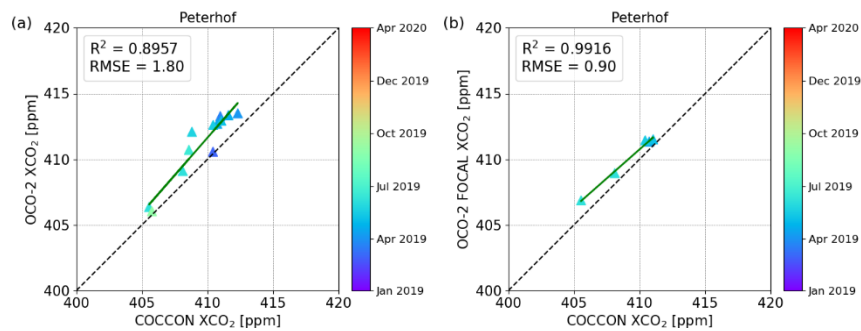


Figure S2 Correlation plots (a-b) between NASA's operational and the FOCAL OCO-2 product and COCCON for XCO₂ at Peterhof.

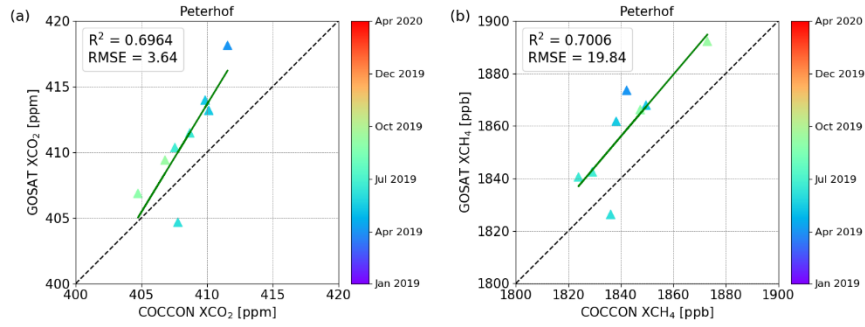


Figure S3 Correlation plots between GOSAT and COCCON for (a) XCH₄, (b) XCO at Peterhof.

Figure S4 shows the averaged bias from different satellite products in comparison with COCCON results. As mentioned above, these comparisons have not taken into account the averaging kernel corrections.

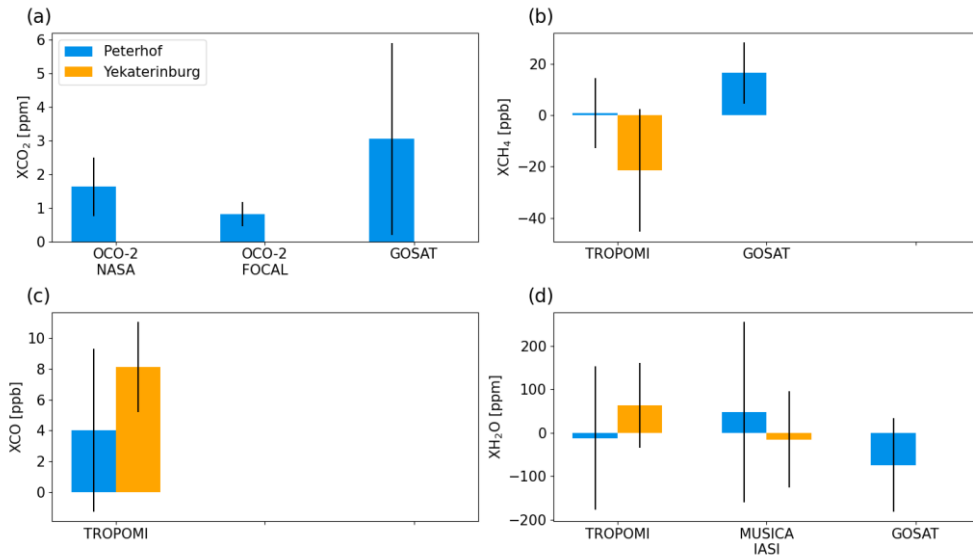


Figure S4 Bar plots of the averaged bias derived from different products with respect to COCCON for (a) XCO₂, (b) XCH₄, (c) XCO and (d) XH₂O at Peterhof and Yekaterinburg. The error bars represent the standard deviation of the averaged bias.

CAMS-COCCON comparisons with satellite products

Figure S5, Figure S6, Figure S7 and Figure S8 shows the comparisons between the combined CAMS-COCCON with satellite products. The main difference with the figures presented in the main paper is that here the original COCCON product by using the MAP files as a-priori was used for generating the combined product, and the fact that no averaging kernel smoothing was applied as well. Finally, in Figure S9 the averaged bias between the CAMS-COCCON product with respect to the satellite products is shown.

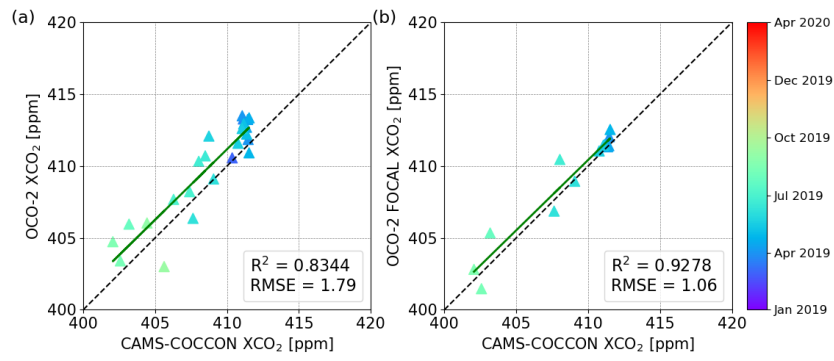


Figure S5 Correlation plots of (a) OCO-2 and (b) OCO-2 FOCAL with respect to CAMS-COCCON XCO₂ at Peterhof.

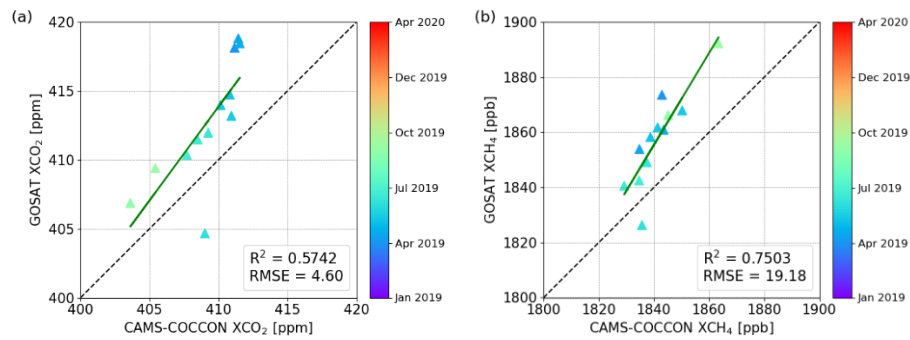


Figure S6 Correlation plots of (a) GOSAT XCO₂ and (b) GOSAT XCH₄ with respect to CAMS-COCCON at Peterhof.

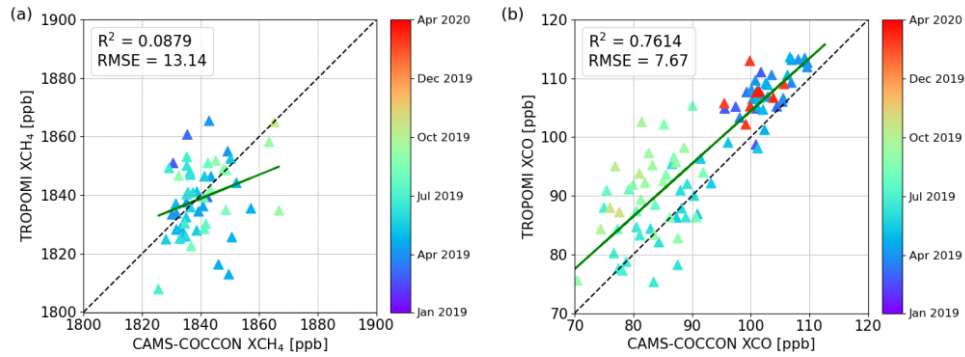


Figure S7 Correlation plots of (a) TROPOMI XCH₄ and (b) TROPOMI XCO with respect to CAMS-COCCON at Peterhof.

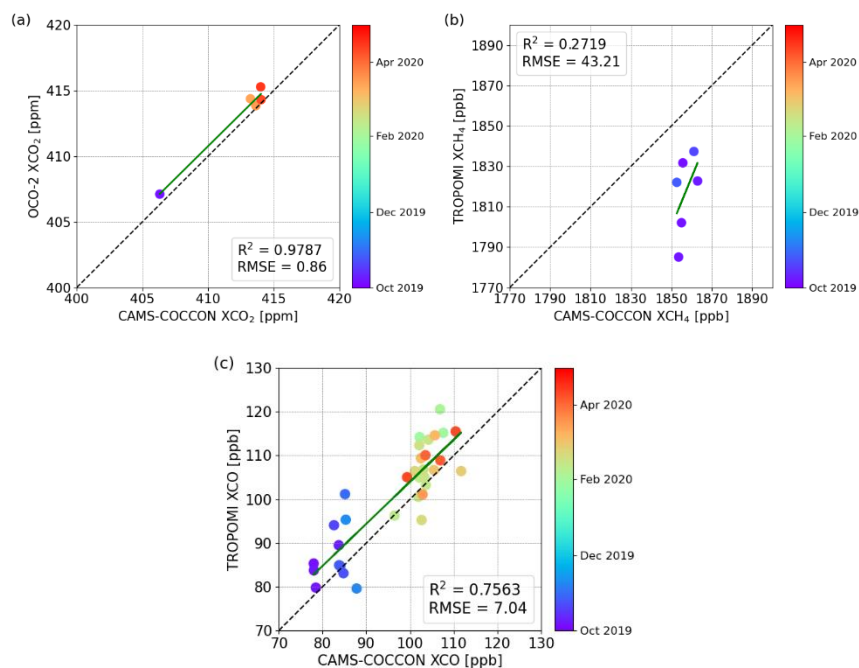


Figure S8 Correlation plots of (a) XCO_2 between OCO-2 and CAMS-COCCON, (b) XCH_4 between TROPOMI and CAMS-COCCON, and (c) XCO between TROPOMI and CAMS-COCCON observations at Yekaterinburg.

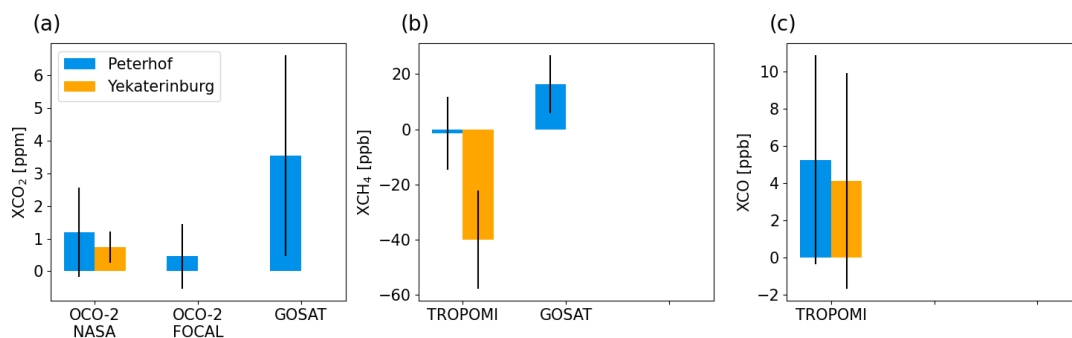


Figure S9 Bar plots of the averaged bias derived from different products with respect to CAMS-COCCON for (a) XCO_2 , (b) XCH_4 and (c) XCO at Peterhof and Yekaterinburg. The error bars represent the standard deviation of the bias.

The following table shows a summary of the averaged bias comparison between satellite and COCCON or CAMS-COCCON products but with two differences with respect to the table on the main paper: (1) COCCON is the original product with MAP as a-priori and CAMS-COCCON was generated based on it and (2) no averaging kernel smoothing was considered.

Table S1 Selected averaged bias and standard deviation between satellite products and COCCON, and between satellite products and CAMS-COCCON at Peterhof and Yekaterinburg. The number of coincident results is shown in the parenthesis.

		OCO-2 XCO_2 (ppm)	TROPOMI XCH_4 (ppb)	TROPOMI XCO (ppb)
Peterhof	COCCON	1.63 ± 0.87 (15)	0.85 ± 13.67 (39)	4.02 ± 5.30 (54)
	CAMS-COCCON	1.19 ± 1.37 (24)	-1.49 ± 13.18 (53)	5.26 ± 5.61 (93)
Yekaterinburg	COCCON	-- (1)	-21.5 ± 23.95 (8)	8.12 ± 2.92 (11)
	CAMS-COCCON	0.74 ± 0.49 (5)	-40.04 ± 17.81 (6)*	4.12 ± 5.80 (33)

* No CAMS XCH_4 in 2020.