

*Roberto Muffoletto, Anita Bokwa*

## **THE CONSTRUCTION OF AWARENESS: EDUCATIONAL IMAGES OF WEATHER AND CLIMATE FROM TEXTBOOK TO THE INTERNET**

*Abstract:* Image, if used correctly, can change the viewer's understanding of a phenomenon at hand. The development of concepts concerning weather and climate was accompanied by the advancement of their images and representations. Weather and climate images can play an important role in the construction of social awareness of such phenomena as current climate change, but their correct perception demands a previously established framework of knowledge related to both weather/climate and technology. Therefore broader usage of weather/climate images in education is of great importance.

*Key words:* image, education, satellite images, climate change perception.

### **1. Introduction**

The images of weather and climate have been evolving since ancient times until today from imagined representations to satellite photos. So were the scientific concepts concerning the nature of weather and climate and the social awareness of the phenomena. What is the role of image in the construction of student's understanding and social awareness concerning weather and climate?

### **2. Image and its Perception**

From the early cave drawing to computer generated virtual reality experiences, images as a re-presentation, or representation, have been constructed to capture and communicate elements of the human experience. We have given witness to an enhancement for capturing the experience of the external world to a point where images have constructed new worlds for us. We can not take seriously enough, the role of representations in our daily personal and professional lives (Nichols 1981). How we have come to know the world and ourselves in it, is a result of our engagements

with various images. As the means of image production moved our experiences closer to what we think reality „looks” like, images formed through oil on canvas, the reaction of light on silver, and electrons hitting a phosphorus coated screen, began to influence our consciousness and ways of knowing ourselves in the world. Technology, as a system of tools and processes, in an attempt to create models and replicas of reality, has allowed us to construct worlds we never could have known or experienced.

There are many examples of this in the past century; the two dimensional aspects of photography, film and television, and the 3-dimensional constructs of film and virtual reality, each development in the „technology of representation” brought new experiences to the viewer. New tools of experience construction, new processes for the cognitive encoding and decoding of what was understood to be reality. We cannot ignore the idea that image production is actually the construction of experience. Simulations are not real, they are constructed experiences (Arnheim 1969; Negroponte 1996). The experience is real, while the image is a fabrication.

### 3. Concepts and Images of Weather and Climate

Both weather and climate are abstract concepts, but weather was defined much earlier than climate. Moreover the meaning of the word “weather” practically has not changed through the history of human kind. It has always meant the state of atmosphere (all phenomena present in the air around us) at a certain moment, while the word “climate” has been defined in many different ways. Ancient Greeks, for example, used to consider insolation as the main climatic factor and they defined five climatic zones due to the height of the Sun above the horizon (Okołowicz 1969). Just to mention a few modern approaches to the definition of climate, A. Humboldt in early 19th century described climate as all atmospheric changes which we can clearly percept with our senses and which influence the amount of heat in the ground and all alive organisms, including man. In 1883 J. Hann introduced the definition of climate where it was meant as the mean state of the weather in a certain place (Okołowicz 1969). Today we usually define climate as the yearly sequence of weather types typical for a certain place which reflects much better than the previous definitions the dynamics of the climate.

We are used to the fact that weather changes all the time, but climate has been considered to be a stable element of the environment, as stable as the relief or soils (Chromow 1977). As state von Storch and Stehr (this volume) humans depend fundamentally on the reliability of climate and sometimes this reliability is perceived as being endangered, especially when sudden changes in climate occur. Today we know that climate has been changing considerably in the past and that it is still changing. Even though there are still many uncertainties about the causes of climate change in the past and at present we consider the climate’s instability to be its permanent feature and we accept that the climate has been changing at various rates in different periods of the Earth’s history. We, scientists, do but this concept still needs to be better implemented in social awareness. So far the changes of climate, for example the current global warming, are presented to the public most often not

by scientists but by the journalists, only to produce front-page news. Therefore different kinds of images are used or rather abused to create false sensation instead of using the image to improve the understanding of the true nature of the phenomenon. People and cattle dying in the countries of Sahel due to long dry periods are shown in the news to prove the effects of global warming even though there is no evidence of the direct link between global warming and changes in global atmospheric circulation which cause both droughts and floods. Also a graph showing a temperature rise in a long period at a certain station may not be used to prove the reality of global warming's existence all over the world. The warming has not been globally uniform and some areas have cooled. The recent warming has been greatest over the continents between 40° and 70°N (IPCC 1996).

The definition of weather has altered little as was mentioned before, but the ideas about the forces causing mainly weather changes, but also climate change had to be gradually discovered with the development of science. In ancient Greece the universe was believed to be made of the four elements: fire, air, water and earth, but they were understood rather as principles than distinct substances, as we think of elements in present-day chemistry. The elements could be transferred into one another in the order:

Fire ↔ Air ↔ Water ↔ Earth

Aristotle (384-322 B.C.) refined and made much more systematic the doctrine of the four elements. He believed these were produced by combination of two of the primary qualities: heat, cold, dryness and moistness, as follows:

hot+dry=fire      hot+wet=air      cold+wet=water      cold+dry=earth

The world-system devised by Aristotle was re-introduced to the West in the twelfth century and it continued to rule the minds of nearly all the investigators of nature up to the time of Galileo (1564-1642). The early revival of scientific activity in Europe was rendered impossible by the philosophical position of the early church. The church claimed complete control of the human spirit, so those who wrote about science in the first millennium were chiefly interested in using it to illustrate and interpret Holy Writ and for example Augustin (354-430) believed that God permitted demons to affect the weather. In such an intellectual environment progress was unlikely. Medieval thinkers were convinced of the unity of the world; they could not understand that there could be more than one way of looking at the universe (Knowles Middleton 1965). At that time violent changes of weather and climate were often interpreted as God's punishment of committed sins and as the portent of apocalyptic horrors (Brazdil, Kotyza 1995). They were also often understood as a result of witchcraft and many women paid with their life for this belief. Witch trials were conducted on as late as 1770s in southwestern Germany, Switzerland, Hungary and Poland (Behringer 1999). The beginning of the modern meteorology and climatology is linked with discovering trade winds by Columbus in 1493 and monsoon by Vasco da Gama in

1497. The invention of first meteorological instruments (barometer, thermoscope, pluviometer) in 17th century was also of great importance (Okołowicz 1969).

The development of concepts concerning weather, climate and the factors conditioning them was accompanied by the advancement of their images and representations. The images of the weather itself appeared as late as 19th century. Earlier we find only its indirect representations, as for example four Greek gods (Boreas, Notos, Zephir and Euros) being mythical personifications of the winds from four main directions of the world (Parandowski 1990), or some pictorial documents used for recording periods of colder climate in western Europe in the late 16th century (Brazdil, Kotyza 1995). The first synoptic map, being the image of weather itself or direct weather image, was published in Germany in 1826 by H.W. Brandes, but it contained only very limited information about atmospheric pressure (Meteorologia synoptyczna 1991). The electric telegraph was invented in 1832 by P.L. Schilling, but the first meteorological telegraphic network was established in France in 1854 (Okołowicz 1969) which enabled the quick development of synoptic map construction. Weather charts are more than just visualisation of the measurement data from the meteorological stations. They show a new value emerging from the gathered data, the large scale weather processes. As they become the tool of weather forecast they gain their own new meaning. Weather diaries were known already in antiquity in China, India and Mediterranean area (Chromow 1977), which means that people already at that time used to observe and record weather at a certain place every day in order to understand and predict it. But it was the development of technology and physics and the appearance of real weather images that enabled us to learn the truth about atmospheric processes and weather changes. In the 20th century the information obtained from weather charts was enriched with aerological observations and satellite images. The first satellite weather images were obtained with the radiometer Suomi installed in the American satellite Explorer 7, launched on 13th October, 1959 (Jasiński et al. 1999). Satellite images brought new dimension as far as weather images are concerned, mainly because we can obtain animated sequences of satellite photos showing the real development of weather processes. However even so advanced techniques cannot give us a complete weather image. They let us learn about some weather elements directly (for example about cloudiness), but there are still some elements about which we can learn from the photos only indirectly (for example the wind speed is deduced from the cloud movements). Therefore the traditional observations are still needed and satellite images can only complete it.

The images of climate have been mainly climatic maps so far, showing either climatic zones (based on complex classifications) or the spatial distribution of mean values of climatic elements (temperature, precipitation etc.). Climatic graphs presented mean, multi-annual values of temperature and precipitation in yearly course. Climate was considered to be stable and its representations were following this assumption. At present climatic maps are often showing the dynamic aspect of climate, its changes and future change predictions. The development of climate reconstructions and modelling is accompanied by new images of climate.

## 4. Perception of Weather and Climate Images

Social perception of different events linked to weather and climate depends not only on how they are presented to the public but also on how competent the public is in that matter. Elements of meteorology and climatology are taught and presented in primary and secondary schools as a part of the natural environment's system, a part of geography. For most people this is the only occasion to understand the basic concepts about weather and climate, why they change and what are the main factors influencing them. This knowledge is later a referring point when we deal in our every day life with something as common as a weather forecast, but also when we see in TV areas destroyed by a tornado or when we read in a newspaper about the threats of global warming. Those working in mass media, advertising, and fields of persuasion, know that the "image", if used correctly, in the right context, at the right time, will have an effect on the behaviours and consciousness of the viewer, or reader of the visual text. Very often weather and climate phenomena are presented to the public using different kinds of images because it enables delivering quite a lot of information in a short time (Salomon 1979). The same technique should be used in schools to help young people learn enough to understand and benefit later by the information about weather and climate delivered to them by media in different ways. The relative correspondence between the image and the phenomena depicted is of critical importance in considering the effect on thinking and knowing. As a technology of representation provides the user a higher correspondence between the image generated and the object itself, an internal schemata or framework is necessary for the image to make sense. In other words, a film displaying cloud movements to be understood as such, demands upon the viewer a previously established framework of knowledge related to clouds, weather, and film as a representational technology. As the ability of technology to realistically render increases, the understanding of the phenomena at hand changes.

## 5. Educational Images of Weather and Climate

Education early on understood the usefulness and effectiveness of audio visual education in the teaching of various concepts, skills, and attitudes (Papert 1993). As early as 1900 in New York City schools, children and teachers were introduced to the world and its peoples through the traditional textbook, as well the image. Stereopticons, two still images, each viewed by a separate eye, created a three dimensional experience of what was pictured. The reality, the veracity of the image engaged the student in ways that the printed or spoken word could not. Later, film, silent and sound, introduced to the classroom two dimensional representations of the world, known and unknown. Through the manipulation of time, space, and perspective, new worlds were introduced to children. The "image", still or moving, black and white or in colour, presented the world as never known. The effect of this on the consciousness of the beholder, was one that effected their understanding of what it was they looked at.

New teaching techniques based on using the internet might be a great help in introducing the new teaching methods. They give access to the images of new quality comparing to those available in textbooks. Satellite images show the life of atmosphere, the formation of weather systems, their development, evolution and disappearance. Therefore watching a series of satellite photos or computer animation based on them gives students the real image of large-scale weather processes, together with their real timing (Jasiński et al. 1999). This can be a good start point to explain some chosen problems concerning for example the formation of the centres of high or low atmospheric pressure. Such an approach is in accordance with the present tendencies in teaching methods aiming to activate students and allow them learn not only by perceiving the information given by the teacher but by looking for the information themselves. In case of geography it means that a student uses observation as a source of knowledge about the environment and learns gradually about the relations both within the natural environment and between man and nature. By such a self-teaching a student develops his/her imagination and integrating thinking, where different cognitive abilities are combined. The teacher is no more in the central point of the educational process. The teacher is supposed to organise the process of studying, help students in looking for the information themselves and control the students' abilities of creative thinking and usage of the knowledge in solving new problems (Kucharska 1991).

A serious problem connected with using the internet is abundance of information available there. Therefore it is necessary to create specialised data bases which could help both students and teachers to find easily the geographical and therefore also meteorological and climatological information. This is one of the aims of the Herodot Project, realised within the frames of the Socrates Programme of European Commission. Eight European countries: Austria, Estonia, Finland, Great Britain, Hungary, Poland, Romania and Spain co-operate to create GeoEduServer and to train teachers in using it. More information can be found at:

<http://www.geo.eduhi.at>

## 6. Conclusions

As the changing technology of representation effected the development and design of educational materials, understandings concerning climate and weather have also changed. How weather is depicted on a page in a textbook, or in a computer program, reflect not only the available and affordable means of iconic reproduction, but also the knowledge base held by educators, textbook editors, and science in general.

## Acknowledgements

A. Bokwa thanks the Kościuszko Foundation in New York for awarding her with the research grant which was realised in Appalachian State University, Boone, North

Carolina. During the stay the author gathered materials used in the preparation of this paper.

## References

- Arnheim R., 1969, *Visual Thinking*, University of California Press.
- Behringer W., 1999, *Climatic Change and Witch-Hunting: The Impact of the Little Ice Age on Mentalities*, *Climatic Change*, 43, 335-351.
- Brazdil R., Kotyza O., 1995, *History of Weather and Climate in the Czech Lands I. Period 1000-1500*, Zürcher Geographische Schriften, 62, Zürich.
- Chromow S.P., 1977, *Meteorologia i klimatologia*, PWN, Warszawa.
- IPCC (Intergovernmental Panel on Climate Change), 1996, *Climate Change 1995: The Science of Climate Change*, Houghton J.T., Meira Filho L.G., Callander B.A., Harris N., Kattenberg A., Maskell K. (eds.), Cambridge University Press.
- Jasiński J.M., Kroszczyński K., Rymarz C., Winnicki J., 1999, *Satelitarne obrazy procesów atmosferycznych kształtujących pogodę*, Wyd. Nauk. PWN, Warszawa.
- Knowles Middleton W.E., 1965, *A History of the Theories of Rain*, Oldbourne History of Science Library, Oldbourne, London.
- Kucharska M., 1991, *Tradycyjne a nowoczesne nauczanie geografii*, *Geografia w szkole*, 5, 286-288.
- Meteorologia synoptyczna t. 1*, 1991, Wyd. Wojsk Obrony Powietrznej Kraju, Warszawa.
- Negroponte N., 1996, *Being Digital*, Vintage Books, New York.
- Nichols B., 1981, *Ideology and the Image: Social Representation in the Cinema and Other Media*, Indiana University Press, Bloomington.
- Okołowicz W., 1969, *Klimatologia ogólna*, PWN, Warszawa.
- Papert S., 1993, *The Children's Machine. Rethinking School on the Age of the Computer*, Basic Books, New York.
- Parandowski J., 1990, *Mitologia*, Czytelnik, Warszawa.
- Salomon G., 1979, *Interaction of Media, Cognition, and Learning*, Jossey-Bass Publishers, London.
- Von Storch H., Stehr N., 2000, *Anthropogenic Climate Change – a Reason for Concern Since the 18<sup>th</sup> Century and Earlier*, this volume.

Roberto Muffoletto  
Reich College of Education  
Appalachian State University  
Boone, NC  
USA

*Anita Bokwa*  
*Institute of Geography*  
*Jagiellonian University*  
*Cracow*  
*Poland*