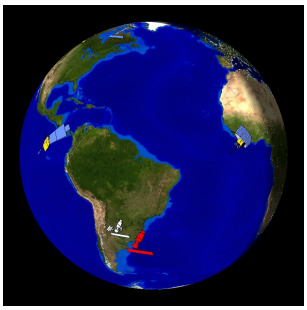
Science On a Sphere®
National Oceanic and Atmospheric Administration

All Satellites

Description



Media Preview

Satellites are a key tool for scientists to monitor and observe the Earth's atmosphere from space. **Geostationary satellites** orbit around the Earth at the same rate as the Earth rotates so that the satellites are over the same spot on Earth all the time. This allows them to collect a continuous stream of data for one location so that "movies" of the data can be made. The satellites are positioned 22,300 miles above the Earth's surface in order to view the Earth's full disk and to maintain their geostationary orbit. Geostationary satellites travel at about 7000mph in order to maintain their geostationary orbit. In addition to geostationary satellites, scientists also use **polar orbiting satellites**. These satellites circle the Earth, crossing the poles on each orbit. Typically, polar orbiting satellites are about 500 miles above the Earth's surface. The satellites travel at almost 17,000mph, allowing them to orbit the Earth in roughly 100 minutes. A polar orbiting satellite is able to cover the whole Earth in less than one day.

There are hundreds of scientific satellites orbiting the Earth. This dataset shows the positions of seven geostationary satellites and the tracks of several polar orbiting satellites, plus the location of the International Space Station over one day, February 15, 2007. The day/night terminator is also included in this dataset. Each of the polar orbiting satellites travel at slightly different heights, allowing them to pass by one another without crashing.

Details

Category
Atmosphere

Audio
Yes

Dataset Source
Rick Kohrs, SSEC, Space, Science, and Engineering Center

Dataset Developer
Rick Kohrs, SSEC, Space, Science, and Engineering Center

Visualization Developer
Rick Kohrs, SSEC, Space, Science, and Engineering Center

Contact
Rick Kohrs

Directory
FTP Link

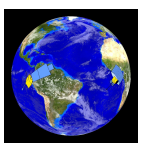
KML
KML File

Keywords
NOAA, GOES, EUMETSAT, JMA, geostationary, polar orbiting, satellites, International Space Station

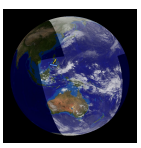
Notable Features

- **Geostationary Satellites**
  - NOAA's GOES-West - 135° West
  - NOAA's GOES-East - 75° West
  - EUMETSAT's Meteosat-9 - 0°
  - EUMETSAT's Meteosat-7 - 57° East
  - ISRO's INSAT-3C - 74° East
  - CMA's FY2C - 105° East
  - JMA's MTSAT-1R - 140° East
- **Polar Orbiting Satellites**
  - Blue - NOAA-17 and NOAA-18
  - Yellow - Defense Meteorological Satellite Program
  - Red - NASA, large ones are Terra and Aqua, small one is TRMM (notice the different orbit type)
- White - **International Space Station**

Related Datasets



Geostationary Satellites



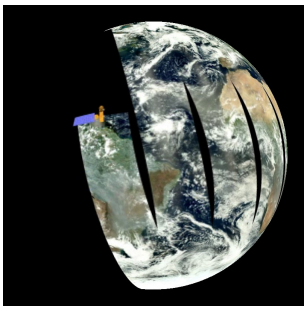
Polar Orbiting Satellite Coverage

International Space Station Track

Science On a Sphere®
National Oceanic and Atmospheric Administration

Aqua Satellite and MODIS Swath

Description



Media Preview

Satellites are important to scientists because the instruments on board can provide almost daily global coverage of the Earth that would otherwise not be available. There are six instruments on board NASA's Aqua satellite. One of them is MODIS, the Moderate Resolution Imaging Spectroradiometer. MODIS measures 36 spectral frequencies of light, which provide a wealth of information about the physical properties of the atmosphere and the biological and physical properties of the oceans and land. The Aqua satellite with MODIS attached was launched May 4, 2002. Since then, Aqua has been circling the Earth at an altitude of 438 miles (705 kilometers) every 99 minutes in a polar orbit passing within 10 degrees of each pole every orbit. The orbit is sun-synchronous, which means that the satellite passes over the same spot of the Earth at about the same local time everyday. Aqua crosses the equator from south to north at about 1:30 pm local time.

This dataset shows the path of the Aqua satellite and MODIS swath over a period of one day, August 27, 2005. The swath of data collected by MODIS is over 1400 miles (2300km) wide. This means that MODIS is able to measure almost the entire Earth surface everyday. MODIS only collects data when it is on the sunlit side of the Earth because it measures reflected light from the Sun. The bright band that appears in the middle of some of the swaths is reflected sunlight off of the ocean. By August 27, 2005 Hurricane Katrina had crossed Florida and was strengthening in the Gulf of Mexico. That hurricane, as well as Typhoon Talim in the western Pacific between Japan and New Guinea, is visible in this dataset.

Notable Features

- Each orbit takes 99 minutes
- Data is only collected on the sunlit side of the Earth
- Hurricane Katrina and Typhoon Talim are visible

Related Datasets

(None)

Details

Category
Atmosphere

Audio
No

Dataset Source
NASA MODIS

Dataset Developer
NASA Goddard Space Flight Center

Visualization Developer
NASA Goddard Space Flight Center

Contact
NASA Goddard Space Flight Center

Directory
FTP Link

Keywords
Atmosphere, NASA, satellites, MODIS, Aqua

Science On a Sphere®
National Oceanic and Atmospheric Administration

Blue Marble (23 degree tilt)

Description

Media Preview

The Blue Marble is an incredibly detailed, true-color depiction of the Earth. NASA is responsible for this dataset made from a compilation of satellite images throughout 2001. Most of the information came from NASA's MODIS, the Moderate Resolution Imaging Spectroradiometer, which is attached to the Terra satellite 435 miles above Earth. The background image of the land and oceans was created using data from June through September of 2001. This could not be done in a single day or even a week because on any given day clouds are blocking a significant portion of the surface. The cloud image is a composite of three days worth of data. The first two days of data were collected in the visible wavelength and the third day was needed to get a view of the clouds over the poles using thermal infrared imagery.

The shading is true color with the oceans shades of blue, the clouds white and the lands varying from green to brown. The brown areas are the sands of the deserts. The shading of the land was done using a dataset compiled by the U.S. Geological Survey's Earth Resources Observation and Science Data Center.

Additional Blue Marble datasets are available to highlight some of the characteristics of the changing Earth. The standard Blue Marble is a year long composite to show an average view of the earth. The Blue Marble without clouds is also available in monthly composites the entire year. This monthly evolution is the seasonal blue marble. The monthly evolution allows audiences to see the changing appearance of the Earth due to the season changes. The most dramatic change is the expansion of the snow cover during the winter months and then the depletion of it during the summer months. **Blue Marble: Next Generation** provides an updated version of the seasonal changes dataset. The Blue Marble is also available without the cloud cover so that the vegetation can be clearly seen. This dataset has also been merged with the **Nighttime Lights** dataset, to create a new dataset. The new dataset shows the Earth with daytime and nighttime views of the Earth, to demonstrate how only half of the Earth is illumintated at one time.

Details

Category
Land

Audio
Yes

Dataset Source
NASA Goddard Space Flight Center

Dataset Developer
NASA Goddard Space Flight Center

Visualization Developer
NASA

Contact
Beth Russell

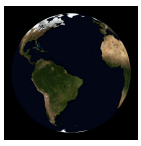
Directory
FTP Link

Keywords
Land, Solar System, Earth, Blue Marble

Notable Features

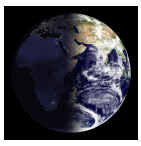
- Vastness of the Sahara Desert
- Shading done in true color: gives Earth's appearance from space

Related Datasets



Seasonal Blue Marble

Earth with Vegetation

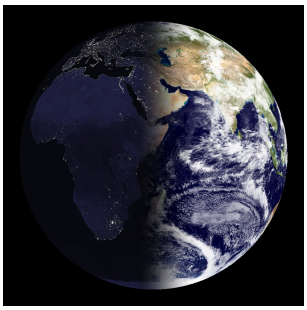


Blue Marble and Nightlights

Science On a Sphere®
National Oceanic and Atmospheric Administration

Blue Marble and Nightlights

Description



Media Preview

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Details

Category
Land

Audio
No

Dataset Source
NASA GSFC, DMSP

Dataset Developer
NASA GSFC, NGDC Earth Observations Group

Visualization Developer
Steve Albers, NOAA/GSD

Contact
Steve Albers

Directory
FTP Link

Keywords
Land, Solar System, Earth, Blue Marble

Notable Features

- Vastness of the Sahara Desert
- Shading done in true color: gives Earth's appearance from space

Related Datasets

Blue Marble (23 degree tilt)

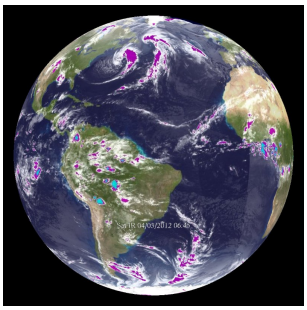
Seasonal Blue Marble

Earth with Vegetation

Science On a Sphere®
National Oceanic and Atmospheric Administration

Real-time: Color Enhanced Infrared Satellite

Description



Media Preview

Infrared satellite images are used by meteorologists to determine where clouds are, but more importantly, how the clouds are moving. The infrared, IR, satellites work by measuring the infrared radiation that is emitted. Because the emitted radiation is proportional to temperature, the data are converted to temperature values, which can be useful for meteorologists. In comparison to clouds, the Earth's surface, even on very cold nights, is warm. When there are clouds, they absorb the radiation emitted by the Earth below and emit their own radiation at a much cooler temperature. Any area that has clouds shows up cooler than the ground, allowing meteorologists to detect the locations of the clouds. The height of clouds is inversely proportional to temperature, meaning that the tallest clouds are the coldest. It is often the tallest clouds that bring the most severe weather.

The satellites that collect these data are geostationary, meaning that they rotate at the same rate as the Earth so that the satellites are over the same spot on Earth all the time. This allows them to collect a continuous stream of data for one location so that "movies" of the data can be made. Over the United States there are two such satellites, the GOES (Geostationary Operational Environmental Satellites) -East and GOES-West. World wide there are many such satellites. This dataset is a composite of GOES, Meteosat, and GMS satellite data. Meteosat and GMS are similar to GOES, but operated by other countries. This real-time, color enhanced dataset is shaded so that the significant clouds are brightly colored in order to stand out from the surface. The lowest clouds are white, medium level clouds are shades of purple, and the highest clouds are teal. The background of this image is the "Blue Marble." The data is constinently updated so that the past thirty days of data are available.

Also available is a collection of biweekly IR satellite interpretations by NOAA scientists that can be used with this dataset. The interpretations are plain-language descriptions of notable climate and weather events visible in the cloud patterns of the two-week period indicated. Interpretations are posted every other Tuesday, and are available for the past six months. The interpretations are made available by the American Museum of Natural History, NOAA Climate Prediction Center, and NOAA National Climatic Data Center. To request access to this Google Docs collection please write Laura Allen at laura@amnh.org.

Details

Category
Atmosphere

Audio
No

Dataset Source
MTSAT

Dataset Developer
Fred Mosher, AWC Steve Albers, NOAA/GSD

Visualization Developer
Steve Albers, NOAA/GSD

Contact
Steve Albers

Directory
FTP Link

Keywords
Atmosphere, IR satellite, real-time, color enhanced, satellite

Notable Features

- Lowest clouds white, medium level clouds purple, and highest clouds teal
- Available in real-time

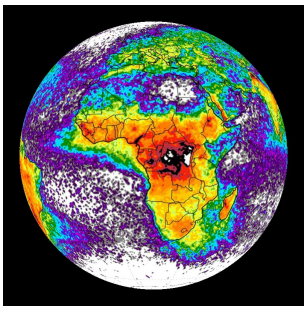
Related Datasets

(None)

Science On a Sphere®
National Oceanic and Atmospheric Administration

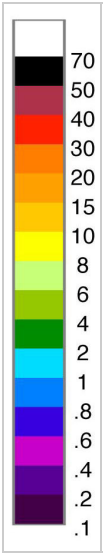
Annual Lightning Flash Rate Map

Description



Media Preview

Before scientists had satellites to detect and measure lightning frequency, it was thought that there were globally 100 lightning flashes per second, an estimate that dates back to 1925. With satellites monitoring lightning frequency, it is now accepted that the global lightning flash frequency is on the order of 40 flashes per second. NASA has two different sensors that measuring flash frequency, the Optical Transient Detector, OTD, and the Lightning Imaging Sensor, LIS. Data from the OTD from 1995 - 2000 and the LIS from 1998 - 2005 has been combined and averaged to create an average annual lightning flash rate map. 11 year of data is included to remove any anomalies that might be present in just one year. The color variations in the map display the average annual number of lightning flashes per square kilometer.



It is clear from this map that the distribution of lightning flashes around the world is uneven. About 70% of all lightning activity occurs in the tropics. The location that receives the greatest number of flashes per year is near the small village of Kifuka in the Democratic Republic of the Congo. The average annual flash rate for this location is about 158 lightning bolts. In the United States, Florida has the highest annual flash rate with an average of 59 lightning bolts per year. Thunderstorms occur most often during the summer, which means that there are only thunderstorms for part of the year. In Central Africa, the climate varies only slightly, allowing for thunderstorms to occur year round. The three key "ingredients" that are needed for a thunderstorm to develop are moisture, instability, and uplift. The moisture is needed for the clouds to develop. Instability in the atmosphere is caused by air that rises because it is warmer than its surroundings. Uplift is what forces the air to initially start rising. Rising air cools and condenses, forming clouds when there is enough moisture. Some examples of uplift mechanisms are mountains that block the path of the airflow, sunlight which warms the air causing it to rise, and front boundaries between weather systems. The land-sea temperature contrast around Florida makes it susceptible to thunderstorms.

Details

Category
Atmosphere

Audio
No

Dataset Source
NASA LIS/OTD

Dataset Developer
NASA LIS/OTD Science Team

Visualization Developer
NASA Marshall Space Flight Center

Contact
Beth Russell

Directory
FTP Link

Keywords
Atmosphere, lightning, thunderstorms

Notable Features

- Highest lightning flash frequency is 159 flashes per year in Central Africa
- Florida has the highest flash frequency in the United States
- The color variation indicates the flash frequency according to the color bar

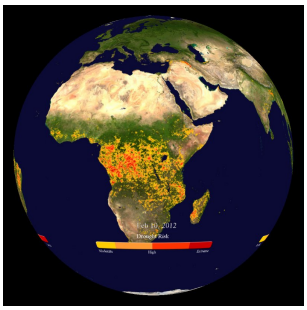
Related Datasets

(None)

Science On a Sphere®
National Oceanic and Atmospheric Administration

Real-time: Drought Risk

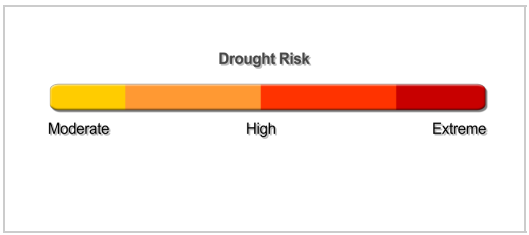
Description



Media Preview

Satellites can detect the difference between rock, grassland, and forests because these surfaces emit energy differently back into space. By measuring these differences and observing the patterns of vegetation --or its lack of growth--NOAA scientists can monitor how droughts are changing across the world through time.

This global drought risk composite is derived from the Normalized Difference Vegetation Index datasets developed by NOAA from measurements of the AVHRR sensor onboard the POES satellite. By monitoring vegetation health, moisture and thermal conditions, scientists are able to identify areas that are considered to be vegetatively stressed due to drought. An important note is that the drought imagery is based solely on the analysis of vegetation health and stress, not soil moisture conditions. But this index serves as a reliable proxy measurement for drought worldwide. Areas of desert and snow cover are not included in the analysis. Yellow areas indicate areas under moderate drought conditions; red indicates areas experiencing extreme drought conditions. A number of other datasets are also being derived from NDVI, including risk indexes for wildfires and malaria. This dataset is updated weekly.



Details

Category
Land

Audio
No

Dataset Source
NOAA

Dataset Developer
NOAA Visualization Lab

Visualization Developer
NOAA Visualization Lab

Contact
NOAA Visualization Lab

Directory
FTP Link

Keywords
Land, drought, seasons

Notable Features

- Location and intensity of drought changes with the seasons
- Drought Risk is updated weekly

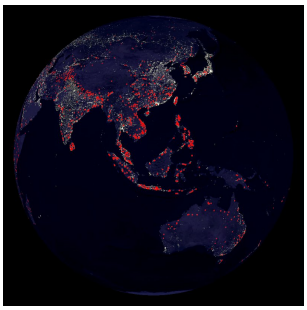
Related Datasets

(None)

Science On a Sphere®
National Oceanic and Atmospheric Administration

Flood Events 2000 - 2009

Description



Media Preview

Flooding is the nation's most common, costly and deadly natural hazard. Heavy rain is the most frequent cause of floods, but there are many other natural triggers, including hurricanes, tidal surges, ice jams and snow melt. Floods and flash floods have happened in all 50 states in the USA. Flooding in river basins is a natural part of the river's processes, serving to improve water quality and provide essential habitat to species, among other benefits. Flooding is a matter of scientific interest, as well as cultural significance, and is critical to land-use planning and policy. It is also a vital concern to the safety and welfare of communities in flood prone areas including those who live along waterways and coasts. People from all walks of life are vulnerable to the effects of flooding.

In this dataset, each orange dot represents a flood from 2000 to 2009 that caused significant damage. The flood events are mapped on top of the night time lights map to give a sense of how many people are affected by flooding. The data was gathered from news, governmental, instrumental, and remote sensing sources by the Dartmouth Flood Observatory at the University of Colorado. The listing is comprehensive and global in scope and all of the events shown are "large flood events with significant damage to structures or agriculture; fatalities; and/or at least 1 to 2 decades long reported interval since the last similar event." For more information on the data source, visit: **http://floodobservatory.colorado.edu/Archives/index.html**

Notable Features

- Each orange dot represents a significant flood event that happened between 2000 and 2009
- Flood data is overlaid on nighttime lights to give a sense of how many people are affected by flooding

Related Datasets

Flood Events - Displaced 250 or More People

Flood Events - 50 or More Fatalities

Flood Events - Due to Heavy Rain

Details

Category
Land

Audio
No

Dataset Source
G.R. Brakenridge, "Global Active Archive of Large Flood Events", Dartmouth Flood Observatory, University of Colorado

Dataset Developer
Lehigh University and Nurture Nature Center

Visualization Developer
Lehigh University and Nurture Nature Center

Contact
Nurture Nature

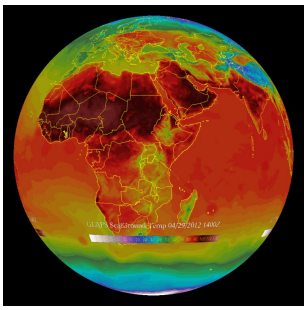
Directory
FTP Link

Keywords
Land, flooding, disaster, Nurture Nature

Science On a Sphere®
National Oceanic and Atmospheric Administration

Real-time: GLAPS Sea Surface / Ground Temperature (F)

Description



Media Preview

The Global Analysis and Prediction System, GLAPS, produces maps for several weather parameters over a large global domain. There are seven GLAPS products available for Science On a Sphere®. It is important for meteorologists to know the current conditions, not only in their local area, but also globally. A computer model is used to create a first guess as to what the map should look like, and then observations are added to enhance the map. The observations come from Doppler radars, satellites, wind and temperature profilers, radiometric profilers, as well as aircraft. GLAPS is such a powerful tool because of its ability to consolidate observations from so many different sources. The GLAPS datasets are available in real-time, updating hourly, and include the data for the past week.

One of the seven GLAPS datasets is not real-time. It is a map of the fraction of the Earth that is green during the year. This dataset shows how the "green fraction" changes during the year from January to December. Brown areas have no vegetation while greener areas represent vegetation. The other six GLAPS datasets all update hourly. The first is a map of the ground and sea surface temperature in degrees Fahrenheit. The second map shows surface air temperature as an image with surface air temperature contours and wind barbs overlaid. The third map is an image of the wind speed at 500mb in knots with wind barbs and 500mb height contours overlaid. The fourth map is similar to the third, but is for the surface. It is an image of the wind speed in knots at the surface with wind barbs and the surface pressure contours overlaid. The fifth map is an image of integrated water vapor (IWV) in centimeters. The sixth map is a radar reflectivity image that contains radar data from the National Weather Service in the United States and the Central Weather Bureau in Taiwan. Radar data is currently unavailable for other countries. Colorbars for each of the datasets are below. Click the colorbars to watch videos of the datasets

Details

Category
Atmosphere

Audio
No

Dataset Source
NOAA GLAPS

Dataset Developer
Steve Albers NOAA/GSD

Visualization Developer
Steve Albers NOAA/GSD

Contact
Steve Albers

Directory
FTP Link

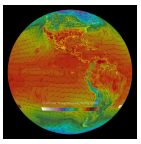
Keywords
Real-time, GLAPS, weather model, precipitable water, temperature, wind, pressure

Notable Features

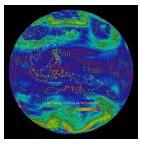
GLAPS Sea Surface / Ground Temperature in °F (1mb)

Related Datasets

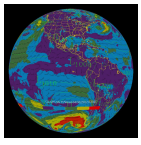
Real-time: GLAPS Green Fraction



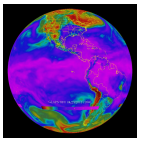
Real-time: GLAPS SFC Temperature (F) + Wind (kt)



Real-time: GLAPS 500mb Height + Wind + Windspeed (kt)



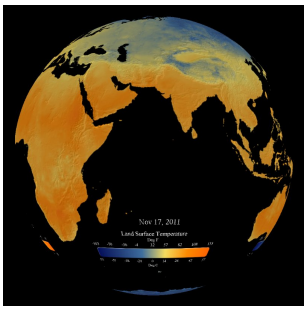
Real-time: GLAPS SFC Pressure + Wind + Windspeed (kt)



Real-time: GLAPS Total Precipitable Water (cm)

Real-time: Land Surface Temperature

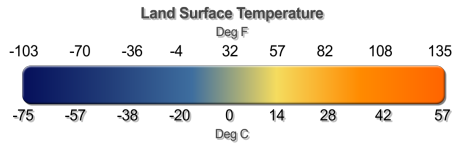
Description



Media Preview

Touch the ground and you will feel the land surface temperature. Satellites can also measure this temperature from space, and that data is plotted here. Though related, land surface temperature is not the same as air temperature since the land surface heats and cools more quickly than air. Land surface temperature is also greatly influence by land use and cover: bare, un-vegetated lands such as deserts are able to heat up to much greater temperatures than areas at the same latitude that are forested. This data is extensively used for modeling weather and climate, along with applications such as agriculture.

The data plots shown here are generated by averaging all of the data collected by the NOAA AMSU and DMSP SSM/I microwave sensors from 4 different polar-orbiting satellites over a 24 hour period. Blue areas are cool and orange areas are warm.



Details

Category
Land

Audio
No

Dataset Source
NOAA

Dataset Developer
NOAA Visualization Lab

Visualization Developer
NOAA Visualization Lab

Contact
NOAA Visualization Lab

Directory
FTP Link

Keywords
Land, surface temperatures, seasons

Notable Features

- Areas of higher altitude tend to be cooler than surrounding areas
- Land surface temperature is strongly influenced by land use and cover

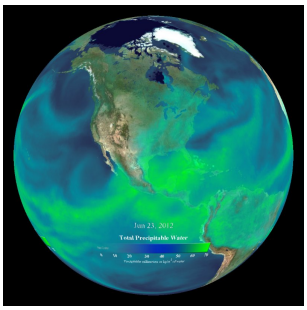
Related Datasets

(None)

Science On a Sphere®
National Oceanic and Atmospheric Administration

Real-time: Total Precipitable Water

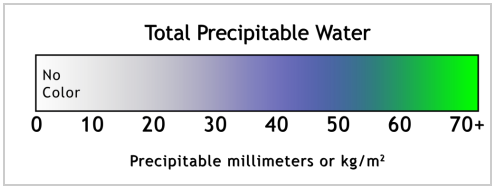
Description



Media Preview

The atmosphere contains an enormous amount of moisture that circulates around the globe. However, not all of it actually condenses into rain, sleet, or snow since the right balance of pressure and temperature are needed to create precipitation. Total precipitable water (TPW) in the atmosphere is the amount of water that can be obtained from the surface to the "top" of the atmosphere if all of the water and water vapor were condensed to a liquid phase. Significant features that can be identified in TPW data are the atmospheric rivers that flow off the oceans and onto coastal land areas. A famous example is the Pineapple Express that forms in the Northeast Pacific and impacts the Northwest United States. Also notice how TPW values are much greater over the equator and ocean. High levels of evaporation in these areas are one of the primary drivers of atmospheric circulation.

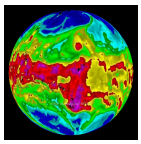
The land, ocean, and atmosphere all emit microwave radiation which can be measured by sensors on satellites, allowing scientists to study various aspects of the Earth. Microwave sounders are able to measure very low levels of microwave radiation naturally emitted by the Earth at different frequencies. Even water vapor emits microwave radiation that can be measured by microwave sounders. There are two datasets for TPW for Science On a Sphere. The first dataset uses data from the Advanced Microwave Sounding Unit, AMSU, which is attached to the NOAA Polar Environmental Orbiting Satellites NOAA 15, NOAA 16, and NOAA 17. Each satellite provides full coverage of the Earth everyday by orbiting the globe 14.1 times per day collecting a swath of data 1426 miles wide on each orbit. The second dataset uses data from the AMSU and the Special Sensor Microwave Imager, SSM/I, which is carried on Defense Meteorological Satellite Program satellites. Both are provided in near real-time. The AMSU dataset is updated hourly and the AMSU/SSMI combined dataset is updated daily.



Notable Features

- Tropics generally have high total precipitable water
- Areas of high total precipitable water typically indicated clouds and precipitation

Related Datasets



Real-time: NESDIS AMSU - Precipitable H2O

Details

Category
Atmosphere

Audio
No

Dataset Source
Advanced Microwave Sounding Unit Project and Special Sensor Microwave Imager

Dataset Developer
NOAA Visualization Lab

Visualization Developer
NOAA Visualization Lab

Contact
NOAA Visualization Lab

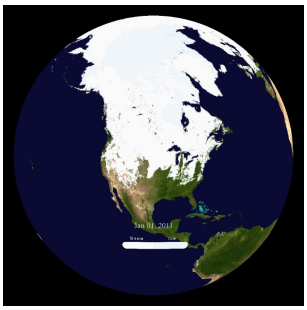
Directory
FTP Link

Keywords
Atmosphere, total precipitable water, satellite

Science On a Sphere®
National Oceanic and Atmospheric Administration

Real-time: Snow and Ice Cover

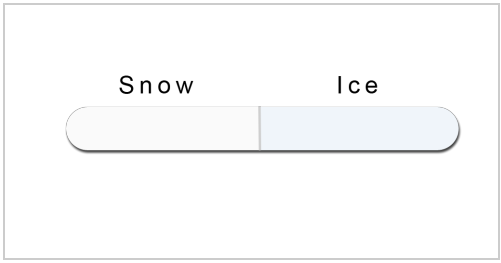
Description



Media Preview

The cryosphere (areas covered by ice, snow, glaciers, or permafrost) is an extremely dynamic part of the global system. Changes in the seasons and climate bring great changes to the extent of Earth's cryosphere. Using satellite data allows scientists to keep a continual eye on these areas.

Infrared and microwave data from multiple satellites including the NOAA's GOES Imager and POES AVHRR, US Air Force DMSP/SSMI, and EUMETSAT MSG/SEVIRI sensors is combined to create these daily maps of global snow and ice cover of the planet. Using multiple datasets provides relatively high spatial resolution (about 4 km/pixel) daily maps in all weather conditions. Light blue areas indicate sea ice extent, whereas white colors indicate all other areas of the cryosphere. This SOS dataset is updated on a daily basis in near real-time.



Details

Category
Ocean

Audio
No

Dataset Source
NOAA, USAF, EUMETSAT

Dataset Developer
NOAA

Visualization Developer
NOAA Visualization Lab

Contact
NOAA Visualization Lab

Directory
FTP Link

Keywords
Ocean, snow, sea ice, real-time

Notable Features

- The seasonal variations are very clear
- During the winter months, the effects of passing snow storms is visible
- In the Northern Hemisphere, the minimum ice concentration occurs in September and the maximum is in March

Related Datasets

(None)