

Table 6.1: The Unified Model in UKMO - version upgrades, hardware platforms and significant changes.
[After Met. Office(1996) and personal communication (M.Hatton, various dates, 1998/99)]

Model Version	Release Date	Operational Release	Hardware Platform: Operating System	Significant Changes and System Enhancement Contributed To Version Upgrades
2.0 2.1 2.2 2.3 2.4 2.5 2.6	16.05.91 27.06.91 15.08.91 23.10.91 07.01.92 26.03.92 04.06.92	05.06.91 16.07.91 17.09.91 12.11.91 11.02.91 12.05.92 11.08.92	Cray YMP-8: Unicos 5.1 Cray YMP-8: Unicos 5.1 Cray YMP-8: Unicos 5.1 Cray YMP-8: Unicos 5.1 Cray YMP-8: Unicos 6.0 Cray YMP-8: Unicos 6.0 Cray YMP-8: Unicos 6.0	Rapid development from <u>Version 2.0 to 2.6</u> to consolidate the performance. A significant number of error corrections arose from the relatively immaturity of the code. Changes included: • Introduction of C I/O routines to replace Cray specific unblocked data files. • Modification of source code for compilation. • Enable vertical interpolation of boundary files. • Introduction of a facility to enable time-series output from diagnostic system. • Modification to convert θ to T by accounting for dynamical formulation of hydrostatic relation.
2.7	01.09.92	27.10.92	Cray YMP-8: Unicos 6.0	Produced mesoscale configuration with 30 vertical levels. Several enhancements of physics, including the components contributing to the first climate version (1CV, now labelled HADAM1): • Convection with an explicit downdraught and rapidly mixed boundary layer code. • Introduction of a separate version of longwave radiation scheme based on transmissivity values derived at ECMWF.
2.8	22.12.92	-	Cray YMP-8: Unicos 6.0	• Upgrade of source code management tool from Cray update to Cray nupdate. • A new packing code into look-up headers of data fields. • Three explicit cloud layers within the shortwave radiation scheme (outstanding 1CV science change). • Time-smoothing during the adjustment timestep.
3.0	15.01.93	23.02.93	Cray YMP-8: Unicos 6.0	Identical code content to that of Version 2.8, but line numbers of code were resequenced and some old comments were removed.
3.1	30.03.93	25.05.93	Cray YMP-8: Unicos 7.0	• Provision of a new option to allow more than one boundary file, so that multiple limited area models could be driven from the same generating run. • Inclusion of initialisation of model analyses with ECMWF perturbation.
3.2	06.09.93	19.10.93	Cray YMP-8: Unicos 7.0	• The first version made portable to work on HP workstation. • Introduction of dynamic allocation of primary fields (i.e. large scale changes to the top level control structure) and sizes of arrays depending on the model configuration passed at run-time, removing the necessity to re-compile when changes in diagnostic output were required. • Real value of missing data was changed from -32768.0 to -2**30.

Table 6.1 (continued)

Model Version	Release Date	Operational Release	Hardware Platform: Operating System	Significant Changes and System Enhancement Contributed To Version Upgrades
3.3	13.06.94	12.07.94	Cray C90: Unicos 7.0	• Facility for users to introduce their own prognostic variables without requiring a change to the user interface (freedom to make & test a greater range of modifications locally). • Provision of an option to GRIB format output. • Provision of a method of reducing CPU costs of the operational mesoscale model without degradation in performance. • Provision of source terms for aerosols, as part of a tracer advection technique for dealing with passive variables.
3.4	24.01.95	07.03.95	Cray C90: Unicos 7.0	• Unix script were brought within code management by nupdate. • Facilitate more efficient use of multi-tasked Cray C90 environment by introducing macrotasking techniques into dynamic, convection and radiation schemes. • New options for atmosphere science routines, constituting the main components of the second climate version (2CV, now labelled HADAM2a). • A new multi-layer soil hydrology scheme. • Inclusion of trace gases in a new version of longwave radiation. • Assimilation of humidity from Moisture Observation Pre-processing System (MOPS). • Inclusion of a dynamical sea-ice in the Slab Model and ice section to the ocean model. • Capability of running on a DEC Alpha workstation.
3.5	13.08.95	-	Cray C90: Unicos 7.0	• Version 3.5 was an interim version to stage larger changes for Version 4.0.
4.0	12.01.96	19.03.96	Cray C90: Unicos 7.0	• Spanned the transfer of central system facilities, from IBM mainframe to a more portable UNIX environment (combination of HP workstation LANs with Cray C90). • Development and partially completion of a new X-windows graphical user interface (the UMUI) through Version 3.5, and fully implemented in Version 4.0. • Addition of science routines to constitute third climate version (3CV, now labelled HADAM2b) – Improved mixed phase and evaporation calculations; explicit flux divergence and flux equilibrium schemes for ice dependent on timestep; re-appraisal of saturated specific humidity formulation. • A new Slingo-Edwards radiation scheme and hydrology routine (Penman-Monteith). • Optional removal of horizontal diffusion for sloping model levels was added. • Provision of latent heat nudging in the assimilation.

Table 6.1 (continued)

Model Version	Release Date	Operational Release	Hardware Platform: Operating System	Significant Changes and System Enhancement Contributed To Version Upgrades
4.1	20.08.96	-	Cray C90: Unicos 8.0	• Extensive addition of routines and code for running on a distributed memory platform. • The WAVE model was introduced into the UM system. • Addition of science routines to constitute a preliminary HADCM3 with MOSES (Met. Office Surface Exchange Scheme) incorporating: a Penman-Monteith boundary layer and hydrology scheme, an improved multi-layer soil moisture and temperature model and an interactive vegetation canopy. • Introduction of code for calculations of the sulphur cycle, with a new chemistry section, wet scavenging, boundary layer and convective transport and tracer advection of aerosol.
4.2	15.01.97	-	Cray T3E: Unicos/mk1.4.1	• Version 4.2 was a development version, giving an MPP capability, without science changes. Version 4.3 consolidated corrections for both MPP and HADCM3 science, providing full functionality for operational and HADCM3 climate models. Most changes were to provide an MPP capability.
4.3	09.06.97	29.01.98	Cray T3E: Unicos/mk1.6.1	• Single processor optimisation of code tailored for a cache based rather than vector based architecture. • Introduction of a new compilation system, based on Unix 'make' operating on nupdate decks: providing consistency between pre-built and locally generated compiled code, with flexibility for quick compilations.
4.4	22.12.97	15.04.98	Cray T3E: Unicos/mk2.0.0	• The second UM version (after 4.0) to be released as a complete portable package, tested on a variety of platforms. • Having a coupler code (OASIS), allowing external models to be coupled with UM models with a minimum of changes to the external model. • Well-formed i/o, with data files re-structured to start at sector boundaries, improving i/o performance to disk. • New science sections (precipitation, convection, vertical diffusion, dynamic adjustment and filtering), optimised for Cray T3E processors but not bit reproducible with equivalent sections. • Introduction of mixed phase cloud and precipitation scheme. • Introduction of MOSES II (Enhancement of MOSES, with surface hydrology and boundary layer scheme modifications), radiationally active anvils in convection and a new ice scheme in radiation (planned for new climate experiment, HADCM4) • Introduction of a scheme for interactive vegetation. • Climate meaning for a Gregorian calendar, faster energy flux and new utilities for generating boundary condition files [reconfigure from another resolution (bcreconf) & generate from dumps (makebc)].

Note: In this study, only Version 4.0 is used in atmospheric global mode. This is the latest portable version available for external use.