15 Terrestrial biodiversity

The following protocol describes the contribution of global terrestrial biodiversity models to ISIMIP2b. Biodiversity is influenced by both climate and land-use change, as well as the biome changes resulting from these drivers. All of these drivers will be considered in biodiversity simulations.

Different model types may be used to simulate biodiversity, such as correlative species distribution models, macroecological species richness models, process-based biodiversity models, and others. There are no restrictions regarding the model type, as long as the methodology has been documented in previous peer-reviewed publications.

In its initial stage, this protocol focuses on correlative species distribution models; it will be amended with the needs and requirements of other model types as required.

Species distribution data, in combination with the observed climate dataset "EWEMBI" provided by ISIMIP, are used for the initial model construction (i.e., model calibration). Biodiversity projections are then calculated using the ISIMIP2b bias-corrected GCM data.

The effects of biome and land-use changes on biodiversity are currently assessed in post-processing by simply overlaying the results from the climate-based species distribution models with layers of future land-use and biome change. In the future, biome and land-use changes may be directly used as predictor variables during model construction.

15.1 Scenarios

Climate scenarios	
picontrol	Pre-industrial climate (year specific for the entire period 1661-2299)
historical	Historical climate.
rcp26	Future climate from RCP2.6
rcp60	Future climate from RCP6.0
Human influences scenarios	
nosoc	No human influences considered. (The different land-use scenarios (see other Sectors) will be included in post-processing and possibly in a more direct way in future model runs.)

Table 35* ISIMIP2b scenarios for global (and potentially regional) biodiversity simulations.

	Experiment	**Input**	**Pre-industrial 1660-1860**	**Historical 1861-2005[1]**	**Future 2006-2099[2]**	**Extended future 2101-2299[2]**
I	pre-industrial climate	Climate	picontrol	picontrol	picontrol	picontrol
	no other human influences	Human & LU	nosoc	nosoc	nosoc	nosoc
II	RCP2.6 climate	Climate	Experiment I	**historical**	**rcp26**	**rcp26**
	no other human influences	Human & LU		**nosoc**	**nosoc**	**nosoc**
III	RCP6.0 climate	Climate	Experiment I	Experiment II	**rcp60**	not simulated
	no other human influences	Human & LU			**nosoc**	

*for now, only correlative species distribution models are considered. Additional scenario combinations will be contributed from other model types in due time.

[1]for the Terrestrial biodiversity sector, "historical" refers to a 30-year period of current conditions (i.e., 1980-2009) derived from the observed climate dataset "EWEMBI"

[2]within these long-term time periods, biodiversity models will be run for average conditions of selected 30-year periods (2006-2035, 2036-2065, 2066-2095, 2086-2115, 2136-2165, 2186-2215, 2236-2265) and the 30-year periods centered around the 1.5°C GCM-specific Global Mean Temperature (GMT) thresholds (1996-2025, 2012-2041, 2018-2047, 2034-2063, 2038-2067, 2042-2071) provided by ISIMIP (https://www.isimip.org/protocol/temperature-thresholds-and-time-slices/) are considered.

15.2 Output data

Table 36 Output variables to be reported by biodiversity sector models.

Variable (long name)	Variable name	Resolution	Unit (NetCDF format)	Comments
Amphibian species probability of occurrence	**amphibian-prob**[2]	30-year averages of selected time periods[1] (0.5°x0.5°)	Probability of occurrence per cell	Results from individual SDMs
Terrestrial bird species probability of occurrence	**bird-prob**[2]			
Terrestrial mammal species probability of occurrence	**mammal-prob**[2]			
Amphibian summed probability of occurrence	**amphibian-sumprob**[2]	30-year averages of selected time periods[1] (0.5°x0.5°)	Summed probability of occurrence per cell	Results from stacked SDMs
Terrestrial bird summed probability of occurrence	**bird-sumprob**[2]			
Terrestrial mammal summed probability of occurrence	**mammal-sumprob**[2]			
Summed probability of endemic amphibian species[3]	**end-amphibian-sumprob**[2]			
Summed probability of endemic terrestrial bird species[3]	**end-bird-sumprob**[2]			
Summed probability of endemic terrestrial mammal species[3]	**end-mammal-sumprob**[2]			

Summed probability of threatened amphibian species[4]	**thr-amphibian-sumprob[2]**			
Summed probability of threatened terrestrial bird species[4]	**thr-bird-sumprob[2]**			
Summed probability of threatened terrestrial mammal species[4]	**thr-mammal-sumprob[2]**			

[1] Currently the following 30-year periods (2006-2035, 2036-2065, 2066-2095, 2086-2115, 2136-2165) and the 30-year periods centered around the 1.5°C GCM-specific Global Mean Temperature (GMT) thresholds (1996-2025, 2012-2041, 2018-2047, 2034-2063, 2038-2067, 2042-2071) provided by ISIMIP (https://www.isimip.org/protocol/temperature-thresholds-and-time-slices/) are considered.

[2] For the Maximum Entropy (MaxEnt) model algorithm the output is not probability, but habitat suitability. Values also range between 0 and 1.

[3] Endemic (range-restricted) species are species, which only occur in one country.

[4] Threatened species are all species that are critically endangered, endangered or vulnerable according to their IUCN red list status.

16 References

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