# 13

## *Whole Earth* without Borders

### *Earth Photographs, Space Data, and the Importance of Visual Culture within Environmental History*

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Back in 2010 I was fortunate enough to interview Donald Worster for a special issue of the *Radical History Review* on transnational environments. While our discussion, like Worster's interests, ranged far and wide, the interview focused on many of the important issues he raised in his seminal 1982 essay "World without Borders," which encouraged environmental historians to question our reliance on the nation state and national boundaries. In both the essay and our 2010 interview, Worster lauded efforts to cultivate a more global environmental history, one that followed nature across political borders, but he nevertheless raised important concerns about such an approach. "Take that picture of Mother Earth hanging on the wall," he explained in the interview. "It, too, can become a way of simplifying the earth." Worster then went on to imagine an astronaut floating in outer space who believes his or her view can encompass the entire planet. "But when you get down to the level of the individual, the world may look different—more complicated than you ever imagined."[1]

What follows is an attempt to bring Worster's astronaut back down to Earth. Or, to put it another way, to "take that picture of Mother Earth hanging on the wall" and analyze its global dimensions without simplifying it. Doing so entails first examining the early history of the *Whole Earth* image, which many environmental historians will be surprised to learn, did not immediately appeal to environmentalists. I then trace how *Whole Earth* became *the* poster child for the environmental movement, paying particular attention to the role played by both global nature as well as technology in space and back down on Earth. The essay concludes by arguing that *Whole Earth*'s more complicated history illustrates the benefits not only of following nature beyond national borders, as Worster argued decades ago, but also of integrating visual culture more fully into the methodological future of our field.

## *22727 before* Whole Earth

*Whole Earth's* origin story begins in late February 1966, when twenty-eight-year-old Stewart Brand placed one hundred micrograms of LSD on his tongue, climbed onto the rooftop of his San Francisco apartment, and took

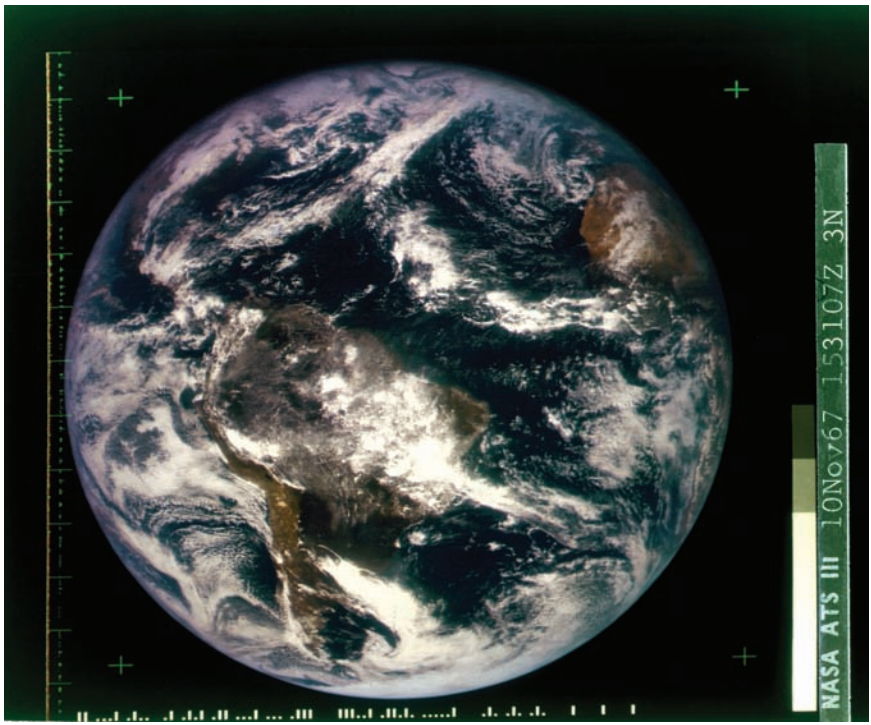


Figure 13.1. Earth photograph, taken from ATS 3, 1967. Courtesy of NASA.

in the view. "The buildings were not parallel," Brand remembered later. They diverged from one another slightly "because the earth curved under them, under me, and all of us; it closed on itself." From his high state he could see for the very first time that the world was not flat and endless, but rather round and finite. Before descending, from both the roof and his trip, Brand decided that a color photograph of the planet from space could provide others with a similar perspective. "The Earth complete, tiny, adrift," he thought, "and no one would ever perceive things the same way."[2] To encourage this view, the next day Brand printed up several hundred buttons with the simple question "Why Haven't We Seen a Photograph of the Whole Earth Yet?," and began hawking them for a quarter apiece to college students at Berkeley, Stanford, Harvard, and MIT. He also mailed them to members of Congress, United States and Russian scientists, and to Marshall McLuhan and Buckminster Fuller. Soon Brand's buttons began appearing on shirt collars and lapels around Washington, DC, and, most importantly, at NASA. Six years later Apollo 17 astronauts snapped 22727, a photograph of the entire Earth free from solar shadow. "And that," Brand argued years later, "helped spawn the environmental movement."[3]

Figure 13.2. Earth photograph, taken from Apollo 8, 1968. Courtesy of NASA.

Many environmental historians have agreed with Brand.[4] So, too, have environmentalists. David Brower, for instance, also credited the photograph that became known as *Whole Earth* for giving birth to environmentalism because it symbolically depicted an imperiled planet in dire need of ecological stewardship. For nearly a decade the first executive director of the Sierra Club travelled the country giving what he called "The Sermon," a public talk at colleges, local community centers, and once in an actual cathedral, that outlined what he called his environmentalist "religion." After recounting the six days of genesis and evolution, Brower focused his homily on the recent birth of environmentalism by holding up NASA's *Whole Earth* photograph. "This is the sudden insight from Apollo," he told his audiences throughout the 1970s. "We see through the eyes of the astronauts how fragile our life is."[5]

Brand, at least, should have known better than to credit *Whole Earth* with jumpstarting the modern environmental movement. He knew only too well that photographic images of the entire planet already existed, and back in 1968 had even published one such image on the front and back covers of the inaugural edition of the *Whole Earth Catalog*, his publication for the counterculture that listed and reviewed small-scale and alternative

Figure 13.3. Earth photograph, taken from Apollo 17, 1972. Courtesy of NASA.

technologies. As Brand explained to his readers, that earlier photo was the "first full-Earth picture," originating from a high-resolution color television film shot in November 1967 from NASA's Advanced Technology Satellite (ATS).[6] Photographs of portions of the Earth from space had an even longer history, beginning in 1962 when John Glenn purchased a Minolta 35 mm camera off the shelf of a Cocoa Beach, Florida, drugstore and used it to take pictures of our planet through the small window of his Mercury spaceship.[7] Every astronaut crew since has brought along a camera and snapped photographs of Earth from space.

These early Earth photographs did not sit on a dusty shelf in a dark corner of the space agency's Washington, DC, headquarters. Rather, the public relations team at NASA immediately circulated these global selfies during the late 1960s to local and national newspapers and magazines, to television networks, and even sold them at a dollar a piece to the public in eleven-by-fourteen-inch lithographs.[8] Corporations also capitalized on the images. "We gaze downward through the lens and from the vehicles of technology seeing our planet from the perspectives provided by science,"

explained an Ashland Oil & Refining Company advertisement titled "The View from Outer Space." The ad, which appeared in *Fortune* magazine in 1969 and reproduced NASA's ATS Earth photograph taken two years prior, concluded with the self-congratulatory tagline "we count ourselves in this effort."[9] NASA even provided photographs of Earth from space for the reels of the popular View-Master 3-D stereoscope.[10] During the late 1960s, then, it was nearly impossible for most Americans to avoid encountering photographs of the entire Earth from space, and quite difficult for them to distinguish these earlier images from the nearly identical *Whole Earth* photograph captured by Apollo 17 in 1972 (see figs. 13.1, 13.2, and 13.3).

These early incarnations of *Whole Earth* rarely sparked concern for a polluted planet from within the blossoming environmental movement.[11] Instead, a different idea infused early public discussions of these images of Earth from space. On Christmas Day in 1968, for example, just hours after Apollo 8 astronauts beamed back live images of the Earth onto television sets worldwide, the *New York Times* published a short essay titled "Riders on the Earth" written by the Pulitzer prizewinning poet Archibald MacLeish. "Men's conception of themselves and of each other has always depended on their notion of the earth," MacLeish began. He then argued that gazing back at the Earth during Apollo 8's mission had altered this conception once more. "To see the earth as it truly is, small and blue and beautiful in that eternal silence where it floats," he explained, "is to see ourselves as riders on the earth together, brothers on that bright loveliness in the eternal cold—brothers who know now they are truly brothers."[12] Readers throughout the world connected deeply with the essay, and the images of Earth that sparked it, and the American press quickly responded in the days, weeks, and months that followed by reproducing it often, almost always accompanied by a photograph of Earth from space.[13] Soon MacLeish's idea of worldwide harmony dominated the cultural meaning of Apollo 8's Earth images and those that followed.[14] Looking back at Earth from space in the late 1960s meant global unity, not planetary environmental concern.

This cultural disconnect between early photographs of Earth from space and environmentalism continued for the next two decades, and is quite evident in the movement's visual culture. Earth Day promotional materials are a prime example. To promote the first Earth Day held on April 22, 1970, organizers drew on a handful of visual symbols that they emblazoned on posters, flyers, pamphlets, and T-shirts. Withering trees, traffic congestion under polluted skies, and a garbage-strewn landscape all appeared prominently.[15] Yet it was the gas mask, worn by mothers pushing baby carriages in parks, by young men trying desperately to sniff spring flowers, and by an Earth depicted by a schoolroom globe, that emerged as the undisputed poster-child


Figure 13.4. Earth Day 1990 logo. Author's collection.

for Earth Day 1970.[16] That the gas-masked Earth was represented by a classroom globe is important; in only a small portion of these promotional materials and photographic coverage of the first Earth Day did an image of the Earth appear, and none included a photograph of the planet from space.

This scarcity of Earth photographs adorning Earth Day promotional materials continued throughout the 1970s and 1980s. During the celebration's tenth anniversary, which drew far less participants than its 1970 counterpart, images referencing the OPEC oil crisis, the Three Miles Island nuclear accident, and endangered species such as whales dominated Earth Day's visual imagery.[17] It was not until the 1990 Earth Day celebration, almost twenty years after Apollo 17 captured 22727, that the Earth photographed from space became a popular Earth Day symbol, appearing on enormous flags unfurled at rallies in Washington, DC, on smaller posters advertising the celebration in small towns across Middle America, and even as the official logo of Earth Day 1990 (see fig. 13.4).[18]

As the early history of NASA's Earth photographs illustrates, Brand's belief that *Whole Earth* launched the environmental movement is more flashback fiction than history. While such photographs from beyond Earth orbit did eventually become important icons for the movement, even late into the

1980s environmentalists had yet to embrace *Whole Earth* and similar photographs from space as powerful political weapons in their battle for a cleaner planet. How, then, did 22727 become *Whole Earth*?

## *Making* Whole Earth

Although environmentalists were slow to accept NASA's photographs of the whole Earth, environmental scientists had been trying to study the whole Earth since the early post–World War II period. Such efforts began back in 1957, when thousands of earth scientists from 65 nations joined together for the International Geophysical Year (IGY), a United Nations–sponsored program of cooperative experiments aimed at studying the Earth as a "single physical system." To accomplish this, IGY scientists collected data from more than 4,000 research stations worldwide as well as from the world's first two orbiting satellites, Sputnik and Explorer 1, the latter of which the United States developed specifically for the IGY program. Although the IGY was unable to obtain a truly worldwide data set—the southern hemisphere was sporadically covered by the program's collection efforts—its unprecedented gathering of regional scientific information illustrated to researchers worldwide the necessity of both orbiting satellites to collect, and computer models to process, global data.[19]

During the 1970s NASA was the key agency in developing both of these technologies. Although the space agency had begun collecting *regional* meteorological data through its Earth-orbiting satellites, including NASA's ATS program initiated in 1967 and its Television-Infrared Observance Satellite (TIROS) launched in 1969, such efforts took a decidedly *global* turn in August 1971 when NASA's Langley Research Center convened fifty Earth scientists from both within and beyond the space agency for a workshop on the possibilities of using satellite sensing technologies to detect gaseous, liquid, and particulate contaminants in the Earth's air and water.[20] The conference's final report, titled *Remote Measurements of Pollution*, concluded that Earth-orbiting satellites could provide global data regarding pollution "that can not be obtained by any other means."[21] Administrators at NASA responded by developing the final satellite in their Nimbus series of orbiting weather forecasters as a so-called "pollution patrol" satellite.[22]

Launched in 1978, Nimbus 7 transported eight highly complex sensors, four of which measured atmospheric pollution, around the entire Earth every six days.[23] While the Stratospheric and Mesospheric Sounder (SAMS) monitored concentrations of water, methane, carbon monoxide, and nitric oxide in the atmosphere, the Stratospheric Aerosol Measurement (SAMS-II) sensor determined the distribution of stratospheric particulates. Complementing this pair of air pollution technologies were two instruments developed

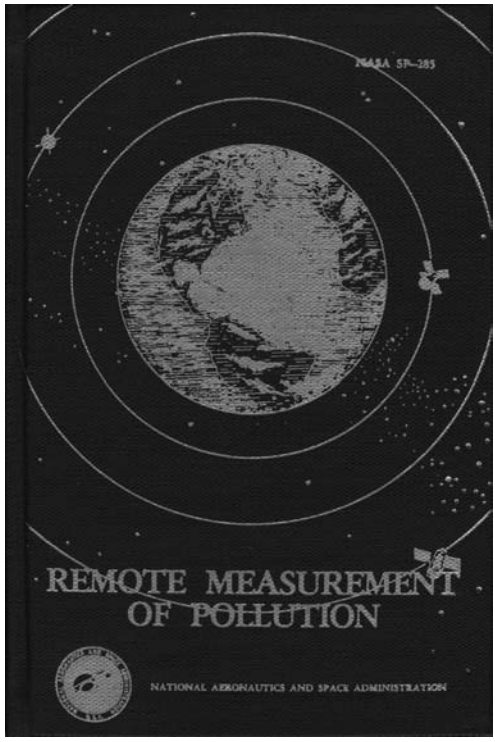


Figure 13.5. Cover from *Remote Measurement of Pollution*, SP-285 (Washington, DC: NASA, 1971).

specifically to measure atmospheric ozone. Engineers and scientists at NASA designed the Limb Irradiance Monitor of the Stratosphere (LIMS) to calculate vertical gas concentrations of water vapor, ozone, nitric acid, and nitrogen dioxide in an attempt to determine if the latter two caused ozone depletion, while the Total Ozone Mapping Spectrometer (TOMS) measured the amount of ozone in a 30-by-125-mile-wide column of air projecting from the Earth's surface to the top of the atmosphere.[24] As NASA later explained, Nimbus 7 was "the single most significant source of experimental data from Earth's orbit" relating to atmospheric processes.[25]

Although global in scope, the data collected by Nimbus 7, like all satellite data, was problematic; it was overwhelmingly large, sometimes inaccurate, poorly calibrated, and often incomplete when clouds made it difficult to "see" through to the Earth's atmosphere. To make this data *function* as global, during the late 1960s the space agency also began developing computer models to "smooth out" these inconsistencies.[26] At the vanguard of such efforts was NASA's Goddard Institute for Space Studies, which since its creation in 1961 served as the space agency's theoretical modeling and

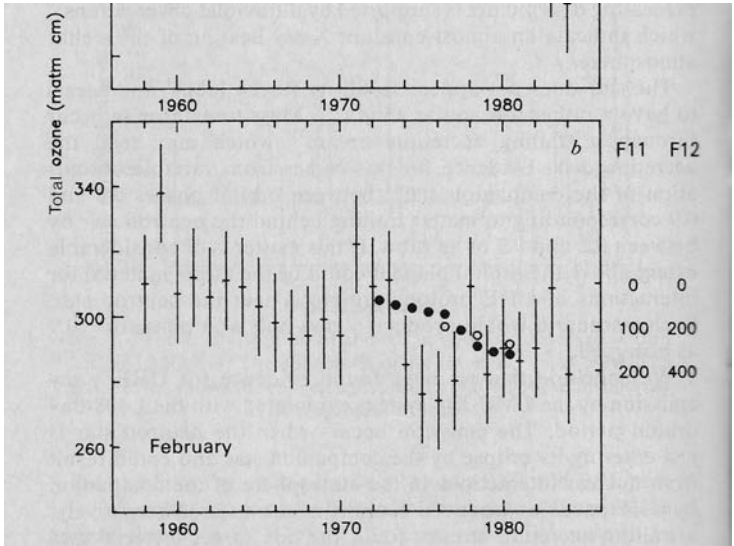


**Fig. 2** Monthly means of total $O_3$ at Halley Bay, and Southern Hemisphere measurements of F-11 (●, p.p.t.v. (parts per thousand by volume) $CFCl_3$) and F-12 (○, p.p.t.v. $CF_2Cl_2$). *a*, October, 1957–84. *b*, February, 1958–84. Note that F-11 and F-12 amounts increase down the figure.

Figure 13.6. BAS ozone depletion graph. Figure 2 in J. C. Faran, B. G. Gardiner, and J. D. Shanklin, "Large Losses of Total Ozone in Antarctica Reveal Seasonal $ClO_x/NO_x$ Interaction," *Nature* 315 (May 16, 1985). Courtesy of Nature Publishing Group.

data analysis center. Beginning in the late 1960s and lasting through the early 1970s, Goddard took a leading role in the Global Atmospheric Research Program (GARP), an international research effort to create global data sets that could be used by scientists to assess pollution of the Earth's atmosphere. While NASA's Nimbus satellites gathered such data, Goddard computer scientists working on GARP-generated mathematical models to assess this data's accuracy and to determine if and how it could be smoothed into global data sets. In early 1979 NASA tested such models through GARP's Global Weather Experiment, which involved more than a half dozen satellites gathering data continuously for two sixty-day periods. The result, explained one space historian, was the world's first "global, quality-controlled, extensive meteorological dataset."[27]

During the mid to late 1980s earth scientists joined NASA's satellite data with computer models to transform two local scientific discoveries into the most important global environmental issues of the post–World War II era.

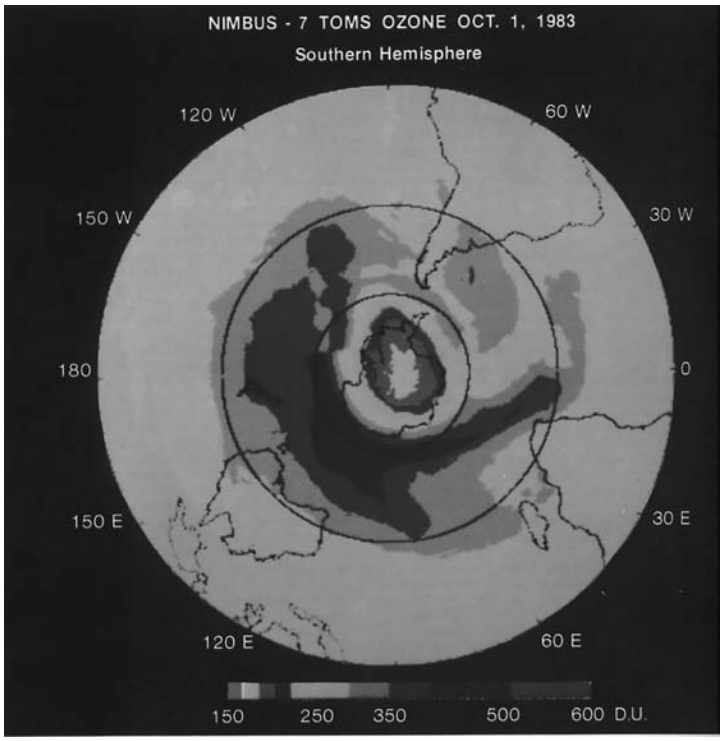


Figure 13.7. NASA ozone hole, 1985. Courtesy of Pawan Bhartia. Bhartia's image appeared in black and white in the *New York Times* on November 7, 1985, and in *Chemical Education* in May 1987.

The detection of both the Antarctic ozone hole and global warming each began on the local level with regional data. Whereas scientists from the British Antarctic Survey (BAS) used ozone data gathered in the early 1980s from two research stations within the Antarctic region, Charles Keeling of the Scripps Institution of Oceanography relied on atmospheric readings of carbon dioxide taken between 1957 and 1971 at the Mauna Loa Observatory in Hawaii.[28] When both teams of researchers published their findings in the late 1970s and early 1980s, few beyond the scientific community noticed.[29] Earth scientists within NASA, however, were not only alarmed by such findings but took immediate steps to deepen the space agency's involvement in this important scientific research.[30] Six months after the BAS team published its ozone research in *Nature* magazine, for example, NASA used data collected by sensors on Nimbus 7 to corroborate such research. "Satellite observations have confirmed a progressive deterioration in the earth's protective ozone layer above Antarctica," explained the *New York Times* to its readers on November 7, 1985.[31] Goddard's director, Jim Hansen, took similar steps regarding

global warming by directing his team to develop highly sophisticated computer models that not only confirmed Keeling's observations in Hawaii but also broadened such research to cover the entire planet. The global warming projected for the next one hundred years, Hansen warned in several papers published during the mid-1980s, "is of almost unprecedented magnitude."[32]

Researchers at NASA not only verified these local scientific discoveries through the collection and modeling of worldwide data, but also helped scientists transform these data sets into signifiers of global environmental crises. Earth scientists accomplished this by embracing the very visual culture that environmentalists had been overlooking since the late 1960s. Beginning in the early 1970s, for example, scientists within NASA and beyond began by "covering" their data detailing worldwide environmental degradation with images of the Earth from space. The space agency began this practice on the cover of *Remote Measurement of Pollution*, the report from its groundbreaking 1971 conference on the uses of satellites for environmental monitoring, which depicted an image of the full Earth encircled by several orbiting satellites (see fig. 13.5). Other scientists followed suit. The important 1971 *Study of Man's Impact on Climate*, a report written by more than thirty scientists in preparation for the 1972 United Nations' Conference on the Human Environment in Stockholm, the Club of Rome's 1972 classic *The Limits to Growth*, and numerous articles and books written during the 1970s and early 1980s by James Lovelock and Lynn Margulis on their Gaia hypothesis, all sported photographs of the Earth from space on their covers.[33]

During the mid-1980s scientists not only covered their global data with images of Earth from space, but also began covering images reminiscent of *Whole Earth* with global data. Such efforts were most obvious with respect to the ozone crisis. The BAS team that initially published its findings in a 1985 issue of *Nature* depicted their data in a graph revealing a local decline in Antarctic ozone (see fig. 13.6). When later that year NASA scientists at Goddard confirmed such findings with the aid of Nimbus satellites and computer models, they instead illustrated their global data with *Whole Earth* in mind. First, Goddard's computer modelers "smoothed" the widespread variation in ozone satellite data by assigning several false colors to particular value ranges within the data set. NASA's scientists further simplified this data by connecting points of equal value with contour lines to give the illusion of continuous measurement across geographic space. When NASA combined these false colors and contours in computers, the result was a *Whole Earth*–like image layered with global data that was more readable, understandable, and alarming for the lay public (see fig. 13.7).[34] The result was also a very different environmental crisis. Whereas only a few media sources covered the BAS team's findings regarding local ozone "depletion" in the Antarctic, six months later the *New*

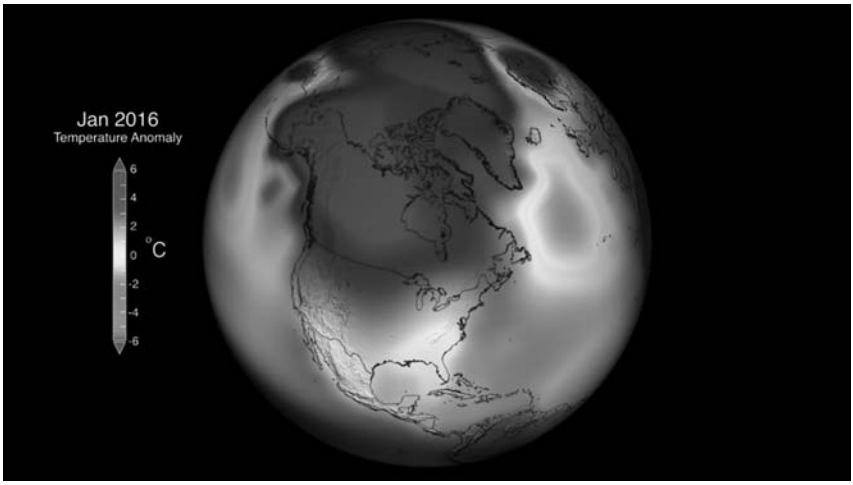


Figure 13.8. Global temperature anomalies from January 2016. This image was developed by the NASA/Goddard Space Flight Center Scientific Visualization Studio and posted on its website in March 2016. It is available in color online at https://svs.gsfc.nasa.gov/4438. Courtesy of NASA.

*York Times* immediately ran a story on NASA's research that for the first time reframed the issue as a global crisis involving an ozone "hole."[35]

Scientists at NASA took similar action regarding global warming. While Keeling's upward sloping graph tracked rising temperatures at Mauna Loa throughout the 1970s without public alarm, from the mid-1980s on NASA began confirming such findings by publishing *Whole Earth*–like images created from satellite data and computer modeling that caused an environmental firestorm. Once again NASA smoothed its incomplete and inconsistent global data by assigning false colors to particular value ranges within its data set. The cultural impact of such images was obvious to climate scientists as well as the public. The Intergovernmental Panel on Climate Change, for instance, in a September 2013 press conference in Stockholm, Sweden, presented to the gathered press an image that could have been mistaken for *Whole Earth*, except that the "big blue marble" appeared to be burning. "This is the face of the surface of our planet if you look at the atmosphere," argued the panel's lead scientist. "It is red. The world has been warming." Scientists at NASA have created similar images since (see fig. 13.8).[36]

## Whole Earth *without Borders and Visual Culture within Environmental History*

When it came to looking back down at Earth from space, Worster thus knew better than Brand. The history of "that picture of Mother Earth hanging on

the wall" was, in Brand's telling, not only a simplification of the Earth but also of the movement that eventually embraced it. For Brand, and for many environmental historians who followed, *Whole Earth* must have become an environmental icon for no other reason than it appeared around the same time as the burgeoning environmental movement.[37] But when you "get down" to a deeper level, as Worster suggested back in 2010, the world does "look different—more complicated than you ever imagined."[38] So does *Whole Earth*, which rose to environmental prominence not only due to the cultural power of this particular photograph, but also because of the scientific legitimacy of satellite data and theoretical computer models. *Whole Earth*, in other words, was constructed over time by grassroots environmentalists as well as NASA engineers, environmental scientists, and the global environment itself. The result is a more complex icon for what one might call *Whole Earth* environmentalism.

The history of this particular photograph also suggests a more fundamental role for visual culture within environmental history. Images have always been central to communicating people's connection to nature. From the Lascaux cave drawings of horses produced more than 17,000 years ago to recent tourist postcards of the Grand Canyon or Niagara Falls, visual culture offers a perspective into the human-nature relationship not found in written sources. Societies throughout time have used images to explain natural processes, to communicate ideas about the environment, and quite often to mark divisions between nature and culture. Yet images do not simply reflect historical reality; they also influence how people think about, and interact with, the natural world. The great majority of environmental historians have unfortunately failed to see visual culture in this light, and instead use it as window dressing for arguments made through more traditional source materials. This history of *Whole Earth*, I hope, will push practitioners in our field to think more analytically about the way paintings, photographs, advertisements, and even computer-generated social media dramatically shape our relationship to the natural environment.

## *Notes*

1. David Kinkela and Neil M. Maher, "Revisiting a 'World without Borders': An Interview with Donald Worster," *Radical History Review* 107 (Spring 2010), 104.

2. My description of this event is based on two of Stewart Brand's own personal accounts. See Stewart Brand, "Why Haven't We Seen the Whole Earth?," in *The Sixties: The Decade Remembered Now, by the People Who Lived It Then*, ed. Lynda Rosen Obst (New York: Random House/Rolling Stone Press Book, 1977), 168–70; and Stewart Brand, "The First Whole Earth Photograph," in

*Earth's Answer: Explorations of Planetary Culture at the Lindisfarne Conferences*, ed. Michael Katz, William P. Marsh, and Gail Gordon Thompson (New York: Harper & Row/Lindisfarne Books, 1977), 184–89. NASA distributed the *Whole Earth* photograph to the national and international press just twelve hours after Apollo 17's splashdown on December 19, 1972.

3. Claudia Dreifus, "Voices: 7/20/69," *New York Times*, July 14, 2009, D2. An astronaut supposedly told Brand that the buttons were being worn at NASA headquarters. For a reference to this, see Vicki Goldberg, *Power of Photography: How Photographs Changed Our Lives* (New York: Abbeville Press, 1993), 54.

4. The historical literature on the importance of NASA's *Whole Earth* photograph, as well as its earlier counterpart titled *Earthrise*, on ecological thought and environmental politics is extensive. See especially Denis Cosgrove, "Contested Global Visions: One-World, Whole-Earth, and the Apollo Space Photographs," *Annals of the Association of American Geographers* 84 (June 1994): 270–94; Goldberg, *Power of Photography*, 52–57; Wolfgang Sachs, "An Ambiguous Modern Icon," *Ecologist* 24 (September/October 1994): 170–75; Yaakov Jerome Garb, "Perspective or Escape? Ecofeminist Musings on Contemporary Earth Imagery," in *Reweaving the World: The Emergence of Ecofeminism*, ed. Irene Diamond and Gloria Feman Orenstein (San Francisco: Sierra Club Books, 1990), 264–78; Holly Henry and Amanda Taylor, "Re-thinking Apollo: Envisioning Environmentalism in Space," supplement, *Sociological Review* 57, no. S1 (May 2009): 190–203; Sheila Jasanoff, "Image and Imagination: The Formation of Global Environmental Consciousness," in *Changing the Atmosphere: Expert Knowledge and Environmental Governance*, ed. Clark A. Miller and Paul N. Edwards (Cambridge, MA: MIT Press, 1996): 309–36; Nina Edwards Anker and Peder Anker, "Viewing the Earth from Without or from Within," in "Scales of the Earth," ed. El Hadi Jazairy, *New Geographies*, no. 4 (2011): 89–94; and Robin Kelsey, "Reverse Shot: Earthrise and Blue Marble in the American Imagination," in "Scales of the Earth," ed. El Hadi Jazairy, *New Geographies*, no. 4 (2011): 10–16. On the environmental history of the *Earthrise* photograph in particular, see also Robert Poole, *Earthrise: How Man First Saw the Earth* (New Haven, CT: Yale University Press, 2008).

5. David Brower, quoted in John McPhee, *Encounters with the Archdruid* (New York: Farrar, Straus and Giroux, 1971), 80.

6. As editor of the *Whole Earth Catalogue*, Brand discusses this image in Stewart Brand, ed., *The Last Whole Earth Catalogue* (Menlo Park, CA: Portola Institute, 1971), 1. For another description of this 1967 ATS photograph, see Goldberg, *Power of Photography*, 54.

7. On Glenn's camera purchase, see Ron Schick and Julia Van Haaften, *The View From Space: American Astronaut Photography, 1962–1972* (New York: C. N. Potter, 1988), 8 and 11.

8. NASA released to the public numerous examples of photographs of Earth from space that predated *Whole Earth* in 1972. For examples from the Mercury mission, see Manned Spacecraft Center, National Aeronautics and Space Administration, *Results of the First United States Manned Orbital Space Flight, February 20, 1962* (Washington, DC: US Government Printing Office, 1962), 126–30; and "Sunset on Earth Seen from Space, Photographed by Scott Carpenter," *Life*, June 8, 1962, 24–28. For examples from the Lunar Orbiter, see "Lunar View of a Socked-In Earth," *Life*, September 9, 1966, 347. For examples from Apollo 8, see John Noble Wilford, "Astronauts Give Television Show on Way to Moon," *New York Times*, December 23, 1968, 1; John Noble Wilford, "Apollo 8 Crew Prepares to Land in Pacific Today; Sends Pictures of Earth," *New York Times*, December 27, 1968, 1; and the cover of "The Moon Age," a special issue of *Newsweek*, July 7, 1969. The *Washington Post*'s front-page coverage of Apollo 8 included a photograph of a partially shaded Earth that closely resembled the *Whole Earth* shot taken during Apollo 17. See "View from 240,000 Miles out in Space," *Washington Post*, December 31, 1968, A1. For similar photographs from Apollo 10, see Walter Sullivan, "NASA Releases Additional Photos Taken by Astronauts," *New York Times*, May 30, 1969, 1. For examples of local newspapers printing NASA photographs of the Earth from space, see "Apollo 8 Photograph Shows Both Sides of Atlantic," *Rome (GA) News-Tribune*, December 30. 1968, 5; "We Look Brilliant and Splendid," *Spartanburg (NC) Herald*, December 24, 1968, 1; "Half-Earth Blue Delight to Apollo 8," *St. Petersburg Times*, December 31, 1968, 1; and "Apollo Astronaut's View of Earth," *Spokesman-Review* (Spokane, WA), December 30, 1968, 16.

9. "The View from Outer Space," Ashland Oil & Refining Company advertisement, *Fortune*, August 1, 1969, back cover. For examples of companies using *Earthrise* to promote their role in developing space technology, see "Peace on Earth Seems So Simple from 251,000 Miles Away," McDonnell Douglas advertisement, *New York Times*, October 10, 1973, 43; "Leading in Communications towards a Bright Tomorrow," AT&T advertisement, *Fortune*, May 15, 1969, 271; "The Programming Skills Man Used to Conquer Space Now Also Help Control His Roadways in the Sky," IMB advertisement, *Aviation Week*, November 13, 1972, 43; "Congratulations, Apollo 17: The Mission's Accomplished, but It's Only the Beginning," Garrett Corporation advertisement, *Aviation Week*, January 1, 1973, 6; "Growth through Change," Bliss & Laughlin Industries advertisement, *Fortune*, May 15, 1969, 340; "We Have Our Own Idea of How Far Away This Really Is," Mannesmann AG advertisement, *Fortune*, August 15, 1969, back cover; "What Made Neil Armstrong Sure He'd Come Back Home?" Knight Newspapers Inc. advertisement, *Fortune*, October 15, 1970, 38–39; and "Welcome Back, Astronauts. We Were Proud to Give You a Lift," Pillsbury ad for "Space Food Sticks," *Milwaukee Journal*, July 25, 1969,

13. For similar examples of company ads depicting *Whole Earth* for similar purposes, see "What The World Needs Now . . . ," American Cyanamid advertisement, *Forbes* , October 15, 1973, 7; and "We'd Like to Make One Thing Perfectly Clear," Combustion Engineering Inc. advertisement, *Personal Business*, April 7, 1972, 7.

10. On the sale of these Earth photographs to the general public, see NASA, "Lunar Surface Photos Available," news release no. 69:83Ja, August 18, 1969, folder OA-250416-01, Apollo Project, NASA Releases, 1969, Space History Series, Technical Reference Files, Archives Division, National Air and Space Museum, Washington, DC. I personally own a View-Master reel that depicts the Earth from space. See "NASA's Apollo Project Moon Landing 1969," View-Master reel no. B 6632, Sawyer's Inc., Portland, Oregon. I would like to thank Emily Greenwald for giving me this View-Master reel as a gift.

11. Few newspapers initially linked these images of Earth from space to the environmental crisis of the late 1960s. For exceptions, see "Another Giant Step," *Christian Science Monitor*, December 28–30, 1968, 14; and "Beneficent Nature," letter to the editor, *New York Times*, January 7, 1969, 40.

12. Archibald MacLeish, "A Reflection: Riders on Earth Together, Brothers in Eternal Cold," *New York Times*, December 25, 1968, 1.

13. For instance, in May 1969 *National Geographic* quoted MacLeish's essay accompanied by a color centerfold reproduction of *Earthrise*. See "A Most Fantastic Voyage," *National Geographic*, May 1969, 593–631. For examples of local newspapers reproducing the essay, see "To See the Earth as It Truly Is . . . ," *Morning Record* (Meriden, CT), December 31, 1968, 6; "Now, Men May Be Brothers Riding Earth," *Miami News*, December 26, 1968, 1; "Man Has New Idea of Earth," *Spokesman-Review* (Spokane, WA), December 24, 1968, 11.

14. Denis Cosgrove argues similarly that *Earthrise* and MacLeish's essay both represent the idea of a unified world. See Cosgrove, "Contested Global Visions," 283. That *Earthrise* promoted the idea of a shared Earth was also evident in media coverage of MacLeish's essay. For examples, see "Apollo 8 Gives Man a New Idea of Himself," *Kansas City Star*, December 26, 1968; and "Seeing Earth as a Whole," *Sunday Denver Post*, December 29, 1968.

15. The organizers of the first Earth Day, a nonprofit group called Environmental Action, never archived promotional materials for the first Earth Day, and the Earth Day Network, which currently organizes the annual event, is also unaware of any archived promotional material from the first Earth Day in 1970. To trace Earth Day's visual culture, I therefore relied on historical photo galleries documenting the events of Earth Day 1970 collected by several organizations, including *National Geographic*, Boston public radio station WGBH and its American Experience history series, the archive at the University of Wisconsin at Green Bay, WWLP (an NBC-affiliated television station

in western Massachusetts), and the *Wall Street Journal*. I also conducted an extensive online image search of posters, flyers, and pamphlets from Earth Day 1970, as well as of media photographs capturing the events of the day, in an effort to further identify visual trends in the event's iconography. This search resulted in more than 100 images, only 6 of which depicted the Earth in any form. For access to these Earth Day 1970 photo galleries, see "PHOTOS: The First Earth Day—Bell-Bottoms and Gas Masks," *National Geographic Daily News*, accessed July 10, 2014, http://news.nationalgeographic.com/news/2009/04/photogalleries/first-earth-day-1970-pictures/; "Photo Gallery: Earth Day across America," WGBH Boston Public Radio, accessed July 10, 2014, http://www.pbs.org/wgbh/americanexperience/features/photo-gallery/earthdays/; "Earth Day Memories: A Photo Gallery of 1970s Activism at Eco U," University of Wisconsin at Green Bay, accessed July 10, 2014, http://news.uwgb.edu/multimedia/photos/04/03/earth-day-memories/; "First Earth Day in 1970," WWLP public television, accessed July 10, 2014, http://interactives.wwlp.com/photomojo/gallery/11922/225372/first-earth-day-in-1970/gas-masks-magnolia-blossums/; and "Earth Day over the Years," *Wall Street Journal*, accessed September 14, 2015, http://www.wsj.com/articles/SB10001424052702303425504577351472739743222.

16. On the prominence of gas mask iconography during Earth Day 1970, see Finis Dunaway, "Gas Masks, Pogo, and the Ecological Indian: Earth Day and the Visual Politics of American Environmentalism," *American Quarterly* 60 (March 2008): 67–99. On the photograph of a masked man trying to sniff flowers, see Timothy Dumas, "An Earth Day Icon, Unmasked," Smithsonian.com, accessed July 10, 2014, http://www.smithsonianmag.com/40th-anniversary/an-earth-day-icon-unmasked-607188/.

17. To access the visual culture of Earth Day 1980, I undertook similar research as explained above in note 15. The only Earth Day 1980 materials depicting the planet that I could locate included a poster from the city of Denver with a drawing of several hands holding up a globe, a poster from New York City depicting a drawn heart-shaped globe, and an Earth Day poster that depicted several individuals stretching out a net to catch a falling Earth. I was also able to find a photograph of an individual wearing a paper-mache Earth for a head.

18. For examples of *Whole Earth* appearing on Earth Day 1990 flags, see the iconic photograph of the celebration on the mall in Washington, DC, at http://www.pollutionissues.com/Co-Ea/Earth-Day.html (accessed September 14, 2015). For examples of *Whole Earth*–like images appearing on Earth Day 1990 posters, see http://monsantoblog.com/2011/04/22/thinking-about-dirt/ (accessed September 14, 2015). Adam Rome discusses this logo, but not its deeper history associated with *Whole Earth*, in his book on Earth Day. See

Adam Rome, *The Genius of Earth Day* (New York: Hill & Wang, 2014), 277. The image even appeared in Jim Henson's public service announcement with Kermit the Frog singing "Bein' Green" from within a *Whole Earth*–like set, see http://muppet.wikia.com/wiki/Earth_Day_1990 (accessed September 14, 2015).

19. On the IGY's impact on scientific collection of global data through orbiting satellites and computer modeling, see Paul N. Edwards, "Representing the Global Atmosphere: Computer Models, Data, and Knowledge about Climate Change," in *Changing the Atmosphere: Expert Knowledge and Environmental Governance*, ed. Clark A. Miller and Paul N. Edwards (Cambridge, MA: MIT Press, 2001), 31–65; Paul N. Edwards, *A Vast Machine: Computer Models, Climate Data, and the Politics of Global Warming* (Cambridge, MA: MIT Press, 2010), 202–7; Erik Conway, *Atmospheric Science at NASA: A History* (Baltimore, MD: Johns Hopkins University Press, 2008), 16–26; and Roger Launius, "Toward the Poles: A Historiography of Scientific Exploration during the International Polar Years and the International Geophysical Year," in *Globalizing Polar Science: Reconsidering the International Polar and Geophysical Years*, ed. Roger Launius, James Rodger Fleming, and David H. Devorkin (New York: Palgrave MacMillan, 2010), 47–81.

20. NASA originally developed weather satellites for Earth from technology used to assess the chemical and atmospheric composition of nearby planets. On this history, see Conway, *Atmospheric Science at NASA*, 94–122. On NASA retooling such technology to assess weather back on Earth, see Conway, *Atmospheric Science at NASA*, 5, 27–49.

21. This report was published as National Aeronautic and Space Administration, *Remote Measurement of Pollution*, SP-285 (Washington, DC: NASA, 1971), 1 and 5. For a description of this conference, see Ellis E. Remsberg, "Remote Measurement of Pollution—A 40-Year Langley Retrospective: Part II—Aerosols and Clouds" (NASA/TM-2012-217578, NASA, Langley Research Center, Hampton, Virginia, 2012).

22. Conway, *Atmospheric Science at NASA*, 141.

23. On NIMBUS 7 being the technological lynchpin to NASA's ability to produce data that could be used to construct, through computer modeling, a global data set, see Conway, *Atmospheric Science at NASA*, 63.

24. On the pollution instruments designed into Nimbus 7, see "Nimbus-7," Earth Observing Portal, accessed June 10, 2014, https://directory.eoportal.org/web/eoportal/satellite-missions/n/nimbus-7; "Total Ozone Mapping Spectrometer-Earth Probe (TOMS-EP)," NASA, accessed June 10, 2014, http://eospso.gsfc.nasa.gov/missions/total-ozone-mapping-spectrometer-earth-probe; and Conway, *Atmospheric Science at NASA*, 142–44.

25. On Nimbus 7, see "Nimbus-7."

26. For an explanation of the incompleteness of global satellite data sets, see Edwards, "Representing the Global Atmosphere."

27. On NASA's role in GARP, see Conway, *Atmospheric Science at NASA*, 65–93.

28. On the local nature of early ozone research, see Sebastian Vincent Grevsmühl, "The Creation of Global Imaginaries: The Antarctic Ozone Hole and the Isoline Tradition in the Atmospheric Sciences," in *Image Politics of Climate Change: Visualizations, Imaginations, Documentations*, ed. Brigit Schneider and Thomas Nocke (New York: Columbia University Press, 2014), 36. On the local context of early global warming research, see Joshua Howe, *Behind the Curve: Science and the Politics of Global Warming* (Seattle: University of Washington Press, 2014), 41.

29. The BAS team published their findings in J. C. Faran, B. G. Gardiner, and J. D. Shanklin, "Large Losses of Total Ozone in Antarctica Reveal Seasonal $ClO_x/NO_x$ Interaction," *Nature* 315 (May 16, 1985): 207–10. Charles Keeling promoted his research regarding rising levels of $CO_2$ around the Manoa Loa Observatory in numerous publications during this period. See especially, C. D. Keeling, "The Concentration and Isotopic Abundances of Carbon Dioxide in the Atmosphere," *Tellus* 12 (May 1960): 200–203; and Charles D. Keeling, "The Influence of Mauna Loa Observatory on the Development of Atmospheric $CO_2$ Research," in *Mauna Loa Observatory: A 20th Anniversary Report*, ed. John Miller (Washington, DC: National Oceanic and Atmospheric Administration, 1978), 35–54.

30. NASA scientists were understandably alarmed because their own satellites, which had not been calibrated finely enough to identify the slight increases recorded by the BAS team, missed the ozone hole. On this embarrassing situation within NASA, see Grevsmühl, "Creation of Global Imaginaries," 34.

31. Walter Sullivan, "Low Ozone Level Found Above Antarctica," *New York Times*, November 7, 1985, B21.

32. On James Hansen's efforts at GISS to model climate change, see Conway, *Atmospheric Science at NASA*, 199–206. J. Hansen et al., "Climate Impact on Increasing Carbon Dioxide," *Science*, August 28, 1981, 957–66; and J. Hansen et al., "Climate Sensitivity: Analysis of Feedback Mechanisms," in *Climate Processes and Climate Sensitivity*, ed. James E. Hansen and Taro Takahashi, Geophysical Monograph 29 (Washington, DC: American Geophysical Union, 1984), 130–63.

33. See National Aeronautic and Space Administration, *Remote Measurement of Pollution*, 1 and 5. For a description of this conference, see Remsberg, "Remote Measurement of Pollution," cover; *Inadvertent Climate Modification: Report of the Study of Man's Impact on Climate (SMIC)* (Cambridge, MA: MIT Press, 1971), cover; and James Lovelock, "More on Gaia and the End of Gaia,"

*Coevolution Quarterly* 31 (Fall 1981): 36; and James Lovelock, *Gaia: A New Look at Life on Earth* (London: Oxford University Press, 1987), cover.

34. On this approach by NASA, see Grevsmühl, "Creation of Global Imaginaries," 37–47.

35. Sullivan, "Low Ozone."

36. For a description of this press conference, see Birgit Schneider and Thomas Nocke, introduction to Schneider and Nocke, *Image Politics of Climate Change*, 1.

37. One exception is Sheila Jasanoff's essay "Image and Imagination." While Jasanoff also argues that *Whole Earth* and similar images of the planet from space *became* culturally powerful *gradually*, she argues that it was a variety of past cultural contexts—especially the emergence of a global environmental consciousness—that gave these images their power. In this essay I have tried to push past Jasonoff's reliance on her rather fuzzy category of "culture" to pinpoint exactly what types of cultures caused this shift toward global environmental concern. Rather, it was specifically the material culture of space technology and earth science that transformed the visual culture of Earth from space into symbols of an imperiled planet, which in turn helped foster an environmentalism that embraced the whole Earth.

38. Kinkela and Maher, "Revisiting a 'World without Borders,'" 104.