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► **To cite this version:**

Sebastian Vincent Grevsmühl. Images, imagination and the global environment: towards an interdisciplinary research agenda on global environmental images. *Geo: Geography and Environment*, 2016, 3 (2), 10.1002/geo2.20 . hal-01357924

HAL Id: hal-01357924

<https://hal.sorbonne-universite.fr/hal-01357924>

Submitted on 30 Aug 2016

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Images, imagination and the global environment: towards an interdisciplinary research agenda on global environmental images

Sebastian Vincent Grevsmühl

Global environmental images have become part of our everyday life experience. We encounter them in news reports, scientific articles and artistic interventions. Yet so far, only the most iconic of these images have received close critical attention from scholars coming mostly from two related fields, science studies and cultural geography. Some of those studies, as for instance research carried out on the famous Apollo photographs, have revealed that the icons of our environmental age do not provide simple readings, that they carry multiple, often contradicting messages, and that they can be vectors of highly ambiguous and even conflicting political beliefs. However, historically informed interdisciplinary research on visual cultures from an environmental perspective is still at its beginning. This essay thus calls for a systematic exploration of the crucial role the visual plays in the creation, circulation, interpretation and adaptation of global environmental knowledge. It is argued that this inquiry cannot be left solely to historians or geographers but calls for a truly interdisciplinary engagement. One central claim is that we need to better understand the constitutive role the visual and associated knowledge practices, conventions and infrastructures play in mediating global environmental phenomena. One possibility, it is argued, is to develop a broader historical framework for understanding how the visual actively shaped scientific and environmental discourse, and how it stimulated the rise of holistic and dynamic understandings of the environment from the nineteenth century onwards. A second important research area that is suggested concerns the crucial role global environmental images play at the interface of science discourse and environmental policy and governance. The essay concludes by suggesting three basic theses which seem particularly promising for future interdisciplinary inquiries into global environmental images.

Key words images; culture; history; global environmental change; Anthropocene; scientific visualisation

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Revised manuscript received 19 May 2016

Geo: Geography and Environment, 3 (2), e00020

Introduction

Few images were as widely reproduced, circulated and adapted as the photographs of the Apollo missions. One photograph in particular, the iconic 'Blue marble' (see Figure 1), taken during the Apollo 17 mission in 1972, conveyed the powerful idea of the Earth as a dynamic and vulnerable system; a finite world in need of care and stewardship (Cosgrove 1994, 2001; Sachs 1999; Jasanoff 2001; Poole 2008). The iconic photograph reflected in many ways an important change of perspective: for some historians, the image was at the origin of an enchantment, produced by the intense, blue colours of Earth's abundant aquatic resources, and in that sense it followed closely aesthetic rules of the

Sublime (Corbin 2001). Other observers postulated a profound alteration of state of mind, induced by the 'overview effect' (White 1987), allegedly brought about by the space age. However, the 'divine' vantage point from outer space inspired not only ideas of global humanity or environmental consciousness, but also projects of total environmental control. Indeed, the complete absence of any human trace, the erasure of cultural diversity and geographical difference, combined with the 'Apollonian' perspective, long anticipated in cartography, were in many ways at the origin of the rise of managerial and technocratic conceptions of the Earth system (Hulme 2010) and of the centralisation of political power and social control (Scott 1998). Protection and assistance are in other words just as much part of the images' influential

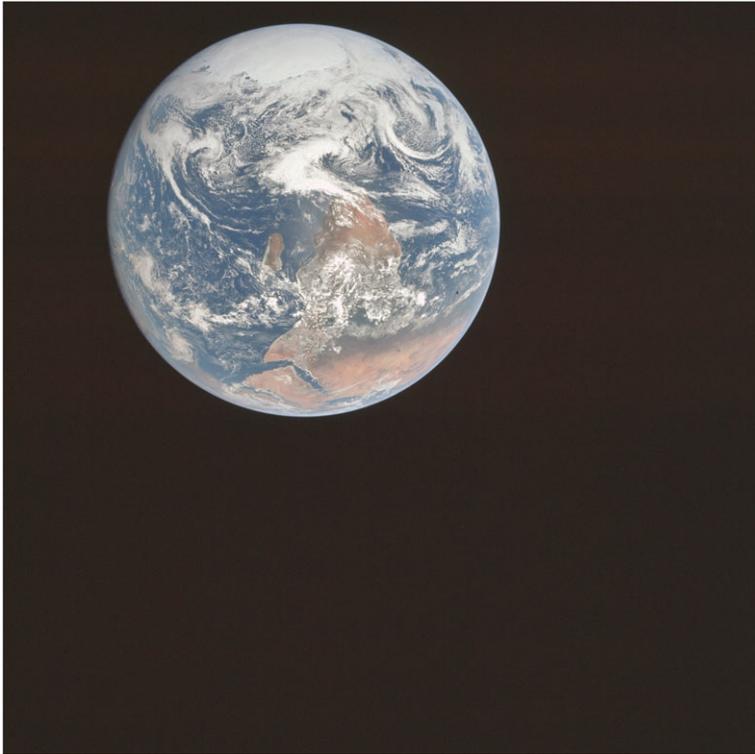


Figure 1 The photograph that would become known (once cropped and reoriented) as the ‘Blue Marble’, 1972

Source: NASA

message as the ability to pilot the Earth as a whole (Fleming 2010; Hamblin 2013; Grevsmühl 2014a; Höhler 2015b). The famous Apollo photographs are therefore powerful reminders that the icons of our environmental age do not provide simple readings, that they carry multiple, often contradicting messages, and that they can be vectors of highly ambiguous and even conflicting political beliefs.

This underlying tension is at the heart of the notion of the ‘global environment’ itself which started to proliferate in particular since the late 1960s in science and policy circles. Indeed, as anthropologist Tim Ingold has argued, the notion refers to two horizons of contradicting scale and experience. The environment usually refers to what surrounds us, we are part of it and we live in it, whereas the globe is an artefact, an object we may act upon from without (Ingold 1993; cf. Lazier 2011). This profound dichotomy between on the one hand planetary steering and control, and on the other engagement with nature, often associated with aesthetically pleasing or emotionally engaging representations of nature, is constantly blurred and transgressed within global environmental imagery. Thus, any analysis of the global environment, especially when it comes to images and visualisations associated to it, must come to grips with this fundamental, underlying tension. As

used here, the notion ‘global environmental images’ is intended to encompass all visual material that shares a global narrative of environmental phenomena or geophysical dynamics, allowing these to be communicated (in the form of maps, graphs, visualisations etc.) and perceived as important global issues, mostly emanating from Western scientific discourse and frequently invoked in governance practices and discourse.

Over the last years, scholars have called attention to the knowledge gap in understanding visual cultures across the human and social sciences in general (Rose 2001), and in history of science in particular (Wise 2006; Bigg 2012). Although it seems clear now that images have a strong impact on how societies structure their interactions with nature (Descola 2005/2013), on how environmental narratives are framed (Latour 1985; Anderson 2009; Dunaway 2015), and on how environmental futures are imagined (Schneider 2012; Sheppard 2012), we do not have any large historical framework for understanding how the visual actively shaped scientific and environmental discourse, how it mediated environmental change, and how it stimulated the rise of holistic and dynamic understandings of the environment. Despite some efforts, historically informed interdisciplinary research on visual cultures from an environmental perspective is in many ways still at its very beginning.

In this essay, I wish to explore the crucial role the visual plays in the creation, circulation, interpretation and adaptation of global environmental knowledge, a subject which in my view has not been sufficiently scrutinised by the human and social sciences. One claim is that we need to better understand the constitutive role the visual and associated knowledge practices, conventions and infrastructures play in mediating global environmental phenomena in order to gain better insight into our understanding of past, present and future conditions of global environmental change. As I will argue here, this inquiry cannot be left solely to historians or science and technology scholars, nor to geographers, communication scholars or interested art historians (cf. *The Technical Image Project* at Humboldt University in Berlin) – although each of these communities has already and will certainly in the near future contribute in important ways to this debate. I would like to propose that we engage in an interdisciplinary research dialogue, mobilising tools from a vast array of disciplines. How this dialogue may eventually look, some central questions that can be raised, as well as some of the diverse areas that may be explored will be outlined below.

As preliminary work carried out during a recent conference by participants coming from a large diversity of disciplinary backgrounds has shown, global environmental images share specific visual traditions, they carry distinct cultural and political meanings, and their study provides for a better understanding of the ‘naturalisation’ processes which help transforming images into robust scientific and political arguments (cf. Grevsmühl 2015). Indeed, all global environmental images – from dramatically dropping ozone values, over increasing biodiversity loss and dangerously rising sea levels, to catastrophic climate change scenarios – participate actively in the construction of the specific global objects and ideas they intend to visualise. And by making new objects, structures and connections visible, these images become in turn driving forces of new knowledge and ideas (cf. pioneering work in science studies on referential translation chains: Latour 1985; Callon 1986). In science, therefore, the visual fulfils mainly two functions and images are hence always both: objects and instruments of knowledge and imagination. Few studies have explored in detail this double function and its close study will help us understand how global environmental processes are visually produced, negotiated, rendered evident, consumed, and how they generate new knowledge and imaginaries (in other domains this double function has been explored successfully, as for instance in the case of cultural representations of the atom: Bigg and Hennig 2009).

In the following, I would like to make several proposals for a historically informed interdisciplinary research agenda on global environmental images, also motivated by the fact that the past may hold crucial

answers for our future. Before suggesting several theses which I consider central to the analysis of global environmental images and which seem to emerge from the current literature, I would like to briefly point out some general areas of interest in which further research is still needed. For the sake of brevity, I mention only two such areas, yet the list of topics is of course in no way exhaustive and I am aware that many other interesting subjects could have been included – from economic considerations and legal questions (e.g. Warren 2009; Hermitte 2011, although the visual constitutes no particular focus here), to the detailed study of the appropriation of global environmental images in the public sphere (cf. O’Neill 2013 and O’Neill *et al.* 2013 on newspaper framings of climate change imagery; O’Neill and Hulme 2009 on non-expert imagery) and in popular culture (e.g. Meister and Japp 2002). However, the three theses that I propose at the end of this essay will hopefully help open up these research areas to further relevant questions and topics of inquiry.

Getting the bigger picture

One major research area concerns our general historical understanding of the evolution of global environmental imagery. A leading characteristic of ‘visual studies’ in general, and of the study of scientific images in particular, is a rather narrow thematic focus with a strong preference for case studies. Indeed, historians now have a rather impressive number of case studies at their disposal – especially when it comes to scientific images and specific scientific visualisation technologies (e.g. Fyfe and Law 1988; Lynch and Woolgar 1990; Sicard 1998; Huber and Hessler 1999; Gugerli and Orland 2002; Latour and Weibel 2002; Coopmans *et al.* 2014). Yet what we are still missing is an overall picture of how major topics, visual styles and framings of global environmental images evolved in general from the nineteenth century onwards. To be sure, this is not to confound with recent tendencies in the field (most importantly in German *Bildwissenschaft*) aiming at establishing a general, unifying (and one is tempted to say universal) interpretative framework for scientific images, an endeavour which for many reasons will most likely never achieve sustained success (cf. Bigg 2012). The idea is rather to identify and bring together relevant case studies, which would have to be complemented by new research, in order to enable a transversal and more general historical perspective on the evolution of the visual material and associated knowledge practices.

For example, one visual tool in particular, the contour line (also known as ‘isogram’ or ‘isoline’), proved to be (and in many ways still is) highly influential in shaping our perception of global environmental phenomena (Grevsmühl 2014a, 2014b). Contour lines visually transform discrete measurements into powerful

global imaginaries of continuous measurement, giving life to all sorts of large-scale geophysical and environmental phenomena in form of maps and graphs. Although known at least since Edmond Halley's pioneering work (see Figure 2) on geomagnetism from the beginning of the eighteenth century (Thrower 1969), it was Alexander von Humboldt who popularised with great success and lasting impact the contour line by introducing it to meteorology in 1817 (see Figure 3). As Hankins (2006, 624) has shown, by the 1840s, a veritable isoline 'craze' had broken out, 'with atlases that described everything imaginable by means of isomaps'. Today, the contour line has become one of the most widespread visual tools, with applications ranging from automatic shape detection in remotely sensed images, to so-called 'false colour' imagery in medicine.

The contour line, however, is only one example amongst a vast array of visual styles and tools that saw

their rise during the nineteenth century and which a more systematic approach to global environmental images can help identify. In so doing, this can also reveal evolutions and changes that occurred slowly, in the long run, providing therefore a larger and more general historical picture. Some of the global environmental objects, ideas and concepts we encounter in images during the nineteenth century have survived (think for instance of climate zones or global-mean temperature); others have disappeared completely (such as the immobility of the ocean floor and continents); and yet others owe their very existence to modern observation technologies and networks, or fairly new branches of scientific knowledge production, as for instance global-mean sea-level rise, the El Niño-Southern Oscillation (ENSO), or the Antarctic ozone hole. Close analysis of the visual can provide for a better understanding of these historical dynamics that profoundly shaped the rise of the Earth sciences, our



Figure 2 Edmond Halley, map of isogones showing magnetic declination, around 1701

Source: Princeton Library Historic Maps Collection

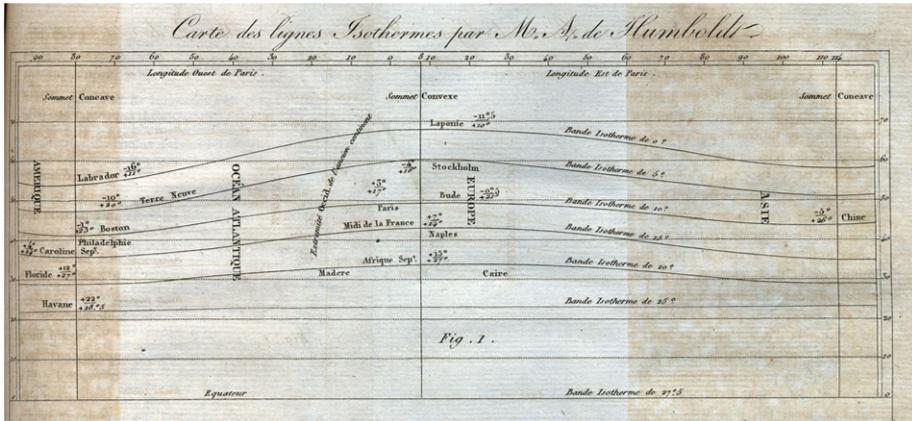


Figure 3 Isolines as mobilised by Alexander von Humboldt in 1817 for global temperature
 Source: Princeton Library Historic Maps Collection

perception and understanding of the natural world, as well as the importance attributed to global environmental phenomena in a large diversity of domains, stretching from governance practices to economics.

In terms of historical framing, the nineteenth century is in many ways crucial to the history of global environmental images and can serve as a useful and meaningful starting point for a more systematic exploration. One important reason is that several of the Earth science branches (as we know them today) started to emerge as self-conscious and more or less independent disciplines, along with their own set of rules, practices, instruments and visual languages. As Martin Rudwick (1976/2004) has shown in his pioneering study considered today a landmark paper in visual history, this was the case of geology during the 1820s and 1830s, when

a common visual language was introduced in conjunction with new printing techniques. Other disciplines within the Earth sciences, such as oceanography, were also rather fast in adapting only a few decades later similarly efficient visual tools in order to give the ocean bed and ocean depth a completely new, and increasingly detailed face (see Figure 4; cf. Höhler 2002a, 2002b; Rozwadowski 2001, 2005). These developments were also driven by an expanding globalisation, reflected by ambitious telecommunication projects, such as intercontinental telegraphic lines, and new modes of travel on rapidly growing train networks and fast steam boat lines (cf. Schröder and Höhler 2005).

The Earth sciences accompanied actively and profited from this rapid acceleration of the circulation of persons, goods, and information on a global scale,

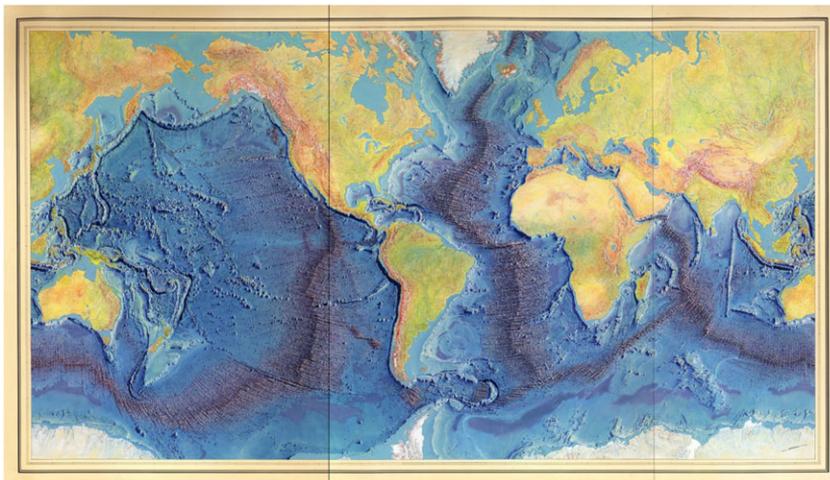


Figure 4 The new face of the ocean as imagined by Marie Tharp (in collaboration with Heinrich Berann and Bruce Heezen), 1977
 Source: US Navy, Office of Naval Research

which also necessitated the harmonisation of weights, measures and time zones. Especially the second half of the nineteenth century saw the flourishing of international scientific congresses and the standardisation of scientific practices which were all inscribed in the tension between nationalism and imperial internationalism, between competition and collaborative efforts of nation states in investigating the commons, from the ocean bed to the upper atmosphere (e.g. Höhler 2015a, 2015b). The idea of a 'global environment' was consolidated precisely within this context and thus a historically informed analysis has to be attentive to these developments.

In sum, despite the crucial historical importance of the visual for the emergence and establishment of the Earth sciences, little is known on how specific visual styles evolved, or what kind of global visual topics and styles have proven influential in the long run. Scientific images, just like artwork, are cultural artefacts and as such they reflect specific historical, social and material conditions of their production. By renewing tools of art history (i.e. iconology), researchers of *The Technical Image* project in Berlin have shown that it is possible to classify and analyse scientific images according to distinct visual styles and that one can identify common traits across a vast array of topics and themes (Bredenkamp *et al.* 2015). Although some related projects, such as Birgit Schneider's *Klimabilder* project (2015), retracing the last 200 years of climate images, have already led to important results, global environmental imagery still calls for a comprehensive analysis that can help identify common visual styles and shared framings, bringing to light connections between images from vastly different scientific disciplines, contexts and historical periods. Indeed, engaging in this type of *longue durée* history promises to provide a first important step towards a distinct *visual* history of globalisation, the rise of the Earth sciences and global environmental change.

Towards a political perspective on global environmental images

A second research area concerns the crucial role global environmental images play at the interface of science discourse and environmental policy and governance. Within global environmental research, in particular when it comes to climate change (which retains today without doubt the greatest scientific, political and public saliency), images have taken a leading political function. Especially once they escape laboratory walls and are brought to the eyes of a broader public, they take on the crucial role of political agents (e.g. Schneider 2012; Mahony 2015). This political function of global environmental imagery must not be underestimated, as numerous case studies show: from the famous ozone hole visualisations, over catastrophic climate scenarios,

to influential expert graphics such as the 'planetary boundaries' proposed by Rockström and colleagues (Rockström *et al.* 2009; see also Karlsson 2013).

In many cases, however, the objects of governance and policymaking – be it stratospheric ozone depletion, deforestation, biodiversity loss or global climate change – are taken for granted; they are often considered as almost self-evident, natural and transparent objects, without taking into account the manifold ways in which the visual actively shapes the horizon of possible responses (cf. Boyd 2010). As argued above, visual spaces are contingent, historically situated spaces, profoundly marked by the material, socio-cultural, political and institutional settings from which they emerge. It is therefore crucial to understand these factors, especially if politically important and potentially far-reaching decisions are to be made, as for instance deciding on how to tackle the problem of ozone depletion or which future scenario of climate change is desirable and which scenarios are to be avoided.

To be sure, within many fields, scientists, policymakers and actors of interest groups are becoming increasingly aware of this crucial function of the visual. For instance, the at the time highly publicised 'hockey-stick' controversy is an iconic example for a particularly controversial discussion on what may actually count as visual evidence within climate change discourse. The contested nature of the graph, the varying claims to objectivity, and the heated discussions that followed (concerning amongst several other issues the 'proper' depiction of uncertainty) all prove that the power of images may surely not be underestimated (cf. Schneider 2009; RealClimate Blog 2010; Hamblyn 2014). Moreover, as Mahony (2015) has shown, expert graphics can also become the object of fierce disputes and their objectivity contested at almost all stages of their production and circulation process. Mahony argues convincingly that the Intergovernmental Panel on Climate Change's (IPCC) so-called 'burning embers' diagram underwent a whole series of modifications precisely because of the highly contested nature of the ways according to which a global threshold, where climate change becomes 'dangerous', should be depicted. His case study is a powerful reminder that today, the objectivity of an image is often locally negotiated and that the frontier between science and politics is not impermeable, and that it constantly shifts in function of different interest groups and local power relations.

Although research has already been conducted on some highly influential icons, as for instance on the making of the famous 'Keeling curve', as well as on its framing in *The inconvenient truth*, large parts of the debate are dominated by a US-centred view (see Kjeldsen 2013; Howe 2014). Comparatively little is known on contributions to the making of global environmental images coming from other geographical areas or other research

areas than climate change, and especially a distinct European perspective seems still largely underdeveloped. A detailed study on the 'ozone hole' (Grevsmlühl, 2014a, 2014b) may serve as a rough guide here. There I show how fundamental research conducted by researchers of the British Antarctic Survey was at the origin of a ground-breaking environmental discovery, a discovery that NASA scientists subsequently turned into an iconic global environmental threat with the help of spectacular satellite imagery (see Figure 5) combined with a powerful metaphor. This framing also had important consequences for global environmental policy. Although the Vienna Convention for the Protection of the Ozone Layer was already well under way (it was agreed upon in 1985 and entered into force in 1988), NASA's global framing contributed at least in part to the rather swift adoption, in 1987, of a substantial addition to the Convention known as the Montreal Protocol, which introduced for the first time a serious regulation framework for CFCs (cf. Christie 2000). So it is fair to say that the imagery and the catastrophic metaphorical framing added a sense of urgency to the negotiations. Indeed, as Benedick who was directly involved in these diplomatic discussions has noted: 'Ironically, if a control protocol had been agreed upon at the Vienna conference, two and a half years earlier, it would not have been as strong' (Benedick 1991, 98). Transnational, comparative case studies are therefore especially promising mainly because they seem to better reflect the international and often collaborative nature of global environmental research as observed in particular since the International Geophysical Year held in 1957–8.

Political spaces of global environmental images may also be charted through analysing the evolution and the changing perceptions of the actual physical sites on which they rely throughout their production process, and of the diverse technologies involved in shaping

global environmental knowledge. For instance, tropical forests have long been subject to rationalising principles, be it through their supposed influence on local climate and precipitation regimes within colonial context (Grove 1995; on deforestation in Western Europe, see Pomeranz 2000; cf. Fressoz and Locher 2015), or, more recently, as crucial components of the global carbon cycle within the context of climate change (Boyd 2010). As Viard-Crétat (2015a, 2015b) has convincingly shown, new mapping and remote sensing technologies, together with new accounting practices helped turn rain forests into a global carbon stock, detaching them completely from their local, ecological context and inserting them, via different legal technologies, into the planned global carbon market. It has thus become commonplace to visualise these forests preferentially only in function of their carbon stock on a global scale (see Figure 6). The United Nations REDD programme and its successors represent in other words only a further step in an increasingly global approach to the commodification of nature, firmly embedded in a much larger historical picture of increasing quantification and rationalisation of the global environment. This evolution, together with shifts and changes, can be directly observed in the different ways tropical rain forests are represented and visualised. Thus, paying close attention to the visual may help better understand how local complexity has to be quantified, reduced and radically simplified in order to fit into a global picture, a historical development which is corroborated by other case studies (cf. Höhler forthcoming; Regnauld and Limido forthcoming).

In a more general way, paying close attention to global environmental images may also help analyse how geographies of environmental crisis shifted over time, and how one may connect environmental theory and science to environmental politics. In one of his last important essays entitled 'Images and imagination in 20th-century environmentalism', cultural geographer Denis Cosgrove (2008) argued that during the twentieth century Western moral concern has seen a powerful shift away from temperate to polar and tropical geographies. In a parallel movement, nature's icons moved from static landscape framings dominated by deep time, to a new focus on a more lively and active nature, populated by living species and presented as actively shaping agents. He further argues that images and imagination seem less prone to dualistic thinking and they help rethink the so-called (ontological, epistemological and political) 'great divide' between nature and culture, between non-humans and humans, which has been described as the major organising principle of modernity (Latour 1993).

Indeed, recent discussions in the human and social sciences on what Crutzen and Stoermer (2000) have labelled the 'Anthropocene' are in line with these new forms of inquiry, paying close attention to the ways human action inscribes itself in the Earth and life sciences and how

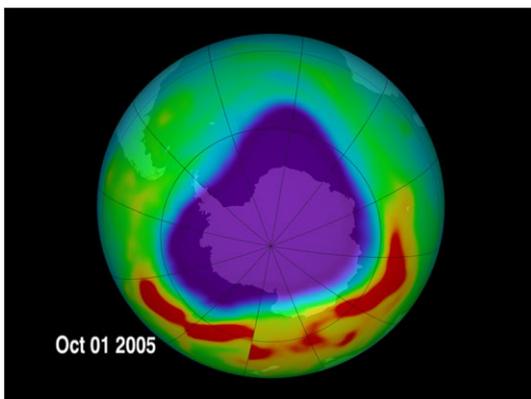


Figure 5 The Antarctic ozone hole in 2005 as depicted by NASA
Source: NASA/GSFC

Carbon stored by forests

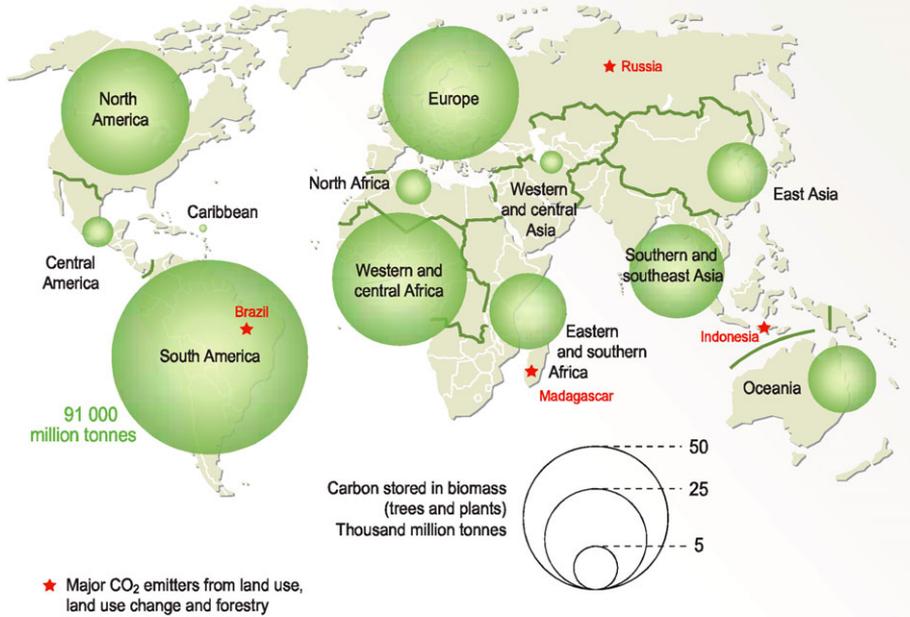


Figure 6 Global carbon stock of forests

Source: UNEP/Grid

conversely, ecological metabolisms (energy, matter, etc.) act upon the thinking and the actions of human collectives (Bonneuil and de Jouvancourt 2014; Bonneuil and Fressoz 2016). Here, critical inquiry into environmental images can offer an alternative historical narrative into which the 'co-production' of nature by human and non-human agents has long been integrated. And maybe more importantly, it can reveal the severe biases of a unidirectional, causal history of the Anthropocene (as proposed by influential scientists such as Paul Crutzen, Eugene Stoermer or Will Steffen) in which human history is mostly reduced to its history as a species. Historical analysis can thus rectify these views by introducing more nuanced and diverse explanatory frameworks (which all have of course their own limits and merits), rejecting at the same time a naturalised, single, grand narrative from nowhere (cf. Bonneuil 2015).

Engaging in such a historical project with strong interdisciplinary ambitions can in other words help bridge the gap not only between different disciplines within the environmental humanities, but also between the social and human sciences, and the natural sciences. In times of growing public concern regarding our own actions on the global environment, a critical assessment of the historical role of the visual is undoubtedly needed, allowing the production of novel information not only for researchers in academia, but also for policymakers, and the interested public in general.

In the following, and to conclude on some reflections that run through many contributions to this growing interdisciplinary field of research, I would like to point out three theses that I consider useful guidelines for analysing global environmental images. Again, this is of course by no means an exhaustive list and although some theses may seem very basic to certain scholars, others, not familiar with recent discussions in a particular field involved, may find them nevertheless stimulating or at least intriguing. The main aim is in other words to single out three fundamental theses which can be beneficial to a large number of scholars coming from a broad diversity of disciplinary backgrounds and hopefully nourishing future interdisciplinary discussions on global environmental images.

Three theses for furthering interdisciplinary inquiry into global environmental images

Thesis 1: The visual is constitutive of global environmental phenomena. Without images, graphs and visualisations, global environmental change would neither be analysable nor communicable. Creating awareness, however, does not automatically equal widespread social or political action.

Maps, graphs and visualisations are a fundamental pillar of the modern sciences. As Norton Wise (among

many others) pointed out several years ago, vast parts of the history of science could be written as a visual history (Wise 2006). He claims that scientific visualisations should not be referred to as merely accompanying illustrations, but that one rather has to consider them as a materialisation of arguments. Yet in history of science and science studies, analysis of scientific images has become only fairly recently an important research approach. Wise's call for a 'materialized epistemology' (2006) is deeply imbedded in developments which one can observe over the last 30 years or so in the field of history of science, with two major influences – one in the form of a new emphasis on practice coming mainly from sociology of science, the other coming from cultural history of science which culminated in the so-called 'material turn', associated with works of the 1980s and 1990s of Ian Hacking, Nancy Cartwright, Peter Galison, David Gooding and Bruno Latour (cf. Lenoir 1998). This heightened interest in the mediating practices within the sciences shows well that visual analysis necessitates paying close attention to the instrumentation and the tools involved in the elaboration of scientific phenomena and knowledge. Thus today, research on mediation practices and material cultures has replaced in large parts analysis of the (more or less problematic) relationship scientific images entertain with the so-called 'outside world' (cf. Grevs Mühl 2007).

Analysis of global environmental images may benefit from these developments. If scientific images fulfil functions that reach well beyond the logics of textual description (Wohlfeil 1986; Boehm 2004) and if they are not just simple substitutes for texts (Schaffer 1998), they can no longer be considered transparent objects that simply communicate, for instance large-scale geophysical or ecological phenomena. On the contrary, the visual has to be understood as a fundamental, constitutive part of the environmental phenomena in question. Without visualisations there would at best only exist measurements and data, without any particular signification, without any conceivable patterns or trends. The synoptic aggregation of those measurements in maps, graphs or diagrams makes environmental phenomena analysable and communicable. In particular, the environmental sciences rely in a fundamental way on all kinds of visualisations which render the invisible visible via the translation of an important 'density' of data (which is of course in the age of big data increasingly difficult to grasp in itself) into visualisations that are analysable and interpretable.

Climate change, for instance, is as such inaccessible to our senses and it can only be observed in a mediated, indirect manner. Although local environmental changes, as a direct consequence of climate change, can certainly become meaningful to many observers already within a generation (think for instance of sea-level rise or receding glaciers), the global and long-term implications stay

necessarily out of the individual observers reach. This lack of 'direct' visual evidence (as opposed to smog in cities for example), especially when considering the temporal dimensions, has contributed to a slow adoption of the problem by international politics as well as to diverging opinions amongst the public (Doyle 2007, 2011). The search for more 'efficient' and engaging visualisations and communication strategies, often through adopting more local and personal perspectives, is therefore still ongoing (cf. Sheppard 2012).

However, visualisations can certainly be in many ways 'efficient', yet they do not automatically spark political action nor do they induce in any systematic way widespread affective engagement. NASA's ozone hole visualisations for instance (as shown in Figure 5) had an important impact on political action (Grevs Mühl 2014a, 2014b), but the image's broader message – that is, manmade substances can affect vital aspects of our environment on a global scale and for a considerable time span – was clearly overlooked. Until today, these fears have unfortunately stayed at the very top of the environmental agenda. As Mahony (forthcoming) points out, the somewhat common belief that in order to induce political action on climate change, we simply have to render carbon emission and global temperature accessible to the 'naked eye' just like the smog of Victorian London, is certainly problematic – and one might add, naive. To be sure, we clearly cannot do without visualisations because they constitute the only practical and efficient way to understand and communicate global environmental change, but we still need more research on why many global environmental icons, despite their high public visibility as dominant visual tropes, often show little impact on widespread political action or affective engagement (O'Neill and Hulme 2009; Doyle 2011). Most theses that follow will pick up on key aspects involved in these issues, such as scale, distance and the advantages or disadvantages of 'expert' and 'non-expert' images.

Thesis 2: Material and visual cultures shape together the outcome and leave a direct imprint on how global environmental change is visualised and thus perceived and interpreted. The underlying choices and presuppositions, however, have to be made more explicit in order to repoliticise global environmental imagery.

If the visual is constitutive of global environmental phenomena, then the producers of the images and the particular mediating technologies involved in their creation must play a key role in knowledge-making. Many scholars have tackled this aspect in the past, amongst which one finds cultural theorists, philosophers, art historians and scholars in science and technology studies who all have contributed in their own crucial way to these debates. In particular research carried out in environmental communication and rhetoric, a vibrant research field with a well established literature that we

can only mention here, provides first promising results (e.g. special issue *Environmental Communication* 7 2013; Cagle and Tillery 2015; Pearce *et al.* 2015; Walsh 2015). In the following, I would like to briefly point out only two of these discussions which can be helpful for furthering inquiry into global environmental images.

The first one concerns realism in artistic representations during the 1950s and 1960s as documented for instance by Blocker (1979, 39–43), involving the contributions of two well known psychologists working in aesthetics: Arnheim and Gombrich. Both showed that, in art, there is no such thing as ‘absolute realism’ or automatic and purely mechanical duplication of nature, or as Arnheim succinctly put it: ‘Representation never produces a replica of the object, but its structural equivalent in a given medium’ (Arnheim quoted in Blocker 1979, 41). Realism, conceived as ‘faithful’ representation of nature, is in other words not a stable category but rather a socio-cultural and historical product. Thus Blocker (1979, 43) concluded that the ‘work of art is not a transparent opening to the world, but a particular human way (among many others) of looking at the world’.

This insight, however, and this brings us to our second, closely related discussion, extends well beyond artistic reproductions of nature and counts in fact for *all* visual productions. As cultural artefacts, they are shaped by historically situated techniques, styles and tools. Science scholars can learn from art history how the gaze is socio-historically conditioned (Baxandall 1972), influenced by disciplinary practices and material cultures (Alpers 1983), as well as the crucial role of shared visual styles and interpretative traditions (Bredekamp *et al.* 2015) all of which can be highly relevant for a historically informed analysis of scientific and environmental images. Similarly to art historian Wölfflin who drew an analogy between artistic style and language, with each style having ‘its own strength in a different direction’ (quoted in Blocker 1979, 42), science historians revealed the crucial importance of the introduction of specific ‘visual languages’ for the constitution of autonomous disciplines within the sciences (e.g. Dagognet 1969; Rudwick 1976/2004). Although the direct comparison with language can prove problematic (Boehm 2004) – in particular because semiotic approaches are far too static and ahistorical to grasp underlying historical dynamics – the core message provided nevertheless a powerful antidote to the conceit of scientism and long-held beliefs in the constant progress of ever more ‘accurate’ scientific representations of the world. Because most scientific images seem to be truthful to nature, they play a crucial role in the way we perceive the global environment, in the ways we apprehend it and finally act upon it. Mobilised by actors of political, social and economic life, understanding how these particular ways of seeing are constructed is therefore of great importance.

What one can observe in many disciplines in the human and social sciences, especially from the 1980s onwards, is a critical interrogation of these various ways of seeing and engaging with nature, of how the visual constructs, reassembles and shapes reality (e.g. Sontag 1977; Latour 1985, Mathis C-F 2010). This also counts for our ability to understand and act upon the environment in social and political life. From cartography (e.g. Monmonier 1991; Harley 2001; Pickles 2004), over photography (e.g. Poole 2008; Cosgrove and Fox 2010; Doyle 2011; Grevsmühl 2014a), to satellite imagery (e.g. Heise 2008; Dubois *et al.* 2014; Wormbs 2013; Höhler forthcoming), practically all visual knowledge practices have received close attention from scholars, stressing the selective nature, the creation of blind spots, yet also the gain in accessibility and manageability. Since there is no unmediated access in knowing global environmental change – the abovementioned examples all make this very clear – there are many lessons to be learnt by engaging in a truly interdisciplinary approach to global environmental imagery. This can help in particular to engage in a more reflexive approach, especially when it comes to climate change. If the choices and assumptions underlying the images are fully assumed, they also have to be made more transparent to the public, helping introduce a process of repoliticisation of global environmental images. In so doing, it can become possible to move from static to more dynamic nature framings, to denaturalise the sole scientific perspective and to introduce a greater diversity of ways of experiencing and knowing nature. In times of loss of trust in scientific knowledge-making and calls for participatory science – and this concerns the Earth system sciences as a whole – engaging in this type of reflexivity can also help introduce and promote new democratic ideals.

Thesis 3: Global environmental images call for a close analysis of the production sites and geographies of knowledge-making, thus inviting to profoundly rethink the relationship between the ‘local’ and the ‘global’. One possibility is to open up discussions to non-Western conceptualisations of the global environment.

Amongst the many turns the humanities have seen during the last decades, the spatial turn (Ophir and Shapin 1991; Smith and Agar 1998) helped introduce powerful new questions to the interdisciplinary study of the environment. By inviting geography to the table of discussion on scientific knowledge-making, a new sensitivity of place and context was developed. David Livingstone’s (2003) call for taking ‘place’ and ‘space’ seriously in the study of science and of the complex interactions of societies with nature has thus become a shared concern for many scholars not only in geography, but also in sociology, anthropology, history and cultural studies (cf. Döring and Thielmann 2008).

Global environmental images reveal an uneasy relationship between the ‘local’ and the ‘global’, between

engaging lifeworlds and the cosmopolitan global. The creation of global environmental phenomena, such as for example the reification of global-mean temperature (Hulme 2010) or of global-mean sea-level rise (Dubois *et al.* 2014) within the climate change regime, implies necessarily a great level of abstraction. This top-down perspective of planetary knowledge, as illustrated by maps showing for instance projected sea-level rise based on satellite measurements (see Figure 7), may thus be argued as often too distant and remote to become meaningful within everyday life. Indeed, as Hulme (2010, 559–60) and others have shown, the ‘globalising instinct in the contemporary making of knowledge about environmental change’ creates objects that are ‘psychologically sterile’ because they lie well beyond our horizon of personal experience. Only substantial efforts of imagination allow for these global environmental objects to be eventually acquired in everyday living.

Thus, one main problem of this kind of planetary knowledge-making lies in the geographies of power it imposes, showing, as argued above, often main traits of technocratic order and highly centralised power, a problem which is (as argued at the beginning of this essay) already at the heart of the notion of the ‘global environment’ itself. But besides this known critique, two further and closely related aspects should be mentioned.

First, the aggregation of local knowledge into global environmental objects creates of course far more blind spots than new knowledge. As top-down views, global environmental images severely neglect the concrete complexity of local environmental change. Yet it is precisely the local signature of environmental change that usually mobilises civil society and bonds resources. For the inhabitants of island nations in the Pacific, such as

Kiribati (cf. Camus 2014), it is for instance far more relevant to know sooner rather than later how exactly local fishing practices or connecting pathways between the islands will be affected, and in the near future, if and how it will be possible to adapt locally to global sea-level rise. In a similar way, global El Niño models and satellite visualisations generally downplay the severe local violence these events regularly provoke, for example in Peru. All globalised knowledge thus rightly stands accused of neglecting to some degree or another local geography – which is precisely all about the complex, local interactions between societies and nature. To be fair, some disciplines have learnt from these critics. For instance, as a consequence, after a long phase of integrating more and more ‘spheres’ (atmosphere, lithosphere, cryosphere, etc.) into their models (cf. Dahan 2007; Edwards 2010), climate modellers are now increasingly turning to local studies of a changing climate and the expected impact for very specific regions and places.

Second, despite their almost ‘universal’ appearance, all global messages take their origin in highly localised scientific practices, institutional settings and socio-technical arrangements. Clearly not everybody has the same access to consuming and even less to creating planetary environmental knowledge. The ‘view from everywhere’ (Hulme 2010) is therefore by no means the ‘view from everyone’. There are of course privileged sites for creating global knowledge and detecting planetary environmental change and these sites reveal shifting geographies over time (cf. Cosgrove 2008). Whereas the mountains functioned all along the nineteenth century as one of these privileged sites for observing the global environment (think for instance of the well known analogy between altitude and latitude), they have given way during the twentieth century to

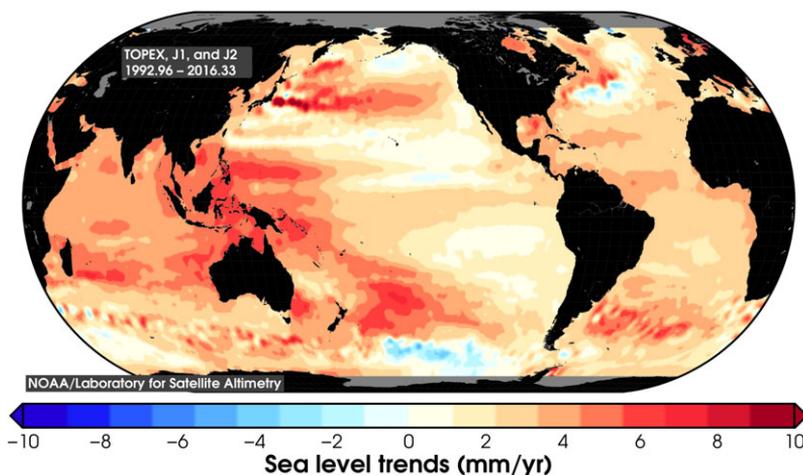


Figure 7 Global map of estimates of sea-level rise

Source: NOAA/NESDIS/STAR

new geographies where the tropics and the polar regions play henceforth the role of ‘benchmark regions’ of global environmental change (Grevsmühl 2010, 2012).

There is in other words a great risk of downplaying cultural difference and of neglecting the radical biases these power relations imply. After all, ‘naturalism’ (Descola 2005/2013) defined as the Western, objectifying, scientific gaze is only one of many (Descola would hold ‘four’) ways of seeing and conceptualising societies’ relationships with their environments. Paying close attention to other ways of seeing, other ‘technological world-pictures’ (Tresch 2007) can help reveal asymmetries and marginalisation processes that occur within the struggle of who has the authority to speak about or in the name of the global environment. In other words, being attentive to these issues can help giving voices to those who do not have access to the large-scale geophysical observation infrastructures, which saw their rise in particular during the Cold War and which represent today the infrastructural backbone of our global environmental surveillance networks (Turchetti and Roberts 2014). Historian John Tresch (2004, 2007; cf. Grevsmühl 2015), by introducing the notion of ‘cosmogram’, has invited us to profoundly rethink these issues. As a contraction of ‘diagram’ and ‘cosmos’, the concept refers to material inscriptions and images that help build relationships with the environment conceived of as a global entity. Thus, while still aspiring to truly global framings, analysis and comparison of different ‘cosmograms’ can bring back cultural diversity to the table of discussions, largely dominated by the objectivist, Western, techno-scientific gaze. Indeed, indigenous movements calling for return to Mother Earth also produce images and collective frameworks for rethinking the relationship of man and nature that are just as important as objectivist arguments produced by Western science.

An interdisciplinary enquiry into global environmental images can thus bring back diversity and local needs to the table of discussions. And by uncovering the underlying power relations, we may finally ask questions that really matter: Which imaginaries of nature, of the global environment, and of the Earth system do we want to put forward? Which ideologies are fabricated and transported through imagery, and what role do science and technology play within the construction of these narratives? How can we effectively reconcile global views with local needs? Global environmental images play an active, performative role within all of these processes that we urgently need to better understand. To be sure, analysing these power structures surrounding global environmental images does by no means deny the urgency or warnings these images try to convey. To the contrary, it may ultimately help to reformulate collectively some of the crucial answers we wish to give.

Acknowledgements

I would like to thank two anonymous reviewers for their helpful comments and critics as well as the Editors for their support, guidance and valuable suggestions. Part of this research was funded by the TEUS project (241009, ERC-SG-SH2) led by Simone Turchetti at Manchester University. The GIS Climat-Environnement-Société under the direction of Sylvie Joussaume generously funded several case studies discussed in this paper via the ENVIGLOB project.

Notes

- 1 The conference ‘New perspectives on global environmental images’ co-organised by GIS Climat-Environnement-Société and Centre Alexandre Koyré was held in Paris on 9–10 October 2014. The presentations as well as the acts of the conference may be accessed online (www.gisclimat.fr/feedback-international-conference-new-perspectives-global-environmental-images).
- 2 Das technische Bild Project Page (www.kulturtechnik.huberlin.de/content/dtb) Accessed 30 March 2016.

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