Supplement to: *Impact of land-water sensitivity contrast on MOPITT retrievals and trends over a coastal city*

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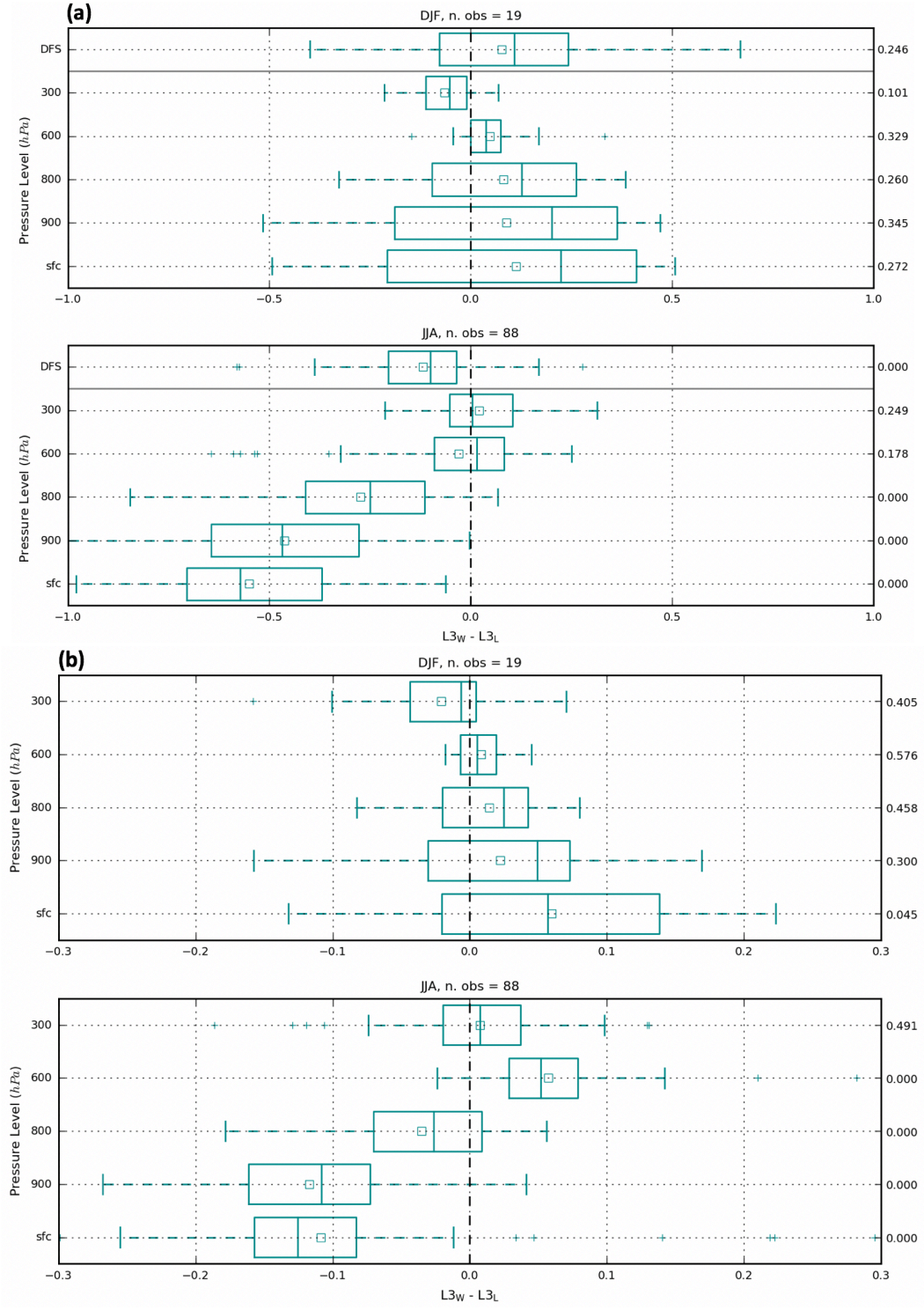
SM1

Figure S1 (next page) shows that sensitivity differences in retrievals over land ($L3_L$) and water ($L3_W$) are greater and more persistent (i.e. sensitivity is regularly greater over one surface than the other) in the LT than MT and UT; and more pronounced in JJA than in DJF (as discussed in Section 3.1.2).



15 **Figure S1;** Boxplots for the distribution of differences ($L3_W - L3_L$) in **(a)** AK rowsums and DFS values; and **(b)** AK diagonal values, that correspond to the mean AK plots shown in Figure 3. Squares = mean differences, with the p value associated with each mean difference (from a 2-tailed Student's t test) given on the right-hand side y axis. Plus symbols = outliers†.

†Outliers defined as: above (below) percentile 75 (25) + (-) 1.5 * interquartile range

SM2

Figure S2 corresponds to Figure 7, discussed in Section 3.1.4. The difference here is that, while Figure 7 is a seasonal median plot, including *all* L2 retrievals made over the plotted region in DJF and JJA, Figure S2 only consists of retrievals made on days when $L3_L$ and $L3_W$ are both present, i.e., only the days analysed in Section 3.1.

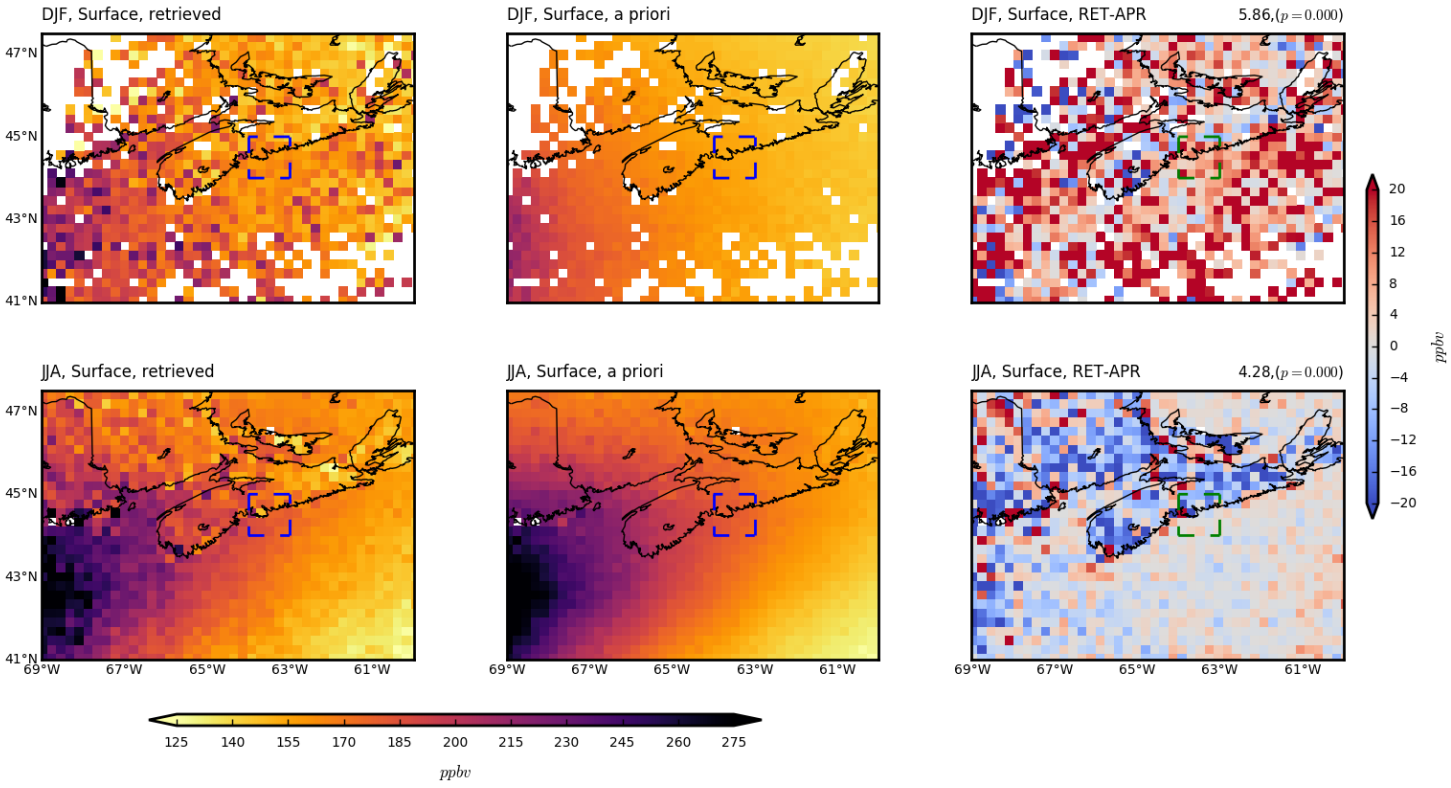


Figure S2 Median L2† retrieved VMR (left column), a priori VMR (centre column), and RET-APR (right column) at the surface profile level for DJF (top row) and JJA (bottom row), for days when $L3_L$ and $L3_W$ are both present. Values to the right above RET-APR plots = $\overline{(\text{L2 retrievals over water})} - \overline{(\text{L2 retrievals over land})}$ for plotted area (data were first binned according to L2 surface index); numbers in brackets correspond to significance of mean difference using a 2-tailed Student's t test. Blue or green dashed square = outline of L3 grid box that contains Halifax. White shading = gridboxes with no retrievals on the days analysed.

†These maps were created from L2 data that were interpolated to a regular 0.25° x 0.25° grid for ease of plotting.

SM3

Figure S3 corresponds to Figure 7, discussed in Section 3.1.4, but for selected other profile levels (Figure S3a-d) and for CO Total Column (TCO) (Figure S3e).

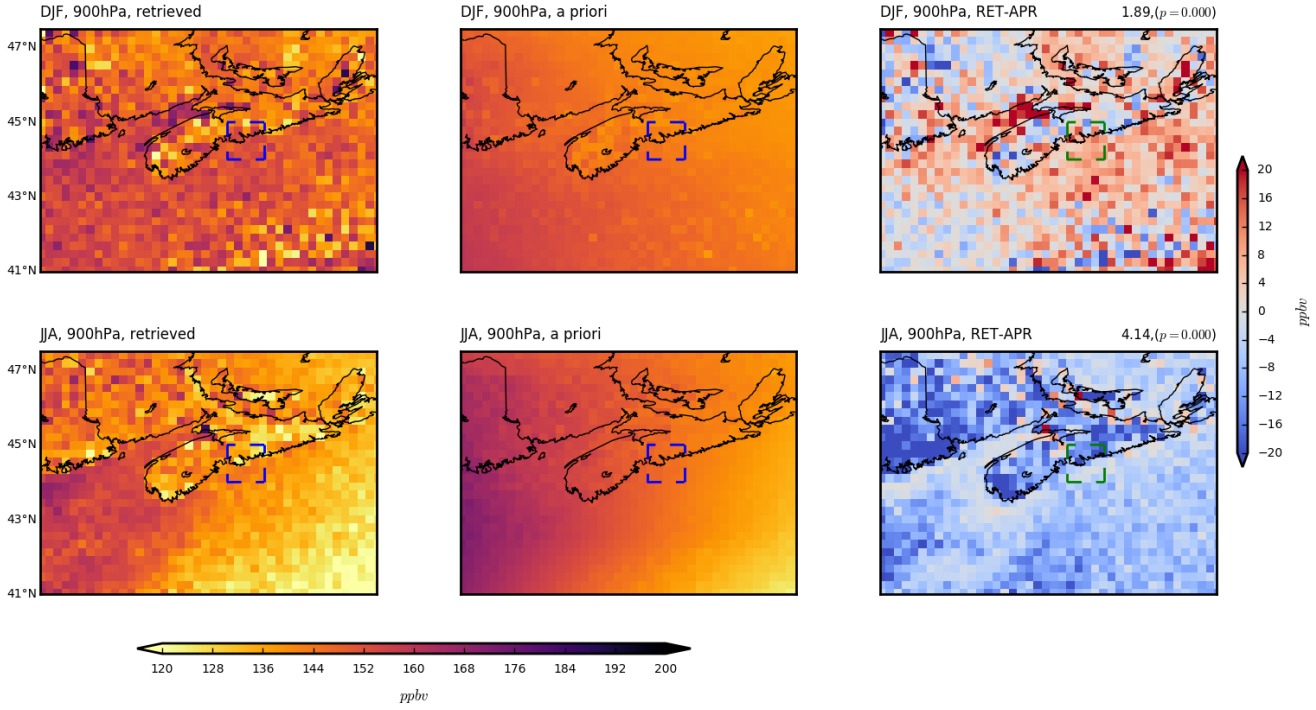


Figure S3a Seasonal median L2† retrieved VMR (left column), a priori VMR (centre column), and RET-APR (right column) at the 900 hPa profile level in DJF (top row) and JJA (bottom row). Values to the right above RET-APR plots = $\overline{(\textbf{L2 retrievals over water})} - \overline{(\textbf{L2 retrievals over land})}$ for plotted area (data were first binned according to L2 surface index); numbers in brackets correspond to significance of mean difference using a 2-tailed Student's t test. Blue or green dashed square = outline of L3 grid box that contains Halifax.

†These maps were created from L2 data that were interpolated to a regular 0.25° x 0.25° grid for ease of plotting.

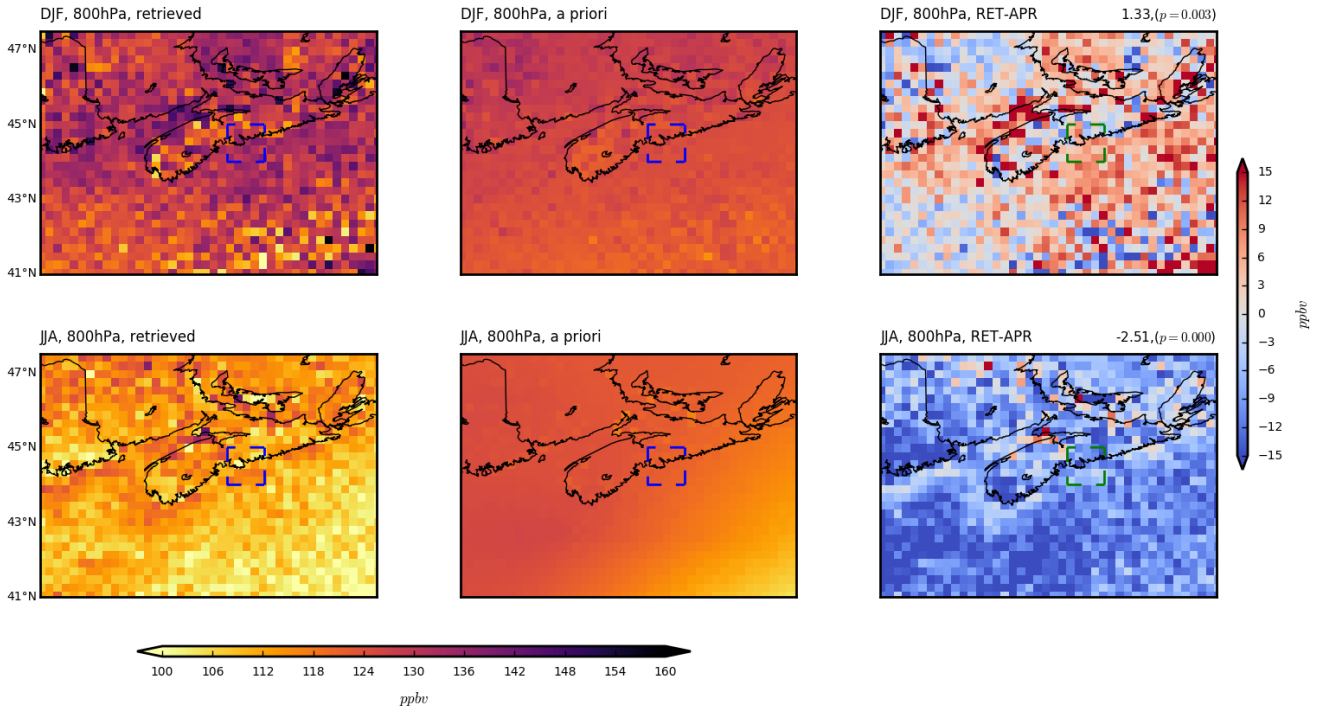


Figure S3b As Figure S3a, but for the 800 hPa profile level.

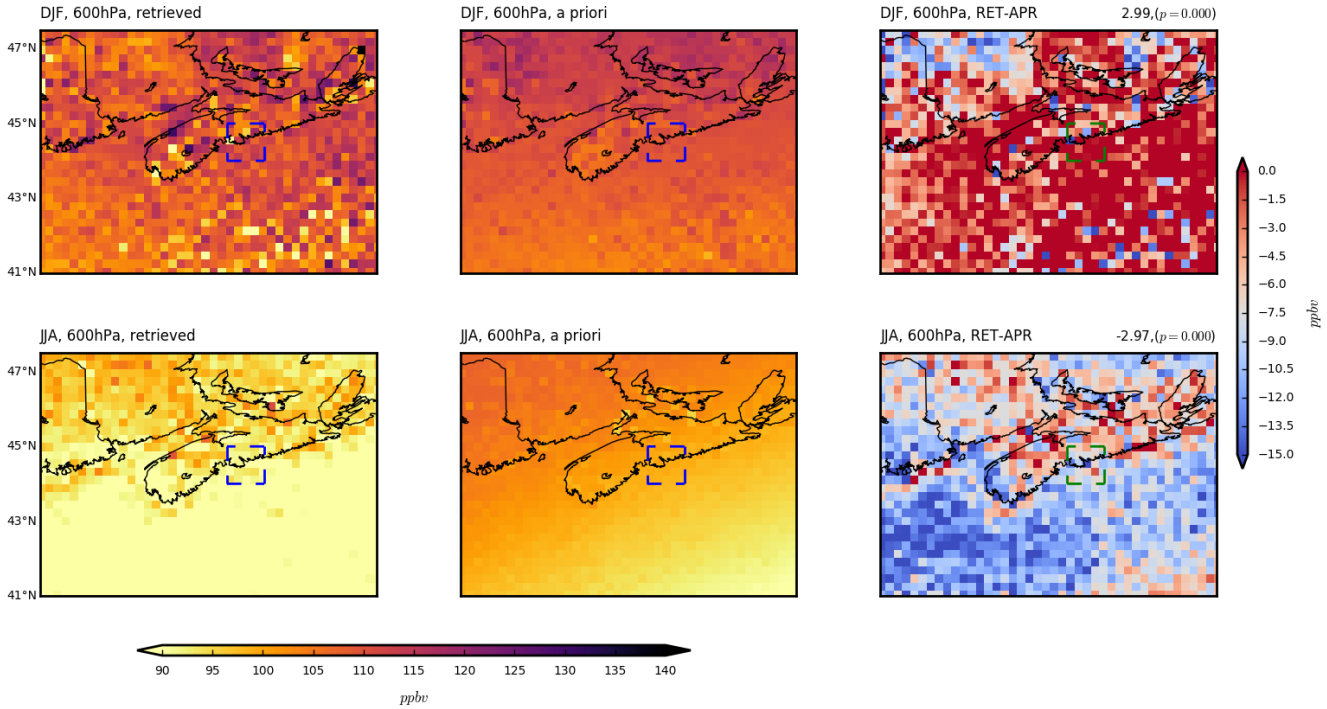


Figure S3c As Figure S3a, but for the 600 hPa profile level.

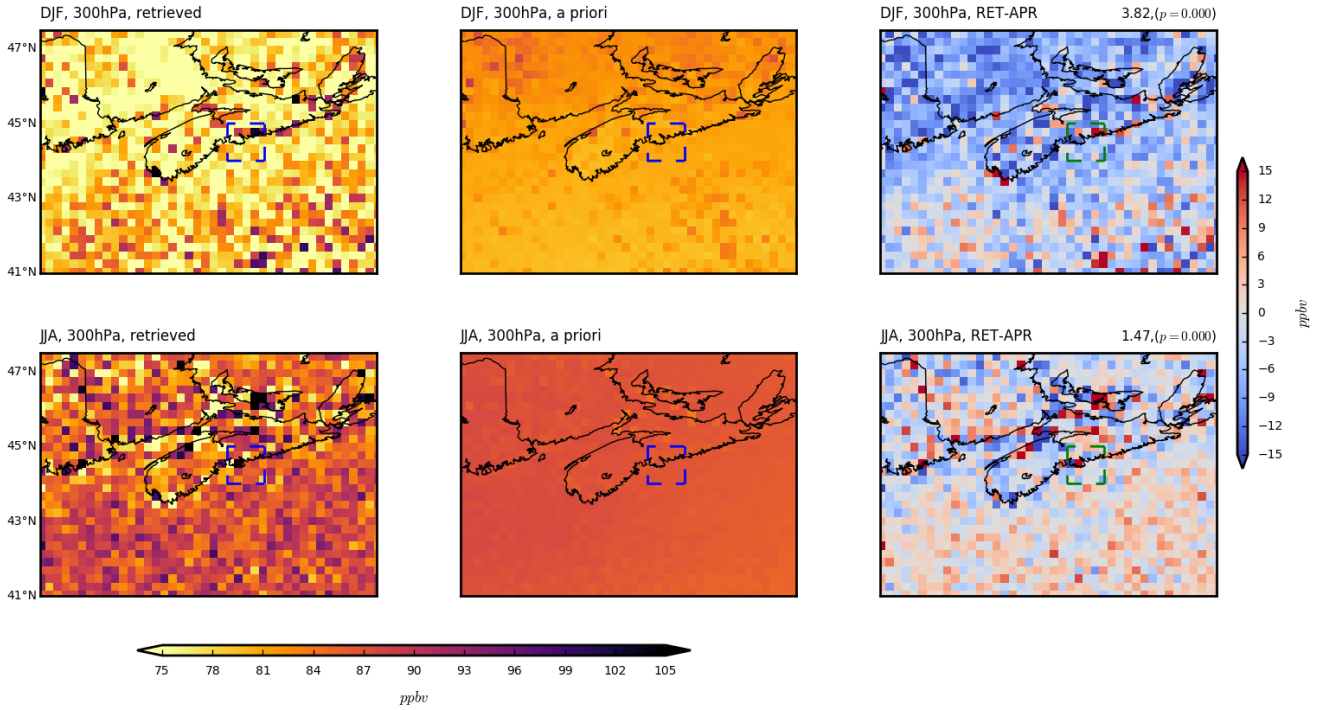


Figure S3d As Figure S3a, but for the 300 hPa profile level.

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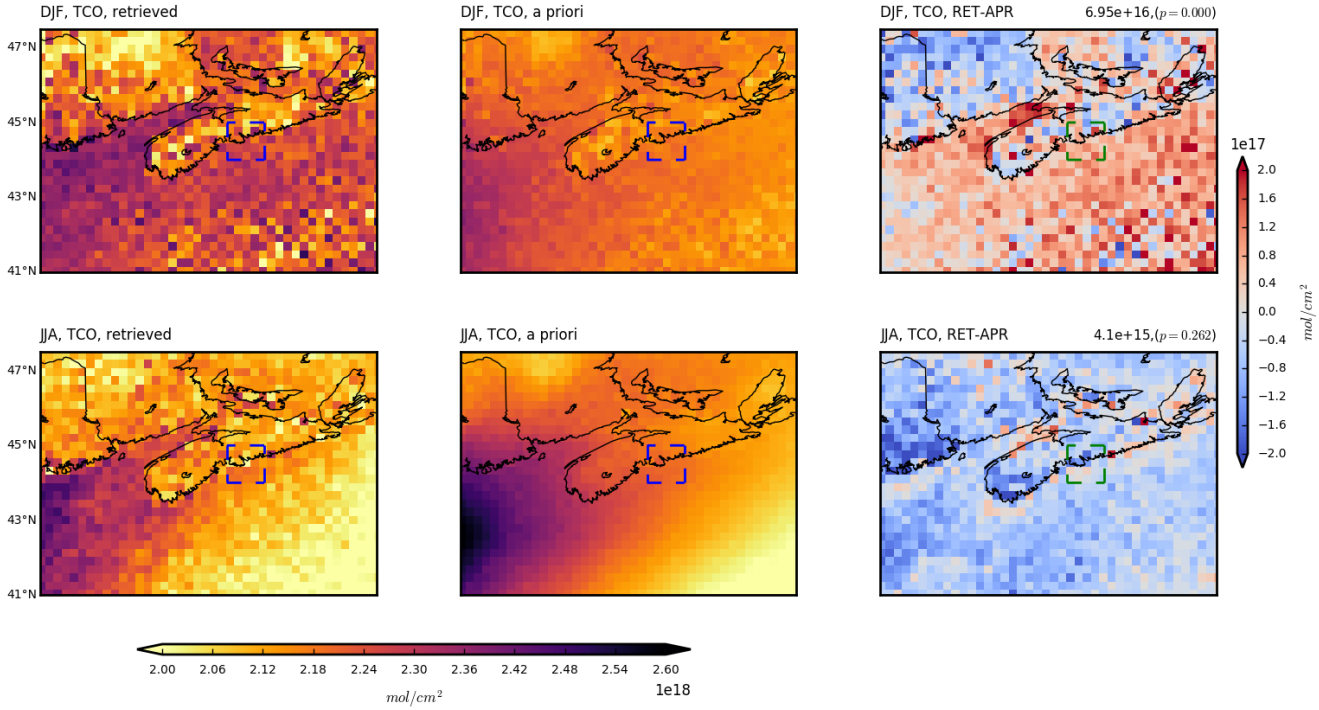


Figure S3e As Figure S3a, but for CO Total Column (TCO).

SM4

Figure S4 corresponds to Figure 8, discussed in Section 3.1.5, but for selected other profile and model wind levels.

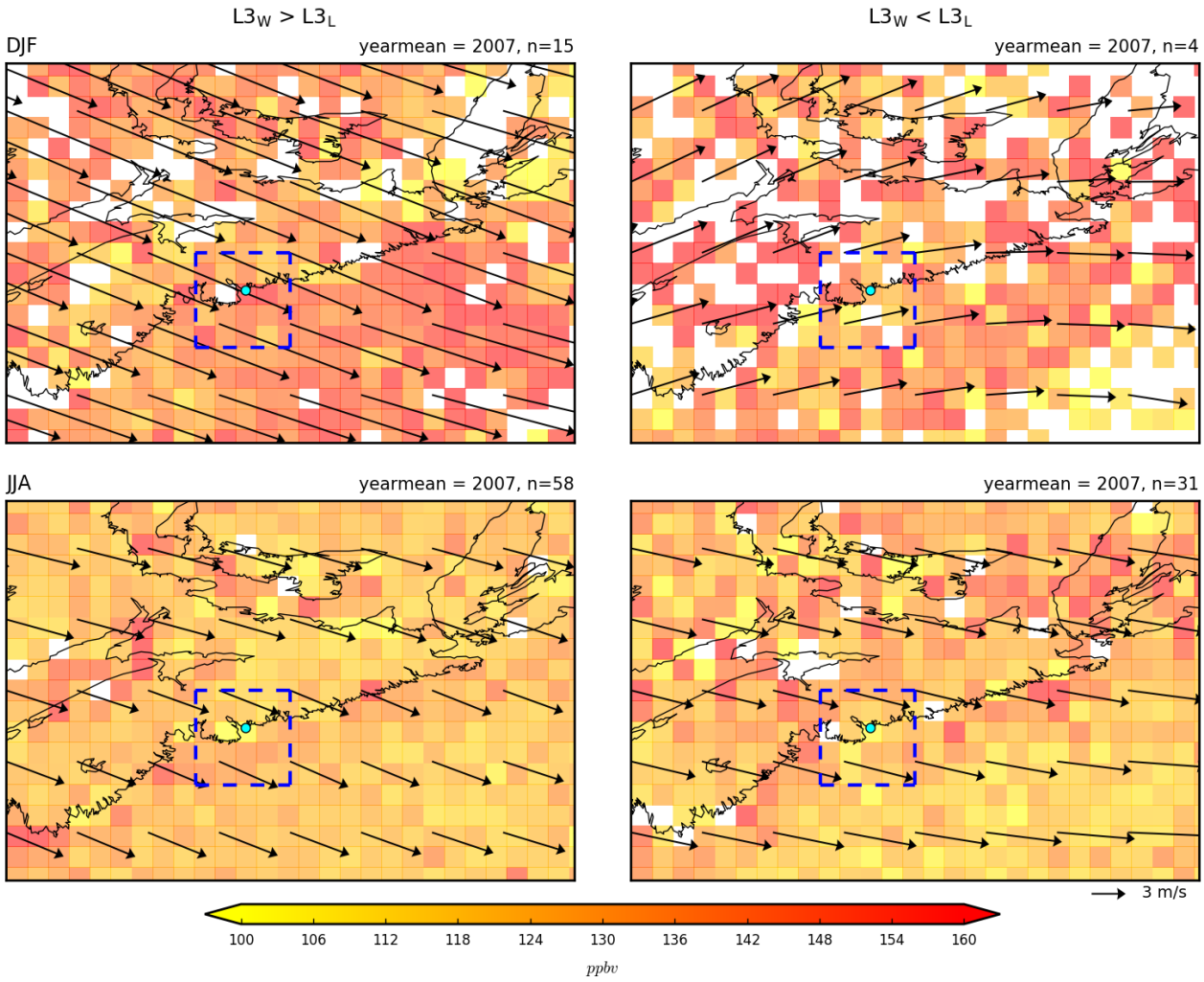
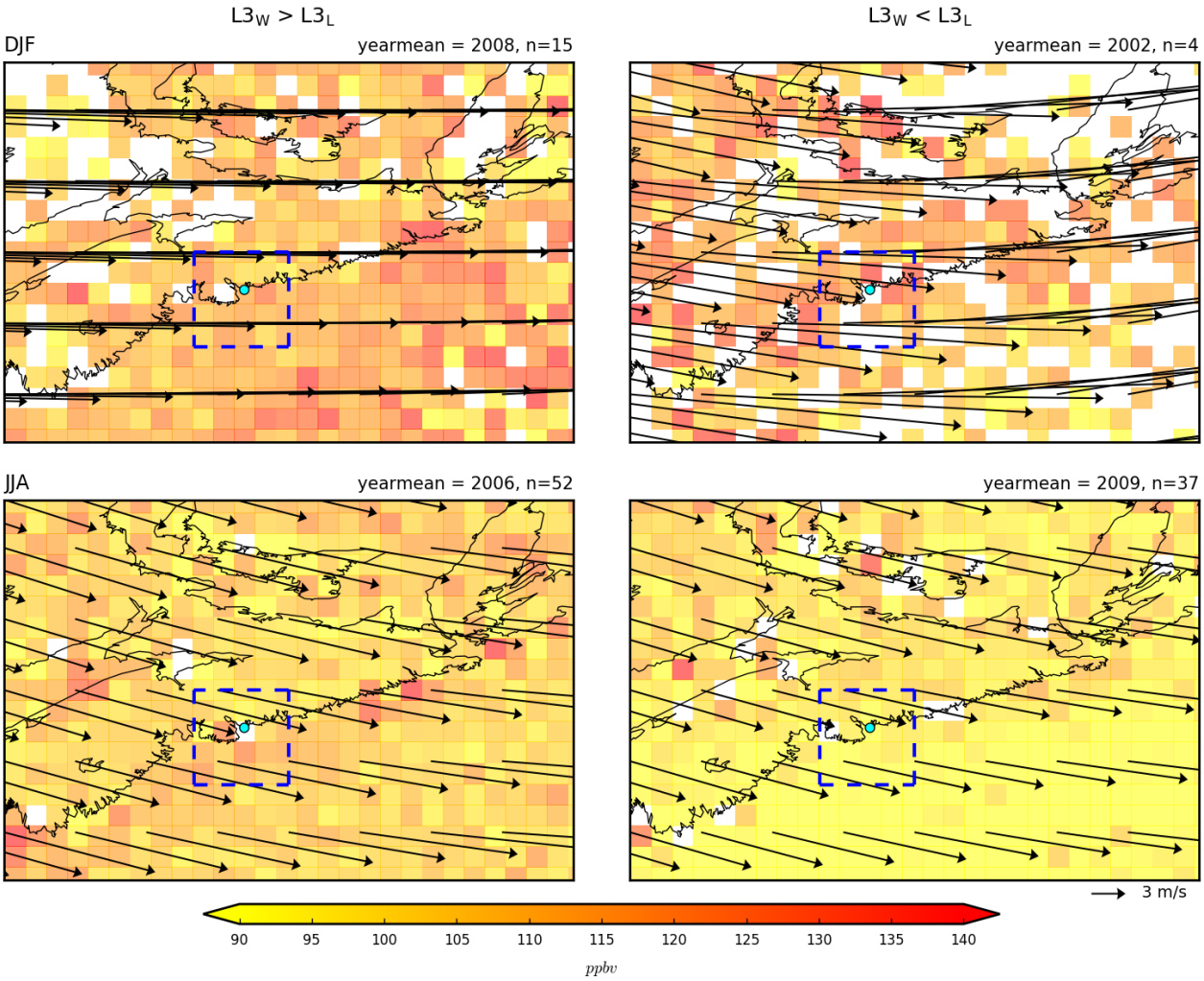


Figure S4a Mean ERA-Interim 850 hPa winds (vectors) and MOPITT L2† VMR at the 800 hPa profile level (shading) for days when retrieved surface level VMRs in $L3_W$ are greater than in $L3_L$ ($L3_W > L3_L$) and days when they are less ($L3_W < L3_L$). Top row = DJF; bottom row = JJA. "Yearmean" corresponds to the mean year in which retrievals from the respective samples took place (study period spans 2000-2017).

†These maps were created from L2 data that were interpolated to a regular 0.25° x 0.25° grid for ease of plotting.



85

Figure S4b As Figure S4a but for mean ERA-Interim 500 hPa winds (vectors) and MOPITT L2† VMR at the 600 hPa profile level (shading).

SM5

Figure S5 corresponds to Figure 9, discussed in Section 3.2.1. The difference here is that, while Figure 9 includes *all* data in the $L3_O$, $L3_L$ and $L3_W$ timeseries, Figure S5 only consists of retrievals made on days when $L3_L$ and $L3_W$ are both present, i.e., only the days analysed in Section 3.1.

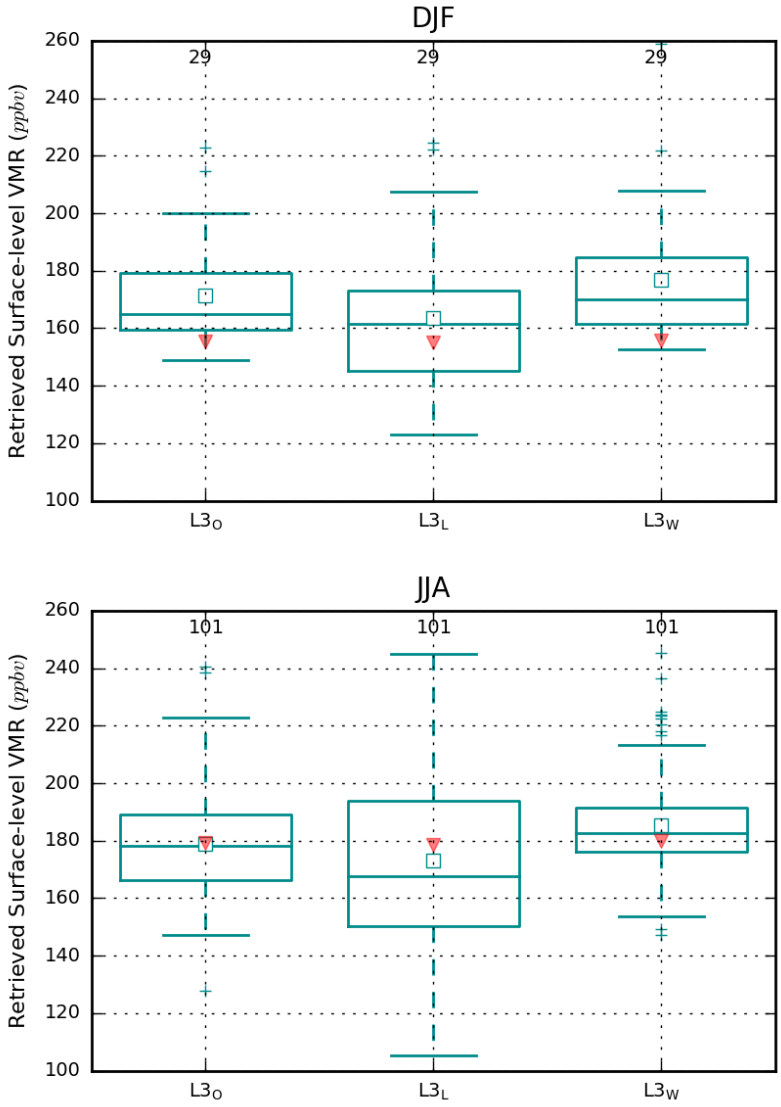


Figure S5 Distribution of retrieved surface level VMR values from $L3_O$, $L3_L$ and $L3_W$, for DJF and JJA, on days when $L3_L$ and $L3_W$ are both present. Squares = mean values; Red triangles = corresponding mean a priori values. Sample sizes are given below the top x axis.

SM6

Figure S6 corresponds to Figure 9, discussed in Section 3.2.1, but for selected other profile levels (Figure S6a-d) and for CO Total Column (TCO) (Figure S6e).

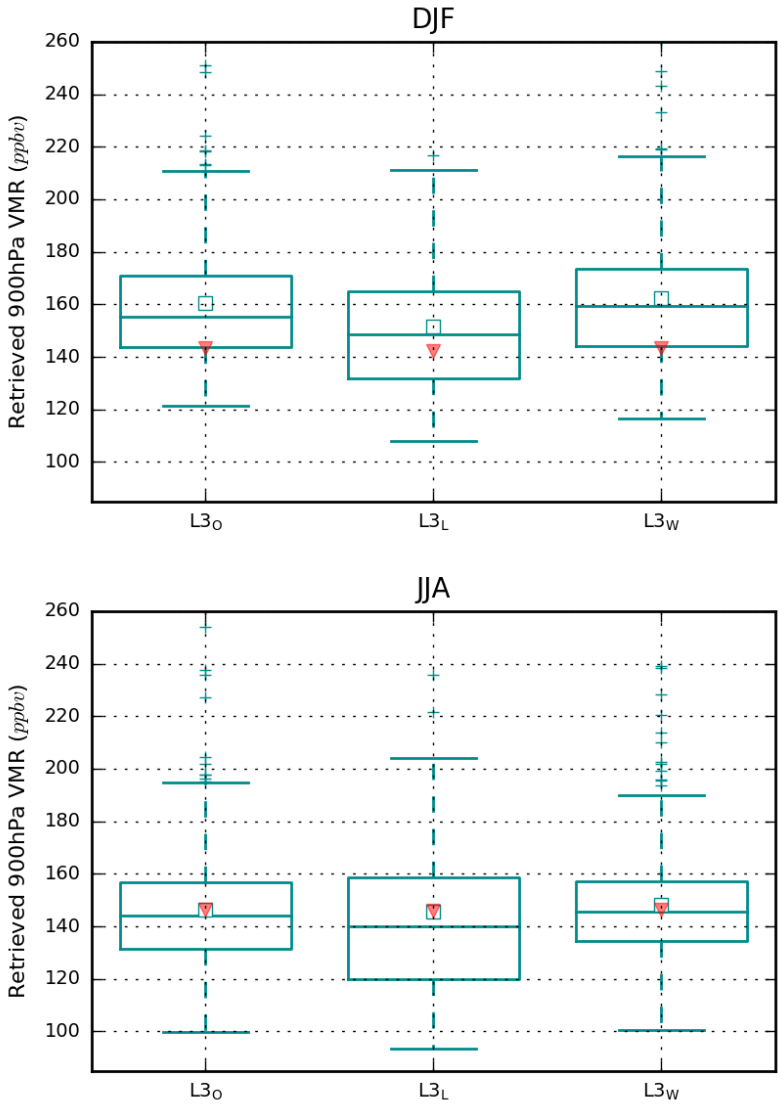
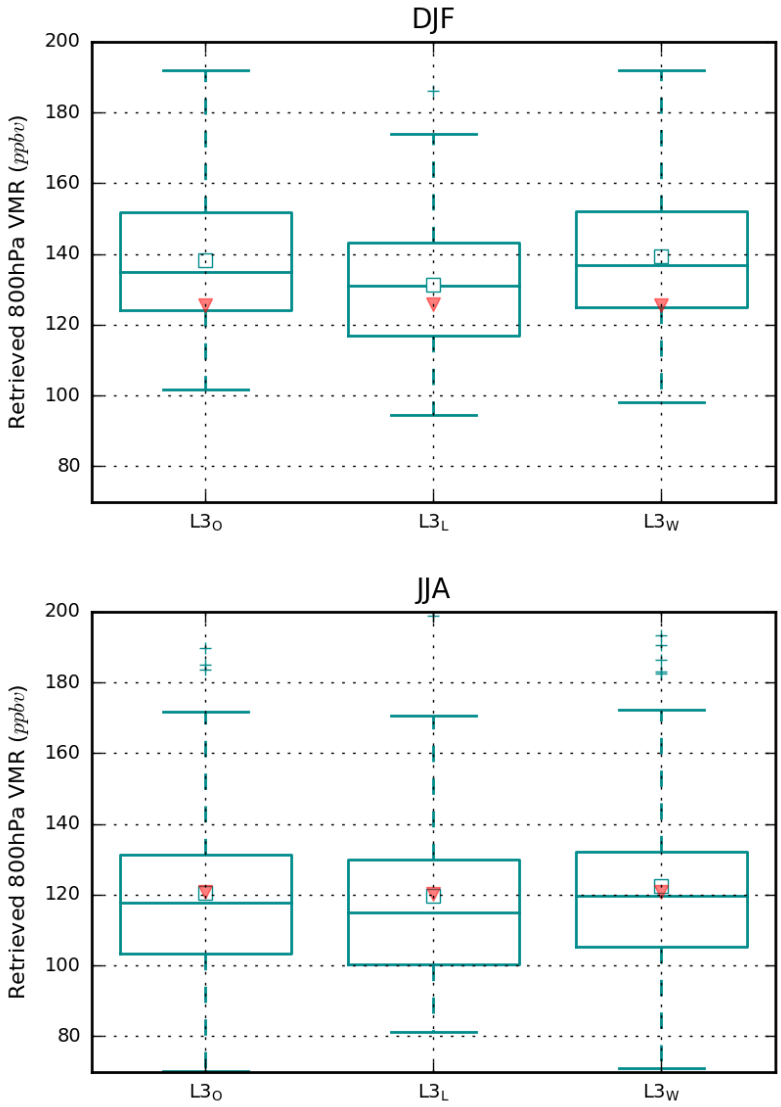


Figure S6a Seasonal distribution of retrieved 900 hPa profile level VMR values from $L3_O$, $L3_L$ and $L3_W$. Squares = mean values; Red triangles = corresponding mean a priori values. Sample sizes are 130, 32 and 127 respectively in DJF; and 248, 106 and 243 in JJA.



115

Figure S6b As Figure S6a but for the 800 hPa profile level.

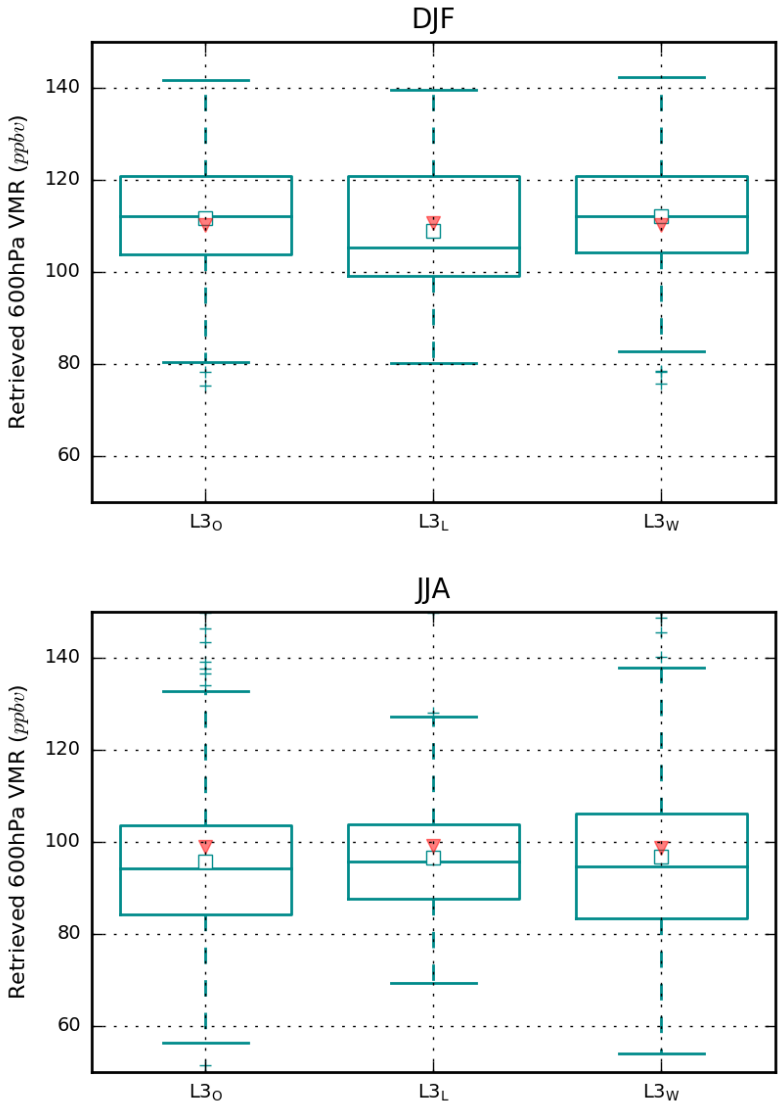


Figure S6c As Figure S6a but for the 600 hPa profile level.

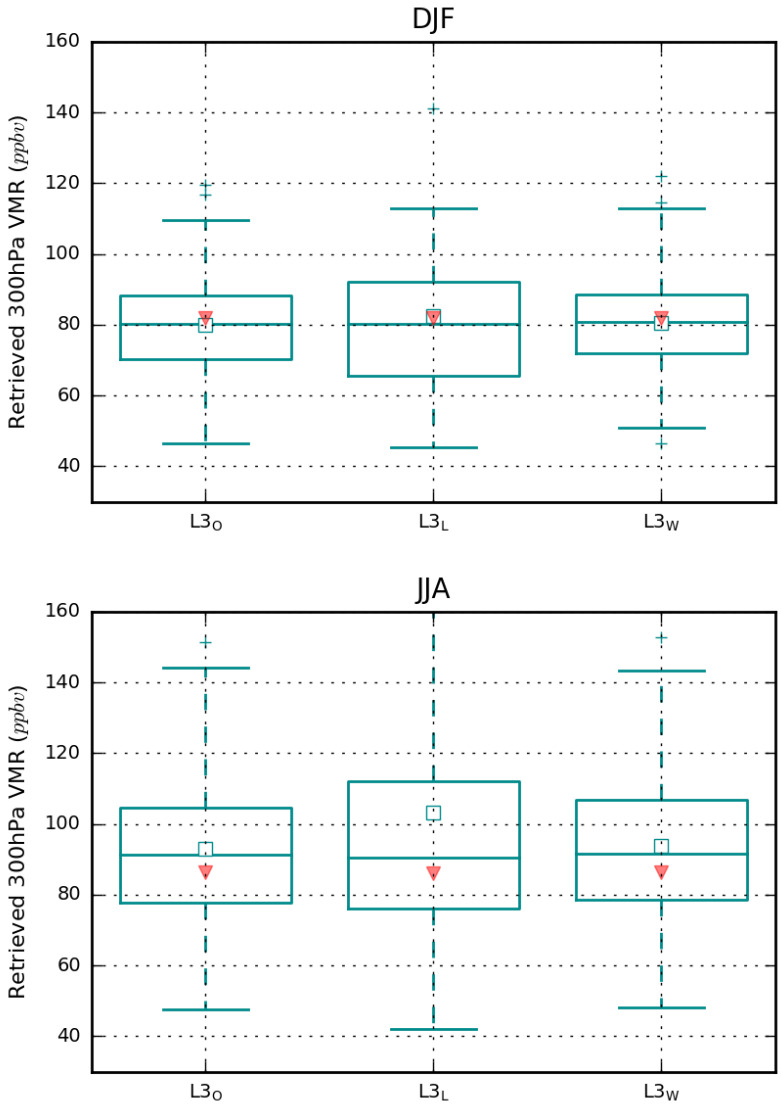
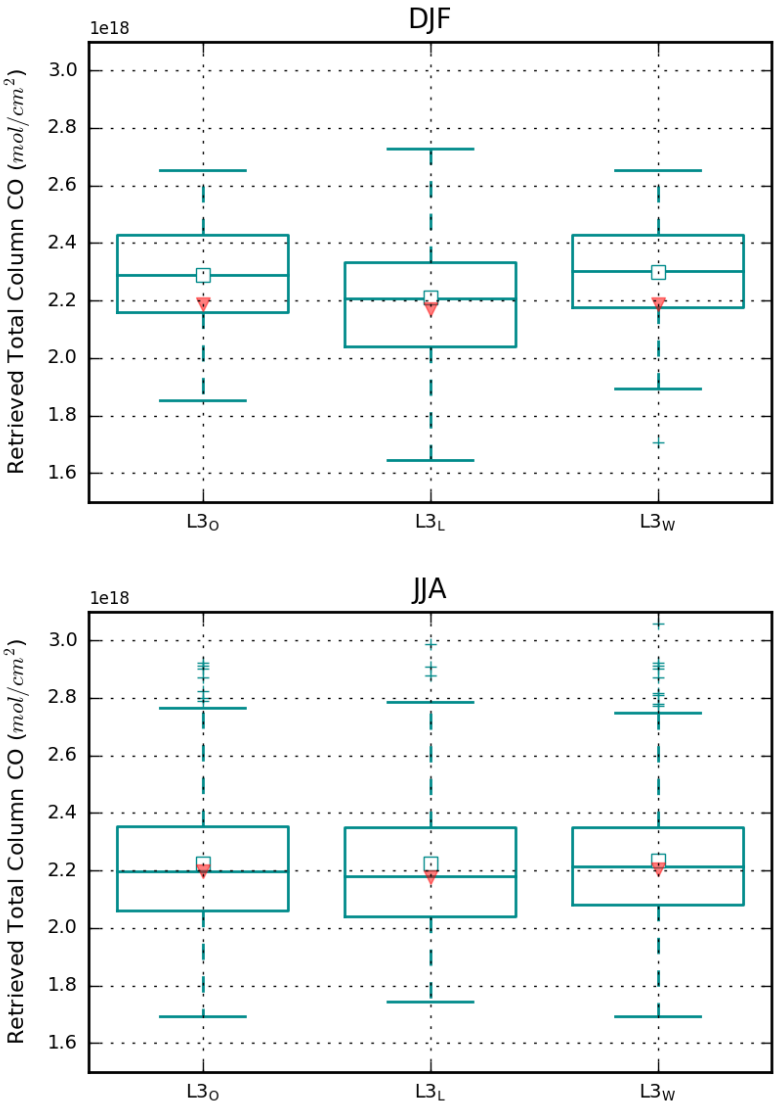


Figure S6d As Figure S6a but for the 300 hPa profile level.



125

Figure S6e As Figure S6a but for CO Total Column (TCO).

SM7

Table S7 and Figure S7 correspond respectively to Table 3 and Figure 10, discussed in Section 3.2.2. The difference here is that, while Table 3 and Figure 10 are from analysis that considers *all* data in the $L3_O$, $L3_L$ and $L3_W$ timeseries, Table S7 and Figure S7 only consist of retrievals made on days when $L3_L$ and $L3_W$ are both present, i.e., only the days analysed in Section 3.1.

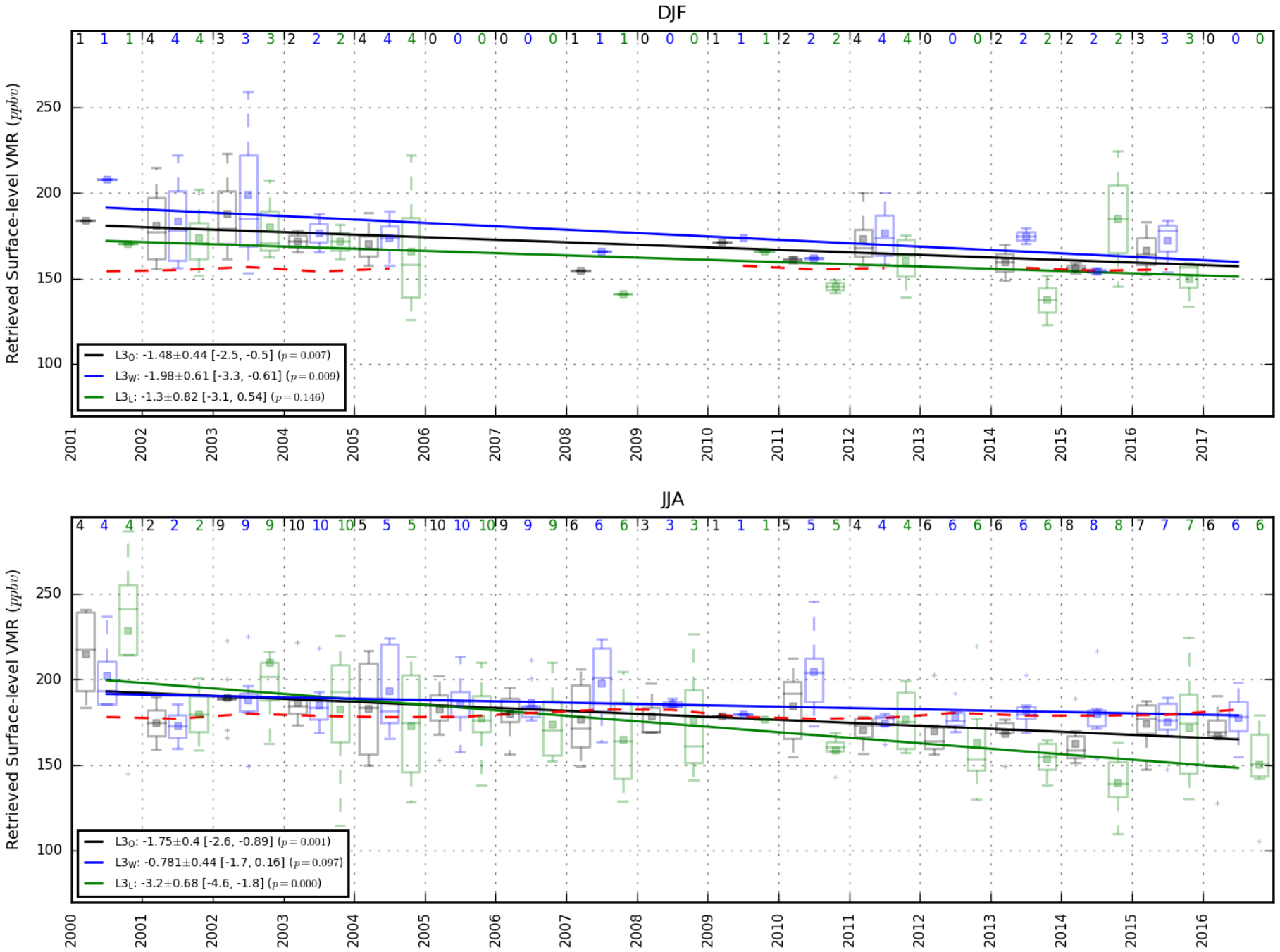
Table S7 (Next page) Results from OLS regression analysis of mean $L3_O$, $L3_L$ and $L3_W$ timeseries for selected profile levels for DJF and JJA, on days when $L3_L$ and $L3_W$ are both present. Units for TCO are mol cm^{-2}, all other levels are ppbv. m = gradient of OLS best-fit line; SE = standard error of gradient; p value = probability that the gradient is zero; % change y^{-1}= mean percentage change in retrieved CO per year, calculated from OLS regression model predicted values (pred) as follows:

$$\%\ \text{change}\ y^{-1} = \left\{\left[\left(\frac{\text{Predicted}_{\text{last}}}{\text{Predicted}_{\text{first}}}\right) * 100\right] - 100\right\}/\text{ny}$$

where ny = number of years. Underlined and italicized rows indicate that the p-value associated with the gradient is > 0.1.

Figure S7 (Page after next) OLS regression best-fit lines calculated from mean timeseries of $L3_O$ (black), $L3_L$ (green) and $L3_W$ (blue) retrieved surface-level VMR for days when $L3_L$ and $L3_W$ are both present in DJF (top) and JJA (bottom). The daily observations corresponding to each mean value are represented by colour-coded boxplots each year (horizontal lines in middle of boxes = seasonal median value; filled squares = seasonal mean value). The dashed red line is the mean of the corresponding seasonal mean $L3_O$, $L3_L$ and $L3_W$ a priori data. Colour-coded values below the top x axis correspond to the number of observations each season. Values in the legend are the value, standard error, 95% confidence limits and probability of zero value of the gradient parameter, respectively.

Season	Level	Timeseries	m	SE	p value	% change y^{-1}
DJF	Surface	$L3_O$	-1.48	0.44	0.007	-0.77
		$L3_W$	-1.98	0.61	0.009	-0.97
		$L3_L$	*-1.30*	*0.82*	*0.146*	*-0.71*
n $L3_O$: 29	900hPa	$L3_O$	-2.01	0.47	0.002	-1.09
n $L3_W$: 29		$L3_W$	-2.29	0.50	0.001	-1.19
n $L3_L$: 29		*$L3_L$*	*-2.23*	*0.71*	*0.110*	*-1.26*
	800hPa	$L3_O$	-1.96	0.43	0.001	-1.22
		$L3_W$	-1.96	0.42	0.001	-1.18
		$L3_L$	-2.31	0.55	0.002	-1.48
	600hPa	*$L3_O$*	*-0.76*	*0.53*	*0.181*	*-0.60*
		$L3_W$	*-0.37*	*0.51*	*0.487*	*-0.30*
		$L3_L$	*-1.12*	*0.65*	*0.115*	*-0.90*
	300hPa	$L3_O$	1.16	0.57	0.069	1.53
		$L3_W$	1.22	0.39	0.010	1.67
		$L3_L$	*0.87*	*1.00*	*0.402*	*1.08*
	TCO	$L3_O$	-1.14E+16	6.20E+15	0.097	-0.45
		$L3_W$	*-1.06E+16*	*5.90E+15*	*0.104*	*-0.41*
		$L3_L$	-1.67E+16	7.70E+15	0.054	-0.68
JJA	Surface	$L3_O$	-1.75	0.40	0.001	-0.85
		$L3_W$	-0.78	0.44	0.097	-0.38
		$L3_L$	-3.20	0.68	0.000	-1.51
n $L3_O$: 101	900hPa	$L3_O$	-2.57	0.74	0.003	-1.43
n $L3_W$: 101		$L3_W$	-2.21	0.70	0.007	-1.22
n $L3_L$: 101		$L3_L$	-3.35	0.80	0.001	-1.83
	800hPa	$L3_O$	-2.25	0.90	0.024	-1.49
		$L3_W$	-2.51	1.10	0.037	-1.60
		$L3_L$	-2.10	0.62	0.004	-1.45
	600hPa	*$L3_O$*	*-0.77*	*0.62*	*0.238*	*-0.69*
		$L3_W$	-1.43	0.76	0.081	-1.21
		$L3_L$	*0.09*	*0.44*	*0.837*	*0.09*
	300hPa	$L3_O$	2.64	0.66	0.001	3.46
		$L3_W$	2.44	0.59	0.001	3.13
		$L3_L$	3.35	1.10	0.007	4.29
	TCO	*$L3_O$*	*-5.85E+15*	*8.10E+15*	*0.482*	*-0.24*
		$L3_W$	*-9.17E+15*	*8.10E+15*	*0.275*	*-0.37*
		$L3_L$	*-1.72E+15*	*8.50E+15*	*0.843*	*-0.07*


DJF
Retrieved Surface-level VMR (ppbv)
L3O: -1.48±0.44 [-2.5, -0.5] (p=0.007)
L3W: -1.98±0.61 [-3.3, -0.61] (p=0.009)
L3L: -1.3±0.82 [-3.1, 0.54] (p=0.146)
JJA
Retrieved Surface-level VMR (ppbv)
L3O: -1.75±0.4 [-2.6, -0.89] (p=0.001)
L3W: -0.781±0.44 [-1.7, 0.16] (p=0.097)
L3L: -3.2±0.68 [-4.6, -1.8] (p=0.000)