Sebastian V. Grevsmühl, science historian

"The cold war was fundamental in the idea of the global environment "

Last 10th February, **Sebastian V. Grevsmühl** delighted us with his talk "*Exploring the borders of lab and field sciences in Antarctica: Which lessons for remote sensing through satellites*?", embedded in the colloquium cycle *Situating space technology between lab and field science*. Grevsmühl, is a science historian, specialized in environmental history and visual studies. Since 2012, he has a doctorate in the history of science (EHESS / Center Koyré). What's more, he has directed and collaborated in several projects, such as ENVIGLOB which gave rise, in 2017, to a special issue published in the journal GEO: Geography and Environment. He is the author of numerous articles on the history of geophysical sciences and its relation with The Cold War, environmental history, spatial and polar history, as well as on visual cultures and the role of images in science.

History based on visual study is not a very common research field in France. How does your interest in this field appear? My interest in visual studies in science probably aroused from my first studies. At first, I studied cultural sciences in Germany. During those studies we were very interested about fundamental medium theories, especially the cultural influences and the consequences of those. The professor who holds the chair in cultural techniques was my tutor during the whole time, and he also knew a lot about the history of sciences. So that is where I got to visual studies and started wondering how techniques shape scientific statements or how images play a fundamental role on how we think about science.

Visual studies look like a very potent tool to reach the public. What role do the visual study researchers play in the public eye, and which one should they play in your opinion? Yeah, in general history of science is a very good field to talk to the public anyway, but it is important to think about the ways we conceptualize certain scientific objects in the past. In general, it is always very helpful. Images bring in other dimensions that are also very interesting for the public in general, but also because they constitute knowledge in a very particular way. They do not have just an illustrative function in science, but they do much more… And that is why they are so interesting. If you can tell stories about what images do, that is very appealing to the public.

One of the most striking environmental topics on the public discourse nowadays is climate change. How do visual sciences contribute to it? Of course, they are important for climate change because they already have a very fundamental role in science. That role of images in science has a very long-standing tradition, and that is why it is more important today, because

we mobilize even more images that we did in the past. Not only because of the quantity, but also because of the ways we reason about certain objects. We cannot think about a global environment without mobilizing images.

One of your projects, called *Better understanding of the Cold War as an engine of geophysics research* revolved around the relevance of field sciences in the Cold War. Did the Cold War represent the start of a paradigm shift in the conception of field sciences? The cold war was fundamental for the development of the idea of the global environment. The military together with the geosciences built the global networks that are still in use today for understanding the global environment. Environmental surveillance networks were put in place during the cold war for reasons that are obvious, such as the monitoring of atomic explosion or control of atmospheric nature… All different kinds of networks were put in place to survey the environment. These fundamental structures give us today the measurements we use for baseline measurements on the global environment. What is more, they also revolutionized knowledge related with the relation between the troposphere and the oceans. We must bear in mind that they were mostly projects run by geoscientists with military implications, but the cold war was totally crucial for much of our understanding today.

During your talk in the cycle "Situating space technology between lab and field sciences" you mentioned that the dichotomy between lab and field sciences did not exist until the XIXth century. How did this dichotomy appear and how has it evolved since then? Yes, the idea that we do produce knowledge in the lab comes with instrumental revolution. We have high-precision instruments that we keep in a certain place, so there is a controlled setting about the way we do science. Robert E. Kholer, in his book "Labscapes and landscpaes", talks about border shift fields from lab to the field and on the other hand, what happens to certain disciplines in science when you move all of a sudden the lab instruments outside in the field and you still can produce the same results.

What I am interested in is basically what you can observe specially in relation to the environment. In the XIXth century the mountain was the perfect figure to build theories on the global scale. That is because the fundamental analogy that exists between the mountain and the earth as a whole. It is the analogy about altitude and latitude. The further you go up, the colder is the temperature of the polar regions. This geographies of how you produce global environmental knowledge have changed a lot. Today we are not much interested on the mountain as a global model, instead we use Antarctica as a benchmark for global environment, and consequently it has also changed the instruments we deploy. Now you can do field work by sitting on a laboratory and reducing measurements you receive by a satellite, so all of a sudden, we feel research is not conducted by people anymore. So, all in all, the distinction between field and lab is not that important...

The backbone of your talk is the discovery of the ozone hole. Could you briefly summarize the story of the discovery of the Antarctic ozone hole? The ozone depletion was discovered in 1985 by researchers of the British Antarctic Survey (BAS) who realized in the late 1970s that ozone levels were going down during austral winter in October, springtime in Antarctica. At first, they thought that something may be wrong with their instrument, so they got a new instrument calibrated, but both instruments produced the same measurements. So, they concluded that ozone levels were actually going down. In 1985, they published a paper in Nature affirming that there was ozone depletion in Halley Bay. The immediate impact of the paper was not very important, not a lot of people came to see Farman (BAS). But what changed was that NASA were also doing ozone research, and they had ozone hole maps, and so produced the first global maps of ozone, basically at the same time, in late 1984. However, they were quite discrete until NASA entered in late 1985, a couple of months after the *Nature* publication.

The British Antarctic survey research group was on the verge to loss its financial support, and what is more, their first discovery of the ozone hole received very little feedback

from the scientific community. Does this story teach us a lesson about the actual value of field sciences? Yes, I think there is a very important lesson we can learn from it, which is less and less heard today. Fundamental science does not produce results in the short time, but this is a risk we need to be aware of. When the BAS moved to Antarctica to start ozone observations, the aim of those was to enhance meteorological observations in order to improve weather predictions for Antarctica. That result was not produced at all. It took a very long time -from late fifties until the mid-eighties- to produce some significant results because there was not true baseline against, they could compare but it was worth waiting.

Can the different points of view between NASA and British researchers be explained only because of instrinsical discipline differences or do the political differences play a role? It is different to speak about a national style of doing science in one way or another, but about there are clear differences between the institutions such as BAS and NASA explained by funding. NASA and the US in general are the only big player. All the others are far beyond since the beginning of the space race. There is a cumulative effect with huge investments since the cold war… For example, the last time they increased the budget for NASA, this small augmentation was the hole space budget of the French space agency. So that means that there are very small nations like the French whose access to space is much more limited than for the US. Specially the ozone team have a big science institution and a fundamental science institution with a very small budget on a very different level.

During the talk, you mention the Antarctica as "a blank space where you can basically test everything". This sounds really interesting, but could it also be somehow a danger? Well… Often one sees Antarctica as this blank space because of its imaginative function. You can project all kinds of things in Antarctica such as laboratories for survival and psychology of the human mind, literary theories, cultural research, heroic explorations, etc. The scenarios are endless. Very different nations are involved in scientific affairs and have a long exploration feeling in Antarctica, specially the British, but also does France, for example. Cultural and political functions are also one way of colonizing this place. For example, the British in the BAS research area is a secta that they claim as their territory. What is more, there was a Nazi investment in the Antarctica and in the subantarctic islands, so the political dimensions are significant.

During the talk you mentioned Walter Sullivan images – the journalist who published in The New York Times (NYT), which introduced for the first time an image with a hole in the earth. To which extent did those images have repercussion in the public eye, and in political regulation of the Chlorofluorocarbons CFCs) substances? That publication from Walter Sullivan in the NYT is very important, not only because of the image, but because of its intrinsic metaphor. This metaphor is very important because it translates a potential catastrophe. By the negotiation time, the Montreal protocol started to put in place a legal framework for the face-out of CFCs that were causing ozone depletions.

However, what was happening in Antarctica was not very clear at that time when they were negotiating the Montreal protocol. So, what they decided in the negotiation process was that although they knew about the existence of ozone hole, they would not use it, arguing that they would only discuss about scientific findings, which were very robust. By analogy, we could compare this story with a judge, who brings evidence in court but decides to strike it from the record. The jury has already seen the evidence, and you cannot strike it from their minds. The same happened with the ozone hole, what started circulating in the public sphere was not removable any more as an impact on the negotiations of the Montreal protocol and the sense of urgency. So, the precautionary principle had to prevail in the end. I think these images and the metaphor fundamentally help to do that.

In your article *The Creation of Global Imaginaries: The Antarctic Ozone Hole and the Isoline Tradition in the Atmospheric Sciences…* you talk about Norton Wise's argument,

which points that scientific visualization could be integrated as materialized arguments instead of mere illustrations accompanying a scientific discourse. Do you think this approach is actually practiced? I think it has come into practice in history of science in general because we are paying closer attention to the actual technologies and material culture involved in science. When Norton Wise talks about materialized epistemology -as I cited in my paper- it is important to think about the material culture implied. Regarding history of science, he thinks less and less about history and more about practice. And that is a recent shift. Until the eighties-nineties, it was a lot about theory, it was a history of ideas. What we call "the practical turn" is to adopt a more reflective attitude, to think about what they are actually doing, how do they produce those theories, and why if you change the instrument does the theory change, or what makes you have a different view of the world… That is translated also of course by the images the different instruments produce. What is more, this materialized epistemology is fundamental as it contributes to transparency in the public sphere. I think it makes science more reliable.

In this respect, do you think the ozone hole is a transparent concept, or it is rather a mediatic concept? Why is it so potent in the public eye? I think the BAS was pretty transparent about the instrument they had calibrated: what were its possibilities, its instrumental error… Regarding the ozone hole terminology, there have been ozone holes since 1930s. I wrote a paper of the history of the metaphor of the ozone hole, were I explained how the hole as a metaphor can map different contexts. In fact, it was originated in the Astronomical context with Sydney Chapman, who was theorizing about creating a temporary ozone hole in order that his astronomical observations would not have this ozone filter that does not allow readings in a certain wavelength. So, the result was that they opened-up a whole new band with wavelengths where they could do astronomical observations.

After many years, in the Cold War, one would think about which substances could be used to produce an artificial hole as a weapon. However, in the end, when it moved outside from the military research the environmental question would prevail. That environmental question is related with supersonic transportation, the effects that the atomic bombs can have in the ozone layer and so on… So, it has been a long time since the ozone hole is around. In fact, the metaphor was there before Walter Sullivan images, but it was then when it really picked up, because the media were talking about it, NASA produced animation movies… All those could then translate the environmental urgency in a global scale.

Isolines are a geophysical tool with a long tradition and have become popular to represent data in science communication. Why are the isolines so potent for data representation? Are they more accurate than other representations? Well, isolines have a long tradition as true measurements taken in the field since 1701 in history of cartography. Alexander Von Humboldt, for example, use isolines for global temperature at the beginning of the XIXth century for the distributions of temperatures in the global hemispheres at different latitudes. The tool is so powerful because it hides the number of measurements you do. An isoline is a homogeneous space that specializes a phenomenon, and it looks like there are continuous measurements. In reality of course, you do not know how many measurements there are. So, this characteristic is a double-edge sword. Isolines are commonly used to depict holes, for example, the black holes. So, the ozone hole is not an exception.

Regarding the visual side, it is so interesting to analyse how the same formal qualities of the image with a long tradition and this style persists for a long period of time. That is where the influence from art history comes into play, and indeed where visual studies come from. In fact, it shows not only the connection between art and science, but they show that art is in science and science is in art… So, on the one hand, you can have a colour theory in art and in the other, scientists that are trained artists like Galileo Galilei or the naturalists, who needed to be good painters to show their work.