Annex 1: Detailed description of the climate data preparation routine

Climate data per day for the period 1980-2010 was obtained from the agMERRA dataset (Ruane et al., 2015). Original columns are the time dimensions year, month, day of the month; temperature variables maximum and minimum temperature (all in degr C); further incoming solar radiation in the plant-available spectrum [MJ/m2) as well as precipitation (mm) and relative humidity (dimensionless) as outlined in Table 1. The remainder of this section explains the steps taken to convert agMERRA data from its original format presented in Table 1 to BGC-MAN readable format presented in Table 2. Calculations and conversions are performed using various packages of the R (R Core Development Team, 2018). Correct citations of the various packages are retrieved from the *utils* package (R Core Development Team, 2018); the full R code is provided in Annex 1.

Table 1: the first rows of an exemplary climate file provided by the agMERRA dataset.

year	month	day	srad_MJ_day	tmax	tmin	prcp_mm	relhum_frac
1980	1	1	18.4	31.3	23.3	2.2	0.91
1980	1	2	22.9	32.3	23.6	0	0.87
1980	1	3	19.9	31.7	23	0	0.89
1980	1	4	22.9	31.7	23	0	0.89
1980	1	5	23.4	32	23.1	0.9	0.87
1980	1	6	9.8	29.7	22.6	3.5	0.99

- The day of the year is calculated using the *ymd* and *yday* commands of the *lubridate* package (Grolemund and Wickham, 2011)
- t_{day} is calculated from tmin and tmax using the tday equation described in Pietsch and Burgmann (2000) after Parton and Logan (1981) and implemented in R base version. It assumes that tday has a sinusoidal behavior whose max and min values are determined by measured data.

$$t_{day} = TEMPCF * (t_{max} - t_{avg}) + t_{avg} \qquad \textbf{(Equation 1)}$$

where TEMPCF is constant at 0.212, tmax and tmin are provided by agMERRA and t_{avg} is the arithmetic mean of the former.

- Daylength (seconds per day) is calculated using the *daylength* command from the *geosphere* package (Hijmans et al., 2017) based on algorithms by Forsythe et al. (1995); it uses each agMERRA point's latitude provided in the agMERRA raw data

- Daily precipitation (cm) and solar radiation (Wat) is converted from original agMERRA data using a factor of 10 for precipitation and by dividing by $\frac{daylenght_{seconds}}{1{,}000{,}000}$ to convert solar radiation from MJ/m^2/day to Watt/ m^2.
- Vapor pressure deficit VPD is calculated using air pressure, relative humidity and tday as input where air pressure is calculated using the *pressure.from.elevation* command in the R package *Bigleaf* (Knauer et al., 2018), where a site's elevation is calculated in QGIS (command: raster value to point) using a digital terrain model and agMERRA point data as input and relative humidity is converted to VPD using the *plantecophys* package (Duursma, 2015)

The resulting data is cleared for the 366th day of the year in the case of leap years and consists of 4267 files in CSV format, one for each location of the agMERRA data; each file consists of 11315 rows, one for each day across 30 years, and nine columns as outlined in Table 2In a final step, one file each representing the 38 ecoregions of Indonesia are merged and converted to BGC-MAN-readable data format using the dmout2bgc application

These steps result in climate variables required by BGC-MAN as presented in Table 2: year, day of the year (DOY), tmax, tmin, day time air temperature (tday), daily precipitation (cm), Vapor Pressure deficit (Pa), solar radiation (Watt/m2) and daylength in seconds.

Table 2: the first rows of an exemplary climate file entering BGC-MAN.

year	DOY	tmax	tmin	tday	precip_cm	VPD_Pa	srad_W	dayl_sec
1980	1	31.2	24.4	28.5208	0.63	469	449.68	45366
1980	2	31.9	24.6	29.0238	0.06	402	414.47	45359
1980	3	31.6	24.6	28.842	0.56	398	295.47	45351
1980	4	32	24.6	29.0844	0.18	565	452.11	45343
1980	5	33.1	24.7	29.7904	0.12	799	441.17	45334