README

Coastal wetland GHG model (CWGM) overview

The coastal wetland GHG model (CWGM) is a power-law based empirical model developed by using data fo
Waquoit Bay and Great Pond estuaries, MA, representing biogeochemical and ecological gradients. The mod
fluxes of CO_2 ($NEE_{CO2,uptake}$, units: µmol/m^2/s), nighttime emission fluxes of CO_2 ($NEE_{CO2,emission}$, units: µmol
CH_4 ($NEE_{CH4,emission}$, units: nmol/m^2/s) from photosynthetically active radiation (PAR, units: µmol/m^2/s), soil
porewater salinity (SS, units: parts per thousand, ppt). A robust multivariate data analytics framework was uti
environmental drivers of fluxes as model inputs. The model is simple, handy and user-friendly, and only requ
to predict the GHG fluxes.

Model Assumptions and Domain

- Coastal salt marshes are productive mainly during the extended growing season (e.g., May to October).
  preferable period of productivity in the model.
- The model is directly applicable to the tidal salt marshes in Cape Cod, Massachusetts. However, the mc
  New England and beyond given comparable environmental regimes.
- The net atmospheric carbon removal (NACR) represents the carbon removed from atmosphere by tidal
  net carbon (CO_2) uptake and net carbon (CO_2 and CH_4) emissions in the salt marshes. NACR is related
  (NECB) of a wetland as follows: NECB = NACR – net lateral flux.

UserGuide

- To run the model, first enable "macros" in your Excel file. If your version of the Excel software does no
  enable "macros" when you open this file. Then save this Excel file as an "Excel Macro-Enabled Workbo
- The model requires at least a single set of data as inputs for the following environmental variables: phot
  (ST), and porewater salinity (SS) in Column B, C, and D, respectively, in the "Coastal Wetland GHG M
- Daily averaged observations of the environmental variables are ideal; however, representative instantan
  recommended to input approximately three sets of observations to represent the beginning (e.g., May), r
  productive period in a year. As a rule of thumb, inclusion of more daily averaged observations of the en
  estimate of the fluxes and NACR over a user-defined period. The 'Example' spreadsheet demonstrates m
  environmental variables for all available days during May-October, 2013.
- Input the desired number of days in Column F ("Enter the number of days for which you want to estima
  predicted GHG fluxes will be upscaled over the user-defined number of days to estimate NACR. We us
  October) for upscaling as a default.
- To quantify the CH_4 emission fluxes and NACR based on IPCC recommended 20 year and 100 year CC
  86 or 34 (recommended) from the dropdown menu in Column G ("Enter CO_2 equivalent global warmin
  from the dropdown menu to estimate the CH_4 emission and NACR without considering any GWP.
- Click the RUN button to get the model predictions and outputs.
- Since this is a power-law based model, you should not give zero or negative values as inputs. A massag
  values are given as inputs. Click OK in the massage box to continue.
- The negative sign of predicted GHG fluxes and NACR indicates uptake (atmosphere to soil) and the po
- Instantaneous daytime uptake fluxes of CO_2, nighttime emission (respiration) fluxes of CO_2, and anytim

3, respectively, as given below. The predicted CO_2 fluxes are upscaled over a user-defined period by ass
for each diurnal cycle (see Eqs. 4-5 below). The CH_4 fluxes are upscaled for 24- hour cycle over the use
NACR over the user-defined period in units of gram carbon per square meter marsh area (gC/m^2).

- A user can choose to use the model for a single or multiple wetland(s) at a time. The model will provide GHG fluxes and NACR if a user provides inputs from multiple wetlands.

〖NEE〗_(CO2,uptake)=−〖10〗^(−3.99) 〖PAR〗^0.6

〖NEE〗_(CO2,emission)=〖10〗^(·

〖NEE〗_(CH4,emission)=〖10〗^(−2.61) |

〖Daytime upscaled net uptake fluxes of CO〗_(2,) 〖NEE〗_(CO2,uptake,upscaled)=(∑_(

〖Nighttime upscaled net emission fluxes of CO〗_(2,) 〖 NEE〗_(CO2,emission,upscaled)

〖Anytime upscaled net emission fluxes of CH〗_(4,) 〖 NEE〗_(CH4,emission,upscaled)=

NACR=〖NEE〗_(CO2,uptake,upscaled)−〖NEE〗_(CO2,emission,upscaled)−〖NEE〗_(C

where, $NEE_{CO2,uptake}$, $NEE_{CO2,emission}$, and PAR are in µmole/m^2/s; $NEE_{CH4,emission}$ is in nmole/m
(ppt). $NEE_{CO2,uptake,upscaled}$, $NEE_{CO2,emission,upscaled}$, $NEE_{CH4,emission,upscaled}$, and NACR are in gC/m^2.
n = number of observational input data (e.g., in the 'Example' spreadsheet, n = 25).
N = User-defined number of days (Column F;183 is used as a deafult)
M =12 g (molecular weight of carbon),
GWP = CO_2 equivalent global warming potential for CH_4 (Column H; 34 is used as a default).

CH_4 GWP options	
1	If GWP is not considered
34	If 100 years GWP is considered (recommended)
86	If 20 years GWP is considered

Model Output

The Excel spreadsheet model will produce the following outputs:

- Predicted CO_2 (units: µmol/m^2/s) and CH_4 (units: nmol/m^2/s) fluxes.
- Upscaled CO_2 and CH_4 fluxes over the user-defined growing period (i.e., up-scaled values) in units of g
- Net atmospheric carbon removal (NACR) over the user-defined period in units of gC/m^2

Reference

Abdul-Aziz, O.I., Ishtiaq, K.S., Tang, J., Moseman-Valtierra, S., Kroeger, K. D., Gonneea, M.E., Mora, J., ar
greenhouse gas (GHG) fluxes in coastal salt marshes: Data analytics, modeling, and predictions." *Under revi*

Copyright and Contact Information

For any query about the model, methodology and excel spreadsheet, please contact with the following pers

1. Dr. Omar I. Abdul-Aziz (email: oiabdulaziz@mail.wvu.edu; omariaaziz@gmail.com)
2. Dr. Khandker S. Ishtiaq (email: khandker.ishtiaq@mail.wvu.edu)

r four different wetlands in
el predicts daytime net uptake
/m^2/s), and net emission fluxes of
temperature (ST, units: °C), and
ilized to select the dominant
ires a single set of input variables

. However, users can decide their

odel can be extended for tidal wetlands in

wetlands. NACR is the difference between
to the net ecosystem carbon balance

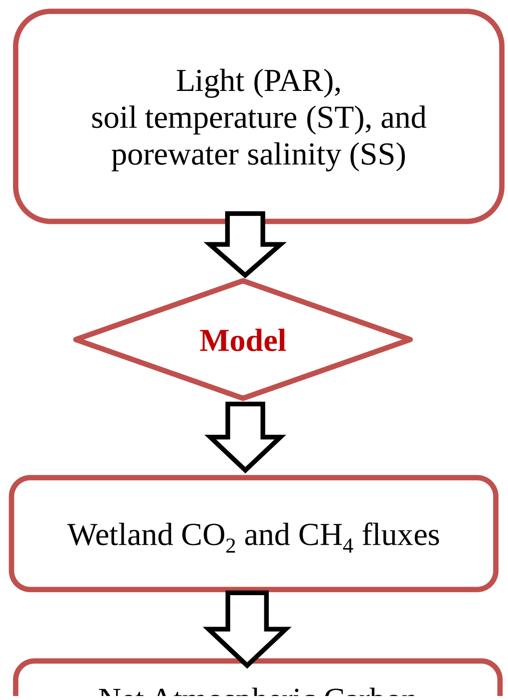
ot have "macros" enabled already, you should be asked to
ook".
tosynthetically active radiation (PAR), soil temperature
Iodel" spreadsheet.
eous observations can also be used. Further, a user is
middle (e.g., August), and end (e.g., October) of the
vironmental variables leads to a more representative
nodel predictions by using daily averaged inputs of

ate net atmospheric carbon removal") from which
ed 183 days (number of productive days from May to

O_2 equivalent global warming potential (GWP), use either
g potential for CH_4"). However, an user can select 1.0

e box will appear indicating an error if zero or negative

sitive sign indicates emissions.
ne emission fluxes of CH_4 are predicted using Eq.1, 2, and



suming 12 hours of daytime and 12 hours of nighttime
ɛr-defined period (Eq. 6). Then, Eq. 7 is used to calculate

Net Atmospheric Carbon Removal (NACR)

ɛ an ensemble average regional-scale predictions of the

(1)

(2)

(3)

$(i=1)^n▒〖NEE〗_(CO2,uptake,i)$ (4)

$=(∑_(i=1)^n▒〖NEE〗_(CO2,emission,i)$ (5)

$(∑_(i=1)^n▒〖NEE〗_(CH4,emission,i))/n×N$ (6)

(7)

^{2}/s; ST is in °C; and SS is in parts per thousand

ɡC/m^2

nd Morkeski, K. (2017). "Environmental controls and emergent scaling of
iew.

sons: