

Supplement 3: Details of environmental predictor variables for each region

1. Australian Wet Tropics (AWT)

Prepared by Karen Richardson, Caroline Bruce, Catherine Graham

- Coordinate reference system: UTM, zone 55, spheroid GRS 1980, datum GDA94
- EPSG:28355
- Units: meters
- Raster cell size: 80m

Table 3.1 Environmental data for the Australian Wet Tropics

Code	Description	Units ¹	Type ²	Notes
bc01	Annual mean temperature	°C	Cont	
bc04	Temperature seasonality		Cont	
bc05	Max. temperature of warmest period	°C	Cont	
bc06	Min. temperature of coldest period.	°C	Cont	
bc12	Annual precipitation	mm	Cont	
bc15	Precipitation seasonality		Cont	
bc17	Precipitation of driest quarter	mm	Cont	
bc20	Annual mean solar radiation	MJ m ⁻² day ⁻¹	Cont	
bc31	Moisture index seasonality		Cont	
bc33	Mean moisture index of lowest quarter MI		Cont	
slope	Mean slope (derived from ~300 m spatial resolution elevation data)	percent	Cont	
topo	Topographic position		Cont	From 0 to 100. 0 = gully; 50 = mid-slope; 100 = ridge
tri	Terrain ruggedness index		Cont	Sum of variation in elevation in a 1 km moving window

¹Variables without units are dimensionless indices

²Cont = continuous; Cat = categorical

[Supplementary Information 3 \(cont'd\). Details of environmental predictor variables for each region.](#)

2. Ontario, Canada (CAN)

Prepared by Falk Huettmann, Jane Elith and Catherine Graham

- Coordinate reference system: unprojected, Clarke 1866 ellipsoid
- EPSG:4008
- Units: decimal degree
- Raster cell size: 0.008333334 degrees (~ 1km)

Note: References at end of Supplementary Information 3.

Table 3.2 Environmental data for CAN.

Code	Description	Unit ^A	Type ^B	Notes
alt	Digital elevation	m	Cont	From SRTM
asp2	Aspect – ranges from -1 to 1 (sin transformation)		Cont	From SRTM
ontprec	Annual Precipitation	mm	Cont	Version 1.2 of Worldclim data (Hijmans et al. 2005)
ontprec4	April precipitation	mm	Cont	Version 1.2 of Worldclim data (Hijmans et al. 2005)
ontprecsd	Precipitation Seasonality		Cont	Version 1.2 of Worldclim data (Hijmans et al. 2005)
ontslp	Slope	degrees	Cont	From SRTM
onttemp	Annual mean temperature	°C * 10	Cont	Version 1.2 of Worldclim data (Hijmans et al. 2005)
onttempstd	Temperature standard deviation		Cont	Version 1.2 of Worldclim data (Hijmans et al. 2005)
onttmin4	April minimum temperature	°C * 10	Cont	Version 1.2 of Worldclim data (Hijmans et al. 2005)
ontveg	Vegetation, from Ontario Land Cover Database (OLC) vegetation map, derived from a mosaic of Landsat images.		Cat	5 classes: 1 = open forest & related; 2 = closed forest; 3 = open water, 4 = agriculture, 5 = human settlement
watdist	Distance from Hudson Bay	m	Cont	

^A Variables without units are dimensionless indices

^B Cont = continuous; Cat = categorical

[Supplementary Information 3 \(cont'd\). Details of environmental predictor variables for each region.](#)

3. North-east New South Wales, Australia (NSW)

Provided by Simon Ferrier

- Coordinate reference system: unprojected, WGS84 datum
- EPSG:4326
- Units: decimal degree
- Raster cell size: 0.000899322 degrees (approx 100m)

Table 3.3 Environmental data for NSW

Code	Description	Units ¹	Type ²	Notes
cti	compound topographic index- a quantification of the position of a site in the local landscape		Cont	Often referred to as the steady state wetness index; defined as: $CTI = \ln (As / \tan B)$ where 'As' is the specific catchment area expressed as m ² per unit width orthogonal to the flow direction and 'B' is the slope angle
disturb	disturbance (clearing, logging etc)	number (ordinal)	Cont	index. 1 = light to 4 = heavy
mi	moisture index.		Cont	Index of site wetness derived from a water balance algorithm using rainfall, evaporation, radiation and soil depth as inputs. Ranges between 0 (dry) and 100 (wet)
rainann	mean annual rainfall	Mm	Cont	
raindq	mean rainfall of the driest quarter	Mm	Cont	
rugged	ruggedness		Cont	Coefficient of variation of raster cells within 1km of cell of interest
soildepth	mean soil depth	m *1000	Cont	predicted from a model relating sampled soil depths to climate, geology and topography
soilfert	soil fertility	number (ordinal)	Cont	class 1 (low) to 5 (high) derived from soil landscape mapping and modeling of geochemical data. Ordered; can be treated as continuous
solrad	annual mean solar radiation	MJm ⁻² day ⁻¹ * 10	Cont	Terrain adjusted radiation
tempann	annual mean temperature	°C * 10	Cont	
tempmin	minimum temperature of the coldest month	°C * 10	Cont	
topo-	topographic position	m	Cont	Mean difference in elevation between raster cell of interest and all cells within 1km radius (-ve values are gullies, +ve are ridges)
vegsys	broad vegetation type	number (category)	Cat	1 = Rainforest 2 = Moist open forest 3 = Dry open forest 4 = Woodland 5 = Coastal sclerophyll complex 6 = Plateau sclerophyll complex 7 = Disturbed remnant 8 = Exotic (pine) plantation 9 = Cleared

¹Variables without units are dimensionless indices

²Cont = continuous; Cat = categorical

[Supplementary Information 3 \(cont'd\). Details of environmental predictor variables for each region.](#)

4. New Zealand (NZ)

Provided by Jake Overton

- Coordinate reference system: New Zealand Map Grid (NZMG), Datum: NZGD49 (New Zealand Geodetic Datum 1949), Ellipsoid: International 1924
- EPSG:27200
- Units: meters
- Raster cell size: 100m

Table 3.4 Environmental data for NZ

code	Description	Units ¹	Type ²	Notes
age	soil parent material: age since last major rejuvenation	number (category)	Cat	3 classes (0 to 2): <2000 yrs, 2000-postglacial (approx. 30,000), and preglacial
deficit	mean October vapor pressure deficit at 0900 hours	kPa	Cont	
dem	digital elevation model	meters	Cont	
hillshade	surrogate for slope and aspect		Cont	index of brightness calculated using default parameters in Arcview
mas	mean annual solar radiation	MJm ⁻² day ⁻¹ * 100	Cont	
mat	mean annual temperature	°C * 10	Cont	
r2pet	average monthly ratio of potential evapotranspiration		Cont	
rain	average annual rainfall	mm	Cont	
slope	slope	degrees	Cont	
sseas	solar radiation seasonality		Cont	$\sigma_J * \left\{ \frac{(J - \bar{J})}{\sigma_J} \right\} - \left\{ \frac{(S - \bar{S})}{\sigma_S} \right\}$ J = June sol rad S = annual sol rad bar = mean of grid sigma = standard deviation
toxicats	toxic cations in soil	number (category)	Cat	0 = low to 3 = high (e.g. serpentine soils)
tseas	temperature seasonality		Cont	$\sigma_J * \left\{ \frac{(J - \bar{J})}{\sigma_J} \right\} - \left\{ \frac{(T - \bar{T})}{\sigma_T} \right\}$ J = July min temp T = mean annual temp bar = mean of grid sigma = standard deviation
vpd	annual vapor pressure deficit	kPa	Cont	

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²Cont = continuous; Cat = categorical

[Supplementary Information 3 \(cont'd\). Details of environmental predictor variables for each region.](#)

5. Continental Brazil, Ecuador, Colombia, Bolivia, and Peru, South America (SA)

Prepared by Bette Loiselle, Lucia Lohman and Catherine Graham

- Coordinate reference system: unprojected, WGS84 datum
- EPSG:4326
- Units: decimal degree
- Raster cell size: 0.008333333 degrees (~ 1km)

Table 3.5 Environmental data for SA

Code	Description	Units ¹	Type ²	Notes
sabio1	annual mean temperature	°C*10	Cont	These were the version 1.2 of worldclim data – see Hijmans et al. (2005)
sabio2	mean diurnal range (mean of monthly (max temp - min temp))	°C*10	Cont	
sabio4	temperature seasonality (standard deviation *100)		Cont	
sabio5	max temperature of warmest month	°C*10	Cont	
sabio6	min temperature of coldest month	°C*10	Cont	
sabio7	temperature annual range	°C*10	Cont	
sabio8	mean temperature of wettest quarter	°C*10	Cont	
sabio12	annual precipitation	mm	Cont	
sabio15	precipitation seasonality (coefficient of variation)		Cont	
sabio17	precipitation of driest quarter	mm	Cont	
sabio18	precipitation of warmest quarter	mm	Cont	

¹Variables without units are dimensionless indices

²Cont = continuous

[Supplementary Information 3 \(cont'd\). Details of environmental predictor variables for each region.](#)

6. Switzerland (SWI)

Prepared by Niklaus E. Zimmermann

- Coordinate reference system: Transverse, spheroid Bessel (note all SWI data has a constant shift applied)
- EPSG:21781
- Units: meters
- Raster cell size: 100m

Table 3.6 Environmental data for SWI

Code	Description	Units ^A	Type ^B	Notes
BCC	broadleaved continuous cover	% cover	Cont	TM-based classification
CALC	bedrock strictly calcareous vs other type	1 (present) or 0 (absent)	Cat	binary
CCC	coniferous continuous cover	% cover	Cont	TM-based classification
DDEG	growing degree-days above the threshold of 0°C	°C * days	Cont	from Zimmermann & Kienast (1999)
NUTRI	soil nutrients index	D mval/cm ²	Cont	index from 0 to 45
PDAY	number of days with rainfall > 1 mm	ndays	Cont	according to Zimmermann & Kienast (1999)
PRECY	average yearly precipitation sum	mm	Cont	from Zimmermann & Kienast (1999)
SFROYY	summer frost frequency – number of days	days	Cont	from Bolliger et al. (2000)
SLOPE	slope	degrees x 10	Cont	
SRADYY	potential yearly global radiation (daily average)	kJm ⁻² day ⁻¹	Cont	from Zimmermann & Kienast (1999)
SWB	site water balance	mm	Cont	as in Zimmermann & Roberts (2001)
TAVECC	average temperature of the coldest month	°C	Cont	from Zimmermann & Kienast (1999)
TOPO	topographic position		Cont	As in Zimmermann & Roberts (2001)

^AVariables without units are dimensionless indices

^BCont = continuous; Cat = categorical

References for Supplementary Information 3

- Bolliger, J., F. Kienast, and N. E. Zimmermann. 2000. Risks of global warming on montane and subalpine forests of Switzerland - a modeling case study. *Reg. Environ. Change* 1:99–111.
- Hijmans, R. J., S. E. Cameron, J. L. Parra, P. G. Jones, and A. Jarvis. 2005. Very high resolution interpolated climate surfaces for global land areas. *Int. J. Climatol.* 25:1965–1978.
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- Zimmermann, N. E., and D. W. Roberts. 2001. Final Report of the MLP climate and biophysical mapping project. WSL, Birmensdorf, Switzerland.