13. Conclusions

The calculations in the report were produced as input to the carbon cycle chapters of the reports of Working Group 1 of the Intergovernmental Panel on Climate Change (IPCC, 1994, 1995). Those reports summarise the results presented here. However, in concluding this report we can take a somewhat wider view, and review the exercise in terms of five main questions that need to be addressed:

- What are the most important specific results and generalisations?
- How reliable are these results?
- How reliable is this type of modelling?
- What are the main reasons for uncertainty?
- How can future modelling be improved?

- The most important specific results are:
  - Continuing increases in fossil carbon emissions will lead to continuing increases in atmsopheric CO_2.
  - Even stabilising emissions at 1995 levels will lead to increasing CO_2 concentrations.
  - Therefore, major reductions in CO_2 emissions are required in order to stabilise atmospheric CO_2 levels.
  - We have emphasised the case of stabilisation at 650 ppmv because this is typical of levels used in atmospheric GCMs in 'CO_2-doubling' experiments — i.e., 650 ppmv is approximately double the 1970s levels often used for $1\times CO_2$ experiments so that the models can be checked against recent climatic data. To stabilise at this level via our suggested profile requires that the rate of increase in emissions decrease at once, peak at between 8 to 12 Gt C y^{-1} around the end of the 21st century, and decline steadily over the 22nd century as the stabilisation level is approached. Maintaining concentrations at 650 ppmv will require further reductions thereafter.
- The main contribution to the uncertainty in the present modelling exercise comes from uncertainties in the current carbon budget. Of these the most important is the current net flux from land-use change. There are additional uncertainties arising from the modelling prescription — the exclusion of feedbacks and the assumption of no 'residual sink' forcing CO_2-fertilisation to be set to balance the budget. Section 12 reported results that went beyond our specifications to explore these issues. Although only a small number of cases were treated, the results suggest that the restrictions that were imposed in Appendix A have not greatly limited the applicability of the results.

  As noted in the introduction, the concentration profiles shown in Figure 8.1 are in no way intended as recommendations for specific action. When actions are proposed under

the Framework Convention on Climate Change, specific calculations will be required and it will be models like those used here that will be available for such calculations. The results presented here indicate that such calculations will be adequate as an initial guide to action but that strategies for achieving concentration targets will have to be defined in an adaptable form that evolves as knowledge improves.

- The scope for improvement in modelling is through better modelling and refinements in techniques for evaluating and validating models. Some particular needs are:
  - Greater effort devoted to the development and validation of models of terrestrial carbon exchanges.
  - The reasons for differences in the transport of the ocean GCMs need to be identified and the models refined. The World Ocean Circulation Experiment should contribute significantly to this.
  - There is a need for more mechanistic models that can directly represent processes that lead to climatic feedbacks.
  - Even without improvement in models, the reliability of modelling can be expected to improve as longer data records become available with the passage of time.

Acknowledgements

The publication of this report has been supported by the Australian Department of Environment, Sport and Territories. Rachel Law, Mark Harvey and Cathy Trudinger gave invaluable assistance with the production. Paul Holper made valuable comments on drafts of the report. Finally the authors wish to thank the modellers both for their contributions and for their patience with the process of preparing this report.

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