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## **The Cultural Dimensions of Computer Simulation**

Sebastian Grevsmühl

Without a doubt, computer simulations have revolutionized our understanding of the sciences during the second half of the 20th century. From numerical weather forecasting to climate simulations, from economic modeling to social planning, computer simulations play a leading role in our understanding of various global socioeconomic, geophysical, and environmental processes. Blurring established norms and transgressing boundaries of traditional fields of science, computer simulations generate their own research logic, their own laboratory practices, as well as fundamentally new forms of knowledge. Indeed, they have helped introduce truly new norms for what counts as knowledge, stirring controversial epistemological discussions among scientists and philosophers regarding whether models can be “validated” or “verified” in a traditional sense or whether they demand a whole new epistemological framework, far beyond traditional approaches established around notions such as theory and experiment.

Reaching well beyond these important epistemological questions, an international conference was convened by the Institute for Advanced Study MECS (Media Cultures of Computer Simulation) at Leuphana University Lüneburg, Germany, in June 2015. Funded by the German Research Foundation (DFG), the two-day international conference, entitled “Dealing with Climate Change: Calculus and Catastrophe in the Age of Simulation,” explored the cultural subtexts and the specific cultural conditions of computer simulation, especially in the context of ongoing debates on past and future climate change. One of the conference’s leading aims was to move beyond the well-known epistemological discussions to engage in more detail in the fundamental cultural, economic, and political underpinnings that make climate simulations a controversial, but highly vibrant and, in many ways, astonishingly robust field of research.

### **Interdisciplinary Explorations of Simulation-Based Knowledge**

The Climate Change MECS Conference was therefore an important step toward exploring more fundamentally, in an interdisciplinary framework and often with the help of concrete case studies, the historical, political, and sociocultural dimensions of environmental and climate simulations. Approximately 50 scholars attended from mostly European countries: most scholars were from Denmark, Sweden, France, the United Kingdom, Germany, and Austria, but some from the United States were also present. The conference organizers Isabell Schrickel and Christoph Engemann put together a well-balanced program in many respects, involving almost equal numbers of female and male speakers and commentators while at the same time leaving enough room for early career scholars to discuss their work with senior researchers and university professors.

The conference organizers called for contributions on historical and recent case studies as well as theoretical contributions that question the cultural conditions and effects of a simulation-based order of knowledge. Given MECS’ intellectual orientation toward cultural and media analysis, as well as a strong interest in material culture, the organizers again found a refreshingly well-balanced disciplinary distribution, allowing for the highly fruitful confrontation of diverse approaches, ranging from anthropology, art history, and geography to the history of science, science and technology studies, and policy and media analysis, just to name a few. This methodological and disciplinary diversity was of course also reflected in the presentations that ranged from historical case studies to aesthetical reflections and climate policy analysis. And as is often the case during inspiring conferences with interesting participants, the lively discussions continued throughout the breaks, allowing the attendees to discuss themes of great trans-disciplinary potential and to exchange in more depth on various topics as well as disciplinary tools and approaches.

Four thematic panels, accompanied by invited comments, a keynote lecture delivered by Paul Edwards (University of Michigan), and a closing presentation by Oliver Geden (German Institute for International and Security Affairs) made up the general structure of the conference.

### **The Challenges of Simulation-Based Knowledge**

Two principle challenges provide for a transversal reading of the rich and diverse conference contributions: first, the challenges faced by reconciling local needs with the increasingly global perspectives imposed by simulation-based knowledge, and second, the challenges of model and simulation results generated at a science-policy level.

The data, images and global projections that various modeling technologies and simulation processes have produced since the 1970s and 1980s in diverse domains (such as environmental risk evaluation, environmental remote sensing, and climate change research) all feed into a global perspective on the environment that is not easy to reconcile with local needs. Numerous contributions during the conference insisted on a shift away from

the human perspective to a more dynamic and mostly statistical approach. Dania Achermann (Aarhus University) explained this is a result in particular of the historical development of the notion of climate that shifted over the 19th and 20th centuries from a stable, timeless, and human object to a dynamic, statistical, and space-related concept. Paul Edwards argued that the steadily increasing complexity of climate models reflects this development as well, where great emphasis is placed on global geophysical processes, often to the detriment of a more local, human perspective. Birgit Schneider explained that this development is also confirmed by most of the scientific images reproduced in the IPCC (Intergovernmental Panel on Climate Change) reports.

Sabine Höhler (KTH Stockholm) provided another excellent case in point: the scientific construction of a global geophysical phenomenon with the help of remote sensing technology, such as the El Niño event, where the transition from rich, local stories to a global, but shallow view of the environment becomes evident. The “grounded” views of century-old oral traditions were gradually supplemented during the second half of the 20th century by increasingly global views. One problematic outcome is that the new global framing and storytelling stripped El Niño of its catastrophic meaning, turning it into a recurring, regular geophysical pattern.

Nonetheless, some of the contributions also pointed at possible solutions for reconciling local perspectives with global modeling. For instance, Sébastien Nobert (University of Leeds) presented a case study on EFAS, a pan-European flood warning system. With EFAS, new networks and democratic ideals were able to emerge. While promoting equal rights to security and well-being throughout Europe, it also placed emphasis on participatory action. EFAS evolved out of EPS, an ensemble prediction system. First introduced to overcome deterministic weather forecasts with an ensemble of predictions that allowed pushing further the time limitations for reliable weather predictions, EPS’s success in meteorology led eventually to its application in real-time flood forecasting. By implementing a probabilistic approach in the forecasting process and by making uncertainties more explicit, it favored the establishment of a flexible distribution of authority, permitting different actors to take decisions at different level. Yet this new framework did not just redistribute power, it also required a new form of training for scientists, new organizational constellations, and a fragmentation of the social in order to prioritize individual response over collective reaction.

Other contributions, such as Paul Edwards’ keynote address, resonated with Nobert’s suggestions. For instance, in climate modeling, recent initiatives place a strong emphasis not on further scaling-up objectives but rather on interoperability processes and common methodologies in order to transform useful knowledge into usable knowledge. For Edwards, this is a question of knowledge infrastructures. By sharing all kinds of data via open-knowledge databases, by mobilizing existing resources that are already at our disposal, and by shifting to a more integrative, but also more pragmatic problem-solving approach in science, we may indeed serve more local needs and allow for a better, more usable knowledge production that can help tackle the serious and diverse problems we face within climate change.

Carson Chan (Princeton University) added to this view a social dimension, proposing to update Anderson’s concept of “imagined communities” by taking into account new social spaces such as “Diaspora space,” where migrant groups and NGOs (nongovernment organizations) also have a voice. According to Chan, the so-called digital revolution, with its self-fulfilling myth of free access to information, helped create new communities within cyberspace where ideas have become more important than geography. Here, however, a more critical approach to the digital revolution, beyond the well-known homage to freedom of speech and democratic ideals, especially concerning some of its problematic political and economic effects, would have been welcome.

A second crosscutting challenge was how simulation-based knowledge relates to and interacts with the political sphere. Especially within climate change research, the science-policy interface is an intensely discussed topic. As geographer Martin Mahony (King’s College, London) pointed out, the evolution of climate modeling in the UK was influenced by strong political interactions with the scientific community. Indeed, politics and science mutually constructed the practices, norms, and priorities of climate science in the UK. The turn to transient climate simulations was for example initiated under Margaret Thatcher and global climate modeling emerged mainly from the political aim of internationalism and the struggle for UK leadership in Europe.

Many other speakers picked up this topic of political and scientific co-construction, such as art historian Birgit Schneider (Potsdam University), who pointed at the normative function of climate imagery. She showed how the IPCC explores and tests future visions with the help of graphs, maps, plots, and charts and more importantly how the IPCC makes normative statements about which future visions are preferable (the colors red and blue for example have precisely this function). In doing so, Schneider made the important point that climate images have agency: by shaping our imagination, they necessarily change reality. Schneider feels that climate modelers especially should be made more aware of this point and other speakers, such as Alexander Bakker (Pennsylvania State University), complemented her argument by pointing at social norms that also play an important role within climate modeling (such as “implicit tuning,” where successful parameterizations are shared among modelers). And just as climate images contain normative elements, clearly indicating preferable climate visions, Samuel Randalls (University College London) discussed how other cultural artifacts such as climate online games also can come to legitimize certain economic ideals and make them seem more respectable than others.

Finally, calling on the responsibility of climate modelers and policy makers alike, Olivier Geden (SWP German Institute for International and Security Affairs) concluded the conference on a rather critical, if not

alarming note. Drawing on research conducted on the science-policy interface in recent climate change discussions on geoengineering technologies, Geden argued that we are dramatically shifting from “evidence-based policy making” to “policy-based evidence making.” His example of a completely untested and highly risky technology known as BECCS (bio-energy with carbon capture and storage) allowed him to make an important point: today, policy makers deliberately ignore the uncertainties of the scientific studies to legitimize their inactions; the modelers, on the other hand, even though they don’t believe that their scenarios are realistic, because they know about the inherent uncertainties, are not sufficiently aware of their part of responsibility in the coproduction of this irresponsibility. Although critical public discussion might finally bring down BECCS, other forms of geoengineering are likely to enter the modeling process in the near future, such as solar radiation management (SRM). This dangerous development can only be prevented by profoundly reshaping the science-policy interface.

## **Conclusion**

Simulation-based knowledge proved to be a highly productive topic at the “Dealing with Climate Change” conference. The participants’ willingness to go beyond the usual epistemological discussions proved especially fruitful, deepening and enriching our understanding of climate models and environmental simulations. Indeed, the diverse and rich contributions and discussions showed not only how simulation-based knowledge profoundly changed the way we perceive and conceptualize climate change and environmental risk in general, but also how cultural and social norms, policy aims, and economic ideologies intervene in this complex historical process.

Finally, and maybe most importantly, the compact two days provided for some engaging and lively discussions between researchers of various disciplinary backgrounds, often continued outside of formal sessions, allowing for new social ties to be established that will certainly show their fruits in the near future.

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***This Events & Sightings installment covers a range of recent events focusing on the history of computing.***

***history of computing, computer simulations, climate simulations, climate research, climate models***