5. Summary of Models

5.1 Descriptions

Table 5.1 summarises the main characteristics of the various models listed in Table 3.1. They are grouped according to the representation of the oceans, comprising one statistical representation of all sink processes (Model C); one with an empirical 'lifetime' for the combined excess carbon in the atmosphere and ocean surface (Model V); one terrestrial-only Model (F); a two-box ocean Model (Z); three with response function representations (F_2, T and W); four versions of the box-diffusion model introduced by Oeschger et al. (1975) (A, B, E, P); three implementations of the HILDA model (G, J, L); one implementation of the 12-box ocean model of Bolin et al. (1983) (Model M); an alternative 12-box advective-diffusive model (R); and three ocean general circulation models (H, O and Q). These types of model are described in Section 3b, above.

The representations of the terrestrial components are more diverse.

Model	Ocean	Land	Initialisation	Fertilisation
F	None			Logarithmic
C	(with land)	(with ocean)		
V	lifetime	None		
Z	2-box	None	Inverse	
F_2	Response function	$(5°×5°)×9$		Hyperbolic
T	Response function	6-box	Inverse	Logarithmic
W	Response function	4-box	Inverse	Hyperbolic
A_1	BDM	ANU-BACE	Inverse	Mechanistic
A_2	BDM	ANU-BACE	Forward	Mechanistic
B	BDM			
E	BDM	2-box	Forward	Hyperbolic
P	BDM	None		-
G	Hilda	6×6	Forward	
J	Hilda	4-box	Inverse	Logarithmic
L	Hilda	6-box	Inverse	Logarithmic
M	12-box			
R, R*	12-box	Image 2.0		
H	HAMOCC-3	OBM3m	Inverse	$\approx$ Hyper.
O	LODYC GCM	None	Inverse	None
Q	GCM		Inverse	

Table 5.1. Characteristics of models. A_1 and A_2 denote alternative initialisations. R* and R denote IMAGE 2.0 with and without CO_2-climate feedback. The $n \times m$ notation for the terrestrial component is number of ecosystem/region classes $\times$ number of physiological reservoirs.

The models differ in the extent to which they have complied with the specifications in Appendix A. We can group them as:

Full models with inverse initialisation: Those models following essentially the procedure of Section 4 were J, L, T and W. Models A_1 and H used a modified inverse approach, performing forward runs to tune the fertilisation to give a budget that balanced over the period 1960–1990, and then running the model in inverse mode over both past and future to deduce industrial emissions. Model Q was also initialised by deducing industrial emissions.

Full models with standard forward initialisation: These followed essentially the forward procedure of Section 4. The models were A_2, E.

Ocean-only models: As noted above, these can provide useful information for those cases prescribed as inverse calculations. The models were O, P, V, Z.

Terrestrial-only models: Similarly, these can be useful for the inverse cases. The only case here is Model F.

Models with climatic feedbacks: The standard specifications requested that climatic feedbacks NOT be included. We discuss runs with climate feedbacks in Section 12b. For the moment we note that these cases will not be directly comparable with the no-feedback cases. Runs with climate feedbacks are either excluded from comparisons or are flagged specially. The models were R^*, T.

Models failing to fit the prescribed stabilisation curves adequately: These were Models G, V.

Others: The statistical representation (Model C) failed to comply with the basic process description. Perhaps a more important failing is that it worked in terms of responses for total CO_2 rather than the perturbation.

In contrast, Model B is not directly comparable with the other models because its representation is more detailed than envisaged in the specified scenarios so that it is not fully compatible with the specifications. In particular, it used an inverse initialisation to deduce an unidentified sink that was continued into the future.

To summarise, the models that can be directly compared for the stabilisation calculations are A_1, E, H, J, L, M, Q, R and W. Models R^* and T [1] differ by including climatic feedbacks; they are not directly comparable but are included in various tabulations of results for completeness. For forward calculations this set of nine models can be augmented by Model G; in the inverse calculations, model G used an alternative CO_2 profile. This is discussed further in Appendix F. The ocean-only models (O, P, V, Z) provide additional comparisons of oceanic uptake in the stabilisation cases (although V had a poor fit to the specified concentration profiles), Model F provides a similar comparison of biotic uptake, and Model B provides an additional comparison of the effects of different choices regarding the terrestrial component.

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[1]Information provided about feedbacks in Model T was ambiguous.