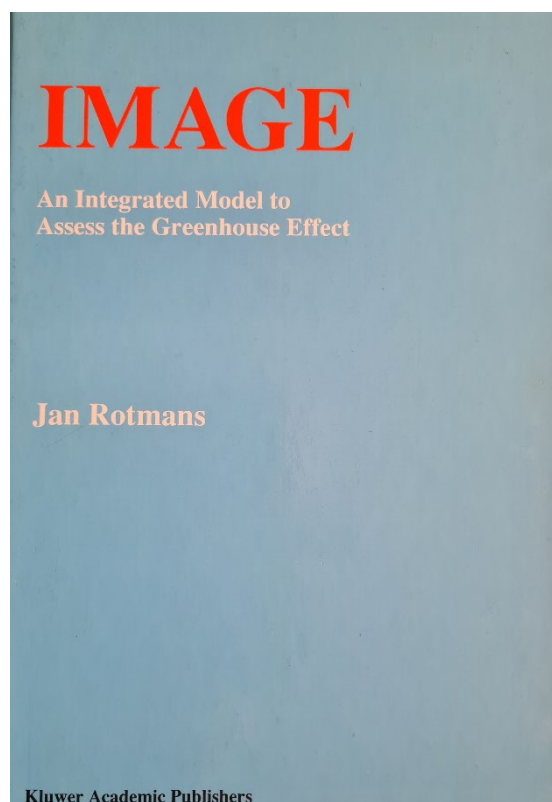


## My 1990 'Climate Book of the Year'

Rotmans, J. (1990) *IMAGE: An Integrated Model to Assess the Greenhouse Effect*. Dordrecht: Kluwer Academic. 289pp.

This essay continues my series of monthly posts in which I select one 'climate' book to highlight and review from one of the 44 years of my professional career in climate research (starting with 1984, my first year of academic employment). The series will end in September 2027, the month in which I shall retire. [See here for more information](#) about the rationale for this series, and the criteria I have used in selecting my highlighted books.

This '1990 essay' can be [download as a pdf](#).



Between 1985 and 1990 climate change moved decisively from being an issue of international science to also being one of international politics. The United Nations' Intergovernmental Panel on Climate Change (IPCC) was conceived in early 1987, given its formal mandate by the UN General Assembly in December 1988, and first reported to the world's governments in May 1990. In June 1988, Toronto hosted the international conference on 'The Changing Atmosphere: Implications for Global Security', which gathered together a rather eclectic, yet impressive, group of political leaders, scientists and NGOs to declare that climate change was a "major threat to international security ... second only to a global nuclear war", and urged world leaders that it was "imperative to act now". In November 1989 a high-level international

ministerial conference was held in Noordwijk, Netherlands, initiating the first serious intergovernmental climate policy discussions, and the following year the UN established the its climate change International Negotiating Committee, which first met in February 1991 paving the way to the signing of the UN Framework Convention on Climate Change in Rio in 1992.

Paralleling this move of climate change from science into the highest echelons of policy and international relations, there began to emerge a few pioneering efforts to develop numerical tools that could assist policymakers as they began to grapple with the complexities of climate change and which could help them evaluate the effect of different

policy scenarios on the trajectory of future warming. These tools belonged to the family of ‘integrated environmental models’, whose inspiration could be traced back to the Club of Rome’s [‘Limits to Growth’ report](#) published in 1972 and its World3 model. Applied to climate change these tools became known as Integrated Assessment Models, or IAMs, developed with the intentional aim of supporting climate policy-making at national and international scales.

One of the very earliest of these IAMs for climate change was developed by a young Dutch environmental modeller called [Jan Rotmans](#) and in 1990 he published the first book on integrated assessment modelling applied to the problem of climate change. It is for this reason that my **Climate Book of 1990** is **‘IMAGE: An Integrated Model to Assess the Greenhouse Effect’**, published by Kluwer Academic Publishers in the Netherlands. The book is less significant for its content—after all, it was basically an edited version of Rotmans’ PhD thesis—than for what it marked, namely the first comprehensive description of a new genre of modelling tools which over the next 35 years would become hugely influential for national and international climate policy. [IAMs have gained a powerful, and sometimes controversial, role](#) in shaping the ways in which climate science, economics, technology and society have been brought together and analysed within policy contexts.

The IMAGE model started as a six month project in 1985/86 for Jan Rotmans, a Master’s student interning at the Dutch National Institute for Public Health and the Environment, otherwise known as RIVM. RIVM had been established in 1910 with a remit to improve public health planning in the Netherlands, but by the 1980s had expanded its remit to include a wider set of environmental concerns, such as acid rain, coastline management and climatic change. A mathematics student at the University of Delft, Rotmans’ task in 1985/86 was, “...to develop a tool that could give a broad overview of the complex greenhouse [anthropogenic climate change] problem, by coarsely combining and aggregating diffuse information from various disciplines.” [p.4] The project formed part of a Dutch Government funded programme called ‘Reference Function for Global Air Pollution/CO<sub>2</sub>’, the global air pollution framing thereby aligning the ‘CO<sub>2</sub> issue’ with other atmospheric pollution problems such as acid deposition and ozone depletion. The prototype IMAGE model developed by Rotmans in 1986 for his MSc, turned into a full PhD thesis under the guidance of his supervisor Koos Vrieze, a Dutch mathematical modeller at the University of Maastricht. Rotmans received his PhD in mathematics from Maastricht in 1990.

Rotmans’ approach took inspiration from two sources, the ‘global modelling’ paradigm pioneered by the Club of Rome in 1972, and the ambition of the related family of integrated environmental models. Rotmans clearly saw his IMAGE model in the context of the World3 systems dynamic model, which in the early 1970s had simulated the interactions between population, industrial growth, food production and the limits of the Earth’s ecosystems. “Global, empirical scenario models are a powerful tool”, says Rotmans referencing the Club of Rome report, “for analysing long-term decision problems.” [p.7] Rotmans also quoted World3 lead developer, Denis Meadows, echoing Meadows’ view that models “...don’t tell

you where to go, but if you know where to go, you can select the best route". The other tradition Rotmans saw himself following was that of integrated environmental modelling, a philosophy which embraces the "whole cause-effect relationship, from the arising of pollution or the taking of a [policy] measure, to the ultimate ecological or socio-economic effect." [p.5] One of the leaders in this field was the '[Regional Air Pollution Information and Simulation' \(RAINS\) model](#), which had been developed in the mid-1980s by Joe Alcamo and Leen Hordijk at the International Institute for Applied Systems Analysis in Austria, to inform the integrated assessment of alternative policy strategies for reducing acid deposition in Europe and Asia.

Rotmans' 1990 book is basically a technical guide and handbook to the IMAGE model. After a chapter offering a general description of the overall model concept and architecture, he then devotes a chapter to each of the sub-models that comprise IMAGE: the carbon cycle, methane, nitrous oxide, CFCs, climate, sea level rise, socio-economic impact, and policy analysis. He introduces in Chapter 11 what he calls the 'temperature increasing potential' (TIP) of different greenhouse gases—what later became known more conventionally as the global warming potential (GWP)—and then a final chapter in which he conducts a sensitivity analysis of the model's predictions to different parameter choices. The approach taken and details offered are exemplary, but it does not make for light reading.

Some of the initial applications of the IMAGE model were made within the Dutch policy environment, in particular informing the Dutch position in the 1989 Nordwijk ministerial meeting mentioned above. It was also used to inform an RIVM report published in 1988 called 'Concern for Tomorrow' ('[Zorgen Voor Morgen. Nationale Milieuverkenning 1985-2010](#)'), which influenced Dutch political discourse by promoting environmental concerns, ranging from local pollution to global threats. IMAGE was also applied internationally. Along with one other IAM—the [Atmospheric Stabilization Framework](#) (ASF) developed by Dan Lashof and Denis Tirpak working at the US Environmental Protection Agency (EPA)—IMAGE was used to construct the first set of emissions scenarios adopted by the IPCC in 1990. As [an IAM expert later remembered](#): "When the IPCC was established, it appeared they needed scenarios [...] and it quickly became apparent [that] only two models existed that could produce scenarios with all greenhouse gas emissions."<sup>1</sup> These models were IMAGE and ASF, and IMAGE has been used centrally in every IPCC Assessment Report since.

Rotmans pioneering work summarised in his 1990 book was hugely significant. The fruit of his PhD labours had created a climate policy support tool which was rapidly taken up and used at national and intergovernmental levels to analyse different climate policy strategies. IMAGE continued to gain financial support, from the Dutch Government via RIVM, but also from the European Commission and other agencies. For example, the IMAGE model was at the heart of [an integrated climate change assessment called ESCAPE](#) (Evaluation of

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<sup>1</sup> Interview quoted in: van Beek,L., Hajer,M., Pelzer,P., van Vuuren,D. and Cassen,C. (2020) Anticipating futures through models: the rise of Integrated Assessment Modelling in the climate science-policy interface since 1970. *Global Environmental Change*. 65: 102191

Strategies to Adapt to Climate change by Adapting to and Preventing Emissions), funded between 1990 and 1992 by the Environment Directorate of the Commission as a joint UK-Dutch project.<sup>2</sup> This funding allowed IMAGE 1 to evolve into IMAGE 2, a new version of the model which included more geographically explicit representations of energy technology, land use, and socio-economic impacts.

By 1994 however, Rotmans had moved on from IMAGE to initiate an even more inclusive integrated model of environmental sustainability—the TARGETS model—oriented towards informing transition management.<sup>3</sup> Joe Alcamo now became the chief manager for IMAGE 2, bringing his experience of having been deeply involved in the development of the RAINS model. A follow-on book about IMAGE 2 was published, again by Kluwer, in 1994: [‘IMAGE 2.0: Integrated Modeling of Global Climate Change’](#).<sup>4</sup> Throughout the 1990s, and beyond, IMAGE was joined by other IAMs applied to climate change, but IMAGE remains today one of the leading models of its type. [IMAGE 3.0 was released in July 2014](#), by then under the leadership of Detlef van Vuuren and owned by PBL, the Netherlands Environmental Assessment Agency, and it continues to evolve through a [new IMAGE research and development strategy](#) covering the period 2022-2027.

Rotmans’ 1990 book about the original IMAGE model was certainly not a climate change best-seller. It is largely a technical book, intended for model developers and users, and it met the requirement for Dutch PhD theses to be published. But I have selected it as my significant book of 1990—the year of the IPCC’s First Assessment Report—because it stands alone at this very early stage in the development of Integrated Assessment Models. At the time, the [only other comparable integrated assessment tools applied to global climate change](#) were the Model of Warming Commitment (MWC) of the World Resources Institute and the ASF of the US EPA<sup>5</sup>, neither of which gained the later visibility or influence of IMAGE.

‘IMAGE’, the book, therefore announced the arrival of IAMs during the important geopolitical year of 1990, during which the institutional architecture of climate change science, politics and policy that would carry forward into the twenty-first century was first being assembled. This assemblage had IAMs at its core, tools like IMAGE which appeared to offer the possibility of climate governance through informed and quantified policy analysis.

Climate change would never be the same again.

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<sup>2</sup> Rotmans, J., Hulme, M. and Downing, T.E. (1994) Climate change implications for Europe: an application of the ESCAPE model. *Global Environmental Change*. 4: 97-124.

<sup>3</sup> Rotmans, J. and de Vries, B. (eds.) (1997) *Perspectives on Global Change: The TARGETS Approach*. Cambridge: Cambridge University Press.

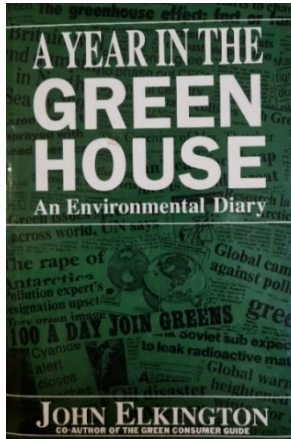
<sup>4</sup> Alcamo, J. (ed.) (1994) *IMAGE 2.0: Integrated Modeling of Global Climate Change*. Dordrecht, Netherlands: Kluwer. 318pp.

<sup>5</sup> Parson, E.A. and Fisher-Vanden, K. (1997) Integrated Assessment of Models of global climate change. *Annual Review of Environment and Resources*. 22: 589-628.

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### Other significant climate books published in 1990

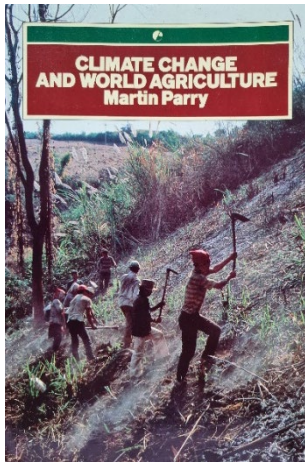
Elkington, J. (1990) *A Year in the Greenhouse: An Environmental Diary*. London: Victor Gollanz Ltd. 279pp.



John Elkington is a British author, corporate and policy advisor, and general environmental entrepreneur. In the 1980s, he helped coin the terms 'green growth' and 'green consumer' and in 1988 co-wrote with colleague Julia Hailes 'The Green Consumer Guide'. The book sold over 150,000 copies in its first three months of sales, and even more during 1989, the year of the public 'climate change awakening' in Europe and North America. Elkington was feted around the world, being elected in 1989 to the UN Global 500 Roll of Honour for 'outstanding environmental achievements'. The following year he published '**A Year in the Greenhouse: An**

**Environmental Diary**', which offered a fascinating insight, day-by-day, into the contemporary politics of the environment. The book traces Elkington's movements around the UK, Europe and the wider world, and the meetings, conferences, media calls and climate publicity stunts that unfolded during the remarkable year of 1990. Elkington's book has the immediacy—and also the idiosyncrasy—of a diary, and captures many of the key events of that year. On the 8<sup>th</sup> November, for example, Elkington records Margaret Thatcher's speech to the UN General Assembly, speaking of "the irretrievable damage to the atmosphere and oceans" and how climate change is now "as dangerous a threat as war" (p.234). The following day in Berlin, the border wall between East and West Germany was opened, and the threat of at least *that* war receded. Elkington records it all in his public diary.

Parry, M.L. (1990) *Climate Change and World Agriculture*. London: Earthscan. 157pp.



In 1990, the newly created Intergovernmental Panel on Climate Change (IPCC) published its First Assessment Report on Climate Change, the beginning of a long, and still on-going, career. Working Group II of the IPCC considered some of the projected impacts of anthropogenic climate change on sectors such as agriculture, forestry, and hydrology. This short, put punchy book, **'Climate Change and World Agriculture'**, published the same year, was written by one of the lead authors of the IPCC's climate impact assessment—Professor Martin Parry, then at the University of Birmingham, UK. This was the first book-length treatment of climate change and agriculture intended for a wide readership, and was published by Earthscan, founded in 1982 by the International Institute for Environment and Development. Parry's chapters addressed the sensitivity of agriculture to climate, methods to assess climate change effects, and summaries of what was known about climate change and plants, soils, pests and diseases, and the overall implications of climate change for agricultural production and food security. Parry concluded that "...we do not at present know whether changes of climate are likely to increase the overall productive potential for global agriculture, or to decrease it" (p.132), a good reminder of the state of ignorance at the time.