

Microclimatic and ecophysiological conditions experienced by epiphytic bryophytes in an Amazonian rain forest

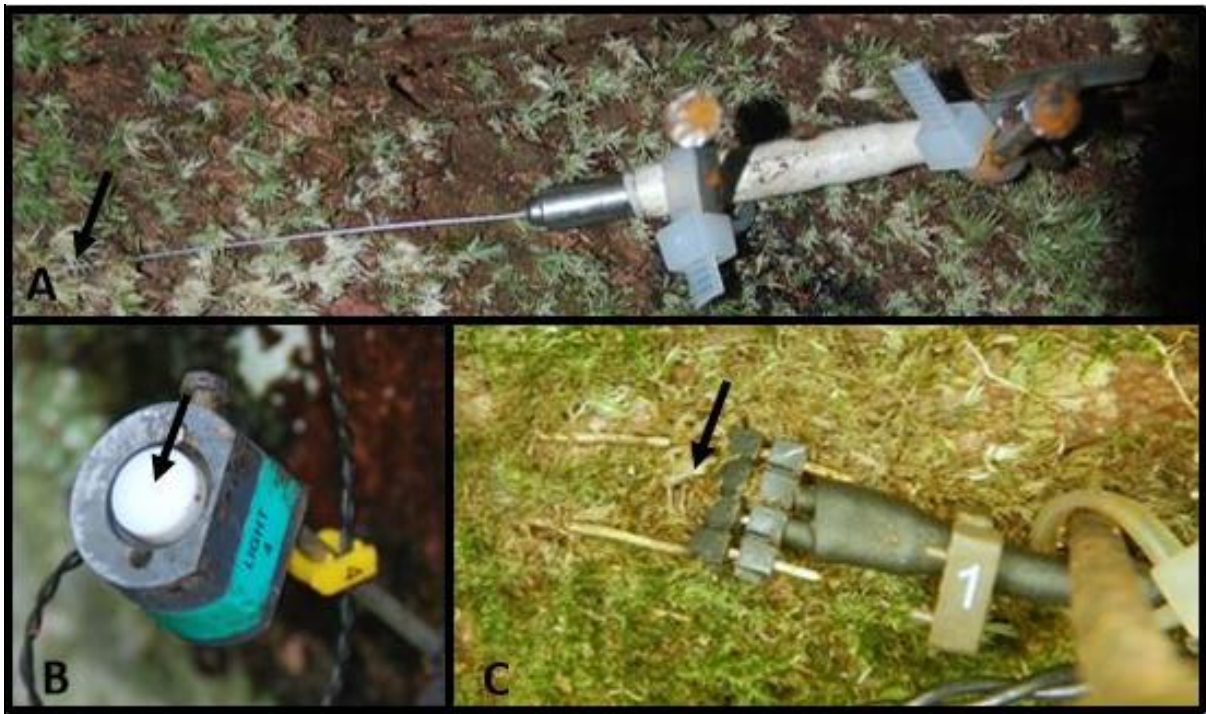


Figure S1: Examples of the temperature sensor (A), light sensor (B), and water content sensor (C) installed in epiphytic bryophytes at the ATTO site. The little arrows show the area of detection, i.e. the sensor tip of the temperature sensor, the area just below the white PTFE cap of the light sensor, and the two inner pins of the water content sensor.

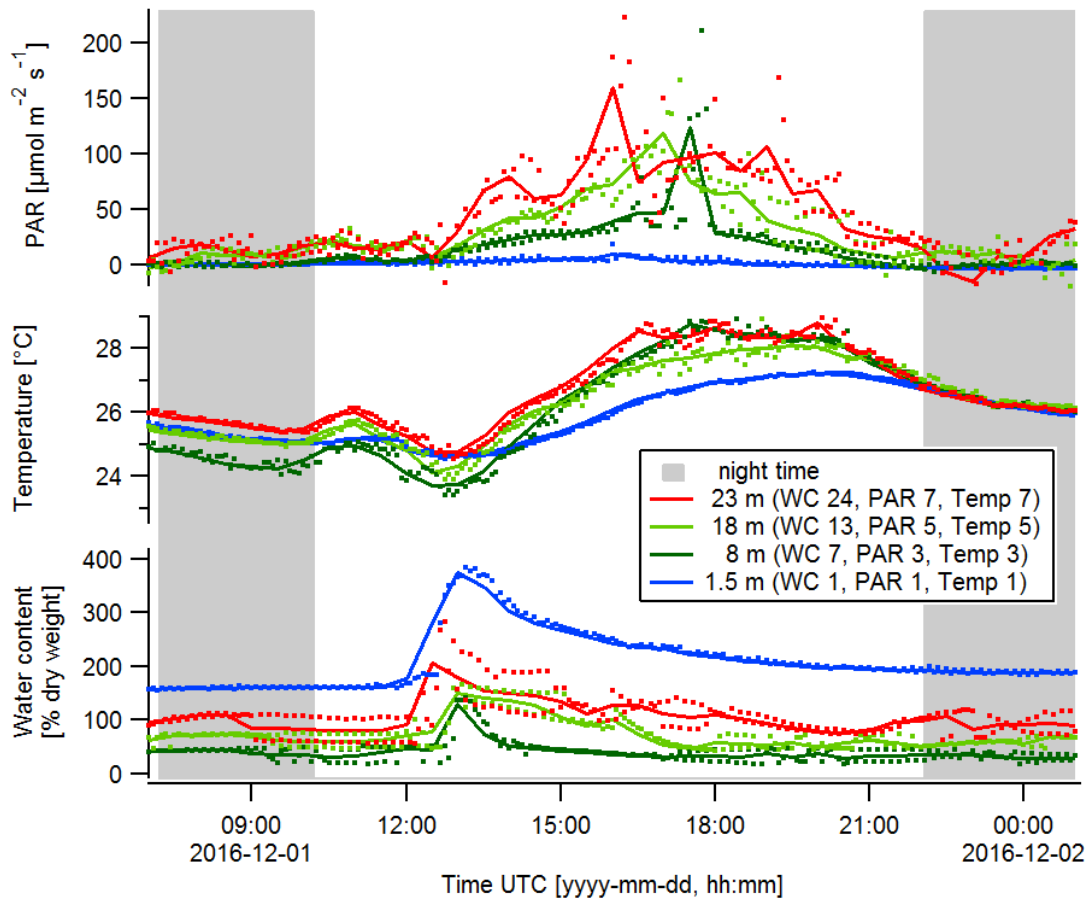


Figure S2: Comparison of 5-minute (dots) and 30-minute (lines) integrals of exemplary sensors at each height level over a period of approx. one day in December 2016.

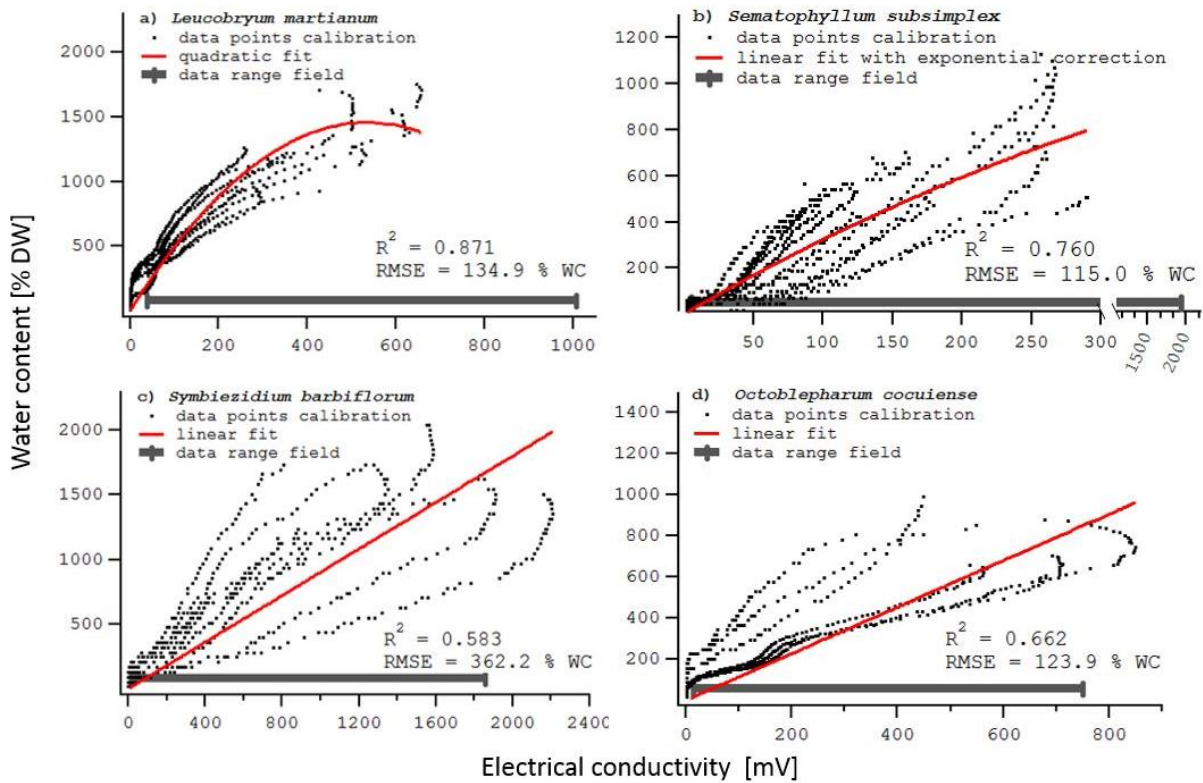


Figure S3: Calibration curves of water content sensors installed within different bryophyte species. The water content [% DW] is plotted against the electrical conductivity [mV] for the species a) *Leucobryum martianum*, b) *Sematophyllum subsimplex*, c) *Symbiezidium barbiflorum*, and d) *Octoblepharum cocuiense*. Of each bryophyte species three replicates (four for *Sematophyllum subsimplex*, two for *Symbiezidium barbiflorum*) were measured over the course of three subsequent wetting and drying cycles. The dots show the measured data points and the lines represent the statistical fit. Depending on the data, a linear fit, quadratic fit or linear fit with exponential correction was used (see methods section for further details). The vertical grey bars indicate the data range covered during the field measurements. For each fit the R^2 and RMSE are given in the graphics.

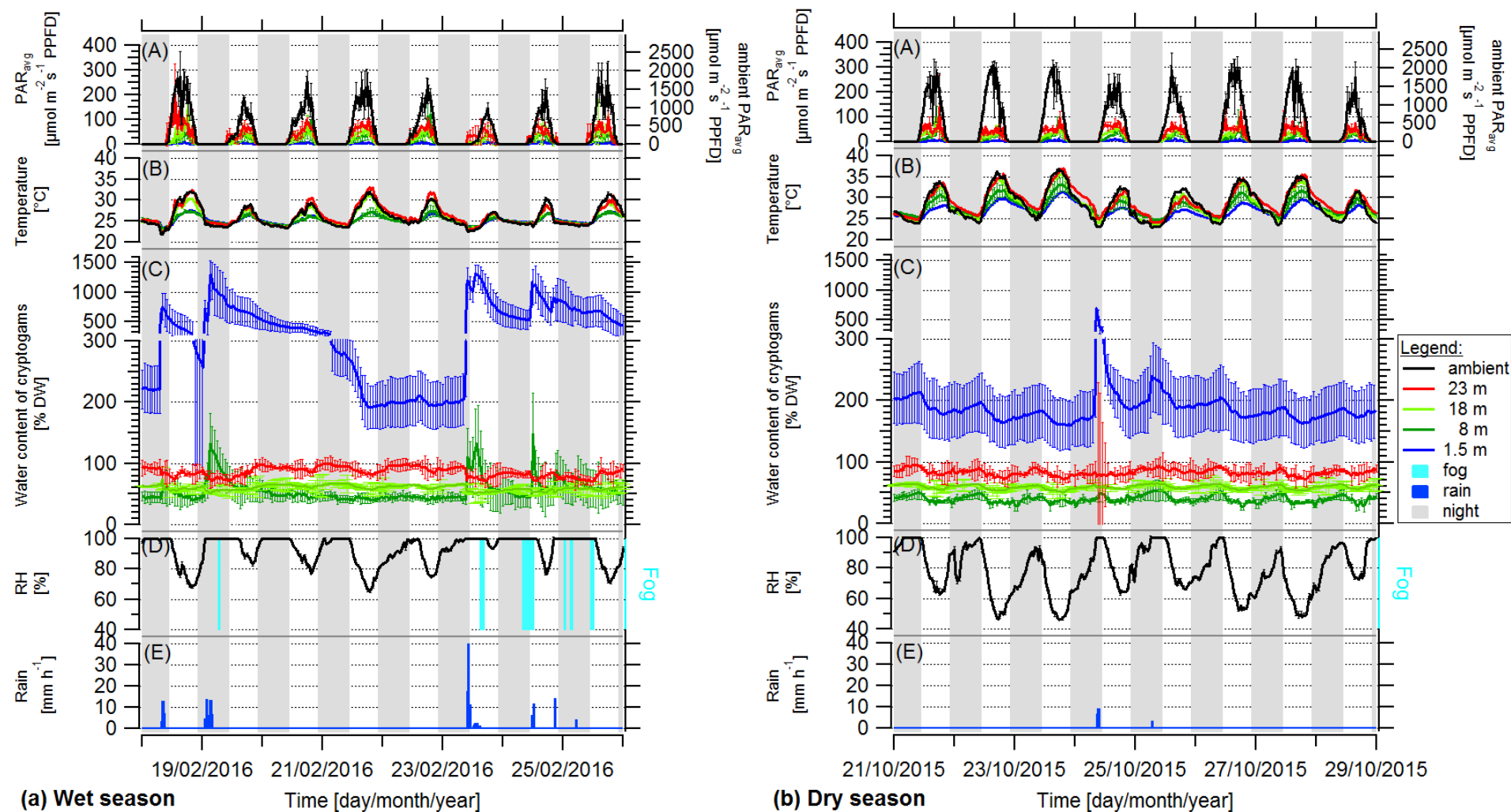


Figure S4: Representative periods during wet and dry season under the influence of El Niño; data show ecophysiological, micrometeorological, and ambient meteorological conditions experienced by epiphytic cryptogamic communities in the Amazonian rain forest. Shown are 8-day periods during a) the wet season 2015 and b) the dry season 2016. Ecophysiological and micrometeorological parameters on top/within epiphytic cryptogamic communities represent (A) the

photosynthetically active radiation (PAR_{avg}) on top, (B) the temperature within, and (C) the water content of cryptogamic communities. The ambient meteorological parameters comprise (A) the ambient photosynthetically active radiation (PAR_{avg} in 75 m), (B) the ambient temperature (in 26 m), (D) the relative air humidity (RH in 26 m), the presence of fog events (turquoise bars), and (E) the precipitation (rain). The data show 30-minute averages \pm SD except for rain, which shows hourly sums. Data of replicate sensors installed within communities at the same height level were pooled, while ambient parameters were measured with one sensor each.

5 The night time is shaded in grey (06:00 – 18:00 LT).

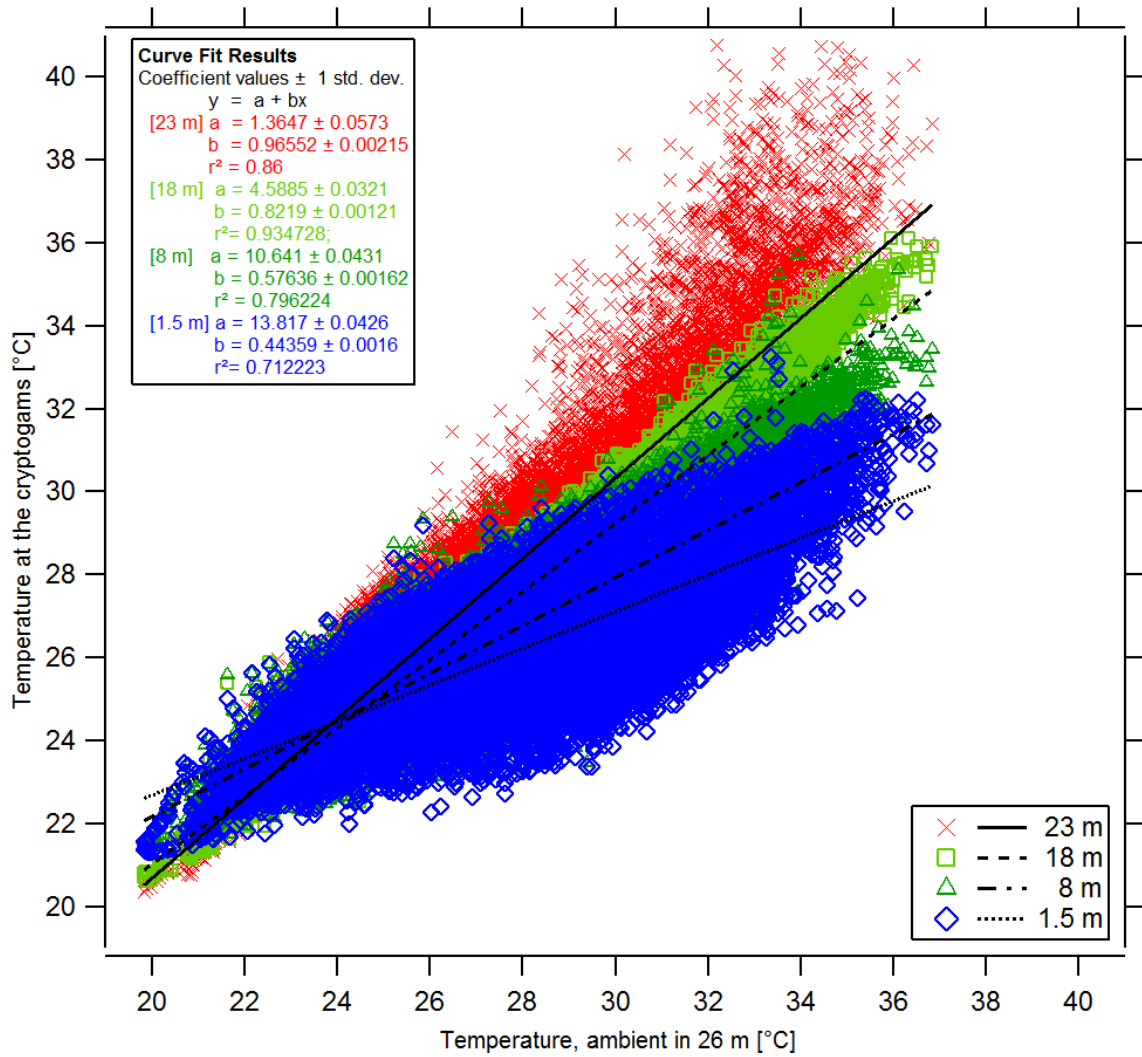


Figure S5: Microclimatic temperature within bryophytes compared to the mesoclimatic ambient temperature. Temperature within bryophytes was measured at 1.5 m (blue diamonds), 8 m (dark green triangles), 18 m (light green squares), and 23 m (red crosses), the ambient temperature at 26 m height on the tower. Data present 30-minute averages with linear fits. For each height level the coefficients and the R^2 are given.

Table S1a: Bryophyte species and calibration data of the water content sensors. Listed are the bryophyte species with their bryophyte type, their height of installation, the minimum ($\text{Min}_{\text{Field}}$) and the maximum ($\text{Max}_{\text{Field}}$) electrical conductivity assessed in the field, the maximum electrical conductivity measured during calibration ($\text{Max}_{\text{Calib}}$), the fit being used for the calibration (l = linear, lec = linear with exponential correction, sqrt = quadratic), the determination coefficient R^2 , and the root mean square error (RMSE). The value of RMSE is given in % dry weight (% DW). Calculations are based on 30 minute integrals of data.

Bryophyte species	Bryophyte type	Height [m]	Height zone	$\text{Min}_{\text{Field}}$ mV	$\text{Max}_{\text{Field}}$ mV	$\text{Max}_{\text{Calib}}$ mV	Fit	R^2	RMSE % DW
<i>Symbiezidium barbiflorum</i>	Liverwort	8, 18, 23	2, 3, 4	16	1857	2207	l	0.583	362
<i>Octoblepharum cocuiense</i>	Moss	8	2	13	750	992	l	0.662	124
<i>Sematophyllum subsimplex</i>	Moss	1.5	1	5	1940	290	lec	0.760	115
<i>Leucobryum martianum</i>	Moss	1.5	1	40	1005	656	sqrt	0.871	135

Table S1b: Height of installation and minimum and maximum values of the individual sensors of the microclimate station measuring water content, temperature, and light (PAR). For the water content sensors, also the bryophyte species are given. Based on 30-minute integrals.

Water content	Height [m]	WC [% DW]		Bryophyte species	Temperature	Height [m]	Temperature [°C]	
		min	max				min	max
Sensor 01	1.5	87	1512	<i>Sematophyllum subsimplex</i>	Sensor 01	1.5	21.1	36.3
Sensor 02	1.5	85	1512	<i>Sematophyllum subsimplex</i>	Sensor 02	1.5	21.4	39.4
Sensor 03	1.5	121	1512	<i>Sematophyllum subsimplex</i>	Sensor 03	8	21.6	34.7
Sensor 04	1.5	194	1455	<i>Leucobryum martianum</i>	Sensor 04	8	20.9	46.3
Sensor 05	1.5	124	1512	<i>Sematophyllum subsimplex</i>	Sensor 05	18	20.3	38.0
Sensor 06	1.5	31	1487	<i>Sematophyllum subsimplex</i>	Sensor 06	18	20.3	37.5
Sensor 07	8	14	1286	<i>Symbiezidium barbiflorum</i>	Sensor 07	23	20.8	41.2
Sensor 08	8	18	798	<i>Octoblepharum cocuiense</i>	Sensor 08	23	20.3	48.7
Sensor 09	8	16	950	<i>Octoblepharum cocuiense</i>				
Sensor 10	8	18	789	<i>Octoblepharum cocuiense</i>	Light	Height [m]	PAR [μmol m⁻² s⁻¹]	
Sensor 11	8	30	1130	<i>Symbiezidium barbiflorum</i>			min	max
Sensor 12	8	29	811	<i>Symbiezidium barbiflorum</i>	Sensor 01	1.5	0	1546
Sensor 13	18	39	782	<i>Symbiezidium barbiflorum</i>	Sensor 02	8	0	1461
Sensor 14	18	38	295	<i>Symbiezidium barbiflorum</i>	Sensor 03	8	0	1502
Sensor 15	18	45	315	<i>Symbiezidium barbiflorum</i>	Sensor 04	18	0	1386
Sensor 16	18	44	327	<i>Symbiezidium barbiflorum</i>	Sensor 05	18	0	1080
Sensor 17	18	32	575	<i>Symbiezidium barbiflorum</i>	Sensor 06	23	0	1326
Sensor 18	18	37	1703	<i>Symbiezidium barbiflorum</i>	Sensor 07	23	0	1351
Sensor 19	23	43	536	<i>Symbiezidium barbiflorum</i>				
Sensor 20	23	45	393	<i>Symbiezidium barbiflorum</i>				
Sensor 21	23	37	864	<i>Symbiezidium barbiflorum</i>				
Sensor 22	23	48	774	<i>Symbiezidium barbiflorum</i>				
Sensor 23	23	66	514	<i>Symbiezidium barbiflorum</i>				
Sensor 24	23	68	492	<i>Symbiezidium barbiflorum</i>				

Table S2: Parameters determining time range of photosynthesis and respiration. The water content (WC), lower water compensation point (WCP_l), water saturation point (WSP), maximal water content (WC_{max}), lower light compensation point (LCP_l), light saturation point (LSP), temperature for optimal net photosynthesis (T_{opt} NP), upper temperature compensation point (TCP_u), and time range of physiological activity as relevant parameters have been extracted from published studies conducted at various study sites in the tropical rain forest.

Parameter	Low	High	Unit	Reference	Study site
WC	400	2000	% DW	Zotz et al. 1997	Panama, lower montane rain forest, 1100 m
WCP_l	30	80	% DW	Wagner et al 2013	Panama, low land rain forest, 0 m
WCP_l	136	225	% DW	Romero et al. 2006	Costa Rica, montane oak-bamboo forest, 2900 m
WSP	349	1053	% DW	Romero et al. 2006	Costa Rica, montane oak-bamboo forest, 2900 m
WC_{max}	663	1558	% DW	Wagner et al 2013	Panama, low land rain forest, 0 m
LCP_l	4.9	10.5	$\mu\text{mol m}^{-2} \text{s}^{-1}$ PPFD	Romero et al. 2006	Costa Rica, montane oak-bamboo forest, 2900 m
LCP_l	10	35	$\mu\text{mol m}^{-2} \text{s}^{-1}$ PPFD	Zotz et al. 1997	Panama, lower montane rain forest, 1100 m
LCP_l	22	69	$\mu\text{mol m}^{-2} \text{s}^{-1}$ PPFD	Wagner et al 2013	Panama, low land rain forest, 0 m
LSP	110	256	$\mu\text{mol m}^{-2} \text{s}^{-1}$ PPFD	Léon-Vargas et al 2006	Venezuela, cloud forest, 2000-4000 m
LSP	200	400	$\mu\text{mol m}^{-2} \text{s}^{-1}$ PPFD	Zotz et al. 1997	Panama, lower montane rain forest, 1100 m
T_{opt} NP	24	27	$^{\circ}\text{C}$	Wagner et al 2013	Panama, low land rain forest, 0 m
T_{opt} NP	25		$^{\circ}\text{C}$	Frahm 1990	Transvvaal, Tanzania, Venezuela, Peru, and Borneo
TCP_u	30	33	$^{\circ}\text{C}$	Wagner et al 2013	Panama, low land rain forest, 0 m
Activity	8.5	52.2	Percentage of time	León-Vargas et al 2006	Venezuela, cloud forest, 2000-4000 m

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Table S3: Monthly mean values and standard deviations (\pm SD) of photosynthetically active radiation (PAR_{avg} daytime, measured in 75 m), daily maxima of photosynthetically active radiation (PAR_{max}), temperature (measured 26 m), and relative humidity (RH, measured 26 m). Rainfall is presented as the monthly amounts and the percentage of days with rain (measured in 81 m), and also the percentage of days when rain detection malfunctioned are listed. Fog events are given as the percentage of days. Due to data gaps in the measured rain data (shown in brackets) values for 21 days of rain were also extrapolated from existing data as described in methods section (values behind data in brackets). Values were calculated from 30-minute intervals. Fog has not being recorded in the time ranges of 31.05.-20.10.2015, 30.04.-06.07.2016, 01.09.-31.12.2016 due to malfunction of the device.

Month	PAR_{avg} daytime [$\mu\text{mol m}^{-2} \text{s}^{-1}$ PPFD]		PAR_{max} [$\mu\text{mol m}^{-2} \text{s}^{-1}$ PPFD]		Temperature [$^{\circ}\text{C}$]		RH [%]		Rain [mm month $^{-1}$]	Rain [% days]	Defect on rain detection [% days]	Fog [% days]
	Mean	\pm SD	Mean	\pm SD	Mean	\pm SD	Mean	\pm SD				
Oct 2014	857	668	2201	509	26.0	2.8	90	11	212	58	0	55
Nov 2014	832	624	2082	423	25.6	2.9	92	11	70	57	0	53
Dec 2014	843	582	2140	346	26.3	2.7	90	11	123	42	0	42
Jan 2015	637	525	1747	735	24.5	2.4	95	8	259	71	0	71
Feb 2015	774	589	2058	600	25.4	2.6	92	10	140	64	0	46
Mar 2015	680	534	2038	575	24.7	2.1	96	7	331	87	0	77
Apr 2015	766	564	2155	463	25.3	2.5	93	10	189	80	0	40
May 2015	725	559	2103	425	27.2	n.a.	93	6	320	90	0	58
Jun 2015	804	562	2237	128	25.0	2.3	94	8	178	80	0	0*
Jul 2015	892	605	2238	188	25.7	3.0	91	11	74	65	0	0*
Aug 2015	1017	636	1722	957	27.1	3.3	83	13	(23) 32*	23	23	0*
Sep 2015	1148	687	2242	467	28.7	3.7	74	15	38	13	20	0*
Oct 2015	968	635	2072	514	28.4	3.6	78	16	55	35	3	13*
Nov 2015	887	624	1859	769	27.9	3.5	81	16	(33) 37*	30	17	23
Dec 2015	862	575	2074	304	28.1	3.0	78	14	38	26	3	6
Jan 2016	882	606	2175	270	28.2	3.4	78	16	52	48	0	13
Feb 2016	743	550	1928	679	25.9	2.6	93	10	(267) 341*	79	52	48
Mar 2016	692	545	2041	545	25.6	2.1	96	7	304	90	0	77
Apr 2016	709	564	2088	443	25.6	2.3	96	7	277	87	0	73
May 2016	817	603	2230	405	26.1	2.6	94	8	236	90	0	0*
Jun 2016	828	584	2178	261	25.6	2.8	92	10	105	57	0	0*
Jul 2016	917	629	2253	118	26.2	3.2	88	12	92	58	0	26*
Aug 2016	1016	648	2146	593	27.1	3.5	83	14	40	32	3	16
Sep 2016	947	662	2230	543	26.5	3.1	89	12	(77) 96*	50	17	0*
Oct 2016	915	641	2323	192	27.1	3.3	86	14	(1) 9*	23	23	0*
Nov 2016	911	610	2227	217	27.1	3.3	87	13	(30) 89*	20	13	0*
Dec 2016	694	553	1955	503	25.4	2.7	94	10	223	71	0	0*

*) Gaps in the data record due to malfunction of the device.

Table S4: Monthly mean values and standard deviations (\pm SD) of the photosynthetically active radiation (PAR_{avg} daytime), the daily maxima of photosynthetically active radiation (PAR_{max}), temperature, and water content of bryophytes at four height levels. Values were calculated from 30-minute intervals. N.a.: data not available.

Month	PAR _{avg} daytime [$\mu\text{mol m}^{-2} \text{s}^{-1}$ PPFD]								PAR _{max} [$\mu\text{mol m}^{-2} \text{s}^{-1}$ PPFD]							
	1.5 m		8 m		18 m		23 m		1.5 m		8 m		18 m		23 m	
	Mean	\pm SD	Mean	\pm SD	Mean	\pm SD	Mean	\pm SD	Mean	\pm SD	Mean	\pm SD	Mean	\pm SD	Mean	\pm SD
Oct 2014	4	8	30	31	55	63	88	90	75	105	285	231	465	369	624	286
Nov 2014	4	11	23	32	27	18	24	37	142	131	396	321	188	185	378	275
Dec 2014	6	18	31	50	52	28	25	33	236	172	435	228	201	173	346	235
Jan 2015	3	8	22	28	46	24	20	27	155	96	341	219	189	167	341	246
Feb 2015	2	3	31	21	52	25	16	17	46	33	173	183	187	139	234	244
Mar 2015	3	4	43	35	42	25	16	15	45	55	292	159	159	125	128	117
Apr 2015	6	20	80	105	48	41	16	18	346	310	480	231	351	232	241	231
May 2015	6	32	66	71	52	52	16	17	634	428	282	236	460	207	146	137
Jun 2015	2	3	73	64	55	55	18	20	42	51	214	125	404	139	177	141
Jul 2015	3	12	54	73	52	59	15	18	168	178	727	301	435	169	152	144
Aug 2015	13	56	66	115	52	71	24	23	601	414	746	193	521	161	227	170
Sep 2015	9	21	28	47	53	61	65	66	248	204	403	224	410	164	492	229
Oct 2015	3	4	15	15	32	28	44	30	53	47	128	99	226	147	221	157
Nov 2015	4	7	16	25	27	21	61	64	82	95	315	151	139	98	475	208
Dec 2015	5	11	22	35	29	19	88	103	112	116	308	171	145	113	645	250
Jan 2016	4	7	16	21	33	24	88	103	72	91	177	143	165	115	692	294
Feb 2016	3	4	13	11	30	26	57	46	46	54	79	76	167	159	388	237
Mar 2016	3	7	28	15	28	27	37	33	102	125	107	80	227	180	268	215
Apr 2016	5	15	27	19	29	46	38	31	192	199	59	27	481	208	270	203
May 2016	3	7	n.a.	n.a.	34	50	45	41	114	109	n.a.	n.a.	339	176	286	209
Jun 2016	2	2	n.a.	n.a.	28	41	58	68	25	34	n.a.	n.a.	301	129	416	199
Jul 2016	2	4	n.a.	n.a.	42	64	72	86	30	44	n.a.	n.a.	386	139	527	204
Aug 2016	9	34	31	52	46	74	71	94	319	216	340	241	477	130	614	256
Sep 2016	3	7	13	24	44	63	55	69	102	84	250	137	387	166	508	244
Oct 2016	2	3	7	9	43	61	47	54	35	28	106	71	428	241	421	219
Nov 2016	3	5	9	13	33	30	73	85	59	51	172	114	216	185	606	251
Dec 2016	4	12	24	38	24	19	52	56	156	131	361	282	117	96	457	274

Continuation of Table S4

Month	Temperature [°C]								Water content [%]							
	1.5 m		8 m		18 m		23 m		1.5 m		8 m		18 m		23 m	
	Mean	± SD	Mean	± SD	Mean	± SD	Mean	± SD	Mean	± SD	Mean	± SD	Mean	± SD	Mean	± SD
Oct 14	25.0	1.3	25.2	1.6	25.6	2.1	26.3	2.9	542	319	54	23	71	20	102	24
Nov 14	25.3	1.2	25.7	1.4	25.9	1.8	26.2	2.3	229	91	43	5	66	18	95	21
Dec 14	25.4	1.1	25.8	1.3	26.1	1.6	26.6	2.1	261	154	44	6	67	17	88	12
Jan 15	24.2	1.1	24.3	1.3	24.5	1.7	24.6	1.8	469	284	49	8	66	14	92	14
Feb 15	24.5	1.0	24.5	1.1	25.0	2.0	25.0	1.8	402	218	48	8	65	8	94	10
Mar 15	24.4	0.9	24.3	0.9	24.6	1.6	24.5	1.3	486	210	55	14	70	12	95	10
Apr 15	24.6	0.9	24.7	1.1	25.0	1.8	24.9	1.8	364	197	47	6	66	12	96	7
May 15	24.6	0.9	24.5	0.9	24.8	1.7	24.8	1.7	486	256	49	10	63	7	96	7
Jun 15	24.5	0.9	24.5	1.0	25.0	1.9	25.0	1.9	n.a.	n.a.	n.a.	n.a.	64	3	98	8
Jul 15	24.5	1.1	25.0	1.5	25.5	2.4	25.5	2.5	262	86	46	7	64	4	96	21
Aug 15	25.4	1.2	26.3	2.0	26.9	2.7	27.0	2.8	203	43	42	5	60	7	90	15
Sep 15	27.0	1.7	27.8	2.2	28.5	3.2	29.0	3.4	180	58	40	5	57	6	83	14
Oct 15	27.2	1.8	28.0	2.2	28.4	3.1	29.4	3.2	179	46	37	5	57	6	83	24
Nov 15	27.2	1.9	27.6	2.3	28.1	3.1	29.2	3.6	174	53	38	7	57	6	83	20
Dec 15	27.3	1.6	27.9	2.0	28.2	2.6	29.4	3.4	169	43	37	7	57	6	81	17
Jan 16	27.4	1.8	28.0	2.2	28.4	3.0	29.4	3.8	174	54	39	9	56	6	82	15
Feb 16	25.2	1.0	25.4	1.2	25.8	2.1	26.2	2.5	421	278	48	18	62	7	88	16
Mar 16	25.2	0.9	25.1	0.9	25.4	1.6	25.6	1.8	417	214	48	13	62	5	89	11
Apr 16	25.2	1.0	25.2	1.1	25.5	1.7	25.7	2.0	381	155	57	21	n.a.	n.a.	89	15
May 16	25.3	1.0	25.3	1.2	25.8	1.9	26.1	2.3	283	118	50	15	n.a.	n.a.	86	14
Jun 16	24.6	1.1	24.6	1.3	25.3	2.2	25.8	2.8	234	63	52	17	n.a.	n.a.	89	7
Jul 16	24.8	1.2	25.3	1.7	25.9	2.5	26.7	3.4	208	68	45	12	n.a.	n.a.	91	10
Aug 16	25.7	1.8	26.3	2.4	26.9	3.0	28.0	4.1	192	75	46	46	n.a.	n.a.	86	7
Sep 16	25.5	1.3	25.9	1.7	26.4	2.6	27.1	3.3	203	95	44	16	n.a.	n.a.	n.a.	n.a.
Oct 16	26.2	1.6	26.8	1.9	27.3	2.9	28.0	3.4	179	22	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Nov 16	25.9	1.7	26.5	2.1	27.1	2.8	28.0	3.4	199	89	68	78	87	44	87	15
Dec 16	25.4	1.3	25.0	1.7	25.3	2.1	25.6	2.5	308	180	118	89	124	73	106	30

Table S5 Seasonal mean values, standard deviations (\pm SD), and statistically significant differences between different height levels and ambient conditions for the parameters photosynthetically active radiation (PAR_{avg}), daily maximum of photosynthetically active radiation (PAR_{max}), temperature, and ambient relative humidity/water content (WC). Values measured as ambient conditions and within/on top of bryophytes at four height levels. Mean values for the respective seasons were calculated from 5-minute intervals of the years 2015 and 2016. Due to the absence of normal distribution and variance homogeneity a non-parametric Kruskal-Wallis test with post hoc test was performed to compare values obtained for different seasons.

Height [m]	PAR_{avg} daytime [$\mu\text{mol m}^{-2} \text{s}^{-1}$ PPFD]			PAR_{max} [$\mu\text{mol m}^{-2} \text{s}^{-1}$ PPFD]			Temperature [$^{\circ}\text{C}$]			WC [%]		
	Mean	\pm SD	sig.	Mean	\pm SD	sig.	Mean	\pm SD	sig.	Mean	\pm SD	sig.
Wet season												
ambient	738	566	a	2086	515	a	25.6	2.5	a	94	9	#
23	30	3	b	248	194	b	25.3	2.0	a	92	11	a
18	39	12	c	282	175	b	25.2	1.9	b	65	9	b
8	31	26	d	144	194	c	24.9	1.1	c	51	12	c
1.5	4	15	e	114	224	c	24.9	1.0	d	403	203	d
p	≤ 0.001			≤ 0.001			≤ 0.001			≤ 0.001		
Transitional season Wet-Dry												
ambient	861	649	a	2227	182	a	25.8	3.0	a	91	11	#
23	41	72	b	414	252	b	25.7	2.8	b	93	10	a
18	44	54	c	351	123	c	25.4	2.3	a	64	4	b
8	66	88	d	165	218	d	24.9	1.4	c	47	12	c
1.5	2	12	e	61	102	e	24.6	1.1	d	227	61	d
p	≤ 0.001			≤ 0.001			≤ 0.001			≤ 0.001		
Dry season												
ambient	973	647	a	2100	609	a	26.7	3.4	a	87	14	#
23	55	9	b	503	231	b	27.2	3.5	b	90	13	a
18	41	13	c	412	190	b	26.5	2.9	c	63	17	b
8	23	16	d	295	268	c	26.0	2.1	d	45	28	c
1.5	6	25	e	209	299	d	25.5	1.7	e	202	68	d
p	≤ 0.001			≤ 0.001			≤ 0.001			≤ 0.001		
Transitional season Dry-Wet												
ambient	785	617	a	1988	509	a	26.5	3.3	a	85	15	#
23	55	91	b	530	297	b	27.2	3.7	b	89	17	a
18	37	28	c	185	109	c	26.6	3.0	c	77	45	b
8	21	47	d	269	178	c	26.3	2.5	a	61	55	c
1.5	4	20	e	107	113	d	26.0	2.1	d	299	238	d
p	≤ 0.001			≤ 0.001			≤ 0.001			≤ 0.001		

Table S6: Daily maximum values of the photosynthetically active radiation (PAR_{max}), the temperature ($Temp_{max}$), and the ambient relative humidity/water content (WC_{max}) of epiphytic bryophytes. Mean values, standard deviations (\pm SD), significance, and p-values are shown for dry and wet seasons of the two years 2015 and 2016. For the ambient data maximum air humidity (RH) values are shown, while for the bryophytes the water content was assessed. Ambient light intensity was measured at 75 m, ambient temperature and relative air humidity at 26 m. Due to the absence of normal distribution and variance homogeneity a non-parametric Kruskal-Wallis test with post hoc test was performed to compare values obtained for different seasons.

Season	PAR_{max} [$\mu\text{mol m}^{-2} \text{s}^{-1}$ PPFD]				$Temp_{max}$ [$^{\circ}\text{C}$]				RH_{max}, WC_{max} [%]			
	Mean	\pm SD	sig	p	Mean	\pm SD	sig	p	Mean	\pm SD	sig	p
ambient												
Dry15	1966	730	a	0.003	33.5	2.1	a	0.000	96	5	a	0.000
Dry16	2232	425	c		32.3	1.8	b		99	2	b	
Wet15	2089	515	ac		28.9	2.4	c		99	3	b	
Wet16	2084	517	ac		30.4	1.9	d		100	1	b	
23 m												
Dry15	431	239	a	0.000	35.8	3.9	a	0.000	125	67	a	0.293
Dry16	575	260	b		37.4	4.7	a		120	39	a	
Wet15	167	202	c		28.4	2.5	b		113	12	a	
Wet16	329	223	d		31.8	3.2	c		121	40	a	
18 m												
Dry15	381	207	a	0.000	33.3	2.0	a	0.000	72	11	a	0.000
Dry16	443	204	b		32.8	2.2	a		120	86	b	
Wet15	274	208	c		28.4	1.9	b		91	22	b	
Wet16	289	188	c		29.6	1.7	c		75	12	c	
8 m												
Dry15	414	381	a	0.000	32.0	3.2	a	0.000	51	14	a	0.000
Dry16	175	258	b		31.0	3.9	b		122	185	b	
Wet15	246	395	b		26.5	1.5	c		68	55	c	
Wet16	44	88	c		27.8	1.8	d		89	66	b	
1.5 m												
Dry15	290	369	a	0.000	29.3	1.6	a	0.000	265	254	a	0.000
Dry16	127	173	b		29.0	2.5	a		304	327	b	
Wet15	132	284	b		26.0	1.0	b		657	381	c	
Wet16	96	140	b		27.0	1.0	c		686	437	c	

Table S7: Daily minimum values of the photosynthetically active radiation (PAR_{min}), the temperature ($Temp_{min}$), and the ambient relative humidity/water content (WC_{min}) of epiphytic bryophytes. Mean values, standard deviations (\pm SD), significance, and p-values are shown for dry and wet seasons of the two years 2015 and 2016. For the ambient data maximum air humidity (RH) values are shown, while for the bryophytes the water content was assessed. Ambient light intensity was measured at 75 m, ambient temperature and relative air humidity at 26 m. Due to the absence of normal distribution and variance homogeneity a non-parametric Kruskal-Wallis test with post hoc test was performed to compare values obtained for different seasons.

Season	PAR_{min} [$\mu\text{mol m}^{-2} \text{s}^{-1}$ PPFD]				$Temp_{min}$ [$^{\circ}\text{C}$]				RH_{min}, WC_{min} [%]			
	Mean	\pm SD	sig	p	Mean	\pm SD	sig	p	Mean	\pm SD	sig	p
ambient												
Dry15	0	0	a	1.000	23.7	1.1	a	0.000	57	11	a	0.000
Dry16	0	0	a		23.1	0.9	b		65	8	b	
Wet15	0	0	a		22.6	1.7	c		81	12	c	
Wet16	0	0	a		23.5	0.7	a		77	9	c	
23 m												
Dry15	0	0	a	1.000	24.7	1.5	a	0.000	58	12	a	0.000
Dry16	0	0	a		24.1	1.3	a		60	10	ab	
Wet15	0	0	a		23.1	0.7	b		78	10	c	
Wet16	0	0	a		23.6	0.6	c		63	10	b	
18 m												
Dry15	0	0	a	1.000	24.0	1.0	a	0.000	46	9	a	0.000
Dry16	0	0	a		23.7	1.0	b		58	20	b	
Wet15	0	0	a		22.9	0.6	c		47	5	a	
Wet16	0	0	a		23.6	0.6	b		49	8	b	
8 m												
Dry15	0	0	a	1.000	25.0	1.0	a	0.000	26	8	a	0.000
Dry16	0	0	a		24.2	0.9	b		23	12	b	
Wet15	0	0	a		23.4	0.5	c		35	9	c	
Wet16	0	0	a		24.0	0.5	b		29	12	d	
1.5 m												
Dry15	0	0	a	1.000	24.8	1.0	a	0.000	159	39	a	0.000
Dry16	0	0	a		24.1	0.9	b		163	43	a	
Wet15	0	0	a		23.5	0.5	c		279	166	b	
Wet16	0	0	a		24.1	0.5	b		258	128	b	

Table S8: Daily amplitudes of the photosynthetically active radiation (PAR_{amp}), the temperature ($Temp_{amp}$), and the ambient relative humidity/water content (WC_{amp}) of epiphytic bryophytes. Mean values, standard deviations (\pm SD), significance, and p-values are shown for dry and wet seasons of the two years 2015 and 2016. For the ambient data maximum air humidity (RH) values are shown, while for the bryophytes the water content was assessed. Ambient light intensity was measured at 75 m, ambient temperature and relative air humidity at 26 m. Due to the absence of normal distribution and variance homogeneity a non-parametric Kruskal-Wallis test with post hoc test was performed to compare values obtained for different seasons.

Season	PAR_{amp} [$\mu\text{mol m}^{-2} \text{s}^{-1}$ PPFd]				$Temp_{amp}$ [$^{\circ}\text{C}$]				RH_{amp}, WC_{amp} [%]			
	Mean	\pm SD	sig.	p	Mean	\pm SD	sig.	p	Mean	\pm SD	sig.	p
ambient												
Dry15	1966	730	a	0.00	9.8	2.1	a	0.00	39	10	a	0.00
Dry16	2232	425	c		9.3	1.6	b		35	8	b	
Wet15	2089	515	ac		6.3	2.8	c		18	13	c	
Wet16	2084	517	ac		7.0	1.8	b		23	9	c	
23 m												
Dry15	431	239	a	0.00	11.2	3.2	a	0.00	67	68	a	0.00
Dry16	575	260	b		13.2	4.5	b		60	42	a	
Wet15	167	202	c		5.3	2.4	c		36	19	b	
Wet16	329	223	d		8.1	3.1	d		58	45	a	
18 m												
Dry15	381	207	a	0.00	9.3	1.6	a	0.00	26	17	a	0.00
Dry16	443	204	b		9.1	1.9	b		62	80	b	
Wet15	274	208	c		5.5	1.8	c		44	22	b	
Wet16	289	188	c		6.0	1.7	d		27	18	a	
8 m												
Dry15	414	381	a	0.00	7.0	3.2	a	0.00	25	18	a	0.00
Dry16	175	258	b		6.8	3.9	b		99	182	b	
Wet15	246	395	b		3.1	1.4	c		32	56	a	
Wet16	44	88	c		3.7	1.9	d		60	62	b	
1.5												
Dry15	290	369	a	0.00	4.4	1.2	a	0.00	106	246	a	0.00
Dry16	127	173	b		4.9	2.4	b		141	314	b	
Wet15	132	284	b		2.5	1.0	c		377	309	c	
Wet16	96	140	b		2.8	1.0	d		428	400	c	

Table S9: Daily maximum of the photosynthetically active radiation (PAR_{max}), the temperature ($Temp_{max}$), and the ambient relative humidity/water content (WC_{max}) of epiphytic bryophytes. Mean values, standard deviations (\pm SD), significance, and p-values are shown for dry and wet seasons of the two years 2015 and 2016. For the ambient data maximum air humidity (RH) values are shown, while for the bryophytes the water content was assessed. Ambient light intensity was measured at 75 m, ambient temperature and relative air humidity at 26 m. Due to the absence of normal distribution and variance homogeneity a non-parametric Kruskal-Wallis test with post hoc test was performed to compare values obtained for different seasons.

Height [m]	PAR_{max} [$\mu\text{mol m}^{-2} \text{s}^{-1}$ PPFD]				$Temp_{max}$ [$^{\circ}\text{C}$]				WC_{max} [%]			
	Mean	\pm SD	sig.	p	Mean	\pm SD	sig.	p	Mean	\pm SD	sig.	P
Dry season 2015												
ambient	1966	730	d	0.000	33.5	2.1	c	0.000				
23	431	239	c		35.8	3.9	d		125	67	d	0.000
18	381	207	bc		33.3	2.0	c		72	11	c	
8	414	381	b		32.0	3.2	b		51	14	b	
1.5	290	369	a		29.3	1.6	a		265	254	a	
Dry season 2016												
ambient	2232	425	d	0.000	32.3	1.8	c	0.000				
23	575	260	c		37.4	4.7	d		120	39	c	0.000
18	443	204	b		32.8	2.2	c		120	86	bc	
8	175	258	a		31.0	3.9	b		122	185	b	
1.5	127	173	a		29.0	2.5	a		304	327	a	
Wet season 2015												
ambient	2089	515	d	0.000	28.9	2.4	c	0.000				
23	167	202	c		28.4	2.5	c		113	12	d	0.000
18	274	208	b		28.5	1.9	c		91	22	c	
8	246	395	ac		26.5	1.5	b		68	55	b	
1.5	132	284	a		26.0	1.0	a		657	381	a	
Wet season 2016												
ambient	2084	517	d	0.000	30.4	1.9	cd	0.000				
23	329	223	c		31.8	3.2	cd		121	40	c	0.000
18	289	188	c		29.6	1.7	c		75	12	b	
8	44	88	b		27.8	1.8	b		89	66	b	
1.5	96	140	a		27.0	1.0	a		686	437	a	

Table S10: Daily minimum of the photosynthetically active radiation (PAR_{min}), the temperature ($Temp_{min}$), and the ambient relative humidity/water content (WC_{min}) of epiphytic bryophytes. Mean values, standard deviations (\pm SD), significance, and p-values are shown for dry and wet seasons of the two years 2015 and 2016. For the ambient data maximum air humidity (RH) values are shown, while for the bryophytes the water content was assessed. Ambient light intensity was measured at 75 m, ambient temperature and relative air humidity at 26 m. Due to the absence of normal distribution and variance homogeneity a non-parametric Kruskal-Wallis test with post hoc test was performed to compare values obtained for different seasons.

Height [m]	PAR_{min} [$\mu\text{mol m}^{-2} \text{s}^{-1}$ PPFD]				$Temp_{min}$ [$^{\circ}\text{C}$]				WC_{min} [%]			
	Mean	\pm SD	sig.	p	Mean	\pm SD	sig.	p	Mean	\pm SD	sig.	p
Dry season 2015												
ambient	0	0	a	1.000	23.7	1.1	c	0.000				
23	0	0	a		24.7	1.5	b		58	12	d	0.000
18	0	0	a		24.0	1.0	c		46	9	c	
8	0	0	a		25.0	1.0	a		26	8	b	
1.5	0	0	a		24.8	1.0	ab		159	39	a	
Dry season 2016												
ambient	0	0	a	1.000	23.1	0.9	c	0.000				
23	0	0	a		24.1	1.3	a		60	10	c	0.000
18	0	0	a		23.7	1.0	b		58	20	c	
8	0	0	a		24.2	0.9	a		23	12	b	
1.5	0	0	a		24.1	0.9	a		163	43	a	
Wet season 2015												
ambient	0	0	a	1.000	22.6	1.7	b	0.000				
23	0	0	a		23.1	0.7	c		78	10	d	0.000
18	0	0	a		22.9	0.6	b		47	5	c	
8	0	0	a		23.4	0.5	a		35	9	b	
1.5	0	0	a		23.5	0.5	a		279	166	a	
Wet season 2016												
ambient	0	0	a	1.000	23.5	0.7	b	0.000				
23	0	0	a		23.6	0.6	b		63	10	c	0.000
18	0	0	a		23.6	0.6	b		49	8	c	
8	0	0	a		24.0	0.5	a		29	12	b	
1.5	0	0	a		24.1	0.5	a		258	128	a	

Table S11: Daily amplitudes of the photosynthetically active radiation (PAR_{amp}), the temperature (Temp_{amp}), and the ambient relative humidity/water content (WC_{amp}) of epiphytic bryophytes. Mean values, standard deviations (\pm SD), significance, and p-values are shown for dry and wet seasons of the two years 2015 and 2016. For the ambient data maximum air humidity (RH) values are shown, while for the bryophytes the water content was assessed. Ambient light intensity was measured at 75 m, ambient temperature and relative air humidity at 26 m. Due to the absence of normal distribution and variance homogeneity a non-parametric Kruskal-Wallis test with post hoc test was performed to compare values obtained for different seasons.

Height [m]	PAR _{amp} [$\mu\text{mol m}^{-2} \text{s}^{-1}$ PFD]				Temp _{amp} [$^{\circ}\text{C}$]				WC _{amp} [%]			
	Mean	\pm SD	sig.	p	Mean	\pm SD	sig.	p	Mean	\pm SD	sig.	p
Dry season 2015												
ambient	1966	730	d	0.000	9.8	2.1	dc	0.000				
23	431	239	c		11.2	3.2	d		67	68	c	0.000
18	381	207	bc		9.3	1.6	c		26	17	b	
8	414	381	b		7.0	3.2	b		25	18	b	
1.5	290	369	a		4.4	1.2	a		106	246	a	
Dry season 2016												
ambient	2232	425	d	0.000	9.3	1.6	b	0.000				
23	575	260	c		13.2	4.5	d		60	42	a	0.037
18	443	204	b		9.1	1.9	c		62	80	a	
8	175	258	a		6.8	3.9	b		99	182	a	
1.5	127	173	a		4.9	2.4	a		141	314	a	
Wet season 2015												
ambient	2089	515	d	0.000	6.3	2.8	c	0.000				0.000
23	167	202	c		5.3	2.4	c		36	19	c	
18	274	208	b		5.5	1.8	c		44	22	c	
8	246	395	ac		3.1	1.4	b		32	56	b	
1.5	132	284	a		2.5	1.0	a		377	309	a	
Wet season 2016												
ambient	2084	517	d	0.000	7.0	1.8	d	0.000				
23	329	223	c		8.1	3.1	d		58	45	b	0.000
18	289	188	c		6.0	1.7	c		27	18	c	
8	44	88	b		3.7	1.9	b		60	62	b	
1.5	96	140	a		2.8	1.0	a		428	400	a	