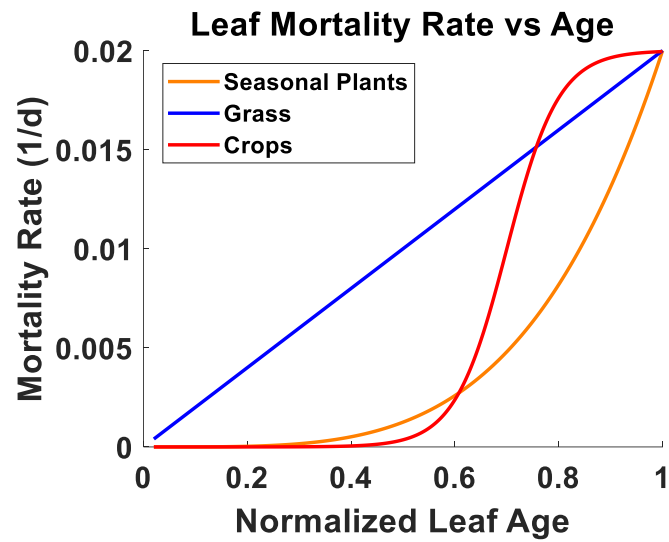


S1: Leaf Turnover Modification



Our modification, in the form of a sigmoidal function, ensures that the majority of leaf turnover occurs as leaf age approaches the critical age, rather than in the early phases, which is more realistic for crops.

S2: Crop Planting and Harvest Dates

BE-LON	Sugar Beet	30/03/2004	29/09/2004	CH-OE2	Winter Barley	29/09/2004	14/07/2005
	Winter Wheat	14/10/2004	03/08/2005		Cover crop	09/08/2005	
	Potatoes	01/05/2006	19/09/2006		Potato	05/05/2006	
	Winter Wheat	13/10/2006	05/08/2007		Winter Wheat	19/10/2006	15/07/2007
	Sugar Beet	22/04/2008	04/11/2008		Winter Rapeseed	28/08/2007	16/07/2008
	Winter Wheat	13/11/2008	07/08/2009		Winter Wheat	07/10/2008	21/07/2009
	Mustard	01/09/2009	01/12/2009		Cover crop	12/08/2009	
	Potatoes	24/04/2010	03/09/2010		Peas	09/05/2010	19/07/2010
	Winter Wheat	13/10/2010	16/08/2011		Winter Wheat	15/10/2010	02/08/2011
	Maize	14/05/2012	13/10/2012		Winter Barley	24/09/2011	09/07/2012
	Winter Wheat	25/10/2012	12/08/2013		Winter Rapeseed	04/09/2012	28/07/2013
	Mustard	05/09/2013	15/11/2013		Winter Wheat	19/10/2013	24/07/2014
	Potatoes	05/04/2014	21/08/2014		Winter Barley	29/09/2014	04/07/2015
	Winter Wheat	14/10/2014	02/08/2015		Cover crop	03/08/2015	
	Mustard	21/08/2015	07/12/2015		Peas	09/05/2016	25/07/2016
	Sugar Beet	12/04/2016	27/10/2016		Winter Wheat	12/10/2016	19/07/2017
	Winter Wheat	29/10/2016	29/07/2017		Winter Rapeseed	30/08/2017	12/07/2018
	Mustard	06/09/2017	06/12/2017		Winter Wheat	11/10/2018	19/07/2019
	Potatoes	22/04/2018	11/09/2018		Winter Barley	04/10/2019	01/07/2020
	Winter Wheat	10/10/2018	01/08/2019		Grass	03/04/2020	19/10/2020
Oat/Faba Bean	09/08/2019	04/12/2019	Maize	01/04/2020	09/11/2009		
Sugar Beet	01/04/2020	12/11/2020	Maize	01/04/2019	21/09/2010		
Spinach	01/04/2021	09/06/2021	Maize	01/05/2018	26/10/2011		
Green Dwarf Bean	22/07/2021	24/10/2021	Maize	01/04/2024	10/10/2012		
US-NE1	Maize	01/05/2010	18/10/2001	US-NE1	Maize	01/04/2029	22/10/2013
	Maize	01/05/2009	04/11/2002		Maize	01/04/2021	28/10/2014
	Maize	01/05/2015	27/10/2003		Maize	01/04/1930	26/10/2015
	Maize	01/05/2003	15/10/2004		Maize	01/05/2019	22/09/2016
	Maize	01/05/2004	15/10/2005		Maize	01/04/2027	25/10/2017
	Maize	01/05/2005	05/10/2006		Maize	01/05/2008	31/10/2018
	Maize	01/05/2001	05/11/2007		Maize	01/04/2019	04/11/2019
	Maize	01/04/2029	18/11/2008		Maize	01/04/2020	17/09/2020

S3: Fertilizer Applications CH-OE2

CH-OE2 Recorded Fertilizer Applications							
Date	N (g m ⁻²)	P(g m ⁻²)	K(g m ⁻²)	Date	N (g m ⁻²)	P (g m ⁻²)	K (g m ⁻²)
15.04.2004	4	0.00	0.00	01.04.2011	5	0.00	0.00
03.05.2004	4	0.70	1.33	02.04.2011	4	0.70	1.33
07.06.2004	2.5	0.00	0.00	02.08.2011	3.75	0.00	0.00
04.08.2004	2.2	0.00	0.00	03.04.2012	4	0.00	0.00
14.04.2005	4	0.00	0.00	28.04.2012	2	0.35	0.67
13.05.2005	2	0.35	0.67	04.09.2012	0	2.27	8.33
14.07.2005	4.05	0.00	0.00	05.04.2013	8.1	0.00	0.00
01.05.2006	7.69	2.52	8.03	18.04.2013	6.3	0.22	0.00
05.05.2006	4.2	2.10	12.00	30.03.2014	5	0.00	0.00
05.05.2006	0	0.00	16.67	17.05.2014	4	0.70	1.33
01.06.2006	8.4	0.00	0.00	24.07.2014	4.4	0.00	0.00
18.10.2006	3.15	0.00	0.00	12.09.2014	0	2.01	8.33
15.03.2007	5	0.00	0.00	10.04.2015	5	0.00	0.00
27.05.2007	4	0.70	1.33	23.04.2015	4	0.70	1.33
15.07.2007	5	0.00	0.00	04.07.2015	2.5	0.00	0.00
28.08.2007	0	0.00	0.00	18.03.2016	11.93	3.91	12.45
28.08.2007	0	0.00	0.00	27.03.2017	5.5	0.00	0.00
02.09.2007	0.5	0.57	2.08	02.04.2017	4.7109	0.54	5.62
17.04.2008	2.7	0.00	0.00	27.05.2017	2.5	0.00	0.00
18.03.2009	0	0.96	5.50	19.07.2017	2.7	0.00	0.00
02.04.2009	3.75	0.00	0.00	29.08.2017	1	0.87	4.17
20.05.2009	4	0.70	1.33	28.02.2018	2.7	2.01	5.00
21.07.2009	3.85	0.00	0.00	09.04.2018	8.1	0.00	0.00
12.08.2009	3.43	3.65	6.88	09.04.2018	6.3	0.22	0.00
27.03.2010	4	4.00	4.00	09.10.2018	0.5	0.44	2.08
06.05.2010	0	0.00	0.00	11.10.2018	0	1.75	5.00
09.05.2010	5.96	1.96	6.23	01.04.2019	5	0.00	0.00
04.06.2010	0	3.01	7.50	24.05.2019	4	0.00	0.00
15.03.2011	3	0.00	0.00	19.07.2019	4.6	0.00	0.00

S4: Site Statistics

US-NE1 – MAIZE CONTINUOUS ROTATION

Yields (Annual)
R-squared: 0.01
RMSE: 2.98 [gC / m²]
IOA: 0.14

LAI DAILY
R-squared: 0.77
RMSE: 1.11
IOA: 0.93

GPP Daily
R-squared: 0.81
RMSE: 4.16
IOA: 0.94

Rn Monthly
R-squared: 0.98
RMSE: 12.95 [W/m²]
IOA: 0.99

H Monthly
R-squared: 0.70
RMSE: 9.73 [W/m²]
IOA: 0.90

QE Monthly
R-squared: 0.98
RMSE: 10.5 [W/m²]
IOA: 0.99

Rn HOURLY
R-squared: 0.99
RMSE: 13.51 [W/m²]
IOA: 0.99

H HOURLY
R-squared: 0.93
RMSE: 20.60 [W/m²]
IOA: 0.92

QE HOURLY
R-squared: 0.99
RMSE: 4.98 [W/m²]
IOA: 0.99

CH-CHA – GRASS

Yields (Annual)
R-squared: 0.89
RMSE: 0.56
IOA: 0.97

LAI DAILY
R-squared: 0.3666
RMSE: 1.3896
IOA: 0.7598

GPP Daily
R-squared: 0.4672
RMSE: 4.6963
IOA: 0.8097

Rn Monthly
R-squared: 0.9989
RMSE: 10.8123
IOA: 0.9899

H Monthly
R-squared: 0.9576
RMSE: 12.4517
IOA: 0.7558

QE Monthly
R-squared: 0.9851
RMSE: 9.8401
IOA: 0.9832

Rn HOURLY
R-squared: 0.9857
RMSE: 16.8752
IOA: 0.9951

H HOURLY
R-squared: 0.8241
RMSE: 14.4625
IOA: 0.9022

QE HOURLY
R-squared: 0.9654
RMSE: 13.6610
IOA: 0.9862

BE-LON– CROP ROTATION

Yields (Annual)
R-squared: 0.52
RMSE: 1.98
IOA: 0.66

LAI DAILY
R-squared: 0.3267
RMSE: 1.4596
IOA: 0.7345

GPP Daily
R-squared: 0.59
RMSE: 5.1289
IOA: 0.7713

Rn Monthly
R-squared: 0.9668
RMSE: 10.6468
IOA: 0.9882

H Monthly
R-squared: 0.6534
RMSE: 15.8937
IOA: 0.7371

QE Monthly
R-squared: 0.9505
RMSE: 21.3993
IOA: 0.8779

Rn HOURLY
R-squared: 0.9988
RMSE: 8.5020
IOA: 0.9984

H HOURLY
R-squared: 0.9748
RMSE: 14.4316
IOA: 0.9371

QE HOURLY
R-squared: 0.9949
RMSE: 11.6733
IOA: 0.9729

CH-OE2 – CROP ROTATION

Yields (Annual)
R-squared: 0.89
RMSE: 0.56
IOA: 0.97

LAI DAILY
R-squared: 0.2604
RMSE: 1.0635
IOA: 0.7040

GPP Daily
R-squared: 0.5153
RMSE: 3.9298
IOA: 0.8375

Rn Monthly
NA site data

H Monthly
R-squared: 0.6862
RMSE: 19.6352
IOA: 0.7063

QE Monthly
R-squared: 0.9455
RMSE: 19.0611
IOA: 0.9176

Rn HOURLY
NA site data

H HOURLY
R-squared: 0.9026
RMSE: 18.1636
IOA: 0.9124

QE HOURLY
R-squared: 0.9967
RMSE: 23.2496
IOA: 0.9162

S5: Site Statistics

Yields: US-NE1			
Year	MODGRAIN	OBSGRAIN	Δ (%)
2002	4.2	5.6	24.6
2003	4.5	5.2	13.8
2004	4.6	5.3	14.1
2005	4.7	5.2	10.5
2006	4.4	4.5	2.8
2007	4.2	5.5	23.6
2008	4.2	5.2	18.7
2009	4.6	5.8	20.4
2010	-	-	-
2011	4.2	5.2	18.1
2012	5.6	5.6	0.2
AVG	4.5	5.3	14.7

Yields: CH-OE2									
CROP	OBS AGB	MOD AGB	Δ (%)	OBS STRAW	MOD STRAW	Δ (%)	OBS GRAIN	MOD GRAIN	Δ (%)
Wheat (2004)	4.5	3.7	17.1	1.6	1.3	17.8	2.9	2.4	15.7
Barley (2005)	4.0	3.5	13.4	0.7	1.2	- 79.9	3.3	2.2	32.5
Wheat (2007)	4.0	2.4	39.0	1.7	0.9	47.5	2.3	1.6	30.0
Rape Seed (2008)	NaN	3.7	NaN	NaN	NaN	NaN	1.8	2.1	- 16.6
Wheat (2009)	4.1	3.4	17.1	1.4	1.2	14.2	2.6	2.2	18.1
Peas (2010)	0.4	NaN		NaN	NaN		0.4	0.7	
Wheat (2011)	4.2	4.3	-0.2	1.5	1.6	-2.4	2.7	2.7	-0.6
Bareley (2012)	4.0	4.3	-7.2	0.8	1.4	- 79.6	3.2	2.9	10.1
Rape Seed (2013)	NaN	4.1	NaN	NaN	NaN	NaN	2.0	2.0	0.1
Wheat (2014)	4.5	3.2	28.5	1.8	1.1	40.1	2.8	2.2	18.9
Barley (2015)	3.8	3.9	-3.7	0.6	1.1	- 71.4	3.1	2.9	8.4
Wheat (2017)	4.1	4.4	-7.2	1.6	1.8	- 10.9	2.5	2.6	-5.1
Rape Seed (2018)	NaN	3.3	NaN	NaN	NaN	NaN	2.3	2.4	-5.2
Wheat (2019)	4.6	4.3	5.1	2.1	1.6	26.1	2.5	2.8	- 14.0

Note: Δ (%) represents percentage difference between modelled and observed values.

YIELDS: BELON										
CROP	YEAR	OBS AGB	MOD AGB	Δ (%) AGB	OBS Grain	MOD Grain	Δ (%) Grain	OBS Straw	MOD straw	Δ (%) straw
Sugar Beet	2004	7.82	6.75	15	NaN	3.89	NaN	NaN	2.85	NaN
'Winter wheat (cv. Dekan)'	2005	5.68	5.97	-5	3.97	3.62	9	1.71	2.37	-28
'Potato (cv. Spunta)'	2006	2.93	2.24	30	NaN	0.37	NaN	NaN	1.87	NaN
'Winter wheat (cv. Rosario)'	2007	4.56	5.98	-23	3.16	3.42	-7	1.39	2.62	-46
'Sugar beet (cv. Calgahri)'	2008	9.89	7.42	33	NaN	4.49	NaN	NaN	2.98	NaN
'Winter wheat (cv. Ararat)'	2009	5.37	6.28	-14	3.84	3.79	1	1.52	2.55	-40
'Potato (cv. Draga)'	2010	3.05	2.42	26	NaN	0.429	NaN	NaN	1.99	NaN
'Winter wheat (cv. Sahara)'	2011	5.49	5.68	-3	3.69	3.11	18	1.79	2.63	-32
'Maize'	2012	7.76	7.24	7	4.15	4.15	0	3.59	4.15	-13
'Winter wheat (cv. Matrix)'	2013	5.98	5.33	12	3.86	3.20	20	2.11	2.18	-3
'Potato (cv. Draga)'	2014	3.2	1.86	71	NaN	0.24	NaN	NaN	1.61	NaN
'Winter wheat (cv. Sahara)'	2015	5.36	6.18	-13	3.55	3.68	-3	1.80	2.53	-28
'Sugar beet (cv. Lisanna KWS)'	2016	9.04	6.67	35	NaN	4.06	NaN	NaN	2.61	NaN
'Winter wheat (cv. Tobak)'	2017	4.99	5.82	-14	3.64	3.29	10	1.34	2.55	-47
'Potato (cv. Agria)'	2018	4.11	2.19	87	NaN	0.37	NaN	NaN	1.81	NaN
'Winter wheat (cv. Smart)'	2019	6.78	5.95	13	4.09	3.56	14	2.67	2.42	10
'Sugar beet'	2020	17.3 6	5.16		NaN	2.48	NaN	NaN	2.85	NaN

CH-CHA			
Cut Date	OBS TC ha ⁻¹	MOD TC ha ⁻¹	Δ (%)
'29/06/2010'	1.03	1.02	-0.1
'22/08/2010'	0.73	0.86	18
'12/10/2010'	1.03	1.19	15
'19/04/2011'	0.82	1.25	52
'15/06/2011'	0.79	1.08	37
'12/07/2011'	0.95	1.19	25
'24/08/2011'	0.76	0.53	-30
'28/09/2011'	0.85	0.99	16

Note: TC refers to Tons of Carbon.

S5: Soil Biogeochemistry

