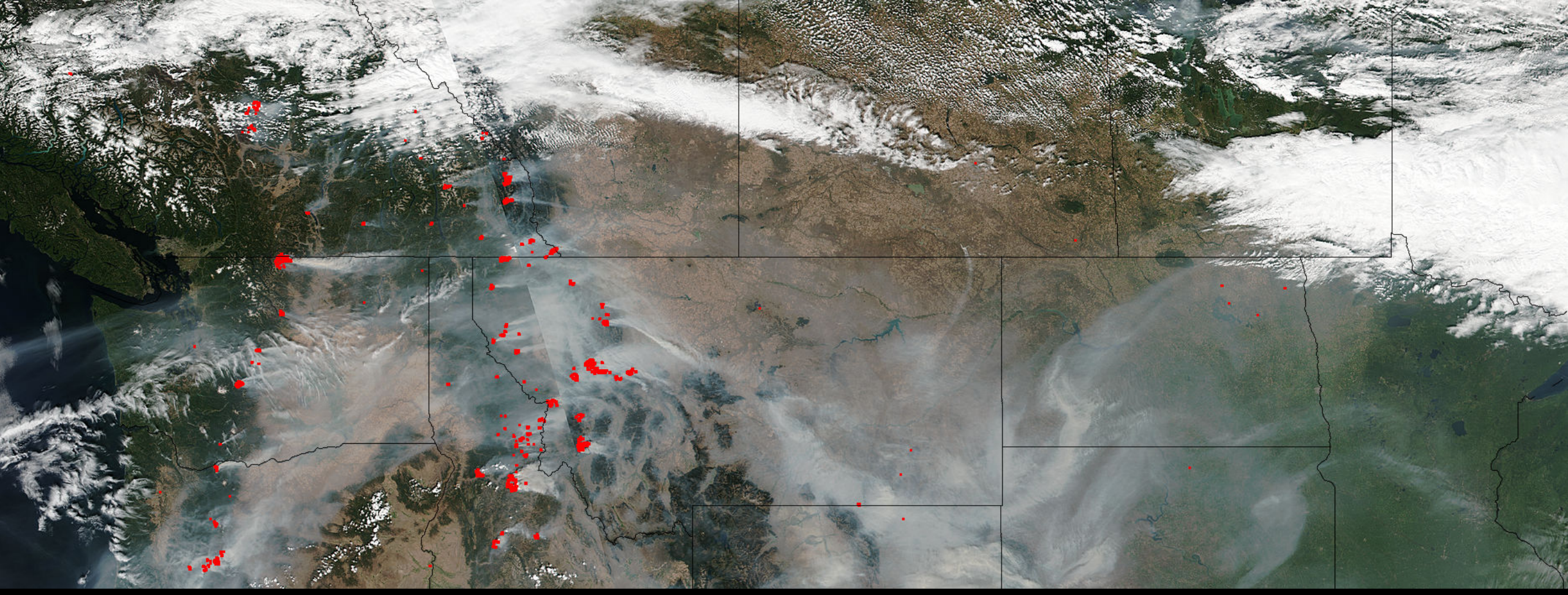


# NASA Earth Observatory and Worldview

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



Earth Observatory

# NASA Earth Observatory

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

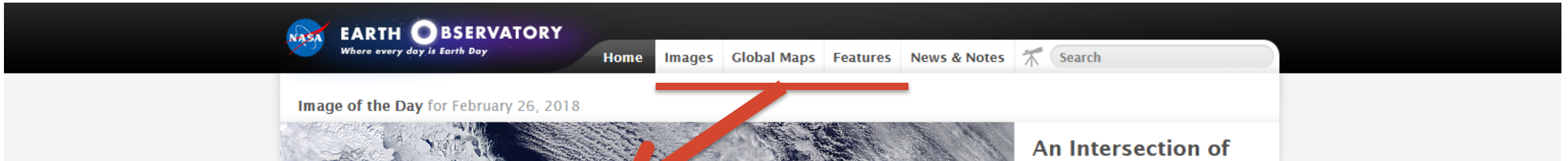
- Shares images and stories that result from NASA research and satellite missions
- Things you will find:
  - Image of the day
  - Research highlights
  - Blogs
  - Global maps



Image of the day: March 7, 2014



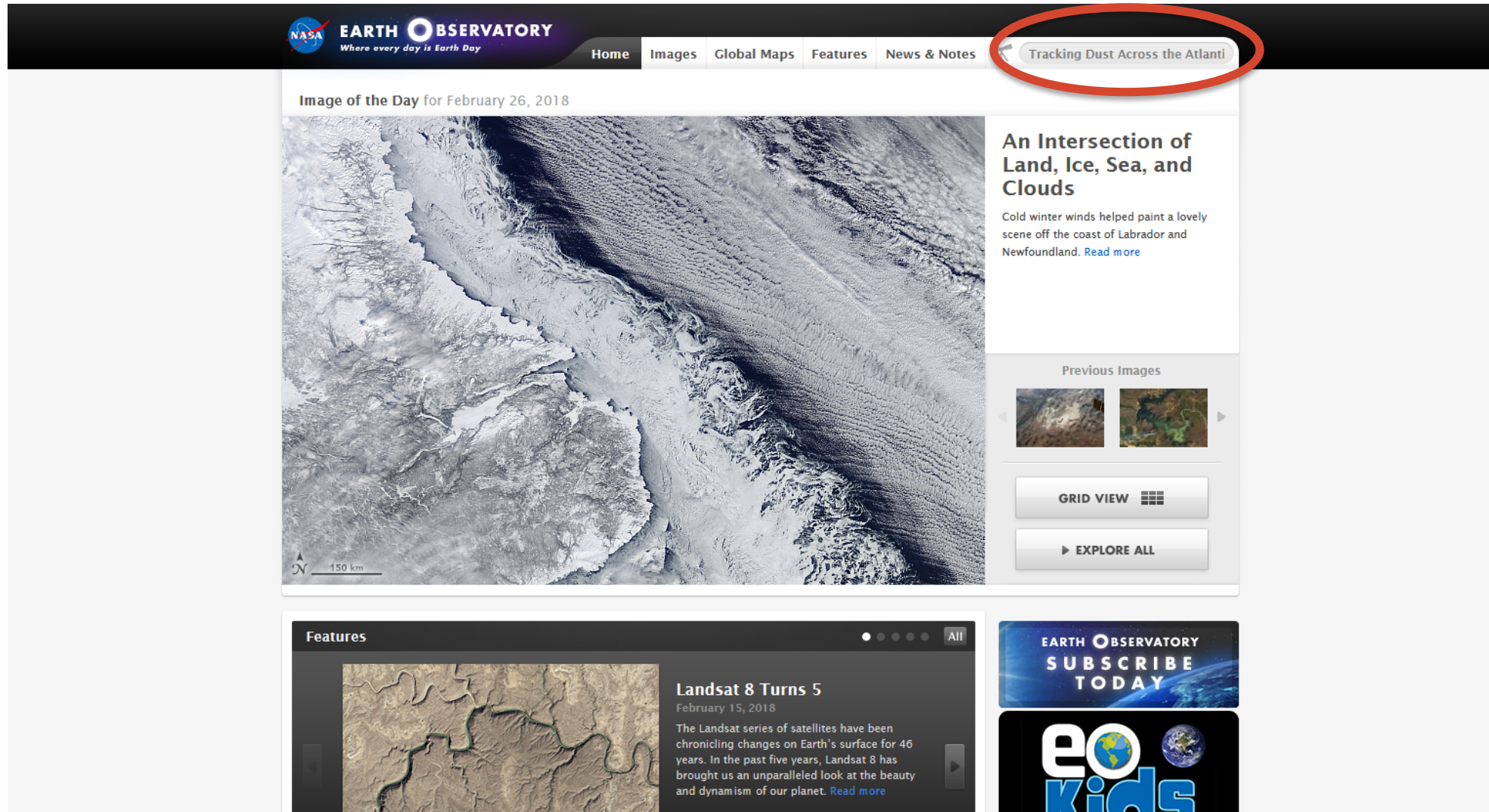
# Step 1: Go to <http://earthobservatory.nasa.gov>



- 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. The top navigation bar includes links for 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 bar, the main content area features a large satellite image of a coastal region with the title "Image of the Day for February 26, 2018" and the subtitle "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, with a "Read more" link. 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" and a "SUBSCRIBE TODAY" banner. The "eo Kids" logo is also visible in the bottom right corner of the page content.

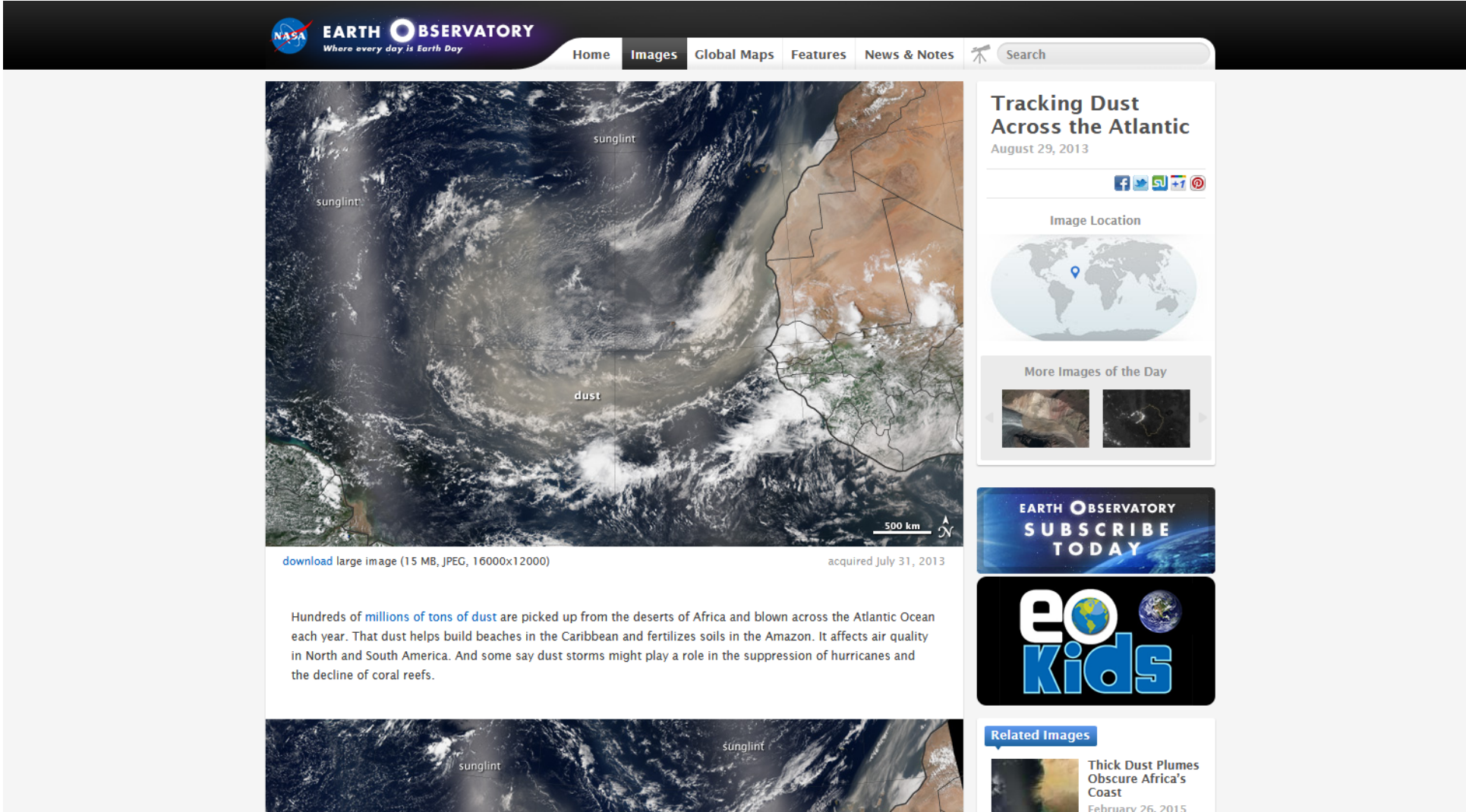


# Step 3: Click on the Top Result

The screenshot shows the NASA Earth Observatory website with a search bar containing the text "Tracking Dust Across the Atlantic". The search results are displayed in a list format. The top result is highlighted with a red oval and includes a small satellite image, the title "Tracking Dust Across the Atlantic : Image of the Day", a date of "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 navigation links for Home, Images, Global Maps, Features, News & Notes, and a search bar. The main content area features a large satellite image of the Atlantic Ocean with a prominent dust plume. The image is labeled with "sunlint" and "dust". Below the image, there 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, there 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, there are promotional banners for "EARTH OBSERVATORY SUBSCRIBE TODAY" and "eo Kids". At the bottom of the sidebar, there is a "Related Images" section with a thumbnail and title "Thick Dust Plumes Obscure Africa's Coast" dated 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

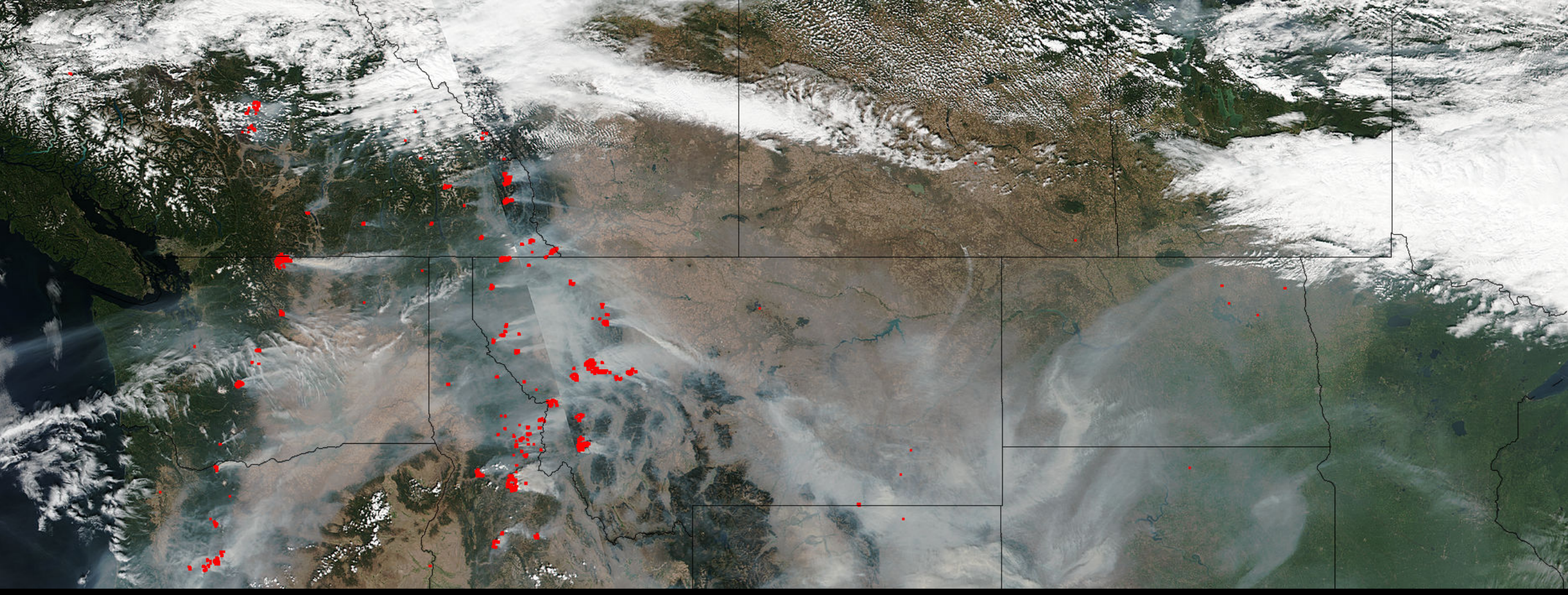




# Exercise Questions:

- 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?

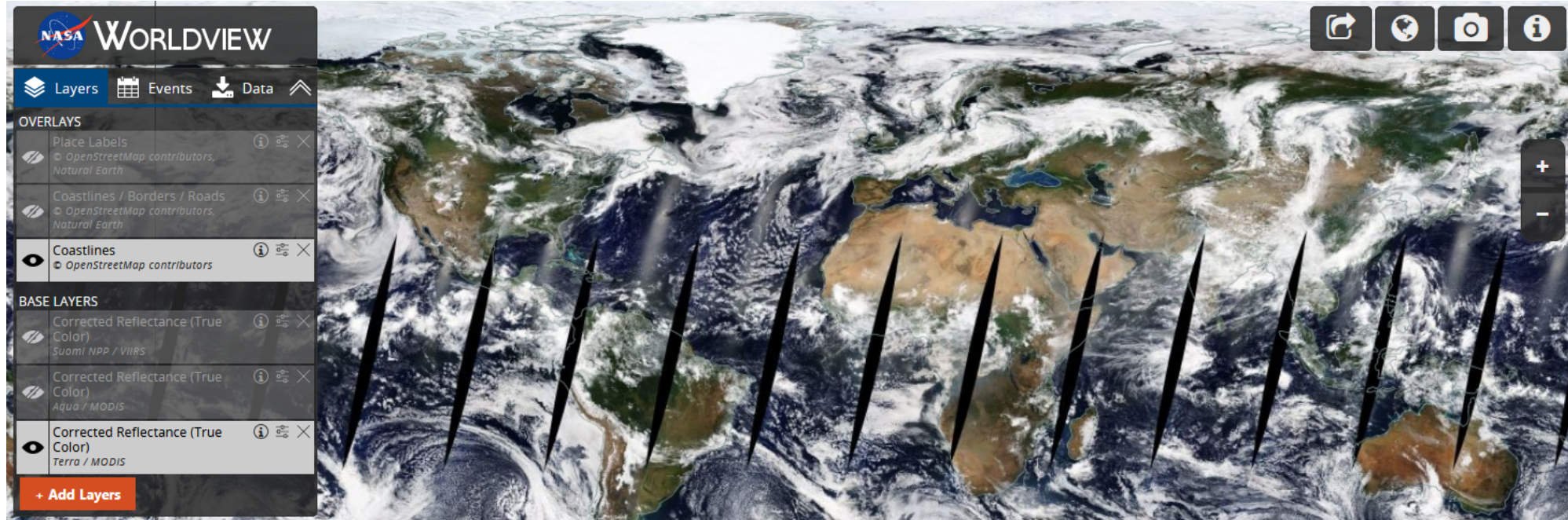




Worldview

# NASA Worldview

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

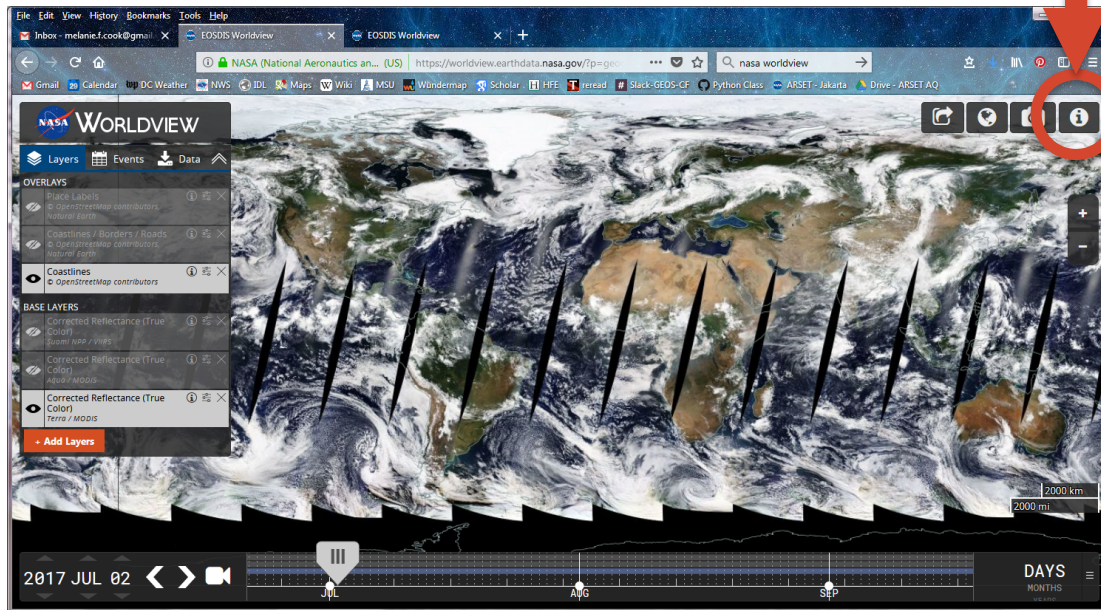


- Application that allows the user to:
  - interactively browse, save, or share satellite imagery layers
  - download the data
- Some imagery available in near real time (NRT) or within three hours of observation



# 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 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 open, showing 'OVERLAYS' and 'BASE LAYERS' sections. A top navigation bar contains icons for 'Share image', 'Change projection', 'Take a snapshot and download image', and 'Help/Info'. A bottom timeline shows the date '2018 FEB 25' and a video camera icon for creating animations. 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



# Step 1: Select Date

The screenshot displays the NASA WorldView web application interface. On the left, a sidebar contains a '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)' options from different satellite sensors. A '+ Add Layers' button is located at the bottom of the sidebar. The main area shows a global satellite view of Earth with several black arrows pointing to specific locations. In the bottom right corner of the map, there are scale bars for '2000 km' and '2000 mi'. At the top right, there are icons for sharing, home, camera, and help. At the bottom, a timeline slider is visible, showing the date '2018 FEB 25' and a play button icon. The timeline has markers for 'JAN 2018', 'FEB 2018', and 'MAR 2018'. To the right of the timeline, there are controls for 'DAYS', 'MONTHS', and 'YEARS'.

Choose date and time



# 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 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 area shows a satellite image of Earth with a zoom control overlay on the right side, consisting of a vertical bar with '+' and '-' buttons. A yellow box highlights this control with the text 'Zoom in/out'. 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 top right corner has icons for share, globe, camera, and info.



# 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

2017 SEP 05

DAYS

JUL 2017 AUG 2017 SEP 2017 OCT 2017 NOV 2017

200 km  
100 mi





# Step 3: Explore the Three Base Layer Options

The screenshot shows the NASA WorldView interface. The main map displays satellite imagery of the United States. On the left, there is a sidebar with the following sections:

- 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 yellow box highlights the 'BASE LAYERS' section, and a yellow callout box points to the eye icons next to each layer, with the text: "Click on an eye to view/hide a layer".

On the right side of the map, there is a white callout box with a red border containing the text: "What are the differences in the features between each of the sensors?".

At the bottom, there is a timeline showing the date "2017 SEP 05" and navigation controls. A scale bar at the bottom right indicates "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 'Events' and 'Data' tabs.
- 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** button.

At the bottom of the interface is a timeline showing the date **2017 SEP 05** and navigation controls. A yellow box highlights the **video camera icon** on the timeline, with a callout box containing the text **Create an animation**. In the bottom right corner, there is a scale bar showing **200 km** and **100 mi**.



# 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 the following sections:

- 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 yellow callout box highlights the '+ Add Layers' button and the text 'Add image layers'. The bottom of the interface features a timeline for the year 2017, with markers for JUL, AUG, SEP, OCT, and NOV. A scale bar in the bottom right corner indicates 200 km and 100 mi.



# Step 5: Add a Layer

The screenshot displays the NASA WorldView interface. On the left, the 'LAYERS' panel is visible, showing 'OVERLAYS' (Place Labels, Coastlines / Borders / Roads, Coastlines) and 'BASE LAYERS' (Corrected Reflectance (True Color) from Suomi NPP / VIIRS, Aqua / MODIS, and Terra / MODIS). A '+ Add Layers' button is at the bottom of this panel. A search window is open in the center, titled 'Search', with tabs for 'Hazards And Disasters' and 'Science Disciplines'. The search results are organized into 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 with a yellow box), 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, 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. The background is a satellite view of a coastal region.



# Step 5: Add a Layer

The screenshot displays 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)'. A '+ Add Layers' button is at the bottom of this panel. The main panel is a search window for 'Fires'. The search results list several layers, with 'Fires and Thermal Anomalies' selected. This layer is further configured to show 'Terra / MODIS' data and 'Fires and Thermal Anomalies (Day and Night)'. Below this, there are options for 'Orbital Tracks' (Ascending/Night and Descending/Day) and a description of the 'MODIS (Terra/Aqua, Terra & Aqua) Fire and Thermal Anomalies' layer, which shows active fire detections and thermal anomalies. The bottom of the interface features a timeline for the month of September 2017, with a play button and a 200 km / 100 mi scale bar.



# Step 5: Add a Layer

The screenshot displays the NASA WorldView web application interface. The main map shows a satellite view of North America with several red dots overlaid, representing fire locations. The interface includes a sidebar on the left with the following sections:

- OVERLAYS:**
  - Fires and Thermal Anomalies (Day and Night) - Terra / MODIS
  - 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

At the bottom of the sidebar is a red button labeled "+ Add Layers". The bottom of the interface features a timeline for the year 2017, with markers for JUL, AUG, SEP, OCT, and NOV. The current date is set to 2017 SEP 05. A scale bar in the bottom right corner indicates 200 km and 100 mi. Various navigation icons are visible 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:

