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Article

Endogenizing Politics—The GLOBUS World Model

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Abstract: The WORLD3 world model, which served as the basis for *The Club of Rome* report *The Limits to Growth* (1972), was criticized, among other things, for not being able to simulate social interactions. In order to remedy this shortcoming, a research group led by Karl Deutsch at the Berlin Science Center developed a far more comprehensive model between 1979 and 1988 entitled GLOBUS, which was supposed to be able to include political developments in the calculation. This article aims to explain the hopes that were attached to the creation of a further world model and the means by which attempts were made to assert its results. To this end, three genealogical lines of the model -I. as part of the world modeling community, II. as part of quantitative international relations research, III. as part of Karl Deutsch's cybernetic-political science research- will be presented. The data basis and the functioning of GLOBUS are then described. Finally, section VI is devoted to the research group's efforts to make the model "effective".

Keywords: Politics Simulations; world models; Karl W. Deutsch; Science Center Berlin; Club of Rome; Harold Guetzkow

I. GLOBUS as part of the Global Modeling Community

> "To those who feel that global modeling is dead, or at least fading fast, I would like to report that global modeling is alive and doing relatively well at the Science Center in West Berlin, and in the next few pages I would like to document this bill of health."[1]

With these words, Stuart A. Bremer, U.S. political scientist at the *Wissenschaftszentrum*/ Science Center Berlin (WZB) introduces his presentation at the seventh *IIASA* Symposium on Global Modelling. He therein expresses his hope that the historic moment of (multi-sectoral) global modelling might not be over yet. The symposium takes place in Laxenburg near Vienna in 1979, seven years after the publication of the first report to *The Club of Rome* entitled *The Limits to Growth*.[2] In addition to enormous media attention to the problem of limited global resources as well as harsh criticism - especially from economists - this report also triggered the emergence of a small group of subsequent computer-based global models.[3] These subsequent models, although often regarded as

[1] Stuart Bremer, "Global Modeling Activities at the Science Center Berlin", *Environmental Aspects In Global Modeling*, 1982, p. 287.

[2] Donella Meadows et al., *The Limits to Growth*, 1972.

[3] A 1981 conference report in *Futures* counts less than 20 world models. For the history of these modeling efforts see, Elodie V. Blanchard, "Modelling the Future", *Centaurus*, 52, 2010; Helga Nowotny, Vergangene Zukunft, *Impulse geben – Wissen stiften*, 2002; Elke Seefried, *Zukünfte*, 2015; Elke Seefried, "Globalized Science", *Centaurus*, 59, 2017; Egle Rindzeviciute/ Jenny Andersson (Hrsg.), *The Struggle for the Long-Term in Transnational Science and Politics*, 2015; Egle Rindzeviciute, *The Power of Systems*, 2016; Jenny Andersson, "Planning the Future of World Markets", *Planning in Cold War Europe*, 2021; dies., "The Great Future Debate and the Struggle for the World, *The American Historical Review*, 117/5, 2012.

advances over Jay Forrester's WORLD3 model within the scientific community, fell however short in attracting the same attention of the global public.

The Institute for Applied System Analysis (IIASA), founded (probably not entirely coincidentally)[4] in the year the *Limits* were published, functioned from 1974 onwards as the intellectual center of the emerging global modelling community;[5] this was less in the sense of active global modeling research along the lines of Forrester, Meadows et al. than as a discussion platform for advanced world models prior to their publication.[6] Administrative sources from the IIASA archive suggest that these activities were continuously accompanied by severe doubts concerning their status as serious scientific endeavors, as can be illustrated by reference to the fare-well remarks by then IIASA Director Roger Levien on occasion of the sixth Global Modeling Symposium 1979,

> "I was gratified that no one in the audience proposed that IIASA develop a global model of this type. Indeed, I did not hear anyone indicate the intention to begin new development on yet another such model. I think that is an important unstated conclusion of this conference. Perhaps it demonstrates the awareness among this group that the flurry of initial activity, ~~the sunrise or the comet shooting across the horizon~~ and the blaze of publicity are dying down."[7]

The publication resulting from this conference ultimately bore the indicative title *Groping in the Dark – The first decade of global modelling*[8], suggesting that the high hopes in the new science following *The Limits* had been disappointed. Dominated by self-criticism of leading figures from the world modelling scene, *Groping in the Dark* drew attention to some important problem areas that needed to be addressed in order to make the research method initiated by WORLD3 more credible and, above all, more effective, i.e. more policy-relevant.[9] In addition to generally establishing the legitimacy of computer-based assumptions about the future, new world models ought to incorporate technological progress and financial flows, be based on meaningful data and be able to depict "political" global developments.[10] With regard to the latter problem area, prominent social scientists such as Marie Jahoda and Paul Neurath had already criticized the global modelling community, which had from its inception been dominated by natural scientists and engineers. Neurath stated that global modelers

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[4] Rindzeviciute, 2016, pp. 54-58.

[5] Concerning the founding process of IIASA, Leena Riska-Campbell, *Bridging East and West*, 2011; Roger Levien, "Applying System Analysis in an International Setting", *Behavioral Science,* 24/3, 1979.

[6] IIASA's task with regard to multi-sectoral world modeling was usually described by members of the institute as a "monitoring role". Concerns about excessive use of research resources for an IIASA world model were joined by rejection of National Member Organizations and fears that IIASA could be confused with *The Club of Rome.* Rindzeviciute, 2016 pp. 129-149.

[7] IIASA Archives, DI General Research. Global Modeling Review Conf/Work. Sixth Symposium. Memo Gerhart Bruckmann to Roger Levien concerning "final statement" 17.05.1979.

[8] Meadows et al. *Groping in the Dark*, 1982.

[9] As (a.o.) Matthias Schmelzer points out, the first report to *The Club of Rome* had little lasting influence on concrete policies, despite its close links to the OECD. Schmelzer, "Born in the Corridors of the OECD, Journal of Global History, 12, 2017.

[10] On the modeling of technological progress compared to later Integrated Assessment Models, see Christophe Cassen/ Beatrice Cointe, "From The Limits to Growth to Greenhouse Gas Emissions Pathways", Contemporary European History, 31, 2022; For a wide range of criticism of the first world model, see e.g. Blanchard, 2010.

were 'skirting' the social, economic and political aspects of their research;[11] Jahoda criticized the absence of the 'human' variable in the models.[12]

In an attempt to remediate these early models' shortcomings, Stuart A. Bremer presents the social-scientific program on global modeling at the WZB as a 'Bill of Health'; its main research output being the 'first political world model' GLOBUS.[13] An acronym for ***G****enerating* ***L****ong-Term* ***O****ptions by* ***U****sing* ***S****imulation* but also the German word for globe, GLOBUS was the product of the work of around 40 contributors over a period of around eight years under the direction of Bremer.[14] Comprising 40.000 variables and parameters and operating via the computation of 8.000 simultaneous equations,[15] the model aimed at simulating the ramifications of world-wide policy decisions, thereby emphasizing the global interdependence of economic and political developments. "It is our hope that Globus will advance global modelling more than a few steps and bring us significantly closer to the point where we can foresee tomorrow's consequences of today's choices."[16] GLOBUS could therefore be described as a computer model set forth to overcome its predecessors' shortcomings in terms of data validity, policy relevance etc., thereby counteracting the *Groping in the Dark*. The path from WORLD3 to GLOBUS, suggested by the rhetorical convergence to the global modeling field, constitutes however only one of three (partially overlapping) genealogical lines of the Berlin Policy Simulator.[17]

II. GLOBUS as part of Quantitative International Relations Research

Besides the project's location in the global modelling community, GLOBUS was largely a product of early, quantitative behaviorist-oriented international relations research. The GLOBUS model's characteristic application of differential or difference equations to the emergence of political conflicts, among other things, had an early precursor in the work of meteorologist and later peace

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[11] Meadows et al. 1982, S. 268. Original: "Third, I am, to some extent, astonished that so many of you skirt the
essentially social, economic, and political nature of your work, of your results, and of the impact that it has on the social and political world around you. True, each of you is fully aware of this. Nevertheless, I find it amazing that so eminently political an activity can be discussed in such generally unpolitical terms."

[12] Marie Jahoda, "Postscript on Social Change", Models of Doom, 1973, p. 209.

[13] WZB Archives, Brochure "Das GLOBUS-Weltmodell – ein politisch-ökonomisches Computer-Simulationsmodell".

[14] A second "theoretical world model" developed at the *Wissenschaftszentrum Berlin* was developed under the title EARTH (Evaluating Alternative Realpolitik Theses) and published in Thomas Cusack/Richard Stoll, Exploring Realpolitik, 1990. As far as we know at present, there is no historical research on either model.

[15] Compared to 150 equations used in WORLD3. P.J. Vermeulen/D.C.J. de Jongh "Dynamics of Growth in a Finite World", *IFAC Proceedings*, 9/3, 1976.

[16] Stuart Bremer, "Modelling the Political Globe", *Intermedia*, 12/4-5, 1984a, p. 46.

[17] From a methodological point of view, Jay Forrester's work on system dynamics was probably not a significant source of inspiration for GLOBUS, as it was only inadequately suited to the simulation of rarely occurring events such as revolutions or wars. Stuart Bremer, "The GLOBUS Model", IIVG Papers, 1984b, p. 7.

researcher Lewis Fry Richardson.[18] Richardson's ideas for a quantitative study of war, presented in his 1919 study *The Mathematical Psychology of War* had been adapted and developed further by influential behaviorist-oriented social scientists, such as Anatol Rapoport.[19] In the still young scientific field of international development, the behaviorist-social science approach was readily adopted - often with reference to Herbert Simon's work on administrative decision-making; from the 1960s onwards, the necessary financial resources for more extensive projects were also allocated to this area.[20] This was reflected, among other things, in the establishment of political simulation models; one of the pioneer works being the *Inter-Nation Simulation* (*INS*) devised by Harold Guetzkow.[21]

Guetzkow, initially working at the Carnegie Institute of Technology (following a recommendation by Herbert Simon) began his U.S. military supported IR studies in 1957.[22] In human-human, respectively human-computer simulations, the participants assumed the position of high-ranking political decision-makers. Modelled on the already widespread war games and experiments in social psychology, the *INS* was intended to familiarize future decision makers with the processes of international politics. The experimental set-up consisted of five 'nations', each staffed with two decision makers - one responsible for domestic policy and one for foreign policy. By making the right decisions, the participants had to try to fulfil predefined domestic and foreign policy objectives and satisfy the population to an extent that would allow them to continue in office. Information on 'world affairs' was obtained via a 'World Newspaper', which was accessible to all, listing relevant trends and events. The 'inter-national conferences' consisted of an exchange of messages written on paper between the participants. Following a simulation run, a 'satisfaction measure' was created by the experimenters based on the of the nations' behavior in order to measure the success of the participants. In later versions of the INS simulation, these were increasingly replaced by electronic computers; in addition, there was a shift in the target group of *INS*[23], which was later increasingly used as a research tool for scientists from the field of international development rather than as preparation for potential decision makers.

GLOBUS Project leader, Stuart Bremer made initial contact with the *INS* as a student in an introductory course at Michigan University. 1971 he graduated at Michigan State with a PhD thesis titled *Simulated Worlds.* The therein outlined *SIPER* (***S**imulated **I**nternational **P**rocess**ER***) model represents a fully computerized version of an INS, ambitiously set „to convert the INS into a complete theory of international relations and subject that theory to empirical testing."[24] In SIPER, the decision-making tasks still performed by human actors in INS are replaced by a rule-based sequence

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[18] Richard W. Chadwick, "Global Modeling", *Simulation & Gaming*, 31/1, 2000; on Richardson: Paul Edwards, *A Vast Machine*, 2010, S. 93-96.

[19] Paul Erickson et al., *How Reason Almost Lost Ist Mind*, 2013 p. 148; Chadwick, 2000.

[20] James N. Rosenau (ed.), *In Search of Global Patterns*, 1976.

[21] Harold Guetzkow, "A Use of Simulation In The Study Of Inter-Nation Relations", *Behavioral Science*, 4, 1959; Guetzkow, "Sizing up a Study in Simulated International Processes", *In Search for Global Patterns*, 1976; Stuart Bremer, *Simulated Worlds*, 1977, p. 12-21; Chadwick, 2000.

[22] Michael D. Ward, "Harold Guetzkow 1915-2008", ASA Footnotes, 37/1, 2009; Guetzkow himself described Simon's studies on decision making as a "deeper source for this work". Guetzkow, 1959, p. 184.

[23] Some of the further developments of the simulation ran under a different title. For reasons of clarity, only "INS" is used here. Relevant adaptations include Paul Smoker's IPS (International Process Simulation) and Clark Abt's TEMPER (Technological, Economic, Military, Political, Evaluation Routine).

[24] Bremer, 1977, pp. 5-6.

model, the decisions' desired outcomes being aimed at political stability, economic growth and national security. Ultimately, the *Simulated International ProcessEr* offered the starting basis for the Berlin World Model; even adopting some of its parts, like the *SIPER* trade algorithm.[25] These findings suggest that GLOBUS could be integrated into the still undifferentiated field of global modelling mainly due to its scaling, whereas from a methodological point of view, quantitative international relations can certainly be seen as the major influencing factor for the model.

III. GLOBUS as part of Karl Deutsch's Politico-scientific Research Program

Even if the first two conceptual genealogical threads leading to the creation of GLOBUS could be tentatively captioned with the names Forrester/Meadows, respectively Simon/Guetzkow, it was another prominent figure in the 20th century history of the social sciences, being responsible for the world models initialization: Karl W. Deutsch - at the time Professor of International Peace Research at Harvard, MA - had already pointed out the important contribution of cybernetic-informed models to the representation and analysis of trends in the international system in his lecture at the annual meeting of *The Club of Rome* in Berlin in October 1974.[26] During this visit to Germany, he also met with representatives of the Federal Ministry of Education and Science, where the details of his appointment to the Berlin Science Centre the following year were arranged.[27] From 1977, Deutsch held the post of one of the two directors of the *International Institute for Comparative Social Research*, specializing in 'Global Developments'.[28] The Science Centre had only been founded a few years earlier (1969) as a private research institution and also as a counter-step to the increasing politicization of universities.[29] It was to be modelled on US research institutions and bring prominent social scientists, such as Karl Deutsch, to West Berlin. The focus of the institute's work was to be on 'practice-oriented basic research', a label that was also applied to the comparatively experimental endeavor of the GLOBUS project.[30]

The recruitment of Stuart Bremer and his appointment as head of the new modelling project were most likely made on the recommendation of Harold Guetzkow, Karl Deutsch's former colleague at Yale.[31] Apart from Bremer, the research group initially consisted of eleven other academics, two of whom came from the field of economics, two from sociology, seven from political science and one from mathematics.[32] With this dominance of actors trained in the social sciences, the team represented an alternative to the previous world models, which were mainly informed by the natural sciences and econometrics.

An evaluation of these existing models was also the first research task of the GLOBUS group. It was to implement the WORLD3 model and its successors, the *World Integrated Model* and the *Latin*

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[25] Bremer, 1984a, pp. 5-6.

[26] Karl W. Deutsch, "On Inequality and Limited Growth", *International Studies Quarterly*, 19/4, 1975.

[27] Deutsch, "Foreword", The Globus Model, 1987, p. xiv. Deutsch's continued employment at Harvard, Ma. and the "part-time position" at the WZB suggest that Deutsch later probably served more as a supporter to the project than as an active contributor to its content.

[28] WZB Archives, presentation to the 7th meeting of the WZB Board of Trustees on December 12, 1977.

[29] Andreas Knie / Dagmar Simon, „Geschichte der Soziologie am Wissenschaftszentrum Berlin", *Handbuch Geschichte der deutschsprachigen Soziologie. Band 1*, 2017.

[30] WZB Archive, Globus FOGRP, Letter from Daniel Frei to Karl W. Deutsch, 10.07.1985

[31] Chadwick, 2000, p. 63.

[32] WZB Archives, Evaluation Report 1976-1978.

America World Model[33], on the WZB computers and check the possibility of reproducing their results.[34] Instead of attempting to further develop these models, Bremer's SIPER was used as the starting point for GLOBUS, not least because of the model's nationally organized structure. In the opinion of the GLOBUS group, the aggregation of the earlier world models at a global or regional level would stand in the way of any utilization by nation-state actors. This was argued on the basis that only a nation-state structure of the model would enable feedback to individual states - as the most important players in the global system - and could therefore be of benefit to policy makers in individual states.[35] Aggregation at the nation-state level also met a demand made by Karl Deutsch, who had gained fame (a.o.) for his work on nationalism.[36] Other demands by Deutsch concerned the political science orientation of the model as well as its complete computerization.[37]

With this emphasis on computerization and the necessary formalization of the model into mathematical language, Deutsch acted to some extent contrary to his own previous political science research. Although he had dedicated his life to applying Norbert Wiener's cybernetic theory to the social sciences, he generally refrained from making extensive use of mathematical methodology.[38] With regard to his hopes for a new computer-based model of the world, Karl Deutsch expressed himself quite ambitiously. For example, the model's technical report is introduced with the words "In the beginning, there was curiosity" - appropriate to the scope of the project. Deutsch also proclaims "a new field of political science"[39], for which it would be necessary "to develop a new scientific capacity for Berlin and the Federal Republic of Germany that has not existed here before and is still rare in the world."[40] This undertaking in what he termed as 'Mega-Politics' must be seen in the context of Karl Deutsch's efforts in peace research against the background of nuclear (and other) threats, as well as his epistemological theory. In his 1980 study *Zur Theorie der Vereinfachung. Reduktion von Komplexität in der Datenverarbeitung für Weltmodelle* (On the Theory of Simplification. Reduction of Complexity in Data Processing for World Models) Deutsch transfers his concept concerning the increase in knowledge to research on world models. In this cybernetic theory, knowledge is interpreted as the result of a reduction in complexity. The relevant form of knowledge in this context functions under the term 'survival knowledge'. By identifying the relevant components and properties of a global system, its complexity can be reduced, which should lead to

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[33] Mihajlo D. Mesarovic/Eduard Pestel, *Menschheit am Wendepunkt*, 1977; Gilberto C. Gallopin, "The Latin America World Model (a.k.a. the Bariloche Model)", *Futures*, 33/1, 2001.

[34] For WORLD3, Stuart Bremer showed that by introducing the variable of technological progress and changing the initial condition, the catastrophe depicted in *The Limits* could be prevented. See: Stuart Bremer, "Technological Progress and the Limits to Growth", *Weltmodellstudien*, 1980.

[35] Wolf-Dieter Eberwein, „Zum Nutzen von Weltmodellen", *IIVG Papers*, 1983, p. 13.

[36] Deutsch, *Nationalism and Social Communication*, 1953.

[37] Deutsch, 1987.

[38] This is in contrast to Herbert Simon, for example, for whose cybernetic social science mathematics was a central element. On the different cybernetic approaches of the two, see: Ronald Kline, "How disunity matters to the history of cybernetics in the human sciences in the United States", *History of the Human Sciences*, 33/1, 2020. On Deutsch's stance towards quantitative research, see Jan Ruzicka, "A Fetish for Measurement?", *International Relations*, 28/3, 2014.

[39] Deutsch, 1987, p. vii.

[40] Deutsch, "Über Weltmodellarbeiten im internationalen Institut für vergleichende Gesellschaftsforschung am Wissenschaftszentrum Berlin", *Jahrbuch 1978 der Berliner Wissenschaftlichen Gesellschaft e.V.*, 1979, p. 130 [transl. M.R.]

a survival-effective reduction of our practical ignorance.[41] On this basis, the world model imagined by Deutsch was to function as an 'early warning system'[42] (as he called it) by helping to identify the scope of politically relevant development patterns at an early stage and to determine threshold values for emerging conflicts. "We need a cognitive mobilization to understand where the dangers are, what they consist of, which problems we can give a little time, such as thermal pollution, which problems are urgent and moving now".[43] For Karl Deutsch, computer intelligence should serve as an orientation aid in determining which global threats should receive increased attention and resources from science and politics.

IV. Event Quantification, Conflict Simulation. Data for GLOBUS

According to Deutsch, the success of this undertaking and the utilization of a system like GLOBUS required not only sufficient computing power, but above all large quantities of high-quality data on global resources, inequality, demographics and, last but not least, political interactions and conflicts.[44] The question of the procurement, quality and informative value of data had preoccupied the global modeling community since its inception.[45] Apart from the fact that there was not enough demographic, economic or environmental data available for some regions of the world, the institutional possibilities for acquiring data were also limited. When *Limits to Growth* was published in 1972, The United Nations, which was often used as a data provider, had only been in existence for just under 25 years and was therefore only poorly suited for long-term forecasts. Further global data for the models was obtained from national statistics offices and international organizations such as the IMF, the ILO and the World Bank. These were also sources for the GLOBUS model staff, who spent a large part of the first few years of the project gathering data.[46]

Where the data practices of GLOBUS differed from WORLD3, for example, was in the use of 'political data', so-called 'events data': An important part of the formation of quantitative international relations research in the U.S. was the 'Events Data Movement', which attempted to quantify previously unquantifiable variables such as cooperation or conflict by creating databases on political events.[47] The aim was to identify patterns that would enable the early detection of political conflicts; a goal that the GLOBUS developers also pursued. The latter made use of the results provided by the second project of WZB's "Global Research" section, which dealt with the creation of a *World Handbook of Political and Social Indicators*. In addition to the data collected 'in-house' from the *Handbook* project, GLOBUS primarily drew on the existing databases *Correlates of War*, the *World Event Interaction Survey* (WEIS) and *COPDAB,* the *Conflict and Peace Data Bank.*

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41 Karl W. Deutsch/Bruno Fritsch, *Zur Theorie der Vereinfachung,* 1980, p. 53; critique by Niklas Luhmann, "Review: "Zur Theorie der Vereinfachung", *Kölner Zeitschrift für Soziologie und Sozialpsychologie,* 33/2, 1981.

42 Deutsch, Toward an Interdisciplinary Model of World Stability and Change, *Journal of Peace Science,* 2/1, 1976, p. 6.

43 Ibid.

44 Deutsch, 1987, p. ix. Deutsch thus positioned himself in the debate on methodology in world modeling against voices such as Jay Forrester's, who classified the importance of data for large-scale, system-dynamic models as secondary.

45 Meadows et al., 1982; Blanchard, 2010.

46 A further important data-gathering source for the GLOBUS project was the euphemistically termed 'guesstimation' practice.

47 John L. Gaddis, "International Relations Theory and the End of the Cold War", International Security, 17/3, 1992.

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Event Statements		Descriptive Events		Analytic Data
Publicly available sources: newspapers, chronologies, historical documents, and so on	coding critieria	Basic COPDAB data collection: 135 actors toward one another and toward their domestic environment	scaling, weighting, aggregating	Statistical data aggregated by time periods to study change in the relations of the 135 countries

Figure 1. The Data Manipulation Process of COPDAB, taken from Azar, 1980, p. 149.

The following brief outline of a 'Data Journey' is intended to shed light on the use of *COPDAB* data for political science research with GLOBUS. This will make visible the processes that are necessary to turn events into data and, in turn, make them operable for the respective purposes:[48] Staff working on the project at Michigan State University had combed through some 70 international sources (mainly newspapers) on reports of events from 135 states for the years 1948-1978, starting in 1968. 'Events' were defined as published occurrences, "distinct enough from the constant flow of 'transactions'".[49] The coding and thus "datafication" was carried out by entering an 80-column card image, i.e. a sequence of information that could be stored on an IBM punch card and contained information on the date, activity, destination, etc. of the event. By 1980, around 500,000 events had been encoded this way, which were later classified on a conflict-peace scale from 15 (civil war) to 1 (voluntary unification into a nation). Finally, the data was aggregated over a period of time (e.g. one month) into 'analytical data' and released for research. Most likely, the *COPDAB* data found its way to the WZB in Berlin in this form, where it had to pass through the Technical University before being used by the GLOBUS team. A 9.6 kilobit line to the Cyber CDC 170 supercomputer located at the TU (opposite the WZB site) was rented for this purpose.[50] The 'reading' of the data requested by the GLOBUS scientists was still done 'by hand'; in other words, the respective data magnetic tapes had to be picked out by employees of the TU and inserted into the computer before the WZB research group could work with them at their interfaces in the building vis á vis.[51] Finally, for the simulation of international political processes, the analytical data from Michigan was given an additional 'intensity score' of 1-102 points for it to be used in mathematical equations. The bombing of civilian areas (among other things) and the peaceful unification of two nations were assigned the highest values. Reports of incipient diplomatic relations or 'strong expressions of hostility' scored around 15 points on this scale. The benefits of this conversion of newspaper reports into points on magnetic data tapes, including the assignment of an intensity value, are explained in more detail in the following section.[52]

[48] Sabina Leonelli/ Niccolò Tempini (eds.), *Data Jourrneys in the Sciences*, 2020.

[49] Azar, 1980, p. 146.

[50] Walter Gruhn, "Appendix I. The Globus Simulation Package", *The Globus Model*, p. 777-779.

[51] Oral History Interview with GLOBUS mathematician Peter Rindfuß (2023).

[52] Sources from the WZB archive suggest that the journey of the data did not end here, but that it was later used for another research project on the ASEAN states. WZB Archive Globus FOGRP, letter from Werner Pfenning to Princess Konstanza zu Löwenstein, 1987.

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V. Functionality and Structure of GLOBUS

The GLOBUS world is fundamentally organized along nation-state lines. However, the number of actors is limited to 25 + 1 nations.[53] This selection was justified by the fact that, based on past experience, these states would also 'decisively shape the future of the world'. Although, in terms of numbers, only one sixth of the existing nations could be included, the selected states were nevertheless considered a representative sample of the world in that they contained, among other things, 74% of the total population, 85% of military expenditure, 80% of world production, 68% of 'inter-national hostilities' and 57% of political protest. The talk of 25 + 1 nations is explained by the introduction of a 26th, 'artificial country', the ROW: Rest of World. The allocation of five-sixths of the existing states to this category is also to be understood in the sense of a mathematical use of the term "remainder" (German: *Rest*): Since the various political-economic 'flows' between the 25 actors do not result in a zero-sum game, it was necessary to introduce this category in order to be able to explain surpluses and deficits. At the same time, this also means that the ROW is deprived of any agency within the simulated future being largely determined by the 25 'most important' players.

Figure two illustrates a simulation run of the overall model. The individual national modules (NATMODS) are depicted as hexagons, each with six influencing factors. The latter (here in red) form the sub-areas relevant to the political behavior of a nation and represent different ministries. In this model, the actions of a state are thus determined by the modules ECOMOD (production, consumption, employment level, prices), DEMMOD (total population, proportion of working people, age composition), BUDMOD (taxes, debt, expenditure), TRDMOD (imports, export prices, partner preferences), POLMOD (mass protests, organized violence, government sanctions) and FORMOD (degree of reaction to hostile or cooperative flows). In a simulation run, the values of the individual NATMODS are linked bilaterally with other NATMODS in order to project the effects of nation-state policies (e.g. increase in the armaments budget) on other nation-states.[54]

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[53] Argentina, Brazil, Germany, Canada, China, Czechoslovakia, Egypt, GDR, France, Great Britain, India, Indonesia, Iran, Italy, Japan, Mexico, Nigeria, Pakistan, Poland, Saudi Arabia, Turkey, Venezuela, U.S.A., U.S.S.R.

[54] During the creation of GLOBUS, one employee was usually entrusted with working on each of the sub-modules, so that GLOBUS was sometimes also referred to as a "model family".

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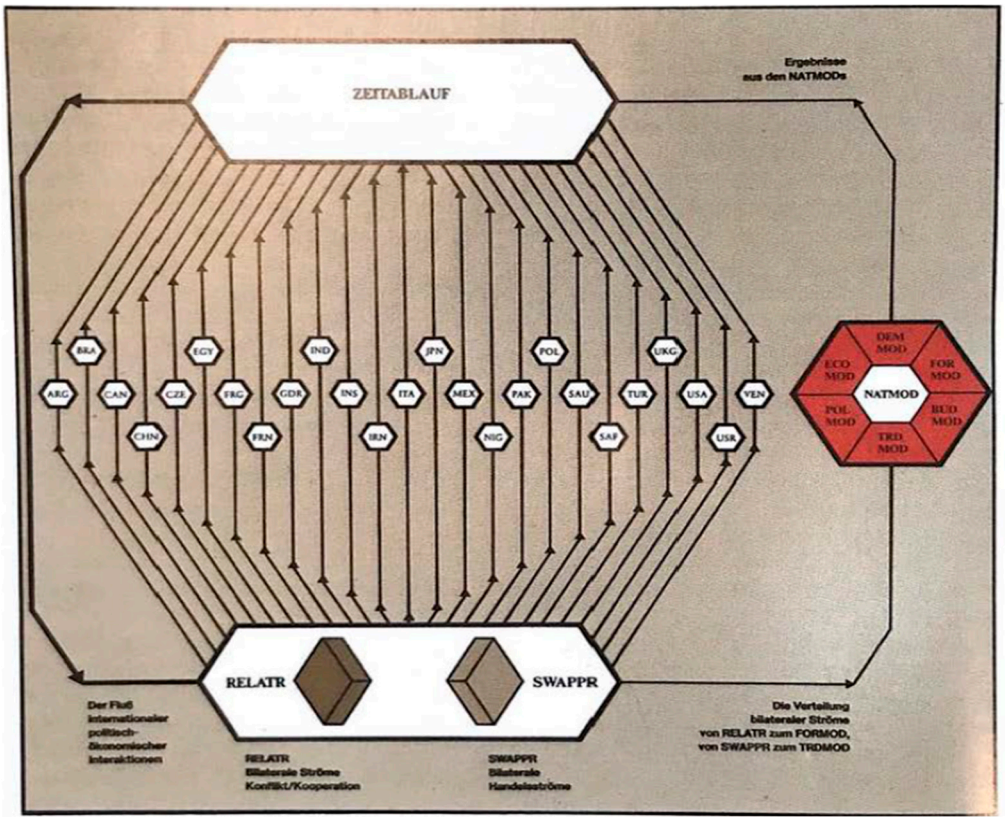

Figure 2. The GLOBUS Structure, WZB Archives, Konstanza Prinzessin zu Löwenstein, Brochure – Das Globus Weltmodell, 1984, p. 16.

In terms of foreign policy, this results in 1200 (25*25*2 forms of reaction) regressions in one run; for foreign trade, there are 3900 (25 nations*24 nations*6 goods classes) trade flows. The extent of the economic or political flows is determined by two further modules SWAPPR and RELATR. Based on the input from the NATMODS, SWAPPR and RELATR should therefore serve as distributors for hostile and cooperative relations or for determining bilateral trade flows. The results of the simulation were always output for a period of 40 years from 1970 to 2010.

Instead of an all-encompassing presentation of the technical report (covering over 1000 pages), the cursory description of one of the sub-models of GLOBUS is intended to further clarify its overall structure: In contrast to the group around Meadows et al. who in WORLD3, among other things, considered elements such as 'pollution' in their simulation, there are no 'environmental' elements in GLOBUS. This can be explained with reference to the assessments of Karl Deutsch and Stuart Bremer, who considered the 'environmental problem' to be less serious than peace policy issues and also questioned the feasibility of such climate models. On the other hand, the absence of the environment in GLOBUS is explained by the assumption that the limits of the earth should rather be seen as a problem of political distribution processes, as a problem of 'planetary' limitations. Nevertheless, GLOBUS does contain a 'climate mode' to a certain extent, albeit in the sense of calculating the *political* climate. GLOBUS researcher Dale Smith's International Political Processes module attempts to capture the changes in the political climate using the values 'hostility' and 'cooperation'.[55] It is largely based on the events data from the *Cooperation and Peace Data Bank* (*COPDAB*) and represents an attempt to make these quantified events usable for the computer simulation.

The equation into which this data must be inserted to calculate the political climate is: $SENT'x,y = a1 * (c1 + (r1 * SENT\ y,x) - SENT\ x,y)$. The changed foreign policy behavior (SENT) of one nation (x) to another nation (y) results here from the multiplication of a time parameter that determines the speed of bureaucratic adaptation (a) with the difference between the desired and the

[55] Dale Smith, "International Political Processes", *The Globus Model*, 1987.

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actual level of hostility or cooperation. This difference is in turn made up of a Policy preference constant (c1) plus the product of the strength of response (r1) with the received policy behavior (SENTy,x) minus the already sent policy behavior (SENTx,y). For a scenario designed to calculate the hostility sent by the U.S.A. to the U.D.S.S.R., the following equation is found: $SENT'x,y = 4.2 * (187.6 + (0.21 * HSENT\ y,x) - HSENT\ x,y)$. This is a matter of calculating the difference to previously sent hostility (H) as a function of the received hostility. The results of these equations ultimately yield values that can be displayed in 'climate index' graphs (Figure 3).

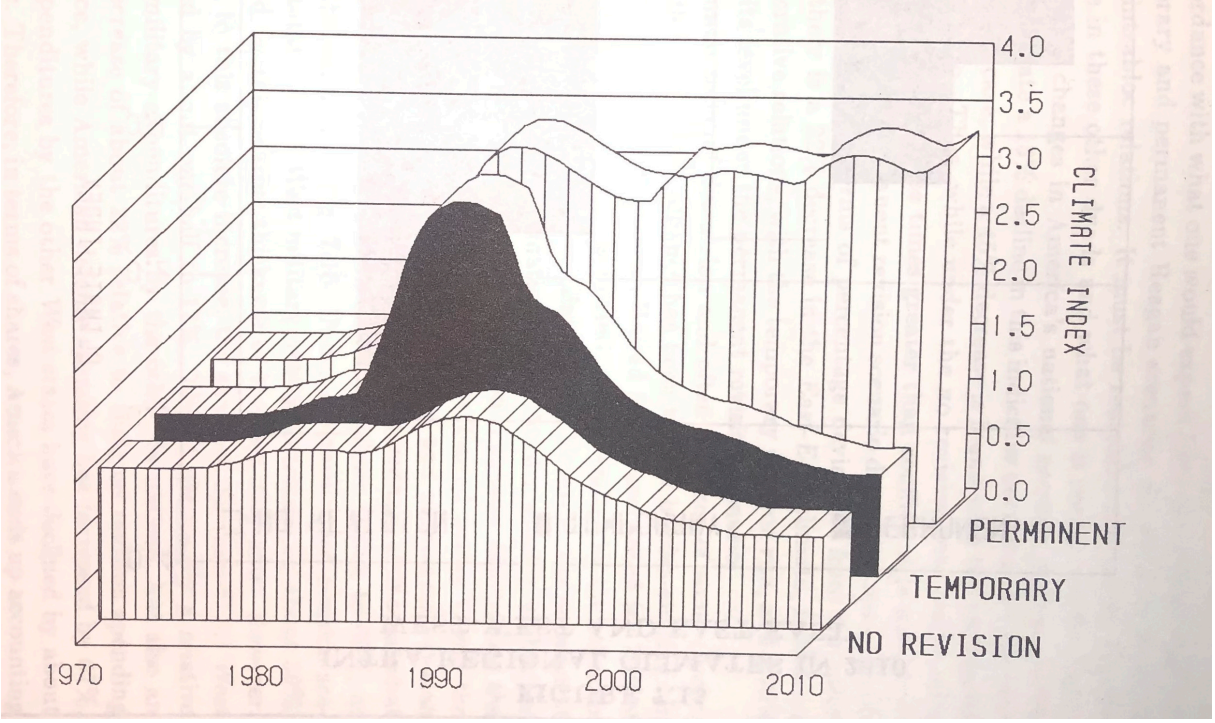

Figure 3. Illustration of possible ramifications of Reagan's revisionism on the climate between East and West; taken from Smith 1987, p. 661.

To give meaning to the values of this index, they are compared with historical data on hostility and cooperation levels between the respective nations. This makes it possible to compare calculated hostility and cooperation levels with different phases of the Cold War, for example, and to identify patterns that are very likely to lead to conflict. For the implementation of a scenario, the model described for International Political Processes represents only one aspect, which had to be supplemented by the interaction with the other modules when using GLOBUS. In this way, economic factors could also be included in the calculation of the political climate between 'Eastern and Western countries'. For example, the effects of the political revisionism announced by Ronald Reagan were 'played through' at the WZB by making corresponding adaptations in BUDMOD - the U.S. budget module - and calculating their effects on hostility and cooperation. Unsurprisingly, the simulated policy adaptation led to a marked increase in the 'climate index' (Figure 5), with the strongest impact on relations between the FRG and the GDR: "the climate in this dyad becomes almost twice as hostile." [56] As in all cases, the so-called 'standard run', i.e. the simulated course of global developments under the assumption that no fundamental (policy) interventions in the course of events in the GLOBUS world would take place, provided the comparative values.

By means of such GLOBUS scenario analyses and the resulting projections, it was hoped to create a more "realistic" picture of the world for international development research and to be able to map global interdependencies in the long term with the help of computer intelligence. Subsequently, the model knowledge generated was also to be used for purposes outside of science.

[56] Smith, 1987, S. 660.

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VI. Making the Model Matter

"Now this [GLOBUS] model is sufficiently developed [...] that some preliminary results are available, [...] for example [...] on how different rates of protectionism or its containment affect world trade and thus the problems we all face. We are the ones who must take up the findings and put them into practice. We Social Democrats are doing everything we can to meet this expectation. [...] We call on the Federal Government to take up, bundle and use the ever-growing tangle of information, to use computer capacities, to help develop this 'GLOBUS model' further and to translate it into political action as quickly as possible. [...] We must develop a sense that the time for short-term national competitive advantages must be over for good. We must fight protectionism."[57]

In the case of GLOBUS, this speech by Anke Martiny-Glotz of the West German Social Democratic Party in the German Bundestag represents one of the rare occasions when the results of the policy simulator served as an argumentative basis for a potential decision maker. The politician's statement was given in the context of a debate on the so-called *Entwicklungspolitik*, i.e. development policy of the Federal Republic of Germany; it was presumably based on the scenarios presented by employees of the GLOBUS research group at a press conference in Bonn in 1984. After seven years of work by the WZB's research focus 'Global Development', more and more voices were calling for a focus on working *with* the model rather than working *on* the model. "GLOBUS must go to the customer, so to speak," stated the 1985 evaluation committee report.[58]

The history of the early global models of the 1970s and early 1980s can also be read as a series of efforts to identify potential users, to bridge the gap between modelers and policy makers, and to exert lasting influence on policy. Significantly, the last of the IIASA symposia on global modeling, in which Stuart Bremer also participated, was held under the title 'Global Modeling at the Service of the Decision Maker'. In order to leverage the influence of GLOBUS, the WZB staff employed various strategies, the most significant of which was probably the creation and presentation of scenario analyses using GLOBUS as a tool for political science research. This was done via press conferences in Germany, written presentations to the UN and UNESCO, as well as a presentation of the model at the Pentagon, according to a report by WZB management.[59] In addition, the research group held workshops with political actors and their scientific staff with the aim of familiarizing them with the possible long-term consequences of political decisions.[60]

The most significant element in these scenario analyses was the 'question' posed to the model. In the speech in the Bundestag, the Social Democrat representative referred to the run of the model that was intended to illustrate the effects of protectionist policies announced by Ronald Reagan on the global political climate. This showed that the consequences of such measures would have a negative impact on hostility and cooperation rates, but that the situation would stabilize relatively quickly if the policies were to be withdrawn.[61] Other scenario runs included the dependence of living standards on technological progress[62], the impact of population growth on the number of mass

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[57] Plenarprotokoll 10/130 Deutscher Bundestag Stenographischer Bericht 130. Sitzung Bonn, Freitag, den 29. März 1985. [transl. M.R.]

[58] WZB Archive, Bericht des Evaluationskomitees vom März 1985. The Committee was comprised of prominent figures in future studies like Carlos A. Mallman, Harold Guetzkow, Gerhart Bruckmann or Jan Tinbergen.

[59] WZB Archives, FOGRP 1: Tischvorlage zur Sitzung des Wissenschaftlichen Rats am 7. Juni 1988.

[60] WZB Archives, Dokumentation GLOBUS, Gesprächsnotizen, 29.03.1984.

[61] Smith, 1987, p. 643-666.

[62] It should be mentioned here that the only indicator of global technological progress used was that of the USA as the "most advanced nation", from which all other countries would benefit.

protests and the potential consequences of an increase in the US arms budget.[63] Furthermore, Stuart Bremer and Barry Hughes published a GLOBUS-supported analysis of the Brandt Commission's proposals for improving the relationship between the Global North and the Global South, concluding: "overall it is not possible to conclude that the […] package would improve North-South relationships." [64] The computer simulation functioned here as a means of questioning the supposedly too short-sighted recommendations of the 'analog working' commission.

The strong belief expressed in "the superiority of the computer over the human mind in the face of such complex, interlocking and often parallel causal relationships"[65] stands in stark contrast to the doubts expressed in other documents as to the validity of the GLOBUS model.[66] In view of the obvious shortcomings of the model already mentioned, it seems doubtful whether the simulation was able to provide any form of meaningful projection at all.[67] This skepticism is also reflected in the archived documentation of the project, but fades into the background in the application-related publications.

The second strategy for fulfilling the evaluation committee's recommendation to 'bring the model to the customer' took place at an educational level. This included the presentation of GLOBUS at the European Simulation Game Forum 1986 in Bad Neuenahr.[68] The main focus, however laid on the development of a GLOBUS PC version with the title MICRO GLOBUS.[69] In contrast to the "difficult-to-read thousand-page tome"[70] of the book publication, MICRO GLOBUS was intended to function as a user-friendly alternative. The WZB's own policy experiments on the model were intended to reduce skepticism towards the world models on the one hand and to increase users' awareness of complexity and interdependence on the other.[71] Despite the developers' insistence that MICRO GLOBUS should not be understood as a game[72], the framing of a "global model in one's briefcase"[73] is strongly reminiscent of contemporary, cybernetically-informed (computer) games, such as *Strategem 2* by Donella and Dennis Meadows, the latter's *Fishbank Ltd*. or Frederik Vester's

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[63] The suggestion made to the WZB in 1984 that the effects of German reunification should be simulated was rejected with reference to the political explosiveness of the topic and the inability of the model to depict structural changes. WZB Archive, address mailings GLOBUS to 88, letter from Stuart Bremer to Meinolf Dierkes, December 11, 1985.

[64] Stuart Bremer/Barry Hughes, "Disarmament and Development", *International Political Science Review*, 11/2, 1990, p. 203.

[65] WZB Archives, FOGRP 1. Tischvorlage zur Sitzung des Wissenschaftlichen Rats am 7. Juni 1988. [transl. M.R.]

[66] Bremer, "Evaluating GLOBUS", *The Globus Model, 1987.*

[67] For a further critique on the usefulness of behaviorist IR models, see Gaddis, 1992.

[68] WZB Archives, MICRO GLOBUS Adress Lists, Stuart Bremer to Walter Rohn, 07.08.1986.

[69] There were also plans to extend the model to 50 nations (interview with Peter Rindfuß), an online version and the creation of an "I[NTERACTIVE] GLOBUS", which would allow interventions in ongoing simulations and clarify the simulation character. (WZB Archives, MICRO GLOBUS Address Lists, Stuart Bremer to Walter Rohn, 07.08.1986.

[70] Ekkart Zimmermann, "Review: The Globus Model", *Politische Viertelsjahresschrift*, 31/4, 1990, p. 710. [transl. M.R.]

[71] WZB Archive, Globus FOGRP. Tischvorlage zur Sitzung des Wissenschaftlichen Rats am 7. Juni 1988.

[72] WZB Archiv, Globus FOGRP, MICRO GLOBUS Information.

[73] Gruhn 1987, p. 795.

Ökolopoly.[74] The response to MICRO Globus was limited in comparison to these explicitly gamified simulators. In August 1992, there were around 100 registered users of the program. Apart from a few requests from consulting firms, the program was mainly purchased by students and lecturers from social science faculties.[75]

When considering the 'effectiveness' of a model, in addition to the strategies for publicizing and possibly implementing it, it is also necessary to take into account what Volker Roelcke refers to as *Karriereressourcen*/'career resources', i.e. "the totality of factors relevant to a potentially successful career from the perspective of (especially young) researchers".[76] In the case of the GLOBUS model, working at the WZB was the first academic position for most employees after graduating from university. For the majority of those involved, the GLOBUS model acted as a catalyst for a university career. To pick out two illustrative examples of further careers: Barry Hughes, who was responsible for "Domestic Economic Processes", developed the -GLOBUS not dissimilar- *International Futures Project*, which formed the foundation for the still active *Frederik S. Pardee Center for International Futures*.[77] Stuart Bremer was appointed to Binghamton University, later Pennsylvania State, and served as Executive Director of the *Peace Science Society* and the *Correlates of War Project*.[78]

The media publications on GLOBUS - described here as the last strategy to make the model more effective - contrast with the often-modest opinions communicated internally by those involved. The headline of the Berlin magazine *Zitty*, which spoke of a "future from the computer"[79], represents a maximum misjudgment of the model's possibilities in the (limited) media coverage;[80] however, the results of the simulation were presented in other publications as "completely unemotional"[81], i.e. with a high degree of credibility. The tenor of the published results of the GLOBUS simulations can be roughly summarized as follows: overcoming current crises is important, but not as hopeless as WORLD3 has made it out to be. As with the evaluation of the Brandt Commission, it would be important to recognize the complexity of the matter and to refrain from rash actions.

The implicit rejection of a pluralistic debate in favor of the authority of the computer can be interpreted as an expression of a political discourse with an affinity for control, which Ariane Leendertz describes as the 'complexity syndrome' of the 1960s and 1970s.[82] In the case of GLOBUS, this reduction of the discourse also evoked criticism from left-wing scientists, who described the GLOBUS model as a 'modern instrument of domination' in the journal *Wechselwirkung* and noted that

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[74] David Kuchenbuch, "Ökolopoly Spielen, Wissen und Politik um 1980", *Nach Feierabend*, 11, 2016; on *Strategem 2*, see Rindzeviciute, 2016, p. 118-120.

[75] WZB Archives, Aussendungen GLOBUS bis 88.

[76] Volker Roelcke, "Auf der Suche nach der Politik in der Wissensproduktion", *Berichte zur Wissenschaftsgeschichte*, 33/2, p. 186.

[77] The International Futures Simulation is free to use via the center's website. https://www.ifs.du.edu/ifs/frm_MainMenu.aspx [accessed: 30.11.2023].

[78] Barry Hughes,"In Memoriam: Stuart Bremer", *Political Science and Politics*, 36/2, 2003; https://correlatesofwar.org/ [accessed: 10.12.2023]

[79] WZB Archiv, "Die Zukunft aus dem Rechner", *Zitty*, 21, 1985. [transl. M.R.]

[80] In addition to the publication mentioned above, there were around 10 radio and newspaper reports on GLOBUS in the German media between 1984 and 1987. The model was also featured in the 1987 exhibition "Berlin, Berlin" at the Martin-Gropius Bau on the occasion of the city's 750th anniversary celebrations, see Berliner Festspiele GmbH, *Berlin, Berlin*, 1987, p. 629.

[81] WZB Archiv, "Berliner Wissenschaftler stellen ein neues Weltmodell vor", *Bild der Wissenschaft*, 7, 1985.

[82] Ariane Leendertz, "Das Komplexitätssyndrom", *Die neue Wirklichkeit*, 2016.

the reliance on data obscured the model's normative claim, even in comparison to its world model predecessors.[83] Following this line of argument, the inclusion of politics, larger amounts of data and trust in artificial computer intelligence led to the depoliticization of the simulation. Contrary to the assumption that a more well-founded database and a nation-state aggregated structure would result in a more 'realistic' depiction of the world and thus an increased implementation benefit, it can be stated - with Paul Edwards - that the early models, such as WORLD3, were less effective at a policy level than at a *politics* level.[84] The 'strength' of these models therefore lay less in their 'degree of reality' than in their appellatory criticism of global political developments. Although sometimes referred to as an instrument of peace research, this critical aspect of GLOBUS took a back seat in favor of a more 'accurate' analytical capability. Developed to remedy the deficits of the previous world models and to 'bring politics into the model', one of the 'weaknesses' of GLOBUS ultimately lay in the 'skirting' of the normative-political content of its own scientific activity, as above formulated by Paul Neurath.[85]

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[83] Eva Emenlauer-Blömers et al., "Mit Globus die Welt im Griff", *Wechselwirkung*, 12/44, 1990. On the journal's role in the field of critical science and technology studies in Germany, see Nils Güttler/Margarete Pratschke/Max Stadler, "Before Critique Ran our of Steam", *Nach Feierabend*, 11, 2016.

[84] Paul Edwards, „Global Comprehensive Models in Politics and Policymaking, *Climate Change*, 32, 1996.

[85] Paul Neurath in Meadows et al., 1982, p. 286.

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