

CO2-O2-stat

Introduction

- **Objective:** This Mathematica notebook calculates covariance parameters and average 24 - h cycles from concentration timeseries of dissolved CO₂ - O₂ pairs in river water .
Mathematica 14.3 - Notebook Version 1.0. Date: 18. Nov. 2025
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- **Manuscript:** Marie-Sophie Maier, Bernhard Wehrli, Cristian R. Teodoru (2025) High-frequency CO₂-O₂ records reveal intensity of river metabolism and lateral exchange in the Danube Delta. Submitted to Biogeosciences <https://www.biogeosciences.net/>
- **Data repository:** CO₂-O₂ timeseries Danube Delta 2016-2018, Dataset, available at ETH research collection <https://doi.org/10.3929/ethz-c-000786936>
- **Terminology** and context see D. Vachon et al. (2020) Paired O₂ - CO₂ measurements provide emergent insights into aquatic ecosystem function. Limnology and Oceanography Letters, **5**, 287-294. <https://doi.org/10.1002/lol2.10135>
- **Notes:** The excess concentration values of CO₂ and O₂ are in micromoles per liter with reference to atmospheric saturation. For simplicity they are labelled as CO₂ and O₂ in the notebook. The *Import* statement will have to be modified for the directory path when the *Balanova* file is downloaded to local storage. Data export to files is omitted here, but could be added using the *Export* command.

Read file input and define time series

read input file, remove outer bracket, remove header, define time series
input file has 3 columns with date and time, exCO2 (excess CO₂ in μM), exO2 (excess O₂ in μM) and measurements all 15'

In[•]:=

```
data = Drop[Flatten[Import[
  "C:\\\\Users\\\\Wehrli\\\\OneDrive\\\\Dokumente\\\\Docs\\\\Publish\\\\Marie_Paper4_sensors\\\\ETH
  Research Collection\\\\Balanova_t_exCO2_ex02.xlsx"], 1], 1]
```

Out[•]=

```
{ { Fri 9 Feb 2018 15:00:00 GMT+1, 20.3878, -8.6902 }, { Fri 9 Feb 2018 15:15:00 GMT+1, 18.571, -8.44062 },
{ Fri 9 Feb 2018 15:30:00 GMT+1, 16.7995, -9.06545 }, { Fri 9 Feb 2018 15:45:00 GMT+1, 16.8346, -9.02323 },
{ Fri 9 Feb 2018 16:00:00 GMT+1, 15.5051, -8.38754 }, { Fri 9 Feb 2018 16:15:00 GMT+1, 15.8842, -8.66834 },
{ Fri 9 Feb 2018 16:30:00 GMT+1, 16.0937, -9.29317 }, { Fri 9 Feb 2018 16:45:00 GMT+1, 16.6812, -9.52142 },
... 29 312 ..., {13-Dec-2018 12:45:00, 3.56277, 12.8164}, {13-Dec-2018 13:00:00, 4.2027, 12.4292},
{13-Dec-2018 13:15:00, 4.06376, 14.5732}, {13-Dec-2018 13:30:00, 3.93966, 15.0398},
{13-Dec-2018 13:45:00, 3.63416, 15.873}, {13-Dec-2018 14:00:00, 3.82943, 16.1094},
{13-Dec-2018 14:15:00, 4.45635, 16.7755}, {13-Dec-2018 14:30:00, 4.78119, 16.8628} }
```

Full expression not available (original memory size: 10.1 MB)



In[•]:= t = Flatten[Drop[Transpose[data], -2], 1]

Out[•]=

```
{ { Fri 9 Feb 2018 15:00:00 GMT+1, Fri 9 Feb 2018 15:15:00 GMT+1 },
{ Fri 9 Feb 2018 15:30:00 GMT+1, Fri 9 Feb 2018 15:45:00 GMT+1, Fri 9 Feb 2018 16:00:00 GMT+1 },
{ Fri 9 Feb 2018 16:15:00 GMT+1, Fri 9 Feb 2018 16:30:00 GMT+1, Fri 9 Feb 2018 16:45:00 GMT+1 },
{ Fri 9 Feb 2018 17:00:00 GMT+1, Fri 9 Feb 2018 17:15:00 GMT+1, Fri 9 Feb 2018 17:30:00 GMT+1 },
{ Fri 9 Feb 2018 17:45:00 GMT+1, Fri 9 Feb 2018 18:00:00 GMT+1, Fri 9 Feb 2018 18:15:00 GMT+1 },
{ Fri 9 Feb 2018 18:30:00 GMT+1, Fri 9 Feb 2018 18:45:00 GMT+1, Fri 9 Feb 2018 19:00:00 GMT+1 },
{ Fri 9 Feb 2018 19:15:00 GMT+1, ... 29 292 ..., 13-Dec-2018 10:15:00, 13-Dec-2018 10:30:00,
13-Dec-2018 10:45:00, 13-Dec-2018 11:00:00, 13-Dec-2018 11:15:00, 13-Dec-2018 11:30:00,
13-Dec-2018 11:45:00, 13-Dec-2018 12:00:00, 13-Dec-2018 12:15:00, 13-Dec-2018 12:30:00,
13-Dec-2018 12:45:00, 13-Dec-2018 13:00:00, 13-Dec-2018 13:15:00, 13-Dec-2018 13:30:00,
13-Dec-2018 13:45:00, 13-Dec-2018 14:00:00, 13-Dec-2018 14:15:00, 13-Dec-2018 14:30:00 } }
```

Full expression not available (original memory size: 7.3 MB)



In[•]:= d = Drop[data, None, 1]

Out[•]=

```
{ {20.3878, -8.6902}, {18.571, -8.44062}, {16.7995, -9.06545}, {16.8346, -9.02323}, {15.5051, -8.38754},
{15.8842, -8.66834}, {16.0937, -9.29317}, {16.6812, -9.52142}, {15.7265, -8.31329},
{15.3201, -8.42876}, {15.0616, -9.05677}, {15.0566, -10.0152}, {15.6344, -10.3696},
{14.7163, -9.9306}, ... 29 301 ..., {4.43778, 6.07555}, {4.45421, 7.38623}, {4.24326, 8.35939},
{4.11726, 10.4461}, {4.49685, 11.4356}, {3.56277, 12.8164}, {4.2027, 12.4292}, {4.06376, 14.5732},
{3.93966, 15.0398}, {3.63416, 15.873}, {3.82943, 16.1094}, {4.45635, 16.7755}, {4.78119, 16.8628} }
```

Full expression not available (original memory size: 2.8 MB)



In[•]:= ts = TimeSeries[d, {t}]

Out[•]=

```
TimeSeries[  Time: 09 Feb 2018 to 13 Dec 2018 ]
Data points: 29 328
```

Defining constants and covariance

calculations

Constants

active months in timeseries

```

In[1]:= months = Range[2, 12]
Out[1]= {2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12}

fm = first month, lm = last month, nm = number of months

In[2]:= fm = 2; lm = 12; nm = 11;
Out[2]= {2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12}

In[3]:= mlabels12 =
  {"Jan", "Feb", "Mar", "Apr", "May", "Jun", "Jul", "Aug", "Sep", "Oct", "Nov", "Dec"};
Out[3]= {"Jan", "Feb", "Mar", "Apr", "May", "Jun", "Jul", "Aug", "Sep", "Oct", "Nov", "Dec"}

In[4]:= mlabels = Drop[mlabels12, 1];
Out[4]= {"Feb", "Mar", "Apr", "May", "Jun", "Jul", "Aug", "Sep", "Oct", "Nov", "Dec"}

```

labels for output parameters

```
In[®]:= outlabels =  
        {"month", "ndata", "c-exCO2", "c-exO2", "stretch", "width", "offset", "slope"}  
  
Out[®]= {month, ndata, c-exCO2, c-exO2, stretch, width, offset, slope}
```

color scheme and labels

define seasonal color scheme `scol` for 12 months, select scheme `col` for active months

parameters and function for drawing covariance ellipse

Calculate the covariance matrix, the stretch and width of the 95% ellipse based on the Eigenvalues and the slope or rotation of the ellipse from the Eigenvectors, details Vachon et al. 2020 L&O Letters doi: 10.1002/lo2.10135

diagonal line for calculating offset

```
In[ ]:= oneline = InfiniteLine[{{0, 0}, {1, -1}}]
Out[ ]=
InfiniteLine[{{0, 0}, {1, -1}}]
```

example : February

```
In[ ]:= tsfeb = TimeSeriesWindow[ts, DateObject[{2018, 2}, "Month"]]
Out[ ]=
TimeSeries[]
```

parameters: stretch = {stretch, width in μM }, centr = centroid {av. exCO₂, av. exO₂ in μM }, rot = rotation

```
In[ ]:= stretch = Sqrt[5.991 Eigenvalues[Covariance[tsfeb]]]
Out[ ]=
{27.5946, 15.694}

In[ ]:= centr = Mean[tsfeb]
Out[ ]=
{14.2102, -28.0919}

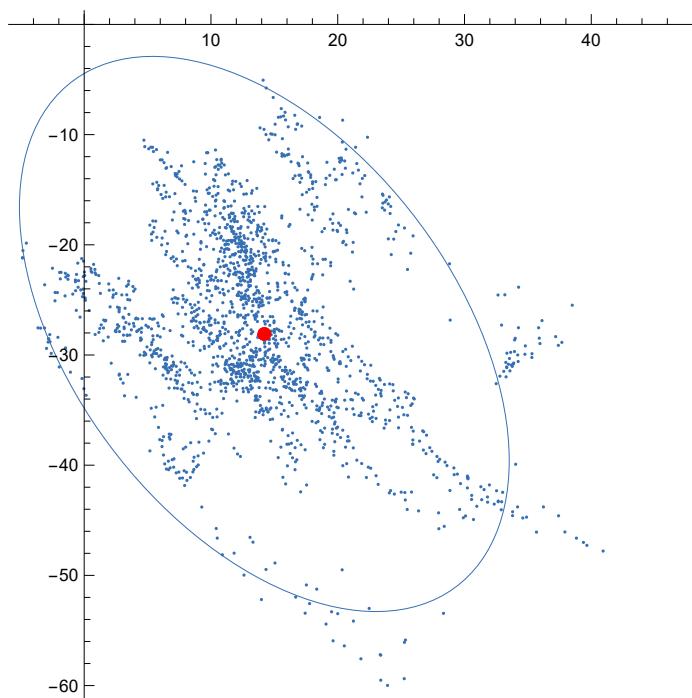
In[ ]:= rot =
ArcTan[Eigenvectors[Covariance[tsfeb]][1, 2] / Eigenvectors[Covariance[tsfeb]][1, 1]]
Out[ ]=
-1.05149
```

function eli for drawing covariance ellipse

```
In[ ]:= eli[li_List] := Show[{ListPlot[li, AspectRatio -> 1, PlotStyle -> col[1]],
ListPlot[{Mean[li]}, PlotStyle -> {Red, PointSize[0.02]}], Graphics[{col[1],
Rotate[Circle[Mean[li], Sqrt[5.991 Eigenvalues[Covariance[li]]]], ArcTan[
Eigenvectors[Covariance[li]][1, 2] / Eigenvectors[Covariance[li]][1, 1]]}]}]}
```

```
In[6]:= eli1 = eli[tsfeb["Values"]]
```

```
Out[6]=
```



Plotting covariance ellipses for all months

Monthly timeseries

the time series is split in monthly lists

```
In[6]:= tsm = Table[TimeSeriesWindow[ts, DateObject[{2018, m}, "Month"]], {m, fm, lm}]
```

Out[6]=

TimeSeries[ Time: 09 Feb 2018 to 28 Feb 2018], Data points: 1859,

TimeSeries[ Time: 01 Mar 2018 to 31 Mar 2018], Data points: 2976,

TimeSeries[ Time: 01 Apr 2018 to 30 Apr 2018], Data points: 2874,

TimeSeries[ Time: 01 May 2018 to 31 May 2018], Data points: 2969,

TimeSeries[ Time: 01 Jun 2018 to 30 Jun 2018], Data points: 2875,

TimeSeries[ Time: 01 Jul 2018 to 31 Jul 2018], Data points: 2971,

TimeSeries[ Time: 01 Aug 2018 to 31 Aug 2018], Data points: 2971,

TimeSeries[ Time: 01 Sep 2018 to 30 Sep 2018], Data points: 2875,

TimeSeries[ Time: 01 Oct 2018 to 31 Oct 2018], Data points: 2971,

TimeSeries[ Time: 01 Nov 2018 to 30 Nov 2018], Data points: 2776,

TimeSeries[ Time: 01 Dec 2018 to 13 Dec 2018], Data points: 1211] }

Derive first and last covered days per month

```
In[7]:= df1 = {{10, 28}, {1, 31}, {1, 30}, {1, 31}, {1, 30}, {1, 31}, {1, 31}, {1, 31}, {1, 30}, {1, 31}, {1, 30}, {1, 12}}
```

Out[7]=

```
 {{10, 28}, {1, 31}, {1, 30}, {1, 31}, {1, 30}, {1, 31}, {1, 31}, {1, 30}, {1, 31}, {1, 30}, {1, 12}}
```

Plotting Months

The *elim* function takes a monthly list of CO2 - O2 pairs and plots the 95 % covariance ellipse . It

first thefines the vertical, horizontal and diagonal grey lines, then ListPlots the list li with the monthly attributes m and then the ellipse as a graphics object calculated from the li data.

Define plot range

```
In[8]:= prange = {{-50, 200}, {-200, 120}}
Out[8]= {{-50, 200}, {-200, 120}}

In[9]:= lx0 = {{prange[[1, 1]], 0}, {prange[[1, 2]], 0}}
Out[9]= {{-50, 0}, {200, 0}}

In[10]:= ly0 = {{0, prange[[2, 1]]}, {0, prange[[2, 2]]}}
Out[10]= {{0, -200}, {0, 120}}
```

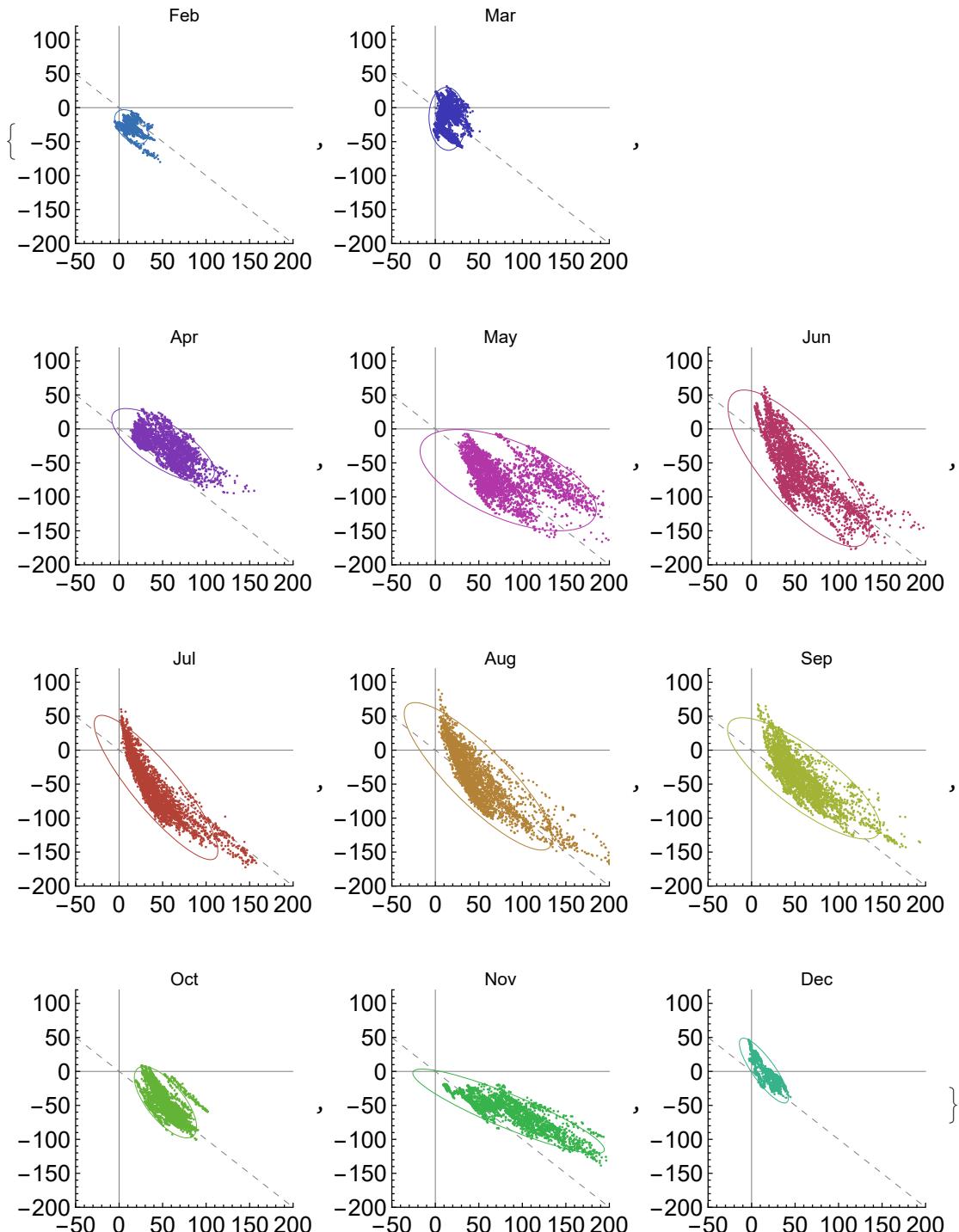
Function $elim$ for plotting covariance ellipses of different months m

```
In[11]:= elim[li_List, m_] :=
Show[{ListPlot[{{prange[[1, 1]], -prange[[1, 1]]}, {-prange[[2, 1]], prange[[2, 1]]}}, PlotRange -> prange, AxesOrigin -> {prange[[1, 1]], prange[[2, 1]]}, PlotStyle -> {Gray, Dashed, Thickness -> 0.003}, PlotLabel -> mlabels[[m]], Joined -> True, AspectRatio -> 1, AxesStyle -> Directive[Black, 14, Thickness[0.005]]], ListPlot[lx0, Joined -> True, PlotStyle -> {Gray, Thickness -> 0.003}], ListPlot[ly0, Joined -> True, PlotStyle -> {Gray, Thickness -> 0.003}], ListPlot[li, PlotStyle -> col[[m]]], ListPlot[{Mean[li]}, PlotStyle -> {col[[m]], PointSize[0.025]}], Graphics[{col[[m]], Rotate[Circle[Mean[li], Sqrt[5.991 Eigenvalues[Covariance[li]]]]], ArcTan[Eigenvectors[Covariance[li]][[1, 2]] / Eigenvectors[Covariance[li]][[1, 1]]]}]]}]
```

Plot monthly ellipses

```
In[8]:= elimp = Table[elim[tsm[[m]]["Values"], m], {m, 11}]
```

```
Out[8]=
```

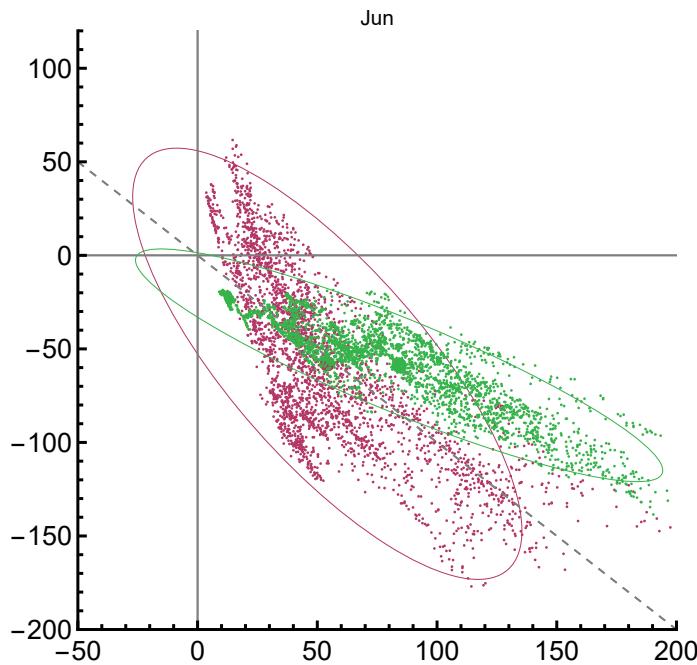


Combine two months (#5 and # 10)

Just for illustration ... for further use --> remove the PlotLabel

```
In[5]:= elicom = Show[elimp[[5]], elimp[[10]]]
```

```
Out[5]=
```



Monthly covariance parameters

Definitions and calculations

number of monthly data

```
In[6]:= ndat = Table[Length[tsm[[m]]["Values"]], {m, 11}]
```

```
Out[6]=
```

```
{1859, 2976, 2874, 2969, 2875, 2971, 2971, 2875, 2971, 2776, 1211}
```

centroid

centroid represents the mean coordinates in the CO2 - O2 plain

```
In[7]:= centroids = Table[Mean[tsm[[m]]["Values"]], {m, 11}]
```

```
Out[7]=
```

```
{ {14.2102, -28.0919}, {14.0014, -16.384}, {50.5495, -24.2927},  
{83.7223, -75.4244}, {54.1757, -57.96}, {42.4657, -54.9412}, {49.3782, -38.5287},  
{60.1082, -41.5475}, {53.2611, -45.369}, {84.1638, -58.7602}, {14.1903, 1.18351} }
```

```
In[8]:= cexCO2 = Transpose[centroids][[1]]
```

```
Out[8]=
```

```
{14.2102, 14.0014, 50.5495, 83.7223, 54.1757,  
42.4657, 49.3782, 60.1082, 53.2611, 84.1638, 14.1903}
```

```
In[8]:= cex02 = Transpose[centroids][[2]]
Out[8]= {-28.0919, -16.384, -24.2927, -75.4244, -57.96,
-54.9412, -38.5287, -41.5475, -45.369, -58.7602, 1.18351}
```

stretch, width

stretch and *width* refer to the large and small axes of the 95%-covariance ellipse, respectively

```
In[9]:= sw = Table[Sqrt[5.991 Eigenvalues[Covariance[tsm[[m]]["Values"]]]], {m, 11}]
Out[9]= {{27.5946, 15.694}, {46.3588, 21.2028}, {74.4939, 29.6924},
{113.378, 54.392}, {133.916, 44.2553}, {124.532, 28.7913}, {133.14, 36.1912},
{119.105, 38.7405}, {59.3033, 23.0093}, {124.208, 23.7081}, {53.7012, 13.7307}}
In[10]:= stretch = Transpose[sw][[1]]
Out[10]= {27.5946, 46.3588, 74.4939, 113.378, 133.916,
124.532, 133.14, 119.105, 59.3033, 124.208, 53.7012}
In[11]:= width = Transpose[sw][[2]]
Out[11]= {15.694, 21.2028, 29.6924, 54.392, 44.2553,
28.7913, 36.1912, 38.7405, 23.0093, 23.7081, 13.7307}
```

slope and offset

slope and *offset* stand for the rotation (tilt) of the covariance ellipse and the nearest distance of the centroid from the theoretical line with -1 slope, respectively

```
In[12]:= slope = Table[Eigenvectors[Covariance[tsm[[m]]["Values"]]][[1, 2]] /
Eigenvectors[Covariance[tsm[[m]]["Values"]]][[1, 1]], {m, 11}]
Out[12]= {-1.74933, -31.3954, -0.890933, -0.596231, -1.56117,
-1.57428, -1.32649, -1.02215, -1.72124, -0.534952, -1.85478}
In[13]:= offset = Table[RegionDistance[oneline, centroids[[m]]], {m, 11}]
Out[13]= {9.81584, 1.68478, 18.5663, 5.8675, 2.6759,
8.82155, 7.67174, 13.1244, 5.58059, 17.9631, 10.8709}
```

Table of monthly covariance parameters

Monthly matrix

```
In[®]:= mmatrix = {months, ndat, cexCO2, cexO2, stretch, width, offset, slope}

Out[®]= {{2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12}, {1859, 2976, 2874, 2969, 2875, 2971, 2971, 2875, 2971, 2776, 1211}, {14.2102, 14.0014, 50.5495, 83.7223, 54.1757, 42.4657, 49.3782, 60.1082, 53.2611, 84.1638, 14.1903}, {-28.0919, -16.384, -24.2927, -75.4244, -57.96, -54.9412, -38.5287, -41.5475, -45.369, -58.7602, 1.18351}, {27.5946, 46.3588, 74.4939, 113.378, 133.916, 124.532, 133.14, 119.105, 59.3033, 124.208, 53.7012}, {15.694, 21.2028, 29.6924, 54.392, 44.2553, 28.7913, 36.1912, 38.7405, 23.0093, 23.7081, 13.7307}, {9.81584, 1.68478, 18.5663, 5.8675, 2.6759, 8.82155, 7.67174, 13.1244, 5.58059, 17.9631, 10.8709}, {-1.74933, -31.3954, -0.890933, -0.596231, -1.56117, -1.57428, -1.32649, -1.02215, -1.72124, -0.534952, -1.85478}}
```

Parameter table

MatrixForm is ready for file export

```
In[®]:= ptab = MapThread[Prepend, {mmatrix, outlabels}] // MatrixForm

Out[®]//MatrixForm=


| month   | 2        | 3        | 4         | 5         | 6        | 7        | 8        | 9        |
|---------|----------|----------|-----------|-----------|----------|----------|----------|----------|
| ndata   | 1859     | 2976     | 2874      | 2969      | 2875     | 2971     | 2971     | 2875     |
| c-exCO2 | 14.2102  | 14.0014  | 50.5495   | 83.7223   | 54.1757  | 42.4657  | 49.3782  | 60.1082  |
| c-exO2  | -28.0919 | -16.384  | -24.2927  | -75.4244  | -57.96   | -54.9412 | -38.5287 | -41.5475 |
| stretch | 27.5946  | 46.3588  | 74.4939   | 113.378   | 133.916  | 124.532  | 133.14   | 119.105  |
| width   | 15.694   | 21.2028  | 29.6924   | 54.392    | 44.2553  | 28.7913  | 36.1912  | 38.7405  |
| offset  | 9.81584  | 1.68478  | 18.5663   | 5.8675    | 2.6759   | 8.82155  | 7.67174  | 13.1244  |
| slope   | -1.74933 | -31.3954 | -0.890933 | -0.596231 | -1.56117 | -1.57428 | -1.32649 | -1.02215 |


```

Daily covariance parameters

Extract daily timeseries and check completeness

The following procedure extracts daily timeseries for each month and reads out the number of data-pairs per day. Note ";" suppresses output.

```
In[®]:= tsd0 = Flatten[
  Table[Table[TimeSeriesWindow[tsm[[m]], DateObject[{2018, months[[m]], d}], "Day"]],
    {d, dfl[[m, 1]], dfl[[m, 2]]}], {m, nm}], 1];

In[®]:= ndays0 = Length[tsd0]

Out[®]= 306
```

Flag and remove critical days with data < 50

could be automated, but for simplicity this is done by hand

```

In[1]:= flag1 = Position[dtest, 48]
Out[1]= {{285} }

In[2]:= tsd = Drop[tsd0, {285, 286}]
Out[2]= ndays = Length[tsd]

In[3]:= ndays
Out[3]= 304

```

Calculate and plot daily covariance parameters

note output is suppressed by ; - a tabular version of the output is presented in the section *Table of daily covariance parameters*

dates

time of day 49 --> 12:00

```
In[•]:= time = Table[tsd[[d]]["Dates"][[49]], {d, ndays}];
```

centroid

```
In[1]:= centroidsd = Table[Mean[tsd[[d]]["Values"]], {d, ndays}];  
In[2]:= cexCO2d = Transpose[centroidsd][1];  
In[3]:= cex02d = Transpose[centroidsd][2];
```

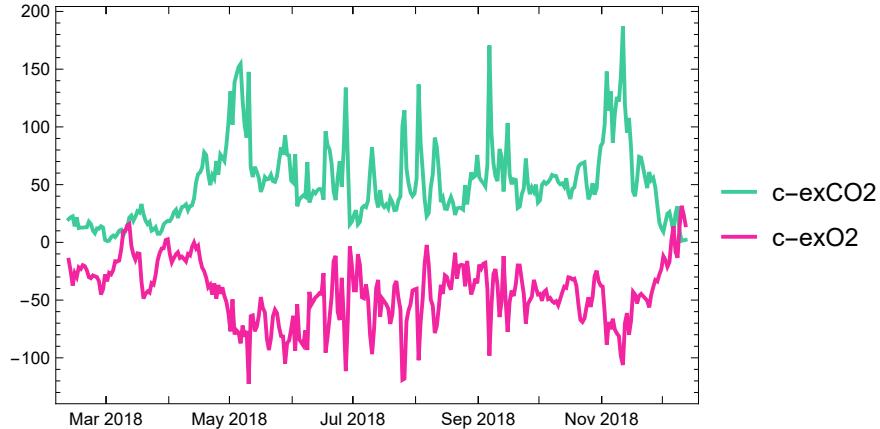
```
In[°]:= tscentr = TimeSeries[centroidsd, {time}]
```

```
Out[°]=
```

TimeSeries [ Time: 10 Feb 2018 to 12 Dec 2018]
Data points: 304

```
In[°]:= pcentroid = DateListPlot[tscentr, PlotLegends -> {"c-exCO2", "c-exO2"}]
```

```
Out[°]=
```



stretch and width

```
In[°]:= swd = Table[Sqrt[5.991 Eigenvalues[Covariance[tsd[[d]]["Values"]]]], {d, ndays}];
```

```
In[°]:= stretchd = Transpose[swd][[1]];
```

```
In[°]:= widthd = Transpose[swd][[2]];
```

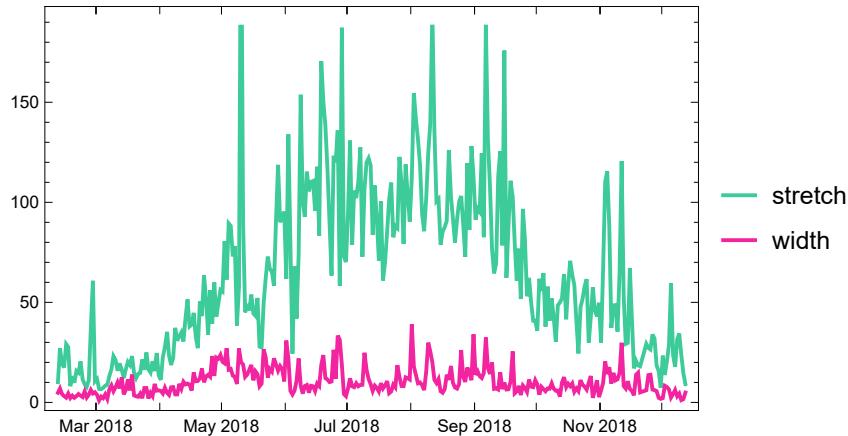
```
In[°]:= tsswd = TimeSeries[swd, {time}]
```

```
Out[°]=
```

TimeSeries [ Time: 10 Feb 2018 to 12 Dec 2018]
Data points: 304

```
In[°]:= psw = DateListPlot[tsswd, PlotLegends -> {"stretch", "width"}]
```

```
Out[°]=
```



slope and offset

```
In[1]:= sloped = Table[Eigenvectors[Covariance[tsd[[d]]["Values"]]][[1, 2]] /  
Eigenvectors[Covariance[tsd[[d]]["Values"]]][[1, 1]], {d, ndays}];  
  
In[2]:= offsetd = Table[RegionDistance[oneline, centroidsd[[d]]], {d, ndays}];  
  
In[3]:= slopoff = Transpose[{offsetd, sloped}];  
  
In[4]:= tsso = TimeSeries[slopoff, {time}]  
  
Out[4]=
```

TimeSeries [ Time: 10 Feb 2018 to 12 Dec 2018]
Data points: 304


```
In[5]:= pso = DateListPlot[tsso, PlotLegends -> {"offset", "slope"}]  
  
Out[5]=
```

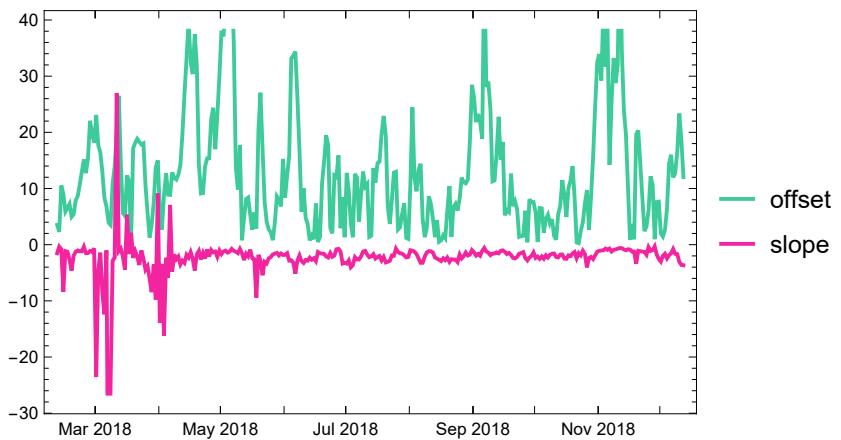


Table of daily covariance parameters

MatrixForm is ready for file export

```
In[1]:= dlabels = Prepend[Drop[outlabels, 2], "date"]  
  
Out[1]= {date, c-exCO2, c-exO2, stretch, width, offset, slope}  
  
In[2]:= dcovpar =  
Prepend[Transpose[{time, cexCO2d, cexO2d, stretchd, widthd, offsetd, sloped}],  
dlabels] // MatrixForm  
  
Out[2]//MatrixForm=
```

date	c-exCO2	c-exO2	stretch	width	offset	slope
Sat 10 Feb 2018 12:00:00 GMT+1	20.0753	-15.0822	10.104	4.81082	3.53061	-1.51756
Sun 11 Feb 2018 12:00:00 GMT+1	21.7374	-24.947	27.1694	6.95606	2.2695	-0.338289
Mon 12 Feb 2018 12:00:00 GMT+1	22.5487	-37.4429	19.4109	4.15069	10.5318	-0.803837
Tue 13 Feb 2018 12:00:00 GMT+1	13.8439	-26.6393	17.4149	3.13678	9.04776	-8.37391
Wed 14 Feb 2018 12:00:00 GMT+1	21.7325	-30.0642	29.1162	2.36913	5.89146	-1.13912
Thu 15 Feb 2018 12:00:00 GMT+1	12.4133	-21.6343	27.6728	4.43219	6.52027	-1.25945
Fri 16 Feb 2018 12:00:00 GMT+1	12.7849	-23.0186	8.09225	2.16076	7.2363	-2.68557
Sat 17 Feb 2018 12:00:00 GMT+1	12.7439	-19.741	13.0312	3.37453	4.94772	-4.60711

Sun 18 Feb 2018 12:00:00 GMT+1	13.0429	-20.6497	9.83283	2.3137	5.37881	-1.97585
Mon 19 Feb 2018 12:00:00 GMT+1	13.0327	-24.1888	15.7511	3.16416	7.88855	-1.25865
Tue 20 Feb 2018 12:00:00 GMT+1	17.9342	-30.1444	14.8567	4.19915	8.63391	-1.02325
Wed 21 Feb 2018 12:00:00 GMT+1	15.8914	-31.0587	20.5155	3.38728	10.7249	-1.18195
Thu 22 Feb 2018 12:00:00 GMT+1	10.2269	-28.6059	11.4903	2.6717	12.9959	-1.18552
Fri 23 Feb 2018 12:00:00 GMT+1	7.92941	-29.374	9.08758	5.46883	15.1636	-0.367089
Sat 24 Feb 2018 12:00:00 GMT+1	12.0932	-30.1051	7.77807	2.4175	12.7363	-1.50583
Sun 25 Feb 2018 12:00:00 GMT+1	11.8712	-33.6876	11.0929	3.8549	15.4265	-1.4854
Mon 26 Feb 2018 12:00:00 GMT+1	13.9785	-45.1714	37.3713	6.2611	22.0567	-1.10932
Tue 27 Feb 2018 12:00:00 GMT+1	12.8751	-40.6827	60.7842	4.4317	19.6629	-1.28025
Wed 28 Feb 2018 12:00:00 GMT+1	2.09305	-27.7793	10.5432	5.07555	18.1629	-0.655781
Thu 1 Mar 2018 12:00:00 GMT+1	1.13246	-33.7741	11.711	3.78509	23.0811	-23.5569
Fri 2 Mar 2018 12:00:00 GMT+1	1.46849	-26.4864	6.71564	0.967113	17.6903	-4.5732
Sat 3 Mar 2018 12:00:00 GMT+1	4.44075	-27.6973	6.626	2.88602	16.4449	-1.42268
Sun 4 Mar 2018 12:00:00 GMT+1	5.89113	-24.1484	7.29316	2.11112	12.9098	-8.53941
Mon 5 Mar 2018 12:00:00 GMT+1	4.53653	-16.3488	8.36204	4.00254	8.35252	-12.3929
Tue 6 Mar 2018 12:00:00 GMT+1	6.97978	-16.5826	8.75394	1.737	6.79022	-1.01929
Wed 7 Mar 2018 12:00:00 GMT+1	10.1856	-15.727	13.1952	6.56947	3.91838	-56.2638
Thu 8 Mar 2018 12:00:00 GMT+1	10.9204	-5.94082	16.5423	8.50942	3.52108	-24.7611
Fri 9 Mar 2018 12:00:00 GMT+1	5.80954	9.53752	23.119	5.60968	10.852	-2.84153
Sat 10 Mar 2018 12:00:00 GMT+1	9.84882	9.907	21.2417	7.58475	13.9695	-2.29276
Sun 11 Mar 2018 12:00:00 GMT+1	13.5184	14.8811	15.8012	10.0127	20.0814	27.0013
Mon 12 Mar 2018 12:00:00 GMT+1	21.4906	15.9922	19.4831	6.97449	26.5043	-1.17918
Tue 13 Mar 2018 12:00:00 GMT+1	23.2376	-2.88998	16.3222	12.4678	14.388	-0.728591
Wed 14 Mar 2018 12:00:00 GMT+1	18.6066	-10.6399	12.1296	4.01235	5.63326	-2.12247
Thu 15 Mar 2018 12:00:00 GMT+1	22.1968	-14.9884	16.6054	6.15338	5.09717	-4.47428
Fri 16 Mar 2018 12:00:00 GMT+1	26.9941	-9.51853	20.23	11.5075	12.3571	5.3483
Sat 17 Mar 2018 12:00:00 GMT+1	25.796	-9.87178	18.7476	6.02122	11.2601	-1.67457
Sun 18 Mar 2018 12:00:00 GMT+1	33.1714	-33.9369	23.1445	13.9076	0.541295	2.11996
Mon 19 Mar 2018 12:00:00 GMT+1	24.3649	-48.6339	14.7434	3.50516	17.1608	-2.356
Tue 20 Mar 2018 12:00:00 GMT+1	18.9209	-44.5753	12.1181	3.04947	18.1404	-1.14398
Wed 21 Mar 2018 12:00:00 GMT+1	15.8475	-42.4872	14.243	2.80383	18.8371	-2.11703
Thu 22 Mar 2018 12:00:00 GMT+1	17.7658	-43.5935	14.7572	4.42398	18.263	-3.60079
Fri 23 Mar 2018 12:00:00 GMT+1	10.1188	-35.3486	21.4806	2.10606	17.8402	-1.01766
Sat 24 Mar 2018 12:00:00 GMT+1	11.01	-36.5249	16.2987	7.18467	18.0418	-2.45335
Sun 25 Mar 2018 12:00:00 GMT+1	13.0599	-28.0284	24.9355	7.19803	10.5843	-4.43709
Mon 26 Mar 2018 12:00:00 GMT+1	7.44098	-15.5807	16.4447	1.95402	5.75566	-3.84213
Tue 27 Mar 2018 12:00:00 GMT+1	7.38198	-9.17054	14.9315	4.78558	1.2647	-6.03849
Wed 28 Mar 2018 12:00:00 GMT+1	10.1883	-5.28152	20.5601	3.13446	3.46962	-8.44694
Thu 29 Mar 2018 12:00:00 GMT+1	15.6378	-5.06311	15.6647	9.21505	7.47744	-3.52592
Fri 30 Mar 2018 12:00:00 GMT+1	17.4578	2.00356	24.6557	5.86061	13.7612	-9.75413
Sat 31 Mar 2018 12:00:00 GMT+1	18.6233	2.61264	13.4326	6.06697	15.0161	9.10096

Sun 1 Apr 2018 12:00:00 GMT+1	18.4466	-9.96	11.2679	5.75791	6.00091	-13.8925
Mon 2 Apr 2018 12:00:00 GMT+1	21.159	-17.3499	22.6009	4.44237	2.69347	-3.41791
Tue 3 Apr 2018 12:00:00 GMT+1	26.0963	-13.6653	27.7012	7.3329	8.79008	-16.1828
Wed 4 Apr 2018 13:30:00 GMT+1	28.2599	-10.2587	35.271	4.73977	12.7288	-2.32509
Thu 5 Apr 2018 12:00:00 GMT+1	21.1555	-8.57447	23.3543	3.71862	8.89612	-5.9167
Fri 6 Apr 2018 12:00:00 GMT+1	26.0455	-13.5167	18.7374	7.55889	8.85917	7.08237
Sat 7 Apr 2018 12:00:00 GMT+1	30.5486	-12.3775	22.0633	7.66767	12.8489	-4.83227
Sun 8 Apr 2018 12:00:00 GMT+1	31.2619	-14.4337	37.2796	4.01692	11.8993	-1.75105
Mon 9 Apr 2018 12:00:00 GMT+1	32.8963	-16.502	30.8144	4.02466	11.5925	-2.61015
Tue 10 Apr 2018 12:00:00 GMT+1	27.7588	-10.1378	33.0995	9.27507	12.46	-2.13148
Wed 11 Apr 2018 12:00:00 GMT+1	31.345	-11.3045	34.9439	6.78554	14.1708	-3.51424
Thu 12 Apr 2018 12:00:00 GMT+1	31.9594	-4.01756	30.4608	10.3428	19.7579	-2.83993
Fri 13 Apr 2018 12:00:00 GMT+1	38.1179	-0.134211	42.0705	8.98061	26.8585	-3.24143
Sat 14 Apr 2018 12:00:00 GMT+1	52.1652	-5.27737	51.4403	9.43552	33.1547	-1.81974
Sun 15 Apr 2018 12:00:00 GMT+1	59.1431	-3.11124	37.9749	8.88847	39.6205	-2.30786
Mon 16 Apr 2018 12:00:00 GMT+1	60.6356	-14.7769	38.8696	5.92389	32.427	-1.33284
Tue 17 Apr 2018 12:00:00 GMT+1	64.8295	-21.8807	44.751	14.9979	30.3694	-2.5096
Wed 18 Apr 2018 12:00:00 GMT+1	77.9769	-25.0152	32.6987	10.6118	37.4496	-4.60628
Thu 19 Apr 2018 12:00:00 GMT+1	75.7064	-30.5824	27.1044	10.6992	31.9074	-1.70604
Fri 20 Apr 2018 12:00:00 GMT+1	59.2401	-38.8342	50.4454	12.0352	14.4292	-1.10237
Sat 21 Apr 2018 12:00:00 GMT+1	49.5319	-36.6408	43.1351	16.9482	9.11532	-2.63212
Sun 22 Apr 2018 12:00:00 GMT+1	58.1619	-45.1731	63.5933	10.0241	9.18449	-1.49813
Mon 23 Apr 2018 12:00:00 GMT+1	55.1115	-35.513	51.8615	12.9906	13.8583	-2.4641
Tue 24 Apr 2018 12:00:00 GMT+1	70.3984	-48.6798	33.9082	13.8062	15.3573	-0.825953
Wed 25 Apr 2018 12:00:00 GMT+1	58.6886	-36.9264	56.0447	12.808	15.3882	-2.11118
Thu 26 Apr 2018 12:00:00 GMT+1	76.057	-44.5087	39.2963	23.1708	22.308	-0.928332
Fri 27 Apr 2018 12:00:00 GMT+1	73.4261	-38.9534	59.9596	13.2432	24.3758	-1.36348
Sat 28 Apr 2018 12:00:00 GMT+1	70.5177	-46.467	42.915	22.4493	17.0064	-1.22112
Sun 29 Apr 2018 12:00:00 GMT+1	84.5367	-51.7381	49.5907	21.8172	23.1921	-2.15751
Mon 30 Apr 2018 12:00:00 GMT+1	103.914	-61.5937	56.2142	23.7068	29.9253	-1.03154
Tue 1 May 2018 12:00:00 GMT+1	130.896	-77.0611	55.4167	20.2835	38.067	-1.68757
Wed 2 May 2018 12:00:00 GMT+1	101.878	-49.4408	80.5307	19.5401	37.0784	-1.20423
Thu 3 May 2018 12:00:00 GMT+1	138.617	-79.6874	61.3391	27.0855	41.6694	-1.05531
Fri 4 May 2018 12:00:00 GMT+1	145.387	-76.2478	89.448	16.3571	48.8887	-1.42141
Sat 5 May 2018 12:00:00 GMT+1	151.885	-78.1556	88.1971	16.7417	52.1347	-1.24965
Sun 6 May 2018 12:00:00 GMT+1	154.554	-87.4822	72.9785	13.4005	47.4268	-0.741365
Mon 7 May 2018 12:00:00 GMT+1	123.047	-72.0427	78.1401	12.7015	36.0653	-1.09457
Tue 8 May 2018 12:00:00 GMT+1	101.36	-81.81	38.4373	9.21565	13.8239	-1.25507
Wed 9 May 2018 12:00:00 GMT+1	90.5789	-76.6725	57.6351	26.9782	9.83329	-1.50946
Thu 10 May 2018 12:00:00 GMT+1	147.652	-122.56	266.945	20.038	17.7425	-0.759868
Fri 11 May 2018 12:00:00 GMT+1	65.0895	-63.982	89.6525	18.9694	0.783131	-1.51936
Sat 12 May 2018 12:00:00 GMT+1	56.6244	-63.2768	44.9728	12.7532	4.70392	-2.73811

Sun 13 May 2018 12:00:00 GMT+1	65.4763	-76.9949	49.1208	13.9377	8.14491	-1.61223
Mon 14 May 2018 12:00:00 GMT+1	61.1846	-73.0482	45.9584	16.2866	8.38882	-2.08093
Tue 15 May 2018 12:00:00 GMT+1	55.9104	-63.5403	53.8902	18.7283	5.39517	-0.878963
Wed 16 May 2018 12:00:00 GMT+1	43.6716	-47.4144	44.4476	11.0224	2.64654	-2.41468
Thu 17 May 2018 12:00:00 GMT+1	48.6318	-56.7646	43.2784	15.5439	5.75073	-2.56337
Fri 18 May 2018 12:00:00 GMT+1	56.5239	-60.5952	52.1955	14.1066	2.87883	-9.40613
Sat 19 May 2018 12:00:00 GMT+1	54.5317	-83.3405	27.8695	8.05796	20.3709	-1.81208
Sun 20 May 2018 12:00:00 GMT+1	54.9957	-93.2599	27.4738	9.37155	27.0569	-2.77993
Mon 21 May 2018 12:00:00 GMT+1	58.5729	-82.9707	49.8203	26.475	17.2519	-5.44875
Tue 22 May 2018 12:00:00 GMT+1	53.0342	-64.0354	62.1582	22.4794	7.77901	-3.06553
Wed 23 May 2018 12:00:00 GMT+1	52.4185	-58.3265	72.8605	12.378	4.17759	-3.35427
Thu 24 May 2018 12:00:00 GMT+1	57.3917	-61.2438	66.6918	16.7318	2.72385	-2.42982
Fri 25 May 2018 12:00:00 GMT+1	70.1385	-73.2691	65.3927	15.4338	2.21373	-2.21948
Sat 26 May 2018 12:00:00 GMT+1	82.2771	-81.1581	58.3072	22.0514	0.791225	-1.73648
Sun 27 May 2018 12:00:00 GMT+1	75.9727	-81.5019	90.995	18.9884	3.90975	-1.59072
Mon 28 May 2018 12:00:00 GMT+1	92.8316	-105.009	118.726	15.8501	8.61104	-1.45861
Tue 29 May 2018 12:00:00 GMT+1	76.0047	-87.372	90.0742	18.1794	8.03795	-1.91696
Wed 30 May 2018 12:00:00 GMT+1	75.3181	-84.9479	92.3871	16.6557	6.80935	-1.57101
Thu 31 May 2018 12:00:00 GMT+1	53.4363	-75.0337	95.333	10.4952	15.2717	-1.83967
Fri 1 Jun 2018 12:00:00 GMT+1	51.7157	-63.6051	61.7659	30.9068	8.40706	-1.79426
Sat 2 Jun 2018 12:00:00 GMT+1	76.463	-93.9461	133.973	22.0726	12.3624	-1.51321
Sun 3 Jun 2018 12:00:00 GMT+1	31.226	-53.639	79.2198	5.75958	15.8483	-2.82917
Mon 4 Jun 2018 12:00:00 GMT+1	37.1104	-84.0021	24.4223	3.95784	33.1575	-2.77266
Tue 5 Jun 2018 12:00:00 GMT+1	39.0119	-86.6482	67.9763	5.88771	33.684	-3.18195
Wed 6 Jun 2018 12:00:00 GMT+1	40.6908	-89.2941	41.9356	10.7473	34.3677	-5.16296
Thu 7 Jun 2018 12:00:00 GMT+1	39.4238	-76.249	73.635	21.9357	26.0394	-2.86118
Fri 8 Jun 2018 12:00:00 GMT+1	69.4411	-93.2378	153.773	8.4281	16.8268	-1.9231
Sat 9 Jun 2018 12:00:00 GMT+1	34.5322	-42.871	99.8984	4.38813	5.89648	-2.9358
Sun 10 Jun 2018 12:00:00 GMT+1	39.6447	-53.8637	92.7664	8.18769	10.0544	-3.25397
Mon 11 Jun 2018 12:00:00 GMT+1	44.0817	-50.8528	115.321	8.70516	4.7879	-2.7193
Tue 12 Jun 2018 12:00:00 GMT+1	42.4687	-47.6938	105.475	4.86443	3.69467	-2.84726
Wed 13 Jun 2018 12:00:00 GMT+1	45.1455	-46.2237	110.221	8.30579	0.762415	-2.31333
Thu 14 Jun 2018 12:00:00 GMT+1	46.3185	-44.0132	110.657	8.06478	1.63014	-2.69283
Fri 15 Jun 2018 12:00:00 GMT+1	45.9608	-44.578	95.8228	5.65923	0.977831	-2.42002
Sat 16 Jun 2018 12:00:00 GMT+1	37.0248	-26.6728	117.809	9.43243	7.32001	-2.92985
Sun 17 Jun 2018 12:00:00 GMT+1	96.193	-95.5294	83.4096	8.19359	0.469265	-1.30791
Mon 18 Jun 2018 12:00:00 GMT+1	83.8612	-81.9273	170.539	18.7578	1.36748	-1.52852
Tue 19 Jun 2018 12:00:00 GMT+1	80.4972	-65.0479	150.553	23.6386	10.9243	-1.58251
Wed 20 Jun 2018 12:00:00 GMT+1	68.0084	-47.0182	138.235	12.1462	14.8424	-1.64201
Thu 21 Jun 2018 12:00:00 GMT+1	43.8812	-16.3169	116.921	11.4568	19.4909	-2.09882
Fri 22 Jun 2018 12:00:00 GMT+1	36.6084	-11.6953	90.4356	10.1589	17.6162	-2.28007
Sat 23 Jun 2018 12:00:00 GMT+1	55.9773	-60.2387	63.4303	10.4526	3.01323	-1.49105

Sun 24 Jun 2018 12:00:00 GMT+1	70.13	-67.2728	123.272	26.2813	2.02037	-2.16086
Mon 25 Jun 2018 12:00:00 GMT+1	48.1486	-30.7287	120.11	11.8386	12.3177	-1.93044
Tue 26 Jun 2018 12:00:00 GMT+1	81.8366	-64.816	136.053	33.3973	12.0354	-0.824864
Wed 27 Jun 2018 12:00:00 GMT+1	134.016	-111.526	58.312	31.2716	15.9024	-0.740015
Thu 28 Jun 2018 12:00:00 GMT+1	71.7104	-67.5689	187.272	19.0452	2.9285	-1.21999
Fri 29 Jun 2018 12:00:00 GMT+1	15.558	-3.5916	72.7897	4.17415	8.46153	-3.35661
Sat 30 Jun 2018 12:00:00 GMT+1	17.8823	-19.763	70.1657	3.10285	1.32981	-3.22448
Sun 1 Jul 2018 12:00:00 GMT+1	23.4475	-41.5151	94.6894	6.95675	12.7757	-3.36671
Mon 2 Jul 2018 12:00:00 GMT+1	27.8435	-41.5454	130.86	12.0369	9.68872	-2.80282
Tue 3 Jul 2018 12:00:00 GMT+1	15.5491	-10.2382	78.7845	8.07488	3.75535	-4.02388
Wed 4 Jul 2018 12:00:00 GMT+1	17.7844	-19.6485	105.867	7.6281	1.31812	-3.65036
Thu 5 Jul 2018 12:00:00 GMT+1	29.7405	-47.5649	102.114	9.56521	12.6038	-2.22768
Fri 6 Jul 2018 12:00:00 GMT+1	31.5553	-48.46	110.163	8.05876	11.9534	-2.63279
Sat 7 Jul 2018 12:00:00 GMT+1	30.5202	-36.2974	127.47	8.7144	4.08513	-2.63935
Sun 8 Jul 2018 12:00:00 GMT+1	36.1233	-48.9122	72.7749	8.81429	9.04316	-2.07389
Mon 9 Jul 2018 12:00:00 GMT+1	61.4048	-79.8047	106.532	24.8212	13.0107	-1.21696
Tue 10 Jul 2018 12:00:00 GMT+1	82.2079	-96.8187	119.922	16.3581	10.3314	-1.10164
Wed 11 Jul 2018 12:00:00 GMT+1	59.2185	-74.5039	122.041	11.78	10.8085	-1.76511
Thu 12 Jul 2018 12:00:00 GMT+1	37.987	-39.9429	118.475	9.10782	1.38306	-2.22464
Fri 13 Jul 2018 12:00:00 GMT+1	30.2695	-32.5353	83.7028	5.71694	1.60215	-2.06055
Sat 14 Jul 2018 12:00:00 GMT+1	45.2849	-64.5525	108.421	8.38429	13.6242	-1.68468
Sun 15 Jul 2018 12:00:00 GMT+1	32.9938	-48.627	91.7828	7.23992	11.0544	-2.47012
Mon 16 Jul 2018 12:00:00 GMT+1	30.5564	-51.0625	70.8417	5.41681	14.5	-2.19245
Tue 17 Jul 2018 12:00:00 GMT+1	32.7731	-53.6819	100.515	9.60546	14.7847	-2.00749
Wed 18 Jul 2018 12:00:00 GMT+1	29.4761	-57.4467	60.9341	6.94301	19.7782	-2.80028
Thu 19 Jul 2018 12:00:00 GMT+1	38.2504	-70.6363	70.0088	8.4601	22.9003	-2.17852
Fri 20 Jul 2018 13:15:00 GMT+1	34.6067	-61.9628	85.8748	10.6399	19.3437	-3.16402
Sat 21 Jul 2018 12:00:00 GMT+1	27.9187	-37.615	101.485	4.59221	6.85632	-3.04313
Sun 22 Jul 2018 12:00:00 GMT+1	28.24	-33.4549	109.838	5.46803	3.68748	-2.8788
Mon 23 Jul 2018 12:00:00 GMT+1	36.5214	-47.8756	82.5163	8.87599	8.02867	-1.91986
Tue 24 Jul 2018 12:00:00 GMT+1	39.769	-57.9233	88.1132	7.54232	12.837	-1.97182
Wed 25 Jul 2018 12:00:00 GMT+1	100.735	-119.085	87.1087	18.5979	12.9752	-0.705378
Thu 26 Jul 2018 12:00:00 GMT+1	114.275	-118.091	122.709	12.7613	2.69817	-1.29492
Fri 27 Jul 2018 12:00:00 GMT+1	64.042	-68.4078	109.135	8.19089	3.08709	-1.52982
Sat 28 Jul 2018 12:00:00 GMT+1	51.3312	-59.0926	79.1776	8.12106	5.48814	-1.59297
Sun 29 Jul 2018 12:00:00 GMT+1	43.2775	-53.6871	118.94	12.5353	7.36071	-1.89236
Mon 30 Jul 2018 12:00:00 GMT+1	40.0698	-41.7581	103.877	12.0994	1.1938	-2.26248
Tue 31 Jul 2018 12:00:00 GMT+1	42.2541	-40.7967	90.3541	11.4528	1.03055	-2.18317
Wed 1 Aug 2018 12:00:00 GMT+1	55.1394	-40.189	112.113	39.0192	10.5715	-0.990102
Thu 2 Aug 2018 12:00:00 GMT+1	136.731	-102.099	154.607	17.9542	24.4885	-1.05295
Fri 3 Aug 2018 12:00:00 GMT+1	86.048	-69.0971	141.651	13.7847	11.9861	-1.24479
Sat 4 Aug 2018 12:00:00 GMT+1	62.6886	-49.2555	131.522	9.55201	9.49865	-1.67254

Sat 4 Aug 2018 12:00:00 GMT+1	102.271	77.51	175.851	9.92022	12.9881	9.99997
Sun 5 Aug 2018 12:00:00 GMT+1	37.1012	-18.2371	118.862	9.95678	13.3389	-2.43076
Mon 6 Aug 2018 12:00:00 GMT+1	22.6292	-2.2634	94.4384	8.72698	14.4008	-3.23189
Tue 7 Aug 2018 12:00:00 GMT+1	25.3229	-18.8415	85.5488	6.15081	4.58309	-3.22073
Wed 8 Aug 2018 12:00:00 GMT+1	47.6115	-49.502	101.791	15.2611	1.3368	-2.13835
Thu 9 Aug 2018 12:00:00 GMT+1	58.9506	-54.8276	124.777	29.8802	2.91539	-1.39392
Fri 10 Aug 2018 12:00:00 GMT+1	90.7053	-78.5328	139.758	25.4369	8.60729	-1.14895
Sat 11 Aug 2018 12:00:00 GMT+1	82.7375	-72.4542	195.767	20.0501	7.27141	-1.18147
Sun 12 Aug 2018 12:00:00 GMT+1	62.3929	-55.8995	135.392	11.2496	4.59153	-1.4
Mon 13 Aug 2018 12:00:00 GMT+1	34.9011	-36.8004	100.495	9.67759	1.34298	-2.27967
Tue 14 Aug 2018 12:00:00 GMT+1	38.4667	-44.6679	101.65	11.6871	4.38493	-2.48655
Wed 15 Aug 2018 12:00:00 GMT+1	29.246	-28.5221	78.8028	5.60705	0.511873	-2.67414
Thu 16 Aug 2018 12:00:00 GMT+1	28.895	-29.9731	85.3815	4.82838	0.762341	-2.91771
Fri 17 Aug 2018 12:00:00 GMT+1	34.666	-37.0089	87.5774	6.65322	1.65669	-2.43199
Sat 18 Aug 2018 12:00:00 GMT+1	39.3235	-40.9415	90.7414	13.8279	1.14408	-2.7611
Sun 19 Aug 2018 12:00:00 GMT+1	34.4412	-25.8764	125.985	11.262	6.05626	-2.29149
Mon 20 Aug 2018 13:15:00 GMT+1	23.7666	-9.01305	102.751	18.2047	10.4324	-3.05421
Tue 21 Aug 2018 12:00:00 GMT+1	29.4562	-31.4002	91.917	9.78787	1.3746	-2.58032
Wed 22 Aug 2018 12:00:00 GMT+1	29.8544	-20.3924	79.9062	7.47867	6.69064	-2.63103
Thu 23 Aug 2018 12:00:00 GMT+1	29.7599	-19.4808	91.5292	6.91554	7.26843	-2.66874
Fri 24 Aug 2018 12:00:00 GMT+1	28.4141	-19.814	100.265	9.21871	6.08124	-3.09075
Sat 25 Aug 2018 12:00:00 GMT+1	49.6043	-38.0381	103.131	26.1476	8.1785	-1.74417
Sun 26 Aug 2018 12:00:00 GMT+1	32.9418	-16.0576	89.0247	12.6773	11.939	-2.44412
Mon 27 Aug 2018 12:00:00 GMT+1	47.5467	-31.852	72.7871	10.2662	11.0978	-2.03732
Tue 28 Aug 2018 12:00:00 GMT+1	60.5589	-45.1218	119.635	17.4763	10.9157	-1.39846
Wed 29 Aug 2018 12:00:00 GMT+1	56.1522	-39.7434	86.1854	14.5378	11.6027	-1.9231
Thu 30 Aug 2018 12:00:00 GMT+1	57.6106	-31.471	128.136	11.1026	18.4835	-1.75942
Fri 31 Aug 2018 12:00:00 GMT+1	75.7271	-35.4797	113.016	34.0194	28.4592	-0.961534
Sat 1 Sep 2018 12:00:00 GMT+1	56.3915	-19.3088	91.3265	13.7857	26.2214	-1.34676
Sun 2 Sep 2018 12:00:00 GMT+1	53.4244	-22.558	96.8764	15.5932	21.8258	-1.94021
Mon 3 Sep 2018 12:00:00 GMT+1	51.3434	-18.4725	95.3666	13.1412	23.2432	-1.64933
Tue 4 Sep 2018 12:00:00 GMT+1	48.5328	-17.6823	124.578	12.1951	21.8146	-1.96065
Wed 5 Sep 2018 12:00:00 GMT+1	67.0635	-40.4054	82.564	14.6467	18.8501	-1.09902
Thu 6 Sep 2018 12:00:00 GMT+1	170.501	-98.1064	189.201	32.4395	51.1909	-0.573788
Fri 7 Sep 2018 12:00:00 GMT+1	95.0961	-55.4192	131.119	17.2511	28.0558	-1.22064
Sat 8 Sep 2018 12:00:00 GMT+1	68.3839	-27.3527	108.353	14.2354	29.0135	-1.4176
Sun 9 Sep 2018 12:00:00 GMT+1	57.2386	-23.1814	76.6961	20.0297	24.0821	-1.86413
Mon 10 Sep 2018 12:00:00 GMT+1	53.071	-37.1137	64.4837	6.7881	11.2835	-1.56397
Tue 11 Sep 2018 12:00:00 GMT+1	80.846	-64.6799	69.3544	7.07972	11.4312	-1.57037
Wed 12 Sep 2018 12:00:00 GMT+1	74.6245	-51.7068	112.971	6.4621	16.2053	-1.36824
Thu 13 Sep 2018 12:00:00 GMT+1	44.1264	-11.9325	125.607	15.0536	22.7645	-1.53945
Fri 14 Sep 2018 12:00:00 GMT+1	70.6623	-49.3114	78.4893	6.64888	15.0973	-1.09509
Sat 15 Sep 2018 12:00:00 GMT+1	102.271	77.51	175.851	9.92022	12.9881	9.99997

Sat 15 Sep 2018 12:00:00 GMT+1	103.374	-11.31	17.0.051	0.00023	10.2004	-0.000001
Sun 16 Sep 2018 12:00:00 GMT+1	58.7747	-51.3708	62.2962	6.45953	5.23537	-1.25112
Mon 17 Sep 2018 12:00:00 GMT+1	50.33	-41.6989	88.3828	6.57103	6.10309	-1.67051
Tue 18 Sep 2018 12:00:00 GMT+1	54.6266	-46.4441	110.775	10.354	5.78591	-1.46511
Wed 19 Sep 2018 13:15:00 GMT+1	54.1108	-36.2342	102.876	25.4936	12.6407	-1.8257
Thu 20 Sep 2018 12:00:00 GMT+1	29.7277	-20.0093	80.2519	4.53159	6.87201	-2.35441
Fri 21 Sep 2018 12:00:00 GMT+1	30.9529	-20.0813	60.9283	5.49172	7.68743	-2.43924
Sat 22 Sep 2018 12:00:00 GMT+1	41.633	-32.7194	76.8463	8.26047	6.30282	-2.17018
Sun 23 Sep 2018 12:00:00 GMT+1	46.7428	-44.7937	51.6701	3.70443	1.37824	-1.5933
Mon 24 Sep 2018 12:00:00 GMT+1	72.5355	-70.3819	96.7185	8.43637	1.52278	-1.47998
Tue 25 Sep 2018 12:00:00 GMT+1	51.2601	-53.5062	81.3139	7.15722	1.5882	-1.32727
Wed 26 Sep 2018 12:00:00 GMT+1	41.7145	-50.254	53.0577	5.21261	6.03836	-2.39357
Thu 27 Sep 2018 12:00:00 GMT+1	47.4737	-46.8815	62.2382	11.4619	0.418747	-2.79739
Fri 28 Sep 2018 12:00:00 GMT+1	43.9118	-32.4738	50.1108	7.88447	8.0879	-2.30107
Sat 29 Sep 2018 12:00:00 GMT+1	50.0165	-39.4093	40.8877	7.5987	7.5004	-2.00806
Sun 30 Sep 2018 12:00:00 GMT+1	34.444	-45.1503	40.9075	11.1359	7.57048	-1.38007
Mon 1 Oct 2018 12:00:00 GMT+1	36.3979	-44.5609	35.8428	9.06112	5.77208	-2.36556
Tue 2 Oct 2018 12:00:00 GMT+1	49.9917	-50.6566	61.7914	3.86043	0.470171	-2.11296
Wed 3 Oct 2018 12:00:00 GMT+1	52.301	-43.0812	55.6728	7.8044	6.51938	-2.52755
Thu 4 Oct 2018 12:00:00 GMT+1	50.5649	-41.4194	64.6654	6.69896	6.46682	-2.09836
Fri 5 Oct 2018 12:00:00 GMT+1	52.137	-49.0931	37.8767	5.57369	2.15234	-2.50302
Sat 6 Oct 2018 12:00:00 GMT+1	54.6149	-48.076	57.8745	6.99392	4.6237	-1.89088
Sun 7 Oct 2018 12:00:00 GMT+1	58.4351	-50.8958	40.8526	6.85216	5.33107	-2.29188
Mon 8 Oct 2018 12:00:00 GMT+1	57.6543	-52.3296	51.9333	9.55368	3.76511	-1.80863
Tue 9 Oct 2018 12:00:00 GMT+1	57.3829	-51.0052	42.2524	6.85265	4.50966	-1.61461
Wed 10 Oct 2018 12:00:00 GMT+1	52.3255	-54.5585	30.3425	5.85583	1.57896	-1.56827
Thu 11 Oct 2018 12:00:00 GMT+1	50.2984	-49.0439	48.542	5.90976	0.887107	-2.18229
Fri 12 Oct 2018 12:00:00 GMT+1	51.0985	-43.3951	49.9605	2.891	5.44709	-2.26387
Sat 13 Oct 2018 12:00:00 GMT+1	48.1883	-38.4107	51.9726	9.9062	6.91387	-1.76815
Sun 14 Oct 2018 12:00:00 GMT+1	55.5471	-39.2986	64.1416	12.6287	11.4894	-1.75059
Mon 15 Oct 2018 13:15:00 GMT+1	42.6147	-30.262	41.5398	7.58692	8.73466	-2.4898
Tue 16 Oct 2018 12:00:00 GMT+1	37.5959	-30.6235	58.6665	9.33976	4.93024	-2.52002
Wed 17 Oct 2018 12:00:00 GMT+1	46.3816	-32.1282	70.7815	8.09455	10.0786	-1.90407
Thu 18 Oct 2018 12:00:00 GMT+1	47.6042	-31.4683	63.8175	9.49883	11.4098	-2.0578
Fri 19 Oct 2018 12:00:00 GMT+1	57.3955	-37.6318	58.6984	5.28383	13.9751	-1.56447
Sat 20 Oct 2018 12:00:00 GMT+1	65.6207	-53.7426	40.8405	6.97908	8.39908	-1.31041
Sun 21 Oct 2018 12:00:00 GMT+1	67.7449	-67.1798	24.4848	5.59519	0.399614	-2.40869
Mon 22 Oct 2018 12:00:00 GMT+1	68.5889	-68.9638	47.4163	11.1353	0.265123	-1.49909
Tue 23 Oct 2018 12:00:00 GMT+1	69.3825	-65.9129	51.6971	8.81689	2.45337	-1.89253
Wed 24 Oct 2018 12:00:00 GMT+1	50.4775	-56.0794	58.0022	7.92087	3.96118	-1.07845
Thu 25 Oct 2018 12:00:00 GMT+1	37.2793	-47.5705	61.6078	6.40537	7.27698	-1.64517
Fri 26 Oct 2018 12:00:00 GMT+1	42.2057	-55.9224	29.923	9.81841	9.69918	-4.0525
Sat 27 Oct 2018 12:00:00 GMT+1	51.1607	-47.2626	42.2712	12.1042	2.60125	-2.25770

Sat 27 Oct 2018 12:00:00 GMT+1	51.1001	-41.9040	42.2110	15.1042	2.0910	-2.0010
Sun 28 Oct 2018 12:00:00 GMT+1	41.3899	-29.3598	57.5667	2.29596	8.50657	-2.17156
Mon 29 Oct 2018 12:00:00 GMT+1	46.4591	-24.5148	45.8006	6.10522	15.517	-2.56422
Tue 30 Oct 2018 12:00:00 GMT+1	68.3869	-33.6647	42.9761	11.069	24.5523	-1.91076
Wed 31 Oct 2018 12:00:00 GMT+1	83.3071	-37.44	49.8091	2.65281	32.4329	-1.25549
Thu 1 Nov 2018 12:00:00 GMT+1	86.2367	-38.2551	29.9349	5.94068	33.9281	-1.10254
Fri 2 Nov 2018 12:00:00 GMT+1	102.519	-61.1789	66.7987	9.77252	29.2316	-1.03053
Sat 3 Nov 2018 12:00:00 GMT+1	147.935	-88.6135	110.06	20.4926	41.9468	-1.00839
Sun 4 Nov 2018 12:00:00 GMT+1	113.865	-69.0236	115.579	14.1708	31.7076	-0.702748
Mon 5 Nov 2018 12:00:00 GMT+1	130.834	-75.2929	87.9455	17.6137	39.2732	-0.929913
Tue 6 Nov 2018 12:00:00 GMT+1	86.2241	-66.12	37.2391	9.39862	14.2158	-0.693767
Wed 7 Nov 2018 12:00:00 GMT+1	111.319	-75.465	48.466	14.7659	25.3526	-1.21667
Thu 8 Nov 2018 12:00:00 GMT+1	125.802	-78.8047	48.677	11.0083	33.2319	-0.91934
Fri 9 Nov 2018 12:00:00 GMT+1	121.881	-81.1863	35.4411	11.5297	28.7755	-0.836773
Sat 10 Nov 2018 12:00:00 GMT+1	144.098	-98.7287	65.1528	14.8164	32.0809	-0.712717
Sun 11 Nov 2018 12:00:00 GMT+1	187.069	-106.18	120.612	29.8134	57.1977	-0.591998
Mon 12 Nov 2018 12:00:00 GMT+1	118.996	-70.1128	53.2438	8.18051	34.5654	-0.612605
Tue 13 Nov 2018 12:00:00 GMT+1	95.1295	-61.266	29.2597	6.92478	23.9451	-0.836287
Wed 14 Nov 2018 12:00:00 GMT+1	107.742	-79.9899	29.7291	10.5951	19.6236	-1.00475
Thu 15 Nov 2018 12:00:00 GMT+1	82.59	-68.2297	67.1897	6.77023	10.1543	-0.808018
Fri 16 Nov 2018 12:00:00 GMT+1	44.0396	-42.8274	41.555	5.67765	0.85715	-0.879241
Sat 17 Nov 2018 12:00:00 GMT+1	39.9262	-45.1278	17.0269	3.56718	3.67805	-1.24079
Sun 18 Nov 2018 12:00:00 GMT+1	54.2936	-52.9374	20.7901	13.8126	0.958948	-1.22847
Mon 19 Nov 2018 12:00:00 GMT+1	74.1256	-46.3734	18.4861	14.8841	19.6237	-3.39438
Tue 20 Nov 2018 12:00:00 GMT+1	73.3701	-44.6049	18.0513	5.00732	20.34	-1.08539
Fri 23 Nov 2018 12:00:00 GMT+1	47.0339	-50.4346	29.2276	6.06161	2.40468	-1.297
Sat 24 Nov 2018 12:00:00 GMT+1	60.8973	-56.3302	27.2403	13.6422	3.22939	-1.78901
Sun 25 Nov 2018 12:00:00 GMT+1	53.9149	-45.3033	26.4844	13.8196	6.08936	-0.447456
Mon 26 Nov 2018 12:00:00 GMT+1	55.9268	-38.7277	33.9606	6.40793	12.1616	-1.12604
Tue 27 Nov 2018 12:00:00 GMT+1	47.76	-32.6318	31.8676	6.13775	10.6973	-0.954516
Wed 28 Nov 2018 12:00:00 GMT+1	32.4134	-33.7928	18.4604	5.65739	0.975386	-0.307613
Thu 29 Nov 2018 12:00:00 GMT+1	17.1118	-27.841	15.6497	2.31733	7.5867	-1.76936
Fri 30 Nov 2018 12:00:00 GMT+1	12.2819	-23.1094	7.35682	1.77774	7.65619	-2.55374
Sat 1 Dec 2018 12:00:00 GMT+1	9.18194	-12.0064	23.3884	2.15235	1.99722	-3.01113
Sun 2 Dec 2018 12:00:00 GMT+1	17.2884	-15.2431	13.7145	8.30929	1.44628	-1.98897
Mon 3 Dec 2018 12:00:00 GMT+1	24.8267	-21.1167	20.5205	7.69553	2.6234	-1.61612
Tue 4 Dec 2018 12:00:00 GMT+1	26.2565	-17.1766	28.6031	6.50267	6.42046	-2.44024
Wed 5 Dec 2018 12:00:00 GMT+1	18.2546	2.14248	59.4483	2.43156	14.4229	-1.86997
Thu 6 Dec 2018 12:00:00 GMT+1	8.67324	13.9782	23.6867	4.1737	16.017	-1.5513
Fri 7 Dec 2018 12:00:00 GMT+1	25.035	-8.10089	17.8052	6.22393	11.9742	-0.765498
Sat 8 Dec 2018 12:00:00 GMT+1	31.2604	-13.2793	31.4537	3.09852	12.7146	-1.62141
Sun 9 Dec 2018 12:00:00 GMT+1	9.99083	13.4295	34.4785	4.41594	16.5607	-1.67513

Mon 10 Dec 2018 12:00:00 GMT+1	1.33025	31.6829	23.7421	1.13047	23.3438	-3.06294
Tue 11 Dec 2018 12:00:00 GMT+1	1.82471	24.4728	14.6372	1.59889	18.5951	-3.59961
Wed 12 Dec 2018 12:00:00 GMT+1	2.18261	14.8348	9.1519	4.90641	12.0331	-3.65796

Monthly averages of the 24 - h cycles

developing the analysis procedure for one month

extract June data in the useful format "DatePath"

```
In[=]:= tx1 = tsm[[5]]["DatePath"]
```

```
Out[=]=
```

{ { Fri 1 Jun 2018 00:00:00 GMT+1, {36.7785, -52.7283} }, { Fri 1 Jun 2018 00:15:00 GMT+1, {38.3598, -55.863} },
{ { Fri 1 Jun 2018 00:30:00 GMT+1, {32.8183, -42.7333} }, { Fri 1 Jun 2018 00:45:00 GMT+1, {32.0847, -40.1382} },
{ { Fri 1 Jun 2018 01:00:00 GMT+1, {31.0357, -52.5687} }, { Fri 1 Jun 2018 01:15:00 GMT+1, {39.3971, -58.2093} },
{ { Fri 1 Jun 2018 01:30:00 GMT+1, {38.794, -61.5778} }, { ... 2862 ... },
{ { Sat 30 Jun 2018 22:30:00 GMT+1, {21.3366, -39.6317} }, { Sat 30 Jun 2018 22:45:00 GMT+1, {22.1718, -41.9937} },
{ { Sat 30 Jun 2018 23:00:00 GMT+1, {23.834, -45.8616} }, { Sat 30 Jun 2018 23:15:00 GMT+1, {24.554, -46.5715} },
{ { Sat 30 Jun 2018 23:30:00 GMT+1, {22.6933, -45.8231} }, { Sat 30 Jun 2018 23:45:00 GMT+1, {29.3465, -60.2405} } }

Full expression not available (original memory size: 1.7 MB)



appends the integer "Hour" to the first record

```
In[=]:= tx11 = Append[tx1[[1]], DateValue[tx1[[1, 1]], "Hour"]]
```

```
Out[=]=
```

{ { Fri 1 Jun 2018 00:00:00 GMT+1, {36.7785, -52.7283}, 0 }

```
In[=]:= tx2 = Table[Append[tx1[[t]], DateValue[tx1[[t, 1]], "Hour"]], {t, Length[tx1]}]
```

```
Out[=]=
```

{ { Fri 1 Jun 2018 00:00:00 GMT+1, {36.7785, -52.7283}, 0 },
{ { Fri 1 Jun 2018 00:15:00 GMT+1, {38.3598, -55.863}, 0 }, { { Fri 1 Jun 2018 00:30:00 GMT+1, {32.8183, -42.7333}, 0 },
{ { Fri 1 Jun 2018 00:45:00 GMT+1, {32.0847, -40.1382}, 0 }, { { Fri 1 Jun 2018 01:00:00 GMT+1, {31.0357, -52.5687}, 1 },
{ { Fri 1 Jun 2018 01:15:00 GMT+1, {39.3971, -58.2093}, 1 }, { { Fri 1 Jun 2018 01:30:00 GMT+1, {38.794, -61.5778}, 1 },
{ ... 2862 ... , { { Sat 30 Jun 2018 22:30:00 GMT+1, {21.3366, -39.6317}, 22 },
{ { Sat 30 Jun 2018 22:45:00 GMT+1, {22.1718, -41.9937}, 22 },
{ { Sat 30 Jun 2018 23:00:00 GMT+1, {23.834, -45.8616}, 23 },
{ { Sat 30 Jun 2018 23:15:00 GMT+1, {24.554, -46.5715}, 23 },
{ { Sat 30 Jun 2018 23:30:00 GMT+1, {22.6933, -45.8231}, 23 },
{ { Sat 30 Jun 2018 23:45:00 GMT+1, {29.3465, -60.2405}, 23 } }

Full expression not available (original memory size: 1.7 MB)



reformat the data for easy selection of records - pattern {CO2, O2, Hour}

In[•]:= **tx3 = Table[{tx2[[t, 2]][1], tx2[[t, 2]][2], tx2[[t, 3]]}, {t, Length[tx2]}]**

Out[•]=

```
{ {36.7785, -52.7283, 0}, {38.3598, -55.863, 0}, {32.8183, -42.7333, 0},
{32.0847, -40.1382, 0}, {31.0357, -52.5687, 1}, {39.3971, -58.2093, 1}, {38.794, -61.5778, 1},
{41.0861, -62.7185, 1}, {40.2317, -66.7992, 2}, {40.1724, -70.5425, 2}, {43.7131, -76.3566, 2},
{45.1929, -83.8663, 2}, {43.0685, -81.889, 3}, {... 2850 ...}, {11.9431, -9.9004, 21},
{16.6735, -22.3456, 21}, {16.8797, -24.9064, 21}, {18.5901, -29.7394, 21},
{19.148, -32.4038, 22}, {20.4464, -36.389, 22}, {21.3366, -39.6317, 22}, {22.1718, -41.9937, 22},
{23.834, -45.8616, 23}, {24.554, -46.5715, 23}, {22.6933, -45.8231, 23}, {29.3465, -60.2405, 23} }
```

Full expression not available (original memory size: 345.6 kB)



extract 24 lists for each hour

In[•]:= **tx4 = Table[Select[tx3, MemberQ[#, h] &], {h, 0, 23}]**

Out[•]=

```
{ {{36.7785, -52.7283, 0}, {38.3598, -55.863, 0}, {32.8183, -42.7333, 0}, {32.0847, -40.1382, 0},
{96.0611, -111.389, 0}, {108.081, -126.955, 0}, {112.709, -133.792, 0}, {110.284, -131.593, 0},
{36.6242, -72.5365, 0}, {36.4488, -71.5333, 0}, {38.2059, -74.4938, 0}, {37.1462, -75.7696, 0}, ... 96 ... ,
{125.967, -112.224, 0}, {121.589, -111.619, 0}, {117.738, -112.067, 0}, {127.208, -115.917, 0},
{10.7133, 7.1213, 0}, {17.4274, -9.49776, 0}, {22.5096, -25.1888, 0}, {18.7382, -16.2872, 0},
{16.1644, -14.3719, 0}, {16.383, -11.5216, 0}, {20.3041, -23.2534, 0}, {19.0393, -22.4854, 0} },
... 22 ..., {92.7272, -98.2646, 23}, ... 118 ..., {... 1 ...}} }
```

Full expression not available (original memory size: 346.7 kB)



calculate the monthly Means for all 24 hours

In[•]:= **tx5 = Table[Mean[tx4[[h1]]], {h1, 24}]**

Out[•]=

```
{ {60.072, -68.6237, 0}, {64.6352, -79.2485, 1}, {67.1142, -84.5266, 2},
{70.9989, -92.0702, 3}, {73.3048, -97.484, 4}, {75.0332, -100.561, 5},
{73.0355, -101.181, 6}, {70.6302, -98.535, 7}, {65.982, -91.6036, 8},
{61.6195, -84.1336, 9}, {57.3293, -74.8378, 10}, {52.4006, -62.3556, 11},
{48., -48.7352, 12}, {42.7763, -33.0458, 13}, {39.0866, -21.8258, 14},
{38.1519, -17.0967, 15}, {35.3322, -9.58284, 16}, {33.7051, -6.20369, 17},
{35.0994, -12.575, 18}, {37.3392, -20.2104, 19}, {41.6663, -30.3641, 20},
{47.532, -40.9011, 21}, {52.3762, -52.8068, 22}, {56.4898, -61.3991, 23} }
```

condense the last steps to one line of code

In[•]:= **tx6 = Table[Mean[Table[Select[Table[{tx2[[t, 2]][1], tx2[[t, 2]][2], tx2[[t, 3]]}, {t, Length[tx2]}], MemberQ[#, h] &], {h, 0, 23}][[h1]]], {h1, 24}]**

Out[•]=

```
{ {60.072, -68.6237, 0}, {64.6352, -79.2485, 1}, {67.1142, -84.5266, 2},
{70.9989, -92.0702, 3}, {73.3048, -97.484, 4}, {75.0332, -100.561, 5},
{73.0355, -101.181, 6}, {70.6302, -98.535, 7}, {65.982, -91.6036, 8},
{61.6195, -84.1336, 9}, {57.3293, -74.8378, 10}, {52.4006, -62.3556, 11},
{48., -48.7352, 12}, {42.7763, -33.0458, 13}, {39.0866, -21.8258, 14},
{38.1519, -17.0967, 15}, {35.3322, -9.58284, 16}, {33.7051, -6.20369, 17},
{35.0994, -12.575, 18}, {37.3392, -20.2104, 19}, {41.6663, -30.3641, 20},
{47.532, -40.9011, 21}, {52.3762, -52.8068, 22}, {56.4898, -61.3991, 23} }
```

example: plot 24 hour averages for June

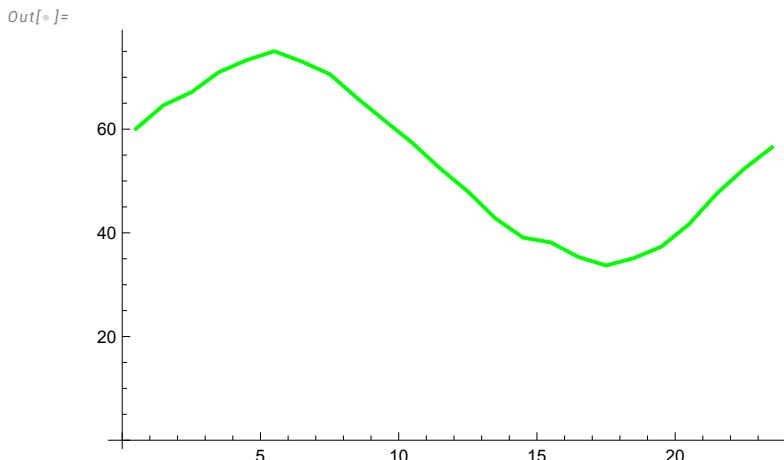
rearrange results

```
In[1]:= hours = Transpose[tx6][[3]] + 0.5
Out[1]= {0.5, 1.5, 2.5, 3.5, 4.5, 5.5, 6.5, 7.5, 8.5, 9.5, 10.5, 11.5,
12.5, 13.5, 14.5, 15.5, 16.5, 17.5, 18.5, 19.5, 20.5, 21.5, 22.5, 23.5}

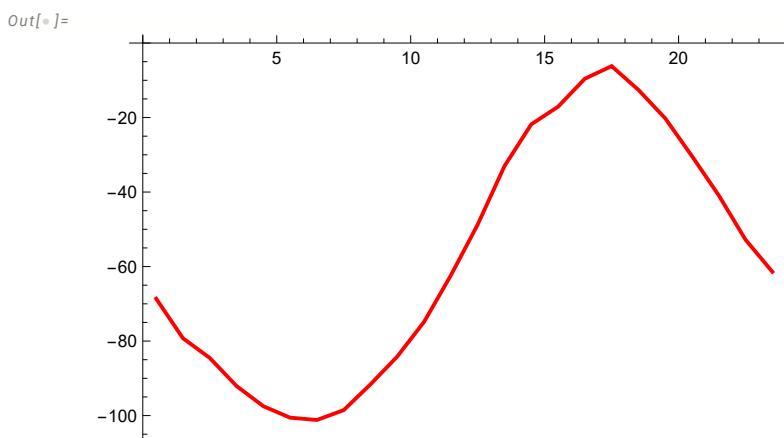
In[2]:= avCO2 = Transpose[tx6][[1]]
Out[2]= {60.072, 64.6352, 67.1142, 70.9989, 73.3048, 75.0332, 73.0355,
70.6302, 65.982, 61.6195, 57.3293, 52.4006, 48., 42.7763, 39.0866, 38.1519,
35.3322, 33.7051, 35.0994, 37.3392, 41.6663, 47.532, 52.3762, 56.4898}

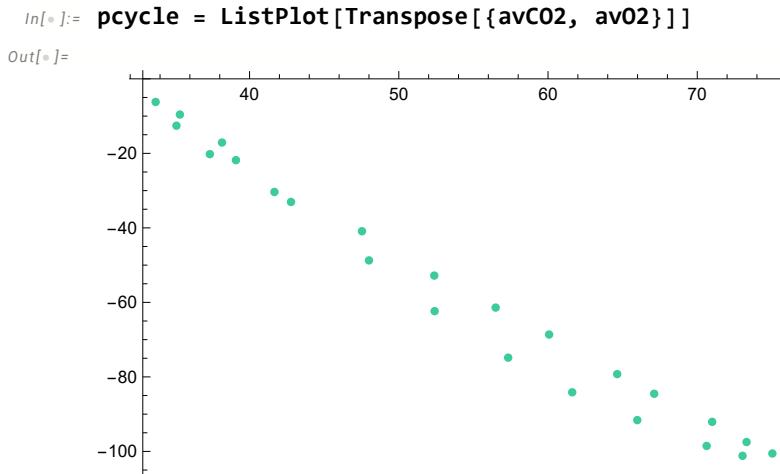
In[3]:= avO2 = Transpose[tx6][[2]]
Out[3]= {-68.6237, -79.2485, -84.5266, -92.0702, -97.484, -100.561, -101.181, -98.535,
-91.6036, -84.1336, -74.8378, -62.3556, -48.7352, -33.0458, -21.8258, -17.0967,
-9.58284, -6.20369, -12.575, -20.2104, -30.3641, -40.9011, -52.8068, -61.3991}
```

```
In[4]:= pCO2 = ListPlot[Transpose[{hours, avCO2}], Joined → True, PlotStyle → Blue]
```



```
In[5]:= pO2 = ListPlot[Transpose[{hours, avO2}], Joined → True, PlotStyle → Red]
```





Calculate 24-h averages for all months

Preparing data structure and averaging

```
In[=]:= tx24 = Table[
  Table[Append[tsm[[m]]["DatePath"][[t]], DateValue[tsm[[m]]["DatePath"][[t, 1]], "Hour"]],
  {t, tsm[[m]]["PathLength"]}], {m, nm}]
```

Out[=]=

```
{ {{ Fri 9 Feb 2018 15:00:00 GMT+1, {20.3878, -8.6902}, 15},
  { Fri 9 Feb 2018 15:15:00 GMT+1, {18.571, -8.44062}, 15},
  { Fri 9 Feb 2018 15:30:00 GMT+1, {16.7995, -9.06545}, 15},
  { Fri 9 Feb 2018 15:45:00 GMT+1, {16.8346, -9.02323}, 15},
  { Fri 9 Feb 2018 16:00:00 GMT+1, {15.5051, -8.38754}, 16},
  { Fri 9 Feb 2018 16:15:00 GMT+1, {15.8842, -8.66834}, 16},
  { Fri 9 Feb 2018 16:30:00 GMT+1, {16.0937, -9.29317}, 16}, ... 1846 ... },
  { Wed 28 Feb 2018 22:30:00 GMT+1, {-2.84743, -28.8244}, 22},
  { Wed 28 Feb 2018 22:45:00 GMT+1, {-2.69373, -28.7983}, 22},
  { Wed 28 Feb 2018 23:00:00 GMT+1, {-2.81443, -28.5244}, 23},
  { Wed 28 Feb 2018 23:15:00 GMT+1, {-2.7853, -28.563}, 23},
  { Wed 28 Feb 2018 23:30:00 GMT+1, {-2.59686, -29.8516}, 23},
  { Wed 28 Feb 2018 23:45:00 GMT+1, {-1.96502, -31.0885}, 23}}, ... 9 ..., { ... 1 ... } }
```

Full expression not available (original memory size: 17.6 MB)

mapping the example above for all 24h-data of all months m and calculating the Mean

```
In[=]:= mtx24 = Table[
  Table[Mean[Table[Select[Table[{tx24[[m, t, 3]], tx24[[m, t, 2]][[1]], tx24[[m, t, 2]][[2]]},
    {t, Length[tx24[[m]]}]],
    MemberQ[#, h] &, {h, 0, 23}] [[h1]], {h1, 24}], {m, nm}]
```

Out[=]=

```
{ {{0, 14.0672, -26.5374}, {1, 14.8162, -27.7599}, {2, 16.247, -30.0091},
  {3, 16.2457, -30.7037}, {4, 16.5359, -31.52}, {5, 16.1026, -31.6055},
```

```

{6, 16.1369, -32.6735}, {7, 15.998, -33.2086}, {8, 15.9934, -33.3761},
{9, 14.6533, -31.8527}, {10, 13.7926, -30.3057}, {11, 13.5999, -29.069},
{12, 13.37, -27.8064}, {13, 14.0594, -27.4405}, {14, 13.8663, -26.4648},
{15, 14.2159, -25.5788}, {16, 13.6008, -25.1471}, {17, 12.4473, -24.3221},
{18, 12.9105, -24.7892}, {19, 12.124, -24.1783}, {20, 11.8296, -24.1042},
{21, 12.6795, -25.2362}, {22, 13.1567, -25.8769}, {23, 13.202, -26.0836}},
{{0, 13.4459, -15.8971}, {1, 13.9421, -17.8632}, {2, 13.3103, -17.722},
{3, 13.5512, -18.8802}, {4, 13.3733, -19.5563}, {5, 13.7257, -20.8625},
{6, 14.2007, -21.7527}, {7, 14.6879, -22.5196}, {8, 14.3342, -22.3537},
{9, 14.1002, -21.24}, {10, 15.1965, -21.303}, {11, 15.1545, -19.8391},
{12, 15.3182, -17.9861}, {13, 15.0933, -15.6552}, {14, 14.7325, -13.7399},
{15, 14.1402, -11.9305}, {16, 13.5418, -10.3914}, {17, 13.5016, -10.1176},
{18, 13.1224, -10.3447}, {19, 12.8922, -10.8507}, {20, 13.3274, -11.964},
{21, 13.2576, -12.1496}, {22, 14.19, -14.0371}, {23, 13.8934, -14.26}},
{{0, 49.3813, -26.591}, {1, 50.3929, -29.7224}, {2, 51.9664, -32.9101},
{3, 52.9192, -34.9519}, {4, 56.7391, -40.3577}, {5, 56.0383, -40.6842},
{6, 54.8024, -40.3076}, {7, 54.3722, -40.2602}, {8, 53.3174, -38.0352},
{9, 52.234, -34.9427}, {10, 52.8557, -31.7749}, {11, 51.5086, -27.004},
{12, 48.6764, -19.772}, {13, 47.1356, -14.1781}, {14, 46.4134, -9.93812},
{15, 44.8707, -5.75299}, {16, 45.5917, -5.59245}, {17, 46.7952, -6.80856},
{18, 47.9393, -9.56853}, {19, 50.5935, -14.5724}, {20, 49.5433, -15.8107},
{21, 49.7729, -18.9439}, {22, 49.5817, -20.9308}, {23, 49.8453, -23.9756}},
{{0, 91.3621, -85.4125}, {1, 92.2179, -90.1537}, {2, 94.0757, -94.9185},
{3, 93.303, -96.0298}, {4, 94.2219, -98.7697}, {5, 93.5738, -100.766},
{6, 94.9839, -102.53}, {7, 93.5385, -100.207}, {8, 89.8087, -94.7223},
{9, 83.8278, -86.6004}, {10, 81.7791, -80.4787}, {11, 81.4002, -74.7349},
{12, 84.738, -70.8387}, {13, 78.1473, -58.8189}, {14, 74.0178, -51.0242},
{15, 70.1344, -44.6904}, {16, 69.9286, -43.6224}, {17, 70.6893, -44.9726},
{18, 74.4451, -52.0935}, {19, 75.541, -56.6061}, {20, 80.3171, -64.3277},
{21, 81.5112, -68.8008}, {22, 82.0002, -71.901}, {23, 83.5298, -76.3579}},
{{0, 60.072, -68.6237}, {1, 64.6352, -79.2485}, {2, 67.1142, -84.5266},
{3, 70.9989, -92.0702}, {4, 73.3048, -97.484}, {5, 75.0332, -100.561},
{6, 73.0355, -101.181}, {7, 70.6302, -98.535}, {8, 65.982, -91.6036},
{9, 61.6195, -84.1336}, {10, 57.3293, -74.8378}, {11, 52.4006, -62.3556},
{12, 48., -48.7352}, {13, 42.7763, -33.0458}, {14, 39.0866, -21.8258},
{15, 38.1519, -17.0967}, {16, 35.3322, -9.58284}, {17, 33.7051, -6.20369},
{18, 35.0994, -12.575}, {19, 37.3392, -20.2104}, {20, 41.6663, -30.3641},
{21, 47.532, -40.9011}, {22, 52.3762, -52.8068}, {23, 56.4898, -61.3991}},
{{0, 38.6291, -52.623}, {1, 43.8639, -65.2452}, {2, 48.2591, -74.6206},
{3, 52.8884, -83.793}, {4, 56.5806, -90.1299}, {5, 59.5119, -94.379},
{6, 62.0257, -97.6839}, {7, 59.1598, -92.9527}, {8, 59.8542, -92.4657},
{9, 57.3948, -86.3259}, {10, 51.6967, -76.1652}, {11, 48.2804, -67.687},
{12, 41.9772, -55.4227}, {13, 39.0046, -45.2466}, {14, 33.6974, -30.0907},
{15, 30.9903, -22.4017}, {16, 26.2916, -11.6394}, {17, 25.5156, -11.4704},
{18, 26.7306, -14.2604}, {19, 28.0854, -19.5943}, {20, 29.0325, -23.1003},
{21, 33.0714, -33.8075}, {22, 32.8325, -36.8093}, {23, 34.092, -41.3255}},
{{0, 52.4816, -41.4088}, {1, 56.8203, -50.9451}, {2, 60.2693, -60.4766},
{3, 60.9027, -65.7971}, {4, 65.2962, -74.1183}, {5, 70.1578, -82.0447},
{6, 74.8689, -90.4997}, {7, 72.8243, -88.8962}, {8, 66.6861, -81.4769},
{9, 62.4452, -69.7166}, {10, 60.9422, -62.4595}, {11, 52.5268, -47.2595},

```

```

{12, 45.4153, -31.5408}, {13, 40.7833, -21.5391}, {14, 33.4459, -6.20322},
{15, 29.6088, 3.02319}, {16, 27.4706, 9.42363}, {17, 25.7269, 13.4805},
{18, 25.9898, 10.6891}, {19, 28.8723, 3.56929}, {20, 33.5346, -6.23219},
{21, 40.6588, -19.0504}, {22, 47.3121, -30.4232}, {23, 50.3678, -35.5071}}, ,
{{0, 59.9745, -43.1437}, {1, 61.921, -47.3474}, {2, 67.7078, -55.9986},
{3, 74.1702, -64.1425}, {4, 78.2785, -70.0437}, {5, 82.1944, -74.1519},
{6, 85.7807, -78.8355}, {7, 86.6835, -81.4454}, {8, 83.8398, -77.8663},
{9, 79.28, -69.4072}, {10, 68.6469, -54.6998}, {11, 59.9324, -44.1791},
{12, 54.2138, -34.0709}, {13, 50.378, -25.6137}, {14, 47.1125, -17.9119},
{15, 41.6575, -9.22036}, {16, 39.7388, -4.15817}, {17, 38.7349, -3.72686},
{18, 40.8151, -9.78139}, {19, 41.9931, -13.7494}, {20, 44.1612, -18.8276},
{21, 48.0828, -26.2231}, {22, 51.0133, -33.0219}, {23, 56.2314, -39.6}}, ,
{{0, 54.6808, -50.0381}, {1, 58.0776, -54.6246}, {2, 60.5366, -58.4975},
{3, 61.149, -60.6374}, {4, 62.1437, -63.2519}, {5, 63.0376, -65.1219},
{6, 62.6111, -65.8995}, {7, 62.9153, -68.145}, {8, 61.5558, -65.724},
{9, 58.5966, -60.199}, {10, 54.2777, -52.4114}, {11, 52.4275, -45.2158},
{12, 48.9954, -36.8225}, {13, 45.6006, -29.6967}, {14, 43.7433, -23.74},
{15, 41.9248, -19.6127}, {16, 40.7518, -18.1013}, {17, 41.9747, -21.3812},
{18, 44.9898, -27.6524}, {19, 47.913, -32.9931}, {20, 50.1736, -37.6305},
{21, 51.2917, -40.1183}, {22, 53.6434, -44.1427}, {23, 55.167, -47.0568}}, ,
{{0, 81.7009, -57.9394}, {1, 85.2121, -61.0195}, {2, 85.4901, -62.1924},
{3, 87.0963, -64.0634}, {4, 91.1102, -67.1555}, {5, 92.7359, -68.3716},
{6, 92.2307, -68.4187}, {7, 93.4582, -70.5556}, {8, 94.2488, -71.7584},
{9, 95.0686, -72.1889}, {10, 93.7885, -69.6838}, {11, 90.1809, -64.7473},
{12, 88.2633, -60.6238}, {13, 82.1579, -54.4671}, {14, 76.1531, -47.5573},
{15, 72.5315, -43.6261}, {16, 72.1443, -43.6806}, {17, 72.8332, -45.115},
{18, 76.1417, -47.9772}, {19, 79.6658, -51.5807}, {20, 80.2142, -52.6969},
{21, 79.8002, -53.6869}, {22, 79.4129, -55.1763}, {23, 78.3651, -55.8785}}, ,
{{0, 15.6947, -2.42664}, {1, 15.4694, -2.77498}, {2, 15.8678, -4.88719},
{3, 15.1874, -5.12756}, {4, 14.6732, -4.69742}, {5, 15.047, -5.74256},
{6, 15.2069, -5.49808}, {7, 15.066, -5.05089}, {8, 15.0404, -4.18463},
{9, 14.294, -2.73481}, {10, 13.3077, 0.738177}, {11, 11.6996, 4.93997},
{12, 11.4677, 7.0238}, {13, 12.221, 7.65535}, {14, 12.576, 8.00615},
{15, 12.6942, 8.57058}, {16, 12.8352, 8.43332}, {17, 13.2142, 7.18052},
{18, 14.1415, 5.20375}, {19, 14.0973, 4.60624}, {20, 14.3729, 4.63166},
{21, 14.6962, 4.49052}, {22, 15.7998, 2.33824}, {23, 15.8651, 0.562379}}}

```

```
In[8]:= tco2 = Table[Table[{mtx24[m, h, 1] + 0.5, mtx24[m, h, 2]}, {h, 24}], {m, nm}];
```

```
In[9]:= to2 = Table[Table[{mtx24[m, h, 1] + 0.5, mtx24[m, h, 3]}, {h, 24}], {m, nm}];
```

cycles

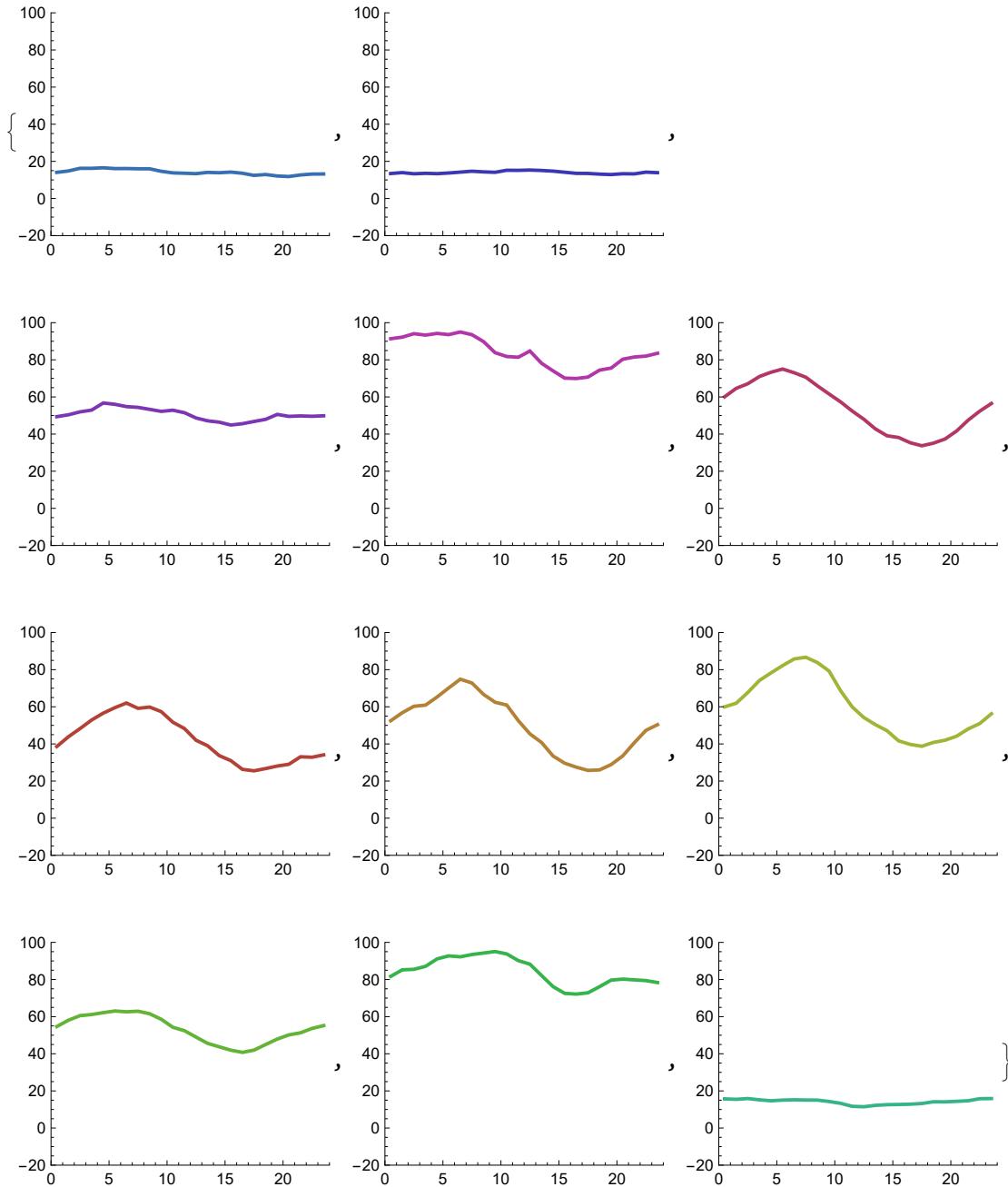
```
In[10]:= co2o2 = Table[Table[{mtx24[m, h, 2], mtx24[m, h, 3]}, {h, 24}], {m, nm}];
```

Ploting daily averages

exCO₂

```
In[8]:= ptc02x = Table[ListLinePlot[tco2[[m]], PlotRange -> {{0, 24}, {-20, 100}}, AspectRatio -> 0.8, AxesOrigin -> {0, -20}, PlotStyle -> col[m]], {m, nm}]
```

Out[•] =

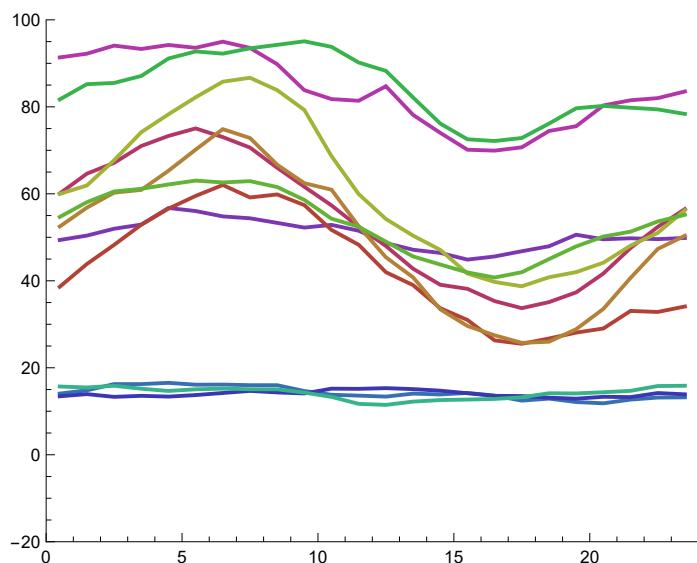


In[•]:= **coltab**

Out[•]=

```
In[6]:= sco2 = Show[ptco2x]
```

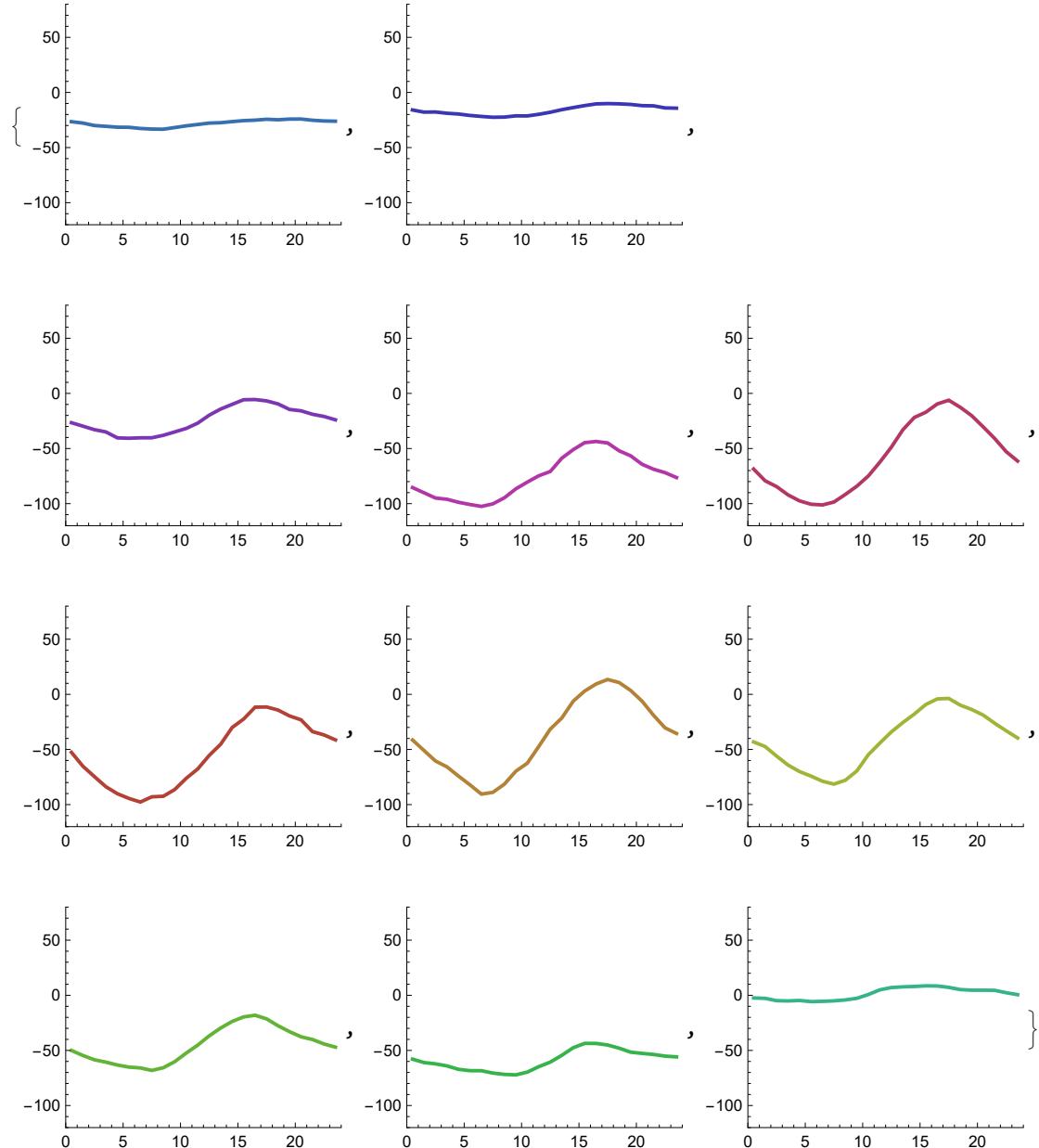
```
Out[6]=
```



ex02

```
In[6]:= pto2x = Table[ListLinePlot[to2[[m]], PlotRange -> {{0, 24}, {-120, 80}}, AspectRatio -> 0.8, AxesOrigin -> {0, -120}, PlotStyle -> col[m]], {m, nm}]
```

Out[•] =

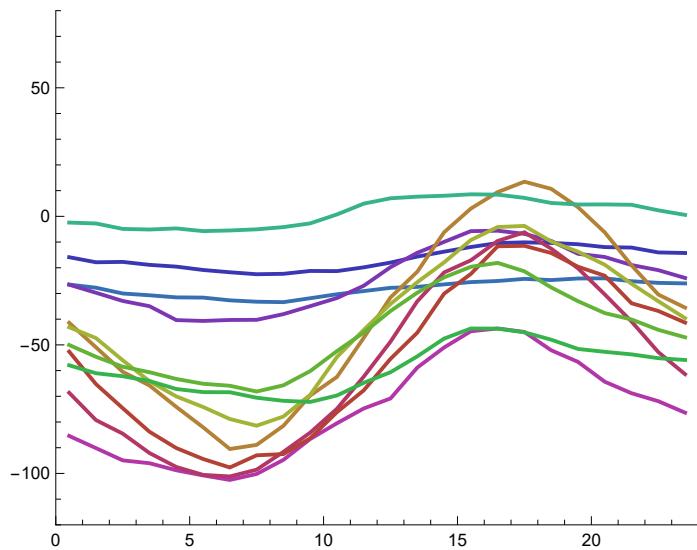


In[•]:= **coltab**

Out[•]=

```
In[6]:= so2 = Show[pto2x]
```

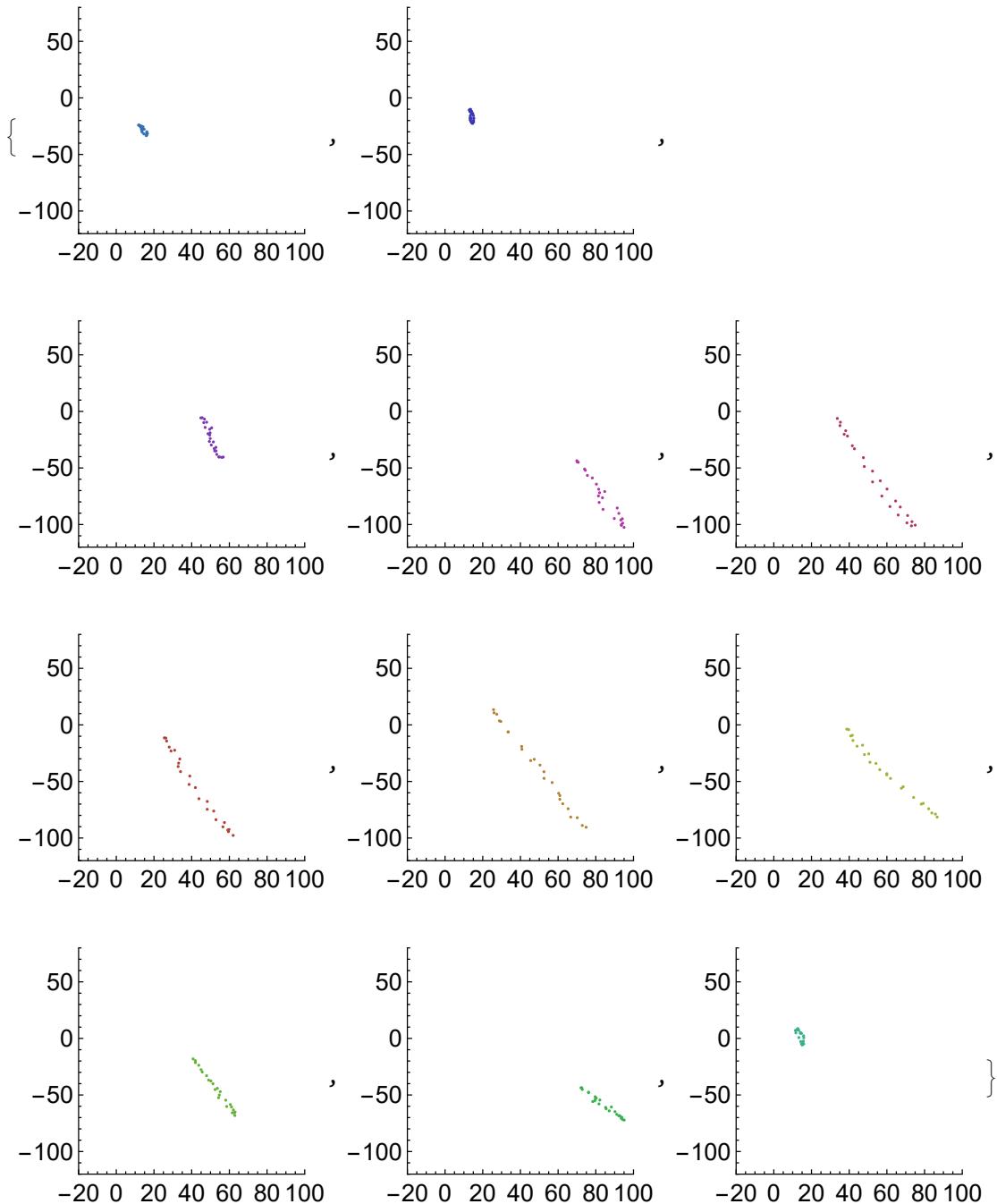
```
Out[6]=
```



24 - h cycles

```
In[5]:= pcycles = Table[ListPlot[co2o2[m], PlotRange -> {{-20, 100}, {-120, 80}}, AxesOrigin -> {-20, -120}, PlotStyle -> col[m], AspectRatio -> 1, AxesStyle -> Directive[Black, 14, Thickness[0.005]]], {m, nm}]
```

Out[•]=

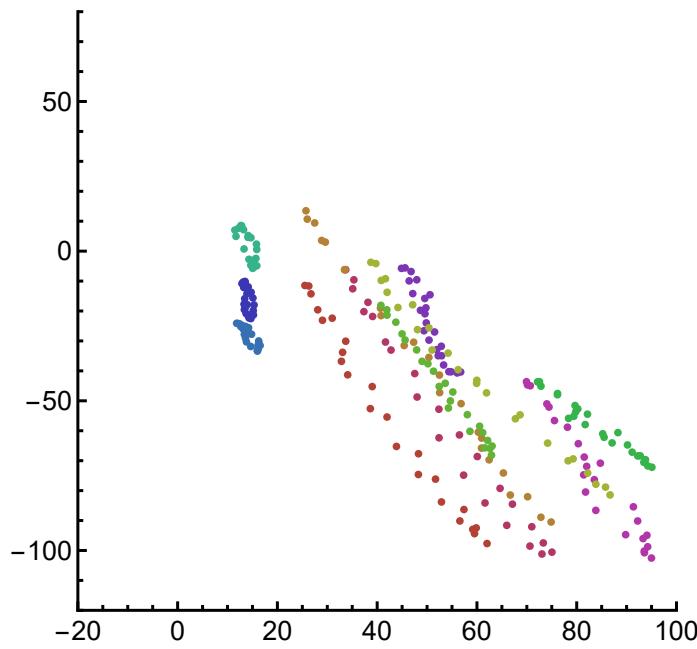


```
In[•]:= coltab
```

Out[•] =

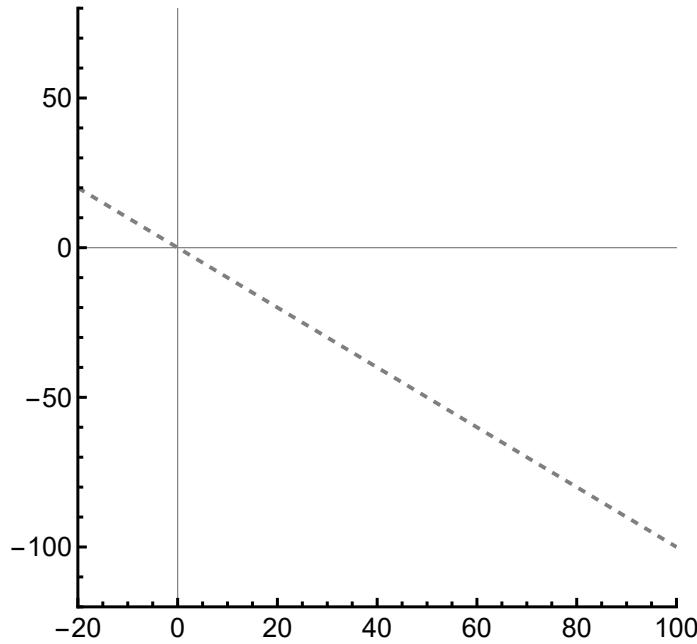
In[6]:= **scycles** = Show[**pcycles**]

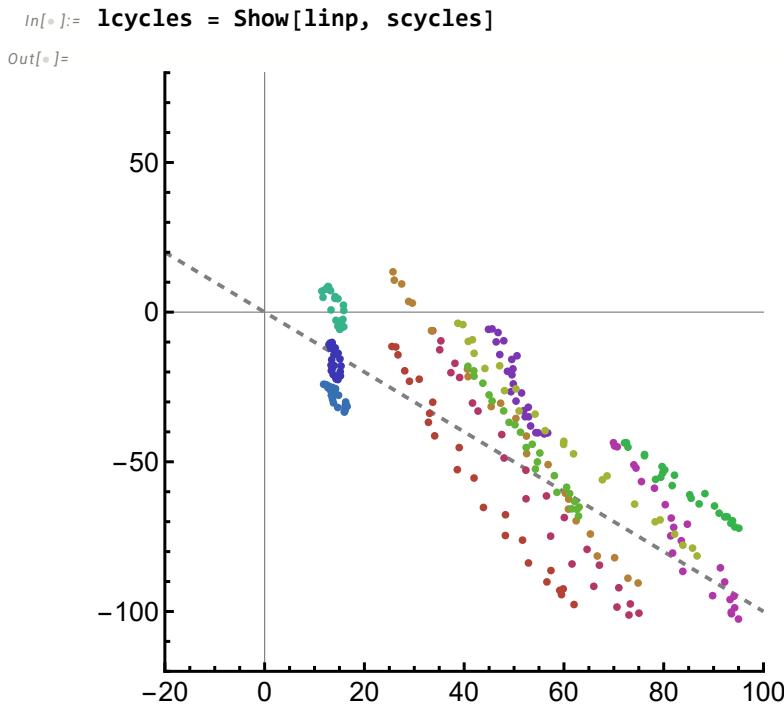
Out[6]=



```
In[7]:= linp = Show[{ListPlot[{{-20, 20}, {100, -100}}, PlotRange → {{-20, 100}, {-120, 80}}, AxesOrigin → {-20, -120}, PlotStyle → {Gray, Dashed}, Joined → True, AspectRatio → 1, AxesStyle → Directive[Black, 14, Thickness[0.005]]], ListPlot[{{{-20, 0}, {100, 0}}}, Joined → True, PlotStyle → {Gray, Thickness → 0.002}], ListPlot[{{0, -120}, {0, 80}}], Joined → True, PlotStyle → {Gray, Thickness → 0.002}]}]
```

Out[7]=





Calculate average daily amplitudes

MinMax extracts the minimum and maximum values of a list as {min, max}. The difference max-min is the average daily amplitude.

```
In[9]:= diffco2 = Table[
  MinMax[Transpose[co2o2[[m]]][[1]]][[2]] - MinMax[Transpose[co2o2[[m]]][[1]]][[1]], {m, nm}]
Out[9]= {4.7063, 2.42601, 11.8683, 25.0553, 41.3281,
36.5101, 49.142, 47.9485, 22.2858, 22.9243, 4.40011}

In[10]:= diffo2 = Table[
  MinMax[Transpose[co2o2[[m]]][[2]]][[2]] - MinMax[Transpose[co2o2[[m]]][[2]]][[1]], {m, nm}]
Out[10]= {9.27197, 12.402, 35.0917, 58.908, 94.9778,
86.2134, 103.98, 77.7185, 50.0436, 28.5628, 14.3131}

In[11]:= difftab = Grid[{Prepend[mlabels, "Month"], Prepend[diffco2, "AmpCO2"],
  Prepend[diffo2, "AmpO2"]}], Dividers -> {False, All}]
```

Month	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
AmpCO2	4.7063	2.42601	11.8683	25.0553	41.3281	36.5101	49.142	47.9485	22.2858	22.9243	4.40011
	01	83	53	81	01		85	58	43	11	
AmpO2	9.27197	12.402	35.0917	58.908	94.9778	86.2134	103.98	77.7185	50.0436	28.5628	14.3131
	97		17		78	34		85	36	28	31

Calculate slopes of average 24 - h cycles

calculate the linear regression fits of the monthly averaged 24 - h co2 - o2 cycles with co2 as parameter x1 and extract the slope and intercept parameters , the extraction pattern ext is mapped over

fitlist.

```
In[1]:= fitlist = Table[Fit[co2o2[[m]], {1, x1}, x1], {m, nm}]

Out[1]= {-1.6007 - 1.86516 x1, 24.41 - 2.91357 x1, 154.461 - 3.53623 x1,
115.45 - 2.27972 x1, 67.5665 - 2.31706 x1, 46.1549 - 2.38062 x1, 67.0177 - 2.13752 x1,
52.44 - 1.56372 x1, 70.4546 - 2.17468 x1, 43.3644 - 1.21332 x1, 42.9663 - 2.93637 x1}

In[2]:= ext = {#[[1]], #[[2]][[1]]} &

Out[2]= {#[1][1], #[1][2][[1]]} &

In[3]:= fitpar = ext /@ fitlist

Out[3]= {{-1.6007, -1.86516}, {24.41, -2.91357}, {154.461, -3.53623},
{115.45, -2.27972}, {67.5665, -2.31706}, {46.1549, -2.38062}, {67.0177, -2.13752},
{52.44, -1.56372}, {70.4546, -2.17468}, {43.3644, -1.21332}, {42.9663, -2.93637}]

In[4]:= fittab = Grid[{Prepend[mlabels, "Month"], Prepend[Transpose[fitpar][[1]], "intercept"],
Prepend[Transpose[fitpar][[2]], "slope"]}, Dividers -> {False, All}]

Out[4]= 

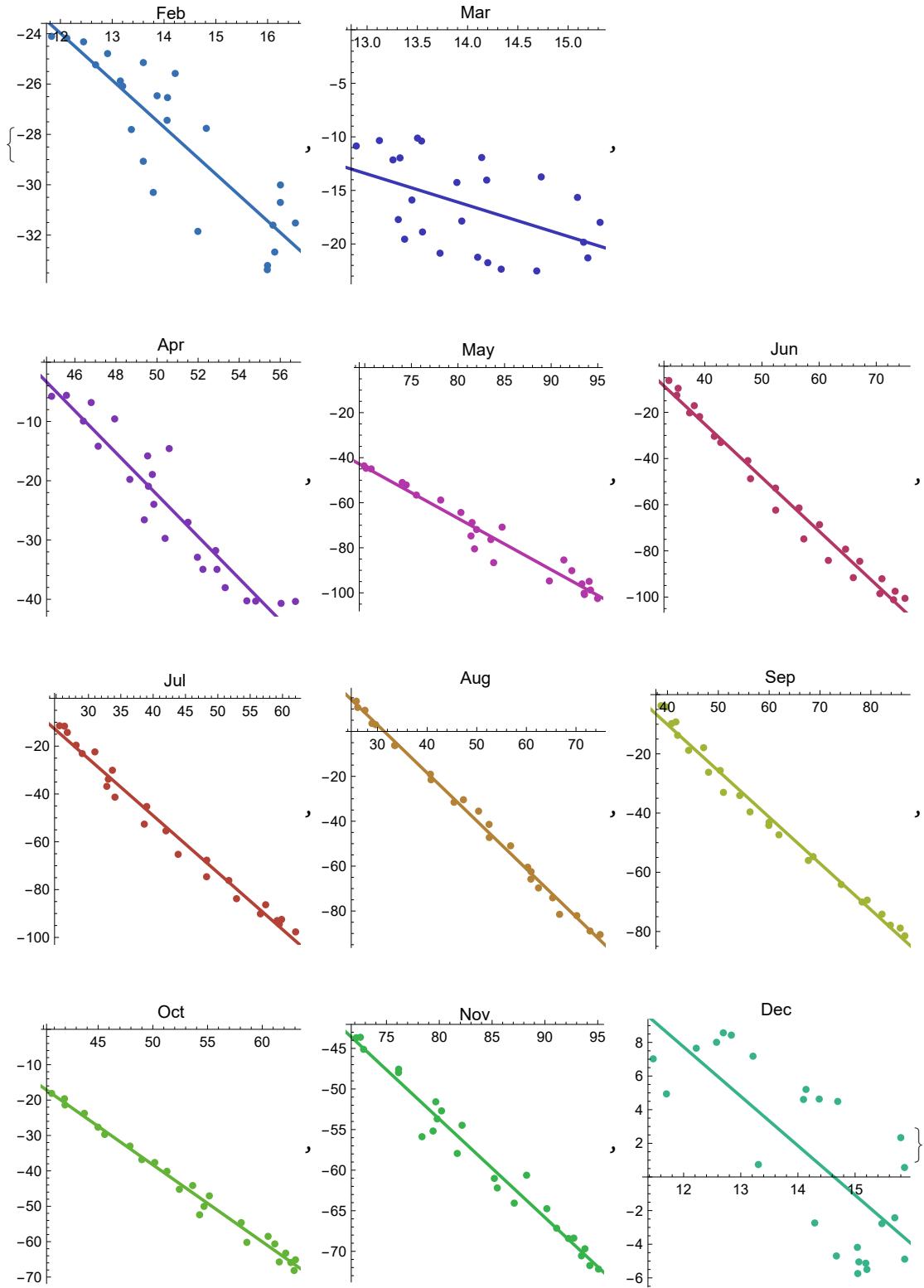
| Month     | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec      |
|-----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| intercept | -1.6007  | 24.41    | 154.461  | 115.45   | 67.5665  | 46.1549  | 67.0177  | 52.44    | 70.4546  | 43.3644  | 42.9663  |
| ce        | 07       |          | 61       |          | 65       | 49       | 77       |          | 46       | 44       | 63       |
| pt        |          |          |          |          |          |          |          |          |          |          |          |
| slope     | -1.86516 | -2.91357 | -3.53623 | -2.27972 | -2.31706 | -2.38062 | -2.13752 | -1.56372 | -2.17468 | -1.21332 | -2.93637 |
|           | 516      | 357      | 623      | 972      | 706      | 062      | 752      | 372      | 468      | 332      | 637      |


```

Visualize slopes

```
In[•]:= sloplots = Table[Show[{ListPlot[co2o2[[m]], PlotStyle -> {col[[m]], PointSize -> Medium}, PlotLabel -> mlabels[[m]], AspectRatio -> 1], Plot[fitpar[[m, 1]] + fitpar[[m, 2]] y1, {y1, 0, 100}, PlotStyle -> col[[m]], AspectRatio -> 1]}]], {m, nm}]
```

Out[•]=



(END of CO2-O2-stat v1 notebook)