I. Goal:

- Explore and visualize carbon flux data from the Ameriflux database

II. Objectives:

- Explore and download metadata and site data from the Ameriflux database
- Use Excel or Matlab to graph and visualize carbon flux data

III. References:

- CZO National Database, <criticalzone.org/national/data/>
- Ameriflux network: ameriflux.lbl.gov/SitePages/Home.aspx
- Ameriflux network (Old): ameriflux.ornl.gov/

IV. Handouts & Reading

- Keeling Curve of atmospheric CO2 concentrations from Mona Loa.
- US Carbon Cycle Science Program, What is the Carbon Cycle?

V. In-class (all in-class work can be done collectively by a group):

Based on your reading, define Net Primary Production (NPP). (1 pts)

1.

Based on the handout, explain the interannual cycles seen in the Keeling Curve? (1 pt)

2.

List at least three ways that vegetation affects rates of carbon fluxes (1 pt)

3.
4.
5.

What three climatic conditions (as measured by a micro-met station) that most affect Carbon fluxes? Also list the typical SI units and equivalent values you would use in a generic unit analysis? (3 pts)

Symbol	Name	SI Unit	L-M-t Unit
6.			
7.			
8.			

Consider a typical CO2 flux rate of 1.0 umole/m^2/s for a temperate forest. Through unit conversions and a little math, show what the annual Carbon flux is in terms of g/m2/yr. There are 12 g/mole of Carbon and 44 g/mole of CO2. (2 pts)

9.

Using your answer from #9, simply estimate the global terrestrial carbon flux in terms of GTC/yr. Assume the total land surface area of the Earth is 1.5 x 10^{14} m^2, but use only a fraction of this value and justify your selection. There are 10^6 g in a metric ton and Giga = 10^9. (2 pts)

10.

Look up typical temperate forest flux rates (g/m2/yr) and global terrestrial rates of NPP. How close are your estimates above? Speculate as to why your values are different. (2 pts)

11.

VI. Accessing Flux Data from the Ameriflux database

In order to give you broader exposure to a high quality Carbon flux dataset and because of network-to-network inconsistencies in the CZO data set, we will focus our initial data manipulations on the excellent Ameriflux network with over 150 sites throughout the Americas. Once you have experience with this data set, it is fairly easy to address similar questions with the CZO data set. The Ameriflux web site is currently in transition from ORNL to LBL. The procedure below is based on the new LBL format. Note that there is a link to the old (CDIAC) data site under method #1.

First we will access a common data record and learn something about it. Then you can look for data anywhere in the system and do your own analysis.

Steps to access the LBL Ameriflux data set:

a. goto: ameriflux.lbl.gov/data/how-to-uploaddownload-data/

b. Create a free account registration.

c. Site Selection: highlight the site on the left and move it (>) to the right. For example, try getting data for "US-Vcp: Valles Caldera Ponderosa Pine" (Note that this is actually one of the CZO sites). You do not need to download the "Additional data files" as this data is included in your zipped data file.

d. Purpose: Confirm that the Intended use is "Education" and acknowledge you have read the AMF data policy.

e. Data and manifest Page: Click on the URL to view the README file. Save the data file to your hard-drive (typically under "downloads" on a PC).

f. Open the zipped data file (.CSV) in Excel. The data should automatically parse the comma delimited fields into separate columns. If not, the "Text Import Wizard" will help you do this.

g. Typically, this file is huge-spanning all years of operation. If your Mac cannot handle this, try downloading data from the old system. Regardless, break the data up into yearly segments by cutting and pasting.

h. Formatting the TimeStamp: Make the first two columns wider and format as a Number (with no decimal part).

i. Fill in the following table with the "header" information and corresponding units. More detailed metadata is availablein the README file. This file can be particularly useful to confirm sign conventions. Add an "M" to the far right-side of the explanation if that variable is missing. (2 pt)

#	col	Header	New Format - Explanation	Units
1	A	TimeStamp_start		
2	B	TimeStamp_end		
3	C	USTAR		
4	D	TA		
5	E	WD		
6	F	WS		
7	G	NEE		
8	H	FC		
9	I	SFC		
10	J	H		
11	K	SH		
12	L	LE		
13	M	SLE		
14	N	G		
15	O	TS_1		
16	P	TS_2		
17	Q	P		
18	R	RH		
19	S	PA		
20	T	CO2_1		
21	U	CO2_2		
22	V	VPD		
23	W	SWC_1		
24	X	SWC_2		
25	Y	NETRAD		
26	Z	PPFD_IN		
27	AA	SW_IN		
28	AB	SW_Dif		
29	AC	PPFD_OUT		
330	AD	SW_OUT		
31	AE	LW_IN		
32	AF	LW_OUT		
33	AG	H2O		
34	AH	RECO_PI		
35	AI	APAR		
36	AJ	PPFD_DIF		
37	AK	FAPAR		
38	AL	ZL		

#	col	Header	Old Format - Explanation – Level 2 Data	Units
1	A	YEAR		
2	B	GAP		
3	C	DTIME		
4	D	DOY		
5	E	HRMIN		
6	F	UST		
7	G	TA		
8	H	WD		
9	I	WS		
10	J	NEE		
11	K	FC		
12	L	SFC		
13	M	H		
14	N	SH		
15	O	LE		
16	P	SLE		
17	Q	FG		
18	R	TS1		
19	S	TSdepth1		
20	T	TS2		
21	U	TSdepth2		
22	V	PREC		
23	W	RH		
24	X	PRESS		
25	Y	CO2		
26	Z	VPD		
27	AA	SWC1		
28	AB	SWC2		
29	AC	Rn		
330	AD	PAR		
31	AE	Rg		
32	AF	RgDiff		
33	AG	PARout		
34	AH	RgOut		
35	AI	Rgl		
36	AJ	RglOut		
37	AK	H2O		
38	AL	RE		
39	AM	GPP		
40	AN	CO2top		
41	AO	CO2height		
42	AP	APAR		
43	AQ	PARdiff		
44	AR	APARpct		
45	AS	ZL		

VII. Calculations

Is there enough information in this table to estimate Reference ET and compare it with the EC-derived value? You might try it if you have time. Make a scatter plot of your estimate vs. the EC-derived value. Why are these different? Why does this make sense? (1 pt)

12.

VIII. Homework I – Data Visualization

For now we will just plot some of these variables. Remember that the easy way to select the full column of data is to place the cursor over the first data value (row 22) and type, End, Shift down-arrow.

- Look at data from another site that you are interested in learning more about.
- Make a plot of Carbon Flux (FC) and Respiration (RE) verses Julian date. Once you have the basic plot, make sure you make it readable (titles, etc) and then edit the x-axis to focus in on a 10 day period (ie. DOY 170-180).
- Make a plot of Rn, LE, H verses Julian date for this same period. Add PAR on a secondary axis.
- Complete the questions above along with these two graphs and bring a copy to your next class.

IX. Preview: Homework II (due 1 week from now) – Develop a simple hypothesis regarding site-to-site or season-to-season differences in data from the Ameriflux or CZLO data network. Clearly state your hypothesis and provide adequate tabular or graphical data either supporting or contradicting your hypothesis. Example questions might range from timing issues to broader ecosystem patterns. Get started on this now if you have time and bring your questions about finding data or forming a hypothesis to class.