

## Supplement

### Variability in a four-network composite of atmospheric CO<sub>2</sub> differences between three primary baseline sites

R. J. Francey, J. S. Frederiksen, L. P. Steele, R.L. Langenfelds

CSIRO Oceans and Atmosphere, Aspendale, Victoria, AUSTRALIA

#### S1 Measurement Linearity

Disagreement between laboratories in CO<sub>2</sub> site-differences can be due in part to different measurement instrument response.

GC/FID (Gas Chromatograph with Flame Ionisation Detector) response versus NDIR (Non-Dispersive InfraRed detector) response is plotted as differences of measured CO<sub>2</sub> mole fractions from a linear regression through routine calibrations of CSIRO GASLAB instruments using different high-pressure cylinder suite calibration scales. Adapted from unpublished Baseline article (Francey et al., 2019)

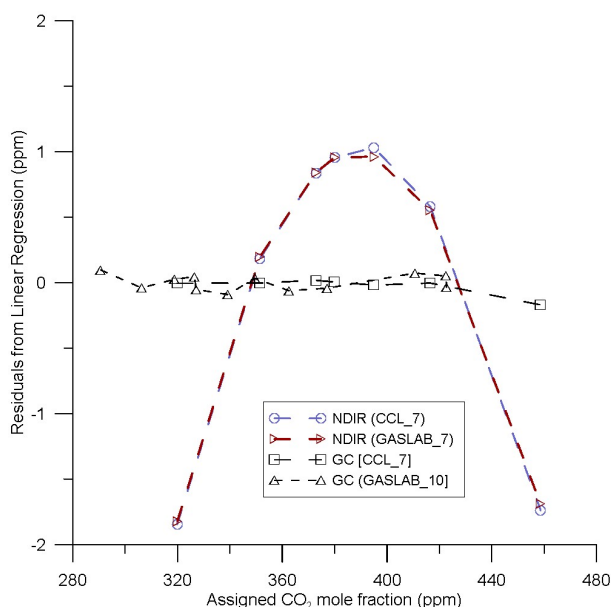


Figure S1: Residuals from a linear regression through the responses of an NDIR and a GC, measuring CO<sub>2</sub> in high-pressure calibration cylinders. Brackets in the caption indicate laboratory assigning CO<sub>2</sub> concentration and the number of cylinders in the suite.

Note that the quadratic response in the NDIR is closely anchored to the extreme (and usually least-well characterised) cylinder values, whereas the weighting is more uniform across the range for the GC calibrations. The GC linearity is markedly superior, but precision slightly worse, compared to the NDIR. The linearity is advantageous for calibration and reducing bias when sample and reference CO<sub>2</sub> are separated in mixing ratio. GC small sample requirements compared to conventional NDIR, permits more frequent measurement to improve precision while leading to longer lifetimes of reference and calibration gases.

#### S2 Historic records of Interhemispheric CO<sub>2</sub>

Historically, the most extensive IH CO<sub>2</sub> difference measurements involve Mauna Loa (mlo) minus South Pole (spo). Significant improvements in measurement quality occurred in all laboratories throughout the 1980s early 1990s (for example related to the composition and storage of standards, from synthetic air in steel high-pressure cylinders through to modified baseline air in passivated aluminium high-pressure cylinders). A significant proportion of missing months occurs in SIO1 data between 1958 and early 1970.

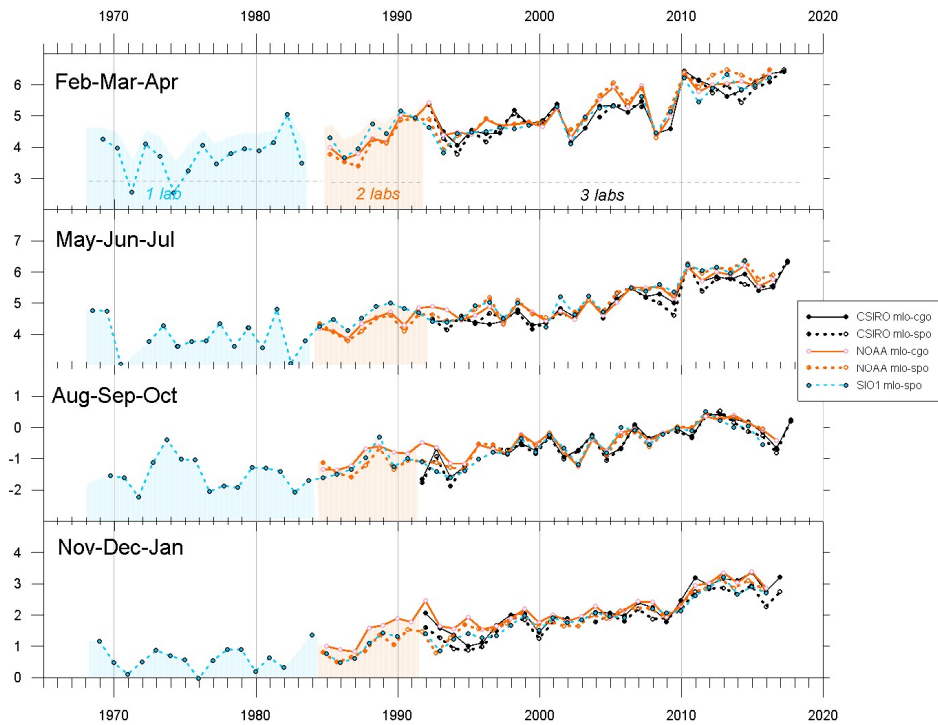


Figure S2: Historic records of mlo-spo and mlo-cgo measured by SIO1, NOAA and CSIRO. Time series of 3-month averages for the indicated seasons are shown.

Figure S2 provides an historic perspective on baseline measurements of CO<sub>2</sub> IH difference from SIO1, NOAA and CSIRO's GASLAB and include Cape Grim (cgo). Data are presented in four seasons that distinguish different modes of IH exchange (see main text). The number of networks contributing data are indicated (for clarity, SIO2 data since 1992 are included elsewhere in the main text analyses but omitted in Figure S2).

In SIO1 and NOAA data between 1984 and 1995, the difference between SIO and NOAA mlo-spo data exhibit a step change of around 0.5 ppm around 1990/91, also a difference in seasonal amplitude around this time .

% missing months				
SIO1	pre 1984 (320 mnths)	mlo	spo	cgo
		23%	28%	—
SIO1 NOAA	1984-1991 (84 mnths)	0%	4%	— 0%
SIO1 SIO2 NOAA CSIRO	1992-2016 (288 mnths)	0%	3%	3%
		6%	6%	6%
		0%	5%	0%
		7%	11%	0%

Table S1: Percentage missing months in monthly data from SIO, NOAA and CSIRO for each baseline site

Standard Error in $y$ (ppm)			
season	pre84	1984-2016	
	mlo-spo		mlo-cgo
Feb-Mar-Apr	0.63	0.41	0.43
May-Jun-Jul	0.66	0.31	0.29
Aug-Sep-Oct	0.50	0.35	0.32
Nov-Dec-Jan	0.43	0.26	0.33

Table S2: Standard error in  $y$  of a linear regression through differences in monthly  $CO_2$  between mlo and Southern Hemisphere sites cgo and spo, used to indicate scatter in the data.

To indicate changes in quality, Table S2 provides standard error in the actual values of mlo minus spo or cgo, compared to a linear regression, for periods before and after 1984 when at least two networks were operating. The regressions are required to address long-term trends in mlo-cgo and mlo-spo due to emissions, mainly from fossil fuel combustion predominantly in the Northern Hemisphere. This analysis is carried out separately for each of four 3-month seasons, chosen based on factors influencing inter-hemispheric  $CO_2$  exchange discussed in FF18.

We conclude from Tables S1 & S2 that pre-1984 data are generally of insufficient quality for the correlation with independent data. One likely contributing factor is that it pre-dates the major improvement in the stability and effective lifetime of  $CO_2$  standards that occurred worldwide through the 1980s. This was the result of a number of factors, one important one being the phased replacement of steel high-pressure cylinders to store standard air, with passivated aluminium cylinders. (Note: at CSIRO early steel cylinders frequently exhibited  $CO_2$  drifts exceeding  $1 \text{ ppm year}^{-1}$ , a drift rate increasing as cylinder pressure dropped; since 1992 the relative drift among a suite of  $\sim 15$  (custom passivated) aluminium cylinders is within  $\pm 0.003 \text{ ppm year}^{-1}$ ).

After about 1994 the variability in IH  $CO_2$  in Figure S2 appears larger in the Feb-Apr period than in other seasons. (It coincides with inter-hemispheric transport by eddy processes at that time of year via the Pacific Westerly duct (FF18)).

### S3 1991-93 NOAA spo anomaly

The behaviour in NOAA cgo-spo in 1991-1993 exhibits a seasonality resulting in low annual mean values not seen in CSIRO data (SIO data at cgo are not available for this period). Based on subsequent behaviour in all networks (and methodology continuity in CSIRO GASLAB, with original regularly monitored calibration cylinders still intact), anomalous seasonally enhanced NOAA spo is implied for the period.

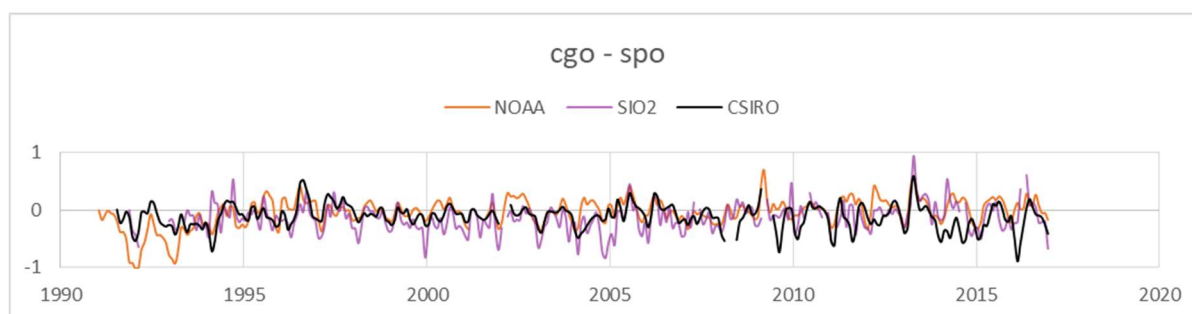


Figure S3: Differences in cgo-spo  $CO_2$  concentration for NOAA, SIO2 and CSIRO highlighting 1991-1993 anomalies in monthly NOAA data compared to CSIRO.

Independent NOAA-CSIRO inter-calibration information is summarised in Figure S3. The most rigorous comparison comes from co-measurement of NOAA samples collected at cgo, “same-air ICP” (Masarie et al., 2001) shown here in Figure S4 with the permission of NOAA; the CSIRO measurements on NOAA flasks and CSIRO flasks filled at the same time are consistent (not shown). CSIRO measurements are on average around 0.1 ppm above NOAA for actual flask samples, but less frequent, scattered and greater before 1995.

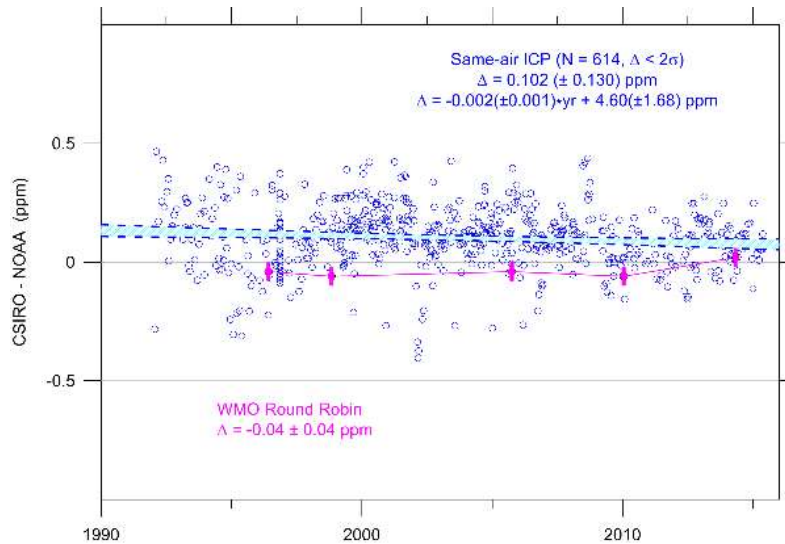


Figure S4: CO<sub>2</sub> inter-calibration activities involving NOAA and CSIRO. Blue circles are measurements on NOAA flasks filled at cgo by both CSIRO and subsequently NOAA. Purple points show WMO high-pressure cylinder inter-comparisons.

Interestingly, comparisons involving high-pressure cylinder World Meteorological Organization Round Robin comparisons show CSIRO measurements lower than NOAA by -0.04 ppm (suggesting a sensitivity to how samples are introduced to detectors.) The focus on within network site differences cancels these mean offsets. The sparsity of data means the 1990-1993 NOAA anomalies of Figure S2 are not elucidated by the inter-calibration data from Cape Grim.

## Reference

Francy, R. J., Langenfelds, R. L., Steele, L. P., Krummel, P. B., and van der Schoot, M.: Bias in the biggest terms in the global carbon budget?, in: Baseline Atmospheric Program Australia 2011–2013, edited by: Krummel, P. B. and Derek, N., Melbourne, Australian Bureau of Meteorology in cooperation with CSIRO Division of Atmospheric Research, in press, 2019.

## S4 Tabulation of Composite Records

<b>1992</b>	1	2	3	4	5	6	7	8	9	10	11	12
mlo-cgo	3.585	4.443	5.591	5.913	5.944	5.405	2.505	0.209	-1.080	-1.410	-0.108	1.648
stdev	0.290	0.194	0.079	0.345	0.425	0.348	0.503	0.199	0.057	0.489	0.336	0.173
mlo-spo	2.898	3.910	5.099	5.870	6.115	5.298	2.131	-0.148	-1.542	-1.793	-0.492	1.025
stdev	0.125	0.497	0.459	0.174	0.186	0.158	0.286	0.076	0.222	0.442	0.143	0.191
cgo-spo	-0.675	-0.362	-0.293	-0.191	0.039	-0.050	-0.238	-0.316	-0.369	-0.427	-0.409	-0.431
stdev	0.313	0.464	0.377	0.196	0.154	0.255	0.272	0.161	0.158	0.203	0.324	0.368
<b>1993</b>	1	2	3	4	5	6	7	8	9	10	11	12
mlo-cgo	2.951	3.373	4.146	5.396	5.990	5.085	2.704	-0.145	-2.182	-1.801	-0.076	1.495
stdev	0.288	0.733	0.157	0.285	0.386	0.181	0.009	0.338	0.245	0.342	0.149	0.124
mlo-spo	2.304	3.011	4.082	5.025	5.823	4.847	2.357	-0.278	-2.385	-2.127	-0.353	1.150
stdev	0.368	0.624	0.238	0.296	0.372	0.171	0.121	0.323	0.329	0.322	0.148	0.180
cgo-spo	-0.560	-0.516	-0.186	-0.272	-0.270	-0.232	-0.217	-0.226	-0.131	-0.287	-0.231	-0.351
stdev	0.316	0.302	0.162	0.050	0.241	0.135	0.110	0.122	0.120	0.053	0.019	0.108
<b>1994</b>	1	2	3	4	5	6	7	8	9	10	11	12
mlo-cgo	2.742	3.190	3.934	5.468	5.811	4.808	2.696	-0.002	-2.017	-1.851	-0.057	1.731
stdev	0.457	0.472	0.273	0.173	0.183	0.130	0.307	0.573	0.211	0.454	0.414	0.628
mlo-spo	2.599	3.107	3.935	5.390	5.903	4.876	2.664	0.205	-2.224	-1.980	-0.261	1.644
stdev	0.438	0.524	0.243	0.160	0.167	0.129	0.335	0.357	0.245	0.324	0.288	0.510
cgo-spo	-0.273	-0.248	-0.051	-0.138	0.077	0.006	0.032	0.245	-0.103	-0.196	-0.155	-0.208
stdev	0.530	0.348	0.147	0.228	0.031	0.141	0.129	0.268	0.163	0.118	0.090	0.080
<b>1995</b>	1	2	3	4	5	6	7	8	9	10	11	12
mlo-cgo	2.583	3.501	4.387	5.385	5.968	5.166	2.924	0.339	-0.923	-1.167	0.306	1.330
stdev	0.432	0.166	0.301	0.134	0.348	0.014	0.737	0.086	0.108	0.431	0.047	0.257
mlo-spo	2.497	3.487	4.485	5.311	5.829	5.398	3.074	0.184	-1.069	-1.477	0.008	1.262
stdev	0.334	0.108	0.285	0.178	0.403	0.149	0.652	0.294	0.134	0.313	0.078	0.330
cgo-spo	-0.133	0.019	0.070	-0.117	-0.125	0.172	0.058	-0.023	-0.126	-0.225	-0.269	-0.007
stdev	0.081	0.092	0.067	0.077	0.175	0.115	0.239	0.238	0.254	0.109	0.106	0.184
<b>1996</b>	1	2	3	4	5	6	7	8	9	10	11	12
mlo-cgo	2.741	3.546	4.585	5.489	5.811	5.174	3.154	0.166	-1.522	-1.279	0.290	1.813
stdev	0.593	0.486	0.394	0.248	0.122	0.283	0.568	0.468	0.372	0.058	0.110	0.201
mlo-spo	2.745	3.418	4.425	5.342	5.871	5.532	3.453	0.511	-1.518	-1.302	0.214	1.495
stdev	0.472	0.522	0.539	0.256	0.205	0.181	0.297	0.338	0.447	0.120	0.197	0.272
cgo-spo	-0.011	-0.178	-0.235	-0.123	0.073	0.339	0.230	0.275	0.108	-0.024	-0.058	-0.279
stdev	0.204	0.197	0.243	0.129	0.174	0.193	0.280	0.126	0.112	0.160	0.191	0.181
<b>1997</b>	1	2	3	4	5	6	7	8	9	10	11	12
mlo-cgo	2.771	3.359	4.233	6.064	5.831	4.418	2.757	0.440	-1.619	-1.461	0.490	2.132
stdev	0.150	0.361	0.280	0.069	0.292	0.200	0.153	0.027	0.103	0.020	0.177	0.105
mlo-spo	2.440	3.362	4.416	6.023	5.991	4.476	2.794	0.644	-1.680	-1.466	0.346	1.908
stdev	0.197	0.307	0.233	0.237	0.194	0.192	0.084	0.141	0.184	0.069	0.289	0.175
cgo-spo	-0.339	-0.126	0.182	0.063	0.134	-0.003	0.041	0.152	-0.010	0.006	-0.146	-0.188

stdev	0.136	0.220	0.095	0.168	0.192	0.076	0.052	0.093	0.128	0.073	0.177	0.115
<b>1998</b>	1	2	3	4	5	6	7	8	9	10	11	12
mlo-cgo	3.116	3.885	4.593	5.983	6.312	5.115	3.503	0.626	-1.018	-0.921	0.754	2.547
stdev	0.057	0.092	0.537	0.549	0.291	0.215	0.586	0.505	0.208	0.109	0.099	0.228
mlo-spo	2.827	3.622	4.612	5.939	6.305	5.146	3.456	0.637	-0.974	-1.067	0.507	2.330
stdev	0.195	0.137	0.406	0.391	0.188	0.252	0.488	0.491	0.173	0.110	0.115	0.198
cgo-spo	-0.310	-0.196	0.013	0.037	0.029	-0.006	-0.085	-0.027	-0.004	-0.174	-0.244	-0.271
stdev	0.235	0.123	0.057	0.127	0.125	0.080	0.057	0.092	0.032	0.052	0.110	0.077
<b>1999</b>	1	2	3	4	5	6	7	8	9	10	11	12
mlo-cgo	3.012	3.464	4.482	6.095	5.599	4.809	3.558	0.820	-1.265	-1.235	0.243	1.662
stdev	0.318	0.166	0.596	0.324	0.274	0.333	0.452	0.182	0.237	0.192	0.119	0.201
mlo-spo	2.910	3.573	4.435	5.979	5.569	4.620	3.485	0.714	-1.485	-1.361	-0.119	1.491
stdev	0.291	0.129	0.563	0.181	0.201	0.337	0.407	0.144	0.182	0.133	0.221	0.198
cgo-spo	-0.112	0.100	-0.056	-0.130	-0.097	-0.133	-0.128	-0.134	-0.141	-0.165	-0.427	-0.230
stdev	0.058	0.047	0.098	0.106	0.114	0.046	0.130	0.165	0.161	0.123	0.348	0.090
<b>2000</b>	1	2	3	4	5	6	7	8	9	10	11	12
mlo-cgo	2.906	3.873	4.802	5.565	5.537	4.742	2.922	0.704	-0.776	-0.614	0.737	1.990
stdev	0.276	0.257	0.200	0.190	0.113	0.056	0.055	0.028	0.094	0.075	0.099	0.060
mlo-spo	2.994	3.609	4.750	5.605	5.329	4.746	3.006	0.700	-0.845	-0.682	0.562	1.769
stdev	0.256	0.347	0.103	0.158	0.246	0.116	0.122	0.070	0.156	0.117	0.179	0.196
cgo-spo	-0.061	-0.077	0.006	-0.061	-0.162	-0.034	0.130	0.015	-0.135	-0.118	-0.169	-0.297
stdev	0.058	0.179	0.231	0.185	0.225	0.190	0.084	0.048	0.156	0.135	0.174	0.130
<b>2001</b>	1	2	3	4	5	6	7	8	9	10	11	12
mlo-cgo	3.180	4.326	5.376	6.247	6.401	5.166	2.748	0.206	-1.546	-1.273	0.711	2.148
stdev	0.299	0.118	0.183	0.331	0.163	0.076	0.022	0.249	0.126	0.334	0.115	0.118
mlo-spo	2.821	4.376	5.350	6.007	6.278	5.214	2.733	0.348	-1.410	-1.294	0.431	1.912
stdev	0.354	0.101	0.225	0.344	0.521	0.462	0.318	0.292	0.187	0.165	0.127	0.171
cgo-spo	-0.310	-0.019	0.020	-0.099	-0.307	-0.167	-0.169	-0.124	0.138	-0.203	-0.420	-0.263
stdev	0.104	0.025	0.008	0.021	0.247	0.003	0.065	0.157	0.148	0.134	0.240	0.061
<b>2002</b>	1	2	3	4	5	6	7	8	9	10	11	12
mlo-cgo	2.661	3.274	4.233	5.135	5.717	5.087	2.748	-0.216	-1.765	-0.994	0.747	2.213
stdev	0.126	0.194	0.284	0.109	0.217	0.028	0.156	0.151	0.285	0.468	0.233	0.212
mlo-spo	2.890	3.391	4.426	5.111	5.673	5.183	2.976	-0.204	-1.811	-1.283	0.451	1.980
stdev	0.219	0.324	0.237	0.174	0.151	0.230	0.182	0.177	0.216	0.403	0.244	0.212
cgo-spo	0.090	0.094	0.105	0.003	-0.015	0.004	0.131	0.061	0.016	-0.102	-0.191	-0.416
stdev	0.100	0.292	0.129	0.224	0.197	0.210	0.141	0.123	0.068	0.018	0.070	0.206
<b>2003</b>	1	2	3	4	5	6	7	8	9	10	11	12
mlo-cgo	3.080	4.040	4.910	6.010	6.566	5.486	3.318	0.834	-1.015	-0.786	0.988	2.380
stdev	0.240	0.028	0.190	0.152	0.148	0.128	0.246	0.346	0.195	0.107	0.311	0.084
mlo-spo	2.779	3.802	4.807	6.095	6.584	5.598	3.315	1.166	-1.023	-0.940	0.841	2.016
stdev	0.113	0.027	0.349	0.149	0.139	0.276	0.136	0.237	0.195	0.149	0.442	0.047
cgo-spo	-0.431	-0.241	-0.097	0.001	-0.031	-0.085	-0.084	0.087	-0.009	-0.215	-0.170	-0.314

stdev	0.071	0.054	0.099	0.034	0.012	0.047	0.183	0.103	0.100	0.289	0.064	0.077
<b>2004</b>	1	2	3	4	5	6	7	8	9	10	11	12
mlo-cgo	3.226	3.998	5.476	6.783	6.537	4.952	2.393	0.064	-1.413	-1.126	0.559	2.076
stdev	0.216	0.167	0.189	0.164	0.191	0.153	0.110	0.176	0.276	0.196	0.175	0.156
mlo-spo	2.823	3.788	5.386	6.668	6.338	5.043	2.406	0.104	-1.602	-1.401	0.518	2.007
stdev	0.133	0.345	0.393	0.193	0.305	0.156	0.174	0.164	0.101	0.203	0.165	0.180
cgo-spo	-0.522	-0.205	-0.081	-0.187	-0.097	-0.040	-0.010	-0.132	-0.369	-0.404	-0.152	-0.151
stdev	0.232	0.241	0.287	0.256	0.227	0.183	0.091	0.148	0.319	0.375	0.367	0.250
<b>2005</b>	1	2	3	4	5	6	7	8	9	10	11	12
mlo-cgo	3.281	4.492	5.743	6.644	6.514	5.258	3.498	0.821	-1.269	-0.845	0.692	2.184
stdev	0.131	0.445	1.013	0.200	0.510	0.130	0.331	0.300	0.530	0.193	0.200	0.159
mlo-spo	3.075	4.715	5.294	6.560	6.295	5.570	3.835	0.810	-1.235	-1.011	0.585	1.974
stdev	0.157	0.308	0.909	0.220	0.455	0.107	0.206	0.295	0.310	0.095	0.157	0.210
cgo-spo	-0.285	0.102	0.115	-0.079	0.127	0.397	0.222	0.070	-0.140	-0.228	-0.143	-0.316
stdev	0.278	0.081	0.094	0.157	0.115	0.089	0.068	0.001	0.186	0.214	0.063	0.246
<b>2006</b>	1	2	3	4	5	6	7	8	9	10	11	12
mlo-cgo	3.316	4.067	5.003	6.533	7.206	5.795	3.468	0.973	-0.560	-0.369	0.921	2.470
stdev	0.009	0.062	0.262	0.170	0.132	0.107	0.189	0.189	0.523	0.069	0.071	0.101
mlo-spo	3.275	4.354	5.190	6.593	7.327	5.707	3.576	0.931	-0.935	-0.519	0.719	2.179
stdev	0.149	0.050	0.345	0.206	0.114	0.118	0.169	0.183	0.508	0.204	0.112	0.233
cgo-spo	-0.009	0.251	0.178	0.112	0.031	-0.107	0.025	-0.075	-0.117	-0.209	-0.248	-0.167
stdev	0.121	0.033	0.079	0.097	0.029	0.127	0.066	0.209	0.093	0.036	0.186	0.018
<b>2007</b>	1	2	3	4	5	6	7	8	9	10	11	12
mlo-cgo	3.835	4.723	5.653	6.791	6.855	5.824	3.387	0.339	-0.993	-0.516	0.871	2.331
stdev	0.741	0.434	0.477	0.070	0.244	0.119	0.477	0.157	0.436	0.127	0.148	0.108
mlo-spo	3.348	4.634	5.351	6.717	6.634	5.666	3.601	0.399	-1.082	-0.816	0.636	1.989
stdev	0.548	0.376	0.392	0.195	0.155	0.161	0.371	0.144	0.323	0.135	0.155	0.187
cgo-spo	-0.203	-0.221	0.005	-0.155	-0.056	-0.116	-0.077	-0.051	-0.254	-0.223	-0.216	-0.351
stdev	0.152	0.076	0.121	0.120	0.076	0.115	0.105	0.073	0.134	0.083	0.070	0.090
<b>2008</b>	1	2	3	4	5	6	7	8	9	10	11	12
mlo-cgo	3.778	4.069	3.903	5.147	6.614	5.998	3.642	0.859	-0.782	-0.612	0.600	1.989
stdev	0.066	0.170	0.802	0.114	0.257	0.132	0.139	0.109	0.149	0.180	0.090	0.184
mlo-spo	3.564	3.939	4.370	5.201	6.469	6.020	3.788	0.769	-0.644	-0.740	0.525	1.950
stdev	0.258	0.196	0.703	0.229	0.391	0.231	0.256	0.119	0.138	0.107	0.071	0.083
cgo-spo	-0.267	0.063	-0.072	-0.145	-0.153	-0.033	0.027	-0.026	0.031	-0.037	-0.159	-0.107
stdev	0.236	0.052	0.087	0.007	0.350	0.151	0.143	0.033	0.059	0.076	0.095	0.163
<b>2009</b>	1	2	3	4	5	6	7	8	9	10	11	12
mlo-cgo	2.966	3.743	4.791	5.794	6.360	5.513	3.401	1.068	-0.633	-0.500	1.055	2.552
stdev	0.373	0.109	0.533	0.268	0.214	0.173	0.047	0.161	0.127	0.043	0.461	0.192
mlo-spo	3.418	4.275	5.380	5.810	6.513	5.506	3.217	1.095	-0.547	-0.622	0.907	2.235
stdev	0.085	0.213	0.325	0.405	0.249	0.371	0.347	0.223	0.119	0.112	0.210	0.211
cgo-spo	0.224	0.700	0.177	-0.105	-0.025	-0.158	-0.278	-0.086	0.024	-0.076	0.112	-0.295

stdev	0.323	0.700	0.010	0.092	0.117	0.216	0.406	0.239	0.035	0.102	0.329	0.177
<b>2010</b>	1	2	3	4	5	6	7	8	9	10	11	12
mlo-cgo	3.553	4.862	6.481	7.869	8.131	6.510	3.873	0.844	-1.086	-0.280	1.314	3.163
stdev	0.117	0.260	0.219	0.168	0.215	0.036	0.107	0.232	0.310	0.127	0.130	0.200
mlo-spo	3.172	5.027	6.190	7.825	8.155	6.615	3.906	0.989	-1.015	-0.358	1.210	2.659
stdev	0.237	0.434	0.237	0.128	0.147	0.117	0.101	0.164	0.223	0.165	0.122	0.206
cgo-spo	-0.292	-0.089	-0.102	0.039	0.199	0.070	0.064	0.039	-0.018	-0.028	-0.105	-0.471
stdev	0.209	0.186	0.130	0.045	0.088	0.037	0.060	0.033	0.093	0.003	0.065	0.139
<b>2011</b>	1	2	3	4	5	6	7	8	9	10	11	12
mlo-cgo	4.704	5.173	5.808	6.875	6.994	5.967	4.179	1.444	-0.351	0.022	1.568	3.287
stdev	0.147	0.308	0.689	0.386	0.096	0.106	0.282	0.364	0.059	0.040	0.071	0.092
mlo-spo	4.534	5.008	5.458	6.886	7.020	6.005	4.372	1.495	-0.257	0.050	1.382	3.032
stdev	0.418	0.493	0.707	0.236	0.428	0.307	0.494	0.247	0.052	0.131	0.243	0.145
cgo-spo	-0.422	-0.104	0.109	0.041	-0.102	0.028	-0.065	-0.224	0.091	0.021	-0.188	-0.248
stdev	0.272	0.167	0.161	0.178	0.228	0.271	0.432	0.293	0.088	0.149	0.217	0.096
<b>2012</b>	1	2	3	4	5	6	7	8	9	10	11	12
mlo-cgo	4.112	4.432	5.839	7.668	7.669	6.042	4.059	1.563	-0.361	-0.233	1.628	3.416
stdev	0.182	0.102	0.176	0.175	0.102	0.358	0.059	0.307	0.051	0.087	0.336	0.212
mlo-spo	3.985	4.626	5.698	7.547	7.701	6.282	4.067	1.368	-0.227	-0.297	1.660	3.045
stdev	0.216	0.353	0.349	0.157	0.208	0.343	0.022	0.418	0.121	0.105	0.375	0.208
cgo-spo	-0.240	0.081	0.026	-0.008	-0.014	-0.011	0.018	0.031	0.085	-0.006	-0.166	-0.336
stdev	0.219	0.302	0.289	0.226	0.151	0.157	0.066	0.100	0.072	0.050	0.037	0.057
<b>2013</b>	1	2	3	4	5	6	7	8	9	10	11	12
mlo-cgo	4.729	5.269	5.614	6.608	7.269	6.293	3.959	1.406	-0.235	-0.207	1.488	3.432
stdev	0.318	0.035	0.366	0.207	0.197	0.236	0.153	0.257	0.137	0.214	0.183	0.150
mlo-spo	4.434	5.488	6.391	6.899	7.556	6.231	4.226	1.219	-0.470	-0.242	1.290	3.074
stdev	0.158	0.156	0.364	0.194	0.277	0.302	0.193	0.258	0.160	0.234	0.316	0.069
cgo-spo	-0.153	0.237	0.713	0.319	0.112	0.156	0.172	0.056	-0.166	-0.040	-0.235	-0.322
stdev	0.130	0.161	0.198	0.043	0.093	0.115	0.097	0.078	0.072	0.163	0.178	0.202
<b>2014</b>	1	2	3	4	5	6	7	8	9	10	11	12
mlo-cgo	4.277	4.481	5.786	7.614	8.054	6.562	3.605	0.934	-0.441	-0.060	1.949	3.723
stdev	0.132	0.394	0.301	0.116	0.147	0.388	0.291	0.366	0.160	0.539	0.110	0.199
mlo-spo	4.036	4.310	5.942	7.668	8.030	6.780	3.676	1.087	-0.514	-0.126	1.635	3.404
stdev	0.165	0.306	0.582	0.306	0.109	0.512	0.565	0.517	0.095	0.385	0.175	0.255
cgo-spo	-0.195	0.077	-0.023	0.013	0.057	-0.070	-0.174	-0.070	-0.180	-0.262	-0.295	-0.380
stdev	0.140	0.451	0.402	0.284	0.162	0.234	0.556	0.388	0.176	0.162	0.019	0.110
<b>2015</b>	1	2	3	4	5	6	7	8	9	10	11	12
mlo-cgo	4.447	4.897	5.969	7.233	7.308	5.856	3.269	0.600	-0.868	-0.102	1.608	2.912
stdev	0.235	0.295	0.299	0.332	0.345	0.008	0.200	0.318	0.158	0.258	0.020	0.071
mlo-spo	4.142	4.671	5.968	7.467	7.513	5.956	3.240	0.694	-0.940	-0.340	1.358	2.738
stdev	0.194	0.201	0.324	0.376	0.294	0.067	0.407	0.200	0.132	0.230	0.118	0.245
cgo-spo	-0.386	-0.124	-0.021	0.067	0.108	0.132	0.196	-0.044	-0.137	-0.153	-0.217	-0.232



stdev	0.164	0.180	0.223	0.145	0.120	0.052	0.062	0.279	0.185	0.041	0.116	0.239
<b>2016</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>9</b>	<b>10</b>	<b>11</b>	<b>12</b>
mlo-cgo	3.910	4.826	6.452	7.791	7.721	6.038	3.142	0.173	-1.420	-0.353	1.804	3.475
stdev	0.189	0.396	0.173	0.076	0.210	0.135	0.340	0.386	0.341	0.206	0.515	0.238
mlo-spo	3.728	5.056	5.779	8.045	7.849	6.183	3.409	0.362	-1.423	-0.491	1.585	3.069
stdev	0.565	0.711	0.653	0.263	0.142	0.162	0.329	0.271	0.275	0.243	0.417	0.315
cgo-spo	-0.327	-0.054	-0.114	0.318	0.138	0.071	0.087	-0.074	-0.124	-0.173	-0.412	-0.415
stdev	0.520	0.490	0.203	0.293	0.050	0.026	0.172	0.145	0.082	0.094	0.261	0.134
<b>2017</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>9</b>	<b>10</b>	<b>11</b>	<b>12</b>
mlo-cgo	4.759	5.504	6.318	7.449	8.044	6.707	4.230	1.581	-0.492	-0.175	1.706	3.071
stdev	0.712	0.256	0.090	0.453	0.104	0.229	0.230	0.073	0.271	0.197	0.252	0.108
mlo-spo	4.501	5.328	6.212	7.854	8.105	6.949	4.451	1.757	-0.614	-0.212	1.539	2.927
stdev	0.108	0.311	0.331	0.456	0.199	0.186	0.141	0.090	0.214	0.180	0.245	0.126
cgo-spo	-1.109	-0.084	0.083	0.097	0.012	-0.007	0.189	0.068	-0.060	-0.062	-0.006	-0.176
stdev	1.375	0.152	0.113	0.106	0.096	0.162	0.054	0.115	0.069	0.121	0.126	0.212