

**Photosynthesis & Eddy Covariance**

1. Answer questions 7, 8, and 9 from the Bonan reading. If you wish, you may use the “toy model” of photosynthesis based on the reading that I’ve provided on the class website. If you’re interested in learning more about photosynthesis though, I encourage you to do the calculations yourself.
2. Download the following two files from the course website:
  - daytime.eddies.txt (<http://tinyurl.com/day-eddies-dat>)
  - nighttime.eddies.txt (<http://tinyurl.com/night-eddies-dat>)

Each file contains a 30-minute record of vertical wind ( $w$ ) and CO<sub>2</sub> concentration ( $C$ ) measured 20 times per second (20 Hz) from the top of the tower. For each case (file), do the following:

- (a) subtract the mean of each variable from the 20 Hz data to obtain turbulent perturbations (deviations) from the mean
  - (b) plot the perturbations in CO<sub>2</sub> concentration ( $C'$ ) against perturbations in vertical velocity ( $w'$ ) on a simple x-y graph
  - (c) fit a regression line to the points on your graph. Report the slope and intercept, the correlation coefficient and the covariance of  $w'$  and  $C'$
  - (d) Using the covariance from part (c) above, calculate the flux of CO<sub>2</sub> into or out of the forest ecosystem, in micromoles per square meter per second
  - (e) Comment on whether your estimate is reasonable, and what further calculations might be required to improve your estimate.
3. Visit the AmeriFlux website (<http://ameriflux.ornl.gov>) and download the Level 2 flux data records for the Glacier Lakes Ecosystem Experiment Site (GLEES), which we will visit on our field trip Sept 26.

Using the data you obtain for the tower, plot the seasonal cycles of net ecosystem exchange (NEE) of carbon, and evapotranspiration (also called latent heat flux), for the years 2006 and 2012. The data are recorded every 30 minutes. You will probably want to use a running average of several days to be able to see seasonal variations through the hour-to-hour and day-to-day variations.

Briefly comment on the differences between the seasonal cycles of carbon and water fluxes between the two years and suggest a mechanism to explain them.