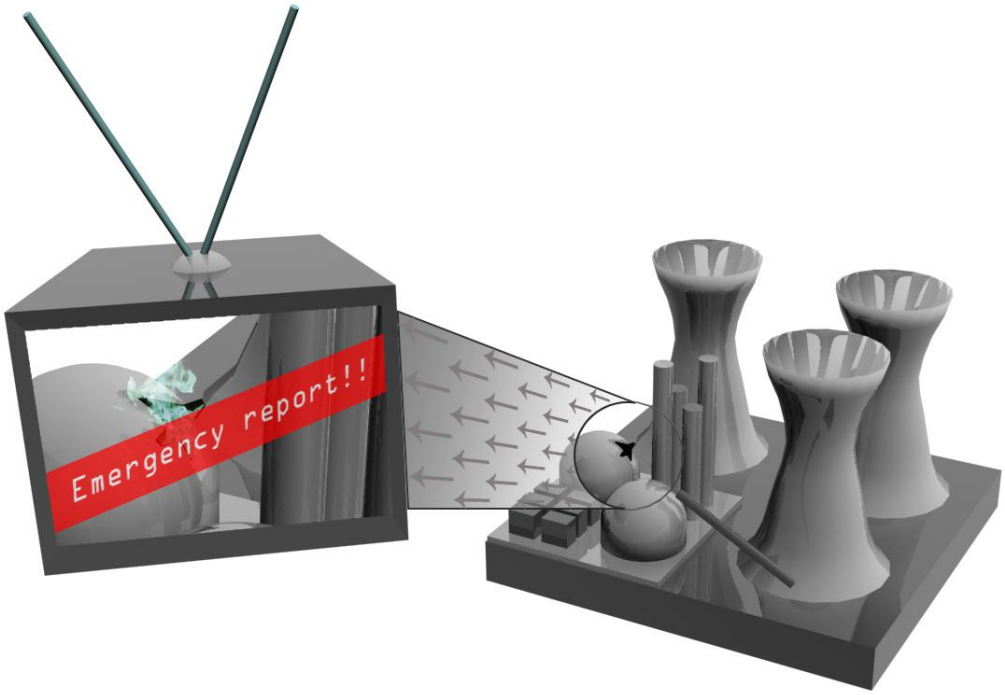
The scientific authority of visualizations



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Abstract

In this article I will argue that the moral panic in the United States with regards to Fukushima radiation has been over sensationalized with the help of weather models and visualizations. I am hereby addressing a real life problem to the epistemological shift described by Evelyn Fox-Keller in her essay “Models, Simulation, and 'Computer Experiments'” wherein she explains that an epistemological shift has occurred from experimentally based science to that of digital simulations. Similar to Gabriele Gramelsberger in her article “Story telling with Code – Archaeology of Climate Modelling”, I will show the consequences of this shift. By doing so, the inherent danger that lies in the agency of these simulations and visualizations will be addressed and critically examined as representations of a codified world.

The danger referred to here is that the ubiquity of visual technology has led to an ever increasing possibility for amateurs to produce content (including visualizations). This allows non-scientific sources to create professionally designed visualizations of research data, which draw heavily on the authority exuded by real scientific practice. I will argue that digital technology and the ease of visualization have a tremendous agency in the way the Fukushima disaster was experienced. In this attempt I will criticize several claims made by popular media on the basis of these visualization and will also try to comprehend how a certain mappings of data has taken hold of the American public.

Keywords: Radiation, Fukushima, Popular media, visualizations, computer models, sensationalism

Contents

Introduction

In the wake of the earthquake of March 11 earlier this year, Japan faced a crisis of nuclear proportion. After the initial earthquake, which scored a 9.0 on the Richter scale, the country was stricken by a tsunami which caused a devastating blow to thousands of houses, villages, farms and towns. However, the crisis and the international media attention were far from over. Apart from 'regular' problems such as finding loved ones, relocation and reconstruction; Japan was also confronted with a growing problem in their nuclear plant in the Fukushima prefecture. With Tsjernobyl still in our memories, international eyes were drawing focused on the potential nuclear disaster befalling Japan.

Since the invention of the atom-bomb and Tsjernobyl, radioactivity and nuclear technology are granted magical powers of destruction and horrid mutation. This horrific notion is exemplified by the so called *father of the atomic bomb* who quoted a Hindu scripture called the *Bhagavad-Gita:* "Now, I am become Death, the destroyer of worlds". With this image in mind, the concern regarding the Fukushima nuclear plant grew as things started to spiral out of control. In the weeks after the earthquake, the media capitalized on this fear of this magical black box of destruction and sensationalized the problem. Digitized visualizations of the fall-out started popping up in the popular media of the United States which usually pointed toward potential danger of radioactive fallout.

In this article I will argue that the moral panic in the United States with regards to radiation has been over sensationalized with the help of weather models and visualizations. I am hereby addressing a real life problem to the epistemological shift described by Evelyn Fox-Keller in her essay "Models, Simulation, and 'Computer Experiments'" wherein she explains that an epistemological shift has occurred from experimentally based science to that of digital simulations. Similar to Gabriele Gramelsberger in her article "Story telling with Code – Archaeology of Climate Modelling", I will show the consequences of this shift. By doing so, the inherent danger that lies in the agency of these simulations and visualizations will be addressed and critically examined as representations of a codified world.

The danger referred to here is that the ubiquity of visual technology has led to an ever increasing possibility for amateurs to produce content (including visualizations). This allows non-scientific sources to create professionally designed visualizations of research data, which draw heavily on the authority exuded by real scientific practice. I will argue that digital technology and the ease of visualization have a tremendous agency in the way the Fukushima disaster was experienced. In this attempt I will criticize several claims made by popular media on the basis of these visualization and will also try to comprehend how a certain representation of data has taken hold of the American public.

In this essay I will argue on behalf of the following statement:

> The computer models and visualizations of the Fukushima disaster, presented by popular media, are granted too much scientific authority due to the epistemological shift described by Keller.

The point that I will be trying to convey is that the epistemological shift described by Keller has added to the authority exuded by visualizations. This added authority is then implemented to sensationalize problems and incite the public more effectively as we can see in the dramatized reports on the Fukushima disaster.

The Fukushima disaster

In the weeks after the initial earthquake, several problems occurred with the Fukushima nuclear power plant causing partial meltdowns in three out of six units of the power plant. These meltdowns were accompanied by several hydrogen explosions and fires which caused radioactive material to spill out of the previously confined space of the power plant. These developments immediately grabbed the attention of journalists around the world causing distress the world over. Reports on Fukushima were constantly flowing in from a wide range of sources.

However, as the immediate threat of an atomic explosion on Japanese soiled died down, the American newscasters started sensationalizing the problem by proclaiming that the United States should be worried of fall-out reaching the western shore (RT.com, 2011). Even the New York Times had no trouble showing the visualization created by the Comprehensive Nuclear Test Ban Treaty Organization (CTBTO) which was created with only weather forecasting systems and not based on actual measurements by the CTBTO[1]. The visualization of the plume's path is nothing more than a function of wind and weather, but this is not how it is perceived by the public.

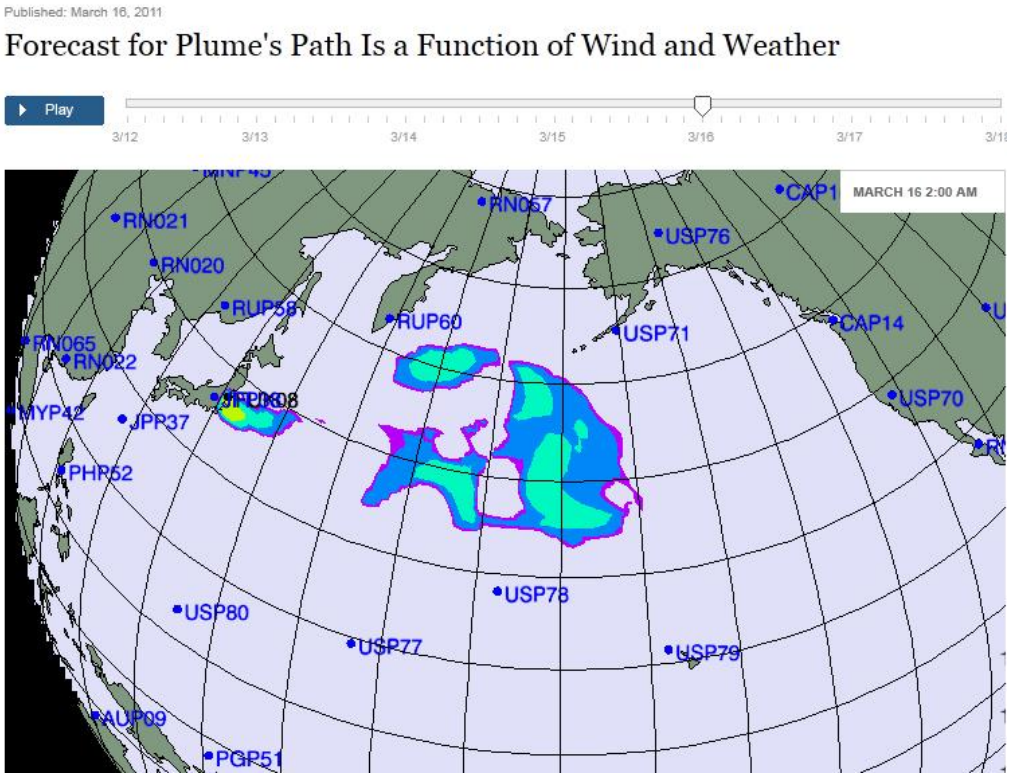

Illustration 1: Forecast radiation plume 16 March (Comprehensive Nuclear Test Ban Treaty Organization, 2011)

[1] We know this because the CTBTO only has 60 measuring points across the world. This is made even clearer in their own visualization which showed that the plume of radiation did not even hit their measuring points (RUP60, USP71 & USP78) by the time the visualization was published on the 16th of March 2011. This little tidbit of information might not seem important as long as disclaimers on methodology are made, but we cannot forget the agency these models and visualizations have on the public.

The ‘interactive’ visualization made predictions of future events regarding the plume’s path.
As you pushed the slider to a future date, the visualization would show how this radioactive plume hits the west coast of the United States. It is therefore no wonder that these visualizations have agency. The visualization of this plume of radioactive material heading towards the United States presented by an esteemed news source seems dangerous and therefore interesting.

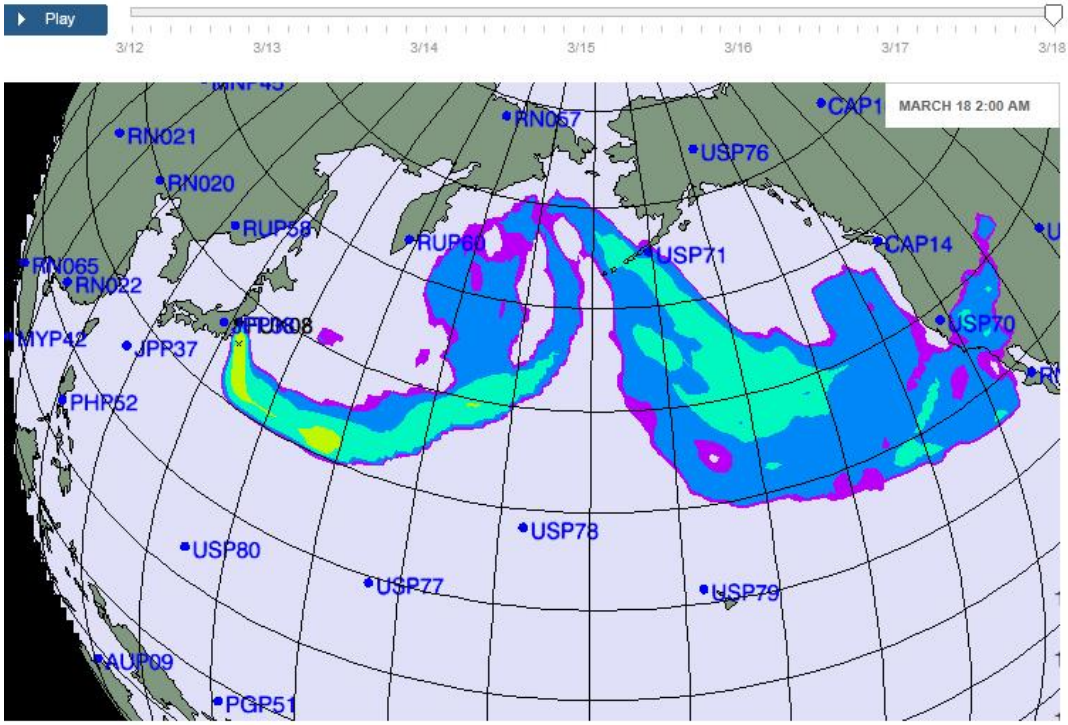

Illustration 2: Forecast radiation plume 18 March (Comprehensive Nuclear Test Ban Treaty Organization, 2011)

These wind and weather models create a false notion of the dissipation of radioactive material. The text does mention that these models are in no way connected to actual radiation and they are merely a function of wind and weather. But it seems that no matter the disclaimer, the visualization itself added to the moral panic in the United States. This is exacerbated through the visualization of colored clouds washing over the shores of the United States. Because even though the New York Times and the CTBTO thoroughly report that the model they are using do not show the level of toxicity (Broad, 2011), there are still people who only remember the scary looking visualization based on the weather model. These people take these visualizations out of the context of the article and use them as evidence for their own agenda. Many can be found on YouTube and the internet in general but I have chosen the following example because she has an overlap in the sources used for this paper.

The example is found in the YouTube user BlessedONE333returnz whom blatantly uses the CTBTO visualization as proof that United State citizens should be weary of radiation poisoning. She explicitly uses the authority exuded by The New York Times to strengthen her point even though the text accompanying the visualization clearly states that there is no danger of radiation. Apart from The New York Times visualization, she also grants enormous agency to the visualization presented by the weather forecast website Stormsurf which displays similar colored wind schemes.

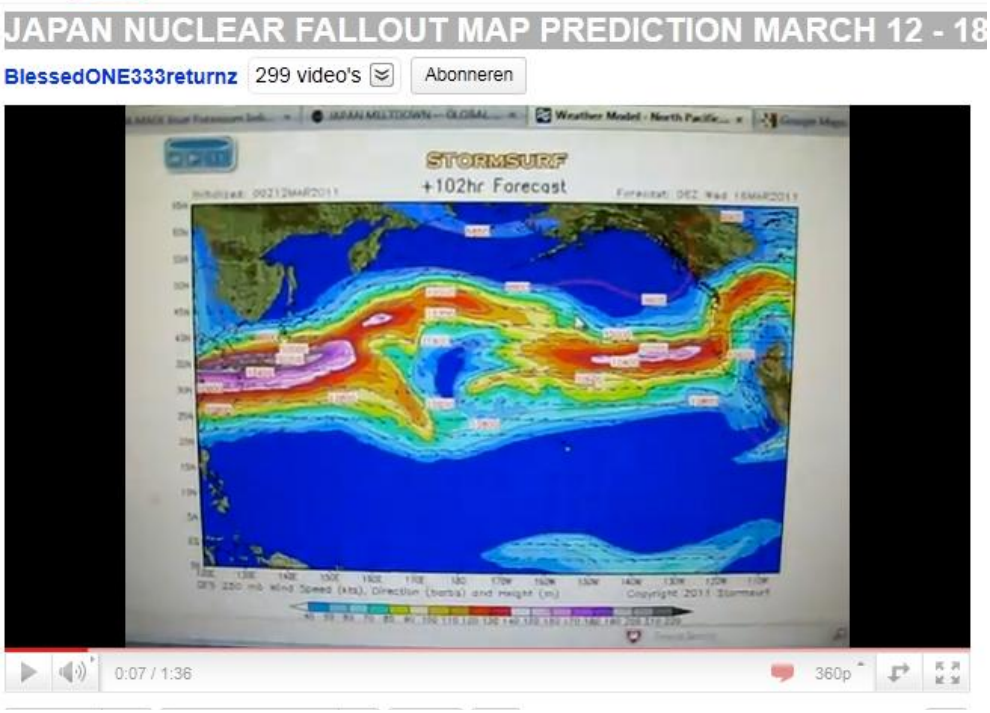

Illustration 3: Japan Nuclear Fallout Map Prediction (BlessedONE333returnz, 2011)

By looking at the profile of BlessedONE333returnz, we can clearly see that she uses the YouTube platform as a faith based soap box and that she is therefore relatively harmless. However, some users are also creating their own visualizations which are quickly spread over the Internet. This was the case with the following illustration which showed the level of deadly radiation coming to Canada and the United States in several days. The illustration (illustration 4) bore the logo of Australian Radiation Service (ARS) whom denied all association with it (Nuclear Fallout Map, 2011). It would appear that someone used the logo to graphically abuse the authority of the scientific community; in this case the ARS. These visualizations are then taken too seriously by certain members of the public who have no reason to assume that these visualizations are not true. In this example we can see that these visualizations imply a sense of objectivity which immediately triggers a sense of validated knowledge in its appearance.

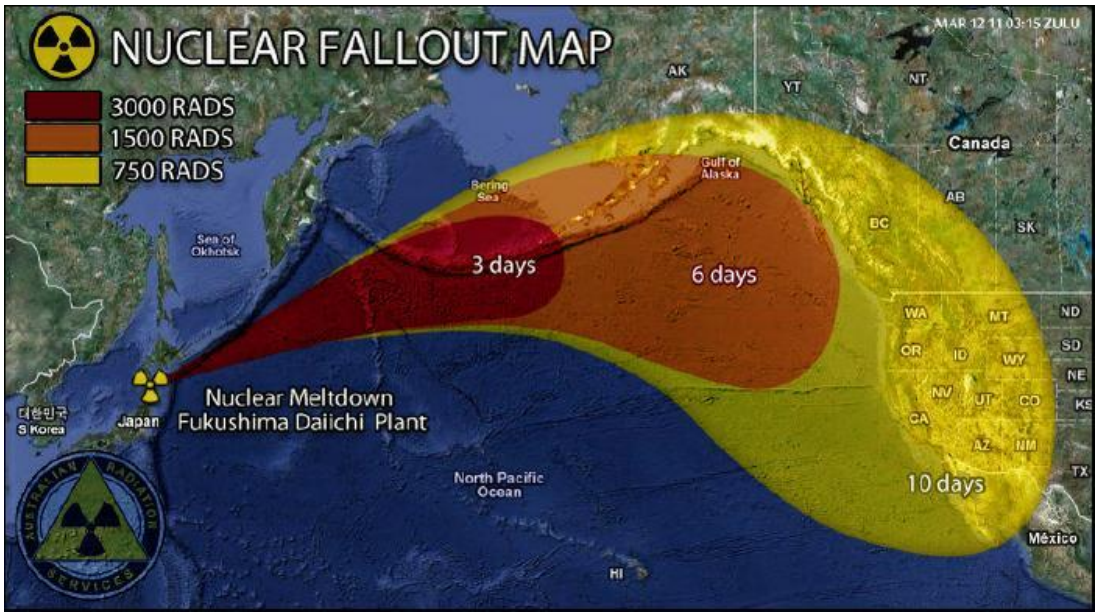

Illustration 4: Fake Nuclear Fallout Map (Nuclear Fallout Map, 2011)

But apart from false visualizations made by anonymous creators, popular media has its share of the blame for the moral panic as well. The fears that are manifesting themselves on the internet are exacerbated by sensationalist news casters. These irrational notions are strengthened by channels such as a CNN news report that are sensationalizing the report for their public by downplaying the physical distance between Japan and the United States.

This practice of over sensationalizing the problem for United States citizens is exemplified by the Nancy Grace new report. Nancy Grace, the hostess, was doing a report on the dangers of radiation for the United States and asks senior meteorologist Bernie Rayno on live television how the wind and radiation from the Fukushima plant is going to affect the United States. However, as he downplays the magical destructive power of radiation, he gets cut off by the hostess who refuses to believe his expert opinion on the matter. It is obvious the report was heading into a more sensational direction before Bernie Rayno opened his mouth as we can see in the illustration below.

Illustration 5: Radiation reaches U.S. (Headline News, 2011)

The report was trying to show that United States citizens should be worried of the effects by showing the relative closeness of the two countries. However, before they Nancy can cut him off completely, he says the following:

> No matter how you slice this. This is not headed for the United States as far as damaging radiation. It did not head to the United States for Tsjernobyl which was volumes bigger than what we have got going on in Japan. This is a huge concern in Japan, no doubt about it. That has to be taken care of. But it is not for the United States. Not the damaging radiation. It doesn't just magically appear, it has got to get here and the large amounts aren't. (Headline News, 2011)

But to no avail. The nuclear panic had once again taken hold of the public causing an uproar nuclear power protests (Nuclear Power Protests in Spain, 2011) (Tabuchi, 2011) (Baetz, 2011). The Fukushima disaster seemed to have struck a nerve with a lot of people who still remember the Tsjernobyl disaster. A nerve that cannot be properly substantiated with rational thought as nuclear power has a lower death/energy ratio than the fossil fuels we are so eager to use (McKenna, 2011).

It would seem that the anti-nuclear lobby (Monbiot, 2011) and newscasters had found a new coat hanger on which to hang all fears of this black box of destruction. This made their reports newsworthy, but also inherently flawed through their appeal to the American public. When news is reported, there is always a justification present in the reason why they have chosen to report one topic instead of another. However, in their attempts to keep up with competing news stations, these reasons start to become convoluted as we can see in the NANCY GRACE Headline News report of CNN. By associating the danger of radiation in Japan directly to the well being of the American public, the news stations try to craft an *experience of involvement* which is designed to provoke an emotional response with the American viewer (Peters, 2011). The preferred method of choice to obtain this emotion response seems to be the power of wind models and visualizations.

We are then left to wonder why visualizations are granted this agency. Why is it that we are so inclined to be persuaded by computer models and computer made visualizations? In the following section I will argue that the visualization of data is a practice that has long been used for scholars to present their findings to the public. It is because of this practice, that the before mentioned visualizations are taken seriously. It is because their appearance exudes and implies a unanimous scientific authority that is not actually present.

Visual authority

Evelyn Fox-Keller describes in her essay "Models, Simulation, and 'Computer Experiments'",
how the scientific community has shifted from using physical models and experiments as a source of knowledge to that of the computer simulation. She thereby focuses her attention on the shift that took place from an experiment based epistemological model to that of a simulation based epistemological model. She claims that practical choices in speed and effectiveness of digital processors have allowed the computer simulation to rival the authority of regular scientific practice. She is thereby showing that computer simulations and the visualization derived from those simulations have thereby appropriated a similar authority as regular scientific practice (Keller, 2003).

The philosopher of science Gabriele Gramelsberger claims that this epistemological shift has thereby transformed science.

> Reflecting on the unexpected insights, the concept of science as a story telling business became increasingly important in my theory of simulation based sciences. Science always has this highly abstract and objective notion in our imagination. Scientists explore the truth, the reality, and they use cryptic and unbribable tools like complex mathematical equations and transformations. The stories they tell establish a specific class of narration: Enormously successful, totally believed by us and with an audience eager to hear more of these stories. (Gramelsberger, 2006, p. 79)

In her essay she illustrates that abstract mathematical equations and models are translated into story to the public "containing all the references of a good story; drama, interesting locations and enormous catastrophic potential" (Gramelsberger, 2006, p. 80) because the abstract models and calculations have become too complex for the public to grasp. We are eager to hear these reports and even more eager to associate them with a sense of truth[2].

[2] It should only be fitting that Gramelsbergers archeology of climate modeling encompasses the same abstract mathematical equations and models used for the Fukushima visualizations. It also bears a noticeable resemblance in its references to a good story; the drama of the loss of lives, interesting

The problem is that the term 'scientific' is for many people synonymous with truth and knowing. The public thereby no longer has a role in the creation of scientific knowledge because they have been told that their presence disrupts the fabric of scientific objectivity. "The public's role now consists solely in acceding to scientific judgments and in rendering support for activities that that scientists deemed desirable or essential" (Shapin, Science and the Public, 1990).

The scientific community has thereby distanced themselves from the public since the 17th century in order for them to exude objective authority. However, this authority has been displaced to the realm of computer simulations and in turn digitally made visualizations of data. This epistemological shift has made the visualization a powerful tool of persuasion. Due to the inherent implied objectivity of maps and visualizations, they are considered a representation of verified knowledge.
But what people fail to understand is that no academic article is capable of truly presenting their entire domain of study and that the presented models are merely idealized versions of reality, prone to all types of methodological faults.

Science is not always right

> I do not have in mind the fables about 'the scientific method' so beloved of textbook writers. I mean that we should seek to find ways of introducing the citizens of democratic societies to the work-world of science-making. We should ways of showing and explaining to them such things as: the collective basis of science, which implies that no single scientist knows all of the knowledge that belongs to his or her field. (Shapin, Why the public ought to understand science-in-the-making',, 1992, p. 28)

In this quote by historian of science Steven Shapin extracted from his essay "Why the public ought to understand science-in-the-making", he deplores that citizens of democratic societies are shielded from the working of science. By consistently keeping the public in the dark in regards to the methodology of scientific practice, they have no reason but to put trust into the results of scientific experiment. And he states that the academic defenders would have it no other way to protect themselves from the public losing favor with scientific practice which in turn would lead to a negation of their scientific prestige (Shapin, Why the public ought to understand science-in-the-making',, 1992). In his earlier works "Science and the Public", Shapin describes how we have gotten to this situation.

It is because science has slowly dissociated itself from the realm of the public since the Scientific Revolution of the 17th century.

> The tradition of observational and experimental sciences which derived partly from the philosophical programme of Francis Bacon, implemented and publicised by Robert Boyle and his colleagues in the early Royal Society of London, was one that vigorously insisted upon the necessity of a public presence in proper scientific practice (Shapin, Science and the Public, 1990, p. 955).

It was even considered unscientific to deny public access to scientific practice which alchemy was routinely chastised on. However, as academia became increasingly institutionalized in the 18th

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location and the catastrophic nuclear potential. It therefore makes an interesting story, a story one can capitalize on through sensationalistic reports; as we could see in the popular media of the United States.

century France, science had started to dissociate itself from the public. This was partly due to the specialization of scientific practice. Specialization made it less in tune with the lived experience of the public which exacerbated dissociation. However, this dissociation did not mean that the public lost trust in science, the opposite is true. Scientist predicated the legitimacy and importance of their work through an enterprise Shapin calls 'natural theology' by which scientist derived their authority through religion. When in the late 19th century, scientists turned away from religion as object of science, they still maintained and expanded their authority to the secular domain. All the while they continued to stipulate that the scientific endeavor should not be compromised by public interests (Shapin, Science and the Public, 1990).

But this dissociative situation is not a healthy one since it gives scientists an irrefutable authority as Francis Bacon probably feared. The ideal situation would be to grant all citizens an insight into the specific methodology of all scientific practice. Without it, the public will always be prohibited from scrutinizing the scientific practice. However, we cannot forgo the socio-political and financial motivations that are in place. Intellectual property is a highly valued commodity and is therefore protected with secrecy in order to stay ahead of the competitor (Shapin, Why the public ought to understand science-in-the-making',, 1992). In this neo-liberal capitalist environment, it would be unwise for corporations and governments to simply give all technology they have available since it would diminish the motivation to invest into scientific research and development.

However, there is another downside to this secrecy relevant to the art of modeling and visualization. The problem with this pragmatic scientific practice is that is has become hard for the public to distinguish between validated scientific practices and shotty reports made with a specific purpose. The secretive, dissociative scientific enterprise now has a significant problem in regards to the disruptive power of non-scientific sources that are more than willing to leach of their authority. Similar to early scientists who used to religion as a vehicle of authority, amateurs are now capable of using visualizations as a vehicle of scientific authority.

New media scholar and professor of Visual Arts Lev Manovich illustrates in his article "What is Visualization" that the development in digital visual technology first started with scientific visualizations in the 1980's (Manovich, 2008). This is when the public first started to associate computer graphics with science. Because computer visualizations were not yet available for regular people, it was deemed to be a phenomenon restricted for people with great knowledge, ability and authority. However, since the 1990s the visual technology for home computers had allowed amateurs to create their own information visualizations which could be, although not completely alike, very similar to scientific visualizations (Manovich, 2008). Whereas the public could previously rely on a scientific basis for visualizations to show truth, they are now confronted with a myriad of sources which are capable of creating similar visualizations that exude the same authority as scientific practice. I propose that this is a manifestation of the epistemological shift described by Keller.

We should be therefore be weary and critical of this phenomenon because it now open for exploitation as we have seen with the Nuclear Fallout Map supposedly made by the ARS and the presented visualizations made by the CTBTO.

It is easy to misinterpret computer models and graphics either consciously or subconsciously because they look so professional and informative. It is because of our inability to grasp the true pragmatics of scientific practice that we are inclined to grant too much agency to visualizations and computer models. Because the public has no way of verifying the calculations behind the computer simulations, either because of legal restrictions or mathematical inability, they are left with the idea that the presented interpretation is correct. When they are confronted with a visualization, there is an assumption present that the visualization must have required a wall of code, complex calculations

and computer skills. But this no longer seems to be the case in a world where visualizations can be made without proper academic training.

I would therefore like to add to Shapin's essay by stating that more transparency is required in the scientific method if it wants to uphold its authority. Scientific visualizations should distinguish themselves from amateur visualizations by showing how scientific practice is performed. If not, I fear that the true scientific work will become lost into a maze of amateur made, unfounded visualizations.

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