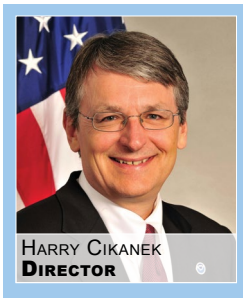


From Harry

Thanks to the hard work and diligence of our JPSS team and partners, 2015 marked tremendous progress with the program. Both the flight system and ground upgrade needed for the JPSS-1 mission moved into the integration, test and verification phase. The JPSS-2 spacecraft work started and is making good progress. The NOAA/NASA Suomi National Polar Partnership (Suomi-NPP) passed its fourth anniversary on orbit and continues to provide excellent performance. At the end of 2015, the full Presidents budget request for Polar Follow-On (PFO) / JPSS-3 and JPSS-4 was funded, enabling the program to begin work on the PFO/ JPSS-3 and JPSS-4 instruments. We look forward to even more accomplishments in 2016 as we move into the final year of preparations for JPSS-1 launch, begin integrated instrument testing for JPSS-2 instruments, continue the Suomi-NPP track record, and begin implementing PFO/JPSS-3 and JPSS-4. To learn more about past JPSS news and achievements, you can read previous issues of the JPSS Newsletter here.

Access to Essential Satellite Data for Weather Forecasting Secured with 20-Year Europe—U.S. Agreement

Did you know that the United States uses data from European polar-orbiting weather satellites, in addition to our own satellites, to help us produce our 3-7 day weather outlook? Our long-standing, international relationships contribute important data we use in U.S. forecasting, critical for the timely notice of severe weather events.

Today NOAA and EUMETSAT (European Organisation for the Exploitation of Meteorological Satellites) signed an agreement to continue to share the burden of operating polar orbiting weather satellites for the next twenty years.

Forecasters use numerical weather prediction models that rely on data collected by polar-orbiting satellites as they circle the Earth multiple times a day. The accuracy of these models depend on timely coverage of the globe which in turn requires observations from two different complementary orbits.

Under the Joint Polar System Agreement, NOAA and EUMETSAT will continue to split responsibility for the two primary orbits: EUMETSAT satellites will cover the mid-morning orbit while NOAA will be responsible for the afternoon orbit.

This agreement cuts costs for the US taxpayer, because the U.S. only needs to build and operate half the polar-orbiting satellites it would need otherwise.

The agreement will cover NOAA's planned JPSS-2, -3, and -4 satellites and EUMETSAT's second-generation Metop satellites, ensuring that the U.S., Europe, and the world will have the data required for modern weather forecasting through the late 2030s. The agreement builds on existing cooperation with the first Generation Metop satellites, the U.S. POES satellites, Suomi-NPP and JPSS-1.

Dr. Stephen Volz, Assistant Administrator for NOAA's Satellite and Information Service, with Alain Raitier, Director General of EUMETSAT ▲

NOAA and EUMETSAT ▶ signed an agreement to continue to share the burden of operating polar orbiting weather satellites for the next twenty years. Under the Joint Polar System Agreement, NOAA and EUMETSAT will split responsibility for the two primary polar orbits.

Reflecting on Reflection: Suomi NPP Instruments Aid Monitoring of Earth's Albedo

Albedo—it's more than just a fancy word to describe the reflectivity of the Earth. It's an important, albeit complex, factor affecting our climate—and the NOAA/NASA Suomi NPP satellite is helping scientists monitor it.

Reflecting on Reflection

As part of their work to understand why global temperatures are rising and how carbon dioxide and other greenhouse gases affect are changing the climate system, scientists regularly monitor Earth's energy budget to determine how much of the sun's energy is absorbed by the earth and how much is lost to space.

Approximately one-third of the sun's energy that reaches Earth is reflected back into space by clouds and the atmosphere. The remaining two-thirds is absorbed by the land, ocean, and atmosphere. But how much energy these surfaces absorb varies.

Light-colored surfaces, such as the Arctic and deserts, reflect more solar energy, whereas darker surfaces, such as the deep ocean and forested areas, reflect less. These varying rates of absorption and reflection can affect temperature.

Albedo is the fraction of solar energy (shortwave radiation) reflected from the Earth back into space. It is a measure of the reflectivity of the earth's surface.

Scientists measure the albedo of Earth's various surfaces on a scale of 0 to 1, with 0 being a completely non-reflective black surface and 1 being a completely non-absorbing white surface.

Satellite measurements across the various surfaces have been accumulated since the late 1970's. Based on this data, scientists say Earth's albedo is about .3, but it varies throughout the year, as a variety of natural and human-caused phenomena can cause Earth's albedo to fluctuate.

For example, ice has a higher albedo than vegetation, soil or water. This means that as more of the earth's surface is covered by ice and snow, more solar radiation is reflected to space and less is absorbed by the surface causing temperatures to decrease. Cooler temperatures lead to increased ice formation, more reflection of solar radiation back to space, and even cooler temperatures (thereby creating what's known as a positive feedback).

But this can work in the opposite direction, too. Once ice begins to melt and uncover land or water, more solar radiation will be absorbed by the surface, raising temperatures and causing even more ice to melt.

Other phenomena, including cloud cover, human activity (e.g. afforestation and deforestation), and airborne particles (such as those from pollution, volcanoes, and dust storms), can alter albedo as well, often on timescales ranging from days to years.

Nevertheless, despite these periodic fluctuations, scientists say no sustained shifts, either up or down, have occurred—yet.

Instruments Provide Insight

How will scientists know if a change in Earth's albedo is something more than short-term fluctuation? By having access to long-term environmental data records, which is precisely what the instruments on Suomi NPP and future Joint Polar Satellite System satellites will provide.

The satellite's Cloud and Earth Radiant Energy System (CERES) instrument provides data on Earth's Radiation Budget to help scientists study the effect clouds have on the planet's energy balance. CERES data also helps assess the radiative effects and climatic impact of natural disasters like volcanic eruptions, major floods and droughts.

"How this [balance] changes over time is critical because in a climate system that's in equilibrium, [absorption and reflection] should balance and, if they do, then temperatures will remain relatively constant with time," said Norman Loeb, CERES principal investigator at NASA's Langley Research Center, in a video about tracking Earth's heat balance. "When you add greenhouse gasses such as carbon dioxide and methane, you change that radiation balance at the top of the atmosphere; you reduce the amount of outgoing

radiation, so that imbalance means that more energy is in the system. Part of it is stored in the oceans and part of it goes into warming the earth."

This CERES data can be combined with the satellite's Visible Infrared Imaging Radiometer Suite (VIIRS) instrument, which provides 22 specific channels with specific wavelength band widths, to produce a better understanding of how the land, oceans, and atmosphere influence Earth's albedo.

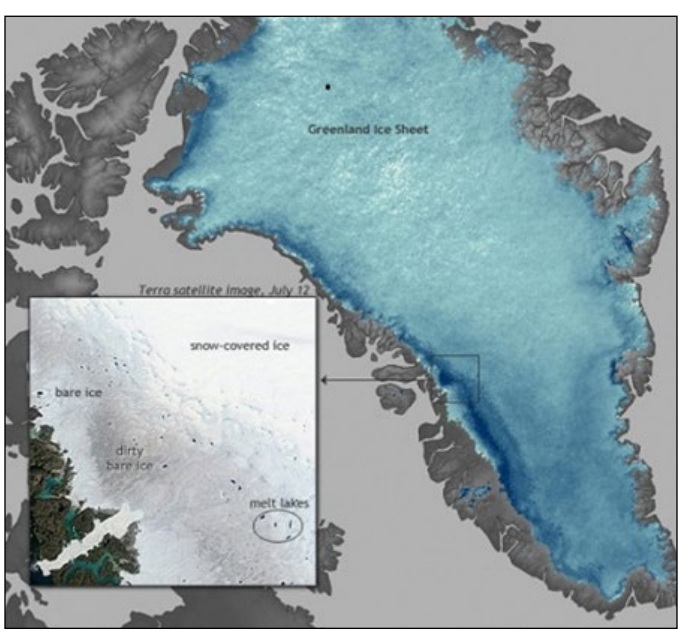
The long term data record provided by these instruments will provide a basis for scientific understanding of climate variations and trends.

"Earth's albedo fluctuates markedly over short time periods due to natural variations in the climate system," said the Langley Research Center's Loeb. "To confidently detect changes in Earth's albedo above natural variability, a much longer record is needed. It is paramount that we continue observations as long as possible."

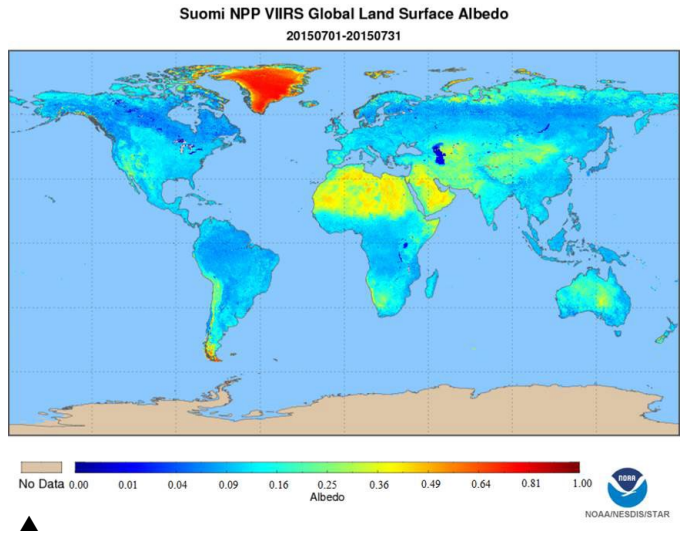
NOAA's JPSS-1, the second spacecraft within NOAA's next generation of polar-orbiting satellites, will contribute to continuity of these measurements following its launch in early 2017.

To see recent Global Land Surface Albedo data from Suomi NPP, visit the NOAA website at www.star.nesdis.noaa.gov/jpss/EDRs/products_Albedo.php.

To learn more about the Suomi NPP satellite, visit www.jpss.noaa.gov.



In this satellite image of southern Greenland, the ice sheet is more reflective than either the land exposed along the coast line. Credit: NOAA ▲



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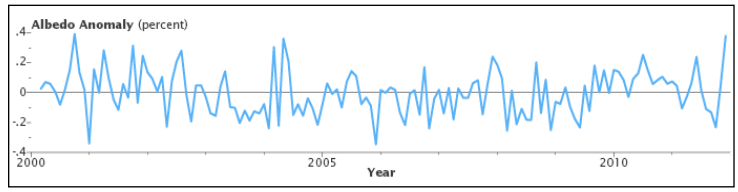
Global Monthly Albedo Map of July 2015, derived from JPSS VIIRS granule albedo product.



▲

As noted above, global albedo rose and fell in different years, but did not necessarily head in either direction for long.

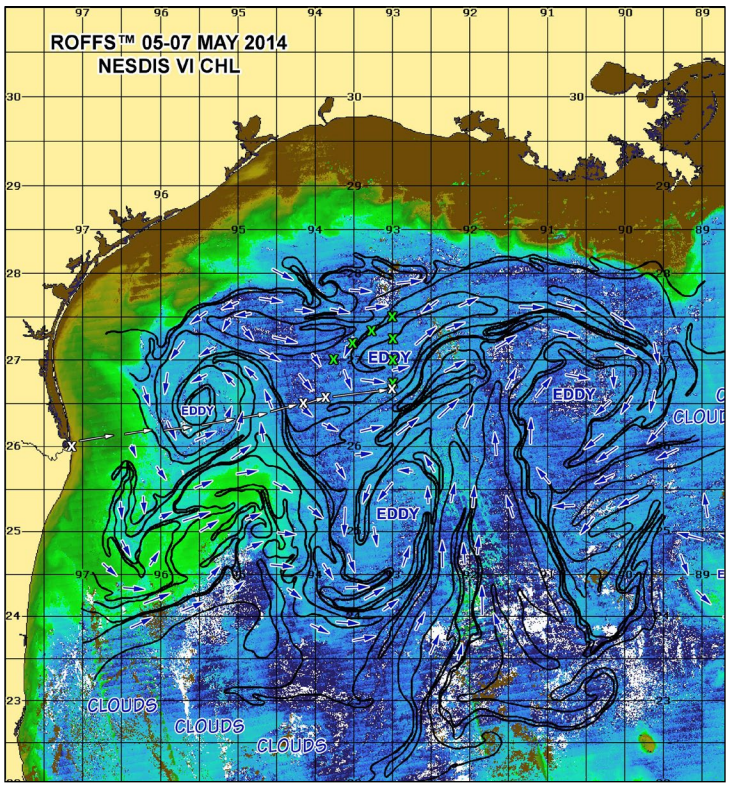
NOAA Celebrates Four-Year Anniversary of Suomi NPP Launch

October 28, 2015 marked the fourth anniversary of the launch of the NOAA/NASA Suomi National Polar-orbiting Partnership (Suomi NPP) satellite. The Suomi NPP satellite is the bridge between NOAA's legacy Polar Orbiting Environmental Satellites (POES) and NOAA's next generation Joint Polar Satellite System (JPSS) weather satellites. Suomi NPP is the first satellite in the JPSS Program and is currently NOAA's primary polar-orbiting weather satellite.

See the full story map here.

JPSS Data Aids Bluefin Tuna Research

Did you know that satellite data products from the Joint Polar Satellite System (JPSS) Program are helping scientists study Atlantic bluefin tuna larval ecology? NOAA's National Marine Fisheries Service (NMFS) uses satellite observations such as topography, sea surface temperature, and ocean color in their studies of highly migratory fish species like the bluefin tuna. Bluefin tuna is one of the most highly evolved fish species and is in danger of overfishing. Prized as sushi, one bluefin tuna can sell for tens of thousands of dollars.



Oceanographic analyses including ocean color from Visible Infrared Imaging Radiometer Suite (VIIRS).
Credit: Roffer's Ocean Fishing Forecasting Service, Inc. (ROFFSTM) ▲

Satellite data has helped researchers gain a better understanding of the migratory patterns of the bluefin tuna. This information assists researchers in understanding the spawning patterns and life cycle, and is used to formulate policies to help prevent overfishing. JPSS data products are an important asset to monitoring and protecting the oceans' ecosystem and global economy by providing timely and high quality data for decision support through significant technological and scientific advances.

NMFS participated in two consecutive 4-year studies in the Gulf of Mexico and Northern Caribbean focusing on the larval ecology of the Atlantic bluefin tuna, in relation to environmental conditions and climate.

◀ *NOAA Ship Nancy Foster*
Credit: NOAA

During a recent cruise on board the NOAA Ship Nancy Foster from April 27- June 5, 2015, NOAA's Center for Satellite Applications and Research (STAR) team members, Mengua Wang and Lide Jiang, provided near-real-time data from JPSS' Visible Infrared Imaging Radiometer Suite (VIIRS) instrument to Dr. Mitchell Roffer, founder of Roffer's Ocean Fishing Forecasting Service, Inc. where the satellite data was integrated into daily oceanographic analyses that included sea surface temperature and color, water mass identification, current direction and relative speed and ocean frontal boundaries to guide the shipboard sampling strategy sent to Dr. John Lamkin of NMFS' Southeast Fisheries Science Center and helped determine if it was necessary to change the location of the sampling stations to increase the chances of finding bluefin tuna larvae.

"This data allows the research team to be able to model how habitats might change in the next 100 years. Their work would not be possible without satellite data," said Dr. John Lamkin, NMFS Team Leader for the Early Life History Laboratory. "These models will aid in creating reliable forecasting of tuna habitats and give researchers and decision-makers better tools for understanding living ecosystems and are invaluable to fisheries oceanography research."

▶ *Larval bluefin tuna*
Credit: NOAA

In addition to aiding in oceanographic studies, JPSS delivers key observations for the Nation's essential products and services, including forecasting severe weather like hurricanes, conditions likely to spawn tornadoes, and blizzards days in advance, and assessing environmental hazards such as, droughts, forest fires, poor air quality and harmful coastal waters, helping to secure a more "Weather-Ready Nation."

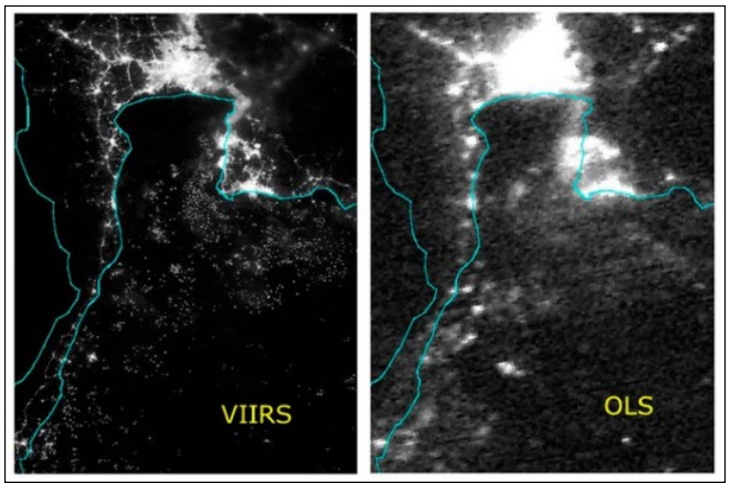
To learn more about these efforts by the National Marine Fisheries Service (NMFS), visit www.nmfs.noaa.gov and visit www.jpss.noaa.gov to experience the science behind the satellites.

JPSS Data to Provide Global Boat Detections

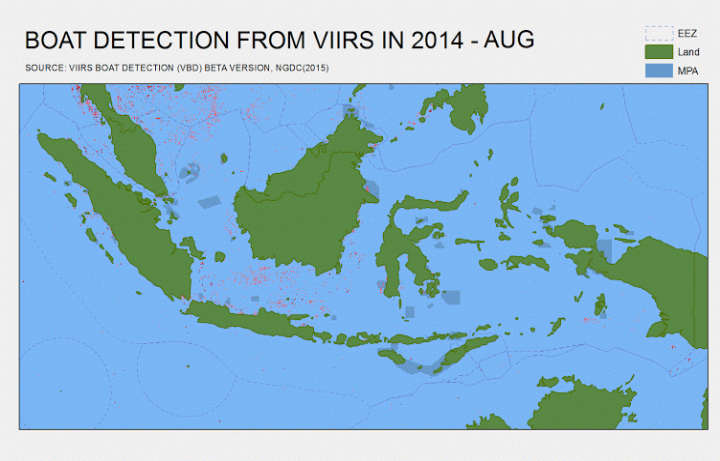
More than 400 leaders from government, academia, and civil society participated in the second Our Ocean Conference in Valparaiso, Chile to find solutions to address illegal fishing, marine plastic pollution, and ocean acidification. At the conference, on October 5th, President Obama announced NOAA's commitment by the end of 2017, to support global efforts to combat illegal fishing, including the use of a near-real time data valuable for observing boats using data collected by the VIIRS instrument onboard Joint Polar Satellite System (JPSS) satellites. VIIRS data are used by local weather service offices to provide improved maritime forecasts. Another emerging application is the use of products developed from VIIRS data that can assist national fisheries management and enforcement agencies monitor local at-sea activities, to assist in the protection of fisheries stocks from illegal and unregulated fishing activities.

With assistance from NOAA scientists, a VIIRS Boat Detection product has been developed that will provide data to help combat illegal, unreported, and unregulated (IUU) fishing. The product provides a unique capability to detect vessels that are lit or use lights, including fishing vessels using lights to attract fish, and to detect human activity in marine protected areas. IUU fishing poses a direct threat to food security and socioeconomic stability in many parts of the world, with developing countries most at risk.

Visible Infrared Imaging Radiometer Suite (VIIRS) vs. Operational Linescan System (OLS). OLS was the first system capable of global monitoring of lit fishing boats. The images compare low light imaging data collected over Bangkok and the Gulf of Thailand region approximately five hours apart on the night of 14 October 2012. Note that the higher spatial resolution of the VIIRS data enables the detection of a vastly larger number of individual lighting features offshore. ▼



The movie loop below shows the VIIRS Boat Detection product by month. The red dots indicate where boats can be seen through VIIRS detection in Marine Protected Areas (MPAs). MPAs are spaces in the ocean where human activities are more strictly regulated and are given special protections for endangered species, sensitive habitats, and cultural heritage.
▼ *Credit: Dr. Chris Elvidge, NOAA*



In 2016, NOAA plans to develop VIIRS Boat Detection products that can be used by fisheries management authorities in Indonesia, the Philippines and three other countries. Based on the success of these programs, future partnerships are planned.

The VIIRS Boat Detection product is being funded by the JPSS Proving Ground & Risk Reduction program and led by Dr. Chris Elvidge, head of the Earth Observation Group of NOAA's National Centers for Environmental Information. This three year project will continue developing VIIRS capability for detecting nighttime boat lights as well as fund improvements to the VIIRS Boat Detection product's algorithm to work for full moon conditions and in cloudy conditions. The product will also be expanded to a global, near-real time product available on the web.

By having these data in hand, national fisheries management and enforcement agencies can improve their fisheries management efforts, including taking steps to protect their fisheries resources from illegal activities.

With the cost of IUU fishing in the billions yearly, the VIIRS Boat Detection product has the potential to be an important component to keeping global fish stocks sustainable and protecting law-abiding fishers and seafood industries.

To learn more about Our Ocean Conference:
www.state.gov/e/oes/ocns/opa/ourocean/index.htm

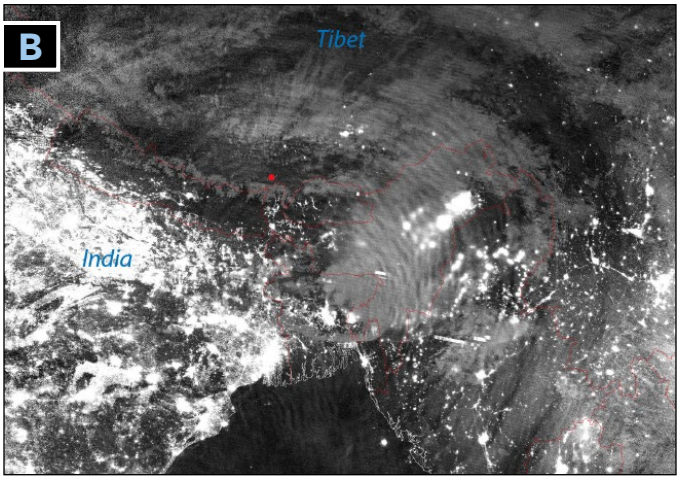
To learn more about JPSS and the VIIRS instrument:
www.jpss.noaa.gov/viirs.html

American Geophysical Union 2015 Fall Meeting

The American Geophysical Union (AGU) 2015 Fall Meeting, the world's largest organization of Earth and space scientists, took place in San Francisco, CA with nearly 24,000 attendees on December 14-18, 2015. At AGU, Suomi NPP environmental satellite imagery was showcased during the "Upper Atmospheric Gravity Wave Details Revealed in Nightglow Satellite Imagery" presentation.

Images from this presentation have also been chosen to be the cover images for the December issue of PNAS (Proceedings of the National Academy of Sciences of the United States). Suomi NPP's VIIRS instrument's Day/Night Band is able to observe clouds on moonless nights using the reflection of downwelling nightglow—light emitted from a geometrically thin and tenuous emission layer residing near the mesopause. The mesopause is temperature minimum at the boundary between the mesosphere and the thermosphere atmospheric regions, roughly 85-95 km above mean sea level. The paper covers a wide assortment of night glow gravity wave structures observed by the DNB, and is meant to serve as an introduction to a new set of measurements that hold promise for researchers and modelers of the upper atmospheric circulation.

The images below show the concentric gravity wave structures as seen from below and above.



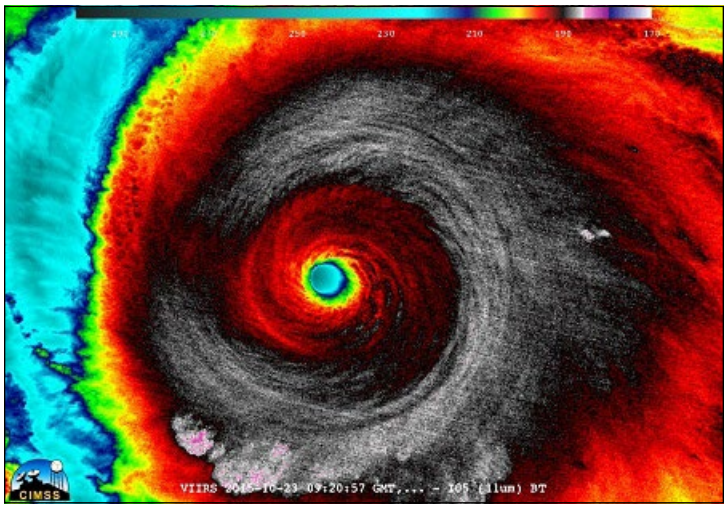
(A)
Photograph of concentric gravity waves taken on the Tibetan Plateau (viewing south) on April 27, 2014.

Photograph courtesy of Dai Jianfeng.

(B)
Corresponding VIIRS Day/Night Band imagery from later that same night is shown below, centered upon the contiguous wave structure that was launched by a thunderstorm complex in Bangladesh. A red dot shows the approximate location of the surface photographer.

Interesting Images

Hurricane Patricia Bears Down on Mexico's Pacific Coast



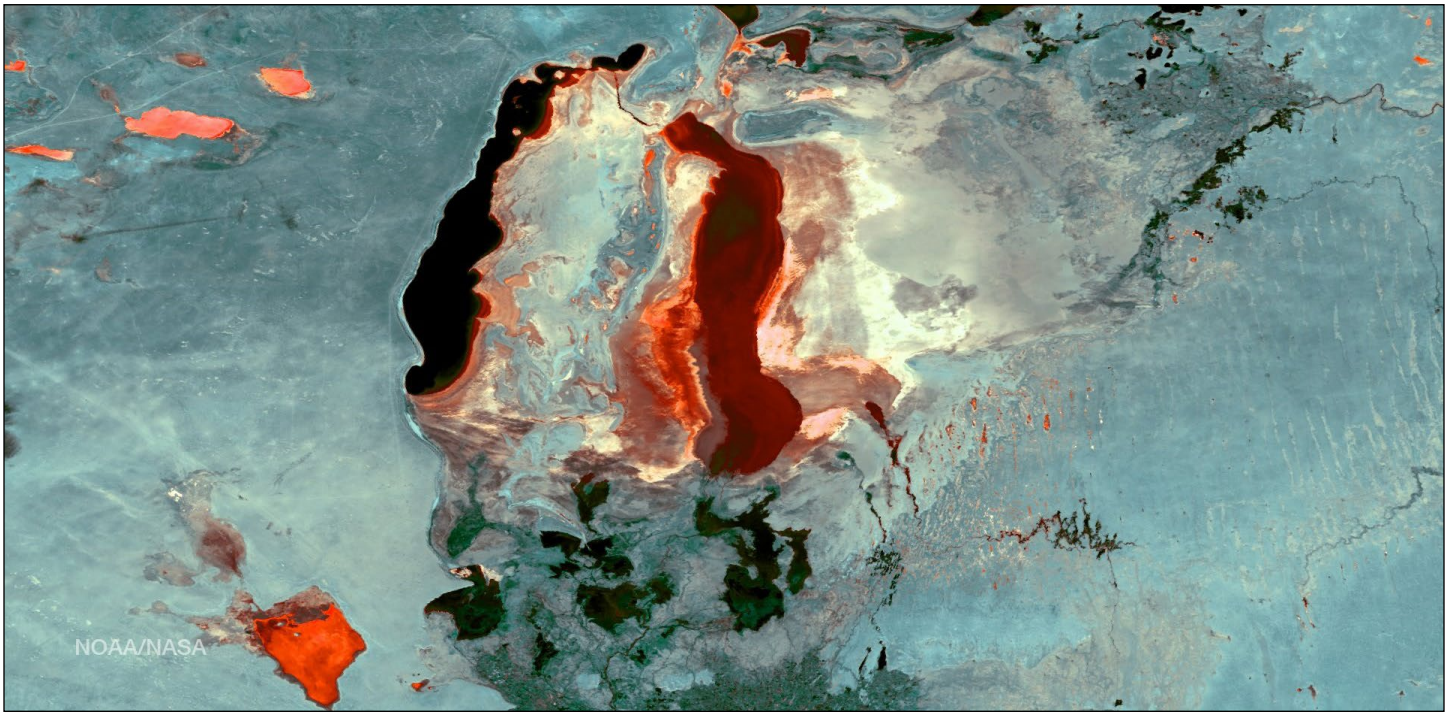
October 23, 2015

This image shows Hurricane Patricia, the strongest land-falling Pacific hurricane in recorded history as the historic storm approaches Mexico's Pacific coast. The Visible Infrared Imaging Radiometer Suite (VIIRS) instrument aboard Suomi NPP captured an infrared image of the typhoon. Hurricane Patricia sustained maximum winds of 200 mph. At landfall Patricia had weakened with winds of 165 mph, still a Category 5 storm.

Credit:
William Straka III, University of Wisconsin-Madison, CIMSS

Colorful Multispectral Imagery of the Aral Sea

November 4, 2015

The Aral Sea, split between Uzbekistan to the south and Kazakhstan to the north, used to be one of the largest lakes in the world. Now, after years of water loss, it is mostly dried up lake beds. This image, taken on October 23, 2015, uses multiple spectral bands from the VIIRS instrument on the Suomi NPP satellite that are sensitive to subtle differences in surface temperature, condition, and vegetation. Dark areas are where water still stands, blues are the surrounding barren lands, and greens are associated with the wetlands that feed the inland sea. The same area looks quite different when using the satellite's spectral channels visible to the human eye.

Credit: NOAA/NASA