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*Supplement of*

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

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## S1: Historic records of interhemispheric CO<sub>2</sub>

Historically, the most extensive IH CO<sub>2</sub> difference (IH  $\Delta$ CO<sub>2</sub>) measurements involve Mauna Loa (mlo) minus South Pole (spo). Significant improvements in measurement quality occurred in all laboratories throughout the 1980s and 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.

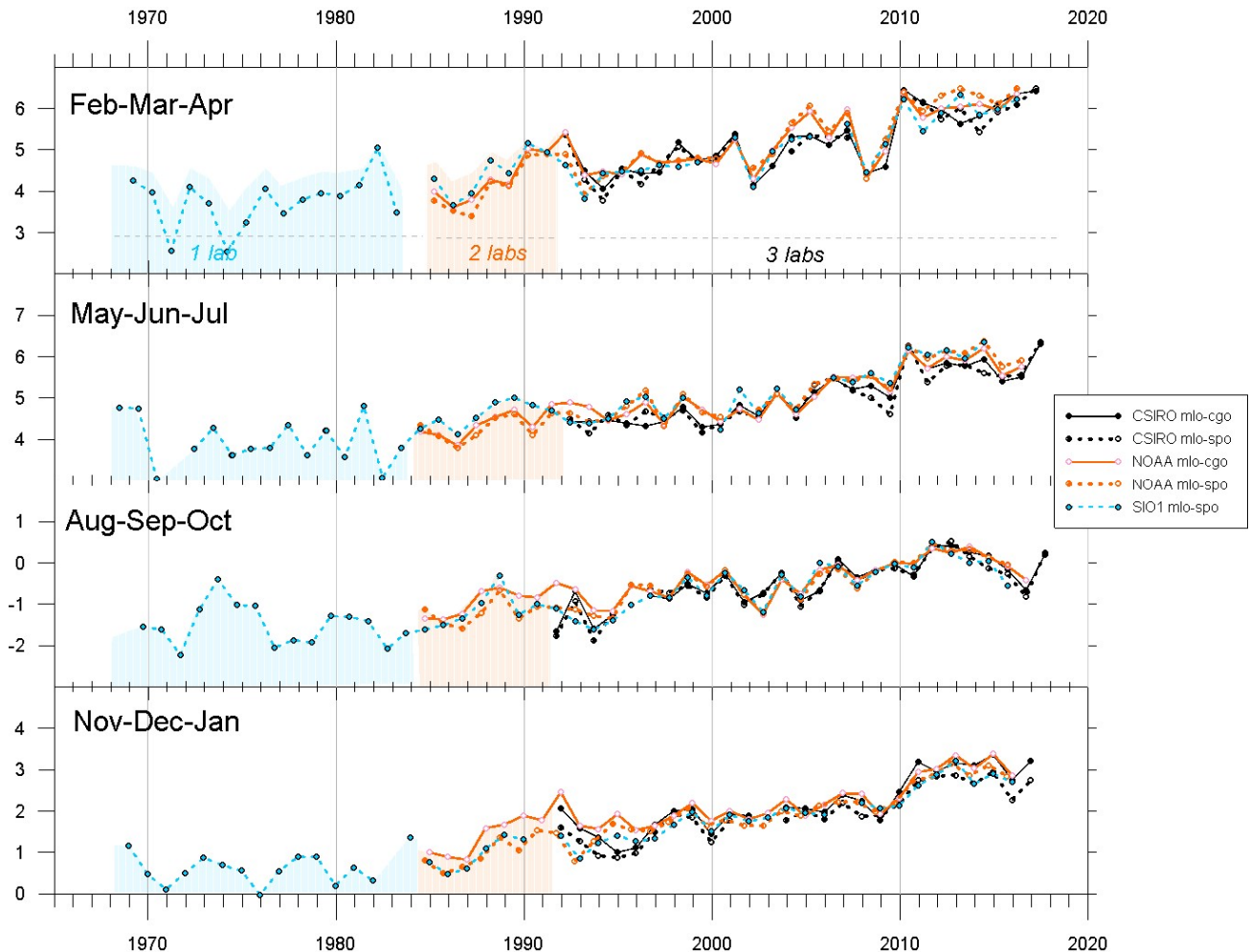


Figure s1: Historic records of mlo-spo and mlo-cgo measured by SIO1, NOAA and CSIRO. Time series of 3-month averages for the indicated periods are shown.

Figure s1 provides an historic perspective on baseline measurements of IH  $\Delta$ CO<sub>2</sub> from SIO1, NOAA and CSIRO's GASLAB and include Cape Grim (cgo). Data are presented in the four periods 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 s1).

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 occurs around this time.

The percentage of missing months for the three periods of Figure s1 are summarized in Table 1.

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

Table 1: Percentage of missing months in monthly data from SIO, NOAA and CSIRO for each baseline site.

To indicate changes in quality, Table 2 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<sub>2</sub> exchange discussed in FF18.

Standard Error in $\Delta\text{CO}_2$ (ppm)			
season	pre-1984	1984-2016	
		mlo-spo	mlo-cgo
Feb-Mar-Apr	0.63	0.41	0.43
May-Jun-Jul	0.66	0.32	0.29
Aug-Sep-Oct	0.5	0.35	0.32
Nov-Dec-Jan	0.43	0.26	0.33

Table 2: Standard error in  $\Delta\text{CO}_2$  of a linear regression through differences in monthly CO<sub>2</sub> between mlo and Southern Hemisphere sites cgo and spo, used to indicate scatter in the data.

We conclude from Table 1 and Table 2 that pre-1984 data are generally of insufficient quality for the correlation with independent data. The major improvement in the stability and effective lifetime of CO<sub>2</sub> standards that occurred worldwide through the 1980s is a likely contributor (For example: at CSIRO early steel cylinders frequently exhibited CO<sub>2</sub> drifts exceeding 1 ppm year<sup>-1</sup>, a drift rate increasing as cylinder pressure dropped; since 1992 the relative drift among a suite of ~15 (custom passivated) aluminium cylinders is within +/- 0.003 ppm year<sup>-1</sup>).

After about 1994 the variability in the highest quality IH  $\Delta\text{CO}_2$  in Figure 1 is noticeably larger in the Feb-Apr period than in other seasons. It coincides with intermittent inter-hemispheric transport by eddy processes at that time of year via the Pacific Westerly duct (FF18)).

## S2: Measurement Linearity

Disagreement between laboratories in  $\text{CO}_2$  site-differences can be due in part to different measurement instrument response.

In Figure s2, GC/FID (Gas Chromatograph with Flame Ionisation Detector) response versus NDIR (Non-Dispersive InfraRed detector) response is plotted as differences of measured  $\text{CO}_2$  mole fractions from a linear regression through routine calibrations of CSIRO GASLAB instruments using different high-pressure cylinder suite calibration scales. These results are adapted from unpublished Baseline article (Francey et al., 2019).

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  $\text{CO}_2$  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

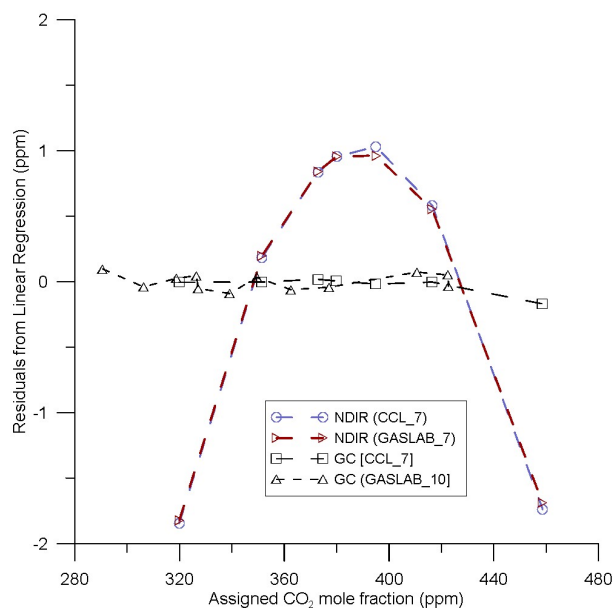


Figure s2: Residuals from a linear regression through the responses of an NDIR and a GC, measuring  $\text{CO}_2$  in high-pressure calibration cylinders. Brackets in the caption indicate laboratory assigning  $\text{CO}_2$  concentration and the number of cylinder standards in the suite.

## S3: Flask sampling advantages and disadvantages

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.

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.

Compared to CO<sub>2</sub> information used in typical growth rate studies, the 25-year composites of within-network spatial differences measured by the flask networks provide additional insights, summarised here:

- Since flask samples from each network are analysed in a central laboratory, bias associated with calibration of an internal calibration scale relative to the international CO<sub>2</sub> WMO mole fraction scale (Zhou and Tans, 2006), and similar bias when relating a reference gas to the internal scale, generally cancel for within-network site differences.
- The IH  $\Delta$ CO<sub>2</sub> suppress the influence of equatorial surface exchanges that are uplifted to an altitude where they can mix into both hemispheres. This improves sensitivity to cross-equatorial atmospheric fluxes that occur in a region where transport is less well-defined than at higher latitudes (e.g. Lintner et al., 2004).
- Multi-species (e.g. other long-lived trace gases and their isotopes) with different biogeochemistry but identical times of air sample collection are often available (particularly from pressurized flasks). A multi-species approach was briefly assessed in FF16 and FF18 and is the subject of further studies.

Disadvantages of flask compared to *in situ* CO<sub>2</sub> sampling include:

- CO<sub>2</sub> artefacts related to extended storage of air in flasks, mainly affecting sampling from remote sites with annual resupply (in this study spo). Flask size, permeation through elastomer seals in pressurized flasks (Sturm et al., 2004), and inadequate surface preconditioning to limit CO<sub>2</sub> adsorption on surfaces, are possible contributing factors. In this study, factors such as the use of larger and/or unpressurized flasks at spo, and corrections informed by co-sampling with *in situ* analysers (e.g. Stavert et al., 2019), help address this concern.
- The brevity of sampling compared to *in situ* measurement. Monthly average concentrations from each site comprise the average of 1-10 or more flask samples (depending on network and site) with the filling of each flask taking approximately 1-20 minutes (depending on differing sampling strategies to precondition and/or pressurize). That is, air sampled over a few hours can be used to represent a monthly value. The effectiveness of baseline selection becomes a critical issue. In the current study it will be seen that the generally small standard deviations in monthly averages across networks with quite different sampling frequency imply that this is unlikely to be a major concern with the selected primary baseline site monthly data employed.

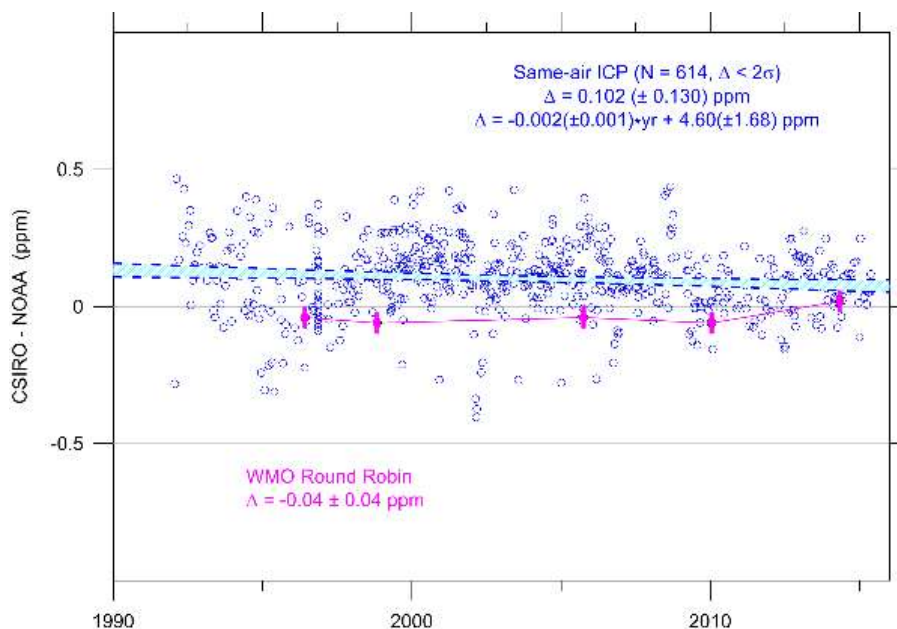


Figure s3: CO<sub>2</sub> inter-calibration activities involving NOAA and CSIRO. Blue circles are measurements on NOAA flasks filled at cgo by both CSIRO and subsequently NOAA (accessed (19 April 2018)). Purple points show WMO high-pressure cylinder inter-comparisons.

#### S4: 1991-93 NOAA spo anomaly

The largest cgo-spo differences occur in 1992 and 1993. In these years the composite cgo-spo involves uninterrupted monthly data from two networks only, NOAA and CSIRO. At this time, CSIRO co-measurement of a subset of NOAA cgo flask samples (Masarie et al., 2001) show CSIRO cgo is around 0.2 ppm higher than NOAA cgo, too small and in the wrong direction to explain the 1992-1993 network difference, rather suggesting a temporary problem with NOAA spo sampling; no such persisting anomalies of this magnitude have occurred since. Prior to Mar 1993, NOAA cgo-spo data are lower by around -0.5 ppm compared to CSIRO data (Supplement Figure s4), with much larger seasonality compared to subsequent NOAA and CSIRO data.

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). Enhanced NOAA spo is implied for the period. Based on subsequent behaviour in all networks, the NOAA seasonality is anomalous. Methodology continuity in CSIRO GASLAB (with original, regularly-monitored calibration cylinders still intact) exhibits no comparable anomaly..

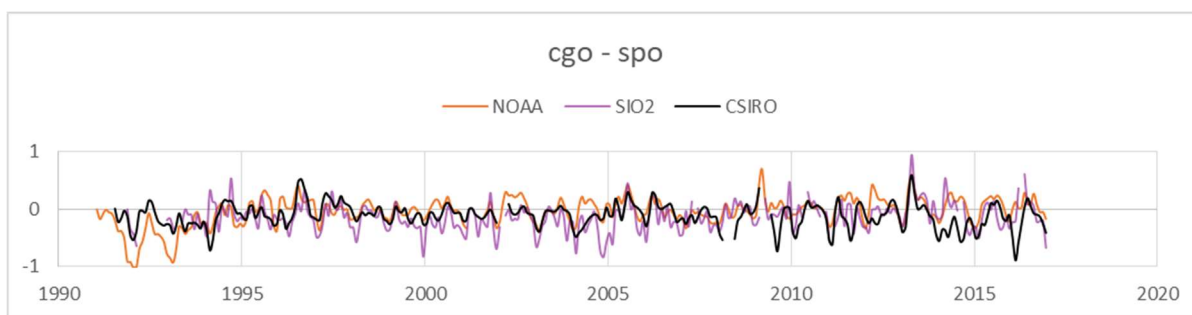


Figure s4: Differences in cgo-spo CO<sub>2</sub> concentration for NOAA, SIO2 and CSIRO highlighting 1991-1993 anomalies in monthly NOAA data compared to CSIRO.

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## S5: Tabulation of Composite $\Delta\text{CO}_2$ 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>	1	2	3	4	5	6	7	8	9	10	11	12
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>	1	2	3	4	5	6	7	8	9	10	11	12
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