Supplement of Biogeosciences, 19, 689–699, 2022
https://doi.org/10.5194/bg-19-689-2022-supplement

Biogeosciences Open Access EGU

Supplement of

Reviews and syntheses: Spatial and temporal patterns in seagrass metabolic fluxes

Melissa Ward et al.

Correspondence to: Kristy J. Kroeker (kkroeker@ucsc.edu)

SUPPLEMENTARY FIGURES

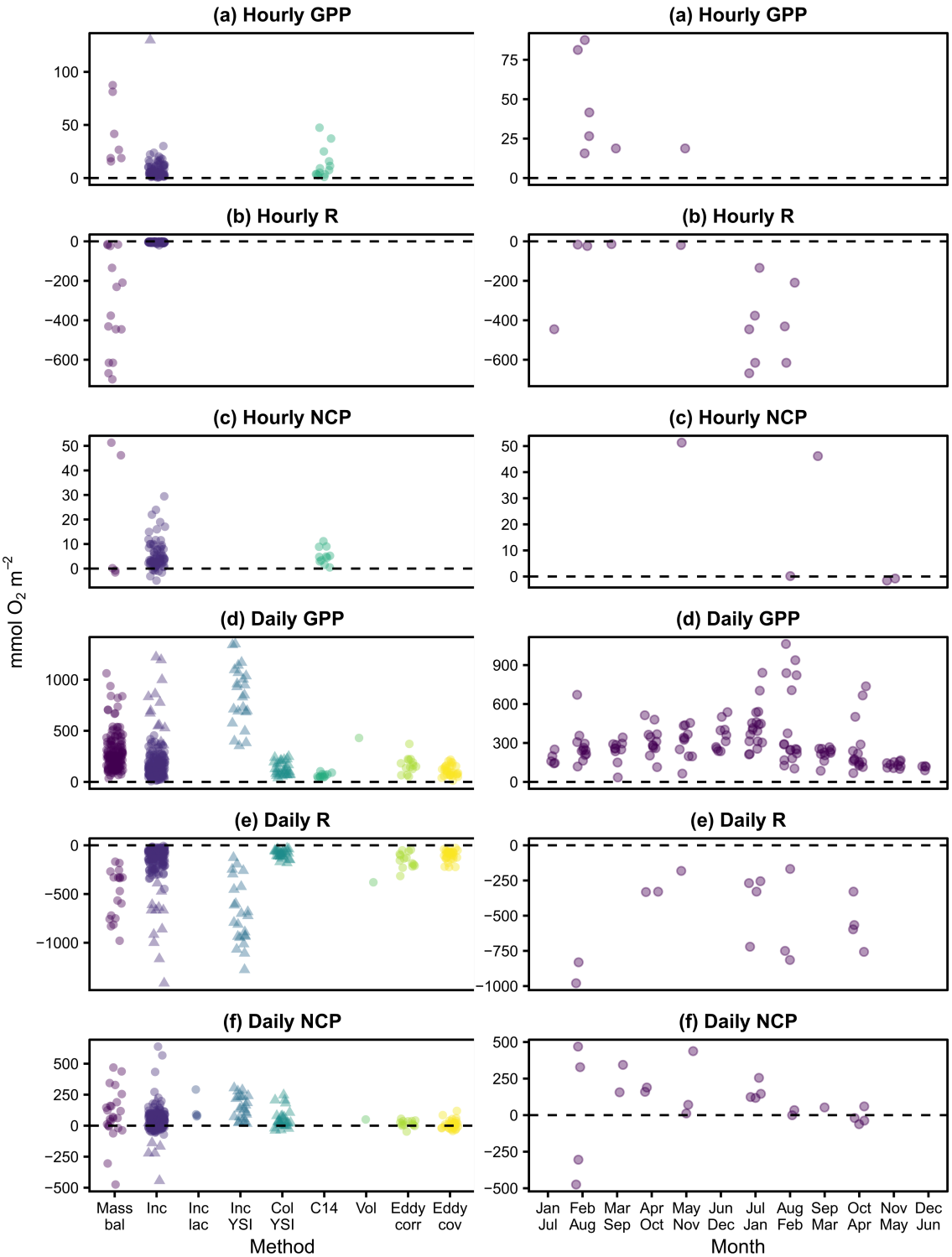

Figure S1. Variation in the magnitude of seagrass community metabolism as a function of the methods used (a), as well as the seasonal variability of studies using the mass balance approach.

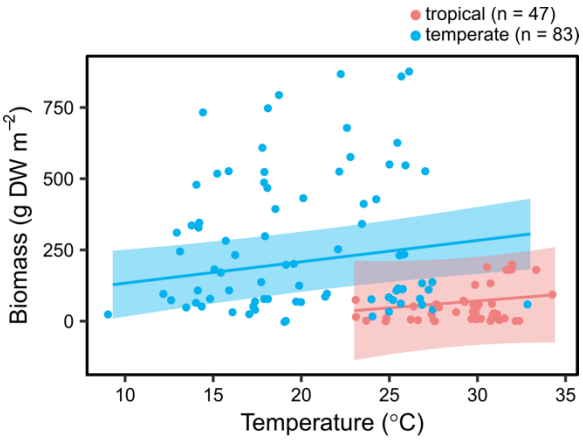

Figure S2. Relationship between temperature and biomass. Significant (⟨=0.05) correlations are denoted by the fit line.

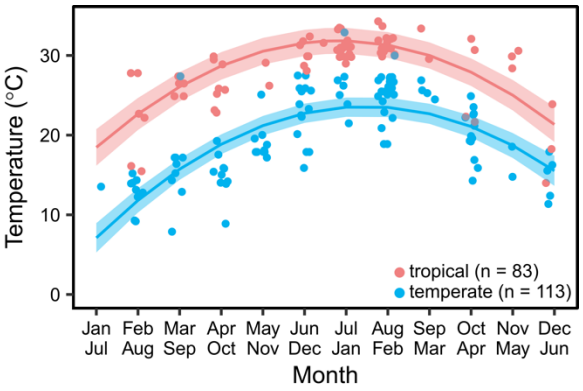

Figure S3. Mean temperature reported in the studies included in the synthesis as a function of season.

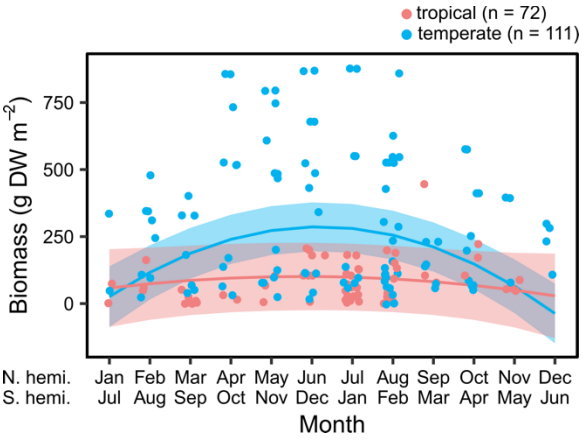

Figure S4. Mean aboveground biomass in the studies included as a function of season.

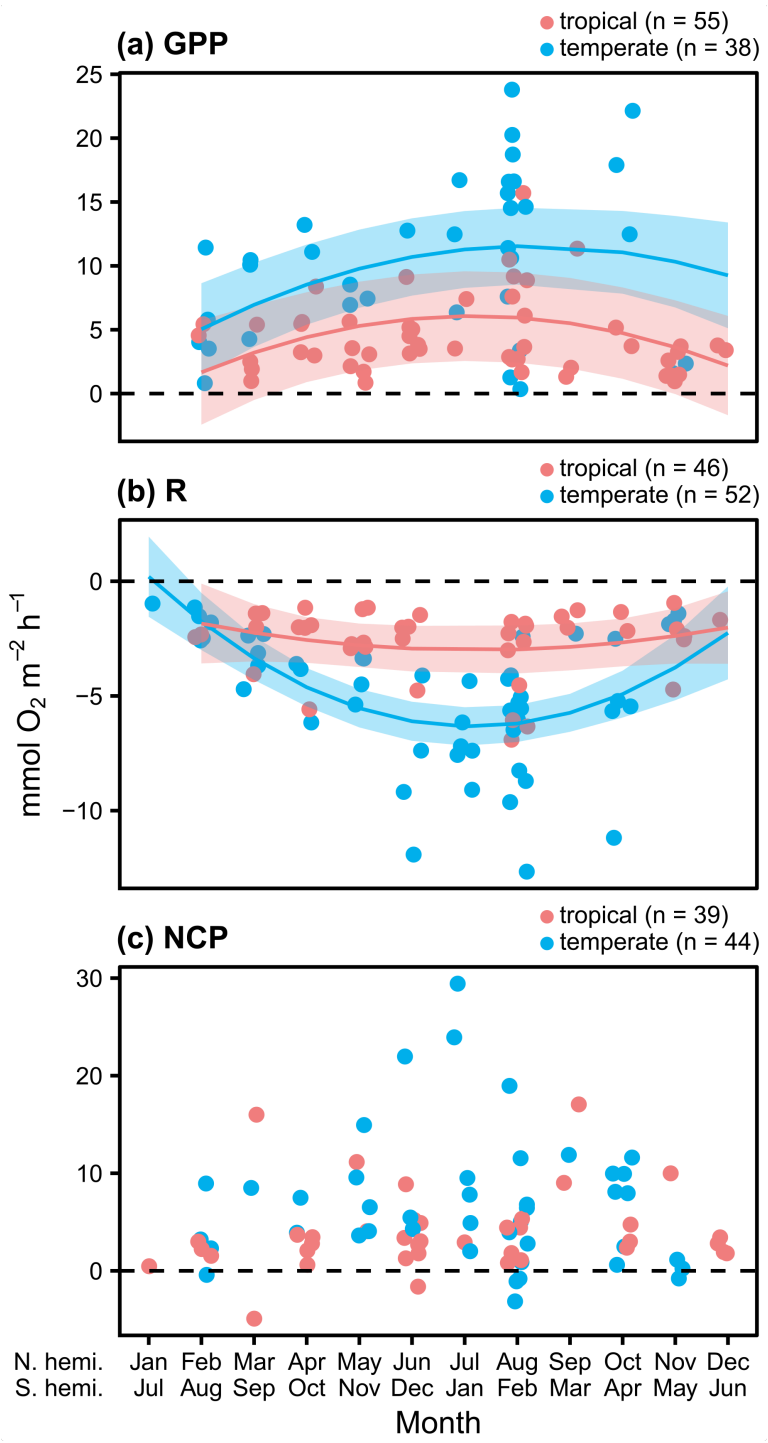

Figure S5. Relationships between hourly rates of seagrass metabolism and season, when Morgan and Kitting (1984) and Herbert and Fourqurean (2008) are removed from analysis.

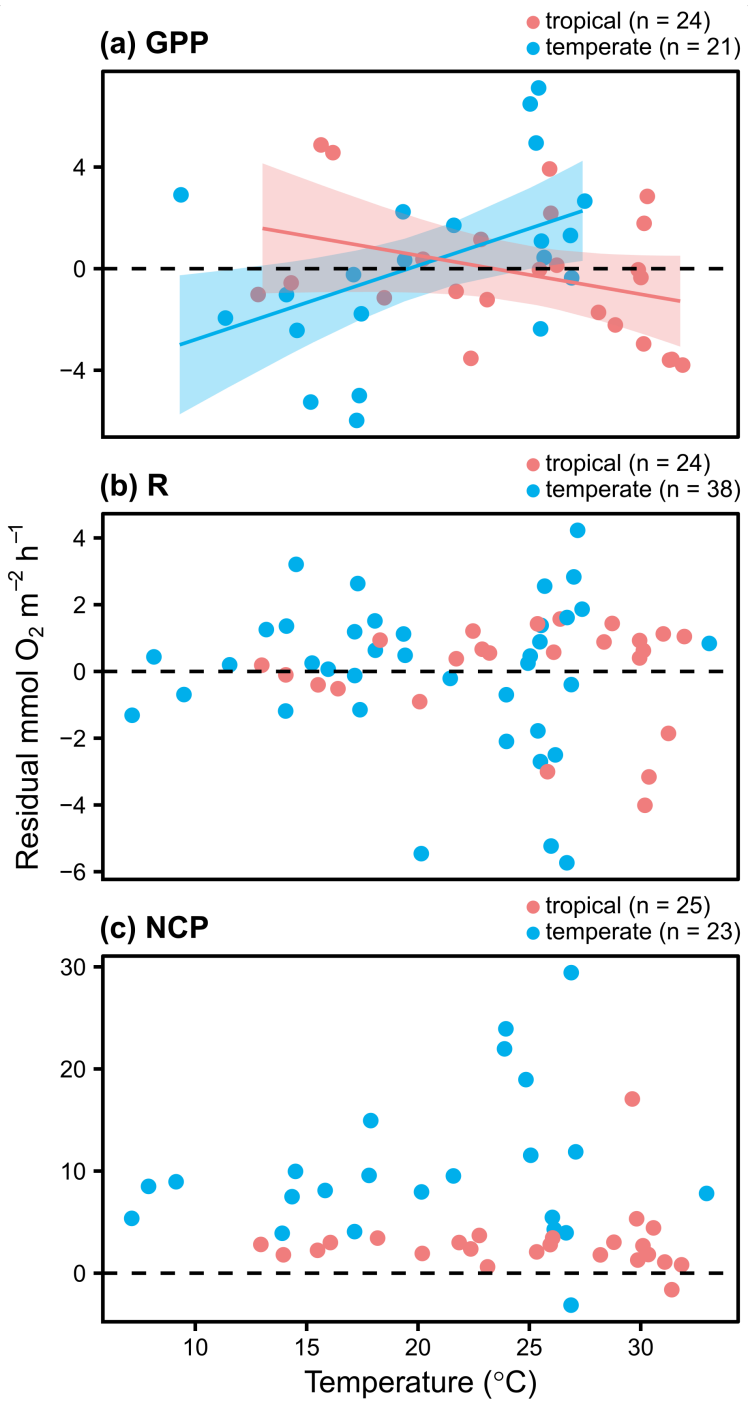

Figure S6. Conditioned residuals of the hourly rates for seagrass O_2 fluxes (mmol m^{-2} h^{-1}) from a seasonal model as a function of temperature measured in the field during metabolism measurements. Studies performed in temperate versus tropical ecosystems are illustrated by color (blue = temperate, red = tropical). Significance is denoted by a fit line and 95% CI.

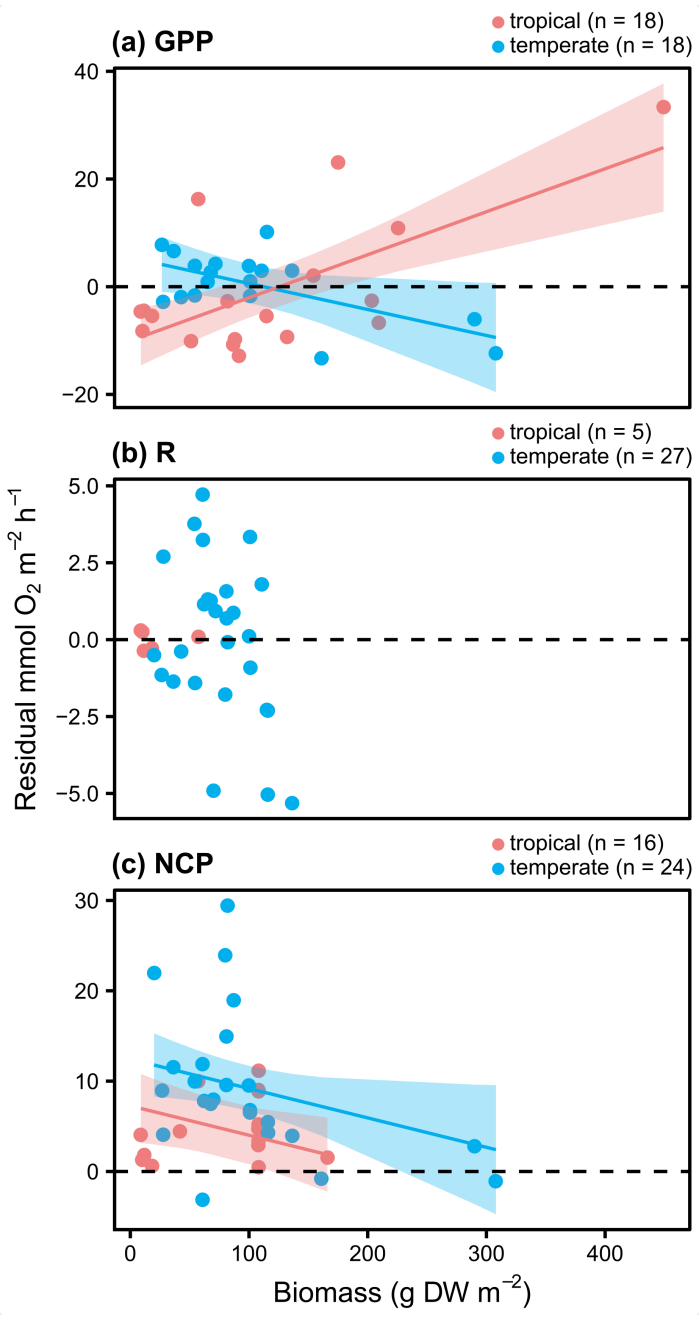

Figure S7. Conditioned residuals of the hourly rates for seagrass O_2 fluxes (mmol m^{-2} h^{-1}) from a seasonal model as a function of aboveground biomass measured in the field during metabolism measurements. Studies performed in temperate versus tropical ecosystems are illustrated by color (blue = temperate, red = tropical). Significance is denoted by a fit line and 95% CI, however panel (c) displays marginally significant model outputs ($p = 0.051$) (Table 3).

Table S1. Included papers

Paper	Dominant seagrass species	Status	MonoMix	Climate	Method
Adams et al. 2016	Zostera muelleri	Natural	Monospecific	Temperate	Incubator
Anton et al. 2009	Halodule wrightii	Natural	Mixed species	Tropical	Incubator
Anton et al. 2020	Halodule uninervis, Thalassia hemprichii, Halodule stipulacea, Thalassodendrum ciliatum, Halophila ovalis	Natural	Monospecific	Tropical	Incubator
Apostolaki et al 2010	Posidonia oceanica	Natural	Monospecific	Temperate	Incubator
Apostolaki et al. 2014	Cymodocea nodosa	Natural	Mixed species	Temperate	Incubator
Banerjee et al. 2018	Halodule sp. and Halophila sp.	Natural	Mixed species	Tropical	Mass balance
Barron and Duarte 2009	Posidonia oceanica	Natural	Monospecific	Temperate	Incubator
Barron et al. 2004	Cymodocea nodosa	Natural	Monospecific	Temperate	Incubator
Barron et al. 2006	Posidonia oceanica	Natural	Monospecific	Temperate	Incubator
Berg et al. 2018	Zostera marina	Restored	Monospecific	Temperate	Eddy correlation
Berger et al. 2020	Zostera marina	Restored	Monospecific	Temperate	Eddy correlation
Burkholz et al. 2019	Cymodecea serrulata, Halodule uninervis, Enhalus acoroides	Natural	Monospecific	Tropical	Incubator
Calleja et al. 2006	Thalassia testudinum	Natural	Monospecific	Tropical	Incubator
Cardini et al. 2018	Halophila stipulacea	Natural	Monospecific	Temperate	Incubator
Champenois and Borges 2012	Posidonia oceanica	Natural	Monospecific	Temperate	Incubator
Champenois and Borges 2018	Posidonia oceanica	Natural	Monospecific	Temperate	Mass balance
Chen et al. 2019	Zostera capricorni, Halophila ovalis	Natural	Monospecific	Temperate	Incubator

Dahl et al. 2016	Thalassia hemprichii	Natural	Monospecific	Tropical	Incubator
Drylie et al. 2018	Zostera muelleri	Natural	Monospecific	Temperate	Incubator
Duarte et al. 2002	Zostera marina	Natural	Monospecific	Temperate	Incubator
Egea et al. 2019a	Cymodocea nodosa	Natural	Monospecific	Temperate	Incubator
Egea et al. 2019b	Cymodocea nodosa	Natural	Monospecific	Temperate	Incubator
Ferguson et al. 2017	Zostera muelleri	Natural	Monospecific	Temperate	Incubator
Frankignoulle and Bouquegneau 1987	Posidonia oceanica	Natural	Monospecific	Temperate	Incubator
Gazeau et al. 2005	Posidonia oceanica	Natural	Monospecific	Temperate	Incubator
Gruber et al. 2017	Enhalus acoroides+ Thalassia hemprichii	Natural	Mixed species	Tropical	Mass balance
Gustafsson & Norkko 2016	Ruppia cirrhosa, Zostera marina	Natural	Monospecific	Temperate	Incubator
Herbert and Fourqurean 2008	Thalassia testudinum	Natural	Mixed species	Tropical	Incubator
Holmer et al. 2004	Posidonia oceanica, Cymodocea nodosa	Natural	Monospecific	Temperate	Incubator
Hume et al. 2011	Zostera marina	Restored	Monospecific	Temperate	Eddy correlation
Johnson et al. 2019	Thalassia testudinum, Halophila stipulacea	Natural	Monospecific	Tropical	Incubator
Koopmans et al. 2020	Posidonia oceanica	Natural	Monospecific	Temperate	Eddy correlation
Long et al. 2015	Thalassia testudinium	Natural	Monospecific	Tropical	Eddy correlation
Maher and Eyre 2011	Ruppia megcarpa, Zostera capricorni, Halophila ovalis, Posidonia australis	Natural	Monospecific	Temperate	Incubator
Martin et al 2005	Zostera marina	Natural	Monospecific	Temperate	Incubator
Moncreiff et al. 1992	Halodule wrightii	Natural	Monospecific	Tropical	C14 enrichment
Morgan and Kitting 1984	Halodule wrightii	Natural	Monospecific	Tropical	C14 enrichment

Moriarty et al. 1990	Halodule uninervis, Syringodium isoetifolium, Cymodocea serrulate, Cymodocea rotundata, Thalassia Hemprichii	Natural	Mixed species	Tropical	C14 enrichment
Murray and Wetzel 1987	Zostera marina, Ruppia maritima	Natural	Monospecific	Temperate	Incubator
Murrell et al. 2018	Thalassia testudinum+ Halodule beaudettei	Natural	Mixed species	Temperate	Mass balance
Nixon and Oviatt 1972	Zostera marina	Natural	Monospecific	Temperate	Mass balance
Odum 1956	Thalassia testudinum	Natural	Monospecific	Tropical	Mass balance
Odum and Wilson, 1962	Thalassia testudinum	Natural	Mixed species	Tropical	Mass balance
Odum et al. 1959	Thalassia testudinum	Natural	Monospecific	Tropical	Mass balance
Odum 1963	Thalassia testudinum, Halodule wrightii	Natural	Mixed species	Tropical	Mass balance
Olive et al. 2016	Posidonia oceanica	Natural	Monospecific	Temperate	Incubator
Penhale 1977	Zostera marina	Temperate	Monospecific	Temperate	C14 enrichment
Plus et al. 2001	Zostera noltii	Natural	Monospecific	Temperate	Incubator
Reyes and Merino 1991	Thalassia testudinum	Natural	Monospecific	Tropical	Mass balance
Rheuban et al. 2014	Zostera marina	Restored	Monospecific	Temperate	Eddy correlation
Santos et al. 2004	Zostera noltii, Cymodocea nodosa	Natural	Monospecific	Temperate	Incubator
Staehr et al. 2018	Zostera marina	Natural	Monospecific	Temperate	Incubator
Stutes et al. 2007	Halodule wrightii	Natural	Monospecific	Tropical	Incubator
Van Dam et al. 2019	Thalassia testudinum	Natural	Monospecific	Temperate	Mass balance
Viaroli et al. 1996	Zostera noltii	Natural	Monospecific	Temperate	Incubator

Yarbro and Carlson 2008	Thalassia testudinum, Halodule wrightii	Natural	Monospecific	Tropical	Incubator

Table S2. Excluded papers

Excluded paper	Reason for exclusion
Asmus et al. 2000	Unclear data, no associated error
Barron et al. 2014	No extractable data (DOC fluxes)
Barry et al. 2013	Biomass addition technique, no oxygen fluxes
Baupet et al. 2013	No oxygen measurements
Beal et al. 2004	Biomass addition technique, no oxygen fluxes
Beer et al. 2006	Methods- experimental incubation of leaves in clay plots in tide pools
Binzer and Sand-Jensen 2006	Methods- ex-situ
Blackburn et al. 1994	No extractable seagrass data
Caffrey 2004	Unclear which sites were vegetated
Challener et al. 2016	Methods- discrete samples only, characterized carbonate chemistry
Clavier et al. 2011	Tropical-temperate data
Clavier et al. 2014	Responses were modeled and not from direct measurements, , no oxygen fluxes
Delgard et al. 2016	Ex-situ, artificial light
Delgard et al. 2016a	Methods - sediment cores for DIC; no productivity data
Erftemeijer et al. 1993	Responses were modeled and not from direct measurements
Eyre and Ferguson 2002	Ex-situ
Felisberto et al. 2015	Acoustic data, unable to extract data
Frankignoulle and Bouquegneau 1990	No oxygen measurements
Frankignoulle and Disteche 1984	No oxygen measurements
Frankignoulle and Disteche 1987	No oxygen measurements
Gacia et al. 2005	Responses were modeled and not from direct measurements
Gacia et al. 2012	No time component available for vegetated sites (compared against a light gradient)
Heffernan and Gibson 1983	Radiocarbon technique, no oxygen fluxes
Hendriks et al. 2014	No daily or hourly oxygen measurements available
Holmer et al. 2001	Ex-situ
Invers et al. 1997	No oxygen measurements
Kapsenberg and Hofmann 2016	No daily or hourly extractable oxygen measurements available over seagrass sites
Khan et al. 2016	Ex-situ - mesocosm
Koch and Madden 2001	Responses were modeled and not from direct measurements
Kristensen et al. 2000	Ex-situ
Lee Nagel 2007	Responses were modeled and not from direct measurements
Lindeboom and Sandee 1989	Responses were modeled and not from direct measurements
Manzello et al. 2012	Lack of seagrass biomass quantification makes comparison impossible (only presence/absence)

Mazzuca et al. 2013	A review without extractable data
Odum & Hoskin 1958	A review without extractable data
Pollard and Kogure 1993	Ex-situ - jars incubations
Qasim and Bhattathiri 1971	Inappropriate assumption of unchanging community respiration rates
Qu et al. 2003	Ex-situ
Quak et al. 2016	Examined sediment loading on seagrass meadows using carbon and nitrogen stable isotope signatures
Ribaudo et al. 2016	Biomass addition technique, no oxygen fluxes
Risgaard-Petersen and Ottosen 2000	Ex-situ, biomass addition technique
Saderne et al. 2013	No oxygen fluxes
Saderne et al. 2015	Non-peer-reviewed, difficult to separate mussel metabolism
Semesi et al. 2009	Unclear timescales and potential inclusion of algae into seagrass community metabolism
Silva et al. 2005	No GPP data available
Tokoro et al. 2014	Methods- discrete samples only, characterized carbonate chemistry
Turk et al. 2015	No daily or hourly extractable oxygen measurements available
Welsh et al. 2000	Ex-situ
Wium-Andersen and Borum 1984	Biomass addition technique, no oxygen fluxes
Ziegler and Benner 1999	Water column fluxes