Supplement S8

October 15, 2021

1 Model Details

Table S8.1. *Time periods for the different models per site that overlap with the flux tower observations, and that are used for model evaluation.*

	Howard Springs	Adelaide River	Daly Uncleared	Dry River	Sturt Plains
BESS	7-8-2001–27-12-2012	1-1-2007–24-5-2009	19-2-2007–27-12-2012	31-8-2008–27-12-2012	28-8-2008–27-12-2012
BIOS2	7-8-2001–31-12-2013	1-1-2007–24-5-2009	19-2-2007–31-12-2013	31-8-2008–31-12-2013	28-8-2008–31-12-2013
LPJ-GUESS	7-8-2001–26-6-2013	1-1-2007–23-5-2009	19-2-2007–21-7-2013	31-8-2008–10-6-2013	28-8-2008–11-6-2013
MAESPA	7-8-2001–27-6-2013	1-1-2007–24-5-2009	19-2-2007–22-7-2013	31-8-2008–11-6-2013	28-8-2008–12-6-2013
SPA	7-8-2001–25-6-2013	1-1-2007–23-5-2009	1-1-2008–31-12-2013	31-8-2008–31-12-2012	28-8-2008–31-12-2012
CABLE	7-8-2001–29-12-2012	1-1-2007–31-12-2008	19-2-2007–30-12-2012	31-8-2008–30-12-2012	28-8-2008–30-12-2012
VOM	7-8-2001–21-12-2016	1-1-2007–24-5-2009	19-2-2007–21-12-2016	31-8-2008–21-12-2016	28-8-2008–21-12-2016

Table S8.2. *Vegetation properties in the Vegetation Optimality Model optimized for maximizing the Net Carbon Profit.*

Parameter	Description	Initial range	Timescale	Unit
$c_{\lambda f,p}$	water use parameter perennial vegetation	0.0 - 10000.0	Long-term	mol mol^{-1} m^{-1}
$c_{\lambda e,p}$	water use parameter perennial vegetation	-3.0 - 0.0	Long-term	-
$c_{\lambda f,s}$	water use parameter seasonal vegetation	0.0 - 10000.0	Long-term	mol mol^{-1} m^{-1}
$c_{\lambda e,s}$	water use parameter seasonal vegetation	-3.0 - 0.0	Long-term	-
$M_{A,p}$	fractional cover perennial vegetation	0 - 1	Long-term	-
$y_{r,p}$	rooting depth perennial vegetation	1.0 - 9.0	Long-term	m
$y_{r,s}$	rooting depth seasonal vegetation	0.05 - 2	Long-term	m
$M_{A,s}$	fractional cover seasonal vegetation	0.00 - (1.0-pct)	Daily	-
$J_{max25,p}$	electron transport capacity perennial vegetation	-	Daily	mol s^{-1} m^{-2}
$J_{max25,s}$	electron transport capacity annual vegetation	-	Daily	mol s^{-1} m^{-2}
$G_{s,p}$	stomatal conductance perennial vegetation	-	Daily	mol s^{-1} m^{-2}
$G_{s,s}$	stomatal conductance seasonal vegetation	-	Daily	mol s^{-1} m^{-2}
$S_{Adr,i,s}$	root surface area distribution of perennial vegetation	-	Daily	m^2 m^{-3}
$S_{Adr,i,s}$	root surface area distribution of annual vegetation	-	Daily	m^2 m^{-3}

Table S8.3. Soil characteristics of the study sites along the North Australian Tropical Transect, based on data from the Soil and Landscape Grid of Australia [**?**, **?**, **?**], in addition to field measurements of J. Beringer and L. B. Hutley. Here, θ_r refers to the residual moisture content, θ_s the saturated water content, α and n the Van Genuchten soil parameters [**?**] and K_{sat} the saturated hydraulic conductivity.

Howard Springs	Soil type	θ_r (-)	θ_s (-)	α (1/m)	n (-)	K_{sat} (m/s)
0.00-0.20m	Sandy Loam	0.065	0.41	7.5	1.89	$1.228 * 10^{-5}$
0.20-0.40m	Sandy Loam	0.065	0.41	7.5	1.89	$1.228 * 10^{-5}$
0.40-0.60m	Sandy Clay Loam	0.1	0.39	5.9	1.48	$3.639 * 10^{-6}$
0.60-bedrock	Sandy Clay Loam	0.1	0.39	5.9	1.48	$3.639 * 10^{-6}$
Adelaide River						
0.00-0.20m	Silt Loam	0.067	0.45	2	1.41	$1.25 * 10^{-6}$
0.20-0.40m	Sandy Clay Loam	0.1	0.39	5.9	1.48	$3.639 * 10^{-6}$
0.40-0.60m	Sandy Clay Loam	0.1	0.39	5.9	1.48	$3.639 * 10^{-6}$
0.60-bedrock	Sandy Clay Loam	0.1	0.39	5.9	1.48	$3.639 * 10^{-6}$
Daly River						
0.00-0.20m	Sandy Loam	0.065	0.41	7.5	1.89	$1.228 * 10^{-5}$
0.20-0.40m	Loamy Sand	0.057	0.41	12.4	2.28	$4.053 * 10^{-6}$
0.40-0.60m	Sandy Loam	0.065	0.41	7.5	1.89	$1.228 * 10^{-5}$
0.60-bedrock	Sandy Clay Loam	0.1	0.39	5.9	1.48	$3.639 * 10^{-6}$
Dry River						
0.00-0.20m	Sandy Loam	0.065	0.41	7.5	1.89	$1.228 * 10^{-5}$
0.20-0.40m	Sandy Clay Loam	0.1	0.39	5.9	1.48	$3.639 * 10^{-6}$
0.40-0.60m	Sandy Clay	0.1	0.38	2.7	1.23	$3.333 * 10^{-6}$
0.60-bedrock	Sandy Clay	0.1	0.38	2.7	1.23	$3.333 * 10^{-6}$
Sturt Plains						
0.00-0.20m	Silt Loam	0.067	0.45	2	1.41	$1.25 * 10^{-6}$
0.20-0.40m	Sandy Clay	0.1	0.38	2.7	1.23	$3.333 * 10^{-6}$
0.40-0.60m	Sandy Clay	0.1	0.38	2.7	1.23	$3.333 * 10^{-6}$
0.60-bedrock	Sandy Clay	0.1	0.38	2.7	1.23	$3.333 * 10^{-6}$