GLM Data Requirements

Driver Data:

Meteorological driver data at daily (or hourly) frequency is mandatory. The following items should be included as daily or hourly average values in columns in a meteorological driver data CSV file.

Item	Column Header	Units	Notes
Time	time	YYYY-MM-DD (or YYYY-MM-DD HH:MM:SS)	
Shortwave Radiation	ShortWave	Watts/meter^2	
Longwave Radiation	LongWave	Watts/meter^2	Can be provided as direct incident intensity, net longwave flux, or estimated from cloud cover fraction(0-1)
Air Temperature	AirTemp	Degrees Celsius	Air temperature at 10 meters above water surface
Relative Humidity	RelHum	%	Relative humidity at 10 meters above the water surface
Wind speed	WindSpeed	Meters/second	Wind speed at 10 meters above water surface
Rainfall	Rain	Meters/day	Rainfall intensity per day (units remain m/day for hourly data)
Snowfall	Snow	Meters/day	Optional snowfall intensity per day (units remain m/day for hourly data)

Notes:

- Longwave radiation can be calculated from shortwave radiation, air temperature, barometric pressure, relative humidity and latitude (Crawford et al. 1999).
- Relative humidity can be calculated from vapour pressure and air temperature (DY. 2002)
- If wind is not measured at 10-meter above water height, a 10-m height estimate can be obtained using the power law with α= 1/7

$$\frac{u}{u_r} = \left(\frac{z}{z_r}\right)^{\alpha}$$

Streamflow data is not mandatory. If available, users should include the following, at a **daily time step**, in a separate CSV file for each inflow and each outflow (only 'time' and 'flow' columns are required for outflow, as the model calculates the water temperature and salinity). Any number of inflows and outflows can be included.

Item	Column Header	Units	Notes
Time	time	YYYY-MM-DD	
Volumetric Flow	flow	Megaliters/day	Convert from m^3/sec to ML/day by multiplying by 86.4
Streamflow Water Temperature	temp	Degrees Celsius	
Salinity	salt	mg/Liter	If salinity is known to be negligible, can be all zero

Lake Specific Parameters:

The following lake-specific parameters are necessary for the model to adequately represent the lake of interest:

Symbol	Parameter Description	Units	Notes
K_d or K_w	Background light attenuation coefficient	$Meters^{-1}$	Can be estimated from 1.7/(secchi depth in meters; Poole and Atkins, 1929)
latitude	Latitude of center of lake	Degrees North	
longitude	Longitude of center of lake	Degrees East	
base_elev	Elevation of the deepest point of lake	Meters above sea level	
crest_elev	Elevation of the crest lake basin	Meters above sea level	
bsn_length	Basin length at crest elevation	Meters	Rough estimates are sufficient
bsn_wid	Basin width at crest elevation	Meters	Rough estimates are sufficient
H	Elevation points for lake morphometry	Meters above sea level	Any number of points is supported
A	Cross sectional areas corresponding to the H elevations	Thousand $Meters^2$	

The following are not required but may improve model performance:

Symbol	Parameter Description	Units	Notes
the_temps	Initial water temperature profile for desired date of simulation start	Degrees Celsius	Any number of points (depths) is supported
the_depths	Depths below surface corresponding to the water temperature measurements	Meters below water surface	
the_sals	Initial salinity profile corresponding to the_depths	Practical salinity units (psu) ?	
lake_depth	Initial water level above deepest point of lake	Meters	
coef_wind_drag (C_M)	Bulk aerodynamic coefficient for transfer of momentum	[dimensionless]	Default is 0.0013; can be estimated from C_M= $0.0013W_s^{1/3}$ where W_s is estimated from surrounding canopy and lake surface area (Read et. al 2014)

References:

Crawford, T.M. and Duchon, C.E. 1999. An Improved Parameterization for Estimating Effective Atmospheric Emissivity for Use in Calculating Daytime Downwelling Longwave Radiation. Journal of Applied Meteorology. 38, 1999, pp. 474 - 480.

DY. 2002. Dynamic Reservoir Simulation Model: DYRESM: User Manual. Crawley WA, Australia : Centre for Water Research, University of Western Australia, 2002.

Hipsey, M.R., Bruce, L.C., Hamilton, D.P., 2014. GLM - General Lake Model: Model overview and user information. AED Report #26, The University of Western Australia, Perth, Australia. 22pp. http://aed.see.uwa.edu.au/research/models/GLM/Pages/Manual/AED_GLM_v1_4_0_20140908_draft.pdf

Poole, H.H., Atkins, W.R.G., 1929. Photo-electric measurements of submarine illumi- nation throughout the year. J. Mar. Biol. Assoc. U.K. (New Series) 16, 297–324.

Read, J. S., Winslow, L. a., Hansen, G. J. a., Van Den Hoek, J., Hanson, P. C., Bruce, L. C., & Markfort, C. D. (2014). Simulating 2368 temperate lakes reveals weak coherence in stratification phenology. Ecological Modelling, 291, 142–150. doi:10.1016/j.ecolmodel.2014.07.029