

14 Tropical cyclones

14.1 Scenarios

The occurrence of tropical cyclones is only influenced by climate change and independent of other human influences. Therefore scenarios only depend on the climate input.

- 5 To simulate tropical cyclones, we use the downscaling technique described in detail by (Emanuel et al., 2008). Broadly, the technique begins by randomly seeding with weak proto-cyclones the large-scale, time-evolving state given by the CMIP5 climate model data. These seed disturbances are assumed to move with the GCM-provided large-scale flow in which they are embedded, plus a westward and poleward component owing to planetary curvature and rotation. Their intensity is calculated using the Coupled Hurricane Intensity Prediction System (CHIPS; Emanuel et al., 2004), a simple axisymmetric hurricane model
- 10 coupled to a reduced upper ocean model to account for the effects of upper ocean mixing of cold water to the surface. Applied to the synthetically generated tracks, this model predicts that a large majority of them dissipate owing to unfavorable environments. Only the ‘fittest’ storms survive; thus the technique relies on a kind of natural selection. Extensive comparisons to historical events by Emanuel et al. (2008) and subsequent papers provide confidence that the statistical properties of the simulated events are in line with those of historical tropical cyclones. We simulate 300 events globally each year and for each
- 15 CMIP5 model, for the period 1950-2005 for the historical period, and 2006-2099 in downscaling the RCP2.6 and 6.0 cases, yielding a total of 16,800 simulated tropical cyclones for each model in the historical period, and 28,500 simulated cyclones per model for the RCP2.6 and 6.0 cases. The response to global warming of both the frequency and intensity of the synthetic events compares favorably to that of more standard downscaling methods applied to the Coupled Model Intercomparison Project 3 (CMIP3) generation of climate models (Christensen et al., 2013).

Climate & CO ₂ scenarios	
picontrol	Pre-industrial climate and 286ppm CO ₂ concentration. The climate data for the entire period (1661-2299) are unique – no (or little) recycling of data has taken place.
historical	Historical climate and CO ₂ concentration.
rcp26	Future climate and CO ₂ concentration from RCP2.6.
rcp60	Future climate and CO ₂ concentration from RCP6.0.

Table 29 ISIMIP2b scenarios for tropical cyclone simulations.

	Experiment	Input	Pre-industrial 1661-1860	Historical 1861-2005	Future 2006-2099	Extended future 2100-2299
I	no climate change	Climate	picontrol	not simulated	not simulated	not simulated
II	RCP2.6 climate	Climate	Experiment I	historical	rcp26	rcp26
III	RCP6.0 climate	Climate	Experiment I	Experiment II	rcp60	not simulated