



Global Models from Malthus to C-ROADS and Beyond

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Impact of Global Modeling on Mental Models, Institutions, and Policy



Before

After

World Dynamics

Before

Limits are remote

Growth is good

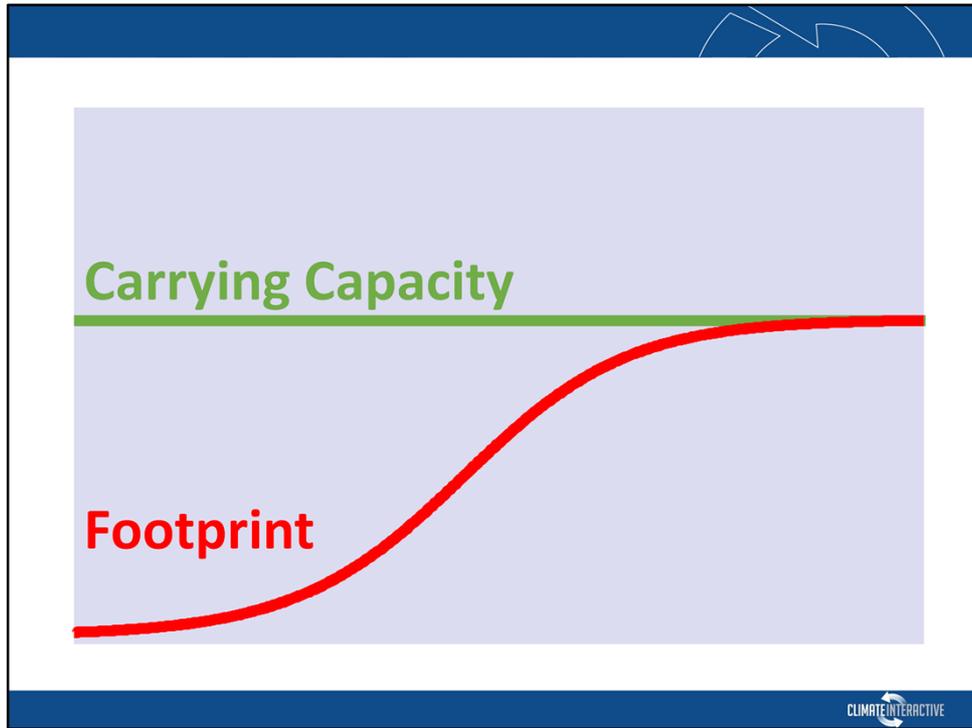
The very idea of modeling
global systems is suspect

No measurement system to
assess limits

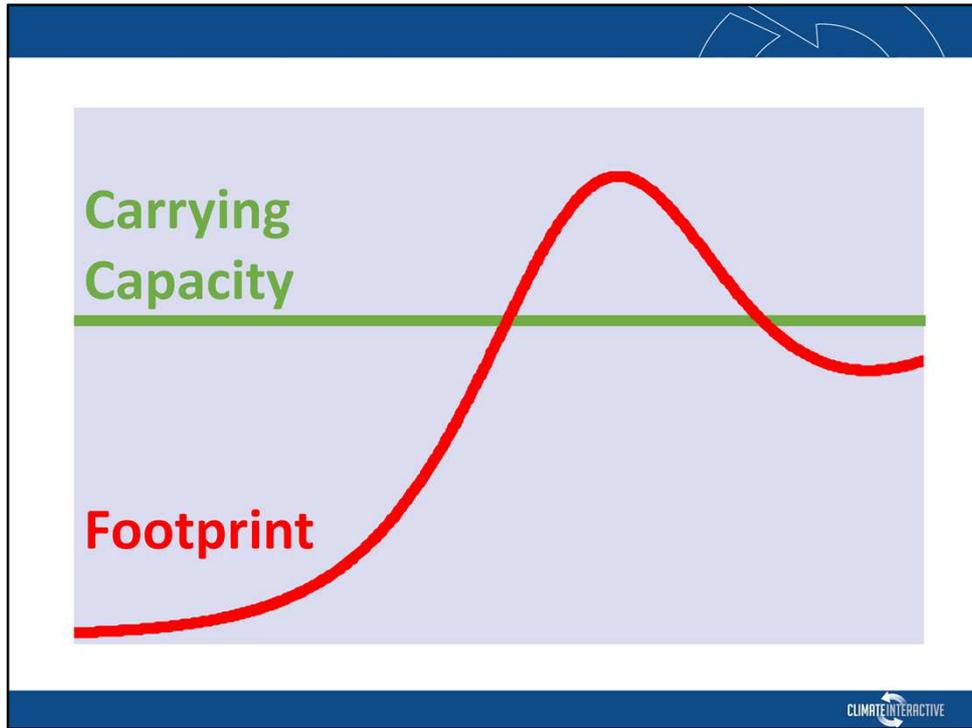
Before world dynamics and LTG launched the global modeling debate, it was widely believed that
Limits are remote, and
Growth is the means to achieve the betterment of humanity
The very idea of modeling the entire world and the long term future was suspect,
And even if you wanted to do it, there was little data available to support the effort



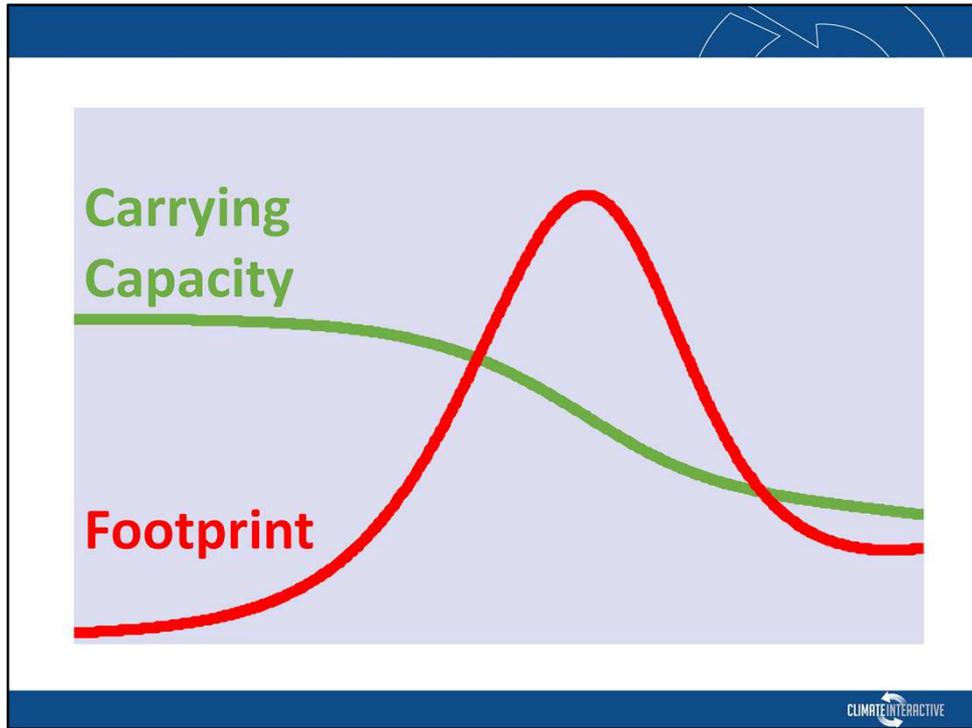
Carrying capacity was not part of the conversation. Economic growth was expected to proceed indefinitely.



Limits introduced the idea that there are finite limits to material throughput from land, resources and pollution

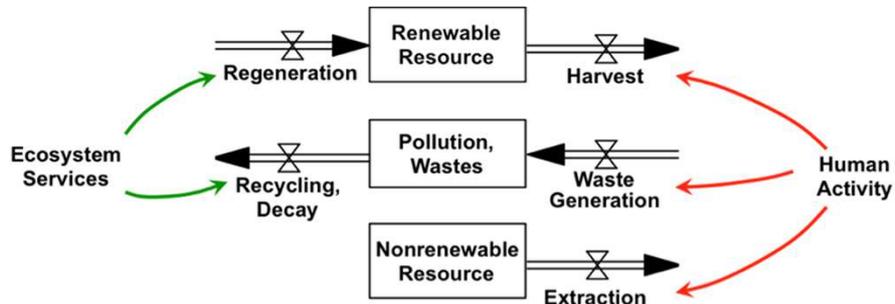


Moreover, there are delays in realizing the effects of those limits, introducing the possibility of overshoot



Overshooting limits erodes carrying capacity, deepening the overshoot

Necessary Conditions for Sustainability



1. Renewable resources

can be used no faster than the rate at which they regenerate.

2. Pollution and wastes

can be emitted no faster than they can be recycled or rendered harmless.

3. Nonrenewable resources

cannot, in the long run, be used at all.

In order to avoid this fate, Limits and World Dynamics explored possibilities for global equilibrium, in which renewables are used no faster than they regenerate, pollution is emitted no faster than it is absorbed, and nonrenewables are eventually not used. Meanwhile, nonmaterial aspects of the economy can grow.

This led to a wide-ranging and sometimes bitter debate, which still rages today.

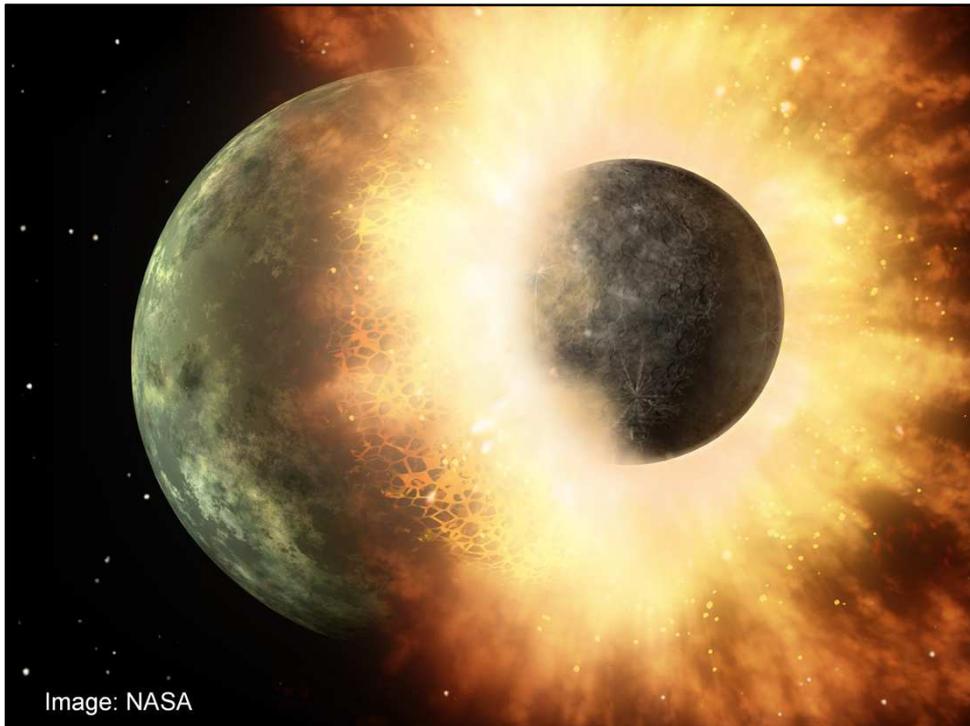


Image: NASA

The response might be described as cataclysmic. Amid the heated words, some points of legitimate critiques were lost. Others proved difficult to reconcile between groups working from different paradigms, a phenomenon which Malthus observed in 1798 (he was right about that, at least).

There were congressional hearings, and a flurry of follow-on models and modeling conferences. By 1983, John Richardson, writing to summarize a survey of global modelers, noted that there had been significant impacts on public opinion, but little effect on decision makers or decisions, and indeed that modelers seemed to know relatively little about decision makers.

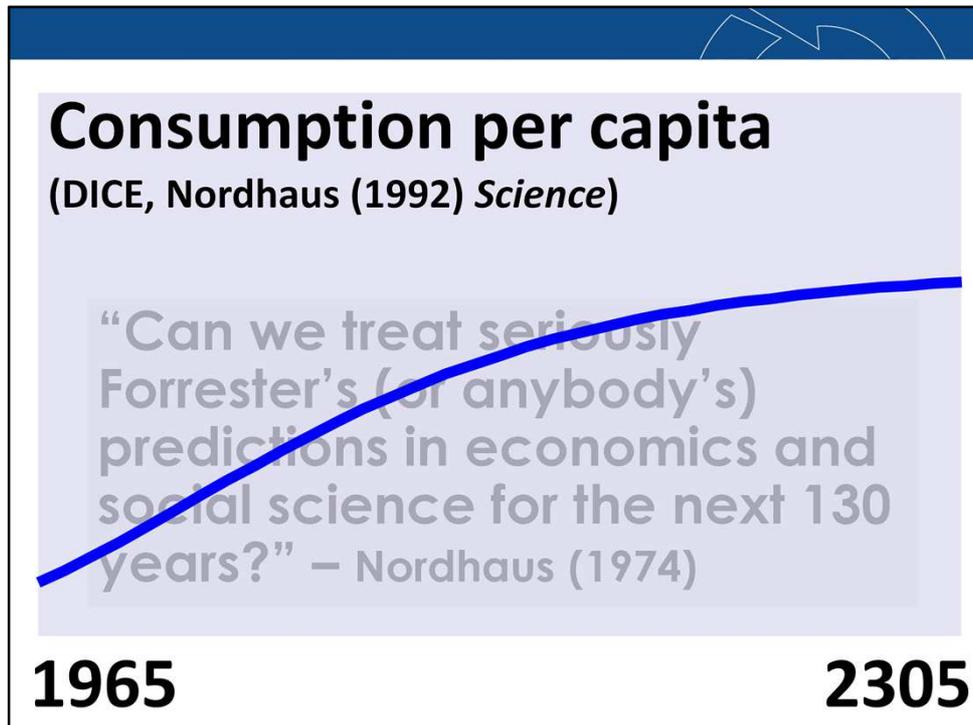
These thresholds are well beyond current levels of human activity. Moreover, our limited supply of fossil fuels limits the production of CO₂ to acceptable levels.

W. D. Nordhaus (1974) "Resources as a Constraint on Growth" *AER* 64(2)

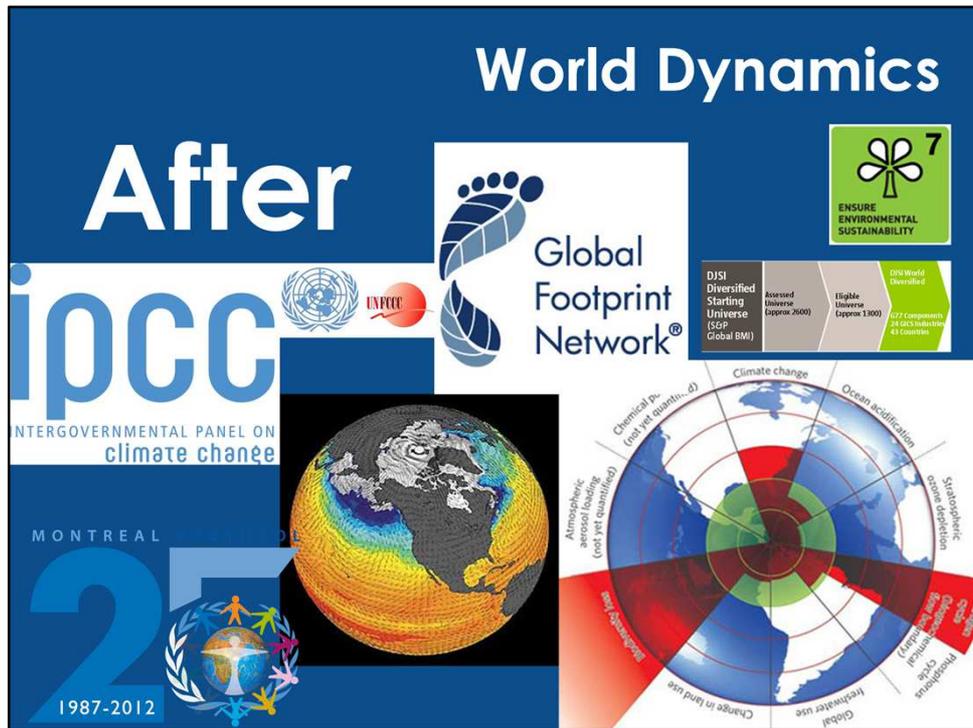
Yet mankind is playing dice with its natural environment through a multitude of interventions--injecting trace atmospheric gases like the greenhouse gases or ozone-depleting chemicals, engineering massive land-use changes such as deforestation, ...

Nordhaus (1994) *Managing the Global Commons*

While many questions are unresolved, minds have also changed. William Nordhaus, one of the strongest critics of *World Dynamics* and *Limits to Growth*, opined in 1974 that climate limits were far away and, ironically, that limited fossil fuel resources prevented breaching CO₂ limits. In 1994 he wrote a book about optimal control of greenhouse gas emissions and has championed carbon taxes.



In 1974, Nordhaus joined others who were skeptical of the very idea of long term or global models.
By 1992, his climate model ran to the year 2305.
In addition, it assumed a natural limit to consumption, justified by expert surveys of economists.



In 1972, the authors had little data to work with, and few model precursors or outlets. Today, there are dozens of agencies and indices, earth observation systems, and academic debates about planetary boundaries. Models of many types and scales are central to the conversation.