# GLOBAL MODELLING OF CLIMATE AND ICE SHEETS

*W. F. Budd and Peter Rayner*

## 1. THE USE OF ENERGY BALANCE MODELS FOR ICE AND CLIMATE STUDIES

For studies of long term global changes of climate, and ice cover, computationally efficient models are needed, which have a complete annual cycle, to compute temperatures over land and over ocean and to determine the seasonal distribution of sea ice and snow on the ground. Atmospheric general circulation models (GCMs), with coupled oceans, for prognostic sea surface temperatures (SSTs) require too much computer time to be used for large numbers of continuous simulations through ice age cycles to study the sensitivity to the numerous parameters required. The GCMs however can be used for series of "snapshot" climate simulations through the time series, e.g. Prell and Kutzbach [1].

The aim of the present work is to develop an effective Energy Balance Model (EBM) to simulate the global climate changes through the ice ages including the growth and decay of the large ice sheets. The time scales for the dominant physical processes in the ice sheet model and the EBM are sufficiently distinct that they can be largely decoupled. To study long term changes the EBM can be run for a series of "instants" with a prescribed ice sheet and other external factors held constant over a number of years (e.g. 80a) to reach an equilibrium climate. The ice sheet model can be run for a period (e.g. 1000a) with that prescribed climate before incremental changes such as the earth's orbital radiation regime are changed and a new sequence started.

Because of this effective decoupling of the ice sheet and climate time scales it is possible to study the independent effects on the global