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Shifting surface: satellite imagery of the Arctic Sea ice and climate change discourse

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Abstract: This research explores how satellite images of Arctic sea ice contribute to climate change discourse. Different discourses require distinct responses. Policy measures are contingent upon representation, be it i.e. a threat or opportunity. The representations discussed are by the NSIDC and NASA, which hold a visual hegemony. First, the introduction discusses visual studies in policy research and identifies a simplified dichotomy of a threat discourse and environmental citizenship. Moreover, the methodology of visual discourse analysis based on poststructuralism is described. The delineated images portray a vertical, planar view allowing for spatial reference. Arctic sea ice is a visible climate change effect and the absence of boundaries, intervisuality with the Earthrise icon and focus on environmental effects support a discourse of citizenship.

Keywords: Climate change communication; Environmental visuality; Arctic Sea ice; Visual discourse analysis.

Superfície instável: Imagens de satélite do gelo do Oceano Ártico e o discurso sobre as mudanças climáticas

Resumo: Esta pesquisa explora como as imagens de satélite do gelo do Ártico contribuem para o discurso das mudanças climáticas. Discursos diferentes requerem respostas distintas. As medidas políticas dependem da representação, seja uma ameaça ou oportunidade. As representações discutidas são do NSIDC e da NASA, que mantêm uma hegemonia visual. Primeiro, a introdução discute estudos visuais na pesquisa de políticas e identifica uma dicotomia simplificada de um discurso de ameaça e cidadania ambiental. Além disso, é descrita a metodologia de análise do discurso visual baseada no pós-estruturalismo. As imagens delineadas retratam uma vista vertical e plana, permitindo referência espacial. O gelo do mar do Ártico é um efeito visível da mudança climática e a ausência de fronteiras, a intervisualidade com o ícone Earthrise e o foco nos efeitos ambientais apoiam um discurso de cidadania.

Palavras-chave: Mudança climática; Comunicação; Visualidade ambiental; Gelo marinho do Ártico; Análise do discurso visual.

And the question of what kind of staging, indeed 'visualization', is necessary and possible in order to overcome this abstractness and render climate change and its apocalyptic consequences 'visible' is particularly urgent.
Ulrich Beck (2009: 83)

Introduction

Various actors of global politics have placed climate change high on their agenda. It is recognized that Arctic sea ice serves as an early harbinger of climate change (OECD, 2008: 60; IPCC, 2014), where "if we wish to understand [...] green issues we must also understand how these discourses are realized visually." (HANSEN; MACHIN, 2008: 777) Therefore, this research explores *how satellite images of the Arctic sea ice cover contribute to climate change discourse*.

To reveal valuable insights, sub-questions enquire what images of the ice cap have been applied and in what context. Importantly, neither global temperatures nor future scenarios of global warming[1] can be experienced or seen, making climate change an invisible phenomenon. To better communicate their findings, scientists, policy makers and activists have primarily pointed to visual media to communicate their intricate findings. In fact, visual representation helped to bring climate change to the fore in the first place. In 1996 the US publicized much of its satellite material, where the "declassification of these images - specifically those that showed contractions in the polar ice sheets - provided scientists with a form of environmental visualization that proved vital to [...] scientific consensus about global climate change." (CARRUTH; MARZEC, 2014: 205) Although a shifting surface of the Arctic sea ice causally correlates with climate change, scholars have not specified what kind of discursive meaning images of this phenomenon portray.

[1] For conceptual clarity and better readability, the terms *global warming* and *climate change* are applied interchangeably throughout the text.

The United Nations Framework Convention on Climate Change (UNFCCC) identifies Arctic sea ice as one of 34 "essential climate variables." (OECD, 2008: 75) This text argues that the sea ice cover of the Northern pole cap is predominantly visualized through satellite data. Furthermore, it maintains that "environmental visualizations are political and politicized." (CARRUTH; MARZEC, 2014: 207) Thus, findings about the visual discourse of Arctic sea ice decline bear relevance since different discourses of climate change impacts require distinct political and economic responses. Policy measures are contingent upon the representation of the issue, be it for instance a threat or an opportunity.

Answering the research question entails a structured process with five parts. This introduction exemplifies the importance of visual studies and provides a literature overview. Additionally, two distinct visual discourses of global warming are identified, namely the representation as a threat and a discussion of ecological citizenship. Furthermore, the methodology of visual discourse analysis based on a poststructuralist pillar is introduced. The second part delineates the images for analysis, their sources, and shortly assesses the medium of remote sensing. As will be shown, two satellite images by the National Snow and Ice Data Center (NSIDC) and the National Aeronautics and Space Administration (NASA) feature Arctic sea ice decline most prominently. Subsequently, the analysis looks at compositional features and the denotation of the images and the two climate change discourses are juxtaposed. The fourth part discusses how Arctic sea ice representation contributes to climate change discourse. At last, the conclusion summarizes the findings and encourages further research.

To reiterate, global warming as a long-term process cannot be seen and is mainly a future scenario, hence leading to scientifically constructed knowledge that

largely manifests in visual representations (SCHNEIDER; NOCKE, 2014: 12). Others have argued from a behavioural science perspective that *seeing* climate change is central to *knowing* about it (SHEPPARD, 2012: 78). Indeed, scientific research and public resonance alike have contributed to a vast body of global warming images. The reports of the Intergovernmental Panel on Climate Change (IPCC) contain a plethora of info-graphics, maps and other visual media; books accommodate climate change imagery; popular fiction like *The Hunger Games* and *Avatar* are linked to global warming; and prize-winning movies such as Al Gore's *An Inconvenient Truth* transport the issue into living rooms. Due to the sheer quantity and the socio-political effects, it is indispensable to critically examine climate change imagery. In fact, "[i]mages in the Anthropocene become a crucial way of detecting climate change, hence it is necessary to pose questions regarding their reality and construction." (SCHNEIDER; NOCKE, 2014: 23)

Nevertheless, climate change visual studies constitute a rather novel field. A recognizable amount of literature has focused on the communication of climate change impacts. Julie Doyle (2007) wrote an influential article on the visual communication techniques of Greenpeace, while also discussing the problem of imaging a future scenario. In this regard, O'Neill and Hulme (2009) argued for an iconic approach to engage the public and facilitate cognition change. Allegedly, melting glaciers and polar bears surrounded by ice constitute the most eminent climate change icons (MANZO, 2010a). In his book *Visualizing Climate Change,* Sheppard (2012) likewise discusses the wider public reception of global warming. Hence, one aspect of the debate has focused on how to best mediate the technical findings of climate science to a lay audience. There has also been increased scholarly interest in scrutinizing specific visual representations, their structure and reception. A popular example is the iconic polar bear on an ice floe (cf. TOLLMANN, 2014; MANZO, 2010b). Taking the literature into account, the debate has further implicitly or explicitly suggested different discourses of climate change.

This research identifies a simplified matrix of a 'threat discourse' of climate change on the one hand and a more positive 'ecological citizenship' on the other. A similar distinction was suggested by Manzo (2010b) who contrasted a fear laden imagery of climate change with more inspirational, positive alternatives. Certainly, this is not a finite list. Other climate change discourses include *inter alia* a critique of the capitalist world order (cf. KLEIN, 2014) and discussion of vulnerability and climate injustice (MANZO, 2010a). Notwithstanding, the dichotomy of threat discourse and ecological citizenship has featured most notably.

The predominant way to depict climate change has been in terms of danger, disaster, risk, catastrophe and apocalypse, briefly summarized as *threat discourse*. The media, policy-makers and institutions alike have fostered fear-inducing representations and continue to largely frame climate change as a threat (cf. O'NEILL; NICHOLSON, 2009: 358f, PAINTER, 2013). Common features of the threat discourse include a (visual) language of catastrophe, the depiction of danger and security issues, a threatening other, and a risk to one's well-being. In his book *Climate Change in the Media* Painter (2013) deduced that a disaster discourse constitutes the overwhelming majority of global warming reporting.

Similarly, Sheppard (2012: 66) claimed that the coverage of climate change effects has been dominated by 'damage reports' and projected catastrophes. Increased extreme weather events and unprecedented changes in the natural environment lead to a "doom and gloom" discourse, with devastating implications for ecosystems and human welfare. Similarly, Swyngedouw (2010) claimed that visual climate change discourse has focused on transmitting an

apocalyptic message. Many scholars of climate change visuality appropriate the imagery in a discourse of risk, where climate change is portrayed as a potential threat and destabilizing factor (cf. DOYLE, 2007, O'NEILL; HULME, 2009). Lastly, there exists a body of literature about the securitization of climate change, inspired by the Copenhagen School. Arguably, global warming is contextualized in security claims and language. Recently, Rothe (2015) elaborated on the visual securitisation of climate change by remote sensing technology. Purportedly, imaging global warming holds surveillance and other security features.

A second discourse has been one of ecological, or environmental, citizenship and cosmopolitanism. Lester and Cottle (2009: 922)) found that visualising the consequences of climate change and symbolism thereof are crucial for constructing a global consciousness and eventually a sense of ecological citizenship. Empirical studies have shown that visual representation of the environment largely resonates cultural meanings of 'community', 'nature' and 'tradition'. Socially reverberating and spectacular images that reference symbols such as the globe and distressed communities construct a discourse of environmental responsibility and citizenship. Moreover, the authors explored how the media co-constituted *global* warming as a universal issue outside of national boundaries.

Arguments may also be borrowed from Ulrich Beck's (2006) *Cosmopolitan Vision*, where he stressed that people increasingly "experience themselves as parts of a [...] society characterized by the simultaneity [...] all over the world" (ibid.: 42). This way, national borders are rendered progressively insignificant and global commons are constructed. Narrow patriotism is superseded due to the simultaneity of global events, a cosmopolitan empathy and the unprecedented information flows. Because of the interdependency of the climate system, global warming represents an inherently planetary phenomenon that is not conceptualized in national terms (BECK, 2006: 2-10).[2] In a related discourse, Szerszynski and Urry (2006) argued that the shift towards a cosmopolitan understanding of place means that people increasingly populate the world at a distance and through cartographic apprehension of locality. They indicated that visuals play a crucial role in constructing a discourse of planetary environmental citizenship and awareness. This emergent, spatially dispersed cosmopolitanism comes in a context of increased capacity to consume many places through media. People are imaginatively transported around the globe through images of distant peoples and places (ibid.: 115f).

[2] Naturally, this very brief description of Beck's theorisation does injustice to his elaborate work. However, it suffices to show that cosmopolitanism serves as a theoretical underpinning for ecological citizenship.

In his book *Citizenship and the Environment* Dobson (2003) found that ecological citizenship lies within a (post-)cosmopolitan framework and stressed the interconnectedness of people and political issues in a globalising world. Interestingly, he introduced global warming as engendering non-reciprocal obligations to the cosmopolitan environment. Thus, ecological citizenship entails to act locally on behalf of the global environment, stretching responsibility and sense of belonging beyond our locality (DOBSON 2003: 208f). This is enabled through discourse, global imagery and communications media that re-embed far-away conditions and experiences in divergent receptive audiences (SZERSZYNSKI; TOOGOOD, 2000). The stock of global imagery is further deployed to call attention to specific regions, which serves to locate the object of the story. This way maps and satellite images are integrated into the discursive character of drastic change (LESTER; COTTLE, 2009: 926f).

The present research addresses an important gap in climate change visuality. As the European Commission's (2013) space program *Copernicus* points out, "sea ice is a *visible* indicator of climate change" (emphasis added). Yet, a careful analysis and discussion of its visual representation is lacking. The findings are relevant as

satellite imagery of climate change is fundamental to effective policies, and vice versa "government interventions require the abstracted knowledge generated by remote sensing imagery." (ROTHE, 2015: 9)

Considering theory, poststructuralism takes issues of climate change not as primordially given, but constructed through social practices and (visual) language (ROSE, 2012: 189). In ontological terms, objects and events attain meaning only through discursive representation. Epistemologically, poststructuralism assumes representations to constitute our social world. It follows that this research does not aim to reveal an objective and verifiable truth, but to understand social practices and disclose underlying structures. Hence, any image is constituted by a row of interpretive steps of representation. The study of climate change visuality acknowledges the "invisibility" of global warming rendering its visualization a product of social practices. For instance, Schneider and Nocke (2014: 14f) express climate change imagery to be an issue of imagination rather than representation.

The research is concerned with the social modality of the image site and borrows from Gillian Rose's (2012) work on *Visual Methodologies*. After thorough contemplation, the Foucauldian-inspired qualitative method of visual discourse analysis makes the main methodological pillar. Equally to text, images can be seen as groups of statements that structure thinking; they produce forms of knowledge and occupy a social space. For instance, we know about the decline of sea ice in the polar region through remote sensing, where its construed pictures appear in a certain setting. A visual discourse analyst is interested in how images construct authoritative accounts of the social world (ROSE, 2012: 136). Discourse analysis further examines how meanings are connected and deconstructs visual regimes of truth (ROSE, 2012: 191). Here, invisibility is as telling as visibility and a product of power struggles. The analysis assesses the visual discursive "assemblage" and asks what is not shown (SHAPIRO, 2013: 4). However, visual discourse analysis makes no static methodology and the image and its details may guide the analysis. In fact, Rose (2012) suggests supplementing elements of semiology, building a "default methodology". This way, an analysis describes an image's denotation and the descriptive level of meaning.

Imag(in)ing Arctic Sea ice

There exist different possibilities to visually represent Arctic sea ice. One image is the iconic polar bear on an ice floe. However, it has earned criticism for being too simplistic, irrational and not conveying climate change awareness. Tollmann (2014) lobbied to abstain from the icon since it is uncanny and overly emotionalized. The image visualizes the humanized suffering of polar bears rather than the decline of sea ice. Another visualization of sea ice is a graph by the IPCC. This scientific illustration lacks aesthetic appeal, however, and has not featured notably in public discourse. As Rose (2012: 193) points out, sometimes "only an audience of scientists [is] capable of seeing such images." The discursive power of an image is conditioned by its reception. Hence, it is defensible to neglect these visualizations of Arctic sea ice and scrutinize satellite imagery.

This research analyses satellite images, given that scholars "consider satellite systems [...] as an important component of a critical communication- and information-based infrastructure for modern societies." (OECD, 2008: 3) The polar regions are remote and inaccessible, leading to satellites offering the primary way of comprehensive observation and visualization (EUROPEAN COMMISSION, 2013). Amongst others, remote sensing can cover a grand geographic scope - Arctic sea ice stretches between four and fifteen million square kilometres. Naturally, different countries run satellite programs and apply

remote sensing technology. Currently, the World Meteorological Organisation's observing system comprises several polar orbiting (e.g. MetOp) and geostationary satellites from various states (OECD, 2008: 115). In 2010 the European Space Agency (ESA) installed CryoSat, which is devoted to monitoring Arctic sea ice (COPERNICUS, 2013). Nevertheless, there have emerged hegemonic US-American visualizations as evidenced by their use in UN documents and the media[3]. Accordingly, this text analyses these widely published images from the NSIDC and NASA. They possess a monopoly of long-term Arctic sea ice data due to the US Landsat program.

[3] For a discussion of US space hegemony see DeLoughrey (2014).

Figure 1, referred to as image 1 hereafter, illustrates the NSIDC visualization of the Northern ice cap, which relies on "NASA-developed methods using passive microwave data from the Defense Meteorological Satellite Program" ("ARCTIC…", s.i.). While it is not very aesthetically appealing, it features most prominently in international reports and Google (2015) bases its site "Arctic Sea Ice Graphs" on NSIDC data and this visualization. The second image (Fig. 2 or 'image 2') is produced by the Scientific Visualization Studio of the NASA Goddard Space Flight Center. It has featured prominently in the media. Furthermore, this research uses the illustration as representative of congruent visualizations such as the *NASA Climate Machine* and ESA images.

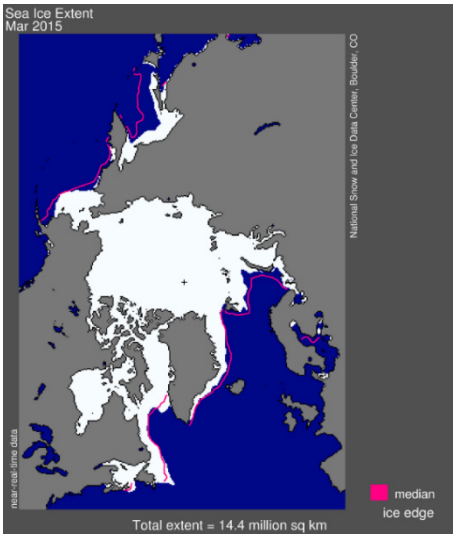

Figure 1. Visualization of the Arctic sea ice by the NSIDC. For the analysis in this text it is labelled "Image1".
© National Snow and Ice Data Center

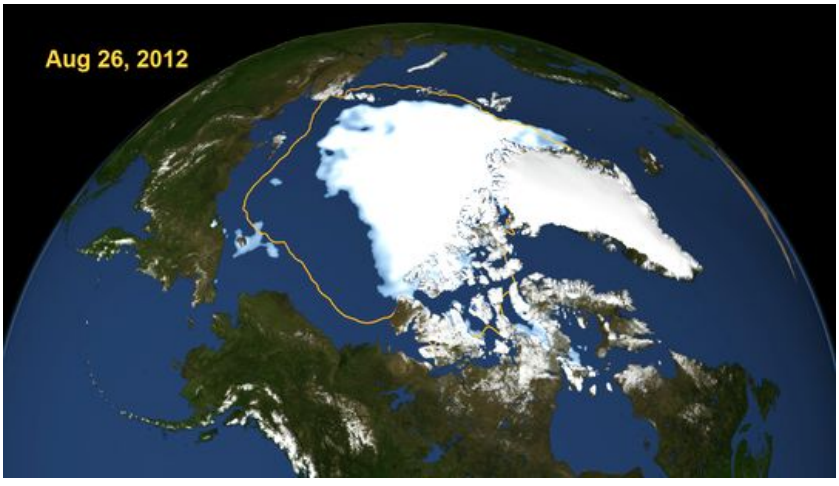

Figure 2. Satellite visualization of the Arctic sea ice with the average extent of that day in a yellow line. For the analysis in this text it is labelled "Image 2".
© Scientific Visualization Studio, NASA Goddard Space Center

Clearly, the visualizations are not satellite images in the literal sense and as commonly perceived, in that they represent a photograph taken from space. As Campbell (2008: 20) foregrounded, no satellite image is an unprocessed depiction of the earth's surface. Appearances, be it the blue globe or white ice sheets, are the result of measuring different bands of wavelengths, digital enhancing and bear no resemblance to the classic notion of 'shutter photography'. Scott (2012) described how the NSIDC creates image 1 from satellite data, cautioning that actually no satellite orbits the North Pole. The institution has no data of 88°N upwards and simply visualizes white in the assumption the ocean is covered with ice. Still, for the course of analysis both representations are labelled "satellite images" as they rely on satellite data for their visual manifestation.

Satellite images epitomise a mimetic quality in appearing to offer transparent and unmediated viewing. Because of the medium's qualities, its images carry a strong truth claim about a territory. In point of fact, Shim (2014) named satellite imagery to hold 'extra-discursivity'. The orbital gaze reveals social and natural patterns such as ice extent that only become apparent from the distance. "By visualizing invisible phenomena and undetected patterns remote sensing imagery provides a particular knowledge, or truth." (ROTHE, 2015: 8) Similarly, Cosgrove (2001: 257) conceptualized visuals from space as simultaneously true representations and virtual spaces. However, the view from above depicts no geographical reality, but creates with a 'logic of exclusion and inclusion' so-called spatial imaginaries. The current critical approach investigates the constitution of a "regime of truth" and the discursive assemblage. It makes explicit that satellite imaging is always the result of an understanding of what is (not) permitted to representation (SHIM, 2014).

In line with poststructuralist thinking images 1 and 2 hold power of evidence and persuasion. One core function of remote sensing pictures is to "make visible what would be hidden to the human eye otherwise" (ROTHE, 2015: 8), especially in inaccessible regions like the Arctic. With the aid of infrared, microwave and thermal technology, satellite images can additionally make visible chemicals and pollutants such as greenhouse emissions. Thus, they also possess a normative character by advancing climate change discourse and implying a political agenda. "Climate science is the paradigmatic field in which images assume a role as political agents." (SCHNEIDER; NOCKE, 2014: 15). This holds especially true for the remote Arctic, where satellite images render it visible and consequently *knowable* (cf. SHIM, 2014: 159). Again, the discourse analyst is interested in how exactly images construct accounts of the social world and their discursive meaning.

Denotation of the imagery

This analysis does not challenge the scientific substance of the images, but scrutinizes the site of the satellite image itself. Issues of analysis include the composition, perspective, framing and context. This part further assesses commonalities and particularities of the two Arctic visual representations. These insights from the aesthetic approach permit to locate the images in climate change discourse in the subsequent part.

First it is necessary to consider the content and denotation of the images. Both portray the Arctic region, defined as the area above the polar circle 66°32" North. They depict the sea-ice cover surrounding the North Pole centred as a white surface. A pink and a yellow line respectively expose the median sea-ice cover extent of previous decades. The assemblage of visual statements enables to compare the current extent of the ice cap to the accumulated average. This way the demise of the sea ice cover in the High North becomes apparent. Importantly,

in the top left corner the date allows to allocate the visual representations correctly in time. In this sense, it is common to situate the images in comparison with ones from earlier years (see Fig. 3 and 4), or alternatively as a timeline where the white surface is shifting. Hence, the images denote the chronological decrease of Arctic sea ice cover. In this regard, Doyle (2007: 137) states that the "need to visually reference the past [...] is contingent upon the nature of climate change as a future possibility."

While both images illustrate the Arctic from an orbital top-down perspective, image 1 provides an azimuthal viewpoint with the North Pole marked in the centre by a small cross. NASA chose a slight angle for image 2. The vertical, planar view onto the world allows a "spatially consistent referent between visual signs and ground features." (DODGE; PERKINS, 2009: 498). As for NASA's image "(t)he avowedly naturalistic look of the virtual globe shrouded in satellite imagery is beginning to replace the world map of nation-states as the default meta-geography" (Ibid.: 497). Interestingly, no national borders are shown, making Arctic sea ice arguably an issue of global concern. Climate change transcends domestic politics and has been framed a transnational issue. Moreover, the Arctic has long been a *terra incognita* and only satellite images have made this extraterritorial space visible and thereby imaginable.

The perspective is further relevant as the extra-terrestrial satellite view arguably represents the culmination of a rise in concepts of global connectivity. In fact, to imagine earth as a globe is itself a visual act. According to some authors the "satellite planetarity" has emerged from the Cold War, where a discourse of "one world" against nuclearization was initiated (DELOUGHREY, 2014). Similarly, the current aerial view leads to a universal (visual) understanding of climate change. By the same token, Naomi Klein (2014: 286) maintains that the emergence of satellite imagery and the omniscient outside viewer have led to a discourse of an "Earth thing" instead of an "earthy thing".

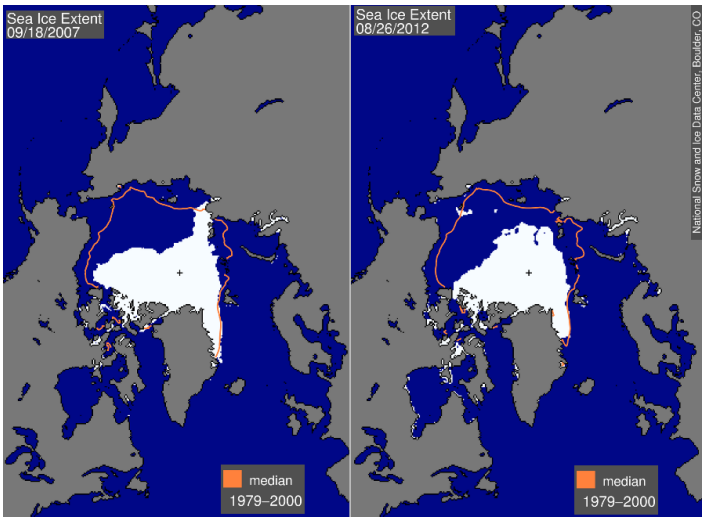

Figure 3. Features of Image 1 include an azimuthal perspective and minimal caption.
©National Snow and Ice Data Center

The pictures of diminishing Arctic sea ice contain representation of territory. The land makes for a common and recognizable feature that enables us to locate climate change and ourselves. Due to the geography and territoriality the viewer sees and thereby knows the state of the polar ice cap, making it easier to categorize global warming. As has been pointed out, satellite imagery has the power to visually reconnect distant territory to people around the world. Another structuring of the satellite data could include "risk colours" such as different shades of red and orange, as has been the case with IPCC climate graphs (MAHONY; HULME, 2014). To invigorate danger and risk with colours is well

known from meteorology and weather forecasts. However, in neither image there is a predominant orange, carmine or crimson red visible.

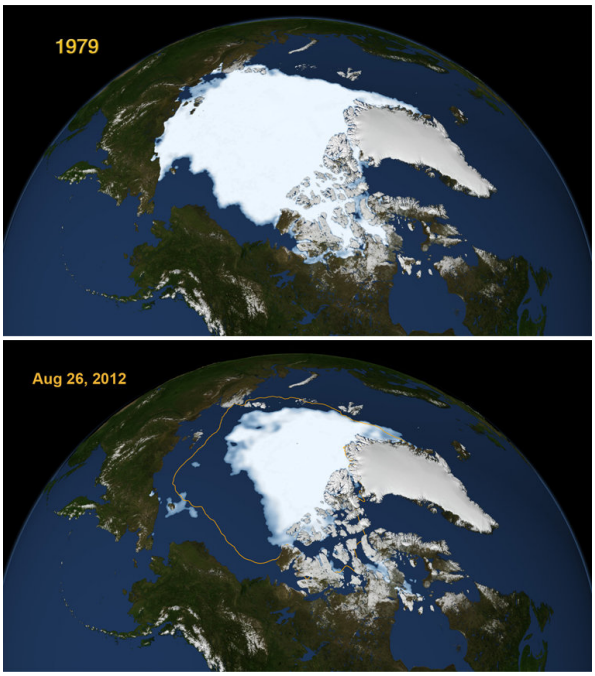

Figure 4. A comparison of the satellite images of Arctic sea ice allows for understanding of climate change as a temporal issue.
© Scientific Visualization Studio, NASA Goddard Space Center)

Indeed, the planetary gaze to visualize the environment has found scholarly resonance. Especially NASA's iconic *Blue Marble* depiction of earth as a fragile ball has been widely discussed (cf. KLEIN, 2014; ROTHE, 2015). The present image 2 relates intervisually to the icon, where the concept of immediacy (HANSEN, 2011, p. 57) argues that visual representation can "evoke an immediate emotive response that exceeds that of text". Indeed, the Blue Marble purportedly generates emotions of care and awe, while supporting imagination about a delicate earth with a coherent ecosystem (SHIM, 2014: 152). Kurt Vonnegut wrote about the first orbital photographs of earth that "[e]arth is such a pretty blue and pink and white pearl in the pictures NASA sent me. It looks so *clean*. You can't see all the hungry, angry Earthlings down there - and the smoke and the sewage and trash." (*apud* KLEIN, 2014: 285)

Considering the logic of inclusion and exclusion and governmental power in construing the image, it is crucial to also assess what is not shown. First, signs of human activity or life are entirely lacking. No cities or other signs of civilization are added to the cartographic images. Neither are the causes of climate change visualized. Undoubtedly, the images would portray a different message if the cause for diminishing sea ice were visible, linking the issue directly with anthropogenic activity.

Furthermore, the Arctic is believed to host a tremendous pool of unexploited natural resources. However, there are no visible signs of an instrumental approach to a diminishing sea ice and business opportunities. Neither oil and gas fields nor continental shelf demarcations, that would guide national exploitation rights, are shown in the two images. The opening of two potentially global shipping lines, namely the North-West Passage and the Northern Sea Route, constitutes another business discourse. Yet, neither the NSIDC nor NASA chose to represent the shipping connections that promise to offer transcontinental shortcuts. What does this framing tell us? The NSIDC and NASA satellite pictures contain a clear and unambiguous focus on Arctic sea ice developments. They

reduce the complexity of one of the most prominent climate change effects. The prevalent narrative tells of a shrinking sea ice surface, where the manifold causes and plausible consequences are excluded.

Visual discourse of climate change and Arctic Sea ice representation

Due to their immediacy and and their constitution as news items, images can generate and contribute to a certain discourse. The (visual) semiology of statements and representations establishes certain meaning. Many scholars of climate change visuality describe the issue in a threat discourse, emphasizing fear-laden imagery, apocalyptic scenarios and the securitisation of climate change. Common features include a (visual) language of catastrophe, the depiction of danger and security issues, a threatening other, instability and a risk to one's well-being. This discursive representation may justify extra-ordinary measures by governmental authorities limiting freedoms and democracy (cf. HANSEN, 2011).

The images at hand denote the decline of Arctic sea ice over the past few years and decades. This by itself does not imply any connotation of catastrophe as neither image illustrates a self-evident threat. While the superlative language of accompanying reports might bear a connotation of unparalleled regional developments, the (con)text does not address disasters and risks. Disastrous consequences of a changing Arctic such as thawing permafrost, changing ocean currents and rising sea levels are not displayed. Moreover, the NSIDC and NASA visual representations abstain from risk colours in different hues of red, orange and. These tones connote emergency and danger, Manzo (2010: 203) even suggests apocalyptic scenarios based on colours. Moreover, the viewer cannot see the causes for a shrinking sea ice surface. A referent object for the purported threat - the link to humans- is missing. Consequently, there is no information about who or what should be threatened and at risk. This may constitute an abstracted danger of satellite imagery because individual suffering and crisis are not shown. However, there is no national or regional reference for a danger or threat, which is especially relevant since most people are not familiar with the geography of the Arctic. In this vein, it is interesting to notice that the "shutter control" remains with governmental agencies, who apparently do not visually securitize Arctic sea ice. Due to the aforementioned reasons, a visual threat discourse of climate change cannot be substantiated in the existing prominent example. No 'other' endangering a nation or specific territory is depicted and immediacy of threat and catastrophe solely on the imagery and context is unlikely.

A second prominent discourse in climate change visuality has evolved around ecological citizenship and underlying cosmopolitan principles. The discourse frames climate change a global issue transcending boundaries and discusses responsibility. As no national borders are shown, the two images may follow Beck's description of domestic boundaries rendered increasingly insignificant in a climate change context. This way, the polar region is framed as a global common rather than a divided nationalized area serving as resource base.

Only very few indigenous groups are Arctic citizens. Yet, by spending significant resources on satellite imagery of the region and scientific visualization thereof, the US governmental agencies imply an intrinsic value of the region outside of the locale. Similarly, O'Neill and Nicholson (2009: 372) found in a UK survey that imagery of melting Arctic ice made respondents rank climate change as important. In other words, the visual representation of a changing Arctic appealed to an audience which had largely never physically been there. While this is not a comprehensive claim that visual representation of Arctic sea ice generates

environmental consciousness, it serves as an indicator. Publishing satellite images depicting climate change possesses a normative character by advancing a certain political agenda, in this case environmental and global awareness. In fact, the orbital gaze bears relevance for more reasons. Allegedly, it has not only catalysed ecology, but also led to environmental consciousness (DELOUGHREY, 2014: 262). Global imagery is broadly applied in daily affairs and Information and Communication Technology, where the globe and maps offer reference points to locate objects of stories in our globalising society. With the two images of sea ice decline in the Arctic, we get to know about a location of global warming. Thus, satellite images are dynamically interpreted into the symbolic discursive constitution of climate change.

Moreover, to understand satellite imagery the viewer must engage with extraterritoriality, where attachment to territory is created at distance. Purportedly, this concept is integral to establishing a meaningful relationship to earth (DELOUGHREY, 2014: 270). Likewise, Szerszynski and Urry (2006) elaborated how we increasingly inhabit the globe at a distance through cartographic apprehension of space. Seeing global warming through an astronaut's view has allegedly translated to local ecological citizenship. The perspective of the NASA and NSIDC imagery further empowers local populations such as Inuit communities, by providing data about their embroilment. Another way to view the images is that the nonappearance of human activity portrays the globe as a coherent whole with value of the land itself.

The presented arguments provide for a cosmopolitan reading of the satellite images, which serves as an underpinning for ecological citizenship. The latter term entails by definition global rights and responsibilities. Global rights are now generally accepted in international politics, whereas it proves more difficult to deduct a human responsibility. While very few people can physically relate to the region, through imagery in mass media and documentaries it is possible to re-embed because of distant viewing. Thus, the visual signs of drastic change and loss in the Arctic may have the social effect of awareness and care, both important building blocks for environmental citizenship.

The image by the NSIDC presents a rather colourless and little aesthetic representation of sea ice decline. The azimuthal perspective and tri-colouration denote a simple message. Thus, the image places weaker in an environmental citizenship discourse since it generates less emotive responses. However, this is different for image 2, which certainly connects intervisually to the iconic Blue Marble depiction of Earth. Its preceding initial photograph *Earthrise* (Fig. 5) from 1968 has been widely analysed in academia.

Figure 1. Earthrise, shot by Apollo 11 in 1968.
© NASA, Wikimedia Commons

To see the fragile earth for the first time floating in black space aided the emergence of transnational environmental conscience in the 1970s and also inspired the annual Earth Day (COSGROVE, 2001; SHIM, 2014).) Although there has been a debate about the emotive consequences of the planetary view there exists consensus about the immediacy of *Earthrise*. Seeing the entire earth small in the wide space leads to an appreciation but also apprehension of the planet's fragile ecosystem and interconnectedness. Image 2 shares many features of the icon and many conclusions drawn from *Earthrise* hold also true for NASA's depiction of Arctic sea ice.

When feeling emotional about or responsible for the earth, as is suggested by image 1 to a small extent and by image 2 significantly, we ascribe value to the land itself. In philosophical traditions, however, it has been established that nothing can bear value outside of anthropocentrism. Thus, it is worth quickly mentioning the thought father of early environmentalism Aldo Leopold (1968). He formed an ethic that "enlarges the boundaries of the community to include soils, waters, plants and animals". His *Land Ethic* changed the role of humans from conqueror of the earth to a part and *citizen* of it. In this regard he affirmed the continued alteration and management of natural resources, though declaring the right of ecosystems to continued existence (ibid.: 204). Naturally, there arise problems with this approach such as how to establish the normative criteria of which ecosystem is worth conserving. Nevertheless, it is relevant to note the construction of one's identity as also encompassing the wider natural environment.

A real-life instance of ecological citizenship and the land ethic can be found in the *buen vivir* (living well) principle. Bolivia passed legislation that grants legal standing to the planet, defined as an indivisible community of all living systems and living organisms. In this sense, ecological citizenship does not replace an attachment to a more localized entity, but adds a layer to our complex personalities. Thus, it is argued that NASA's image especially and the NSIDC visual to a limited extent constitute important visual discourse examples of ecological citizenship and cosmopolitanism in climate change visuality.

Conclusion

A considerable amount of literature argues that global warming constitutes an essential danger to human welfare. This visual threat discourse of catastrophe and dooming apocalypse paints an image of droughts, floods and health hazards swaying the earth. Others have written about an increasing visual securitisation of climate change. Since policy is contingent upon representation of an issue, this discursive depiction may call for extra-ordinary measures that limit freedoms. On the other hand, climate change visuality also generated ideas about ecological citizenship and cosmopolitanism.

In a novel approach, this paper has set out to test the threat and ecological citizenship claims in the case of satellite imagery of Arctic sea ice. This selection is relevant because the sea ice extent of the High North is one of the most visible effects of climate change. For this endeavour poststructuralism provides a valuable pillar because it permits to study the generation of meaning through the representational gap between the signifier and the signified. The medium of remote sensing stands impeccable to visualize the remote polar region since it provides an orbital gaze and synoptic view. The Arctic widely constitutes a *terra incognita* that most spectators get to know through extra-terrestrial visualization methods. Since the start of Landsat satellite observations in 1979 the US-American institutions NSIDC and NASA have acquired a certain visual hegemony

of depicting the ice sheet. One image respectively has been analysed, whereas they stand representative for other satellite images of Arctic sea ice cover.

Both images denote a retreating sea ice surface from an orbital perspective, emphasizing the phenomenon in a climate change context. It is especially telling what the images do not epitomise. Neither visual portrays anthropogenic activity, the causes of climate change or possible endangering consequences of a shifting sea ice surface. Intertextuality with meanings of a more urging nature such as sea level rise and permafrost thawing can neither be identified. In fact, the visual discourse analysis and semiology discussion find that due to the lack of a depiction of risk and catastrophe the imagery does not contribute to a threat discourse. Moreover, the structural absence of human life and national territory representation suggests a connotation of a unitary globe. One cannot deduct a threatening 'Other' that endangers the referent object of the 'Self' (humans). Despite many assertions of climate change as a catastrophic visual scenario, the prominent images at hand cannot validate the claim.

Both pictures are apprehended cartographically which permits to relate to polar ice by departing one's own locality. This way and due to the lack of boundary representation, a connotation of cosmopolitanism is asserted. By consuming an increasing amount of images of the globe we do not only learn about distant places, but also relate personally to them. The extraterritoriality of Arctic sea ice imagery assists in developing emotive responses to global warming effects. Whereas the NSIDC image is spread across scientific and media reports, it holds no strong discursive meaning outside the techno-scientific discourse. By the same token, NASA's image relates intervisually to the iconographies *Earthrise* and *Blue Marble*. The naturalistic view on our fragile planet arguably generates feelings of awe and appreciation. Thus, this image serves as an auxiliary representation for ecological citizenship. Lastly, in an attempt to conceptualize and author new ideas, an ontological link to Aldo Leopold's Land Ethic is indicated which could form a moral basis for valuing sea ice.

Future research may further theorize the role of satellite imagery in generating cosmopolitan ideas and ecological citizenship and shed light into conceptual predicaments. Alternatively, a deconstruction of the site of production at space agencies and their power structures may reveal insights about the framing of environmental issues. In the end, visual representation of the global environment is political. Climate change can be pitted against humans as a threat, or conversely, people can be construed as active agents within.

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