



*Supplement of*

## **Ability of the 4-D-Var analysis of the GOSAT BESD XCO<sub>2</sub> retrievals to characterize atmospheric CO<sub>2</sub> at large and synoptic scales**

**S. Massart et al.**

*Correspondence to:* S. Massart ([sebastien.massart@ecmwf.int](mailto:sebastien.massart@ecmwf.int))

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Table 1: Coefficient for the fitting of the free run bias against the data of each TCCON station. See appendix A for more details.  $a$  is in ppm per year,  $b$ ,  $\alpha$  and  $\beta$  are in ppm and  $\varphi$  in fraction of  $\pi$ . RMSE is the root mean square error of the difference between the raw bias and the smoothed bias.  $r$  is the correlation coefficient between the raw bias and the smoothed bias. Stations in italic are not used for the fitting.

Station	$a$	$b$	$\alpha$	$\beta$	$\varphi$	RMSE	$r$
Ascension	-3.769	4.410	1.681	0.055	0.930	0.340	0.888
Bialystok	-0.526	-1.866	1.622	-0.974	0.737	1.024	0.800
Darwin	0.258	1.485	1.048	0.361	1.022	0.534	0.846
<i>Edwards</i>	<i>-6.699</i>	<i>6.888</i>	<i>-1.024</i>	<i>-0.319</i>	<i>0.895</i>	<i>0.644</i>	<i>0.894</i>
Garmisch	2.837	-2.311	0.463	-0.986	0.801	0.817	0.785
Izana	-0.510	0.553	0.281	-0.463	0.678	0.450	0.654
<i>Jpl</i>	<i>14.786</i>	<i>-0.281</i>	<i>2.565</i>	<i>-0.491</i>	<i>0.618</i>	<i>1.067</i>	<i>0.363</i>
Karlsruhe	0.721	-2.644	1.035	-1.314	0.845	0.594	0.898
Lamont	-1.405	0.254	1.600	-0.906	1.074	0.912	0.783
Lauder	2.081	-0.888	-0.289	-0.129	0.675	0.273	0.897
Orleans	0.148	-1.490	1.527	-0.912	0.859	0.476	0.880
Parkfalls	-0.338	-1.372	0.912	-1.398	0.863	0.660	0.880
<i>Pasadena</i>	<i>-1.736</i>	<i>2.954</i>	<i>1.794</i>	<i>-0.080</i>	<i>1.227</i>	<i>1.020</i>	<i>0.725</i>
Reunion	-1.546	1.295	1.219	0.583	1.002	0.290	0.898
Saga	-0.560	-1.052	1.154	-1.058	0.975	0.638	0.861
Sodankyla	2.013	-3.061	-0.294	-1.792	0.687	0.464	0.932
Wollongong	1.275	-0.117	0.653	0.068	1.165	0.313	0.925

Table 2: Same as tab. 1 but for the analysis.

Station	a	b	$\alpha$	$\beta$	$\varphi$	RMSE	r
Ascension	-4.064	3.030	1.590	-0.055	0.950	0.367	0.859
Bialystok	0.302	-1.513	1.097	-0.913	0.860	1.080	0.699
Darwin	-1.481	0.846	1.340	0.334	0.977	0.415	0.849
<i>Edwards</i>	<i>-7.394</i>	<i>6.754</i>	<i>-0.448</i>	<i>-0.033</i>	<i>1.206</i>	<i>0.499</i>	<i>0.852</i>
Garmisch	3.966	-2.379	0.037	-1.080	0.822	0.821	0.789
Izana	0.081	0.372	0.092	-0.431	0.693	0.336	0.665
<i>Jpl</i>	<i>11.119</i>	<i>0.973</i>	<i>1.322</i>	<i>-0.279</i>	<i>0.608</i>	<i>1.083</i>	<i>0.500</i>
Karlsruhe	2.355	-2.818	0.488	-1.382	0.896	0.582	0.892
Lamont	-1.257	0.559	0.860	0.098	1.081	0.668	0.512
Lauder	0.472	-1.220	-0.151	0.118	1.312	0.254	0.545
Orleans	1.008	-1.380	1.269	-0.930	0.954	0.364	0.920
Parkfalls	1.672	-1.512	0.059	-1.172	0.908	0.457	0.876
<i>Pasadena</i>	<i>-1.105</i>	<i>2.996</i>	<i>1.392</i>	<i>0.323</i>	<i>1.326</i>	<i>0.904</i>	<i>0.718</i>
Reunion	-2.226	0.421	1.019	0.370	0.965	0.271	0.781
Saga	1.516	-1.673	-0.065	-1.115	0.785	0.752	0.669
Sodankyla	6.824	-4.352	-1.233	-1.633	0.822	0.479	0.912
Wollongong	0.321	-0.922	0.387	0.292	0.904	0.383	0.737

Table 3: Same as tab. 1 but for the standard deviation.

Station	a	b	$\alpha$	$\beta$	$\varphi$	RMSE	r
Ascension	0.975	0.128	-0.207	-0.256	0.928	0.181	0.592
Bialystok	0.387	0.472	0.465	0.010	1.605	0.399	0.636
Darwin	-0.055	0.573	0.158	0.083	1.062	0.175	0.544
<i>Edwards</i>	<i>0.239</i>	<i>0.158</i>	<i>0.530</i>	<i>-0.158</i>	<i>1.035</i>	<i>0.243</i>	<i>0.619</i>
Garmisch	0.123	0.535	-0.202	0.120	0.479	0.320	0.482
Izana	0.277	0.175	-0.150	0.072	0.823	0.174	0.536
<i>Jpl</i>	<i>4.183</i>	<i>0.160</i>	<i>-0.633</i>	<i>0.031</i>	<i>1.256</i>	<i>0.314</i>	<i>0.646</i>
Karlsruhe	0.230	0.481	0.301	0.067	1.549	0.280	0.600
Lamont	-0.224	0.974	0.628	-0.137	1.463	0.321	0.819
Lauder	0.014	0.338	-0.052	0.071	1.191	0.121	0.459
Orleans	-0.108	0.570	0.197	0.093	1.327	0.213	0.581
Parkfalls	-0.101	0.826	0.622	-0.265	1.424	0.395	0.774
<i>Pasadena</i>	<i>0.086</i>	<i>1.416</i>	<i>-0.013</i>	<i>0.366</i>	<i>1.140</i>	<i>0.455</i>	<i>0.505</i>
Reunion	0.148	0.277	0.080	0.095	1.520	0.115	0.482
Saga	-0.129	0.504	0.131	0.012	1.075	0.230	0.298
Sodankyla	0.017	0.634	-0.072	0.247	0.608	0.185	0.741
Wollongong	-0.161	0.590	0.200	0.050	0.885	0.154	0.593

Table 4: Same as tab. 2 but for the standard deviation.

Station	a	b	$\alpha$	$\beta$	$\varphi$	RMSE	r
Ascension	0.806	0.209	-0.220	-0.265	0.983	0.174	0.584
Bialystok	0.148	0.606	0.416	0.108	1.491	0.378	0.642
Darwin	0.089	0.524	0.071	0.107	1.132	0.178	0.527
<i>Edwards</i>	<i>0.698</i>	<i>-0.122</i>	<i>0.590</i>	<i>-0.086</i>	<i>1.134</i>	<i>0.206</i>	<i>0.690</i>
Garmisch	0.147	0.526	-0.229	0.118	0.536	0.353	0.468
Izana	0.144	0.191	-0.068	0.062	0.728	0.127	0.474
<i>Jpl</i>	<i>17.986</i>	<i>-2.350</i>	<i>3.014</i>	<i>-0.455</i>	<i>0.569</i>	<i>0.520</i>	<i>0.676</i>
Karlsruhe	-0.023	0.549	0.204	0.126	1.373	0.244	0.542
Lamont	-0.014	0.845	0.385	-0.030	1.530	0.247	0.746
Lauder	0.263	0.225	-0.121	0.033	1.228	0.138	0.508
Orleans	-0.187	0.522	0.136	0.092	1.271	0.144	0.564
Parkfalls	-0.101	0.679	0.305	-0.030	1.415	0.268	0.605
<i>Pasadena</i>	<i>-0.170</i>	<i>1.725</i>	<i>0.091</i>	<i>0.414</i>	<i>1.172</i>	<i>0.567</i>	<i>0.443</i>
Reunion	0.041	0.325	0.072	0.063	1.526	0.114	0.432
Saga	0.105	0.424	-0.029	-0.048	0.637	0.220	0.160
Sodankyla	-0.086	0.636	-0.070	0.213	0.653	0.230	0.618
Wollongong	-0.150	0.709	0.134	0.104	0.968	0.208	0.383

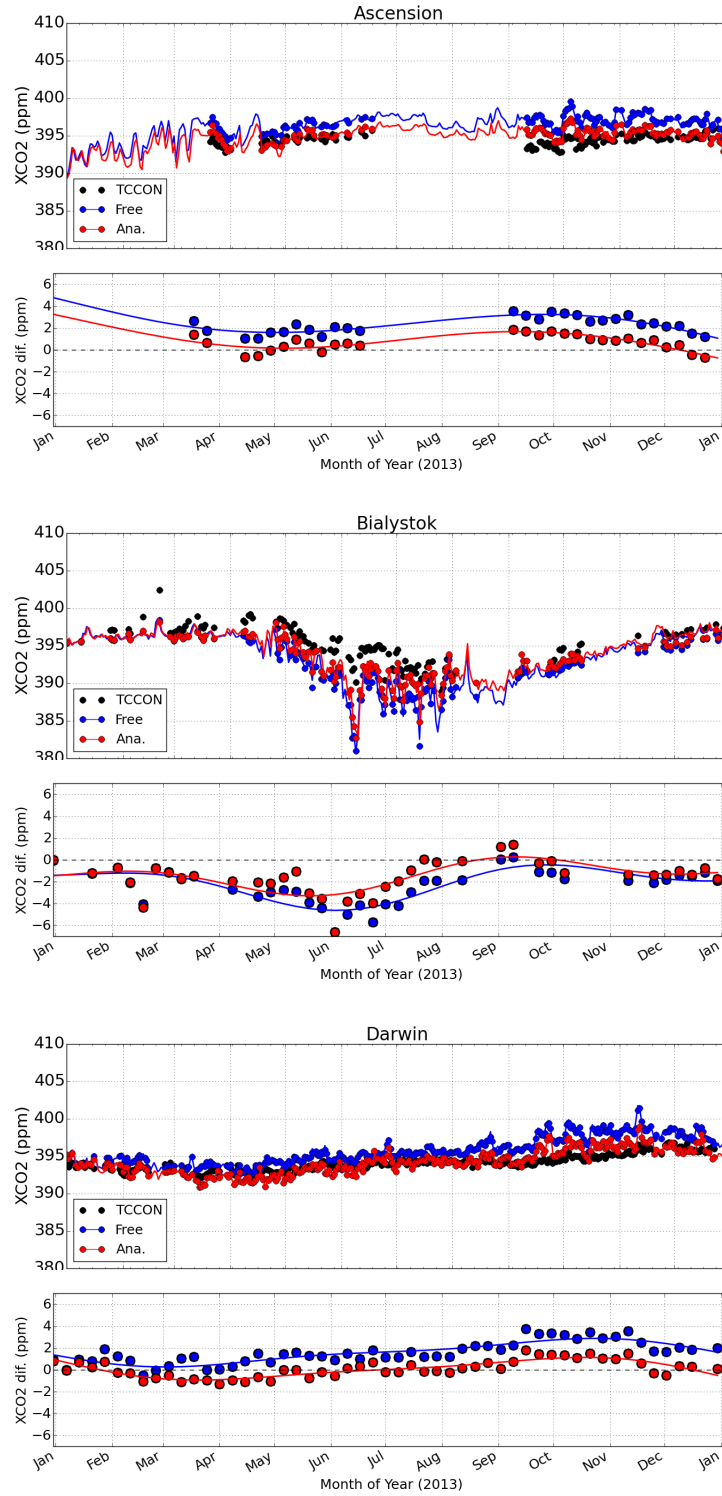


Figure 1: Same as Fig. 4 of the article for Ascension, Bialystok and Darwin (from top to bottom).

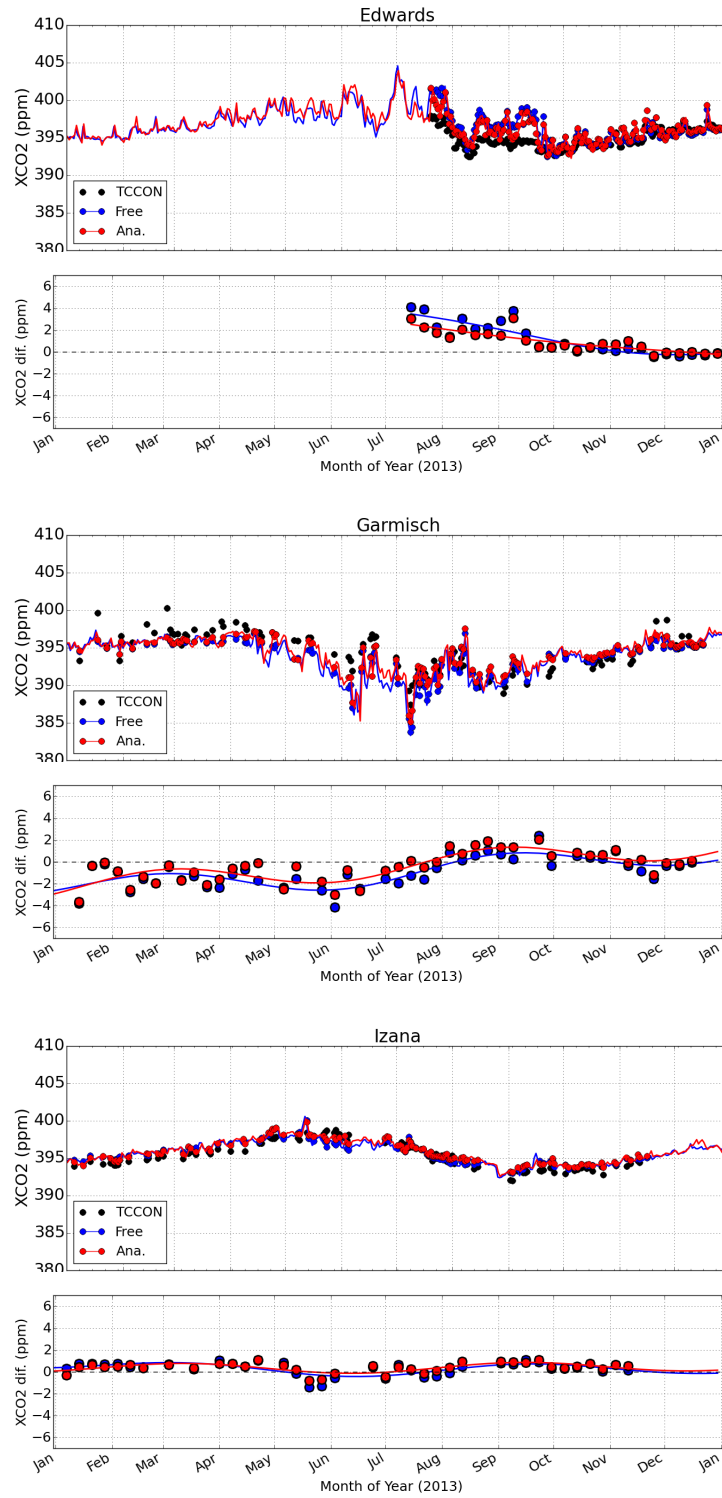


Figure 2: Same as Fig. 4 of the article for Edwards, Garmisch and Izaña.

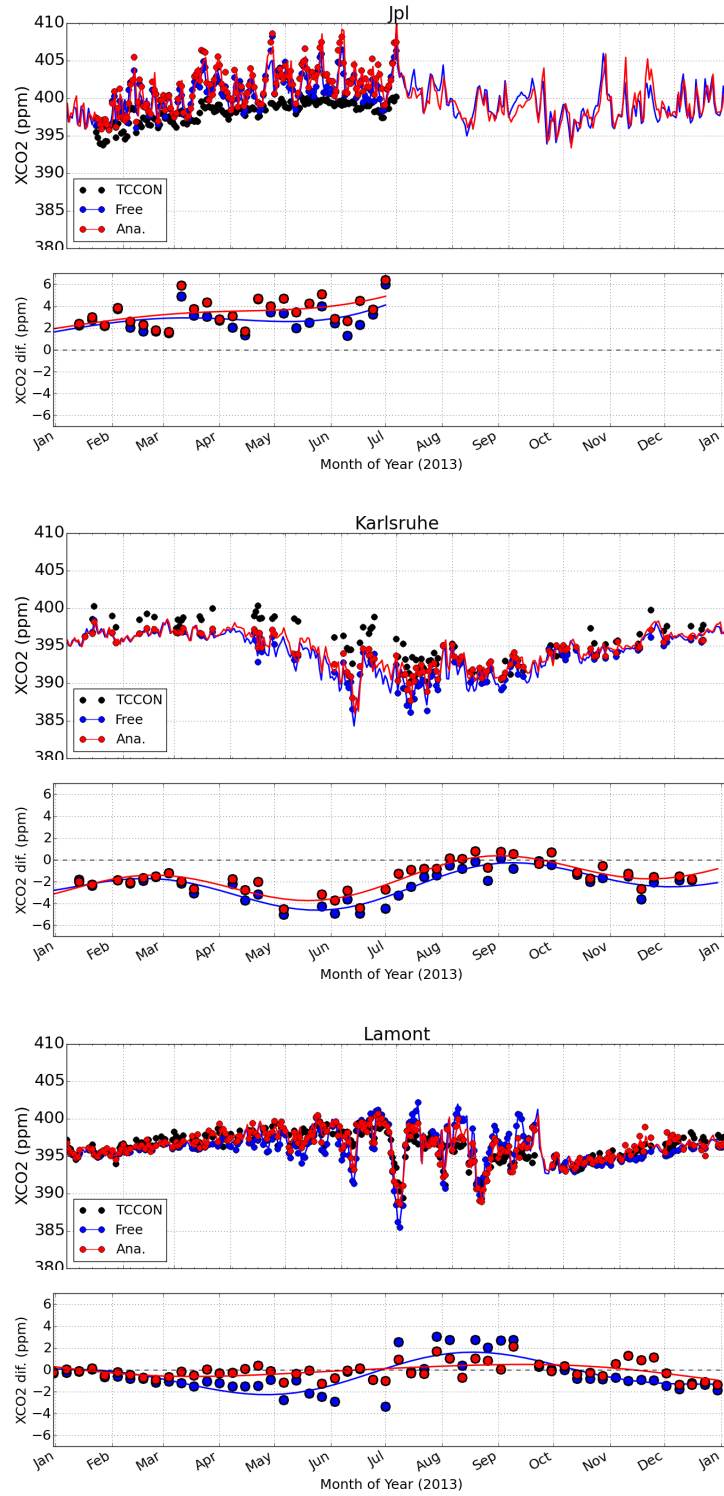


Figure 3: Same as Fig. 4 of the article for JPL, Karlsruhe and Lamont.

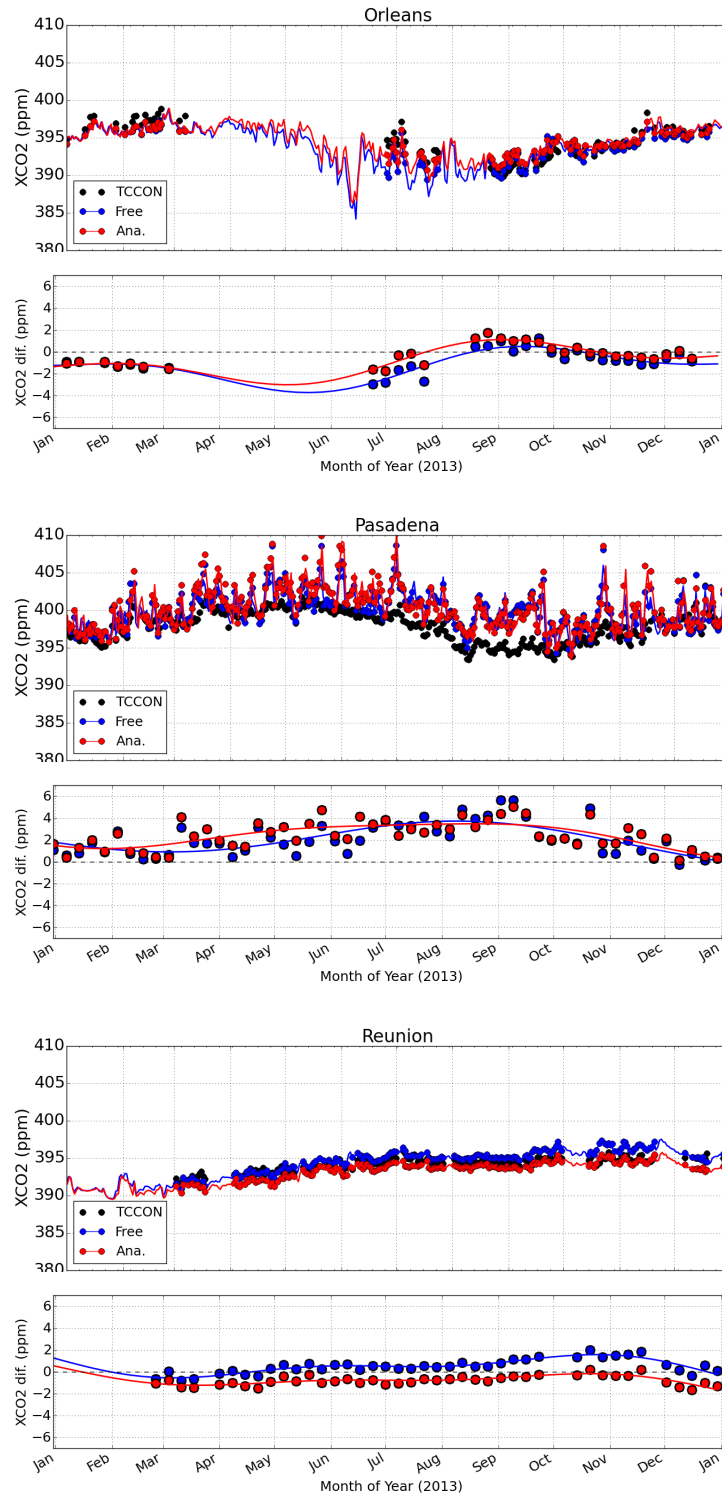


Figure 4: Same as Fig. 4 of the article for Orleans, Pasadena and Reunion Island.



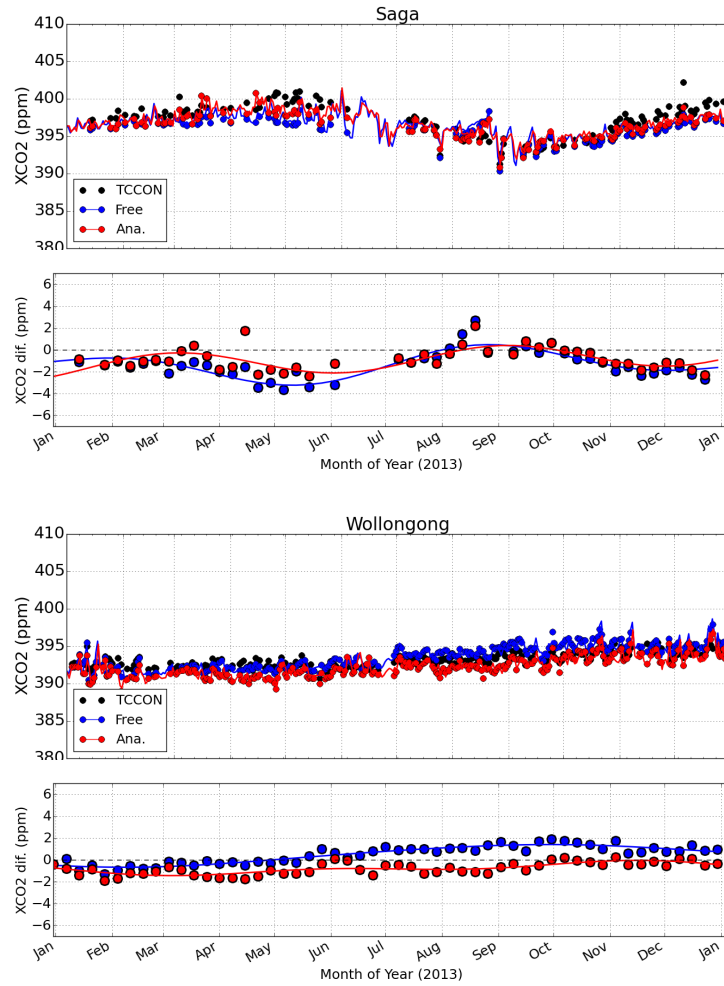


Figure 5: Same as Fig. 4 of the article for Saga and Wollongong.