ffk Journal
Film- und Fernseh-wissenschaftliches Kolloquium

Patrick Henschen | Lew Töpfer
Paderborn | Wien

Images of Climate Crises

Critical Remarks on Climate-Technical Imagery Production and the Possibilities of Desirable Futures

Abstract: Satellite technology produce imagery to monitor the status and changes of human and natural environments; AI-driven technology creates models for calculations and predictions that serve purposes of optimization and adaption. These two core technologies that originate from modernity´s socio-technological order provide the epistemic access to facilitate the triple planetary ecological crisis. Both operate at necessary scales and symbolize (Western) epistemic success for humankind. However, their technological production interacts with the societal urgency to address the climate crisis in complex ways. Beyond conventions of scientific-technological progress, situated climate imaginaries are urgently needed for productive future visions as foundation for political actions.

Patrick Henschen (M.A) ist derzeit wissenschaftlicher Mitarbeiter am Institut für Medienwissenschaften an der Universität Paderborn. Nach Bachelor- und Masterstudium der Kulturwissenschaften an der Leuphana Universität Lüneburg forscht er an der Universität Paderborn im Sonderforschungsbereich/TRR318 „Constructing Explainability“ zu Erklärbarkeit und Erklärprozessen von Künstlicher Intelligenz. Sein Dissertationsprojekt beschäftigt sich mit der Verschaltung von Künstlicher Intelligenz als physikalischer Infrastruktur und dem Wechselverhältnis zur Klimakrise.

Lew Töpfer (B.A) ist Lehrender für Weltraumrecht an der Leuphana Universität Lüneburg. Nach einem Bachelorstudium mit einem Schwerpunkt auf Weltraumrecht an der Leuphana Universität Lüneburg war er in der Raumfahrtagentur im DLR als Projekt-Assistent für UN-Angelegenheiten im Bereich Space4SDGs und Space4Climate tätig und studiert nun an der Diplomatischen Akademie Wien sowie an der Universität Wien Internationale Beziehungen und Menschenrechte.

1. Introduction

„Something [...] we doubt [...] seems proven when we see a photograph of it“,[1] writes Susan Sontag. In images, we encounter certainty about the present developments and future consequences of the triple planetary crisis, referring to ubiquitousness of climate change, ecosystems´ pollution and loss of biodiversity. Whether they center individuals impacted from flooding or fire disasters or showcase the bleaching of corals or mass extinction of animals during heatwaves, the destructive effect of the Anthropocene is, for all intents and purposes, well documented. In contrast to this awareness and knowledge of climate crises, what we face in our fields could be described as an incapacity to act – either due to the statistical generated, abstract research object of climate[2] or due to nature being a silent actor opposing economic, political and societal interests within modern capitalism.[3]

The proof of imagery and the willingness to act accordingly are in misalignment. We define images of climate crises as a description of any visual material in the context of climate crisis, since they serve as media of knowledge and heuristic tools of thought.[4] This includes photographs, graphics, sketches, any visual form that raises awareness, insights and realizations of drastically changing ecological conditions. Mainly, in the following we will rely on satellite imagery as a central epistemic thing[5] due to their capability to record climate change on a global scale. Latest advancements make use of the academically and publicly well discussed probabilities of generative artificial intelligence (GenAI) to produce satellite images of potential flooding areas as additional visualization,[6] situating the technologies within each other. As follows, these images serve as objects to locate media epistemologies, central contradictions of modernity and lacking imaginative capacities. We suggest critical evaluations of these images, their production and their unused anticipatory potential with the purpose to coordinate action that strives for desirable futures.

2. Satellite images and climate imageries

The first climate-technological object concerns outer space technologies. Remote sensing, or earth observation, describes

1 Sontag 2005: 3.
2 Schneider 2018: 22.
3 Beckert 2024: 86.
4 Schneider 2018: 31.
5 Rheinberger 2001: 24.
6 Lütjens et al 2024: 24.

> the gathering of information about planet Earth's physical, chemical, and biological systems via remote sensing technologies [...] used to monitor and assess the status of […] the natural environment and human landscape.[7]

In the 1970s, as the excitement and the funding over interplanetary research diminished in the Western countries,[8] our eyes turned back to Earth, and satellite imagery has developed into a sophisticated field of scientific research, with the European Space Agency (ESA) alone operating over 40 satellite missions conducting earth observation. Following the groundbreaking moment since the beginning of satellite imagery means to acknowledge that an epistemic success is followed by new ontological questions due to the possibility of humankind to see itself from a bird's-eye perspective, constituting a „part of an ongoing project of knowing and understanding ourselves and our environment".[9] What we learned from the awareness of climate change though, is that to locate humankind in its own geosphere comes with certain modes of reflection. The possibility to generate data of the earthly conditions and activities by the satellite-driven bird's-eye perspective is diluted by abstractions and visual distance. This also marks a possible change in thought from centric thinking to one that is peripheral and oscillating between both modes of thinking.

Moreover, astronauts, engineers and researchers agree on the ethical dimension that is connected to earth observations which imply that „[k]nowing ourselves means knowing our own responsibility, especially for any long-term damage or harm. Earth Observation is an indispensable tool in this project of self-knowledge".[10] Therefore, the connection to climate crisis seems evident since satellite imagery offers the necessary data to adequately complex and changing natural ecosystems. Next to this success story of modern science and technology, there is a counterpoint, namely the inscribed and climate related environmental costs of satellite technology. Current research focuses primarily on two issues: the environmentally harmful effect of rocket launches and the handling of space debris at the end of satellite missions.[11] Water gases released during rocket launches have a demonstrable impact on the depletion of the ozone layer.[12] Rocket and satellite technologies are the sole human activity[13] causing direct emissions beyond the lowest layer of atmosphere, the troposphere. During launch, man-made greenhouse gases are released directly into the middle and upper stratosphere, which consequently entails their faster diffusion, thereby increasing their climate impacts. Beyond this unique contribution to greenhouse gas emissions, satellites in space continue to pose a threat to the environment. Collisions can produce space debris, which can have a lasting impact

7 Rapp 2025: 140.
8 Reinecke 2021: 756.
9 Eyres 2017: 5.
10 Ibid.
11 Durrieu/Nelson 2013: 4.
12 Ross/Toohey/Peinemann 2009: 27.
13 Zisk 2023.

on the use of space.[14] While atmospheric drag causes satellites that are no longer functional to gradually fall back to Earth and thus burn up almost completely, this process can take several decades, during which the risk for collision and fragmentation is very high.[15] More and more researchers and political entities are therefore advocating that earth's orbit should be viewed as a resource that must be used adequately to preserve it for future generations.[16] Consequently, this would require a limitation on the amount of missions launched and would therefore be oppositional to the current increase in earth observation missions.

Clearly, the gathering of climate images from the vantage point of space comes at a stark cost. On the other hand, Earth observation systems such as Copernicus provide consistent data sets that can map the Earth system in its entirety and are therefore indispensable for the collection of global data and its effective use.[17] We propose that this relationship, which is often reduced to an economic or environmental cost-benefit-analysis between monitoring damage to mitigate it and causing it in turn, should rather be recognized as a complex interdependence of epistemological and political viewpoints which requires further critical reflection.

Earth observation satellites produce long-term, global images of the Earth's surface and ecosystems. They thus provide a data basis for effective environmental protection and nature conservation. Illegal activities such as illegal logging can also be monitored and prevented through continuous monitoring from space. The analysis of soil quality enables the precise and resource-efficient use of water and fertilizers in agriculture. Images of earth – and its climate – are made ubiquitous, both in quantity and detail. It is this vantage point of space, from which the evidence seems overwhelming, from which we start this analysis: „The existence of the earth is rather part of the whole picture which forms the starting-point of belief".[18] Rene Daumal describes the relationship between distance and knowledge in his book *Mount Analogue*: "One climbs, one sees. [...] There is an art of conducting oneself in the lower regions by the memory of what one saw higher up". [19] What is true about mountaineering is multiplied with the increased view from the height of space.

For one, space images serve as an explication of the relationship between severity and scale. For example, in the critically acclaimed documentary *Ocean*, the narrator David Attenborough describes the severity of the impact of industrial fishing on the climate by remarking that „[t]he trawlers tear the seabed with such force that their trails of destruction can be seen from space".[20] Here, satellite images of the climate crisis underscore the violence conducted through industrial fisheries on the

14 Schrogl/Williamson 2010: 61.
15 Kessler/Johnson: 2010: 7.
16 Durrieu/Nelson 2013: 9.
17 Lorenzen 2011: 146.
18 Wittgenstein 1984: 209.
19 Daumal 1992: 14.
20 Ocean 2025.

ecosystem of the ocean. The all-encompassing nature of anthropological intervention is felt most by, quite literally, seeing the entire globe. From the hole in the ozone layer to the global change of color of coral reefs, what can be individualized and reduced to its local impacts in the close-up, can be quantified and observed as a whole, showing both the severity of the damage – and the necessity to act.

But while satellite imagery is often conceptualized as a tool of seeing ourselves, a „project of self-knowledge“[21] – as Carl Sagan puts it: „That's here. That's home. That's us.”[22] – the distance distorts. Even with this incorporation of ontological reflection and fundamental re-positioning of humankind through satellite imagery, their epistemological value does not automatically create orientation patterns for collective global action. Satellite imagery that shows the melting ice of glaciers previously taken as a natural border between countries provokes renegotiations of the delimitation between countries due to climatological changes. Yet, this single frame captured by satellites is not accordingly transferred into the discourse of modern world's international law and thought. The epistemic insights seem to be perceived as something outside from the very complex interplay of economies, political and publics on global scales that manifest modern capitalism[23], instead of disruptively re-directing actions for better outcomes in face of global climate change. Sophia Engelmann observes, “this universalising [sic!] of experience through a claim to wholeness and unity evacuates the possibility of a critical climate imaginary“.[24] Instead of resolving the ever-lasting tension between universal postulations and partial interests, climate-technological images like earth observation are produced and interpreted within certain socio-cultural embeddings of presenting a promise of a full picture which it cannot fulfill.

The distortion is also temporal in nature. Gitte Du Plessis stipulates that „In this time, our time, the legacy of human activities is profoundly altering geologically significant processes on the planet, with resulting changes in climate, erosion, and the chemical composition of oceans, soils, and the atmosphere“.[25] Indeed, the ubiquitous availability of satellite data, with contemporary global revisit periodicities providing the possibility to image the earth every few days, serves as a “uninterrupted data archive“, a chronological documentation of this destruction since the operationalization of the LandSat programme in 1972.[26] The quantifiability of the changes in the earth system, "[t]he magnitude of the space enterprise[,] seems to me beyond dispute".[27] But the magnitude can also serve as an inhibitor to political action. With over 100 terabytes of images being produced every day, as summarized

21 Eyres 2017: 5.
22 Sagan 1994: 12.
23 Beckert 2024: 45.
24 see in: Engelmann et al 2022: 240.
25 see in Walker et al 2018: 102.
26 NASA Landsat Science.
27 Arendt 1968: 51.

by John Naisbitt and often reiterated by space practitioners, „[w]e are drowning in information but starved for knowledge".[28] as the analytical processing of the provided data both overwhelm and obfuscate. It seems easy to feel alienated from the ever-growing data charts and climate models announcing devastating change in ever-incremental intervals observed by a space-based Panopticon. It seems even more easy, then, to look away.

3. AI and climate crisis – calculating materiality and materiality costs

Applications and systems based on AI technology that produce images of climate crisis can be seen as another climate-technology that represents thought and practice of a computerized world. Further, it strikingly symbolizes the progression towards future imaginations of societies and human kind. The umbrella term AI is used ubiquitously and broadly describes computers and machines that are able to do tasks comparable to human perception, reasoning, and decision-making. Especially in recent years generative AI received a lot of attention due to its striking capabilities in meaning production. Following the conceptual framework of Paolo Bory and colleagues,[29] both academic and public discourses seem dominated by strong AI narratives, that promote AI as super-human technology and not by weak AI narratives, namely single, situated cases of AI appliance and use. Referring to images of climate crises, it seems worth mentioning that in relation to climatological topics, AI is often taken as a self-evident key for sustainability, a tool to adequately adapt already established processes to new sustainability standards. Once more without disruptive character, AI-system´s predicted capabilities for calculating endless amounts of data and instead activate an out-of-focus future vision, which, against the used semantics, does not develop holistic approaches in which climate issues are solved by AI-driven systems. Within the framework of strong and weak AI narratives, the authors point out that strong AI narratives in general seem far more prominent than weak AI narratives.[30] Transferring the observation made by Bory et al. (2024), AI-technologies in this context seem to be debated as to-be-solution beyond human capabilities and sociopolitical context factors (strong AI) instead of narrow applications to solve climate change issues of certain matters (weak AI).

One example of its application can be seen in disaster preparedness. GenAI methods can produce fictitious satellite imagery for sketching potential floodings that is meant to offer decision makers and publics descriptive visualizations. As this application seems attainable for critical evaluations to support anticipatory agency, in some instances its hallucinations, seemingly incorrect visualizations of flooding

28 Naisbitt 1982: 6.
29 Bory et al 2024: 3.
30 ibid: 4.

fitting the statistical calculations of GenAI but not geophysical circumstances, did not match realistic estimations of flood flows, e.g. due to higher elevation of certain areas.[31]

Similar to satellite technology, AI-driven technologies interrelate to human and natural environments on more dimensions than just through the production of climate crises imagery. To say AI systems are inherently connected to climate change could strike one as speculative statement. Based on large amounts of data, probabilistic models driven by AI technology are used for calculation, modelling and prediction of weather events, conditions of ecosystems and changing climatic conditions. Smart-Grid systems of renewable systems and weather forecasts are extended by big data driven models with an ever-extending ambition for higher precision and reliability. Next to this epistemic value and data gathering for intersecting disciplines and sectors, recent research discloses the material effects of AI technology and its impact on discourses related to sustainability.

Prominently, Kate Crawford amends in *The Atlas of AI: Power, Politics, and the Planetary Costs of Artificial Intelligence* the costs of natural resources caused by AI-driven technology by costs of work, privacy and freedom.[32] Sophie Falk and Aimee van Wynsberghe provide an overview of the growing corpus of literature based on the linked keywords 'artificial intelligence' and 'sustainability'.[33] Among other things, the authors noticeably differentiate the concepts of 'sustainability of AI' from 'sustainability for AI'.[34] In the field of computer science, Roy Schwartz and colleagues suggest the labels of RedAI and GreenAI that mark increasing use of resources due to necessary computing time, which besides ecological effects also opens up questions for the computer science community on the possibility to participate in their own field.[35] Regarding discursive formations, Emily West investigated corporate promises, in this case Amazon´s Climate Pledge, as a form of public relations and the related governing infrastructure of distribution platforms.[36] Lately, along the rise of AI driven systems in almost any field of research, any sector of economy and its consequent prominence in public and private debates, more information on rising emissions of Internet-based technology and particularly the carbon footprint of AI is available.[37] It is crucial to bring attention to the material foundations of AI-driven technology, as more and more sources point towards the environmental consequences of larger data centres for ever improving AI tools, namely energy consumption, e-waste and emissions. This type of research seems to be latent to the AI hype, that often positions AI technology as a one-fits-all solution for any type of problem or setting.

31 Climate Portal 2024.
32 Crawford 2021: 30.
33 Falk/van Wynsberghe: 1347.
34 Ibid: 1351.
35 Schwartz et al 2024: 58.
36 West 2023: 273.
37 van der Ven et al. 2024: 9.

Situating the uses of AI further within critical discourse, latest media theory can undoubtedly provide productive insights. For example, Angus Siobhan argues for a new material history of photography in *Camera Geologica*. In her book, she contributes to media history by following the materials that are needed for photographic processes.[38] Next to convincingly tracing the relation between materiality, representation and visual form, this serves as further inspiration to keep in mind the reciprocal relationship between research and development of AI technology and its material links. Even though this is not a call of any sort to technological essentialism, this perspective places much more emphasis on the very specific socio-material constellations in which technical objects are used. Media scholar Tobias Matzner highlights the materiality of *Algorithms* by taking the situatedness of users, programmers hardware and software into account:

> neither the user nor the programmer is "closer" to the "reality" of the file. Rather, both are differently situated. What is often termed as proximity to some "real" material substrate pertains to the difficulties in relating one form of situatedness to the other.[39]

For evaluating and reflecting AI-driven systems as climate-technology, this conceptualization of situatedness is central to find not only solutions possible through state-of-the-art technology, but even more important to strive for desirable futures. Sceptical views, however, criticize solutionist accounts promoting AI as a tool equal to a holistically operating quick fix for climate issues. Following the ambivalence of images of climate crises, it seems only plausible to heavily doubt that one single technology could serve as an integral, wide-ranging solution without any complications. To search for specific use cases and cross-learning appliances seems much more productive in this regard instead of following the promise that AI-driven technology will solve present and future problems. Rather than artificial intelligence being considered as some embodiment of techno-scientific progress itself, one could advocate for AI technology that enables the exploration of possible futures out of distinctive learnings about climatical development and adoption scenarios.

4. Images without imagery

In sum, these climate-technological producers of images of climate crisis can be characterized by two factors: First, seemingly inexhaustible amount of epistemic material, and secondly, the evaluation of their ecological usefulness in contrast to the material use and ecological harm their development and usage imply. Now, what would be missing in order to act adequately on the growing danger of climate change with the climate-technological tools of satellite imagery and AI models? So far, these climate images producers can visualize and calculate both current and

38 Siobhan 2024: 4.
39 Matzner 2024: 60.

potential scenarios of climate change in molecular detail. Being deeply integrated into the (Western) logics of modernity, these media epistemologies align with specific socio-technical imaginaries, a concept prominently introduced by Sheila Jasanoff and Sang-Hyun Kim as "collectively held, institutionally stabilized, and publicly performed visions of desirable futures, animated by shared understandings of forms of social life and social order attainable through, and supportive of advances in science and technology".[40] The crux here for media epistemologies discussed earlier is that imaginaries of Earth observation technology, respectively of advances in artificial intelligence, ambivalently impact social life and social order. While they stabilize perpetual modes of governance and thought, they seem rarely applied for speculative, non-linear futuristic accounts of exploration that integrate their ecological harm. To point out missing climate imaginaries for these media epistemologies is not say to abandon them, but to search for their deliberative, ethical and case-specific usage.

The idea that "any action is harmful" can be found in macro socio-economic analyses, sceptical realists like German sociologist Jens Beckert critically sketch economic growth and energy consumption as inherently linked.[41] Accordingly, dislocating the material effects of capitalistic wealth aggregation is a key process[42] of modern capitalist societies to such an extent that today´s actors in economy, politics and societies are hardly able to act and think beyond growing markets, growing consumption and growing use of natural resources[43] – including actors who promote and rely on space observation technology and AI-driven systems. Combined with the ascribed progression in science and technology and even after years of awareness raising, designs and formulations of desirable futures in face of the epistemologically approachable dangers and risks due to climate change are yet missing. At the same time, aggregative practices are replicated in both examined technologies, with both an increasing launch of satellites and explosive development of AI technologies outpacing the application of its produced results.

To some extent, socio-political backlash based on misappropriated interpretations of images of climate crises can observed, e.g. when political actors distract from their own responsibilities by redirecting blame towards any other actors. More crucially, the above discussed media epistemologies seem rarely discussed openly and critically. Nor do they seem to be activated for adaptive and unconventional strategies that reach beyond the continuation of extractive behavior that modern science and technologies customary provided the tools for. The given tools for the production of images of climate crisis – extra-terrestrial satellite imagery-based calculations on the one side, AI model-based calculations on the other side – have been used within the logical frameworks they are developed in. Socio-technological

40 Jasanoff/Kim 2015: 4.
41 Beckert 2024: 100.
42 Ibid: 42.
43 Ibid.

imaginaries can be distinguished from ideology[44], nevertheless the "ideological doctrines of disembodied scientific objectivity"[45] seem to replicate themselves within the context of the climate crisis. The enormous amount of data that is available to understand single events and larger developments related to climate change did not lead to uniform and holistic political action. The clarity of said fact is as surprising as it is frustrating. Given the environmental impacts of both technologies, this reality needs to be adequately reflected in the development and advancement of both technologies in the pursuit of climate change mitigation and adaption. What – in climate policy and beyond – is perceived as a natural progression to socio-technological progress is rather an active act of futures creating within such a socio-technological context. Political work with images of the climate crisis requires an active emancipation from the former and an open recognition of the latter.

5. Conclusion

Satellite imagery in fact contains the potential for (self-)knowledge about human and ecological relations, undoubtedly this opens up the potential for collectively held reflections as guidance for conjoint actions. AI-driven technology provides the heuristics that combine previous techno-scientific attempts to capture the experienced world, it therefore certainly also integrates the contradictions and injustices the modern modes of thinking created. However, sensitivities of agency, scales and time seem more than evident. As shown, trusted media epistemologies come with their own pitfalls that re-evaluate the status of satellite imagery and AI-driven systems as clean solutions of climate change. The astonishing ways in which images of climate crisis are produced are misleadingly taken as answers, as they firstly have an ambivalent position in all of this, and, secondly, solely lead to starting points for productive climate imagination.

Facing these arrangements of media epistemologies within the contradictions of modernity, this is not at all a call to stop searching for ideas and solutions to the far-reaching problems and risks caused by a global ecological state of emergency. However, it requires a "coherent sense of the broader problems and patterns that enable us to see why some details and specificities might be more significant than others"[46], which needs to be explicated across disciplinary thought to ensure effective action on the basis of what the images of climate crisis grasp and how they are produced.

Being aware of historical caesura and present contradictions, for the future it will be crucial to evaluate what humankind decides to strive for as desirable futures. As in the sphere of science, the epistemological tools of climate crisis imagery are given to

44 Jasanoff/Kim 2015: 20.
45 Haraway 1988: 576.
46 Walker et al 2018: 89.

engage with the challenges of triple planetary crises, both cultural engagement and political decision-making have to adequately catch up to "realign the practices and contexts of science production",[47] that facilitate the images of climate crisis. We follow Birgit Schneider's hypothesis for climate imagery. Schneider sees these current developments more as a problem of imagination rather than a problem of representation.[48] Accordingly, she promotes modes of anticipatory, productive future imagination that persists of more (heterogenous), less (overly promoted and sterotyped) and new, recombinded images.[49] Further, as we would argue, such alternative images of climate crises take into account global vulnerabilities within these visions on how the world could and ought to be. We emphasize situated, anticipatory, and ethically grounded climate imaginaries to enable images of climate crises based on satellite observation technology and AI-driven systems to disrupt customary modes of thought and to promote the development of desirable future vision guiding collective political actions.

47 Yusoff & Gabrys 2011: 518.
48 Schneider 2018: 43.
49 Ibid: 390f.

Bibliography

Arendt, Hannah (1963): "Man's Conquest of Space". In: The American Scholar 32.4, pp. 527–540.

Beckert, Jens. (2024): Verkaufte Zukunft: Warum der Kampf gegen den Klimawandel zu scheitern droht. Neue Ansätze zu einer realistischen Klimapolitik. Berlin: Suhrkamp.

Bory, Paolo/Natale, Simone/Katzenbach, Christian (2025): Strong and weak AI narratives: an analytical framework. AI & Society 40, pp. 2107–2117

Climate Portal (2024): "New AI tool generates realistic satellite images of future flooding", last accessed on 29.08.2025 via: https://climate.mit.edu/posts/new-ai-tool-generates-realistic-satellite-images-future-flooding

Crawford, Kate (2021): Atlas of AI: Power, Politics, and the Planetary Costs of Artificial Intelligence. New Haven: Yale University Press.

Daumal, René (1992): Mount Analogue: a novel of symbolically authentic non-Euclidean adventures in mountain climbing. Boston: Shambhala.

Durrieu, S./Nelson, R. F. (2013): Earth observation from space – The issue of environmental sustainability. Space Policy, 29(4), 238–250.

Engelmann Sasha/Dyer, Sophie/Malcolm, Lizzie/Powers, Daniels (2022): "Open-weather: Speculative-feminist propositions for planetary images in an era of climate crisis". Geoforum 137, pp. 237–247

Eyres, Henry (2017): Seeing Our Planet Whole: A Cultural and Ethical View of Earth Observation. Cham: Springer.

Haraway, Donna (1988): Situated Knowledges: The Science Question in Feminism and the Privilege of Partial Perspective." Feminist Studies, 14, 3, pp. 575–99.

Jasanoff, Sheila/Kim, Sang-Hyun (2015): Dreamscapes of modernity: Sociotechnical imaginaries and the fabrication of power. Chicago: The University of Chicago Press.

Lorenzen, Dirk H. (2011). Mission Earth: Our planet explored by satellite = Mission Erde : Satelliten erforschen unseren planeten = Mission Terre : Les satellites explorent notre planète = Misión: La Tierra : Los satélites exploran nuestro planeta (M. Garrard, M. Pontone & P. Díaz-Aller, Trans.). Potsdam. Ullmannn

Lütjens, Björn et al. (2024): Generating Physically-Consistent Satellite Imagery for Climate Visualizations. Transactions on Geoscience and Remote Sensing, vol. 62, pp. 1-11

Matzner, Tobias (2024): Algorithms: Technology, Culture, Politics. London: Routledge.

Naisbitt, John (1982): Megatrends: Ten New Directions Transforming Our Lives. New York: Warner Book

NASA Landsat Science. "Data". last accessed on 27.08.2025 via https://landsat.gsfc.nasa.gov/data/

Ocean with David Attenborough. 2025, Nowlan, Toby/Butfield, Colin/Scholey, Keith. 95 Min.

Rapp, Lucien (2025): The Spationary. A dictionary of essential space terminology for lawyers. Leiden: Brill/Nijhoff.

Reinecke, David (2021): When funding fails: Planetary exploration at NASA in an era of austerity, 1967–1976. Social Studies of Science. 51(5), pp. 750-779.

Rheinberger, Hans-Jörg. (2001): Experimentalsysteme und epistemisches Ding: Eine Geschichte der Proteinsynthese im Reagenzglas. Göttingen: Wallstein.

Ross, Martin., Toohey, Darin/Peinemann, Manfred/Ross, Patrick (2009): "Limits on the Space Launch Market Related to Stratospheric Ozone Depletion". Astropolitics, 7(1), pp. 50–82.

Sagan, Carl. (1994): Pale Blue Dot: A Vision of the Human Future in Space. New York: Ballantine Books.

Schneider, Birgit. (2018): Klimabilder: Eine Genealogie globaler Bildpolitiken von Klima und Klimawandel. Berlin: Matthes & Seitz.

Schwartz, Roy/Dodge, Jesse/Smith, Noah/Etzioni, Oren (2020): Green AI. Commun. ACM 63, 12.

Sontag, Susan (2005): On Photography. New York: RosettaBooks

van der Ven, Hamish/Corry, Diego/Elnur, Rawie/Provost, Viola Jasmine/Syukron Muh (2024): Generative AI and Social Media May Exacerbate the Climate Crisis. Global Environmental Politics 2024; 24 (2): pp. 9–18.

West, Emily (2023): Decoding Amazon's Climate Pledge-Public Relations and the Platformization of Governance. in: Smith, Paul/Manea, Alexander/Santiago, Maillim (2022): Amazon's Climate Pledge - Amazon at the Intersection of Culture and Capital. Dublin: Bloomsbury, pp. 269-285

Walker, R. B. J/Shilliam, Robbie/Weber, Heloise/Du Plessis, Gitte (2018): "Collective discussion: Diagnosing the present". International Political Sociology 12/1 (2018): pp. 88-107.

Wittgenstein. Ludwig (1984): Über Gewißheit. Suhrkamp: Frankfurt am Main.

Yusoff, Kathryn/Gabrys, Jennifer (2011): Climate change and the imagination. Wiley Interdisciplinary Reviews: Climate Change, John Wiley & Sons, 2(4), pp. 516-534.

Zisk, Rachel (2023): "The Space Industry's Climate Impact: Part 2." last accessed on 14.11.2025 via https://payloadspace.com/the-space-industrys-climate-impact-part-2/