JOINT POLAR SATELLITE SYSTEM PROGRAM

NEWSLETTER

2016 • QUARTER #2

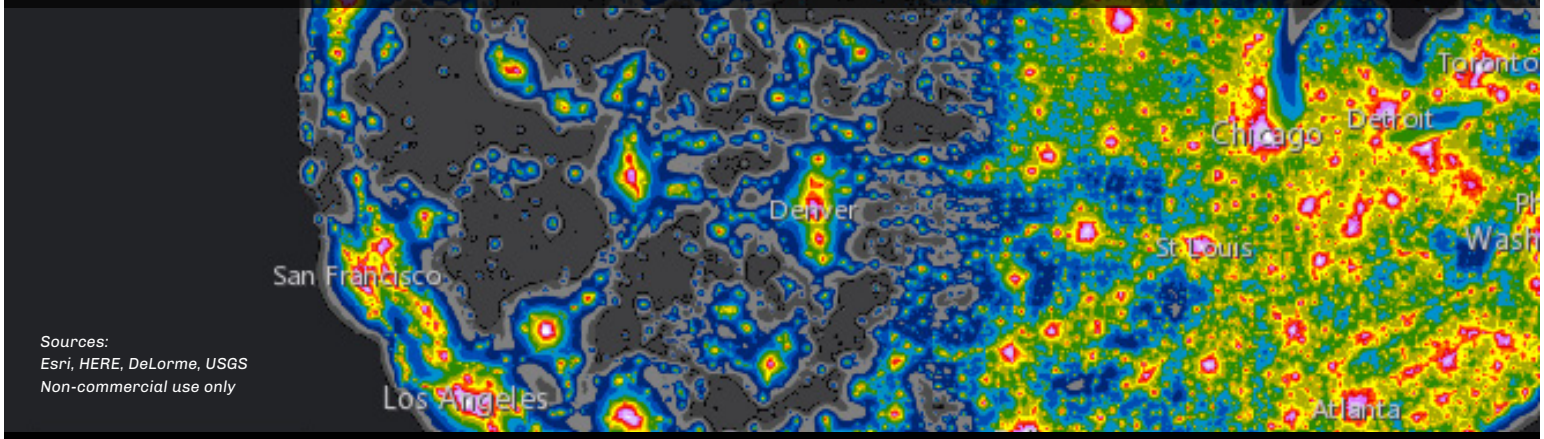
FROM HARRY

This edition of our JPSS newsletter highlights the role of JPSS satellites in the news, by monitoring recent events like the Pavlof Volcano eruption and the Fort McMurray fires, as well as dust storms and light pollution. JPSS imagery, 'The Blue Marble' was even showcased in the U.S. Post Offices' "Views of Our Planets" Forever stamps.

JPSS also continues to broaden opportunities through workforce training where students are exposed to our mission, products, pioneering research from the state-of-the-art Instruments and use of these products for weather, climate and ocean applications.

To learn more, you can read previous issues of the JPSS Newsletter here.

SUOMI NPP DATA USED TO CREATE WORLD ATLAS OF ARTIFICIAL SKY BRIGHTNESS



Sources:
Esri, HERE, DeLorme, USGS
Non-commercial use only

The Milky Way, the brilliant river of stars that has dominated the night sky and human imaginations since time immemorial, is but a faded memory to one third of humanity and 80 percent of Americans, according to a new global atlas of light pollution produced by Italian and American scientists, including Chris Elvidge of NOAA's National Centers for Environmental Information and Kimberly Baugh of NOAA's Cooperative Institute for Research in Environmental Sciences.

"We've got whole generations of people in the United States who have never seen the Milky Way," said Elvidge. "It's a big part of our connection to the cosmos and it's been lost."

Light pollution is most extensive in countries like Singapore, Italy and South Korea, while Canada and Australia retain the darkest skies. In Western Europe, only small areas of night sky remain relatively undiminished, mainly in Scotland, Sweden and Norway. Despite the vast open spaces of the American west, almost half of the U.S. experiences light polluted nights.

Light pollution does more than rob humans of the opportunity to ponder the night sky. Unnatural light can confuse or expose wildlife like insects, birds and sea turtles, with often fatal consequences.

The atlas takes advantage of low light imaging now available from the Suomi NPP satellite, calibrated by thousands of ground observations. The brighter the area in this map the harder it is to see stars and constellations in the night sky.

For more information about the study, see http://goo.gl/gWeZvs and to read the study in its entirety, go to http://goo.gl/dDsmju.

View of Pavlof Volcano from 20,000 feet.
Credit: LtCdr. Nahshon Almandmoss, U.S. Coast Guard

SUOMI NPP SATELLITE MONITORS

PAVLOF VOLCANO ERUPTION

On any given day, the Alaska Region presents a wide assortment of challenges to forecasters, with an ever-changing mix of sea ice, snow cover, and multi-layered cloud patterns. When one of the Aleutian Chain volcanos erupts, spewing ash into all levels of the atmosphere, the stakes are raised for forecasters in the region.

Volcanic ash is a notorious hazard to the jet aircraft which frequent these skies on domestic and international routes. The fine, glass-like particles of some ash plumes can sand-blast cockpit windows, and damage engines, even to the point of in-flight failure.

Such impacts could not have been far from the minds of forecasters on the afternoon of March 27, 2016 when the Pavlof Volcano, one of the Aleutian Range's most active, erupted with a 20,000 foot high ash plume tracking rapidly to the northeast and into the heart of the Alaskan mainland.

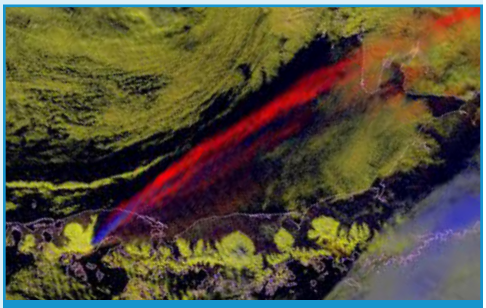
To gain a better perspective on the Alaska Region, forecasters appeal to their 'eyes in the sky.' Some weather satellites carry instruments that provide critical information on a volcanic ash plume's height and content.

The top image to the right, for example, was collected by the NOAA/NASA Suomi NPP satellite at about 1:30 a.m. local time, roughly 9 hours after the initial eruption. Information from Suomi NPP's Day/Night Band sensor (measuring reflected moonlight off snow, clouds, and ash) has been blended with other measurements that are sensitive to the temperature and composition of water/ice clouds and volcanic ash.

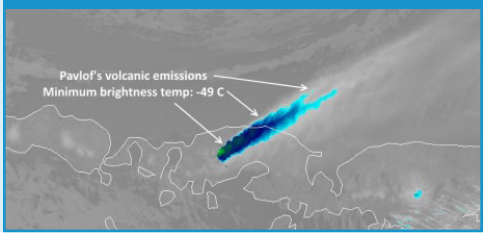
With each unique observation playing its part, the low water clouds and snow cover are shown in yellow, higher/thicker ice clouds in shades of purple, and the heart of Pavlof's ash plume streaming to the northeast is depicted in pink/red. For reference, the coastal boundaries are drawn in purple.

Using a variety of satellite data including Suomi NPP's VIIRS, forecasters issued timely and accurate guidance for this rapidly changing hazard. Airlines used information provided by the Anchorage Volcanic Ash Advisory Center (VAAC) to re-route, and in some cases, cancel flights. NOAA operates the Washington D.C. and Anchorage, Alaska, VAAC, two of nine worldwide.

Data from polar-orbiting satellites like Suomi NPP (and the upcoming JPSS-1, which will launch in 2017) remain the most crucial sources of data for the Alaskan Region, providing a broad and accurate view of weather, climate, environmental and oceanographic conditions unavailable from other sources.



Above & Below Images Credit: Steven D. Miller, Cooperative Institute for Research in the Atmosphere

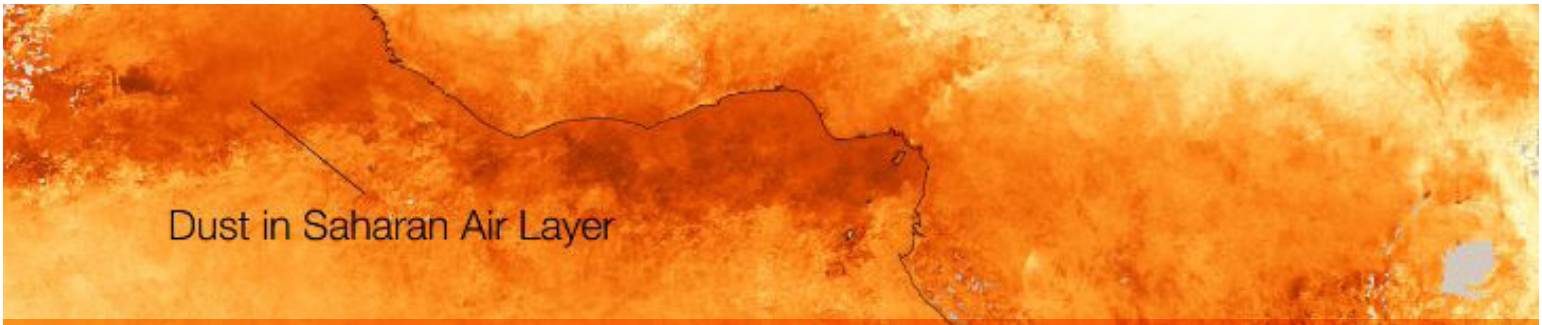


JPSS STUDENTS PROFESSIONAL AND ACADEMIC READINESS WITH KNOWLEDGE IN SATELLITES (SPARKS) WORKFORCE TRAINING

NOAA CREST

The NOAA-Cooperative REmote Sensing Science and Technology (NOAA-CREST) center aims to conduct research, educate, and train a diverse group of students, early career scientists, and engineers in NOAA related Science missions to help create a diverse STEM workforce for NOAA, NOAA contractors, academia, industries and private sector. This summer, four CREST students are taking the JPSS Students Professional and Academic Readiness with Knowledge in Satellites (SPARKS) workforce training where they are exposed to the JPSS mission, products, pioneering research from the state-of-the-art instruments and use of these products for weather, climate and ocean applications. JPSS SPARKS is a pilot program created to help recruit, train and graduate a world-class cadre of students, with core competency skills needed to join the NOAA workforce, particularly from underrepresented and underserved minority populations.

Established in 2001, the NOAA-CREST center is led by CUNY and brings together Hampton University, University of Puerto Rico at Mayaguez, California State University, and University of Maryland Baltimore County, and industrial partners like Raytheon, Northrop Grumman and I.M. Systems Group, Inc.



This data map shows the presence of aerosols in the atmosphere based on data from the AVHRR and VIIRS sensors aboard NOAA polar-orbiting spacecraft

THE DIRT ON ATMOSPHERIC DUST

SCIENTISTS DEVELOP NEW TOOLS TO DETECT THE DUST IN THE WIND

It might seem small, but atmospheric dust is a big deal. Consisting (mostly) of tiny pieces of metal oxides, clays and carbonates*, dust is the single largest component of the aerosols in Earth's atmosphere, and it has a significant impact on the Earth's climate, effecting a wide range of phenomena, including from temperatures Atlantic Ocean temperatures to the rate of snowmelt in the southwestern U.S.* And yet, while its effect on Earth's ecosystems is easily detectable, its presence in satellite imagery may not be.

If you're wondering how a satellite like the Suomi NPP traveling 824 km (512 miles) above the Earth's surface can even detect something as small as dust in the first place, it's because dust like other aerosols in the atmosphere, reflects or absorbs light. Satellite sensors, such as the VIIRS instrument aboard Suomi NPP and the GOES I-M imager aboard the GOES-13 and -15 satellites, the Advanced Very High Resolution Radiometer (AVHRR) on POES and MetOp satellites, can detect these areas of reflection and absorption, thus indicating varying amount of aerosol in the atmosphere.

In the map of AVHRR and VIIRS aerosol optical thickness data shown above, areas of the atmosphere with thick aerosol layers (i.e., areas in which a lot of light is reflected or absorbed) are colored in deep orange, whereas areas with low aerosol optical thickness are colored light yellow. (Note the large plumes of aerosols from sand, dust and salt-spray moving westward, off the coast of Africa.)

DUST DETECTION DIFFICULTIES

Of course, just because satellites can detect dust in the atmosphere does not mean scientists can always detect it in satellite imagery.

For example, Suomi NPP's VIIRS instrument, a more advanced instrument compared to its predecessors, allows scientists to create photorealistic images of Earth by combining three (red, green, and blue) of VIIRS's 22 channels. In these so-called "true-color" images, such as in the one of China's Taklimakan Desert below, dust clouds show up quite clearly, even over lighter areas. Unfortunately, these types of images are only available in the daytime, which presents a problem for scientists trying to track the development and distribution of atmospheric dust clouds over time.

Taking a different approach, the scientists at the Cooperative Institute for Research in the Atmosphere have developed an algorithm known as "DEBRA," for Dynamic Enhanced Background Reduction Algorithm. As its name implies, DEBRA works by reducing the background in an image (be it a polar-orbiting or geostationary satellite) to grayscale, thereby enhancing the appearance of dust clouds, which appear yellow. The intensity of the yellow corresponds to confidence that a given pixel contains dust.

WHAT IT IS AND WHERE IT COMES FROM

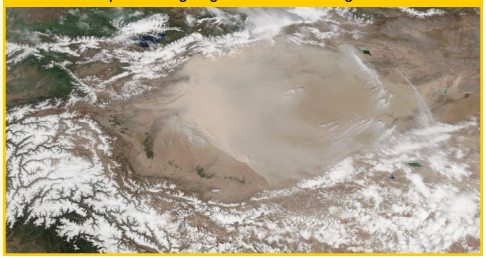
Improving our ability to detect dust in the atmosphere is beneficial because just how much dust enters the atmosphere each year is unclear – projections range from 200 to 5,000 teragrams a year* (a teragram, Tg, equals one trillion grams). Scientists estimate that, on average, about 20 Tg of dust are suspended in the atmosphere at any given time, but seasonal variability is common. Inter-annual variability is also a factor, as ocean-related weather phenomena such as the North Atlantic Oscillation and El Niño have been associated with greater Saharan dust transport across the Atlantic.

And speaking of the Sahara, Lake Chad, which sits just below it in the north-central part of Africa, is the Earth's largest single source of atmospheric dust. In fact, about half of the dust suspended in Earth's atmosphere originates in North Africa*, due to both the abundance of dust sources there and the region's position under the subtropical jet stream, which carries dust around the world. The rest is said to come from just a handful of other well-known dust-producing regions, including northwestern China's Taklimakan Desert, parts of Arabia, Iran, the shore of the Caspian Sea, the Lake Eyre Basin in Australia, and the area around Utah's Great Salt Lake.

Atmospheric dust arises from these locations because they all share a common trait: they all sit in low-elevation basins near or surrounded by mountains, which feed rivers that deposit large amounts of sediment in these low-lying areas. These particle-producing places also tend to be completely flat and devoid of significant (or any) vegetation cover, two features that allow winds to build momentum and drive more dust into the atmosphere.

How long dust hangs around in the atmosphere depends on the size of the individual particles. Particles with radii between 0.1 and 1.0 micrometers (a micrometer is one-millionth of a meter) can stay aloft for 20 or more days. Larger dust particles with radii between five and 10 micrometers usually fall out of the sky within 24 hours.

This true-color image of northwestern China's Taklimakan Desert from Suomi NPP shows a dust cloud over a light background. The Taklimakan is among the handful of well-known dust-producing regions around the globe.



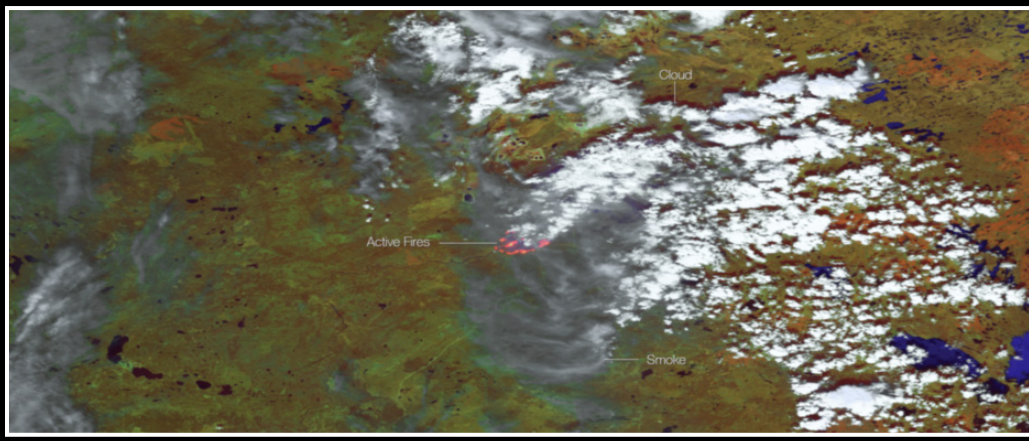
* "Mineral Dust and Climate." ***Earth Gauge.*** National Environmental Education Foundation (Web PDF) <http://www.crh.noaa.gov/Image/lot/misc/CF_Dust.pdf>

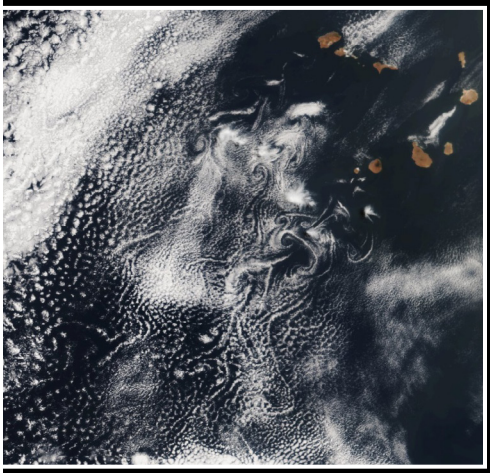
INTERESTING IMAGES

FORT MCMURRAY FIRE GLOWS FROM SPACE

A large wildfire burns in Canada's Alberta province near Fort McMurray, one of the largest oil-producing areas in the world. This image, taken by the Suomi NPP satellite on May 5, 2016, uses visible and thermal imagery to distinguish cloud, smoke, land, and areas of active fires. The thermal signature is so strong in this fire that it is easily detected by the satellite's VIIRS sensor, 512 miles up in space.

Credit: NOAA Environmental Visualization Lab





SWIRLING CLOUDS STREAM OFF OF THE CAPE VERDE ISLANDS

Often, satellite imagery reveals unique cloud features not otherwise easily seen from the ground. One such feature, called cloud streets, appear as long rows of cumulus clouds. These rows run parallel to the direction of the wind and are formed by convection rolls -- a series of rising warm air masses and sinking cool air masses that align with wind direction.

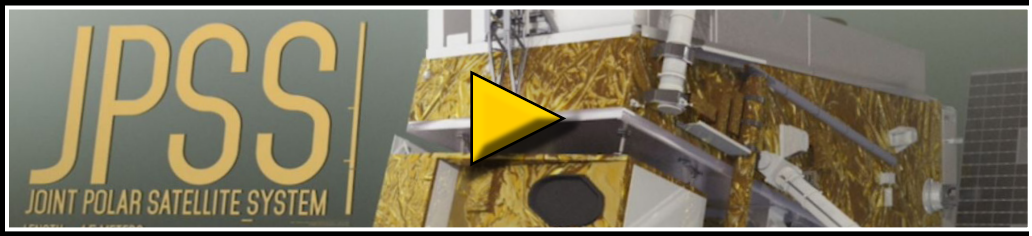
Cloud streets typically form long straight lines over large flat areas of the ocean. However, geological features, like islands and volcanoes, can disrupt the flow of the wind and create spiral patterns, not dissimilar to the way large boulders create downstream eddies in rivers. The spirals are called von Karman vortex streets. These vortices were named after Theodore von Karman, a co-founder of NASA's Jet Propulsion Laboratory, who was one of the first scientists to describe this type of atmospheric phenomenon.

This image was captured by the Suomi NPP satellite on June 8, 2016.

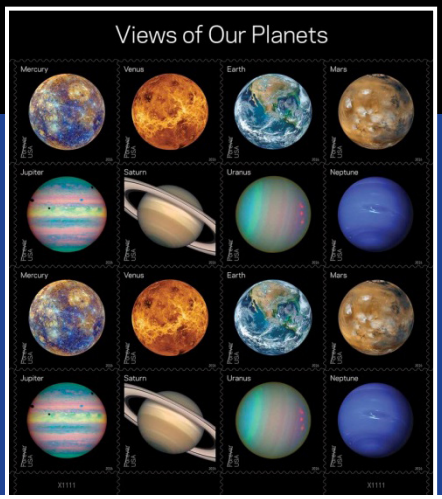
Credit: NOAA Environmental Visualization Lab

DID YOU KNOW?

JPSS produced an informational overview video about our mission. Learn about JPSS instruments and applications, you can view and download it here.



'BLUE MARBLE' EARTH POSTAGE STAMP ARRIVES

On May 31, 2016, The U.S. Post Offices presented "Views of Our Planets" Forever stamps featuring iconic images of the planets in our solar system, including the well-known "Blue Marble" image of Earth from the Visible Infrared Imaging Radiometer Suite (VIIRS) instrument on Suomi NPP.

The first-day-of-issue stamp dedication ceremony was open to the public, and held in New York City at World Stamp Show-NY 2016. NASA Oceanographer Norm Kuring who created the Blue Marble image in 2012, was a featured speaker at the dedication. This international gathering of stamp collectors occurs only once each decade in the United States, and – with more than 250,000 visitors attending – it is the largest stamp show in the world.