

3.13.2 Spatial extensions

The Climate, Soil and Vegetation modules were duplicated in each cell of a grid. This method was implemented as inheritance of the non-spatial *Climate*, *Soil* and *Plant* classes (Derry 1998) by extended hierarchies that incorporated spatial features (see Appendix 6), distributed across a grid. The result was that each spatial class contained a grid of equivalent dimensions (I columns by J rows, and each cell had co-ordinates (i,j) , where $i \in \{1, \dots, I\}$ and $j \in \{1, \dots, J\}$), rather than the alternative of a single grid containing many spatial classes. The benefit was that during the introduction of spatial features (e.g., cell altitude with which to generate a topographic landscape), module integrity was more easily maintained. For example, within grid communication such as runoff to neighbouring cells is a process occurring at the soil surface and was, therefore, coded for within the *Soil* module. Individual cells were referenced using the co-ordinate system, while whole grid data was collected by systematic contiguous sampling (i.e., in sequence from top left corner, column-by-column).

Herbivore species were able to access the extent of the modelled area, therefore only one instance of each *Herbivore* class was required. However, a grid-based implementation of the existing diet selection object pointer method (see Derry 1998) was introduced by which selection of a spatially distributed diet and the associated herd movement could be predicted on a daily basis.

~~3.13.3 Scale issues~~

~~It is imperative to consider scale issues when modelling ecological systems (Wu & Hobbs 2002, Chave & Levin 2003). Many problems that may have hindered the development of this model were avoided by tracking most state variables in terms of density per unit area. Only the *Animal* module dealt in absolute values. For example, selected plant biomass was converted from a measure of dry matter density (kg DM/ha) to absolute biomass (kg DM) in order to calculate total herd consumption. Animal populations comprised age classes tallied by their total membership, but population~~