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Ozone dry deposition through plant stomata: multi-model comparison with flux observations and the role of water stress as part of AQMEII4 Activity 2

Anam M. Khan et al.

Correspondence to: Anam M. Khan (anmikhan@gmail.com)

Table S1: Number of simulations and associated parameter values for each parameter and single-point model

Parameter	Model	Number of simulations	Simulation values
$R_{s,H_2O,ideal}$	WRF-Chem Wesely	5	[100, 163, 225, 288, 350]
	GEOS-Chem Wesely	5	[100, 163, 225, 288, 350]
	IFS SUMO Wesely	5	[100, 163, 225, 288, 350]
	IFS GEOS-Chem Wesely	5	[100, 163, 225, 288, 350]
	GEM-MACH Wesely	5	[100, 163, 225, 288, 350]
	GEM-MACH Zhang	5	[100, 163, 225, 288, 350]
	CMAQ STAGE	5	[100, 163, 225, 288, 350]
	TEMIR Wesely	5	[100, 163, 225, 288, 350]
	TEMIR Zhang	5	[100, 163, 225, 288, 350]
$G_{s,H_2O,max}$	DO_3SE multi	5	[0.001, 0.0025, 0.004, 0.0055, 0.007]
VPD_{max}	DO_3SE multi	5	[2.5, 2, 1.5, 1, 0.5]
D_o	DO_3SE psn	5	[2, 2.25, 2.5, 2.75, 3]
B_{VPD}	GEM-MACH Zhang	6	[0, 0.1, 0.2, 0.3, 0.4, 0.5]
	TEMIR Zhang	6	[0, 0.1, 0.2, 0.3, 0.4, 0.5]
B	TEMIR Wesely BB	5	[2.5, 3.625, 4.75, 5.875, 7]
	TEMIR Wesely Medlyn	5	[2.5, 3.625, 4.75, 5.875, 7]
W_{wlt}	IFS SUMO Wesely	6	[-1.0E+9, 0.01, 0.0325, 0.055, 0.0775, 0.1]
	CMAQ STAGE	6	[-1.0E+9, 0.01, 0.0325, 0.055, 0.0775, 0.1]
	MLC-CHEM	6	[-1.0E+9, 0.01, 0.0325, 0.055, 0.0775, 0.1]
	DO_3SE multi	6	[-0.5, 0.01, 0.0325, 0.055, 0.0775, 0.1]
	DO_3SE psn	6	[-0.5, 0.01, 0.0325, 0.055, 0.0775, 0.1]
$\psi_{soil,wlt}$	TEMIR Wesely BB	6	[-1.0E+9, -3000, -2375, -1750, -1125, -500]
	TEMIR Wesely Medlyn	6	[-1.0E+9, -3000, -2375, -1750, -1125, -500]
$\psi_{leaf,min}$	GEM-MACH Zhang	7	[-1.0E+9, -5, -4.55, -4.1, -3.65, -3.20, -2.75]
	TEMIR Zhang	7	[-1.0E+9, -5, -4.55, -4.1, -3.65, -3.20, -2.75]
$g_{1,BB}$	TEMIR Wesely BB	5	[4, 5.8, 7.5, 9.3, 11]
$g_{1,M}$	Temir Wesely Medlyn	5	[1.5, 2.5, 3.5, 4.5, 5.5]
$g_{1,L}$	DO_3SE psn	5	[6, 7.3, 8.5, 9.8, 11]
	MLC-CHEM	5	[6, 7.3, 8.5, 9.8, 11]
$f(VPD)$	IFS SUMO Wesely	5	[0.1, 0.325, 0.55, 0.775, 1]
	GEM-MACH Wesely	5	[0.1, 0.325, 0.55, 0.775, 1]
$f(RH_l)$	CMAQ STAGE	5	[0.1, 0.325, 0.55, 0.775, 1]

Table S2: Parameter values used for the base simulation of models using the $G_{s,H_2O,max}$ parameter

Parameter	Model	Site	Base value
$G_{s,H_2O,max}$	DO_3SE multi	Harvard Forest	0.00549
		Borden Forest	0.00549
		Ispra	0.00549
		Hyytiälä	0.00463
		Ramat Hanadiv	0.00475
		Bugacpuszta	0.00659

Table S3: Parameter values used for the base simulation of models using the VPD_{max} parameter

Parameter	Model	Site	Base value
VPD_{max}	DO_3SE multi	Harvard Forest	3
		Borden Forest	3
		Ispra	3.25
		Hyytiälä	3.1
		Ramat Hanadiv	4
		Bugacpuszta	3

Table S4: Parameter values used for the base simulation of models using the D_o parameter

Parameter	Model	Site	Base value
D_o	DO_3SE psn	Harvard Forest	2.42
		Borden Forest	2.42
		Ispra	2.42
		Hyytiälä	2.55
		Ramat Hanadiv	2.25
		Bugacpuszta	2.15

Table S5: Parameter values used for the base simulation of models using the B_{VPD} parameter

Parameter	**Model**	**Site**	**Base value**
B_{VPD}	GEM-MACH Zhang	Harvard Forest	0.34
		Borden Forest	0.34
		Ispra	0.36
		Hyytiälä	0.31
		Ramat Hanadiv	0.27
		Bugacpuszta	0
	TEMIR Zhang	Harvard Forest	0.36
		Borden Forest	0.36
		Ispra	0.36
		Hyytiälä	0.31
		Ramat Hanadiv	0
		Bugacpuszta	0

Table S6: Parameter values used for the base simulation of models using the B parameter

Parameter	**Model**	**Site**	**Base value**
B	TEMIR Wesely BB	Harvard Forest	4.508
		Borden Forest	4.46
		Ispra	3.97
		Hyytiälä	3.66
		Ramat Hanadiv	4.52
		Bugacpuszta	4.9
	TEMIR Wesley Medlyn	Same as TEMIR Wesley BB	

Table S7: Parameter values used for the base simulation of models using the W_{wlt} parameter

Parameter	**Model**	**Site**	**Base value**
W_{wlt}	IFS SUMO Wesley	Harvard Forest	0.0954
		Borden Forest	0.078
		Ispra	0.059
		Hyytiälä	0.0522
		Ramat Hanadiv	0.1
		Bugacpuszta	0.081
	CMAQ STAGE	Same as IFS SUMO Wesely	
	MLC-CHEM	Same as IFS SUMO Wesely	
	DO_3SE multi	Same as IFS SUMO Wesely	
	DO_3SE psn	Same as IFS SUMO Wesely	

Table S8: Parameter values used for the base simulation of models using the $\psi_{soil,wlt}$ parameter

Parameter	Model	Base value
$\psi_{soil,wlt}$	TEMIR Wesely BB	-1500
	TEMIR Wesely Medlyn	-1500

Table S9: Parameter values used for the base simulation of models using the $\psi_{leaf,min}$ parameter

Parameter	Model	Site	Base value
$\psi_{leaf,min}$	GEM-MACH Zhang	Harvard Forest	-2
		Borden Forest	-2
		Ispra	-1.9
		Hyytiälä	-2
		Ramat Hanadiv	-2
		Bugacpuszta	-1.5
	TEMIR Zhang	Harvard Forest	-1.9
		Borden Forest	-1.9
		Ispra	-1.9
		Hyytiälä	-2
		Ramat Hanadiv	-1.5
		Bugacpuszta	-1.5

Table S10: Parameter values used for the base simulation of models using the $g_{1,BB}$, $g_{1,M}$, and $g_{1,L}$ parameters

Parameter	Model	Site	Base value
$g_{1,BB}$	TEMIR Wesely BB	Not site specific	9
$g_{1,M}$	Temir Wesely Medlyn	Harvard Forest	4.45
		Borden Forest	4.45
		Ispra	4.45
		Hyytiälä	2.35
		Ramat Hanadiv	5.25
		Bugacpuszta	5.25
$g_{1,L}$	DO_3SE psn	Harvard Forest	8.17
		Borden Forest	8.17
		Ispra	8.17
		Hyytiälä	6.355
		Ramat Hanadiv	8.17
		Bugacpuszta	8.17
	MLC-CHEM	Not site-specific	9.09

Table S11: Stress functions in the base simulations of models that use $f(VPD)$ and $f(RH_l)$.

Stress function	Model	Base value
$f(VPD)$	IFS SUMO Wesely	Varies as a function of VPD
	GEM-MACH Wesely	Varies as a function of VPD
$f(RH_l)$	CMAQ STAGE	Varies as a function of RH_l

Table S12: Parameter values used for the base simulation of models using the $R_{s,H_2O,ideal}$ parameter

Parameter	Model	Site	Season	Base value
$R_{s,H_2O,ideal}$	WRF-Chem Wesely	Harvard Forest	Midsummer	70
			Autumn	1.0E+11
		Borden Forest	Midsummer	100
			Autumn	500
		Ispra	Midsummer	70
			Autumn	1.0E+11
		Hyytiälä	Midsummer	130
			Autumn	250
		Ramat Hanadiv	Midsummer	120
			Autumn	1.0E+11
		Bugacpuszta	Midsummer	120
			Autumn	1.0E+11
	GEOS-Chem Wesely	Harvard Forest	Not season-specific	200
		Borden Forest	Not season-specific	200
		Ispra	Not season-specific	200
		Hyytiälä	Not season-specific	200
		Ramat Hanadiv	Not season-specific	200
		Bugacpuszta	Not season-specific	200
	IFS SUMO Wesley	Harvard Forest	Not season-specific	250
		Borden Forest	Not season-specific	250
		Ispra	Not season-specific	250
		Hyytiälä	Not season-specific	250
		Ramat Hanadiv	Not season-specific	225
		Bugacpuszta	Not season-specific	100
	IFS GEOS-Chem Wesely	Harvard Forest	Not season-specifc	200
		Borden Forest	Not season-specific	200
		Ispra	Not season-specific	200
		Hyytiälä	Not season-specific	400
		Ramat Hanadiv	Not season-specific	200
		Bugacpuszta	Not season-specific	200
	GEM-MACH Wesely	Harvard Forest	Midsummer	100
			Autumn	800
			Late Autumn	800
			Winter	800
			Spring	190
		Borden Forest	Midsummer	100
			Autumn	800
			Late Autumn	800
			Winter	800
			Spring	190
		Ispra	Midsummer	70
			Autumn	9999
			Late Autumn	9999
			Winter	9999
			Spring	140
		Hyytiälä	Midsummer	130
			Autumn	250
			Late Autumn	250
			Winter	400
			Spring	250
		Ramat Hanadiv	Midsummer	70
			Autumn	9999
			Late Autumn	9999
			Winter	9999
			Spring	140
		Bugacpuszta	Midsummer	120
			Autumn	9999
			Late Autumn	9999
			Winter	9999
			Spring	240
	GEM-MACH Zhang	Harvard Forest	Not season-specific	150
		Borden Forest	Not season-specific	150
		Ispra	Not season-specific	150
		Hyytiälä	Not season-specific	250
		Ramat Hanadiv	Not season-specific	150
		Bugacpuszta	Not season-specific	100
	CMAQ STAGE	Harvard Forest	Not season-specifc	200
		Borden Forest	Not season-specific	100
		Ispra	Not season-specific	200
		Hyytiälä	Not season-specific	175
		Ramat Hanadiv	Not season-specific	200
		Bugacpuszta	Not season-specific	100
	TEMIR Wesely	Same as GEOS-Chem Wesely		
	TEMIR Zhang	Harvard Forest	Not season-specifc	150
		Borden Forest	Not season-specific	150
		Ispra	Not season-specific	150
		Hyytiälä	Not season-specific	250
		Ramat Hanadiv	Not season-specific	150
		Bugacpuszta	Not season-specific	150

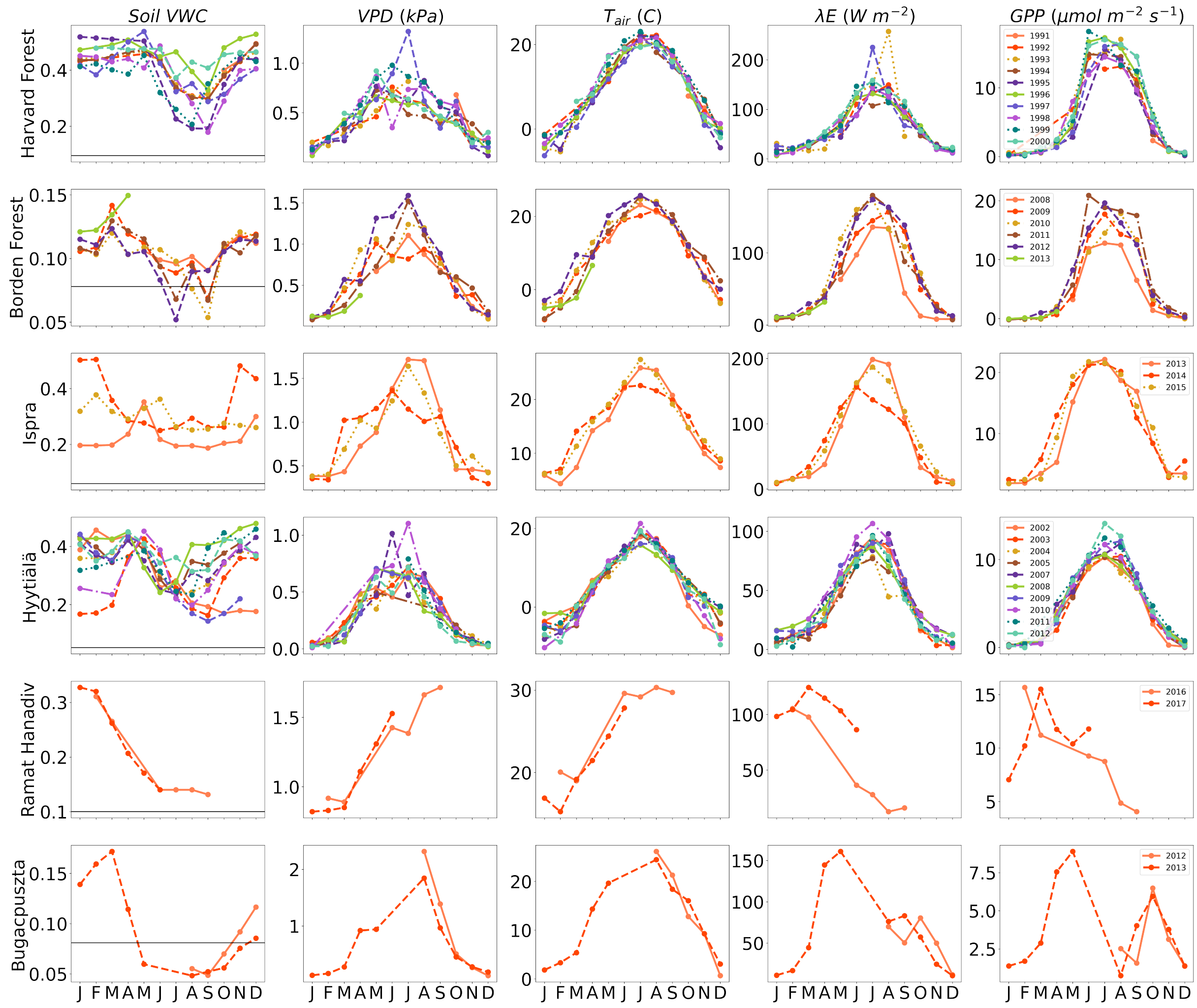

Figure S1: Monthly averages of soil volumetric water content ($Soil\ VWC$), air vapor pressure deficit at measurement height (VPD), air temperature (T_{air}), latent heat flux (λE), and gross primary productivity (GPP) at flux tower sites used in the study. Rows are labeled by site and columns are labeled by the variable plotted on the y-axis. The horizontal gray line in column 1 marks the wilting point for soil moisture that was set for the site in single-point model base simulations. Details about site observations are listed in Table 1. Months without dots do not have available data.

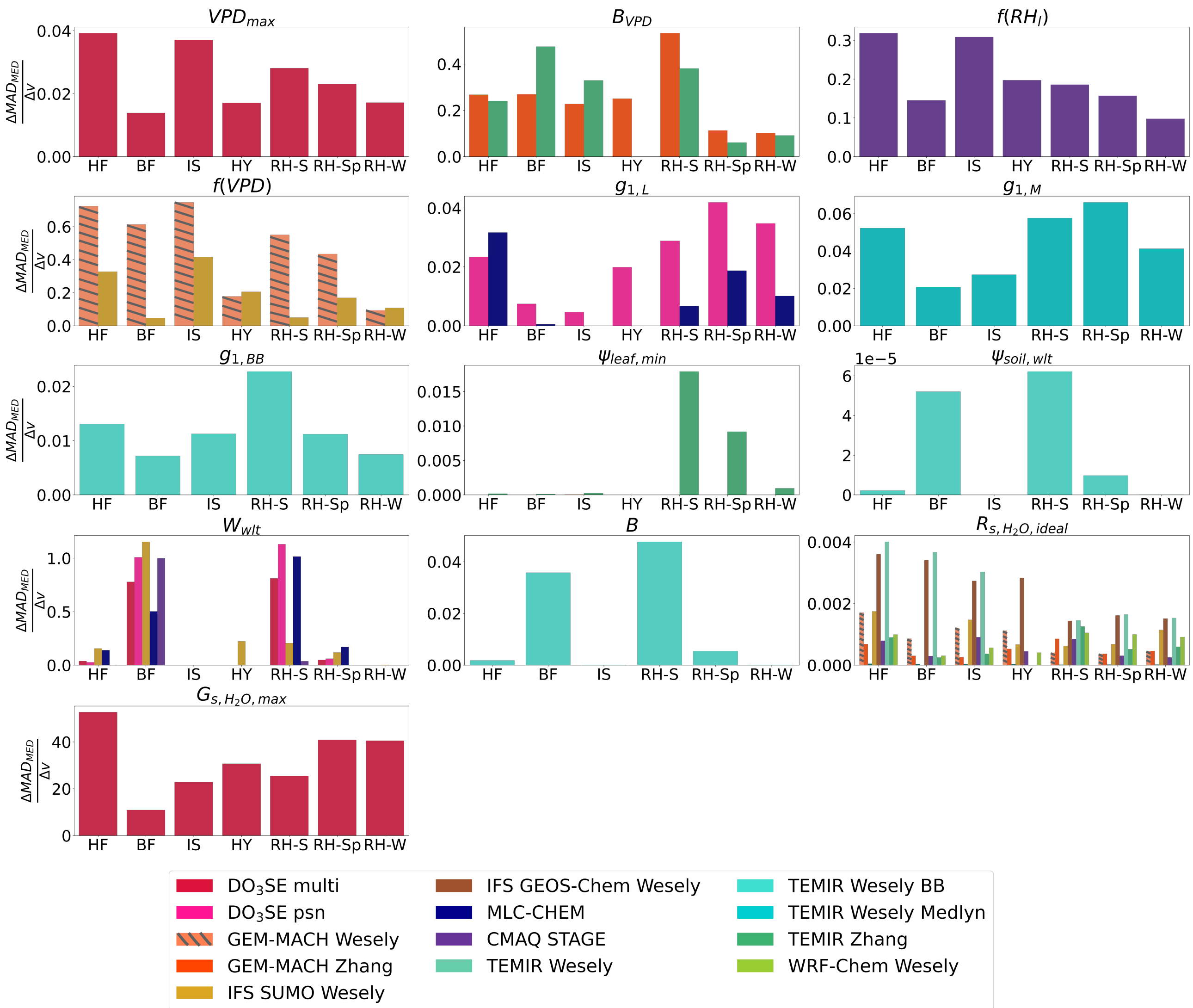

Figure S2: Comparisons of the change in median absolute difference between single point modeled eg_s and flux-based $eg_{s,MED}$ (ΔMAD_{MED}) with change in a parameter or stress function value (Δv) for each parameter and stress function at each site. For each model-parameter pair or model-stress function pair, one summer $\frac{\Delta MAD_{MED}}{\Delta v}$ was calculated for Harvard Forest (HF), Borden Forest (BF), Ispra, (IS), and Hyytiälä (HY), and three $\frac{\Delta MAD_{MED}}{\Delta v}$ were calculated for Ramat Hanadiv: winter (RH-W), spring (RH-Sp), and summer (RH-S). MAD_{MED} was calculated using daytime (half-) hourly estimates of eg_s.

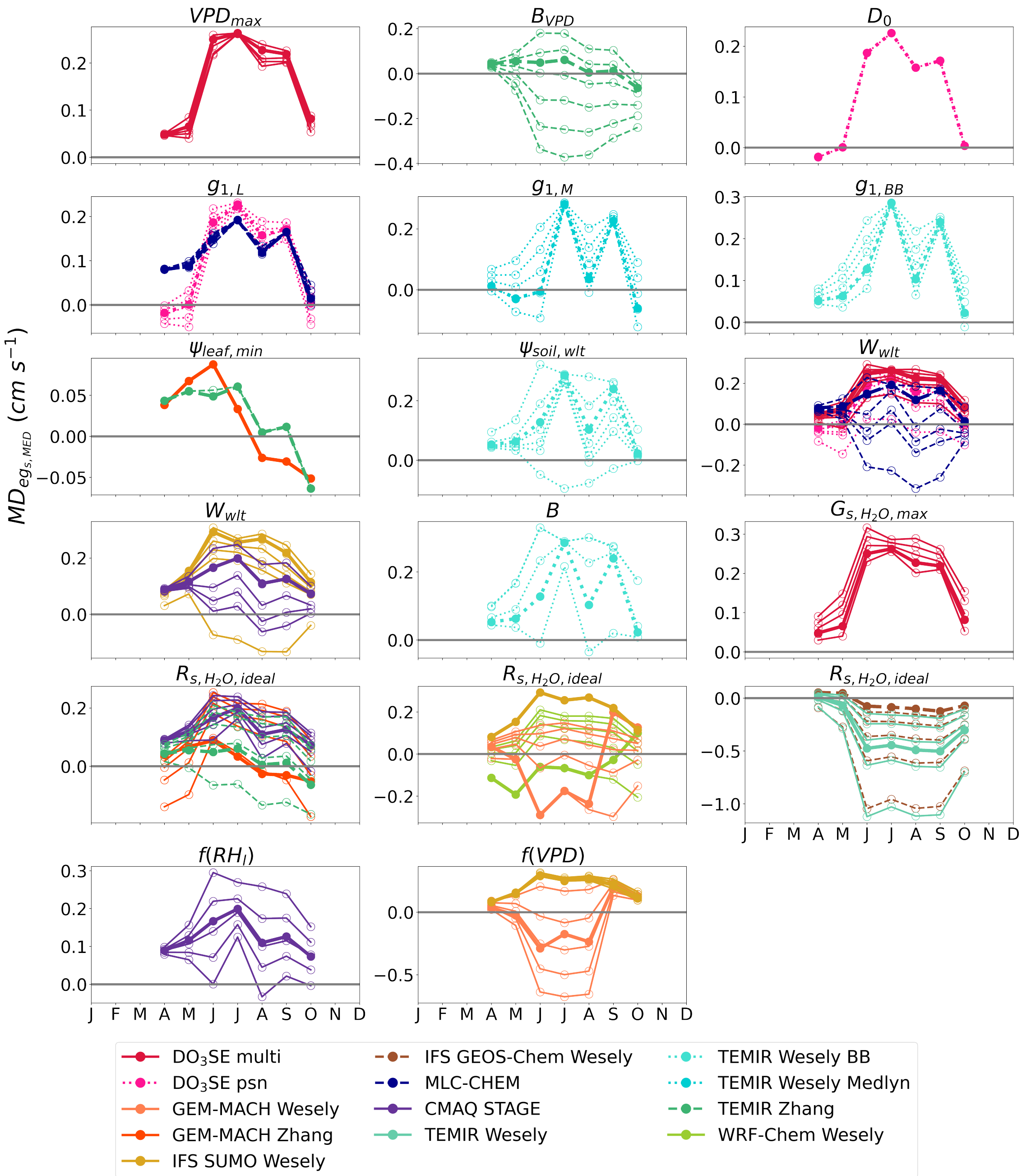

Figure S3: The 2011 and 2012 multiyear monthly median difference between single-point modeled eg_s and observed flux-based $eg_{s,MED}$ ($MD_{eg_{s,MED}}$) at Borden Forest for base and sensitivity simulations of single-point models. Sensitivity simulations perturbed the values of each parameter and stress function. Lines with filled dots show the $MD_{eg_{s,MED}}$ for base simulations of single-point models. Lines with open dots show the $MD_{eg_{s,MED}}$ for each parameter or stress function perturbation where each line represents one perturbation. Table 2 lists the interpretation of the parameters, stress functions, and the values used for sensitivity simulations. W_{wlt} and $R_{s,H_2O,ideal}$ are shared among many models, and they are displayed in multiple plots to avoid plotting many model results in a single plot.

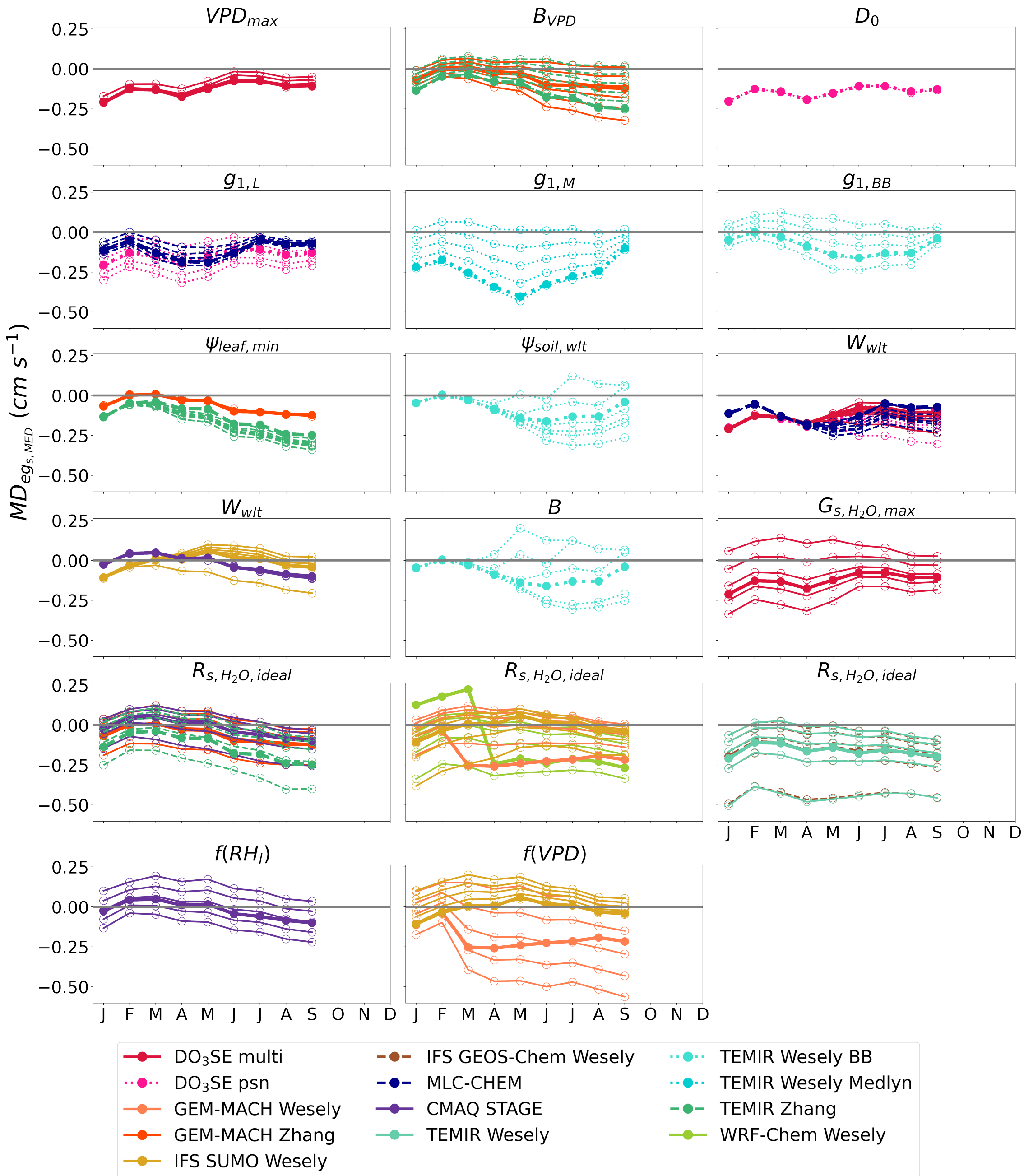

Figure S4: Monthly median difference between single-point modeled eg_s and observed flux-based $eg_{s,MED}$ ($MD_{eg_{s,MED}}$) at Ramat Hanadiv for base and sensitivity simulations of single-point models. Some months have multiple years of data. Sensitivity simulations perturbed the values of each parameter and stress function. Lines with filled dots show the $MD_{eg_{s,MED}}$ for base simulations of single-point models. Lines with open dots show the $MD_{eg_{s,MED}}$ for each parameter or stress function perturbation where each line represents one perturbation. Table 2 lists the interpretation of the parameters, stress functions, and the values used for sensitivity simulations. W_{wlt} and $R_{s,H_2O,ideal}$ are shared among many models, and they are displayed in multiple plots to avoid plotting many model results in a single plot.