Table 4.3: Major development and improvement of previous GCMs of tropical deforestation.

Model	Reference	Development / Improvement
GISS	i. Henderson-Sellers and Gornitz (1984)	Designed specifically to permit long-period climatic integrations and computations of many parameters such as sea-ice, cloud cover and type and also ocean surface temperature. Their ocean submodel included ocean temperature calculation, fixed ocean transports and simulation of sea ice to allow investigation of the global teleconnections.
NMC	i. Shukla *et al.* (1990)	The first high-resolution GCM with deforestation. Included efficient radiation scheme to permit the simulation of diurnal cycle, radiative transfer calculations for the longwave component of terrestrial radiation, and modified convection and large-scale precipitation. Used parameterization for the transfer of shortwave radiation, vertical diffusion of momentum, heat and moisture in the planetary boundary layer.
UKMO	i. Lean and Warrilow (1989)	Improved model with cloud prediction and land-surface schemes. Employed a four-layer soil temperature calculation, a parameterization of canopy interception of precipitation and its re-evaporation, and calculation of surface and subsurface runoff. Included a statistical parameterization of subgrid-scale variability in precipitation.
	ii. Mylne and Rowntree (1992)	Despite a simple land-surface scheme, this model was specially improved to study the effects of albedo change associated with tropical deforestation. The albedo for any grid square was the weighted average of the albedo appropriate to the average vegetation type and the average soil colour.
	iii. Lean and Rowntree (1993)	Modification of sub-grid scale processes to improve the representation of micrometeorology within the model. Improved the canopy representation particularly on rainfall interception processes. The treatment of surface runoff was more realistically formulated.
LMD	i. Polcher and Laval (1994a, b)	No report of major changes. However, the 11-year integration time first introduced in their experiment [cf. Polchar and Laval (1994b)] can be regarded as a significant improvement that had facilitated an extensive statistical analysis related to modelling experiments of tropical deforestation.
CCM	i. Dickinson and Henderson-Sellers (1988)	The introduction of a coupled atmosphere-biosphere model (CCMOB and BATS). Included a nonlinear parameterization of atmospheric vertical diffusion and diurnal as well as annual cycles in solar radiation. Added geographical distribution of vegetation type, soil colour and soil texture. The model's surface-runoff formulation was modified for runoff to decrease less rapidly with drying of the surface layer.
	ii. Henderson-Sellers *et al.* (1993)	New improved cloud parameterization and radiation updates. Simulations accounted for full seasonal and diurnal cycles. The first deforestation simulation that incorporating more detailed ocean description with ice model subcomponent and q-flux to correct for ocean advection of energy and the prescription of a fixed mixed layer depth (50 m).
	iii. McGuffie *et al.* (1995)	Improved the formulation of the q-flux correction used in the slab ocean model for ocean advection of energy from the same version used by Henderson-Sellers *et al.* (1993). The Henderson-Sellers *et al.*'s standard flux correction (see Note f in Table 4.2) failed to fully include oceanic advection and produced seasonal cycles of much reduced SSTs at many ocean points. The improved correction scheme adds a second energy correction term based on the temperature trend from the control run of the original model. The mixed layer ocean model, therefore, can be said to represent a calculated SST derived as a net radiative perturbation of the original specified SSTs. While the seasonal cycle was fixed, the range of the seasonal variation could change.
	iv. Zhang *et al.* (1996a, b)	Extended the same scenario as that of McGuffie *et al.* (1995) but with the use of longer integration time to cater for evaluation of regional to global-scale changes from deforestation beyond their detailed process-based analysis of the local changes.