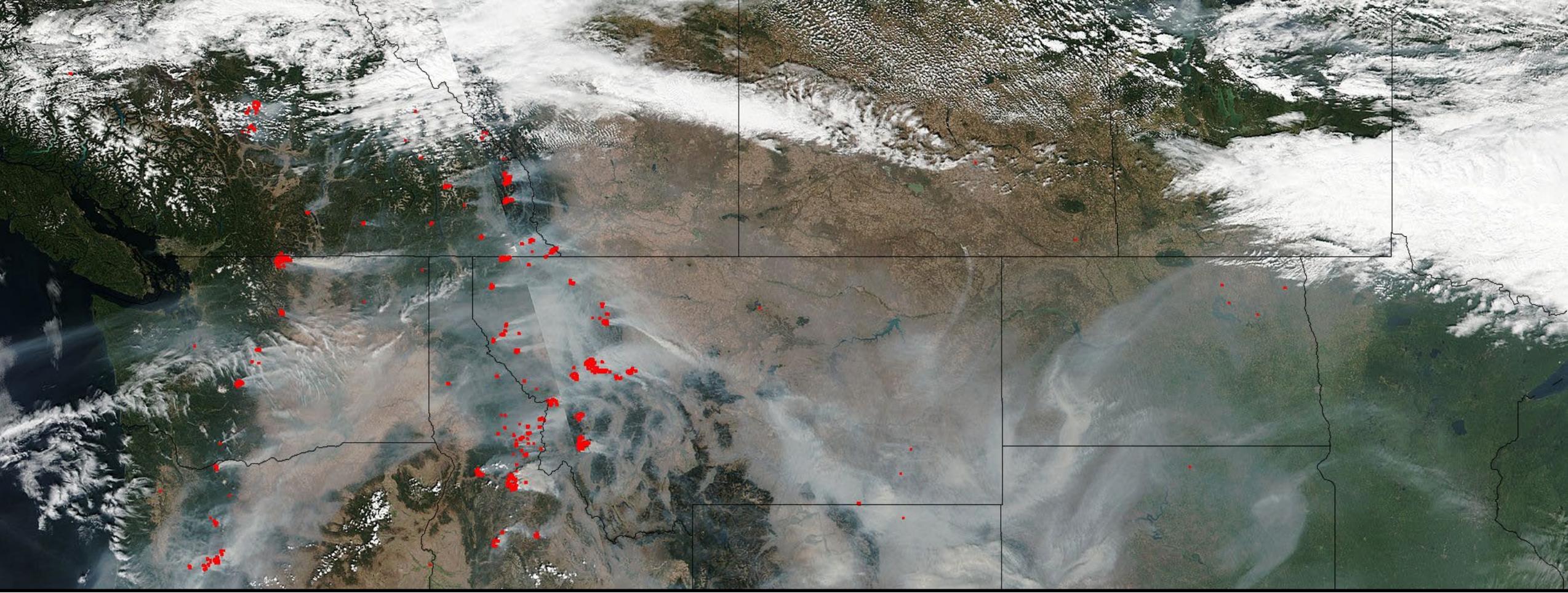


NASA Earth Observatory and Worldview

Melanie Follette-Cook and Pawan Gupta

Satellite Remote Sensing of Dust, Fires, Smoke, and Air Quality, July 10-12, 2018



Earth Observatory

NASA Earth Observatory

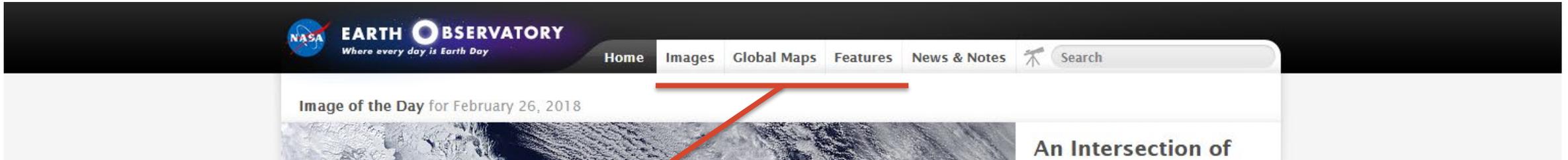
<https://earthobservatory.nasa.gov/>

- 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' text are visible. Below the navigation menu, a search bar contains the text 'Tracking Dust Across the Atlantic', which is circled in red. The main content area features a large satellite image of a coastal region with a title 'Image of the Day for February 26, 2018' and a sub-title 'An Intersection of Land, Ice, Sea, and Clouds'. To the right of the image is a text block describing the scene off the coast of Labrador and Newfoundland. Below the main image is a 'Previous Images' section with two small thumbnails and a 'GRID VIEW' button. At the bottom, there is a 'Features' section with a video player and a 'SUBSCRIBE TODAY' button.

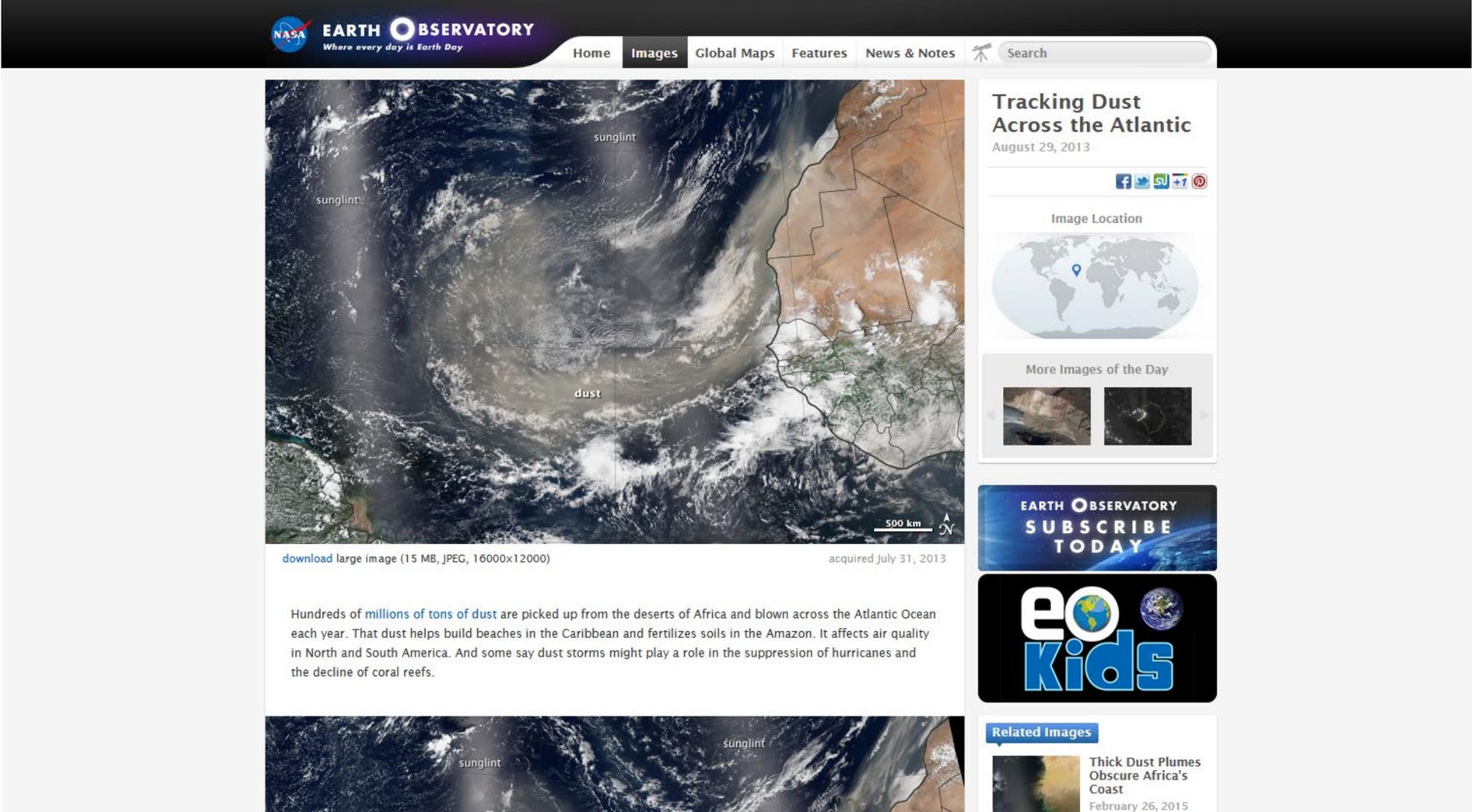


Step 3: Click on the Top Result

The screenshot shows the NASA Earth Observatory website with a search bar containing the text "Tracking Dust Across the Atlantic". The search results are displayed in a list format. The top result is circled in red and includes a small satellite image, the title "Tracking Dust Across the Atlantic : Image of the Day", the date "Aug 29, 2013", a brief description of dust being picked up from the deserts of Africa and blown across the Atlantic Ocean, and a URL: <https://earthobservatory.nasa.gov/IOTD/view.php?id=81864>. Other results include "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".



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



The screenshot shows the NASA Earth Observatory website interface. At the top, the NASA logo and "EARTH OBSERVATORY" text are visible, along with the tagline "Where every day is Earth Day". Navigation tabs include Home, Images, Global Maps, Features, and News & Notes. A search bar is located on the right. The main content area features a large satellite image of the Atlantic Ocean with a massive dust plume originating from Africa. Labels "sunglint" and "dust" are overlaid on the image. A scale bar indicates 500 km, and the acquisition date is July 31, 2013. Below the image is a "download large image" link and a descriptive paragraph about dust transport. To the right, a sidebar contains a title "Tracking Dust Across the Atlantic" with a date of August 29, 2013, social media icons, an "Image Location" map, and a "More Images of the Day" section. Further down the sidebar are "EARTH OBSERVATORY SUBSCRIBE TODAY" and "eo Kids" banners, and a "Related Images" section with a link to "Thick Dust Plumes Obscure Africa's Coast" from February 26, 2015.

Tracking Dust Across the Atlantic
August 29, 2013

Image Location

More Images of the Day

EARTH OBSERVATORY
SUBSCRIBE
TODAY

eo Kids

Related Images

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

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.

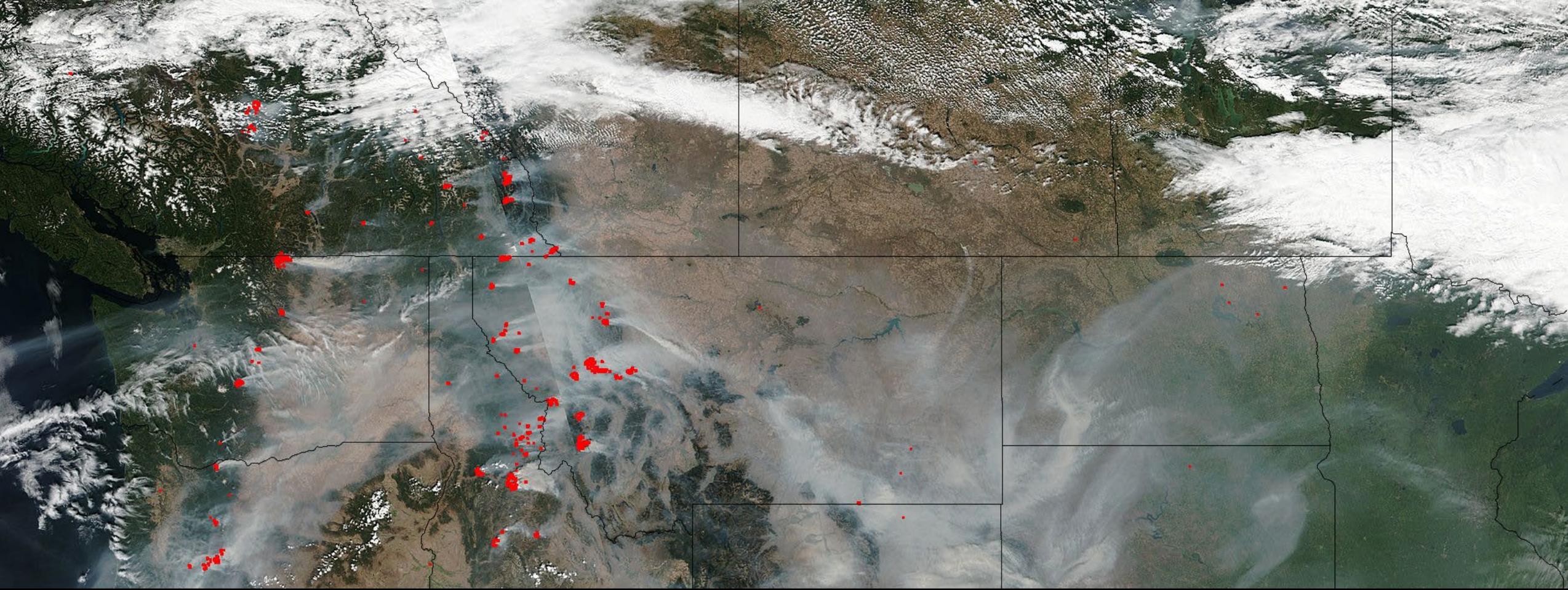
Exercise:

- 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:

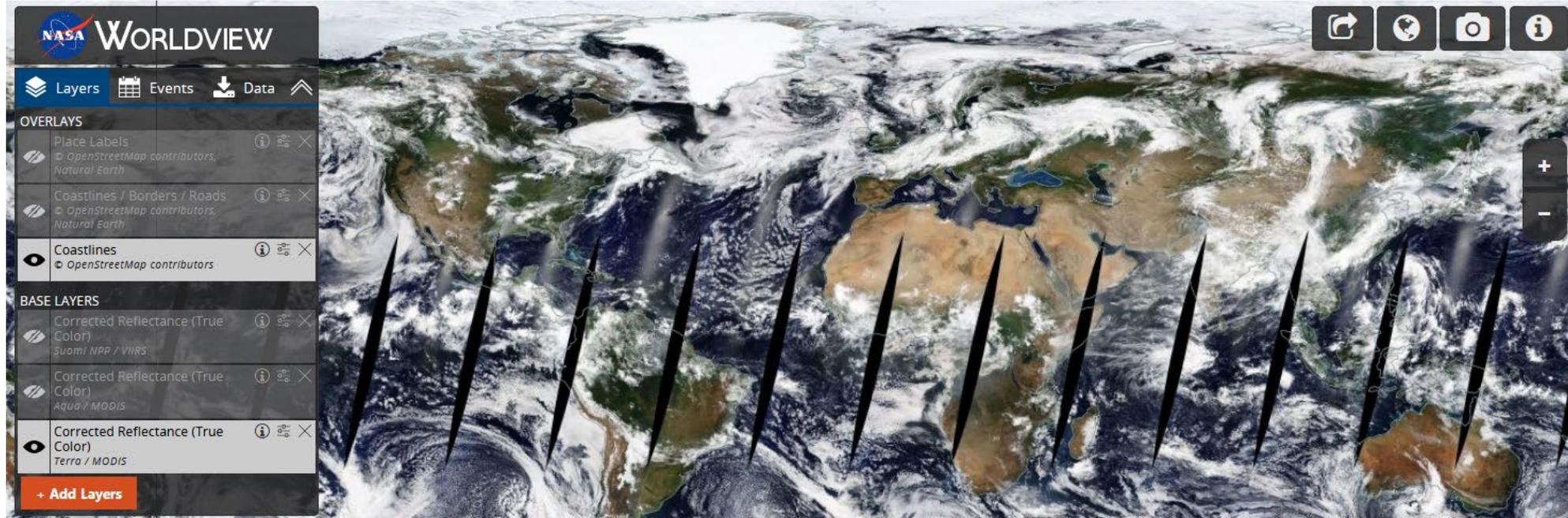
- Which satellite, sensor, and/or datasets have been used in the Earth Observatory story to highlight the selected air quality event?
- Based on visual inspection of the images in the Earth Observatory story, what type of air quality event (e.g., fire, dust storm, urban pollution, etc.) did you select?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



Worldview

NASA Worldview

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

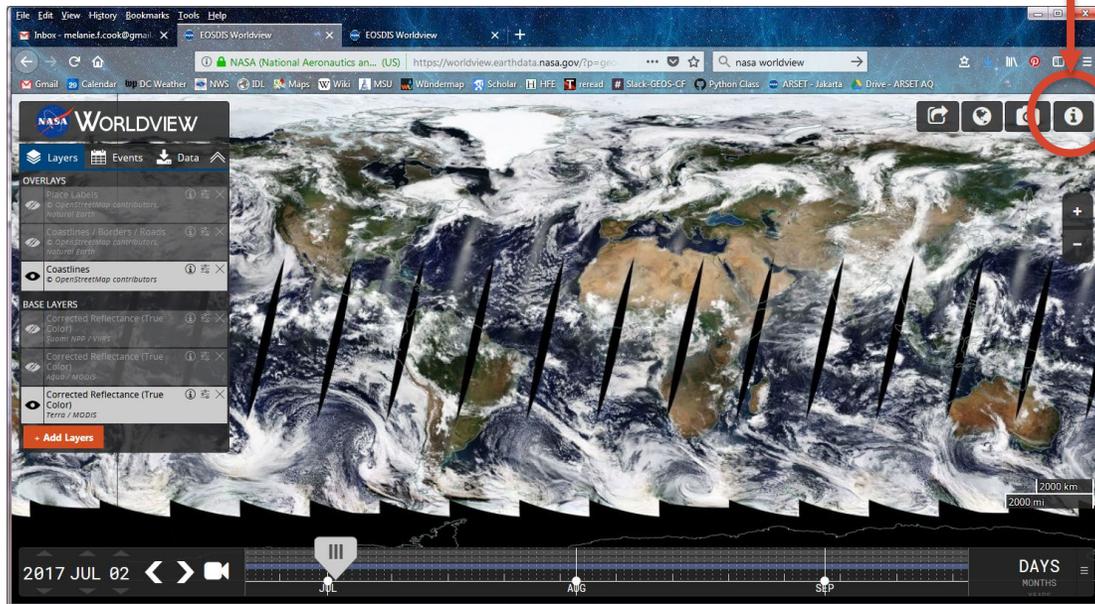


- Application that allows the user to:
 - interactively browse, save, or share satellite imagery layers
 - download the data
- Some imagery available in near real time (NRT) or within three hours of observation



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 screenshot shows the NASA Worldview interface with several callout boxes highlighting key features:

- Take a snapshot and download image**: Points to the camera icon in the top right toolbar.
- Share image**: Points to the share icon in the top right toolbar.
- Change projection**: Points to the globe icon in the top right toolbar.
- Help/Info**: Points to the information icon in the top right toolbar.
- Zoom in/out**: Points to the vertical zoom controls (+ and -) on the right side of the map.
- View layers, events, Or download data**: Points to the Layers, Events, and Data buttons in the top left navigation bar.
- Add image layers**: Points to the "+ Add Layers" button in the left sidebar.
- Choose date and time**: Points to the date/time navigation controls at the bottom left.
- Create an animation**: Points to the video camera icon in the bottom left navigation bar.

The interface includes a left sidebar with "OVERLAYS" and "BASE LAYERS" sections, a central map view of Earth, and a bottom timeline for date navigation. A scale bar in the bottom right indicates 2000 km and 2000 mi.



Step 1: Select Date

The screenshot displays the NASA WorldView web application interface. On the left, a sidebar menu includes 'Layers', 'Events', and 'Data'. The 'OVERLAYS' section lists 'Place Labels', 'Coastlines / Borders / Roads', and 'Coastlines'. The 'BASE LAYERS' section lists three 'Corrected Reflectance (True Color)' options from different satellite sensors. A '+ Add Layers' button is at the bottom of the sidebar. The main area shows a satellite image of Earth with a timeline at the bottom for date selection. The timeline is currently set to '2018 FEB 25' and shows months from 'JAN 2018' to 'MAR 2018'. A text box with a yellow border and the text 'Choose date and time' is overlaid on the timeline. The top right of the interface has icons for sharing, home, camera, and info. A scale bar in the bottom right indicates '2000 km' and '2000 mi'.



Step 2: Zoom in on the Region of Interest

The screenshot displays the NASA WorldView web application interface. On the left, a sidebar contains a 'Layers' panel with 'OVERLAYS' and 'BASE LAYERS' sections. 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 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 scale from 'JAN 2018' to 'MAR 2018'. A scale bar in the bottom right indicates '2000 km' and '2000 mi'. The top right corner has icons for share, globe, camera, and info.



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 United States with various overlays. On the left, a sidebar contains a 'LAYERS' panel with two sections: '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 with the text 'Click on an eye to view/hide a layer' points to the eye icons. Below the layers panel is a '+ Add Layers' button. The top of the interface includes the NASA logo, 'WORLDVIEW' title, and navigation tabs for 'Layers', 'Events', and 'Data'. The bottom of the interface features a timeline for the month of September 2017, with a play button and a 'DAYS' label. A scale bar in the bottom right corner shows 200 km and 100 mi. The main map area shows a satellite image of the United States with various overlays, including a grid and a semi-transparent map overlay.



Step 3: Explore the Three Base Layer Options

The screenshot displays the NASA WorldView interface. On the left, a sidebar contains a 'LAYERS' panel with 'OVERLAYS' and 'BASE LAYERS' sections. The 'BASE LAYERS' section is highlighted with a yellow box and contains three entries: 'Corrected Reflectance (True Color) Suomi NPP / VIIRS', 'Corrected Reflectance (True Color) Aqua / MODIS', and 'Corrected Reflectance (True Color) Terra / MODIS'. Each entry has an eye icon. Below the 'BASE LAYERS' section is a red '+ Add Layers' button. The main map area shows a satellite view of North America with a semi-transparent overlay. A white callout box with a red border is overlaid on the map, containing the text: 'What are the differences in the features between each of the sensors?'. At the bottom, a timeline shows the date '2017 SEP 05' and navigation controls. A scale bar in the bottom right corner indicates 200 km and 100 mi.

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

Click on an eye to view/hide a layer



Step 3: Explore the Three Base Layer Options

The screenshot displays the NASA WorldView interface. On the left, a sidebar contains the 'NASA WORLDVIEW' logo and navigation tabs for 'Layers', 'Events', and 'Data'. Below these are 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)' options from different satellite sensors: 'Suomi NPP / VIIRS', 'Aqua / MODIS', and 'Terra / MODIS'. A '+ Add Layers' button is at the bottom of the sidebar. The main map area shows a satellite image of the United States with a grid overlay. In the bottom left, a timeline shows the date '2017 SEP 05' and a 'DAYS' label. A yellow box highlights a camera icon on the timeline with the text 'Create an animation'. The bottom right corner features a scale bar for '200 km' and '100 mi'.



Step 3: Explore the Three Base Layer Options

The screenshot displays the NASA WorldView web application interface. The main view is a satellite image of the United States. On the left, a sidebar contains the following sections:

- Layers**: Includes icons for Layers, Events, and 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)

A red button labeled "+ Add Layers" is highlighted with a yellow box. A yellow callout box with the text "Add image layers" points to this button. At the bottom of the sidebar, there is a "2017 SEP 05" date selector and navigation arrows. The main map area includes a scale bar in the bottom right corner showing "200 km" and "100 mi". A timeline at the bottom of the map shows months from JUL 2017 to NOV 2017, with a play button icon in the center.



Step 5: Add a Layer

The screenshot shows the NASA WorldView interface. On the left, the 'LAYERS' panel is visible, showing 'OVERLAYS' and 'BASE LAYERS'. The 'OVERLAYS' section includes 'Place Labels', 'Coastlines / Borders / Roads', and 'Coastlines'. The 'BASE LAYERS' section includes three instances of 'Corrected Reflectance (True Color)' from different satellite sensors (Suomi NPP / VIIRS, Aqua / MODIS, Terra / MODIS). A red '+ Add Layers' button is at the bottom of the panel.

A search window is open in the center, with a search bar at the top. Below the search bar, there are two tabs: 'Hazards And Disasters' (selected) and 'Science Disciplines'. The search results are displayed in a grid of categories, each with a representative image and a list of layers:

- 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** (highlighted in a yellow box), Carbon Monoxide, Corrected Reflectance, Earth at Night, Land Surface Reflectance, ...
- Floods**: Corrected Reflectance, Cloud Fraction, Cloud Multi Layer Flag, Cloud Phase, Cloud Pressure, Cloud Effective Radius
- Severe Storms**: Corrected Reflectance, Cloud Fraction, Cloud Multi Layer Flag, Cloud Phase, Cloud Pressure, Cloud Effective Radius
- Shipping**: Corrected Reflectance, Brightness Temperature, Land Surface Reflectance, Sea Ice, Sea Surface Temperature

At the bottom of the interface, there is a timeline showing the date '2017 SEP 05' and a 'DAYS' slider. A scale bar indicates '200 km' and '100 mi'.



Step 5: Add a Layer

The screenshot displays the NASA WorldView interface. On the left, a sidebar lists 'OVERLAYS' and 'BASE LAYERS'. The 'OVERLAYS' section includes 'Place Labels', 'Coastlines / Borders / Roads', and 'Coastlines'. The 'BASE LAYERS' section includes three instances of 'Corrected Reflectance (True Color)'. A '+ Add Layers' button is visible at the bottom of the sidebar. The main panel shows a search for 'Fires' with a list of layers. The 'Fires and Thermal Anomalies' layer is selected, and its configuration options are shown. The 'Terra / MODIS' option is highlighted with a yellow box. Below it, the 'Orbital Tracks' section has 'Ascending/Night' and 'Descending/Day' options. The 'MODIS (Terra/Aqua, Terra & Aqua) Fire and Thermal Anomalies' section provides temporal coverage and a description of the layer. The bottom of the interface shows a timeline for the month of September 2017, with a 'DAYS' button and navigation arrows. A scale bar in the bottom right corner indicates 200 km and 100 mi.

NASA WORLDVIEW

Layers Events Data

OVERLAYS

- Place Labels
- Coastlines / Borders / Roads
- Coastlines

BASE LAYERS

- Corrected Reflectance (True Color)
- Corrected Reflectance (True Color)
- Corrected Reflectance (True Color)

+ Add Layers

Search

Categories / Fires

- Aerosol Optical Depth
- Fires and Thermal Anomalies
- Carbon Monoxide
- Corrected Reflectance
- Earth at Night
- Land Surface Reflectance
- Land Surface Temperature
- Sulfur Dioxide

Fires and Thermal Anomalies

Aqua / MODIS, Terra / MODIS, Aqua and Terra / MODIS, Suomi NPP / VIIRS

Terra / MODIS

Fires and Thermal Anomalies (Day and Night)

Orbital Tracks:

- Ascending/Night
- Descending/Day

MODIS (Terra/Aqua, Terra & Aqua) Fire and Thermal Anomalies

Temporal Coverage: 8 May 2012 - present

The MODIS Fire and Thermal Anomalies layer shows active fire detections and thermal anomalies, such as volcanoes, and gas flares. Fires can be set naturally, such as by lightning, or by humans, whether intentionally or accidentally. Fire is often thought of as a menace and detriment to life, but in some ecosystems it is necessary to...

2017 SEP 05

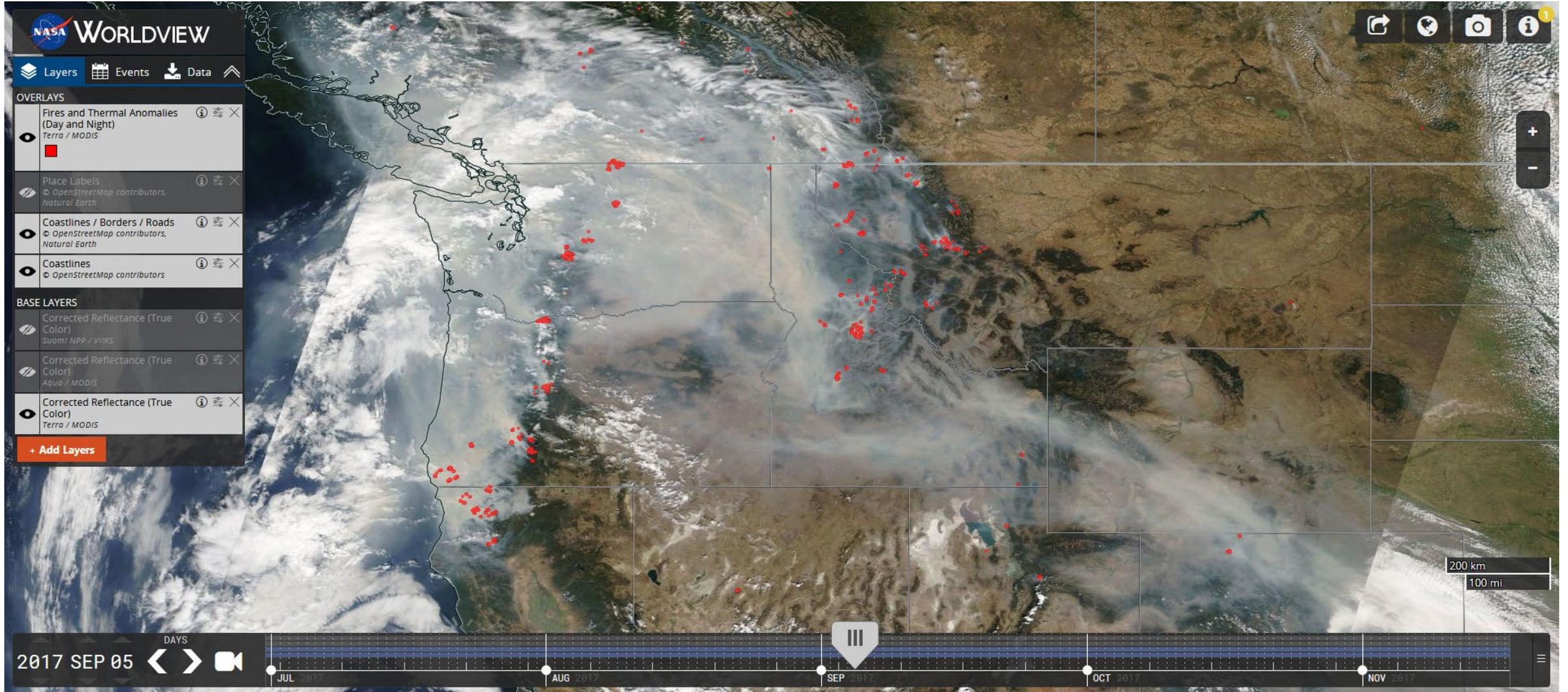
DAYS

JUL 2017 AUG 2017 SEP 2017 OCT 2017 NOV 2017

200 km
100 mi



Step 5: Add a Layer



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:

