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The Anthropocene and the Aesthetics of Planetary Abstraction[1]

1. A second Copernican revolution

In 1999, climatologist Hans Joachim Schellnhuber, the founding director of the Potsdam Institute for Climate Impact Research and a leading expert in the International Geosphere-Biosphere Programme (IGBP), described a second «Copernican revolution»: five hundred years after the scientific revolution made possible by the optical amplification techniques of the telescope and microscope, satellite images and computer-generated simulations of the Earth system were now able to produce and compile a «planetary inventory» and were starting to effectively visualize patterns of global environmental change (Schellnhuber 1999). According to Schellnhuber:

> This new revolution will be in a way a reversal of the first: it will enable us to look back on our planet to perceive one single, complex, dissipative, dynamic entity, far from thermodynamic equilibrium — the 'Earth system'. It may well be nature's sole successful attempt at building a robust geosphere–biosphere complex (the ecosphere) in our Galaxy, topped by a life-form that is appropriately tailored for explaining the existence of that complex, and of itself.

The introduction to the public of the notion of the Anthropocene in the year 2000 by Nobel Prize-winning atmospheric chemist Paul Crutzen and ecologist Eugene Stormer represented the culmination of a vast and diverse body of scientific research on the Earth system (Ellis 2018; Uhrqvist and Linnér 2015; Waters et al. 2014). The planetary change associated with the notion of the Anthropocene was conceived as the combination of key phenomena affecting the Earth, such as the increase in atmospheric carbon dioxide concentrations and alteration of biogeochemical cycles; deforestation and mass extinction events; human exploitation of natural resources and anthropogenic climate change (Will Steffen et al. 2004; Grinevald 2008). An intense–and still ongoing–debate about the criteria for stratigraphic evidence (Lewis and Maslin 2015; Zalasiewicz et al. 2011) and how to establish the start of the Anthropocene has accompanied the definition of this new geological epoch, generating a variety of origin stories that locate the start of the Anthropocene at different times, from the Neolithic Revolution to the Industrial Revolution and the «Great Acceleration» in the mid-twentieth century (Schwägerl and Crutzen 2014; Scott 2015; W. Steffen et al. 2011; Yusoff 2016).

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As in Schellnhuber's vision, the notion of the Anthropocene presupposed since its initial formulations the possibility to represent planetary anthropogenic environmental change through methods of data collection, and through imaging techniques that make use of satellite reconnaissance and remote sensing technologies, computer simulations and modeling. The emergence of the Anthropocene paradigm prompted researchers working within the earth system sciences, climatology, geology, and within the international scientific bodies to evolve and improve existing forms of visual communication to maximize their public outreach. With this sort of «aesthetic turn», the sciences became aware of «the importance of aesthetic factors to their pursuit of knowledge» (Welsch 1996, 15). Since the emergence of the Anthropocene paradigm, anthropogenic climate change has been regarded by the geosciences and science-policy programmes such as the IPCC (Intergovernmental Panel on Climate Change), IPBES (Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services) and the Stockholm Resilience Centre not exclusively as scientific realities to be communicated to broader audiences (Grainger, Mao, and Buytaert 2016), but also as complex socio-ecological objects to be visually constructed (Cohen et al. 2013; Kirby 2009; Reyers et al. 2018; Totin et al. 2018). Deeply rooted in scenario thinking and modeling (Alcamo 2008; Guivarch, Lempert, and Trutnevyte 2017) and heavily reliant on imaging techniques developed for addressing future socio-ecological states of the Earth system (Bertschi et al. 2011; Carruth and Marzec 2014; Crutzen 2002; Kull et al. 2018; Lindgren and Bandhold 2004; Mauelshagen 2017; Marzec 2014; Marzec et al. 2018; Peterson, Cumming, and Carpenter 2003; Star et al. 2016; Van Notten 2006; Wack 1985; Walker and Cooper 2011), the paradigm of the Anthropocene has developed together with visual representations of the global environment and climate change (Bai et al. 2016; Cooper 2010; Verburg et al. 2016).

An example of this complex visual infrastructure of the Anthropocene paradigm and of the aesthetic efforts to communicate climate action is *Welcome to the Anthropocene*,[2] the influential website sponsored by the IGBP and the Stockholm Resilience Center and developed by the visual studio Globaïa. Since 2012, through interactive media, a short film, graphics, charts and maps, the website has defined a visual canon for the Anthropocene, emphasizing the geosciences' reliance on visual methodologies of research and communication. The diverse collection of images contained in *Welcome to the Anthropocene* is also paradigmatic of the difficulties encountered by traditional systems of representation in describing phenomena that span through geological timescales and that defy human understanding (Demos 2017, 12). For visual culture theorist T.J. Demos, the abundance and ubiquity of these types of visualizations of climate change and the Anthropocene, substitute photographic images with satellite-generated imagery, signaling that

> We have essentially moved from photography (historically and conventionally measured to human perception) to remote sensing technology (scaled to global, even interplanetary, measurements). Ostensibly existing as self-evident images, satellite imagery resembles and is often interpreted as photographs, but in reality comprises a composite set of digitized files, the result of processed amounts of data collected by satellite sensors, much of it invisible to human perception. (2017, 13,16)

According to Demos, and as recently pointed out by Stefania Barca as well (Barca 2020, 7–18)**,** the visual devices contained in the *Welcome to the Anthropocene* website implicitly reinforce a series of euro-centric «master narratives» (Barca 2020, 7) and not only «show generally positive examples of modern development, but have also already been interpreted for viewers (or rather

[2] www.anthropocene.info

consumers) to the extent that they have been packaged as images, but without typically offering access to location data, ownership, readability, or source information». This is possible because the images «look hyper-readable, but in reality are anything but transparent or direct» (Demos 2017, 16). The increasingly widening gap between a human-centered visual experience of the planet and one that is mediated and composed by a series of machinic-eyes and processing networks, represents the evolution towards the hegemonization of an abstract image of the earth. Sensing technology makes evident the incommensurable amounts of data that lie under the threshold of detectability of the human senses, and offers instead an image of a more complex, constantly evolving planet that can only be interpreted through data processing and modeling. This regime of planetary abstraction represents the true Copernican revolution of the Anthropocene as a visual paradigm, as it decenters human perception in favor of an increasingly complex assemblage of visual technologies and optic infrastructures.

2. Anthropocene and the arts

The representations of climate change popularized by the geosciences and intergovernmental programmes within the framework of the Anthropocene thesis are also relevant for understanding the broad impact of these categories on the construction of the image of the earth (Höhler 2015; Nitzke and Pethes 2017) in the visual arts. Climate knowledge and imagination have been at the forefront of the Anthropocene episteme thanks, also, to the efforts of the IPCC, the intergovernmental organization that is mainly responsible for the dissemination of research on anthropogenic climate change and its visualizations to the public and to policy-makers (Kirby 2009; Totin et al. 2018; Washington and Parkinson 2005). Climate visualizations (models, simulations, scenarios, charts, photographic and video essays) are simultaneously scientific tools used in academic contexts and imaginative narratives that dramatize risk for the public and elicit collective emotional responses (Burgio and Facchetti 2020; Latour 2018; Swyngedouw 2010; Yusoff and Gabrys 2011) Within the vast production of anthropocenic visualizations, a fundamental role has been played by those aimed at simulating and perceiving current and future stages of anthropogenic climate change (Edwards 2010).

The introduction of the Anthropocene thesis in the public sphere and its widespread popularization, has led to a growing awareness that climate change communication requires interdisciplinary approaches and collaborations between scientists, designers and visual artists. This awareness has inspired the launch of numerous arts–sciences initiatives focused on environmental visualizations and ecological imaginaries. Arts-based methods, technologies and styles of visualization of planetary emergencies and futures, and collaborations with environmental humanities scholarship and the social sciences, have emerged. These artistic-scientific collaborations have functioned not only as tools for disseminating geoscientific knowledge to general audiences, but also as collaborative and experimental artistic research approaches and as a creative strategy to produce understandable images of planetary phenomena that are, otherwise, incomprehensible to human senses. The Anthropocene has thus become the object of a productive visual exploration as well as of multiple, and often competing, images and narratives of global change and future scenarios (Armiero and De Angelis 2017; Arias-Maldonado 2015; Emmett and Lekan 2016; Shellenberger and Nordhaus 2011). The reception of the Anthropocene paradigm by artists, art institutions, natural history museums, design studios and a variety of other cultural practices has generated and is continuing to produce a large and diverse corpus of arts-based and research-oriented visualizations of climate change, species extinction and other markers of the Anthropocene. These

visualizations originating in the arts intervene in ongoing debates within the social sciences and in some cases have expanded – or called into question – the visualization methods and grand narratives of the geosciences. Since uncertain planetary socio-ecological scenarios are at the core of the Anthropocene epistemology (Glaser, Ratter, and Welp 2012; Glaser et al. 2012; Verburg et al. 2016), the visual arts are now playing a key role in introducing creative methods for providing perceptual representations of environmental conflicts and alternative futures.

The contemporary visual arts have reacted quickly to the Anthropocene thesis, partnering with scientific institutions and interrogating its definition through several art projects and a series of ambitious exhibits that have tested the sensory and aesthetic dimension of the Anthropocene (Robin et al. 2014). A pioneering example of these cross-disciplinary visual explorations is *The Anthropocene Project*, a collaboration started in 2013 between the Haus der Kulturen der Welt (Berlin), the Max Planck Society, the Deutsches Museum (Munich) and the Rachel Carson Center (Munich). Through a series of major exhibitions, workshops, conferences, publications, events, an online curriculum, virtual projects and digital companions, a team of artists, humanists and scientists has produced multiple visualizations and critical reflections on the Anthropocene (Renn and Scherer 2017).[3]

The visual arts have since played a major role in producing knowledge and constructing critical images of the Earth and the Anthropocene, focusing on climate change and the interactions of humans and non-humans, species extinction, natural history and Earth phenomena on multiple scales (Davis and Turpin 2015; Demos 2016; Reiss 2019). Several galleries and contemporary art institutions have designed exhibition-led inquiries into the Anthropocene and socio-ecological visualizations, also in collaboration with ecologists, architects, urbanists and designers. In this context, natural sciences museums and institutions have constructed, in collaboration with artistic research, special exhibits and visual explorations of key aspects of the Anthropocene, such as climate change, mass extinctions, postcolonial ecologies, and climate-induced migrations.

3. Verticality, data, and the aesthetics of planetary abstraction.

Within the increasingly vast corpus of art-centered representations of the Anthropocene and climate change, a few visual artists have started to reflect on the new planetary visuality introduced by the Anthropocene paradigm and the struggle for describing the massively dispersed phenomena associated with it. Specifically, aerial and satellite images seem to occupy an important place in displaying the progression in both time and space of the effects of climate change. Aerial photographs of glaciers and the Arctic, for instance, have become ubiquitous in climate discourse and as this type of visualizations «take advantage of the long standing appeal of aerial earth images» (Houser 2014, 327), like for example NASA's epoch-defining photograph *Blue Marble*, they have become intrinsically associated with a general sense of wholeness, urgency and environmental crisis. The awareness of the obsolescence and inadequacy of photography as an artistic medium for these tasks is recent, as many early representations of the Anthropocene consisted of aerial-photography projects depicting large minerary sites, melting glaciers, and other

[3] Among the initiatives promoted by *The Anthropocene Project,* the Deutsches Museum hosted major exhibitions on the Anthropocene: *Welcome to the Anthropocene: The Earth in Our Hands* (2014–2016) (Möllers, Schwägerl, and Trischler 2015) and *Anthropocene Observatory* curated by Armin Linke and Anselm Franke (2013–2018), accompanied by the conference *Environing Exhibits: Science, Technology, and Museums in the Anthropocene* (October 2014), and the experimental four-volume theory and art publication *Textures of the Anthropocene: Grain Vapor Ray* (Klingan et al. 2014).

distinctive landscapes normally associated with anthropogenic climate change. This is the case, for instance, of Edward Burtynsky's *Anthropocene Project* (2014-2018), whose pictorial, aesthetically-pleasing aerial-photographs of extractive sites (implicitly constructed as testimonies of planetary human agency) have become associated with a form of petro-capitalist extractive sublime (Demos 2017, 65). Other examples of this vertical photographic approach are Symrin Gill's *Eyes and Storms* (2012) and the audiovisual piece *Bending to Earth* (2015) by Rosa Barba. The latter represents a significant evolution of the aerial-photography approach of Burtynsky and Gill, as Barba films radioactive fields[4] using a hand-held camera from a helicopter, capturing the sounds and the material distortion of radioactivity together with the human infrastructure sprawling below the artist's point of observation. The presence of the artist in the film is made evident by the camera movements, the editing, the shadow of the helicopter, and it contributes to position the human eye of the artist in a space that lies in between the earth and the satellites above. Justin Brice Guariglia, instead, goes in a different direction. In this case, the artist uses aerial-photographs of the melting Arctic ice landscapes as the starting point for his exploration of the Anthropocene, rather than its end product. He processes this photographic data into large size[5] tactile photo-painting hybrid artworks that incorporate polystyrene plastics, acrylic paint, carbon, gold, pewter (Horn 2019, 4). The final product is not a photograph anymore, but rather a complex material witness of the Anthropocene, as the materiality of this artifact recalls the presence and the deep future stratification of chemical and industrial compounds mobilized by human activity that are forever embedded in the planet's geological domain (Horn 2019, 6).

On the other side of the spectrum, the obsolescence of photography as a tool for conveying the socio-ecological changes affecting the planet and their evolution over time becomes evident in art and design research-oriented projects that make substantial use of satellite imagery and other types of remote sensing technology. As pointed out by Wolfgang Sachs «satellites equipped with sensors are veritable heavenly spies, scanning the earth's surface so as to gather information hidden even from people on the ground. That process links a synoptic view with probing» (Sachs 1999 in Deloughrey 2014, 261). The visualizations deriving from such synoptic and probing scan of the earth represent a further move towards the construction of an abstract image of the planet, and they are, for instance, at the core of Territorial Agency's recent work *Oceans in Transformation*[6] and its spin-off project *Sensible Zone*. In these works, satellite images of bodies of water and urban areas around the world are elaborated and transformed into data-dense animated digital depictions of some of the socio-ecological transformations simultaneously affecting all the planet's oceans at once. Following these flows of data in their interactions with cities, continents, and extractive sites,

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[4] From the artist's website: «The film Bending to Earth is a further investigation into inscriptions and transformations of society manifested in the landscape. Several radioactive fields are circled by a hand camera in a helicopter, while a recorded voice-over which appears through several—often distorted—world radio stations describes the materials of those constructions and opens up a mediation of order systems and landscape archives. The fields represent a sort of alphabet of an image engineered in the earth; the camera is an observer of this document and its relation to reality, not just as a pre-existent form but as a potential or imagined object—the part that remains behind the scene, the break within the narrative.« https://www.rosabarba.com/solar-flux-recordings-2017-1

[5] For example, Guariglia's work JAKOBSHAVN I (2015-2016), a representation of the homonymous Greenlandic glacier, is almost five meters high.

[6] «The project combines Earth Sciences and remote sensing datasets in complex dynamic compositions. These compositions are produced with data from satellites, floating buoys, GPS, artificial intelligence, sonar scans, and climate models of the interactions between sea, sky, and land. Multi-temporal and multi-scalar, they form an image of the oceans as unframed, asynchronous, and discontinuous.»(Scammacca and Zyman 2020)

the viewer not only becomes aware of the epochal changes constituting the Anthropocene, but also of how these phenomena are geographically and geo-politically distributed.

The artistic trajectories of two very different artists, American painter Diane Burko and Japanese electronic sound and visual installation artist Ryoji Ikeda, demonstrate an aware and critical engagement with the forms of visual abstraction of climate change and the Anthropocene. Diane Burko's recent exhibit *Seeing Climate Change* at the American University Museum - Katzen Art Center in Washington, D.C. displays nineteen years (2002-2021) of the artist's career. Trained as an abstract painter, Burko moved her first steps as an artist drawing inspiration from the likes of Arshile Gorky, Matta, Joan Mitchell, de Kooning, with a particular fascination for the use of color and space (Burko 2021, 11). In the last twenty years, Burko has oriented her artistic practice towards climate activism and has been extensively collaborating with academic and environmental institutions by following scientific expeditions to the Arctic and other endangered environments. As her work has been exhibited both in art galleries and scientific and academic contexts, Burko perfectly embodies the profile of the climate artist-activist working within Anthropocene visuality. Moved by the understanding that massive phenomena such as climate change impact different timescales and geographies, Burko's career can be seen as an attempt to operationalize and actualize the painting medium (in her case, landscape and abstract painting) for reflecting on the challenges posed by the Anthropocene epoch.[7]

Defined as «scientifically informed abstractions» (Ratcliff 2021), Burko's paintings have evolved profoundly through her career in some significant ways. In the earliest works of the *Politics of Snow* series (2007-2010), Burko depicts mountain peaks and glaciers, sometimes in temporal sequences through which the effects of climate change become evident for the viewer. These works, closer to more traditional landscape painting, add the element of time and force the observer to establish a comparison between a «before» and an «after». These icescapes also imply a conventional human eye as a point of observation within the painting, as the views could realistically be the product of a human-produced photograph or memory. In later examples from the same series, new elements are added into the artworks. In the 2010 *Columbia Glacier Tryptich*, for instance, the point of observation is elevated, as it would be from a helicopter, and, in the third painting, lines marking the progressive retreat of the glacier are juxtaposed over the painting. These two elements reveal the artist's awareness of the limitations of the human eye and of her own medium in conveying the complex temporality of climate change, to which she responds by using visual strategies borrowed from geoscientific communication. These additions to her medium mark also a point of no return in her trajectory, as Burko, since then, has embedded more complex sets of data in her work. Burko's visual integrations to painting are as much indicative of the visuality of the Anthropocene as are the mutations of the objects depicted in her paintings. Similarly, the point of view implied in her works has been progressively elevated to the point of becoming manifestly satellitary in nature. In her 2014 *Polar Map* series, for example, four paintings record the changes in ice levels of the Arctic through time from an outer space perspective. Besides the implied satellite vision, Burko includes in this view also meridian and parallel lines, graphic elements that can, of course, be visible only in a processed visualization and not in a photograph of the planet. The fourth painting in this series, Polar *Map 2007 C (After NASA)*, unexpectedly erases the cartographic elements from the painting, offering the viewer blue, white, green swirls of paint that reveal, *in absentia*, the optic infrastructure of the Anthropocene.

[7] The history of painting in the context of the Anthropocene and environmental humanities debates has an important role, as, for example, 19th century landscape painting has been studied in relations to changing climates and the impact of industrial activity on urban and natural environments (Finch-Race 2021; Mirzoeff 2014).

In other works, such as NOAA II (which is the name of a series of satellites used for atmospheric and weather research), Burko's uses more vivid colors that resemble the saturated color palettes of climate visualizations.
If analyzed through the years, Burko's paintings acquire a self-reflecting quality. The artist becomes increasingly aware of the limitations in conveying the scale of planetary transformation through traditional painting, a fact that seems to deeply trouble her. On the other hand, the intrusion of data into the artistic medium, exemplified by the addition of lines, parallels, meridians and even graphs, timelines, and maps from climate sciences (as for instance in the 2020 paintings *Summer Heat 1* and *Summer Heat 2*), signals the ubiquity of geo-scientific communication tools in the public sphere and its deep presence within the artistic unconscious. In Diane Burko's works, planetary abstraction manifests as a process of «melting away», where the historically defined objects of traditional landscape painting (the peaks, the glaciers, the oceans, etc.) slowly vanish and regress, revealing an irreducible core, a substratum, a structure underneath the aestheticizing gesture of the painting. This structure, composed of data and lines that slowly reveal themselves underneath the natural landscapes, is the Anthropocenic planet in its bare bones.

Ryoji Ikeda (1966) is a sound and visual artist who, since the late 1990s and early 2000s, has been focusing «on the essential characteristics of sound itself and that of visuals as light by means of both mathematical precision and mathematical aesthetics.»[8] In his practice, Ikeda creates large, immersive audiovisual installations which often are accompanied by a live sonic or performative component. Ikeda's audiovisual installations are presented in extra large digital screens, creating an immersive cinematic experience. In his works, Ikeda has not addressed climate change or the Anthropocene directly, but, instead, his multimedia creations have focused on the subject of nature from a purely materialist perspective and have engaged with concepts drawn from quantum mechanics and physics. His recent project *Dataverse* (2019), which was presented at the 58th Venice Biennale, represents both a culmination of Ikeda's work on data aesthetics and sonic environments, as well as a reflection on the pervasiveness of data visualization in our everyday lives. *Dataverse* is an audiovisual piece in which the artist elaborates massive sets of «open-source scientific data from institutions including CERN, NASA and the Human Genome Project»[9] into a complex, hypnotic cinematic experience. In this work, Ikeda offers the viewer a glimpse into a never ending stream of data unconsciousness, creating visuals from data taken from astronomy, biomedical science, neural paths, climatology, satellite and sonar imagery. This data *pastiche*, completely detached from its scientific and informational purposes, reveals the visual infrastructure of the Anthropocene and the abstract relationship between the human observers and the material transformations affecting the planet. *Dataverse* produces in the audiences a sense of both alienation and familiarity, as it overstimulates them with types of data visualizations they have experienced many times before, but never in a way so detached from the object of visualization itself. *Dataverse* is an eerie representation of the contemporary visual experience itself, largely produced by non-human actors and to be consumed and interpreted by non-human eyes and artificial intelligences. Ikeda edits and animates these visualizations without any form of added information and displaces them in an uncanny valley of somewhat recognizable moon landscapes, bio-chemical structures, medical diagnostics and forensics, and speculative future states of the planet. He stages and cinematizes this aesthetic experience by conflating planetary, cosmic, and microscopic scales and by pointing at the constant multiscalar mediation we

[8] https://www.ryojiikeda.com/biography/
[9] https://www.audemarspiguet.com/com/en/news/art/ryoji-ikeda-data-verse-trilogy.html

participate in our everyday lives. It is this never ending labor of mediation and scaling at the source of the planetary abstraction of Anthropocene visuality. Planetary abstraction manifests in Ikeda's *Dataverse* as the aware detachment of the object of data extraction from its visualization and it becomes an immersive aesthetic experience of its own. The immersiveness and the soundscape of Ikeda's installation attempt to scale down the centrality of the human eye from this experience, highlighting the fact that these forms of data visualization already live somewhere in the neural paths of our brain.

4. Conclusions.

Since the popularization of the Anthropocene thesis and together with intuitive representations of climate change, science-led initiatives have heavily relied on satellite images of the planet and creative forms of data visualizations in order to communicate the impact of human activity on the planet to a wide public. This aesthetic effort found its way within the visual arts, as climate and planetary change have become objects of representation that are aesthetically defined by data visualization and satellite imagery. The crisis of photography as the preferred medium to display scientific realities and the non-human dimension of the timescales mobilized by the Anthropocene imagination have had deep consequences on the artistic representations of the earth. This representational challenge has accelerated a process of planetary visual abstraction that was initiated decades before the formulation of the Anthropocene thesis, and coincided with the mass deployment of remote sensing technology and satellite vision.
Re-adapting David Chandler's recent formulation, the debate on the human geological epoch has brought to the center stage a recognition of abstraction as either a critical aspect of the rise of the Anthropocene thesis or a fundamental starting point for possibile post-anthropocentric futures:

> The Enlightenment or modernist episteme was problematic because through the power of abstract thinking, it alienated man from himself and from the world, opening up a separation between nature and culture, which narrowed and reduced the world (including the vast majority of humanity) to passive objects for instrumental manipulation. (Chandler 2019, 9–10).

This reduction was also facilitated by the visual capabilities of satellite imaging and data processing, but as much of «the affirmative post-critical politics of the Anthropocene seeks to remove the ambiguities of abstraction through moving in the opposite direction: intensifying and putting to productive use the power of abstraction» (Chandler 2019, 11), the visual domain of the Anthropocene remains a politically contested space. Within the visual arts, planetary abstraction has manifested in representations of the planet heavily mediated by data extraction and satellite vision and it has been at times understood as both a co-cause of the environmental crisis and as a possible tool to imagine new futures of sustainable habitation of the earth.

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