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A modeling approach to investigate drivers, variability and uncertainties in O_2 fluxes and $O_2 : CO_2$ exchange ratios in a temperate forest

Yuan Yan et al.

Correspondence to: Yuan Yan (yuanyantwincities@gmail.com)

Table S1. Nomenclature and abbreviations. ** Units with m^{-2} indicate "per leaf area" (otherwise always "per ground area").

Abbreviation	Unit	Full name
ARQ	$mol\ mol^{-1}$	apparent respiratory quotient
b	$\mu mol\ m^{-2}\ s^{-1}$ **	intercept of Ball-Berry model after Collatz et al. (1991)
$CO_{2\ atm}$	ppm	atmospheric CO_2 mole fraction
c_p	$J\ kg^{-1}\ K^{-1}$	specific heat capacity of air
DOY		day of year
Equ_{O_2}	ppm	difference of O_2 mole fraction from 209750 ppm (derived as the intercept of the relationship between measured atmospheric O_2 and CO_2 mole fractions, see Table 1 in the main text)
ER	$mol\ mol^{-1}$	O_2:CO_2 exchange ratio
ER_A	$mol\ mol^{-1}$	O_2:CO_2 exchange ratio of gross assimilation
ER_A^b	$mol\ mol^{-1}$	a priori mean of ER_A
ER_{An}	$mol\ mol^{-1}$	O_2:CO_2 exchange ratio of net assimilation
ER_{conc}	$mol\ mol^{-1}$	atmospheric O_2:CO_2 mole fraction ratio
ER^z_{conc}	$mol\ mol^{-1}$	height dependent atmospheric O_2:CO_2 mole fraction ratio
ER_{eco}	$mol\ mol^{-1}$	ecosystem O_2:CO_2 exchange ratio
ER^z_{eco}	$mol\ mol^{-1}$	height dependent ecosystem O_2:CO_2 exchange ratio
ER_R	$mol\ mol^{-1}$	O_2:CO_2 exchange ratio of ecosystem respiration
ER_R^b	$mol\ mol^{-1}$	a priori mean of ER_R
ER_{rd}	$mol\ mol^{-1}$	O_2:CO_2 exchange ratio of leaf dark respiration
ER_{soil}	$mol\ mol^{-1}$	O_2:CO_2 exchange ratio of soil respiration
ER_{stem}	$mol\ mol^{-1}$	O_2:CO_2 exchange ratio of stem respiration
F_A	$\mu mol\ m^{-2}\ s^{-1}$	gross assimilation CO_2 flux (gross carboxylation minus photorespiration)
F_A^b	$\mu mol\ m^{-2}\ s^{-1}$	a priori mean of F_A
F_{CO_2}	$\mu mol\ m^{-2}\ s^{-1}$	net ecosystem CO_2 flux
$F^z_{CO_2}$	$\mu mol\ m^{-2}\ s^{-1}$	height dependent net ecosystem CO_2 flux
$F^{\sim}_{CO_2}$	$\mu mol\ m^{-2}\ s^{-1}$	net turbulent CO_2 flux
f_{DBH}		fraction of stem diameter to the diameter at breast height

f_{LAI}		fraction of LAI per layer
F_{O_2}	µmol m^{-2} s^{-1}	net ecosystem O_2 flux
$F_{O_2}^{z}$	µmol m^{-2} s^{-1}	height dependent net ecosystem O_2 flux
$F_{O_2}^{\sim}$	µmol m^{-2} s^{-1}	net turbulent O_2 flux
F_R	µmol m^{-2} s^{-1}	gross ecosystem respiration CO_2 flux
F_R^b	µmol m^{-2} s^{-1}	a priori mean of F_R
F_{rd}	µmol m^{-2} s^{-1}	leaf dark respiration CO_2 flux
F_{soil}	µmol m^{-2} s^{-1}	soil respiration CO_2 flux
F_{stem}	µmol m^{-2} s^{-1}	stem respiration CO_2 flux
H	W m^{-2}	net ecosystem sensible heat flux
$H^{\sim}$	W m^{-2}	net turbulent sensible heat flux
ht	m	canopy height
J		cost function
J_{max25}	µmol m^{-2} s^{-1}	maximum electron transport rate at 25 °C
k_{ball}		slope of Ball-Berry model after Collatz et al. (1991)
K_c, K_o, K_T, K_v	m^2 s^{-1}	eddy diffusivity of CO_2, O_2, heat and water vapor
LAI	m^2 m^{-2}	leaf area index
LE	W m^{-2}	net ecosystem latent heat flux
$LE^{\sim}$	W m^{-2}	net turbulent latent heat flux
$leaf_{out}$		DOY for the start of leaf growth
$leaf_{full}$		DOY for the end of leaf growth
$leaf_{fall}$		DOY for the start of leaf fall
$leaf_{fall\_complete}$		DOY for the end of leaf fall
MCMC		Markov-Chain Monte Carlo methods
$O_{2\ atm}$	ppm	atmospheric O_2 mole fraction
OR		oxidative ratio
r_1, r_2		coefficients for exponential relationship between soil temperature and soil respiration
R_{d25}	µmol m^{-2} s^{-1}	leaf dark respiration at 25 °C
RMSE		root mean squared error

T	°C	air temperature
T_{leaf}	°C	leaf temperature
T_{optjm}	°C	optimum temperature for electron transport
T_{optvc}	°C	optimum temperature for maximum carboxylation
V_{cmax25}	μmol m^{-2} s^{-1} **	maximum carboxylation at 25 °C
WAI	m^2 m^{-2}	wood area index
z	m	height above the surface
α		fraction of the photosystem II activity
Δc	ppm	vertical CO_2 mole fraction difference
$\Delta F_{O_2,(c,T,v)}$	μmol m^{-2} s^{-1}	difference between O_2 fluxes derived by the flux-gradient method and by model simulations. The subscripts c, T and v represent the considered scalar profiles for CO_2 mole fraction, temperature and water vapor.
Δo	ppm	vertical O_2 mole fraction difference
ΔT	°C	vertical air temperature difference
Δv	kg m^{-3}	vertical water vapor density difference
Δz	m	vertical height difference
θ_J		curvature parameter of light response curve
λ	J kg^{-1}	latent heat of vaporization
ρ_m	kg m^{-3}	air mass density
ρ_n	mol m^{-3}	air molar density
σ_{ER_A}	mol mol^{-1}	a posteriori uncertainty of ER_A
$\sigma_{ER_A^b}$	mol mol^{-1}	a priori uncertainty of ER_A
σ_{ER_R}	mol mol^{-1}	a posteriori uncertainty of ER_R
$\sigma_{ER_R^b}$	mol mol^{-1}	a priori uncertainty of ER_R
σ_{F_A}	μmol m^{-2} s^{-1}	a posteriori uncertainty of F_A
$\sigma_{F_A^b}$	μmol m^{-2} s^{-1}	a priori uncertainty of F_A
$\sigma_{F_{CO_2}}$	μmol m^{-2} s^{-1}	uncertainty of CO_2 flux estimates
$\sigma_{F_{O_2}}$	μmol m^{-2} s^{-1}	uncertainty of O_2 flux estimates
σ_{F_R}	μmol m^{-2} s^{-1}	a posteriori uncertainty of F_R
$\sigma_{F_R^b}$	μmol m^{-2} s^{-1}	a priori uncertainty of F_R

References

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