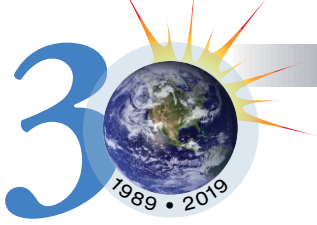
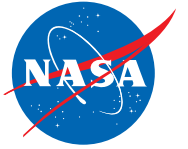


# The Earth Observer



March – April 2019. Volume 31, Issue 2

Editor's Corner  
**Steve Platnick**  
EOS Senior Project Scientist

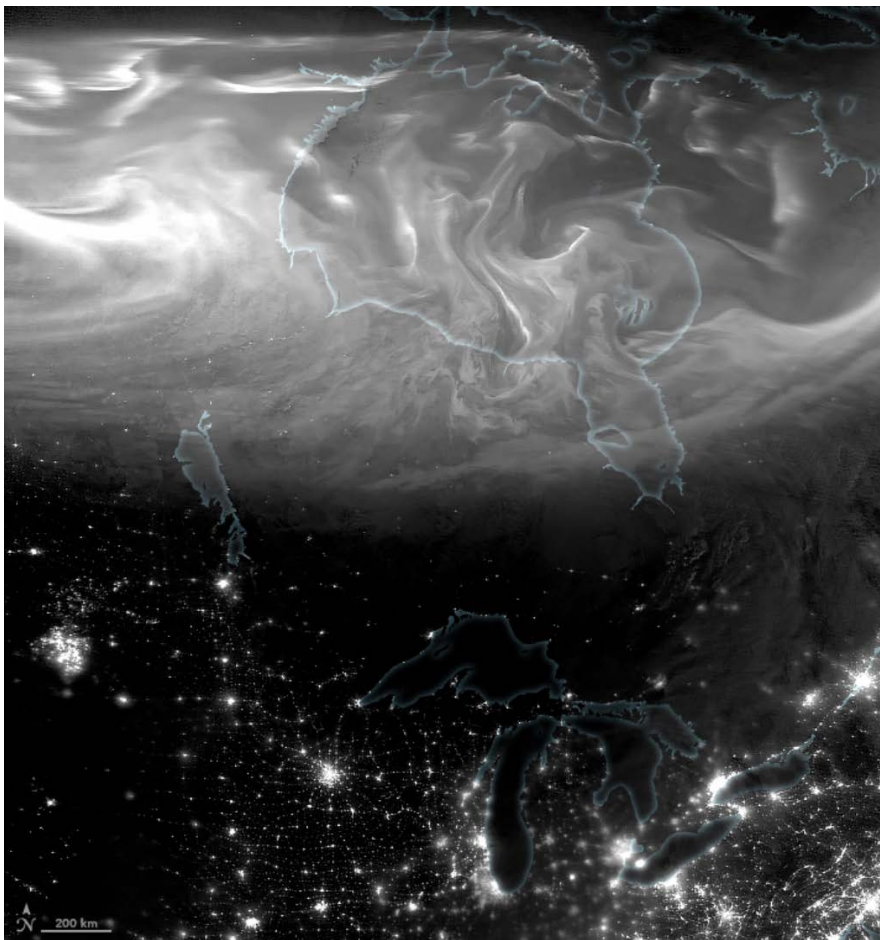
This issue of *The Earth Observer* marks the thirtieth anniversary of the publication of our first issue (March 1989)—shortly after the official beginning of NASA's Earth Observing System (EOS) Program. At that time, when the Internet was still in its infancy, print media was the best way to get the word out about the program, meetings, results, announcements, and the like to hundreds of interested researchers across the country and the world. Enter *The Earth Observer!*

Times have certainly changed since those early days, with digital media now allowing for instantaneous communication. Nevertheless, *The Earth Observer* has adapted over the years, maintaining its role for three decades. It is well known and respected throughout the global Earth science community, with around 5300 subscribers (including both print and digital, the latter being part of our 'Go Green' campaign)<sup>1</sup> around the world at last count. Now in **Volume 31**, the newsletter continues to live out the mission it had from its inception: to report timely news from NASA's Earth Science Program. The three-decade legacy is a tribute to the contributors and editorial staff who work hard to produce each issue—including the current one, which features a new thirtieth anniversary masthead and tagline.

On page 4 of this issue, our Executive Editor, **Alan Ward**, offers his perspective on the publication's evolution over the time he has been involved—which encompasses nearly two-thirds of *The Earth Observer's* history.

<sup>1</sup> Any who are interested can opt to forego receiving the print issue. See back cover for details on how to "Go Green."

continued on page 2



NASA's Earth Observatory (EO) website (<https://earthobservatory.nasa.gov>) will celebrate its twentieth anniversary on April 29, 2019. Not unlike *The Earth Observer*, which celebrated its thirtieth anniversary in March 2019, EO was intended to help improve communications between Earth scientists and the general public. These two communication platforms work together to report NASA Earth Science. Images and stories originally published on the EO website are sometimes printed in the newsletter. An example is shown here. On March 28, 2019, a stunning *aurora borealis*—commonly known as the Northern Lights—made an appearance over Hudson Bay in Canada. The Visible Infrared Imaging Radiometer Suite (VIIRS) on the Suomi National Polar-orbiting Partnership satellite acquired this nighttime image of the dancing lights over North America. VIIRS has a *day-night band* that detects city lights and other nighttime signals such as auroras, airglow, and reflected moonlight. In this image, the sensor detected the visible light emissions that occurred when energetic particles rained down from Earth's magnetosphere and into the gases of the upper atmosphere. **Credit:** NASA's Earth Observatory

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**Reminder:** To view newsletter images in color, visit  
[eosps.nasa.gov/earth-observer-archive](https://eosps.nasa.gov/earth-observer-archive).

On a related note, the *Earth Observatory* website (<https://earthobservatory.nasa.gov>) celebrates its twentieth anniversary on April 29, 2019. The website was launched in anticipation of the Terra launch (which took place in December 1999).<sup>2</sup> The site was intended to improve communication between Earth scientists and the general public, taking advantage of Internet technologies, which were rapidly emerging at that time. Over the past two decades, it has become an outstanding platform for presenting compelling Earth science images and stories in ways the public and mainstream media can easily understand. The site has grown considerably since it began, becoming one of NASA's most popular websites. Its longevity and growth are due to the many dedicated individuals who have worked to produce content for the site over the years. A sincere thank you to the *Earth Observatory* team, past and present, for a remarkable job. *The Earth Observer* plans a more detailed feature article on the activities related to the *Earth Observatory's* twentieth anniversary later this year.

These milestone anniversaries for *The Earth Observer* and *Earth Observatory* come during a season of milestones for NASA. Last year was the Agency's sixtieth anniversary, and also the sixtieth anniversary of the launch of Explorer 1—the first satellite launched by the U.S. This year the milestones continue. July will mark the fiftieth anniversary of the Apollo 11 Moon landing, and more specific to the realm of Earth science, December will mark the twentieth anniversary of the launch of EOS Terra.

This issue contains an article on another sixtieth anniversary milestone that, while somewhat lesser known,

<sup>2</sup> See "NASA Unveils The Earth Observatory Web Space" in the March–April 1999 issue of *The Earth Observer* [Volume 11, Issue 2, pp. 17–18—[https://eosps.nasa.gov/sites/default/files/efiles/pdfs/mar\\_apr99.pdf#page=17](https://eosps.nasa.gov/sites/default/files/efiles/pdfs/mar_apr99.pdf#page=17)].

was foundational to the evolution of Earth science investigations as we know them today—the launch on February 17, 1959 of Vanguard II, which was the first meteorological satellite. The mission opened the pathway for the development of the early TIROS series of meteorological satellites, which was then followed by the Nimbus Program, which in turn led to the development of current high-performance satellites and instruments capable of observing Earth as a system (e.g., EOS). Vanguard's history is more than a story of satellite and rocket hardware development, however. It is also a human drama, as it encompasses the successes and failures of the efforts of scientists and engineers who envisioned this new frontier. The story involves national politics, budget uncertainties, military service rivalries, technological challenges, and scientific competition. For those curious to know more, turn to page 7 of this issue to read the story.

Even as we celebrate our past history, NASA's Earth Science Division (ESD) must have a strong leadership team in place to guide our activities and ensure the achievement of future milestones. **Michael Freilich**, who had been the Director of the ESD since 2006, officially retired at the end of February.<sup>3</sup> A search to find Freilich's successor did not result in a selection. **Thomas Zurbuchen**, Associate Administrator for the Science Mission Directorate, noted that this is an important period of time when a strong team needs to be in place to implement the 2017 Earth Science Decadal Survey recommendations. In approximately one year, the call for candidates will be reopened. In

<sup>3</sup> Freilich's retirement was announced in the Editorial of the September–October 2018 issue of *The Earth Observer* [Volume 30, Issue 5, p. 3]. His accomplishments during his tenure as Director of the Earth Science Division were summarized in <https://science.nasa.gov/news-articles/nasa-earth-science-director-announces-retirement>.

the meantime, **Sandra Cauffman**, the ESD's Deputy Director since May 2016, will continue to serve as Acting ESD Director. In addition, **Paula Bontempi** has been appointed to serve as Acting Deputy ESD Director. At ESD since 2003, Bontempi has a background in ocean biology, biogeochemistry, and carbon cycle science, and is the program scientist for MODIS (Terra and Aqua), Suomi NPP, and PACE. My congratulations, and great appreciation, to Cauffman and Bontempi for taking on these roles in the coming year.

Some of our Earth-observing satellite missions achieve milestones of longevity, thereby ensuring continuity of crucial climate data records. One recent example is the Solar Radiation and Climate Experiment (SORCE), which marked the sixteenth anniversary of its launch in January 2019. Considering that the SORCE prime mission ended in 2008 and had to overcome technical challenges related to a failed reaction wheel, failed star tracker, and diminished battery power, it is nothing short of remarkable that SORCE survived long enough to overlap by more than a year with the Total and Spectral Solar Irradiance Sensor-1 (TSIS-1), which launched in 2017.

SORCE has maintained a *Day-only Operations* mode since 2014, essentially shutting down during each orbit's eclipse, only to awaken again when its solar panels are illuminated at every sunrise. In the same year, TSIS-1 was approved to fly on the ISS after several years of uncertainty following reconfigurations of the multi-agency NPOESS and JPSS programs. Once the decision to fly on ISS was made, NASA, NOAA and the Laboratory for Atmospheric and Space Physics at the University of Colorado moved with full purpose to ensure that TSIS-1 would reach orbit by late 2017. Thus, the events of 2014 were critical in maintaining continuity of the solar irradiance climate data record—now in its fifth decade (41 years)! In the event that SORCE did not continue until the launch of TSIS-1, the Total Solar Irradiance Calibration Transfer Experiment (TCTE), flying a SORCE Total Irradiance Monitor (TIM) spare, was launched on the U.S. Air Force's STPSat-3 in 2013 to mitigate a possible gap in total solar irradiance.

The achievements of SORCE are many. One of the major highlights is the establishment of a new value of total solar irradiance: 1361 W/m<sup>2</sup>. Another is that SORCE initiated the first daily record of solar spectral irradiance. Moreover, surviving long enough to make the connection to TSIS-1 will be one of its lasting legacies. SORCE will end operations in January 2020, performing final experiments to gain additional insight into the performance of its radiometers. TCTE is planned to operate through the end of June 2019. Meanwhile, TSIS-1 will carry the solar irradiance record into the next decade and, almost simultaneously, into the next solar cycle.

Thus far, the TSIS-1 instruments that measure total and spectral irradiance have been performing as designed. Comparisons between the TSIS-1, SORCE, and TCTE Total Irradiance Monitors (TIM) show that they agree within their respective uncertainties, even though they were calibrated at the component level over a period of 15 years. The performance of the TSIS-1 Spectral Irradiance Monitor (SIM), the first rebuild of the trailblazing SORCE SIM, has been equally impressive. The changes in design of the TSIS-1 SIM, based on lessons learned from SORCE, appear to have achieved the expected results. It will be fascinating to see what these observations reveal during the early phase of the next solar cycle, since uncertainty abounds over how quiet the Sun has become—stay tuned.

The Orbiting Carbon Observatory-3 (OCO-3) is now at Cape Canaveral Air Force Base in Florida getting ready for launch as a part of the Commercial Resupply Service #17 (CRS17) to the ISS, scheduled for April 25, 2019. The OCO-3 payload was trucked from NASA/Jet Propulsion Laboratory in California to NASA's Kennedy Space Center in December 2018. Since then, the spacecraft has been integrated with the SpaceX Dragon Trunk. Now, OCO-3 waits with other cargo for the scheduled launch on the SpaceX Dragon cargo spacecraft on the Falcon 9 rocket. Once deployed on the ISS, the in-orbit checkout (IOC) for OCO-3 is expected to last no more than 90 days. The Level-1b (L1b) product will be released 90 days after the end of IOC and the Level-2 product 90 days after the L1b release.

OCO-3, flying the OCO-2 flight spare instrument, will extend the atmospheric carbon dioxide (CO<sub>2</sub>) data record begun by OCO-2 in 2014 into the diurnal domain. The OCO-3 instrument was upgraded to include an agile Pointing Mirror Assembly that allows the instrument to operate in a *snapshot* mode to provide highly dense data coverage over an area of about 50 x 50 mi (80 x 80 km). In addition to CO<sub>2</sub>, OCO-3 will provide Solar Induced Chlorophyll Fluorescence (SIF), a byproduct of photosynthesis. OCO-3 will leverage OCO-2 data processing and algorithms.

OCO-3 will be installed on the Japanese Experiment Module-Exposed Facility (JEM-EF) in site #3. Two other NASA instruments are already installed on JEM-EF—ECOSTRESS and GEDI. These three ISS instruments will offer an unprecedented view of ecosystems through near coincident retrievals of evapotranspiration, biomass structure, CO<sub>2</sub>, and SIF. ■

**Note:** List of undefined acronyms from the *Editor's Corner* and the *Table of Contents* can be found on **page 39**.

## A Thirtieth Anniversary Reflection from the Executive Editor

Alan B. Ward, NASA's Goddard Space Flight Center/Global Science & Technology Inc., [alan.b.ward@nasa.gov](mailto:alan.b.ward@nasa.gov)

This issue marks the thirtieth anniversary of the release of the first issue of *The Earth Observer*. This is a remarkable achievement for a NASA publication. It's also a source of immense pride for me, because my entire professional career has been spent supporting work related to NASA Earth Science. More specifically, I've been reviewing content and occasionally contributing articles for *The Earth Observer* since 2001—and since 2006, I have been its executive editor. In that role, I not only edit every word that is published in the newsletter, in consultation with other members of the editorial team (and with the EOS senior project scientist as required), I also plan each issue and develop an overall vision for the publication.

As the executive editor, I wrote this personal perspective, but—clearly!—I don't do what I do alone. As noted above: I have the help of a talented team that currently includes four other editors and a designer. I want to extend kudos to the current team: to **Heather Hanson, Mitchell Hobish, Ernest Hilsenrath, Douglas Bennett, and Debbi McLean**; thanks to each of you for all you do!<sup>1</sup> This team not only spends many hours researching articles we write ourselves, but many more hours editing contributions from other authors involved in various aspects of NASA Earth Science (e.g., research, applications, education), helping them transform rough drafts into publishable newsletter articles. One contribution that is specific to me is that each *Editor's Corner* must be meticulously researched, written, and fact checked, as it represents an official record of the highlights of NASA Earth Science at that given moment in time from the perspective of the EOS senior project scientist.<sup>2</sup> Much of the work our editorial team does is behind the scene and therefore “transparent” to readers, but without it the bimonthly publication of *The Earth Observer* would not be possible.

In many ways, the publication you hold in your hand—or perhaps you're scrolling through as a .pdf file on your computer or tablet—doesn't look much

like **Volume 1, Issue 1** did in March 1989, shortly after the official beginning of NASA's Earth Observing System (EOS). (The **Figure** on page 5 shows how the look has changed over the years.) As challenging as developing the space flight hardware has always been, there was an equally large logistics issue that needed to be addressed at that time. A huge program involving hundreds of researchers strewn all over the nation—and eventually the globe—was trying to get off the ground, and they needed a means to communicate. The Internet, which we take for granted today, was in its infancy at that time. If you wanted to get the word out about upcoming meetings, results from those meetings, announcements, and the like, print media was still the way to go. Enter *The Earth Observer*!

The full story of the intimately interconnected history of EOS and *The Earth Observer* was told in our twenty-fifth anniversary issue and need not be repeated here.<sup>3</sup> Instead, I will offer my own perspective on the publication's evolution over the time I have been involved—which encompasses about two-thirds of the newsletter's history. Thus, the reflections that follow don't necessarily represent NASA's official position on this publication. Rather, they are my own reflections based on my nearly 20 years of working on *The Earth Observer*.

When I made my first contribution to *The Earth Observer* in 2001, EOS was really just getting started. Terra had only launched a couple years earlier and the other flagship missions (Aqua and Aura) had not yet been launched. During my tenure, I've watched the EOS Program come of age. *The Earth Observer* has chronicled the establishment and now graceful aging of NASA's Earth-observing fleet of satellites and airborne and ground-based sensors. We continue to report on NASA Earth Science as we move beyond the Suomi NPP and Joint Polar Satellite System (JPSS) era, and into other endeavors such as Decadal Survey missions, including the Earth Venture element. We've reported on the launches of new (or recently launched) missions along the way, as well as on the remarkable scientific achievements of ongoing ones as, one by one, they exceeded their planned mission lifetime by many years and celebrated a decade or more in orbit. We've also reported on historical satellite missions and programs such as Nimbus and—on page 7 of this issue—Vanguard, which also encompasses Explorer and

<sup>1</sup>It is also fitting to acknowledge **Claire Parkinson** [NASA's Goddard Space Flight Center—*Aqua Project Scientist*], who conducts a final review of most issues prior to printing. We appreciate her ongoing contributions to the quality of *The Earth Observer*.

<sup>2</sup>The editorials (and old newsletters) were a major source of information for the article “A Trip Through Time via the Archives of The Earth Observer,” which starts at the beginning in March 1989 and travels forward in time to March–April 2018, making several stops along the way to highlight what was going on at that time. You can read it in the March–April 2018 issue of *The Earth Observer* [**Volume 30, Issue 2**, pp. 5–11—[https://eosps.nasa.gov/sites/default/files/2018-04/Mar-Apr\\_2018\\_color%20508\\_0.pdf#page=5](https://eosps.nasa.gov/sites/default/files/2018-04/Mar-Apr_2018_color%20508_0.pdf#page=5)].

<sup>3</sup>To read the full story, refer to “The Earth Observer: Twenty-Five Years Telling NASA's Earth Science Story” in the March–April 2014 issue of *The Earth Observer* [**Volume 26, Issue 2**, pp. 4–13—[https://eosps.nasa.gov/sites/default/files/2014-04/Mar-Apr2014\\_508finalcolor.pdf#page=4](https://eosps.nasa.gov/sites/default/files/2014-04/Mar-Apr2014_508finalcolor.pdf#page=4)].