**Photosynthesis model documentation**

* LI-6400 files

The first step is to set up your data file. Bad data will cause considerable estimations errors. Therefore, basic quality control is needed before you run the model. You can make some simple plots of your A/Ci or A/q data. Exclude bad curves or single data points caused by gas chamber leakage, licor parts malfunctioning or other issues during the measurements. I recommend you to keep detailed and clear records during the measurements in field and examine your data as soon as possible after your field measurements. It is easier to remember what happened and to decide whether to keep or discard some ambiguous data points.

Your files should be saves as csv files and have the following format. Reading raw xls files from licor is not stable. In addition, different licors may have different output format. In order to avoid the Incorporating version control of different licor output files is tedious. Therefore, we use this csv format as the standard data input format for model run.

You can keep all variables from raw licor file. But only the following variables are the ones needed in the model run: ‘Photo’, ‘Ci\_Pa’ and ‘PARi’. The order of the variables does not matter. We keep the variable names the same as they are shown in the raw licor file. Therefore, there is no need to adjust the variable names. If you have multiple species or multiple replicates for one species, you will need to add a species (‘spp’) and replicate (‘rep’) column to distinguish different species and replicates. If you want to include the effects of month and year on photosynthetic parameters, you can also add a ‘year’ and a ‘month’ column. If you collected both A/Ci and A/q curves and would like to run them separately, you will need a ‘curve’ column.



Fig 1. Format of csv file needed for model data input.

* Set up priors

One advantage of Bayesian analysis is that prior information for parameters can be assimilated into models, which can improve model performance especially when data are limited. Priors for photosynthetic parameters in the model are derived at a broad taxonomic or functional level. The prior distributions listed below are derived from a wide range of temperate grassland species since the model is designed to estimate photosynthetic parameters using data collected from a prairie in Urbana, Illinois. If you work with species from ecosystems such as tropical forest or tundra, you will need to reset the prior distributions. When insufficient prior information is available, an uninformative prior distribution is assigned to the parameter to reflect a small contribution of information. However, in order to fully take advantage of Bayesian analysis, I do not recommend you to use uninformative priors.

#Prior for maximum electron transport rate (μmol m-2 s-1).

#Based on Wullschleger (1993), Medlyn et al. (2002)

**Jmax ~ dlnorm(4.7,2.7)**

#Prior for quantum yield (mole electrons/mole photon)

# Based on Skillman (2008)

**alpha~dnorm(0.25,100)**

#Prior for maximum rubisco capacity (μmol m-2 s-1).

#Based on Medlyn et al. (2002) and Kattge et al. (2009)

**vcmax ~dlnorm(4.6,2.7)**

#Prior for leaf respiration

**r ~ dlnorm(0.75,1.56)**

# Prior for CO2 compensation point (Pa)

**cp ~ dlnorm(1.9,2.7)**

# Prior for model residual error

**tau ~ dgamma(0.1,0.1)**

* Process model
* Diagnostic plots