



NASA Earth Observatory and Worldview

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Satellite Remote Sensing of Air Quality, 18-19 November 2018



Earth Observatory

NASA Earth Observatory

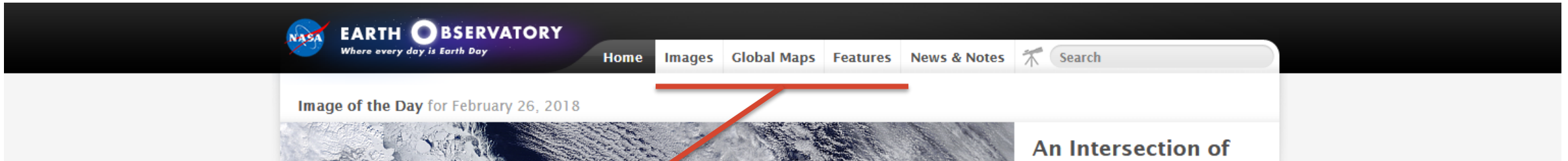
<https://earthobservatory.nasa.gov/>

- Shares images and stories that result from NASA research and satellite missions
- Things you will find:
 - Image of the day
 - Research highlights
 - Blogs
 - Global maps



Image of the day: March 7, 2014

Step 1: Go to <http://earthobservatory.nasa.gov>



- Images:
 - Image of the day by date and/or topic
- Global Maps:
 - Monthly average maps of land, ocean, and atmosphere
- Features:
 - Notes from field campaigns
 - Sensor highlights
 - Science articles



Step 2: Search for “Tracking Dust Across the Atlantic”

The screenshot shows the NASA Earth Observatory website. At the top, the NASA logo and 'EARTH OBSERVATORY' are visible, along with the tagline 'Where every day is Earth Day'. A navigation menu includes 'Home', 'Images', 'Global Maps', 'Features', and 'News & Notes'. A search bar on the right contains the text 'Tracking Dust Across the Atlantic', which is circled in red. Below the navigation, the main content area features an 'Image of the Day' for February 26, 2018, titled 'An Intersection of Land, Ice, Sea, and Clouds'. The image shows a coastal scene with a scale bar of 150 km. To the right of the image is a text block describing the scene: 'Cold winter winds helped paint a lovely scene off the coast of Labrador and Newfoundland. [Read more](#)'. Below this is a 'Previous Images' section with two small image thumbnails and a 'GRID VIEW' button. At the bottom of the page, there is a 'Features' section with a video player titled 'Landsat 8 Turns 5' dated February 15, 2018, and a 'SUBSCRIBE TODAY' button. The 'eo Kids' logo is also visible in the bottom right corner of the page content.



Step 3: Click on the Top Result

The screenshot shows the NASA Earth Observatory website with a search bar containing the text "Tracking Dust Across the Atlantic". The search results are sorted by relevance. The top result is circled in red and is titled "Tracking Dust Across the Atlantic : Image of the Day". The description for this result reads: "Aug 29, 2013 ... Hundreds of millions of tons of dust are picked up from the deserts of Africa and blown across the Atlantic Ocean each year. That dust helps build beaches in the Caribbean and fertilizes soils in the Amazon. It affects air quality in North and South America. And some say dust storms might play a role in the ...". Below this result are several other entries, including "Dust Storm Over North Africa : Natural Hazards", "A Dust Bath for Cape Verde : Image of the Day", "Dust Storm over Mauritania : Natural Hazards", "Cape Verde Under Dust : Natural Hazards", and "Terra Tracks Atlantic Dust Storms : Image of the Day".

Tracking Dust Across the Atlantic : Image of the Day
Aug 29, 2013 ... Hundreds of millions of tons of **dust** are picked up from the deserts of Africa and blown **across the Atlantic** Ocean each year. That **dust** helps build beaches in the Caribbean and fertilizes soils in the Amazon. It affects air quality in North and South America. And some say **dust** storms might play a role in the ...
<https://earthobservatory.nasa.gov/IOTD/view.php?id=81864>

Dust Storm Over North Africa : Natural Hazards
A low-pressure system **over** North Africa lofted a large plume of **dust** toward Europe and the **Atlantic** Ocean.
<https://earthobservatory.nasa.gov/NaturalHazards/view.php?id...>

A Dust Bath for Cape Verde : Image of the Day
Jan 28, 2018 ... Winter winds pick up sand from the Sahara and blow it over the North Atlantic islands. ... As temperatures drop and high pressure builds on the continent, strong winds known as the harmattan blow west across the Sahara. ... NASA Earth Observatory (2013, August 29) **Tracking Dust Across the Atlantic**.
<https://earthobservatory.nasa.gov/IOTD/view.php?id=91642>

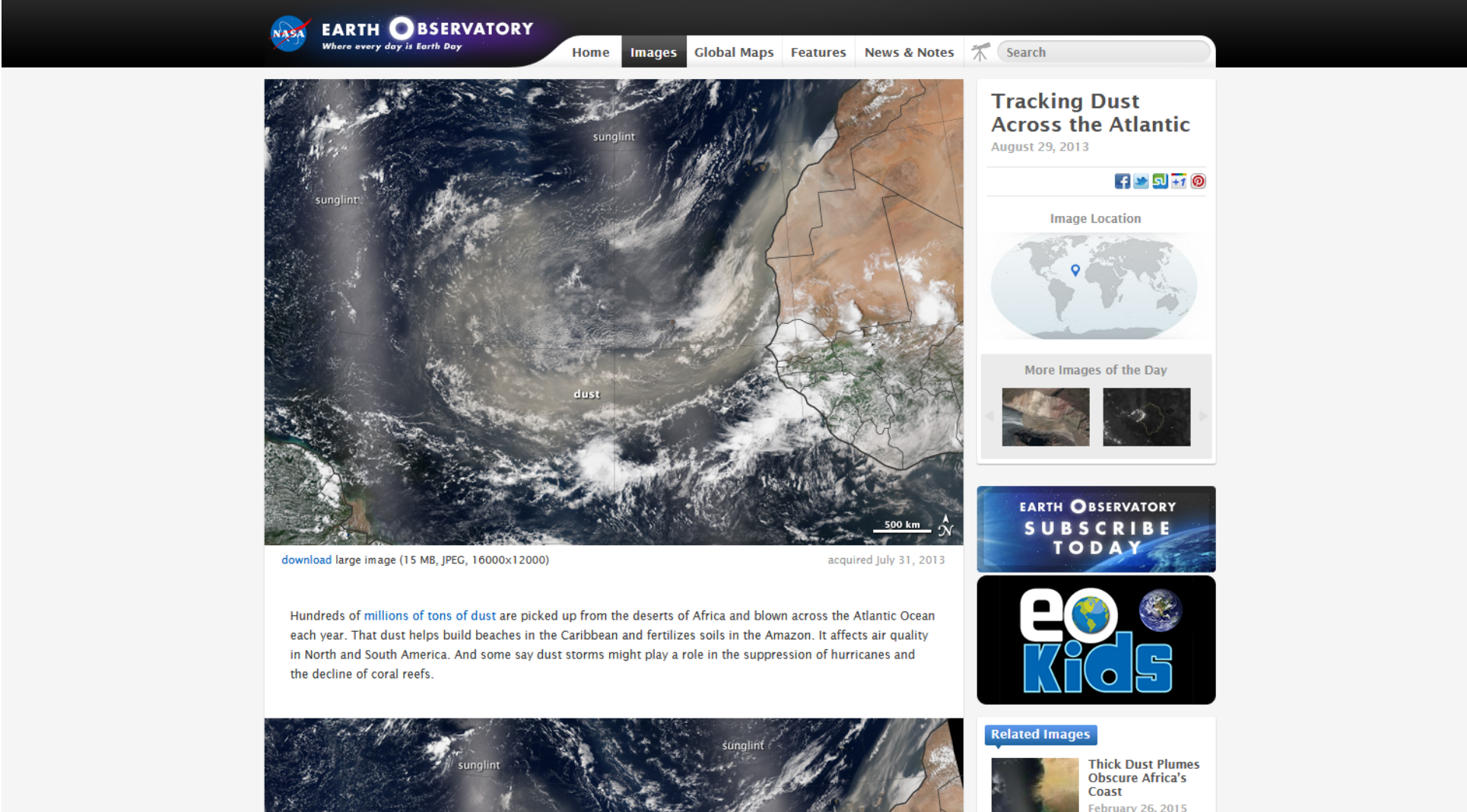
Dust Storm over Mauritania : Natural Hazards
A Saharan **dust** storm yellowed the skies **over the Atlantic** Ocean off the coast of Africa on May 21, 2003.
<https://earthobservatory.nasa.gov/NaturalHazards/view.php?id...>

Cape Verde Under Dust : Natural Hazards
Winter winds, the harmattan, swept a cloud of **dust** out of West Africa and **across the Atlantic**.
<https://earthobservatory.nasa.gov/NaturalHazards/view.php?id...>

Terra Tracks Atlantic Dust Storms : Image of the Day
Dec 24, 2009 ... Observations from different sensors on NASA's Terra satellite are combined to track



Step 4: Read Through the Result to See What Information is Available



The screenshot shows the NASA Earth Observatory website. The main content area features a large satellite image of the Atlantic Ocean with a massive dust plume originating from Africa. The image is labeled with 'sunlint' and 'dust'. Below the image is a 'download large image (15 MB, JPEG, 16000x12000)' link and the text 'acquired July 31, 2013'. A paragraph of text explains that hundreds of millions of tons of dust are picked up from the deserts of Africa and blown across the Atlantic Ocean each year, affecting air quality and coral reefs. To the right of the main image is a sidebar with a title 'Tracking Dust Across the Atlantic' dated August 29, 2013, social media sharing icons, an 'Image Location' map, and 'More Images of the Day' thumbnails. Below the sidebar are 'EARTH OBSERVATORY SUBSCRIBE TODAY' and 'eo Kids' banners. At the bottom right of the sidebar is a 'Related Images' section with a thumbnail titled 'Thick Dust Plumes Obscure Africa's Coast' dated February 26, 2015.

Tracking Dust Across the Atlantic
August 29, 2013

download large image (15 MB, JPEG, 16000x12000) acquired July 31, 2013

Hundreds of millions of tons of dust are picked up from the deserts of Africa and blown across the Atlantic Ocean each year. That dust helps build beaches in the Caribbean and fertilizes soils in the Amazon. It affects air quality in North and South America. And some say dust storms might play a role in the suppression of hurricanes and the decline of coral reefs.

EARTH OBSERVATORY SUBSCRIBE TODAY

eo Kids

Related Images
Thick Dust Plumes Obscure Africa's Coast
February 26, 2015

Exercise:

- Explore the Earth Observatory site for about 5 minutes. Specifically these sections:
 - Images
 - Global Maps
 - Features
- Using the search option, search for an air quality event in your area of interest. You can use keywords like smoke, dust, or air pollution, along with the name of a geographical area (for example, “Smoke and Fires in Australia”)
 - If you cannot find a relevant event in your region, look in another region
 - Select an event that can affect local or regional air quality
 - Note the date, satellite and sensor, region, event type, parameter displayed, and any other relevant information for your selected air quality event



Exercise Questions:

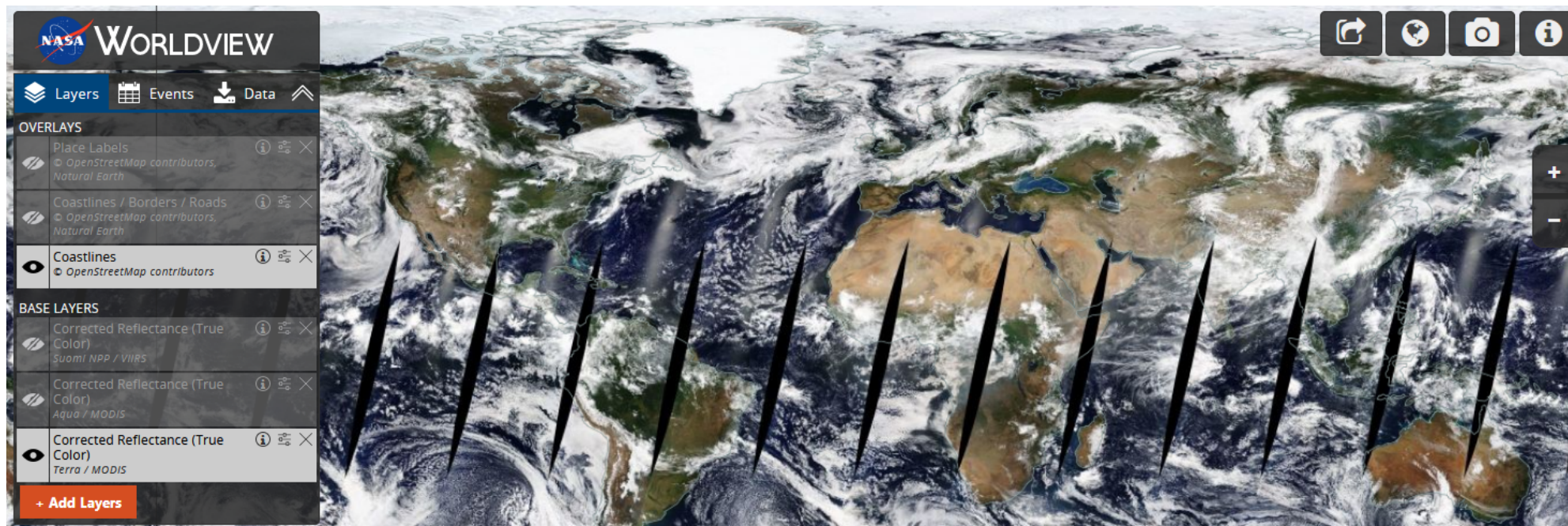
- Which satellite, sensor, and/or datasets have been used in the Earth Observatory story to highlight the selected air quality event?
- Based on visual inspection of the images in the Earth Observatory story, what type of air quality event (e.g., fire, dust storm, urban pollution, etc.) did you select?
- What are two potential applications of the images found on Earth Observatory?



Worldview

NASA Worldview

<https://worldview.earthdata.nasa.gov/>

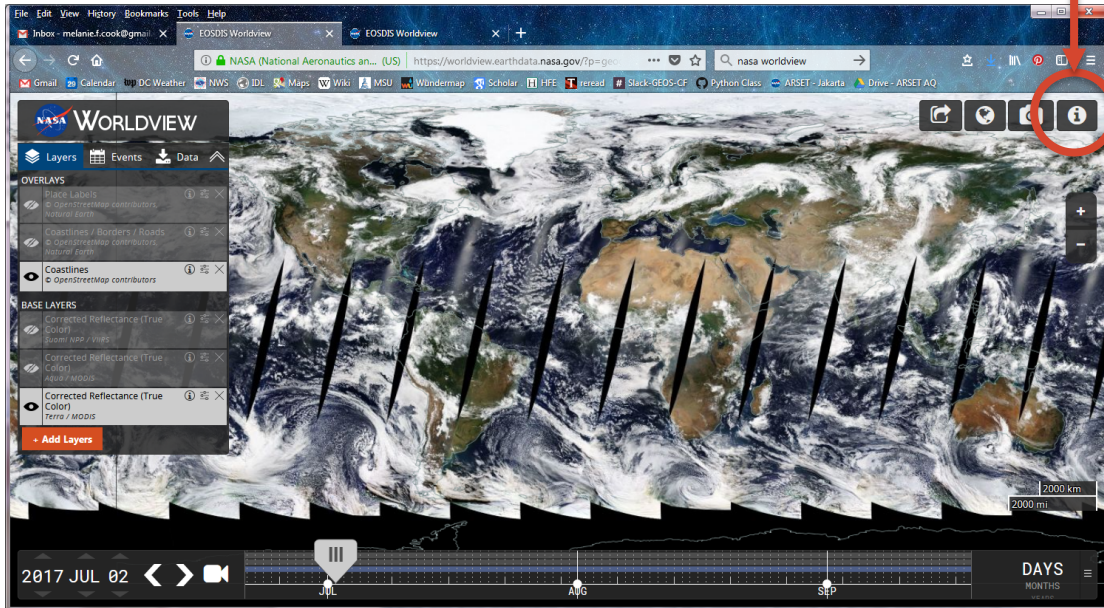


- Application that allows the user to:
 - interactively browse, save, or share satellite imagery layers
 - download the data
- Some imagery available in near real time (NRT) or within three hours of observation



Worldview tutorials

- Worldview tour can be accessed here



- HAQAST tutorial video, written tutorial (with downloadable pdf)
 - <https://haqast.org/nasa-tools/>
- Earthdata webinar
 - <https://www.youtube.com/watch?v=96Nt36euLJY>



Worldview Controls

The image shows the NASA Worldview web application interface. The main display is a satellite view of Earth with a 2000 km / 2000 mi scale bar. The interface includes a left sidebar with 'LAYERS', 'EVENTS', and 'DATA' tabs. The 'LAYERS' panel is expanded, showing 'OVERLAYS' and 'BASE LAYERS' sections. A top navigation bar contains icons for 'Share image', 'Change projection', and 'Help/Info'. A bottom navigation bar shows a date selector set to '2018 FEB 25' and a 'Create an animation' button. A zoom control is visible on the right side of the map.

Take a snapshot and download image

Share image

Change projection

Help/Info

View layers, events, Or download data

Zoom in/out

+ Add Layers

Add image layers

Choose date and time

Create an animation

2018 FEB 25

JAN 2018 FEB 2018 MAR 2018

DAYS MONTHS YEARS



Step 1: Select Date

The screenshot displays the NASA WorldView web application interface. On the left, a sidebar menu includes 'Layers', 'Events', and 'Data'. Under 'OVERLAYS', there are options for 'Place Labels', 'Coastlines / Borders / Roads', and 'Coastlines'. Under 'BASE LAYERS', there are three 'Corrected Reflectance (True Color)' options from different satellite sensors (Suomi NPP / VIIRS, Aqua / MODIS, Terra / MODIS). A '+ Add Layers' button is at the bottom of the sidebar. The main area shows a satellite view of Earth with a timeline at the bottom. The timeline is currently set to '2018 FEB 25' and shows a progression through 'JAN 2018', 'FEB 2018', and 'MAR 2018'. A play button icon is visible on the timeline. In the bottom right corner, there are controls for 'DAYS', 'MONTHS', and 'YEARS'. A scale bar in the bottom right of the map area indicates '2000 km' and '2000 mi'. A yellow box with the text 'Choose date and time' is overlaid on the timeline area.



Step 2: Zoom in on the Region of Interest

The screenshot displays the NASA WorldView web application interface. On the left, a sidebar contains the 'NASA WORLDVIEW' logo and navigation tabs for 'Layers', 'Events', and 'Data'. The 'Layers' panel is expanded, showing 'OVERLAYS' (Place Labels, Coastlines / Borders / Roads, Coastlines) and 'BASE LAYERS' (Corrected Reflectance from Suomi NPP / VIIRS, Aqua / MODIS, and Terra / MODIS). A '+ Add Layers' button is at the bottom of the sidebar. The main area shows a satellite view of Earth with a yellow box highlighting a zoom control panel on the right side, containing '+' and '-' buttons. A callout box labeled 'Zoom in/out' points to these buttons. At the bottom, a timeline shows the date '2018 FEB 25' and a playback control. A scale bar in the bottom right indicates '2000 km' and '2000 mi'. The bottom right corner features a dropdown menu for time units: 'DAYS', 'MONTHS', and 'YEARS'.



Step 3: Explore the Three Base Layer Options

The screenshot displays the NASA WorldView web application interface. The main map shows a satellite view of the Earth, centered on the Indonesian archipelago. The interface includes a top navigation bar with the NASA logo and 'WORLDVIEW' text, and a left sidebar with 'Layers', 'Events', and 'Data' tabs. The 'Layers' panel is open, showing 'OVERLAYS' and 'BASE LAYERS' sections. The 'BASE LAYERS' section is highlighted with a yellow box and contains three entries, each with an eye icon: 'Corrected Reflectance (True Color) Suomi NPP / VIIRS', 'Corrected Reflectance (True Color) Aqua / MODIS', and 'Corrected Reflectance (True Color) Terra / MODIS'. A callout box with a yellow border and text says 'Click on an eye to view/hide a layer'. The bottom of the interface features a timeline for the month of February 2018, with a play button and a 'DAYS' dropdown menu. A scale bar in the bottom right indicates 500 km and 200 mi.

Click on an eye to view/hide a layer



Step 3: Explore the Three Base Layer Options

NASA WORLDVIEW

Layers Events Data

OVERLAYS

- Place Labels
OpenStreetMap contributors, Natural Earth
- Coastlines / Borders / Roads
OpenStreetMap contributors, Natural Earth
- Coastlines
OpenStreetMap contributors

BASE LAYERS

- Corrected Reflectance (True Color)
Suomi NPP / VIIRS
- Corrected Reflectance (True Color)
Aqua / MODIS
- Corrected Reflectance (True Color)
Terra / MODIS

+ Add Layers

Click on an eye to view/hide a layer

What are the differences in the features between each of the sensors?

500 km
200 mi

2018 FEB 19 < > [video icon]

JAN 2018 FEB 2018 MAR 2018

DAYS MONTHS YEARS



Step 3: Explore the Three Base Layer Options

The screenshot displays the NASA WorldView interface. On the left, a 'LAYERS' panel is visible, divided into 'OVERLAYS' and 'BASE LAYERS'. The 'BASE LAYERS' section is highlighted with a yellow box and contains three entries, each with an eye icon: 'Corrected Reflectance (True Color) Suomi NPP / VIIRS', 'Corrected Reflectance (True Color) Aqua / MODIS', and 'Corrected Reflectance (True Color) Terra / MODIS'. A yellow callout box points to the eye icon in the first entry with the text: 'Click on an eye to view/hide a layer'. The main map area shows satellite imagery of Indonesia with a red callout box containing the text: 'Is there a change in visible volcanic ash from the morning (Terra) to the afternoon (Aqua/VIIRS)?'. At the bottom, a timeline shows the date '2018 FEB 19' and a scale bar for '500 km' and '200 mi'. The interface also includes a 'NASA WORLDVIEW' logo, navigation icons, and a 'DAYS MONTHS YEARS' selector.



Step 4: Create an Animation

The screenshot displays the NASA WorldView interface. On the left, a sidebar contains the 'LAYERS' panel with sections for 'OVERLAYS' and 'BASE LAYERS'. The 'OVERLAYS' section includes 'Place Labels', 'Coastlines / Borders / Roads', and 'Coastlines'. The 'BASE LAYERS' section includes three 'Corrected Reflectance (True Color)' layers from different satellite sensors. A '+ Add Layers' button is at the bottom of the sidebar. The main map area shows a satellite view of Southeast Asia with a black diagonal line. A yellow box highlights the text 'Create an animation' in the center of the map. At the bottom, a timeline shows the date '2018 FEB 19' and a video camera icon, which is also highlighted with a yellow box. The timeline includes a play/pause button and a date range from 'JAN 2018' to 'MAR 2018'. On the right side of the map, there are zoom controls (+/-) and a scale bar showing '500 km' and '200 mi'. The top right corner has icons for sharing, home, camera, and info.



Step 5: Add a Layer

The screenshot displays the NASA WorldView web application interface. The main window shows a satellite view of Earth with a dark vertical band across the center. On the left, a 'LAYERS' panel is visible, containing two sections: 'OVERLAYS' and 'BASE LAYERS'. The 'OVERLAYS' section includes 'Place Labels', 'Coastlines / Borders / Roads', and 'Coastlines'. The 'BASE LAYERS' section includes three 'Corrected Reflectance (True Color)' options from different satellite sensors. A red button labeled '+ Add Layers' is highlighted in the bottom left of the layers panel. A yellow callout box with the text 'Add image layers' points to this button. The bottom of the interface features a timeline for the month of February 2018, with a play button and a 'DAYS' dropdown menu. A scale bar in the bottom right indicates 500 km and 200 mi. The top right corner contains navigation icons for home, search, and information.



Step 5: Add a Layer

The screenshot displays the NASA WorldView web application interface. A search overlay is active, showing a grid of layer categories. The 'Ash Plumes' category is selected, and the 'Sulfur Dioxide' layer is highlighted with a yellow box. The interface includes a left sidebar with 'OVERLAYS' and 'BASE LAYERS' sections, a top navigation bar with 'Layers', 'Events', and 'Data' tabs, and a bottom timeline showing the date '2018 FEB 18'. The main map area shows a satellite view of the Earth with a scale bar indicating 500 km and 200 mi.

Search Results:

- Hazards And Disasters**
 - All
 - Aerosol Optical Depth
 - Aerosol Albedo
 - Areas of No Data (mask)
 - Blue Marble
 - Brightness Temperature
 - Carbon Dioxide
 - ...
- Air Quality**
 - Aerosol Optical Depth
 - Carbon Monoxide
 - Corrected Reflectance
 - Dust Score
 - Fires and Thermal Anomalies
 - Nitric Acid
 - ...
- Ash Plumes**
 - Aerosol Optical Depth
 - Corrected Reflectance
 - Fires and Thermal Anomalies
 - Land Surface Reflectance
 - Sulfur Dioxide**
 - Volcano Hazard
- Drought**
 - Corrected Reflectance
 - Dams
 - Drought Hazard
 - Land Surface Reflectance
 - Land Surface Temperature
 - Precipitation Estimate
 - ...
- Dust Storms**
 - Aerosol Optical Depth
 - Dust Score
 - Corrected Reflectance
 - Land Surface Reflectance
- Fires**
 - Aerosol Optical Depth
 - Fires and Thermal Anomalies
 - Carbon Monoxide
 - Corrected Reflectance
 - Earth at Night
 - Land Surface Reflectance
 - ...
- Floods**
- Severe Storms**
- Shipping**



Step 5: Add a Layer

The screenshot displays the NASA WorldView interface. A search bar at the top contains the text "Search" and "Categories / Ash Plumes". Below the search bar, a list of categories is shown, including "Aerosol Optical Depth", "Corrected Reflectance", "Fires and Thermal Anomalies", "Land Surface Reflectance", and "Sulfur Dioxide". The "Sulfur Dioxide" category is expanded, showing a list of sub-layers: "Suomi NPP / OMPS", "Aura / OMI", "Aura / MLS", and "Aqua / AIRS". The "Suomi NPP / OMPS" layer is highlighted with a yellow box. Below this list, there are four checkboxes for "Sulfur Dioxide" sub-layers: "Sulfur Dioxide (Lower Troposphere)", "Sulfur Dioxide (Middle Troposphere)", "Sulfur Dioxide (Upper Troposphere and Stratosphere)", and "Sulfur Dioxide (Planetary Boundary Layer)". The "Sulfur Dioxide (Middle Troposphere)" checkbox is highlighted with a yellow box. Below these checkboxes, there is a section for "Orbital Tracks:" with a checkbox for "Ascending/Day". At the bottom of the interface, there is a timeline showing the date "2018 FEB 18" and a "Sulfur Dioxide (SO2) Lower Troposphere" layer selected. The timeline also shows "Temporal coverage: 1 January 2005 - present" and a scale bar for "500 km" and "200 mi".



Step 5: Add a Layer

The screenshot displays the NASA WorldView web application interface. The main map shows a satellite view of the Indonesian archipelago with a blue pixelated overlay on the island of Sumatra. A vertical black bar is visible on the right side of the map. The interface includes a top navigation bar with 'Layers', 'Events', and 'Data' tabs. The 'Layers' panel on the left is open, showing two sections: 'OVERLAYS' and 'BASE LAYERS'. In the 'OVERLAYS' section, 'Sulfur Dioxide (Middle Troposphere)' is selected and active, with a range of '< 1.000 DU' to '>= 32.000 DU'. Other overlays include 'Place Labels', 'Coastlines / Borders / Roads', and 'Coastlines'. The 'BASE LAYERS' section includes 'Corrected Reflectance (True Color)' from Suomi NPP / VIIRS, Aqua / MODIS, and Terra / MODIS. A '+ Add Layers' button is at the bottom of the panel. The bottom of the interface features a timeline for February 2018, with a play button and a 'DAYS' control. A scale bar in the bottom right indicates 500 km and 200 mi. Utility icons for sharing, home, camera, and info are in the top right corner.



Exercise:

- Explore Worldview for about 10 minutes.
- Use the Date Selection at the bottom of the page
 - Go to the date of the air quality event you selected for Part 1
- Zoom in on the region of the air quality event using the ‘+’ and ‘-’ sign on the top right side of the page
- Explore the base layer options (top, left side of the page) to select images from Aqua/MODIS, Terra/MODIS, and Suomi NPP/VIIRS
- Display each of the layers one by one and write down the difference in the features over the selected region
- Use the date changing arrows to see the progress of the event over several days. Use the animation feature (camera sign on bottom left side) to create an animation
- Add an additional interesting layer



Exercise Questions:

- What additional information did you learn from the Worldview portal that wasn't on the Earth Observatory page?
- What additional satellite layer did you add? What additional information did it provide?
- Use the 'share this map' feature (on the top right corner of the page) to copy the link and paste it here:

