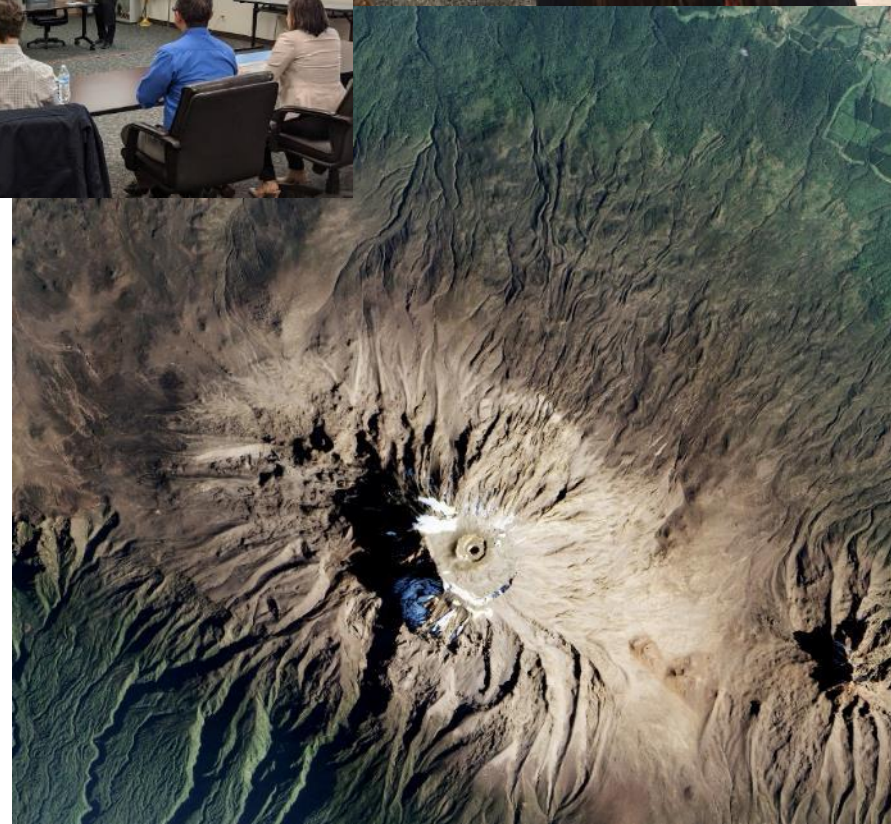


EARTH SCIENCE
APPLIED SCIENCES

NASA Applied Sciences & Capacity Building Program

November 20, 2020

NASA & Applied Sciences

EARTH SCIENCE
APPLIED SCIENCES

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

When you think of NASA, what do you picture?

Moon Landing

Astronauts

What about Earth-observing Satellites?

All Photo Credits: NASA

ABOUT NASA

To discover and expand knowledge for the benefit of humanity.

- NASA began operations on October 1, 1958
- Today, NASA has 10 Centers & 6 facilities around the country, with its headquarters in Washington DC

All Photo Credits: NASA

NASA ORGANIZATION

5 Mission Directorates

Science | Human Exploration & Operations | Space Technology | Aeronautics Research | Mission Support

The Science Mission Directorate (SMD) uses the vantage point of space to achieve a deep scientific understanding of our planet, other planets, solar system bodies, the interplanetary environment, the Sun and its effects on our solar system, and the universe beyond.

- Universe
- Solar System
- Sun
- Earth
- Space Experiments
- Missions
- Science & Technology

- How do planets and life originate?
- How does the universe work and what are its origin and destiny?
- How and why are Earth's climate and the environment changing?
- How and why does the Sun vary and affect Earth and the rest of the solar system?
- Are we alone?

EARTH SCIENCE DIVISION

Understanding Earth as a system

The Earth Science Division (ESD), conducts scientific studies to understand the Earth as a system & on all time scales. ESD utilizes NASA's ability to view the Earth from the unique vantage point of space.

ESD provides uniformly high-quality data covering the planet to support the pursuit of answers to fundamental science questions. There are four lines of business:

Flight

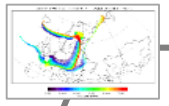
Develops, launches, and operates NASA's fleet of Earth-observing satellites, instruments, and aircraft. Manages data systems to make the data freely and openly available.

Technology

Tests and demonstrates scientific technologies for future satellite and airborne missions: Instruments, Information Systems, Components, In-Space Validation.

Research & Analysis

Supports research that advances knowledge of the Earth as a system. Six focus areas plus field campaigns, modeling, and scientific computing.



Applied Sciences

Supports innovative and practical uses of Earth observations and scientific knowledge by private and public sectors to inform their planning, decisions, and actions.

APPLIED SCIENCES PROGRAM

Harnessing Earth observations to find solutions to Earth's greatest challenges.

The Applied Sciences Program helps people across the world use NASA data to solve big problems right here on Earth.

- Provides support and funding to help institutions and individuals make better decisions about our environment, food, water, health & safety
- Strategically invests in projects and teams that develop innovative and practical uses of Earth observations & lower the barriers to using Earth science information
- Enables the early and ongoing involvement of users throughout the lifecycle of Earth science satellite and instrument missions
- Supports improved abilities for users to ideate applications, contribute to planning and design, be prepared to use the data after launch, engage with mission scientists, & provide unique feedback to mission teams

EMPOWERING PEOPLE & COMMUNITIES

Making Earth Data Accessible to All

The Capacity Building Program provides individuals and institutions with workforce development, training activities, and collaborative projects to strengthen understanding of Earth observations and expand their use around the world.

Through our ARSET, DEVELOP and SERVIR programs and our Indigenous Peoples Pilot project, we work with everyone at every level — from first-time users to long-time professional users of Earth observation data.

We work through global networks like CEOS, GEO, and professional societies like AGU, to promote open data access and coordinate capacity building activities focused on users needs.

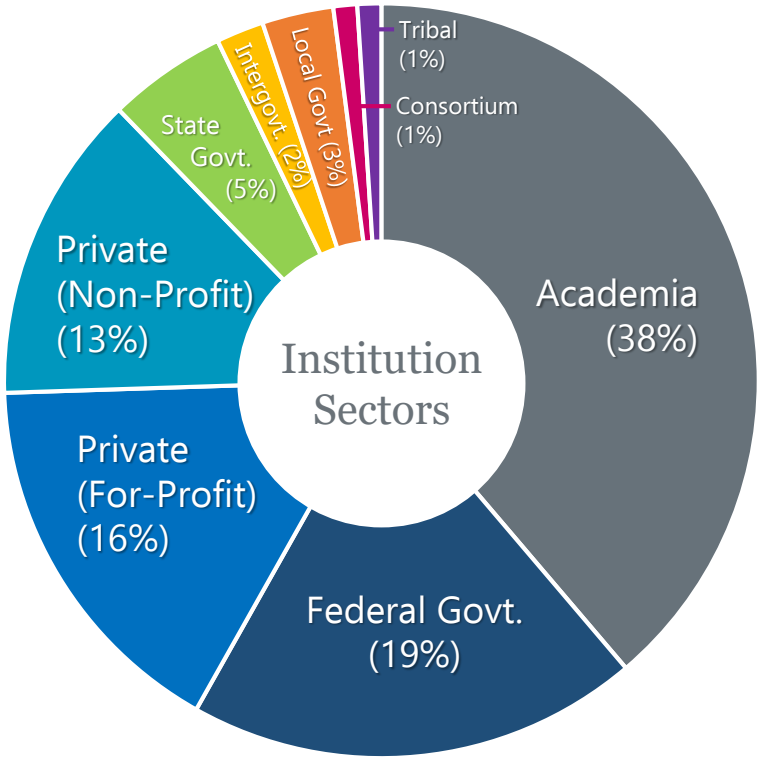
https://appliedsciences.nasa.gov/what-we-do/capacity-building

All Photo Credits: NASA

2019 REACH

14,445 Individuals & **4,556** Institutions *in* **158** Countries & **50** U.S. States *through*

- **163** Trainings
- **71** Co-developed Projects
- **56** Feasibility Studies



https://appliedsciences.nasa.gov/join-mission/publications-resources/2019-capacity-building-annual-report

APPLIED REMOTE SENSING TRAINING

ARSET

ARSET empowers the global community through remote-sensing trainings. Through online and in-person trainings, participants learn how to use NASA Earth science data, applications, and models. Participants can then apply these free resources to environmental management and decision support.

With a target audience of policymakers, non-governmental organizations (NGOs), and other applied science professionals, these trainings are open and free for everyone.

Trainings:

- Online & in-person
- Live & on-demand
- Thematic-focused (ex. Water resource management) & satellite-focused (ex. NASA EO fleet)
- Awareness → Fundamentals → Introductory → Advanced
- One day to three weeks

ARSET TRAININGS

https://appliedsciences.nasa.gov/arset

Upcoming ARSET Trainings

- Satellite Remote Sensing for Urban Heat Islands
- Introduction to NASA's "Black Marble" Night Lights Data

Relevant ARSET Trainings

- Fundamentals of Remote Sensing
- An Introduction to Synthetic Aperture Radar
- Radar Remote Sensing for Land, Water, & Disasters Applications
- Remote Sensing for Disasters Scenarios
- Monitoring Urban Floods Using Remote Sensing
- NASA Remote Sensing for Flood Monitoring and Management
- Monitoring Tropical Storms for Emergency Preparedness
- Integrating Remote Sensing into a Water Quality Monitoring Program
- Using Earth Observations to Monitor Water Budgets for River Basin Management
- An Inside Look at How NASA Measures Air Pollution
- Application of Satellite Observations for Air Quality and Health Exposure
- Land Cover Classification with Satellite Imagery
- Accuracy Assessment of a Land Cover Classification

WORKFORCE DEVELOPMENT

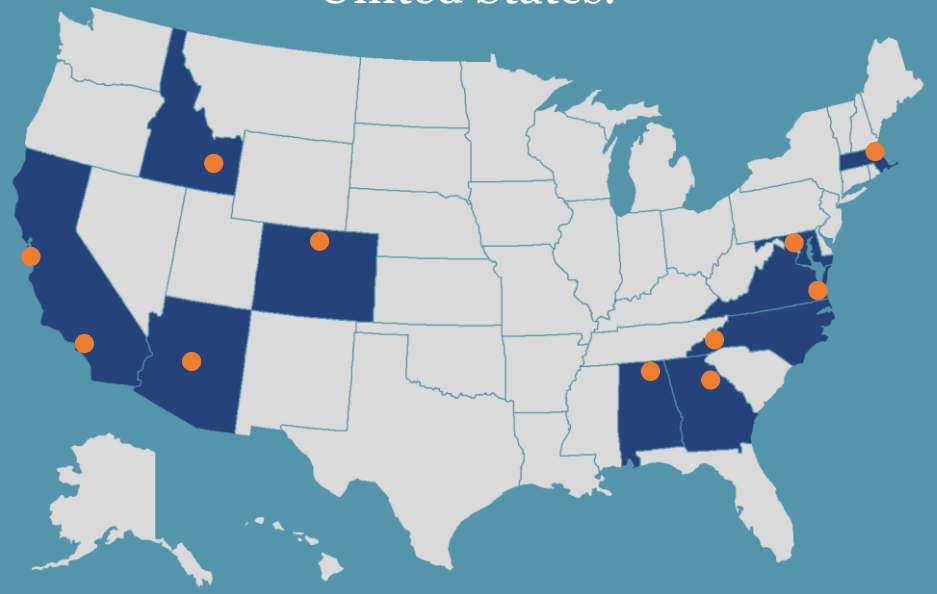
DEVELOP

DEVELOP addresses environmental and public policy issues through interdisciplinary research projects that apply the lens of NASA Earth observations to community concerns around the globe. Each feasibility study explores the integration of freely-available NASA Earth observations into partner decision making processes.

Through 10-week feasibility projects, the program builds capacity to use Earth observations in participants (recent graduates, students, and transitioning professionals – anyone 18 and over) and partner organizations (ex. state & local govt., NGOs, etc.). Projects are conducted under the guidance of NASA and partner organization Science Advisors & mentors.

40-50 feasibility studies are conducted each year during three terms (spring, summer, and fall).

DEVELOP has 11 locations across the United States.



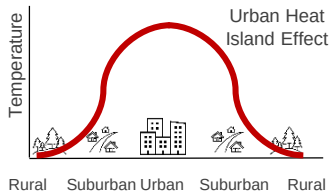
Feasibility Studies:

- 10 weeks
- Local scale
- Apply NASA Earth observations
- Address partner decision making needs

https://develop.larc.nasa.gov/

DEVELOP STUDY EXAMPLE

Cambridge Urban Development: Quantifying Changes in Urban Albedo with NASA Earth Observations to Reduce Urban Heat Island Effect in Cambridge, Massachusetts

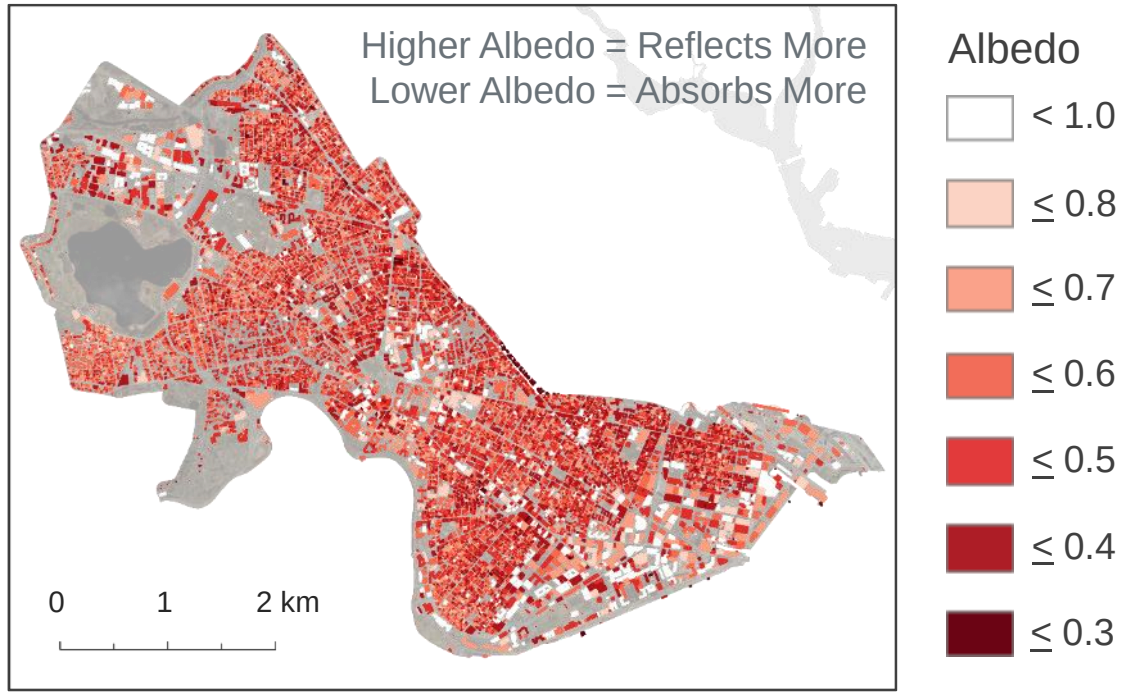


Partners:

- City of Cambridge's Community Development Department
- AGU TEX

Objectives:

- ✓ Calculate changes in rooftop albedo using MODIS data
- ✓ Map temperature "hotspots"
- ✓ Create an interactive ArcGIS Dashboard



Results:

On average, albedo increased by 0.12 across the city, with the majority of positive change in commercial areas. Analysis of mean summer nighttime land surface temperature between 2003 and 2019 revealed a non-significant increase in temperature, although temperature anomaly maps demonstrated that Cambridge was warmer on average than rural areas. These results were incorporated in the interactive Cambridge Urban Heat Dashboard, which allows users to explore temporal trends in albedo.

Useful Links:

- Project Archive
- Interactive Mapper
- YouTube Gallery
- GitHub Repository

Opportunities:

Apply to be a participant

Summer Term

Term Dates: 6/7 – 8/13

Application Window: 1/18 – 2/26

For more information about eligibility requirements and logistics, visit: https://develop.larc.nasa.gov/apply.php

CONNECTING SPACE TO VILLAGE

SERVIR

A joint development initiative of NASA and USAID, SERVIR works in partnership with leading regional organizations world-wide to help developing countries use information provided by Earth observing satellites and geospatial technologies for managing climate risks and land use.

SERVIR empowers decision-makers with tools, products, and services to act locally on climate-sensitive issues such as disasters, agriculture, water, and ecosystems and land use.

Using a service planning approach, SERVIR co-develops geospatial services, tools, data, and training resources.

SERVICE PLANNING TOOLKIT

In 2015, SERVIR adopted a Service Planning approach to ensure its services help developing countries. The Service Planning Toolkit is publicly available and used by the SERVIR network to design, deliver, and implement services.

SAR HANDBOOK

With over 500,000 views from 180 countries since April 2019, the *SAR Handbook: Comprehensive Methodologies for Forest Monitoring and Biomass Estimation* is an example of the types of resources SERVIR is providing to the global community.

- SERVIR's Coordination Office is located at NASA Marshall in Huntsville, AL
- SERVIR has 5 regional hubs: Amazonia, West Africa, Eastern & Southern Africa, Hindu Kush-Himalaya, and the Lower Mekong

GLOBE

Global Learning & Observations to benefit the Environment Program

The GLOBE Program is an international science and education program, sponsored by NASA, NSF, and the Department of State that provides students and the public worldwide with the opportunity to participate in data collection and the scientific process, and contribute meaningfully to our understanding of the Earth system and global environment.

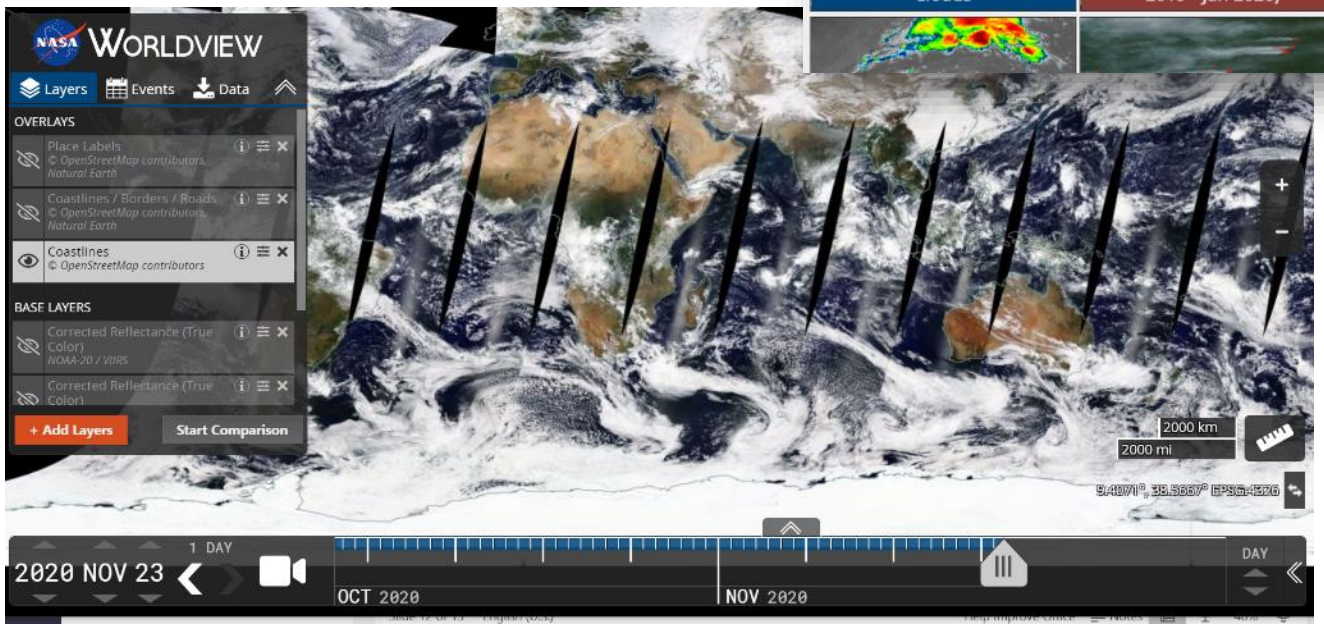
- Provides grade level-appropriate, interdisciplinary activities and investigations about the atmosphere, biosphere, hydrosphere, and soil/pedosphere
- Connects students, teachers, scientists, and citizens from different parts of the world to conduct real, hands-on science about their local environment and to put this in a global perspective.

https://www.globe.gov/

GLOBE Observer is an international network of citizen scientists and scientists working together to learn more about our shared environment and changing climate.

NASA's WORLDVIEW

Visually explore the past and present data



NASA's EOSDIS provides the capability to interactively browse over 900 global, full-resolution satellite imagery layers and then download the underlying data.

This supports time-critical application areas such as wildfire management, air quality measurements, and flood monitoring.

You can access on a tablet and smartphone devices, generally supported for mobile access to the imagery.

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

All Image Credits: NASA

Remote Sensing Fundamentals

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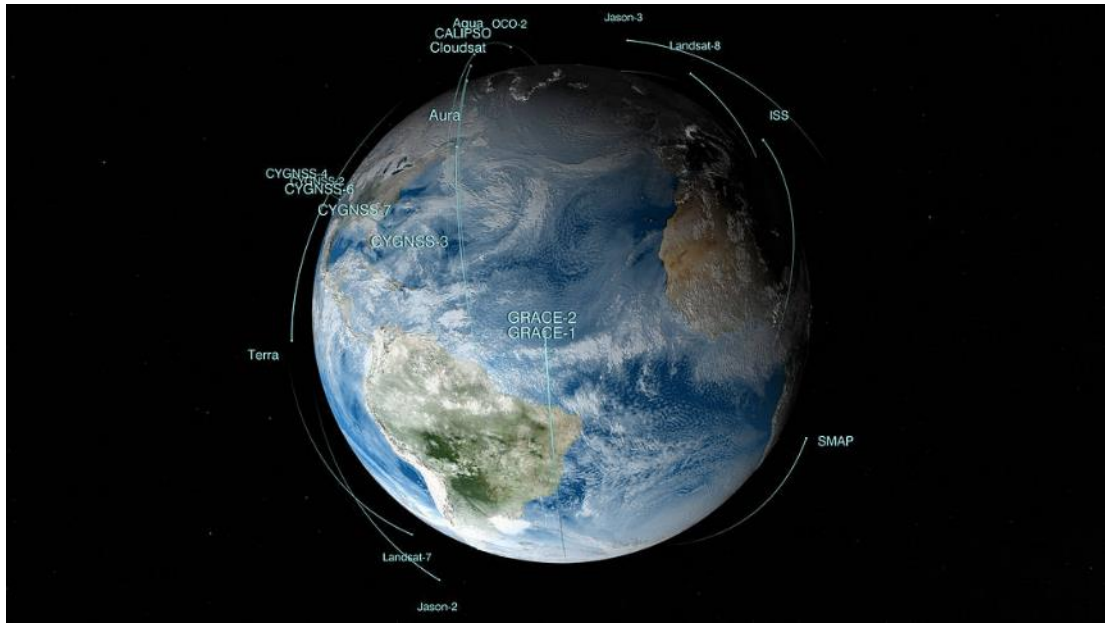
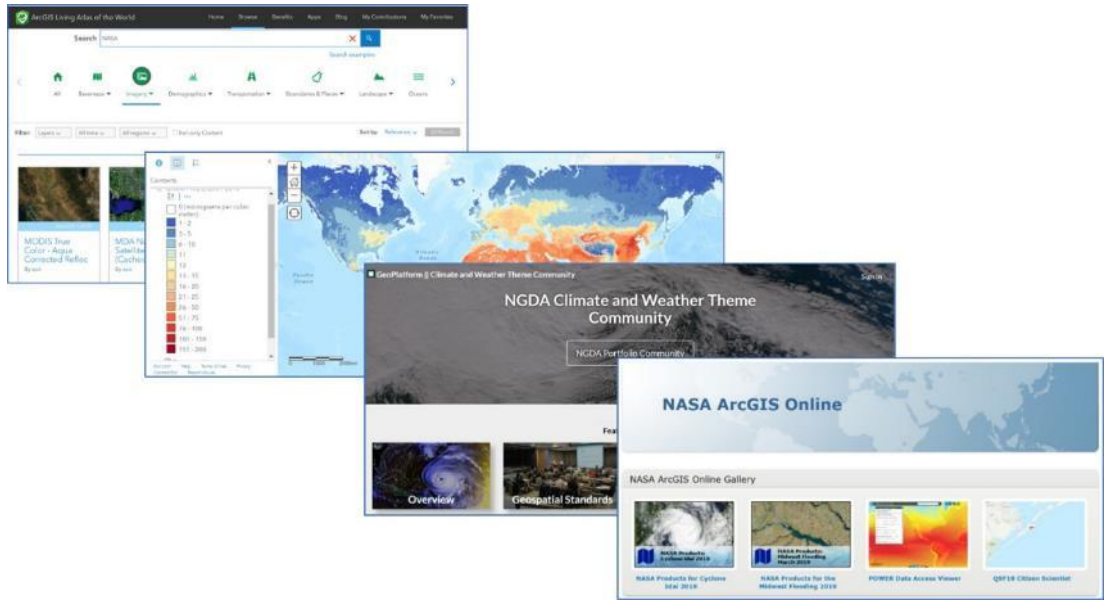
What is Remote Sensing & Geospatial Analysis?



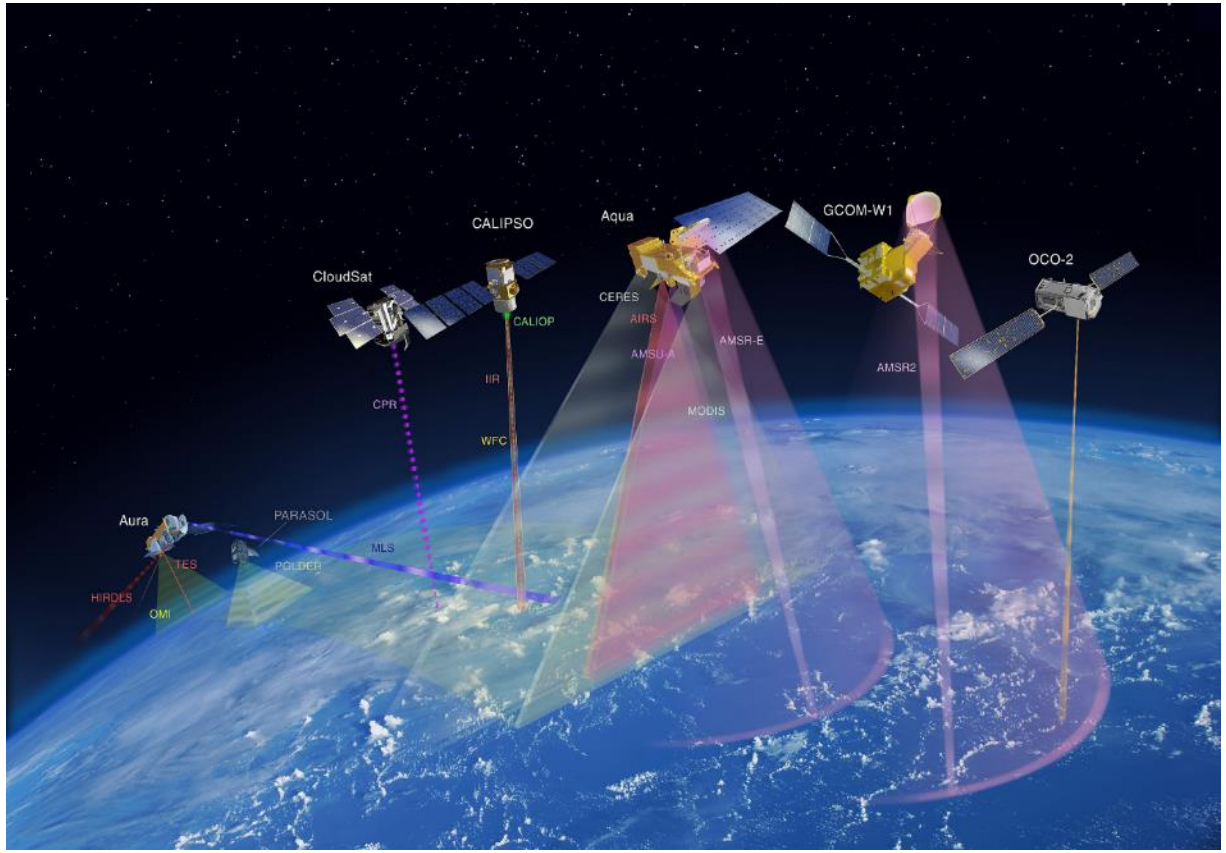
Remote sensing is the science of identifying, observing, and measuring an object without coming into direct contact with it. Satellites serve as a great vantage point for observing the Earth remotely.



Geospatial analysis is the method of gathering information about certain geographical locations using satellites imagery & data sources to examine change on Earth.

All Image Credits: NASA

Benefits of Using Satellite Remote Sensing Data & Geospatial Analysis

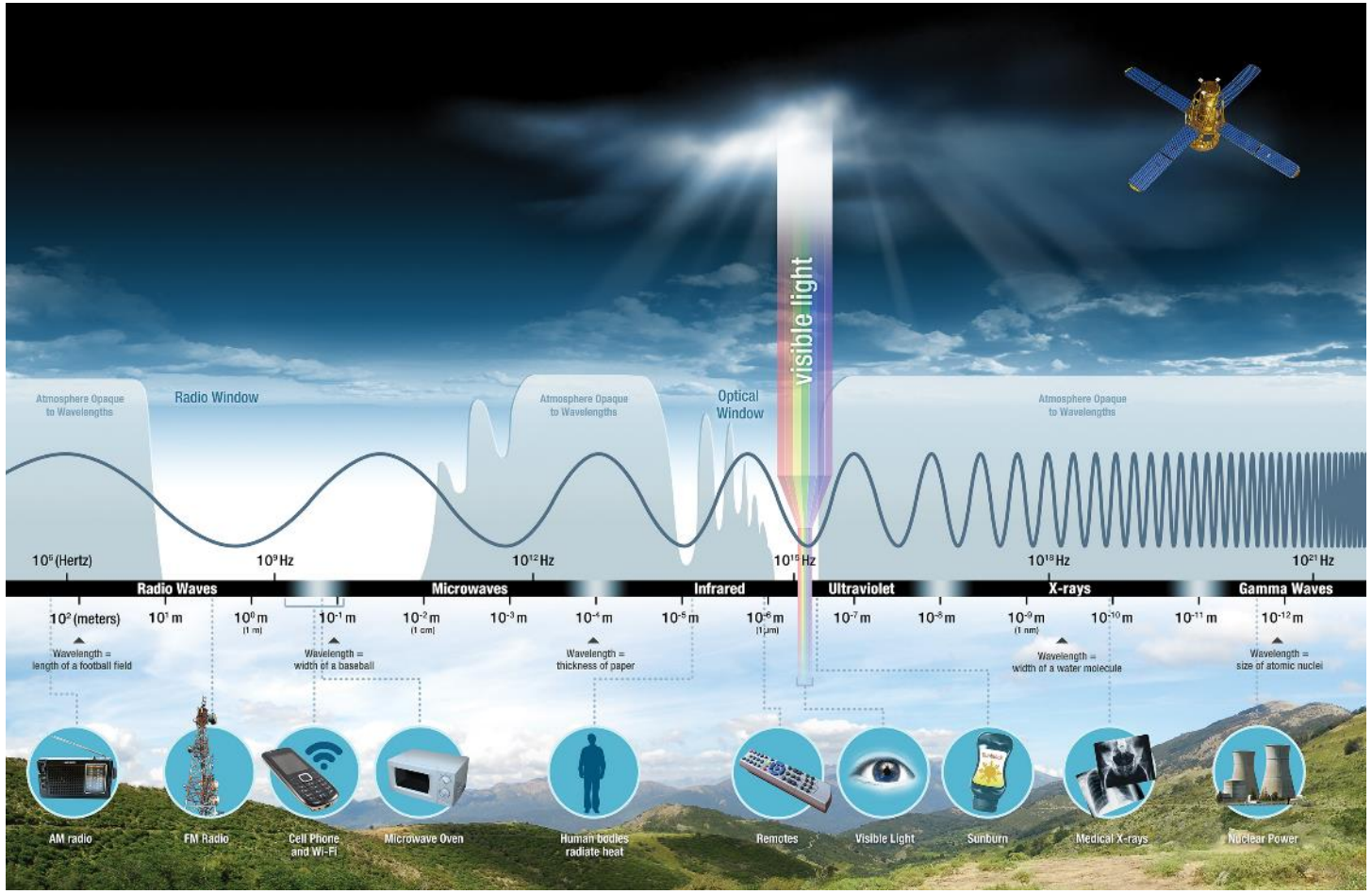


All Image Credits: NASA

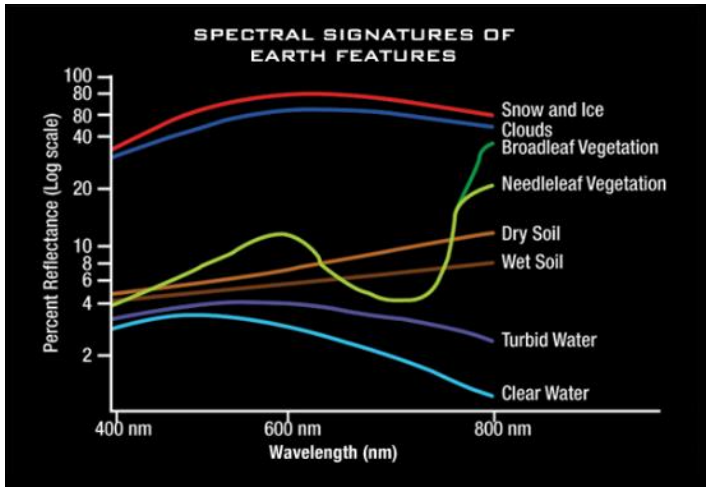
- Observe and characterize the Earth's surface from your computer
- Collect information over large spatial areas and across time
- Monitor and understand change over years
- Satellite data can be integrated with in situ measurements for a holistic understanding of our environment
- Visualize your results in a multitude of ways through mapping, data plots, heat maps, etc.

- NASA Earth observation data are a free and open resource for the world

REMOTE SENSING: ELECTROMAGENETIC SPECTRUM



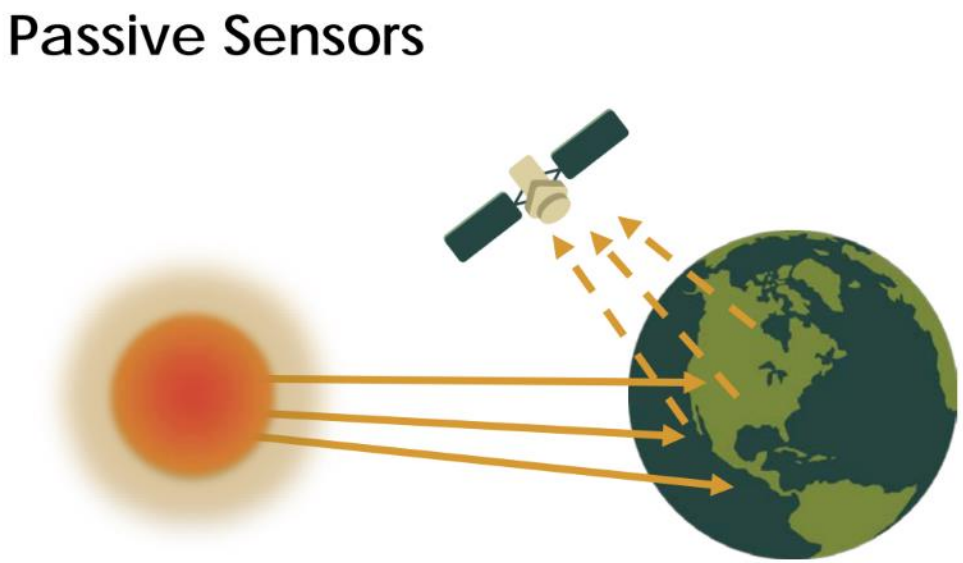
Electromagnetic Spectrum

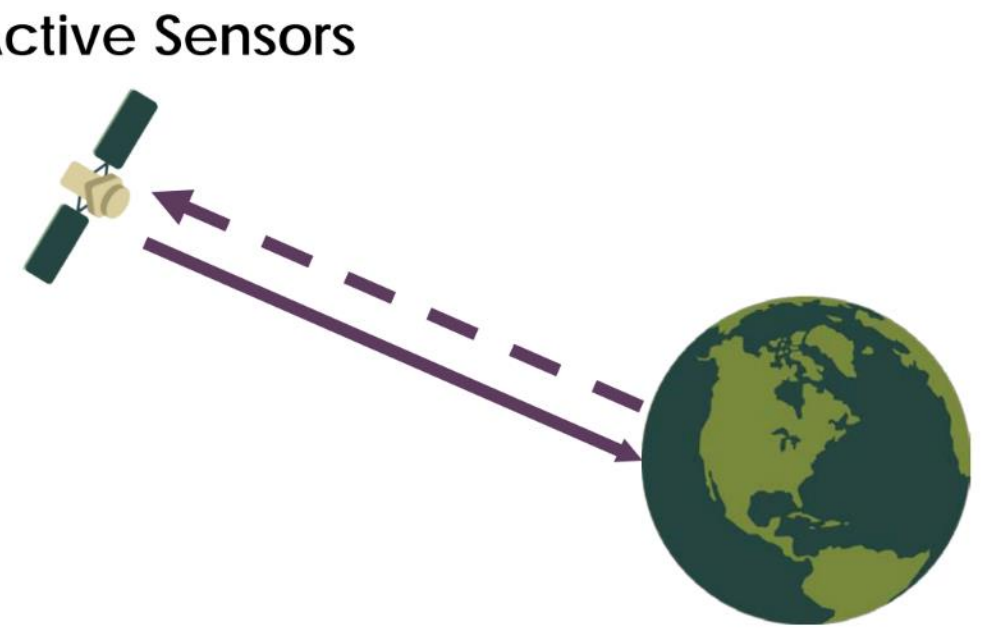


- Electromagnetic energy, produced by the vibration of charged particles, travels in the form of waves through the atmosphere and the vacuum of space
- The primary source of the energy observed by satellites, is the sun.
- All things on Earth reflect, absorb, or transmit energy, the amount of which varies by wavelength.

All Image Credits: NASA

REMOTE SENSING: SENSORS





Sensors, or instruments, onboard satellites and aircraft use the sun as a source of illumination or provide their own source of illumination, measuring the energy that is reflected back. Sensors that use natural energy from the sun are called passive sensors; those that provide their own source of energy are called active sensors.

All Image Credits: NASA

REMOTE SENSING: RESOLUTION

Landsat 8 data from July 7, 2019 over Iceland showing varying spatial resolutions.

Resolution plays a role in how data from a sensor can be used. Depending on the satellite's orbit and sensor design, resolution can vary. There are four types of resolution to consider for any dataset—radiometric, spatial, spectral, and temporal.

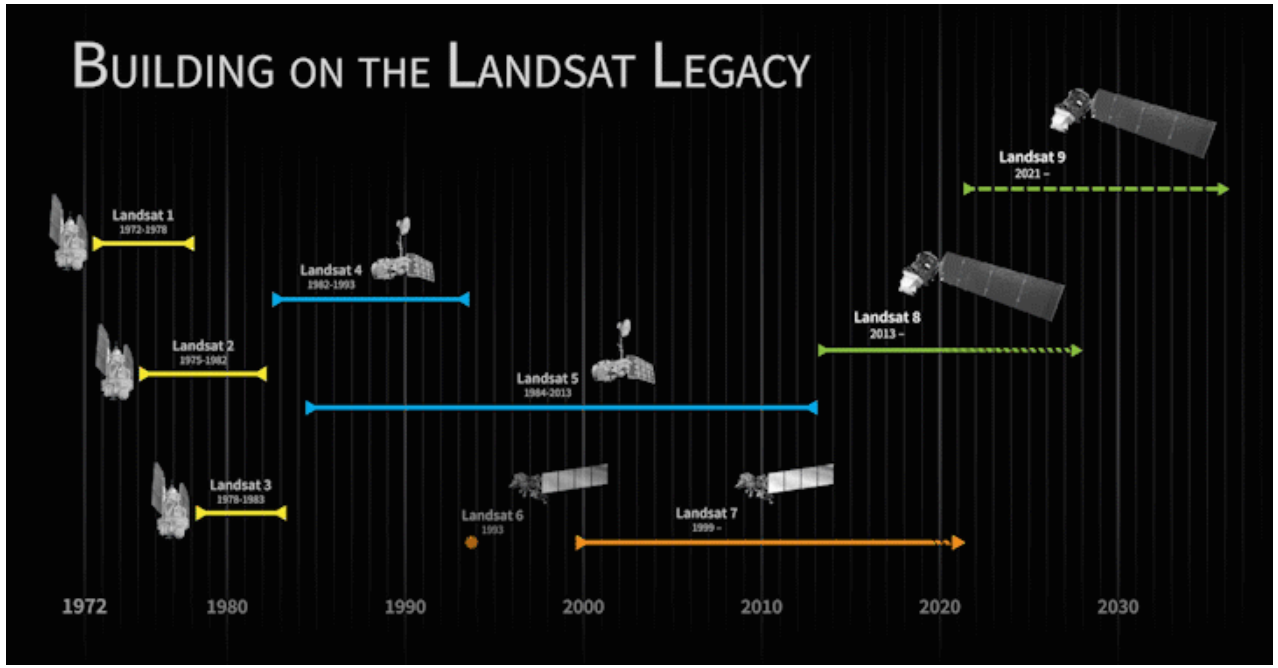
- **Radiometric resolution** is the amount of information in each pixel, i.e. the number of bits representing the energy recorded.
- **Spatial resolution** is defined by the size of each pixel within a digital image and the area on the Earth's surface represented by that pixel.
- **Spectral resolution** is the ability of a sensor to discern finer wavelengths, that is, having more and narrower bands.
- **Temporal resolution** is the time it takes for a satellite to complete an orbit and revisit the same observation area.

All Image Credits: NASA

LANDSAT

What is Landsat?

- The Landsat series of satellites provide the longest continuous space-based record of the Earth's land in existence (1972 to present)
- Currently Landsat 7 (launched 1999) and Landsat 8 (launched 2013) are collecting 30m multispectral data of the entire Earth's surface every 16 days



All Image Credits: NASA

How can you use Landsat data?

Landsat data informs decisions in many disciplines, especially: human health, agriculture, climate, energy, fire, natural disasters, urban growth, water management, ecosystems and biodiversity, and forest management.

https://landsat.gsfc.nasa.gov/

MODIS

What is MODIS (Moderate Resolution Imaging Spectroradiometer)?

- MODIS instruments are onboard the Terra (launched 1999) and Aqua (launched 2002) satellites
- Terra MODIS and Aqua MODIS are viewing the entire Earth's surface every 1 to 2 days
- Spatial Resolution: depends on the product, ranging between 250m, 500m, 1km
- Temporal resolution: daily, 8-day, 16-day, monthly, quarterly, yearly (2000-present)
- Data format: Hierarchal data format- Earth observing format (HDF-EOS)
- Spectral Coverage: 36 bands

How can you use MODIS data?

MODIS collects data supporting four discipline groups: Atmosphere (ex. air quality, clouds), Calibration, Land (ex. snow cover, land surface temperature, vegetation, land cover, albedo, wildfires, evapotranspiration), and Ocean (ex. ocean color).

https://modis.gsfc.nasa.gov/

All Image Credits: NASA

NASA Data Resources

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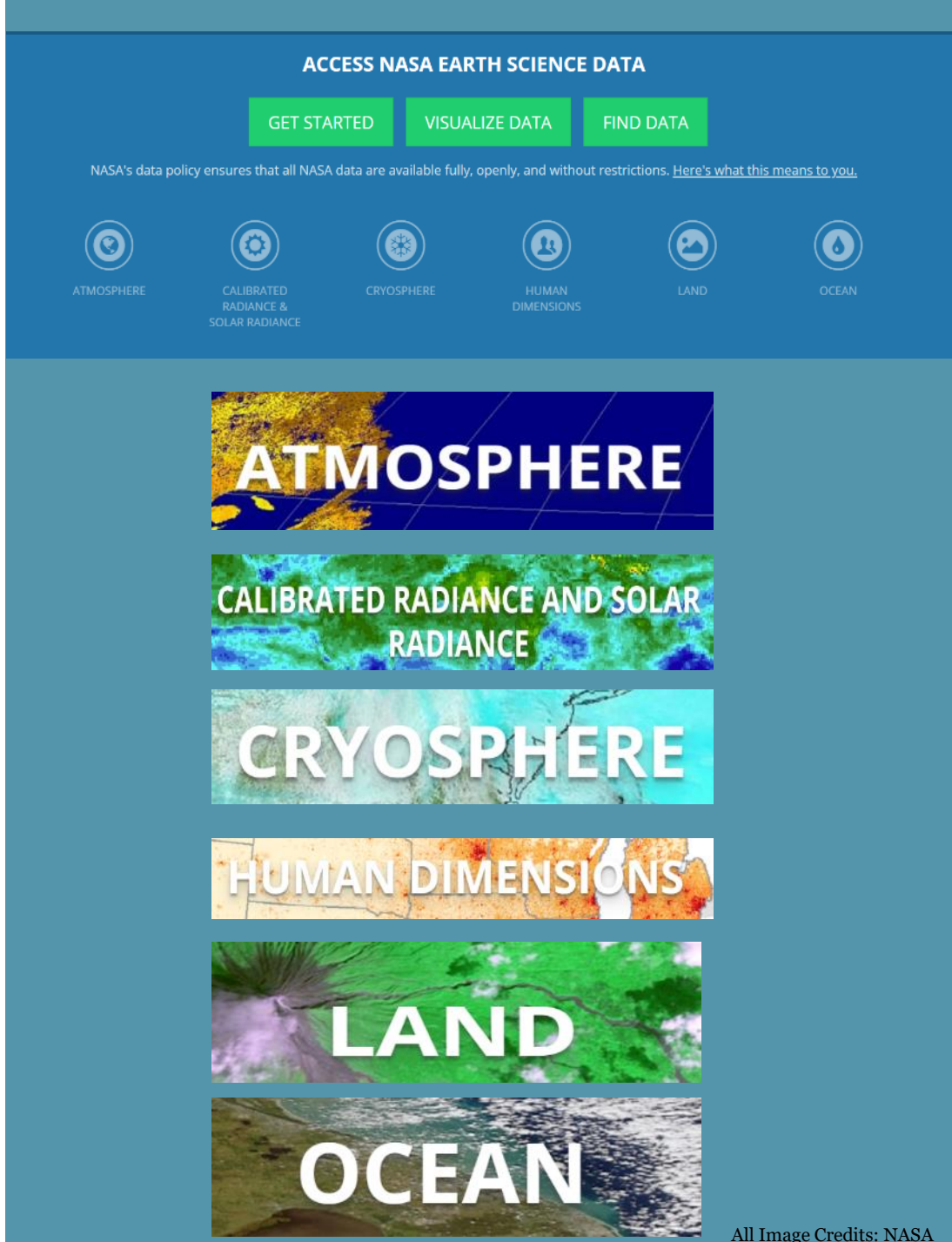
NASA DAACs
(Distributed Active Archive Center)

Where do I find NASA data?

- ASDC (ATMOSPHERIC SCIENCE DATA CENTER)
- ASF DAAC (Alaska Satellite Facility)
- CDDIS (Crustal Dynamics Data Information System)
- GES DISC (Goddard Earth Sciences Data and Information Services Center)
- GHRC DAAC (Global Hydrology Resource Center)
- LAADS DAAC (Level-1 and Atmosphere Archive & Distribution System)
- LP DAAC (Land Processes Distributed Active Archive Center)
- NSIDC DAAC (National Snow and Ice Data Center)
- OB.DAAC (Ocean Biology Processing Group)
- ORNL DAAC (Oak Ridge National Laboratory)
- PO.DAAC (Physical Oceanography Distributed Active Archive Center)
- SEDAC (Socioeconomic Data and Applications Center)



All Image Credits: NASA

SEDAC

Socioeconomic Data and Applications Center (SEDAC)

One of NASA's data centers within NASA’s Earth Observing System Data and Information System

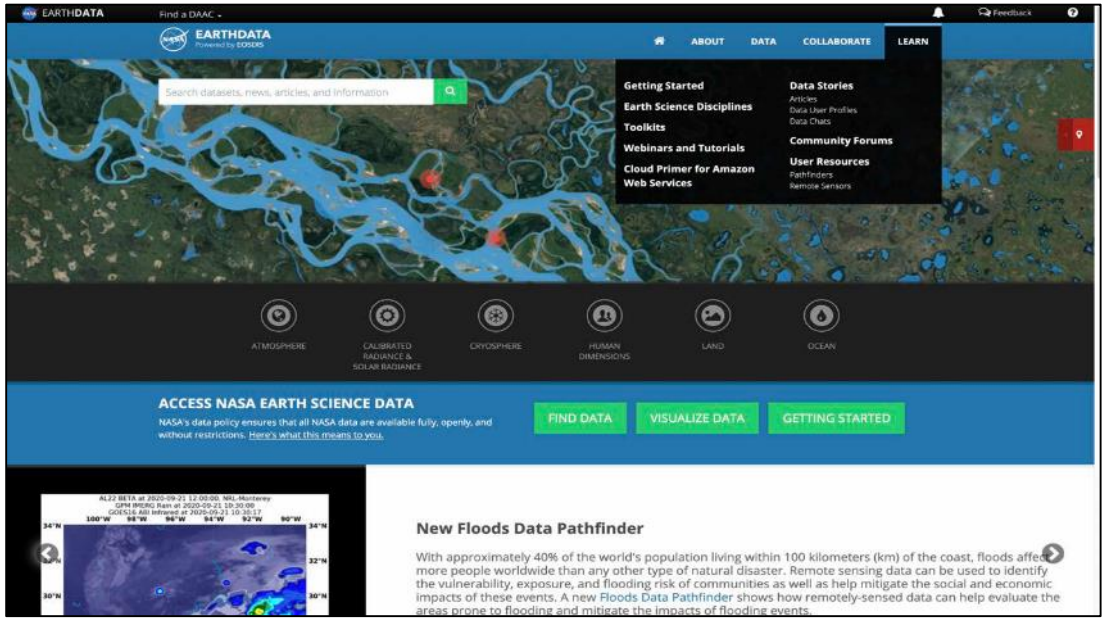
- Focused on human interactions in the environment, SEDAC's mission is to develop and operate applications that support the integration of socioeconomic and Earth science data and to serve as an "Information Gateway" between Earth sciences and social sciences.
- SEDAC data and information products and services are designed to help users integrate and apply socioeconomic and Earth science data in their research, educational activities, analysis, and decision making.

https://sedac.ciesin.columbia.edu/

- SEDAC provides case studies, maps, open-source data, and other visualizations for users to utilize
- Focuses on multiple types of environmental challenges from urbanization, poverty, agriculture, floods, and more

All Image Credits: NASA

NASA DATA PATHFINDERS



- NASA's Data Pathfinders provide a path for users to understand what datasets are relevant to their environmental issues and needs
- Point you to NASA's freely available data

https://earthdata.nasa.gov/learn/pathfinders

Areas of focus:

- Agriculture and Water Resources
- Biological Diversity and Ecological Forecasting
- COVID-19
- Disasters
- Geographical Information Systems
- Health and Air Quality
- Sea Level Change
- Water Quality
- Wildfires

All Image Credits: NASA

Thank You.

For further information, please visit:

NASA Applied Sciences:
https://appliedsciences.nasa.gov/

Capacity Building Program:
https://appliedsciences.nasa.gov/what-we-do/capacity-building

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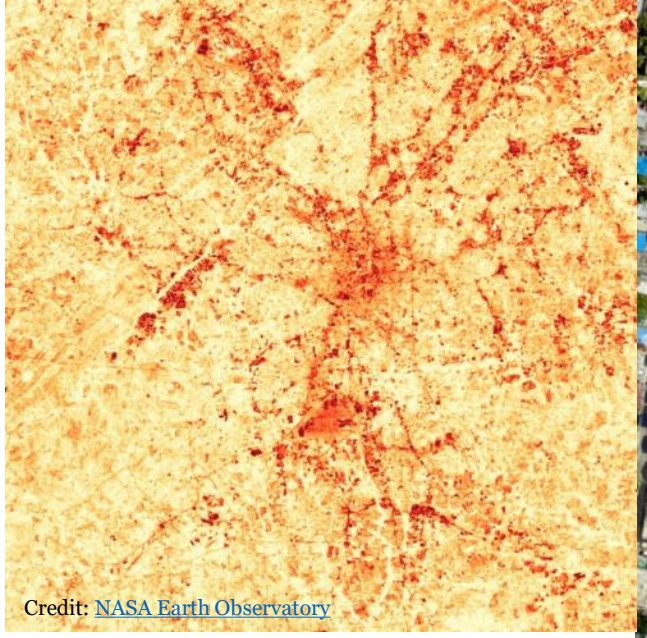

Credit: NASA Earth Observatory

Credit: NASA

Introduction to Urban Heat Islands, Flooding, and Canopy

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Credit: ARSET

Urban Heat Islands

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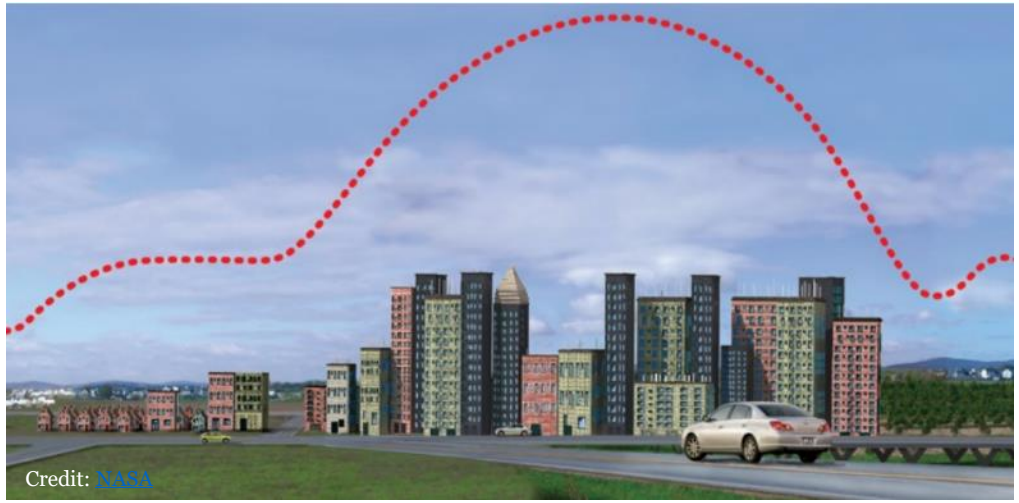
What are urban heat islands?

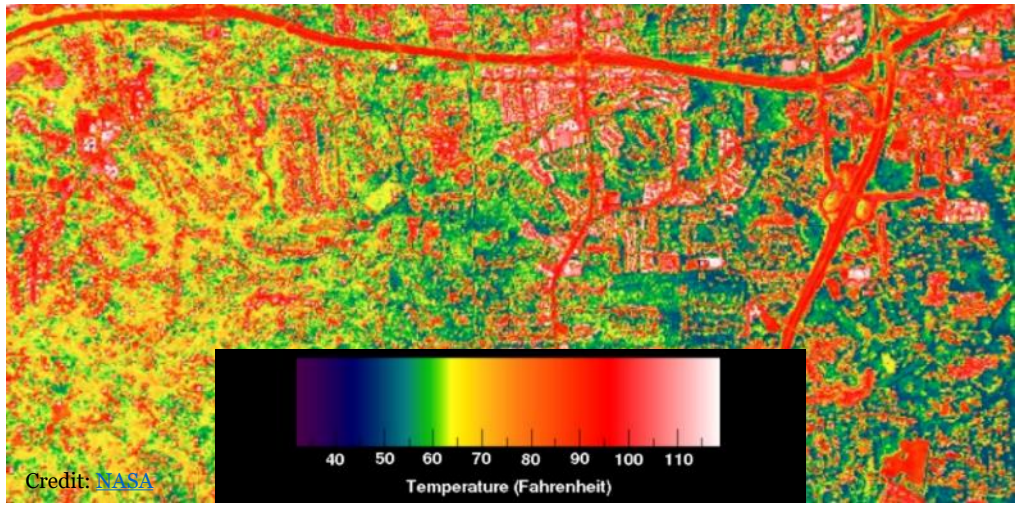
Urban areas experience higher temperatures than outlying areas. This difference in temperature is what constitutes an urban heat island (UHI).



Two types of urban heat islands:

Surface Urban Heat Islands

Represents the temperature difference between impervious and natural surfaces



Credit: NASA

Atmospheric Urban Heat Islands

Refers to effects on air from the surface to treetops/rooftops

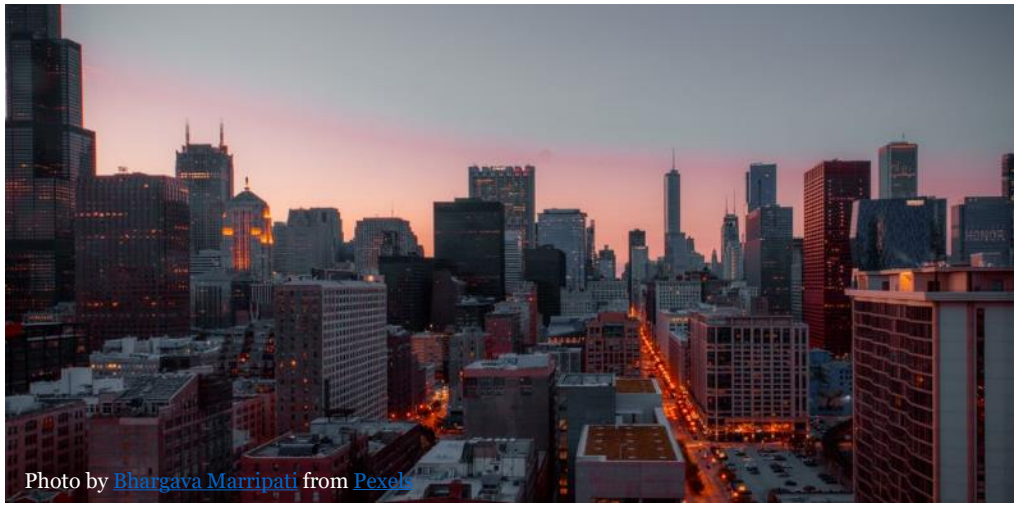


Photo by Bhargava Marripati from Pexels

What causes urban heat islands?

Difference in temperature has to do with modifying land surfaces.

Temperatures vary in cities due to the amount of space water, soil, vegetation, and **impervious surfaces** occupy.

Impervious Surfaces: surfaces that don't allow fluid to pass through them, such as buildings and pavement

Surfaces such as asphalt, concrete, and brick absorb – rather than reflect – the sun's heat, which makes it hotter

Photo by Abby Chung from Pexels

Tall buildings act as obstacles and reduce wind flow which would make it cooler

Credit: Anthony Quintano

Less vegetation minimizes the natural cooling effects of shade

Photo by Cameron Casey from Pexels

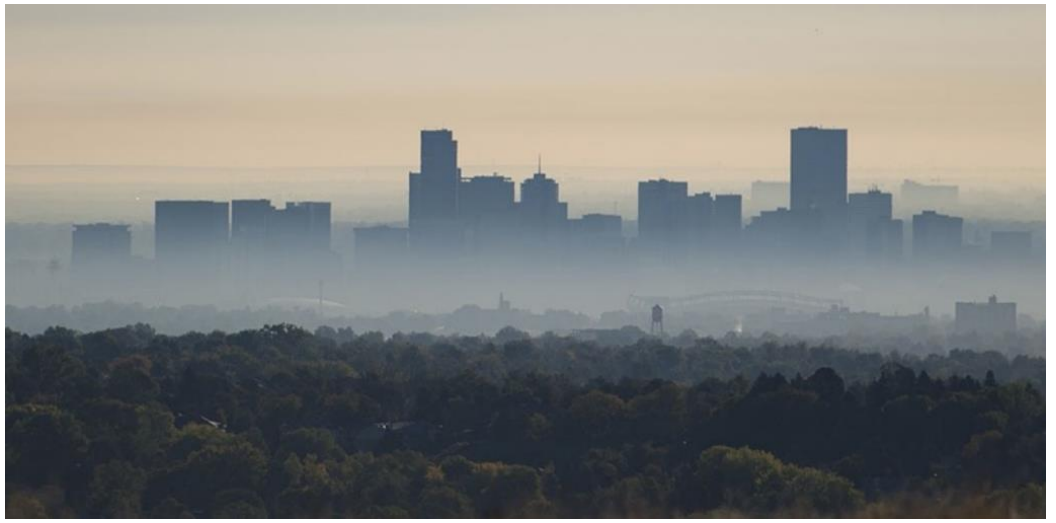
Vehicles, air-conditioning units, buildings, and industrial facilities all emit heat

Photo by Craig Adderley from Pexels

What are the risks of urban heat islands?

- Increased risk of heart-related mortality and morbidity
- Increased energy consumption
- Elevated emissions of air pollutants and greenhouse gases
- Degraded water quality

Credit: NIEHS



Credit: NOAA

Urban Flooding

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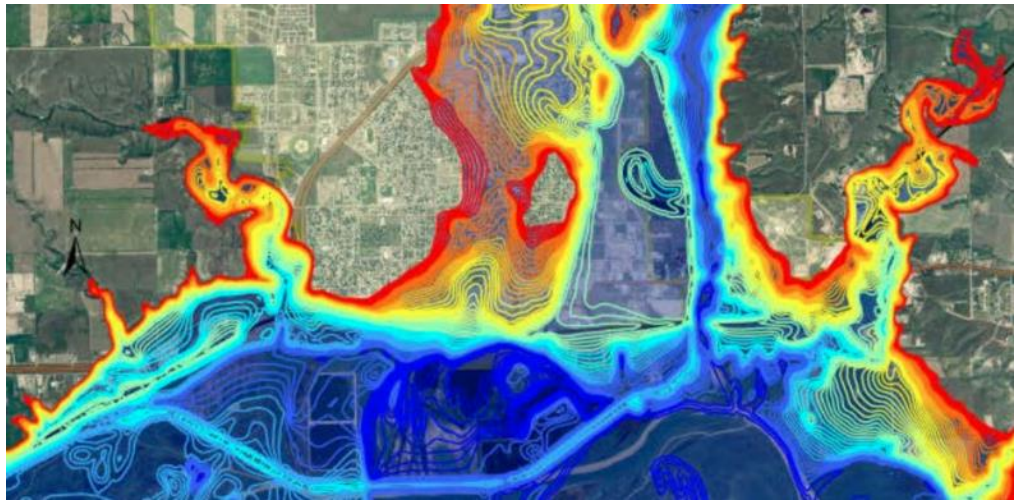
What is urban flooding?

When urban areas flood, it is because of excessive runoff in developed areas where the water doesn't have anywhere to go.

Urban flooding is different than rural flooding – urbanization increases flood risk

Credit: ARSET



Credit: NASA

What causes urban flooding?

Natural	Human-Induced
• Heavy precipitation • Snowmelt • River floods • Coastal storms	• Lack of proper drainage systems • Unplanned development • Infrastructure failure

Photo by Genaro Servín from Pexels

Credit: Pixabay

What are the risks of urban flooding?

Danger to human lives

Damage to buildings, housing, roads, utility works, drainage systems

Direct economic impacts

Projections indicate that by 2050, two thirds of the world's population will be living in urban areas.

Rapid, unplanned increases in urbanization and inadequate infrastructure make cities more vulnerable to urban floods.

Urban Canopy

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What is urban canopy?

Urban tree canopy is the layer of leaves, branches, and stems of trees that cover the ground when viewed from above.

Credit: Pixabay

Credit: Pixabay

What are the effects of urban canopy?

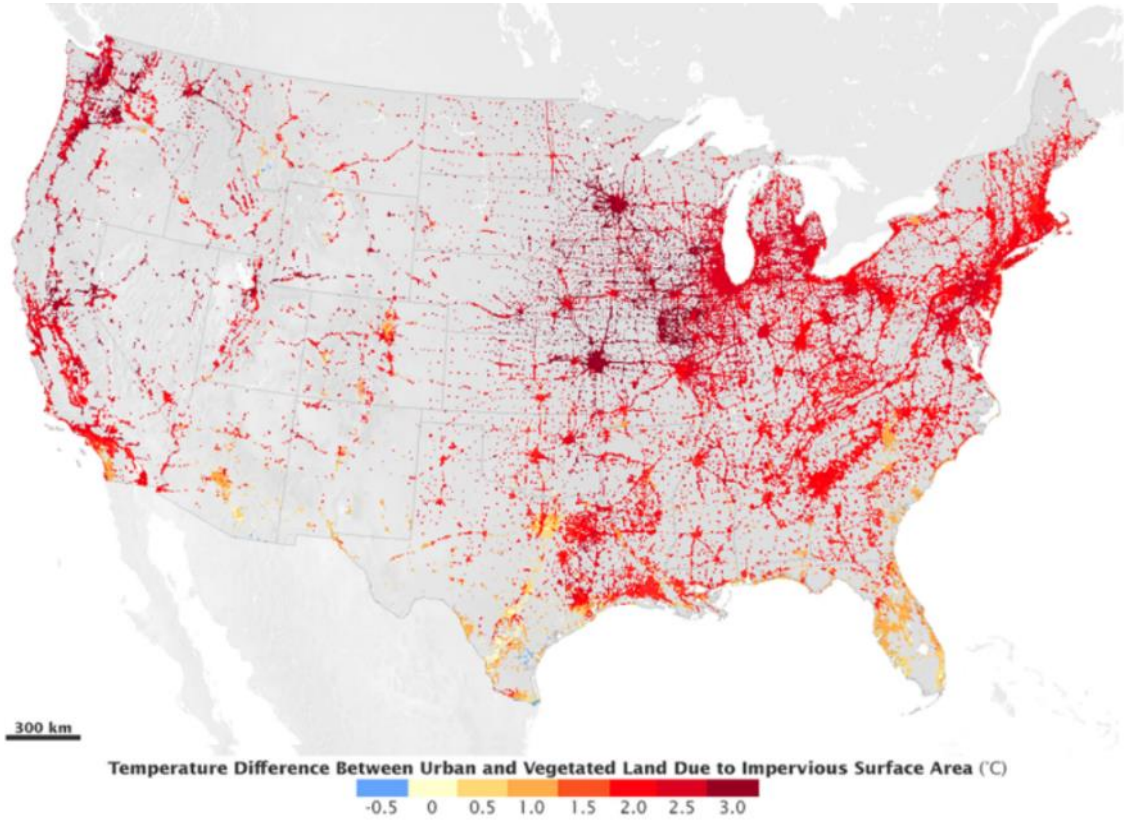
A benefit of urban tree cover is the mitigation of the effects of urban heat islands through factors including shade and **evapotranspiration.**

Evapotranspiration: the sum of evaporation and plant transpiration from the Earth's land and ocean surface to the atmosphere

Credit: NASA

How do urban heat islands, flooding, and canopy relate to remote sensing?

Satellites are used to measure and monitor heat islands, flooding, and canopy. Mapping this data can provide insight about how vulnerable cities are, which is in important step in adaption and mitigation.



Credit: NASA

Break Between Modules

EARTH SCIENCE
APPLIED SCIENCES

Thank You.

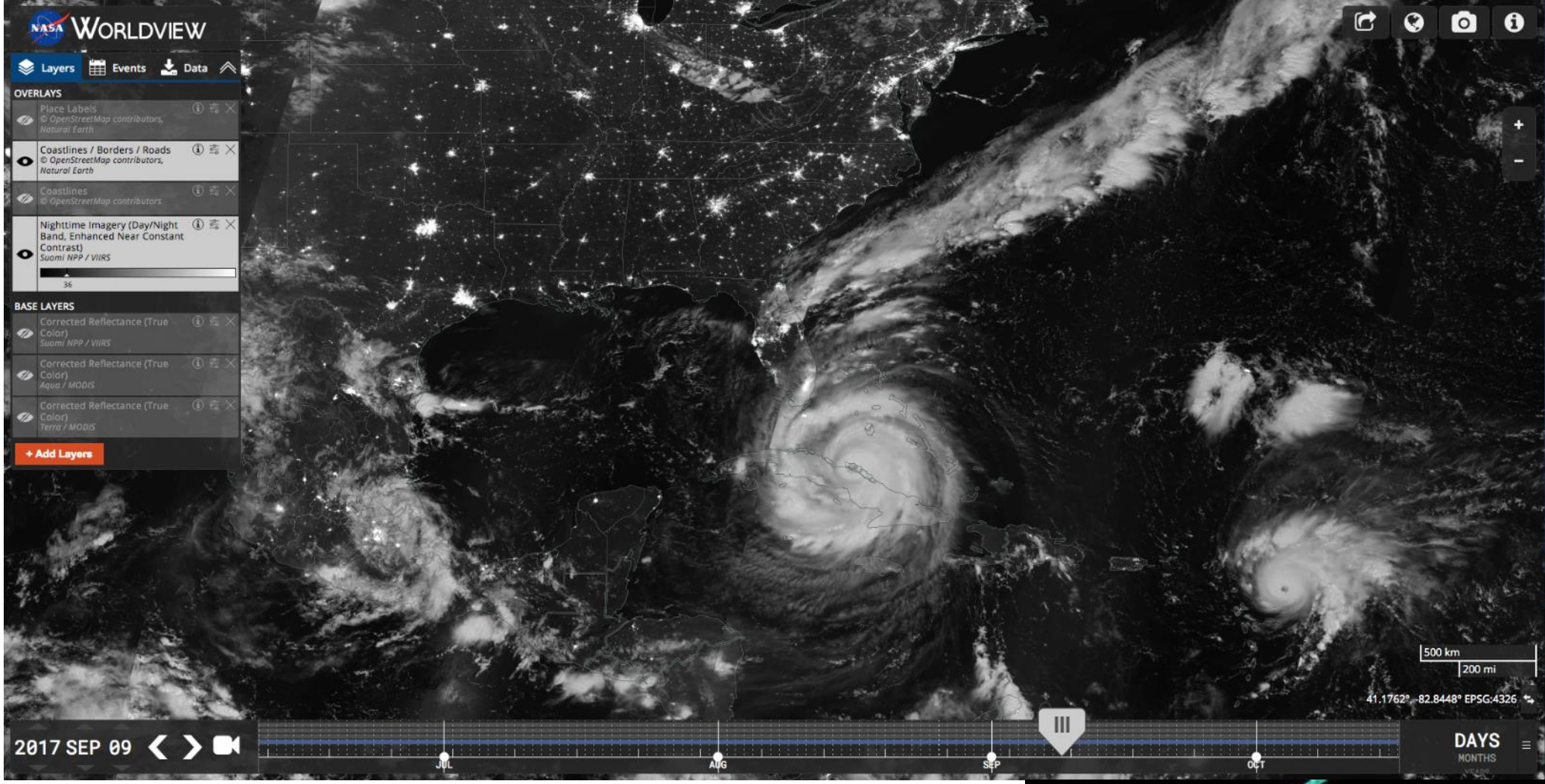
For further information, please visit:

NASA Applied Sciences:
https://appliedsciences.nasa.gov/

Capacity Building Program:
https://appliedsciences.nasa.gov/what-we-do/capacity-building

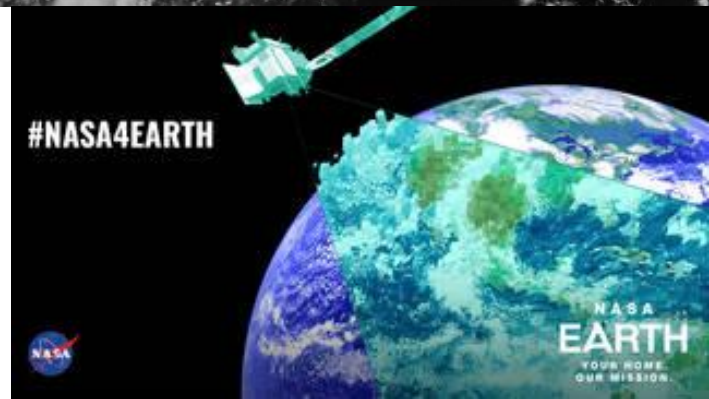
EARTH SCIENCE
APPLIED SCIENCES

Credit: NASA



Introduction to NASA's Worldview

EARTH SCIENCE
APPLIED SCIENCES



Credit: NASA

Satellite Imagery

EARTH SCIENCE
APPLIED SCIENCES

What does Satellite Imagery tell us about Earth?

- Satellites help us is many ways such as providing GPS location, communicating with others through cellular devices, watch TV, and more!
- Satellites more specifically help us to retrieve data about Earth such as; ocean data, atmospheric data, land data, etc.
- You can analyze weather patterns, population trends, levels of carbon emissions, and other environmental impacts that require continuous monitoring of earth's changing climate!
- Many of the Satellites launched into Space analyze specific environmental trends. Ex: The newly launched Sentinel-6 will be monitoring and gathering ocean data to predict better climate change models.

Check Out the Satellites!

Image Credits: NASA

How to get started?

- There are many ways to observe real time satellite imagery, one example is using Google Earth and Maps. Just by simply locating your home address, you are able to get a visual location of where your home is located at and a 3d view of how your surrounding neighborhood looks like from satellite imagery (including your home!)
- Earth observers and other scientists retrieve datasets of satellite imagery through online platforms such as DAAC, GLOBE, NASA's Earth Datasets, and NASA's Worldview
- NASA's Worldview is a great resource to start off because it is interactive and it includes many environmental focuses to choose from, we can get real time data, and create visual comparisons between one previous time period to another
- In the next few slides, you will learn how to comfortably navigate NASA's Worldview platform!

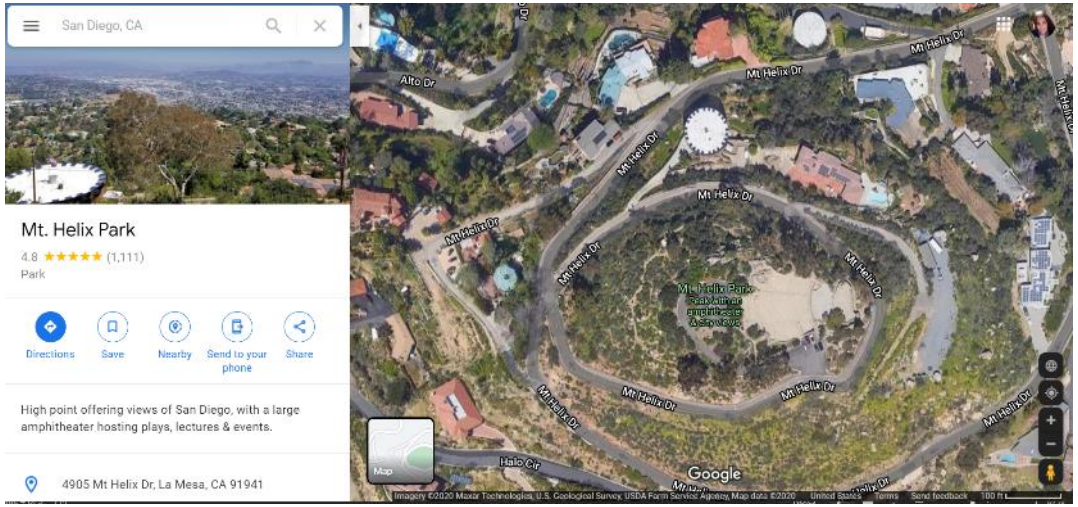


Image Credit: Google

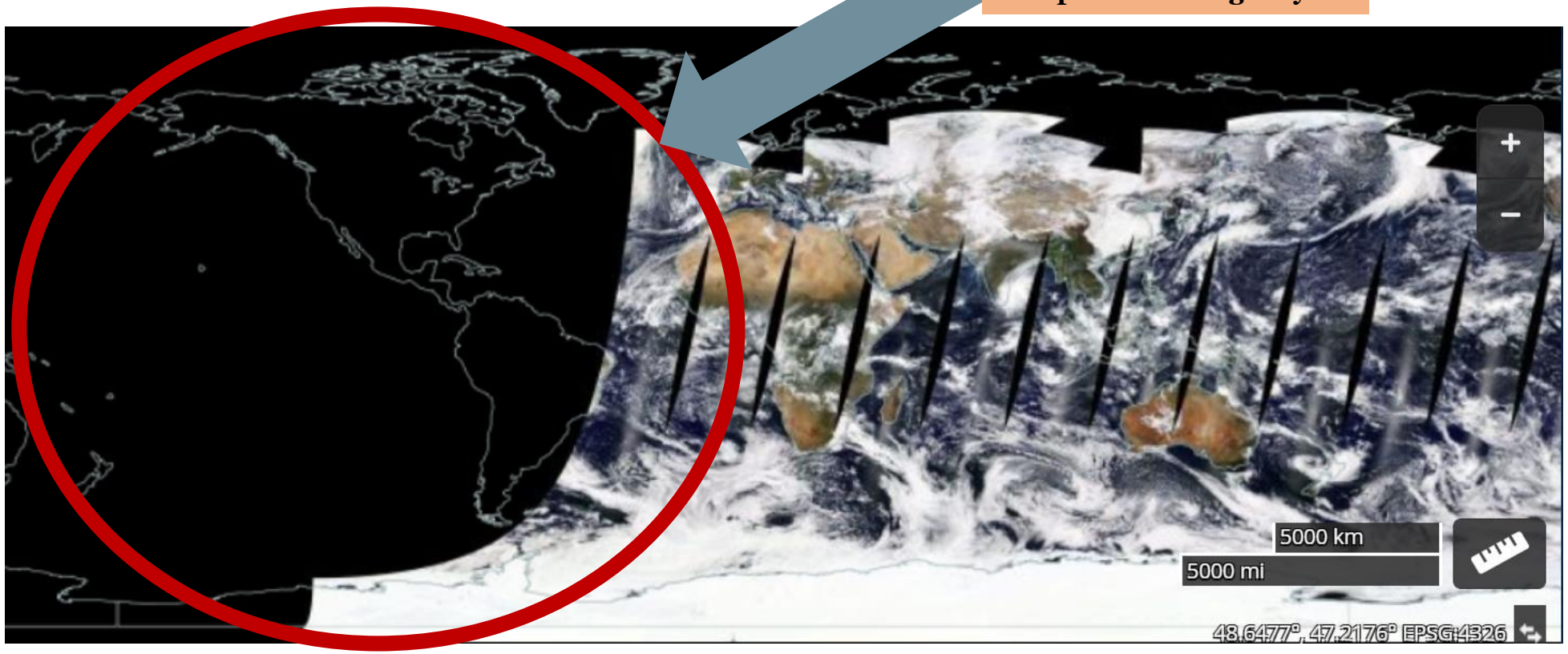
Getting Started with NASA Worldview

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

Image Credits: NASA

Satellite Imagery

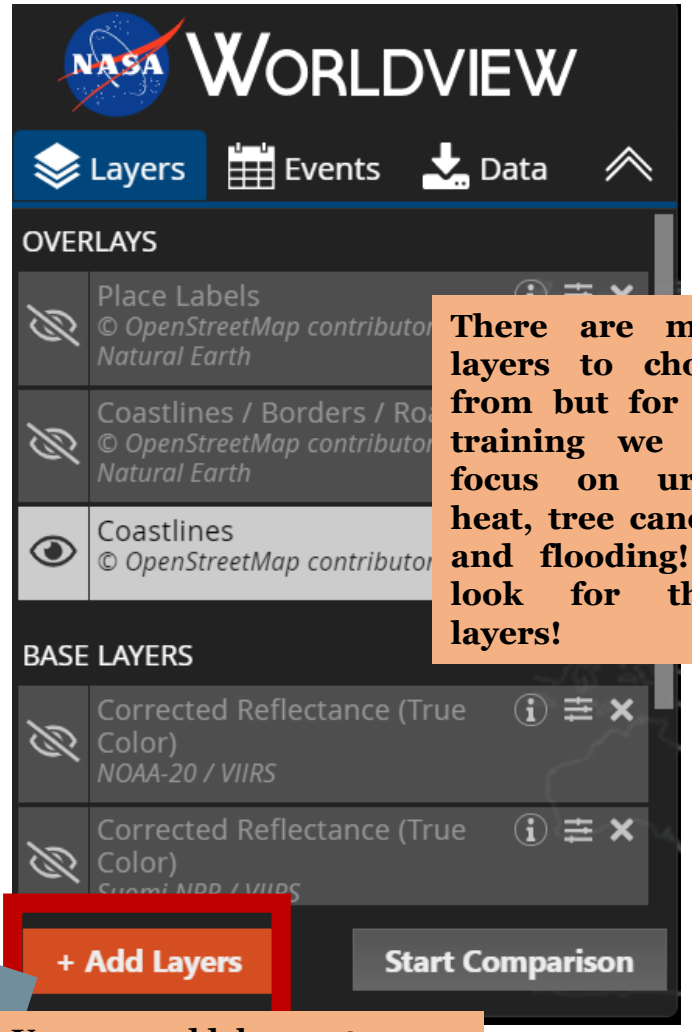
The parts of the map that are in black means the satellite has not orbited at that part of the region yet!



You can control which date you'd like to view on the map! The recorder allows you to record snapshots of images on the map!

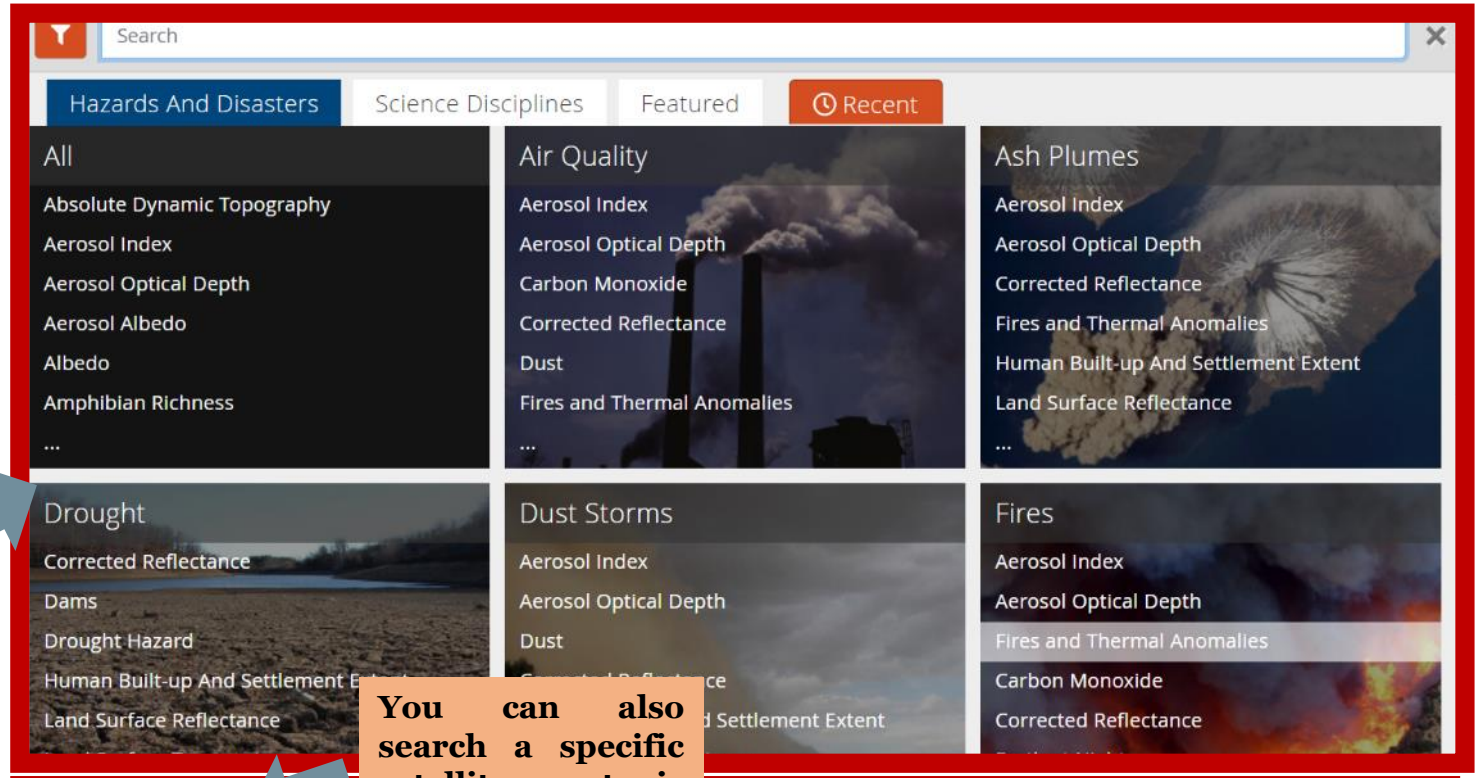
Image Credits: NASA

Satellite Imagery



There are many layers to choose from but for our training we will focus on urban heat, tree canopy, and flooding! So look for those layers!

You can add layers to your map using different satellite filters and using associated satellites when analyzing any of the environmental topics you pick.



You can also search a specific satellite or topic you'd like to map.

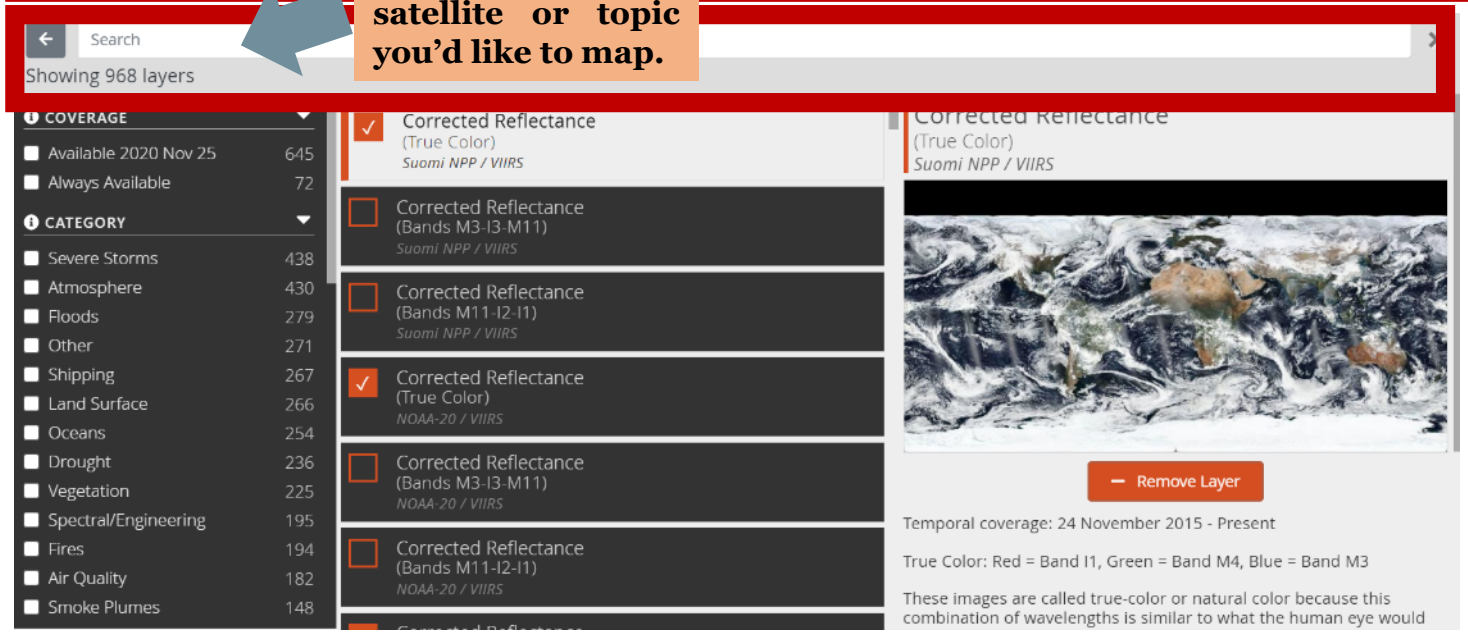


Image Credits: NASA

As an example, I decided to type in the Terra Orbiting Tracker and clicked day. As you can see below, it added a layer where now you have descending day times where the Terra Satellite observed the Earth. If you look closely, each point that the satellite orbited has a time stamp.

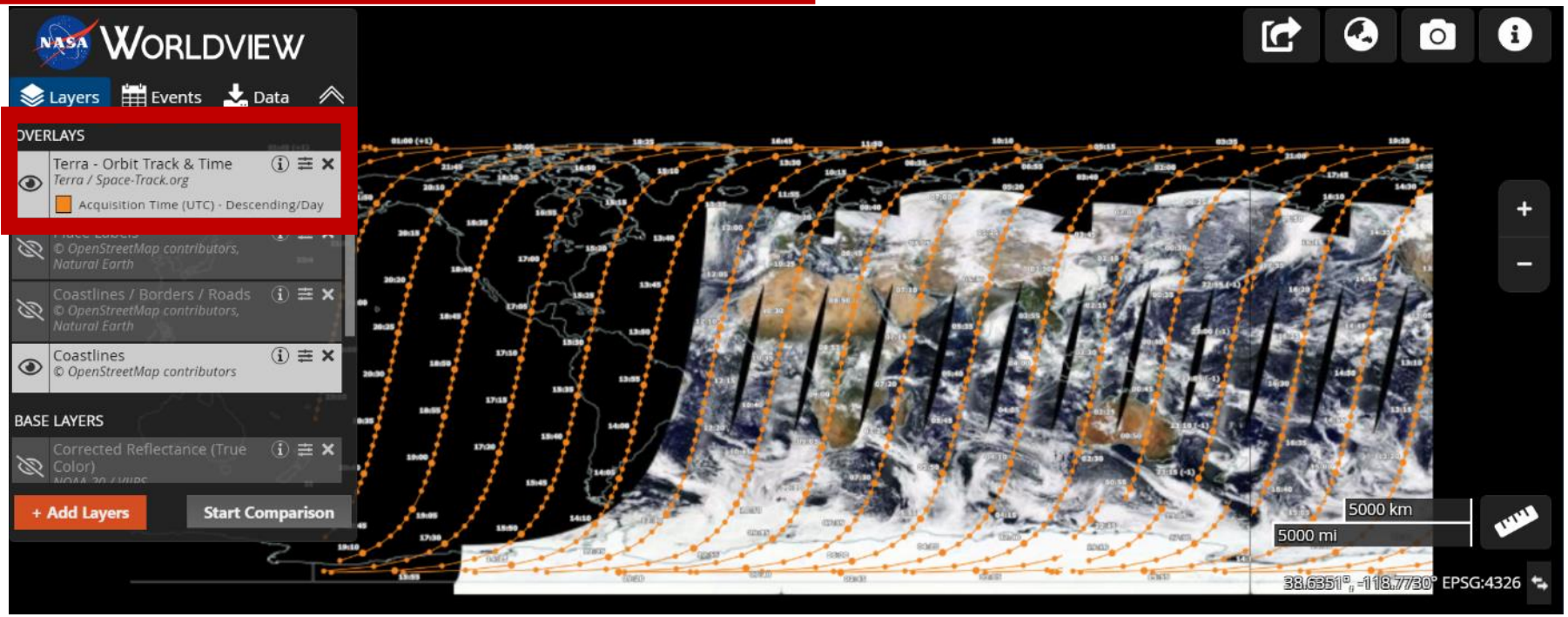
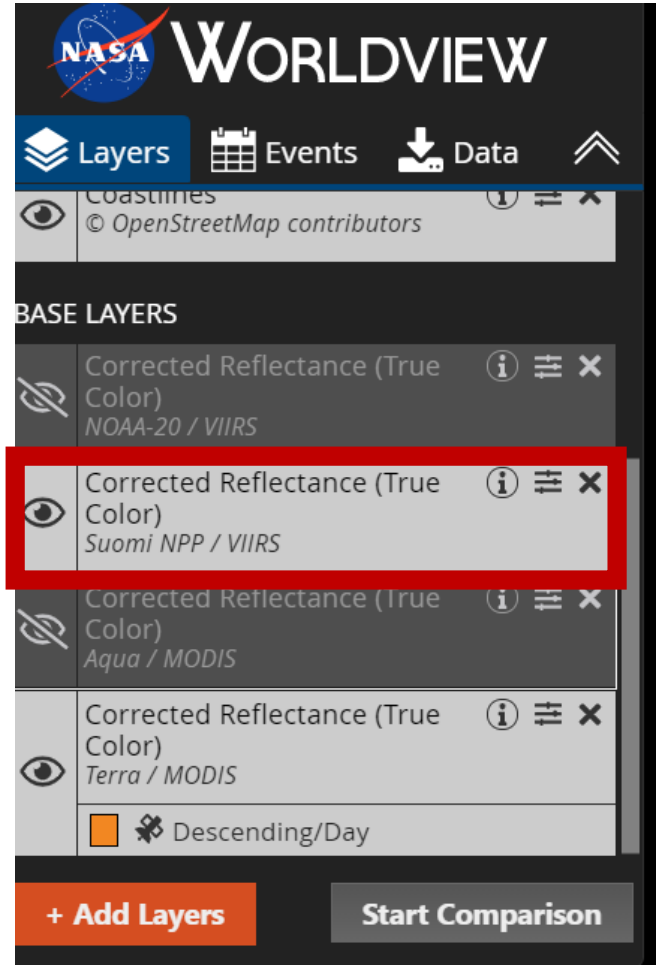
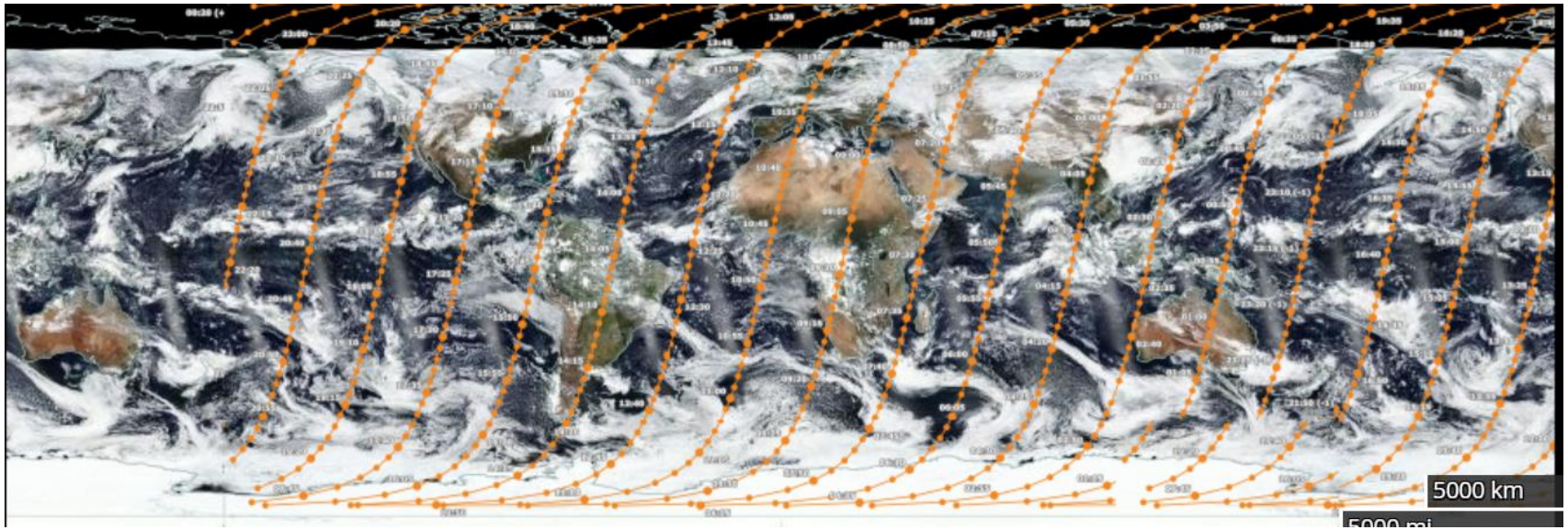


Image Credits: NASA

Satellite Imagery





When I open another layer called, Corrected Reflectance (True Color) for the Suomi NPP/VIIRS satellite, I get a better view with no gaps for the map of the Earth. You may also need to consider the date because if you are trying to analyze current data on the Earth, some satellites have not orbited certain parts of the Earth. You will notice that when the map is covered with the black layers.

Image Credits: NASA

How to know which layer to use?

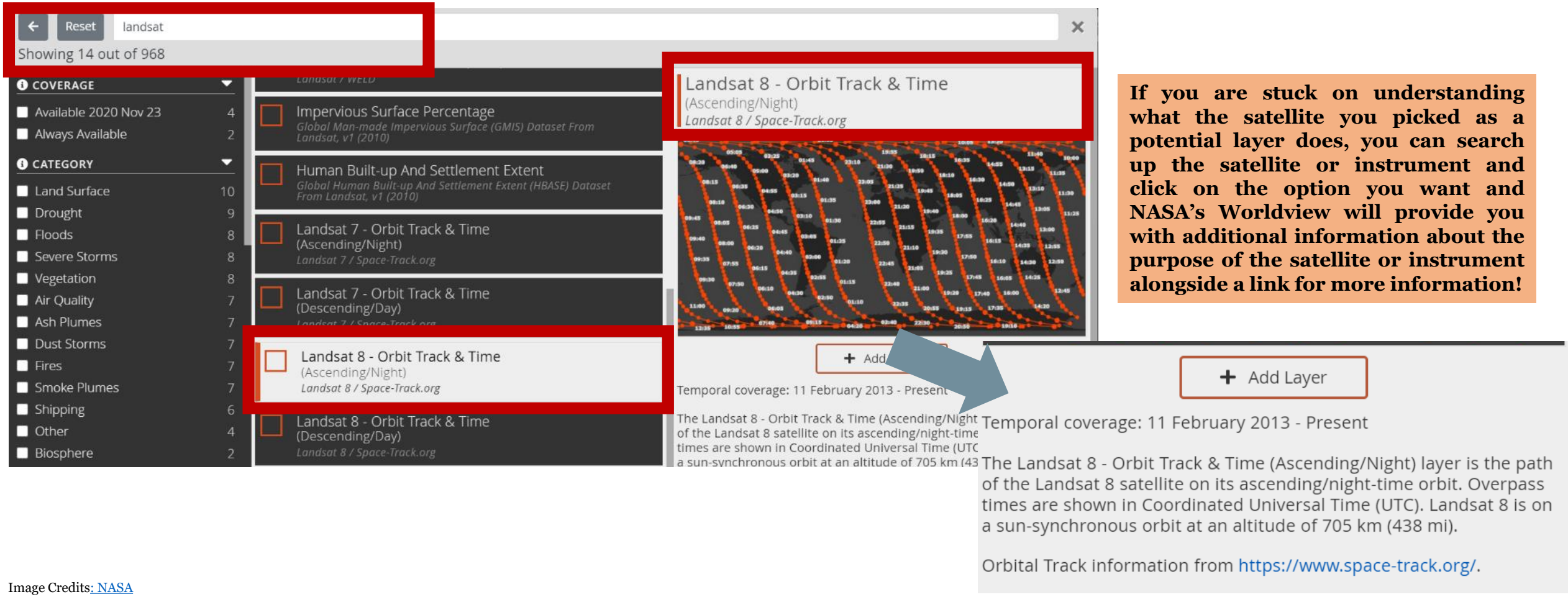
- Knowing which layer to implement may not be as intuitive and requires a little bit of knowledge about current orbiting satellites!

- There are about 16 orbiting satellites that collect data on the Earth:

Aqua	ISS
Aura	Landsat 7/8
CALIPSO	OCO-2
CYGNSS	OSTM/Jason 2
GPM	SMAP
GRACE-FO	Suomi NPP
TERRA	

- The main satellites and instruments we will mostly rely on in collecting data from observations about urban heat, tree canopy and flooding is; **Landsat Satellites and the instrument called MODIS.**
- Landsat 7 and 8 which are currently orbiting Earth and collecting data, provide multispectral data of the Earth's entire surfaces at a resolution as fine as 30m. Each Landsat satellite revisits the same spot on the Earth every 16 days.
- Landsat data helps us to understand trends and change around the globe and is one of the best resources for those working at the community level all the way to the global scale.
- MODIS datasets are some of the most widely used as they provide daily measurements of the entire globe. However, while their temporal resolution is fine, their spatial resolution is coarse ranging between 250m to 1km depending on the data product.
- Like Landsat, MODIS can collect information on urban areas and is a popular source for retrieving data on surface temperatures and more!

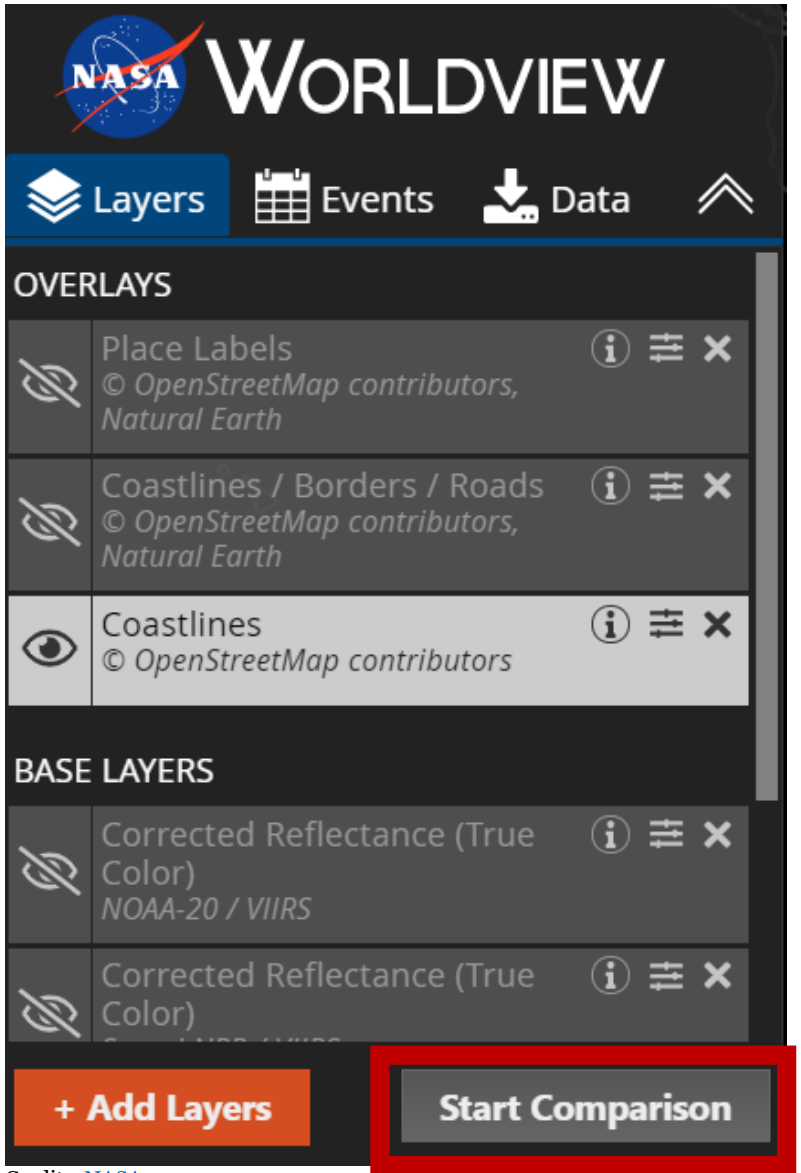
Retrieving more information about Satellites through NASA's Worldview

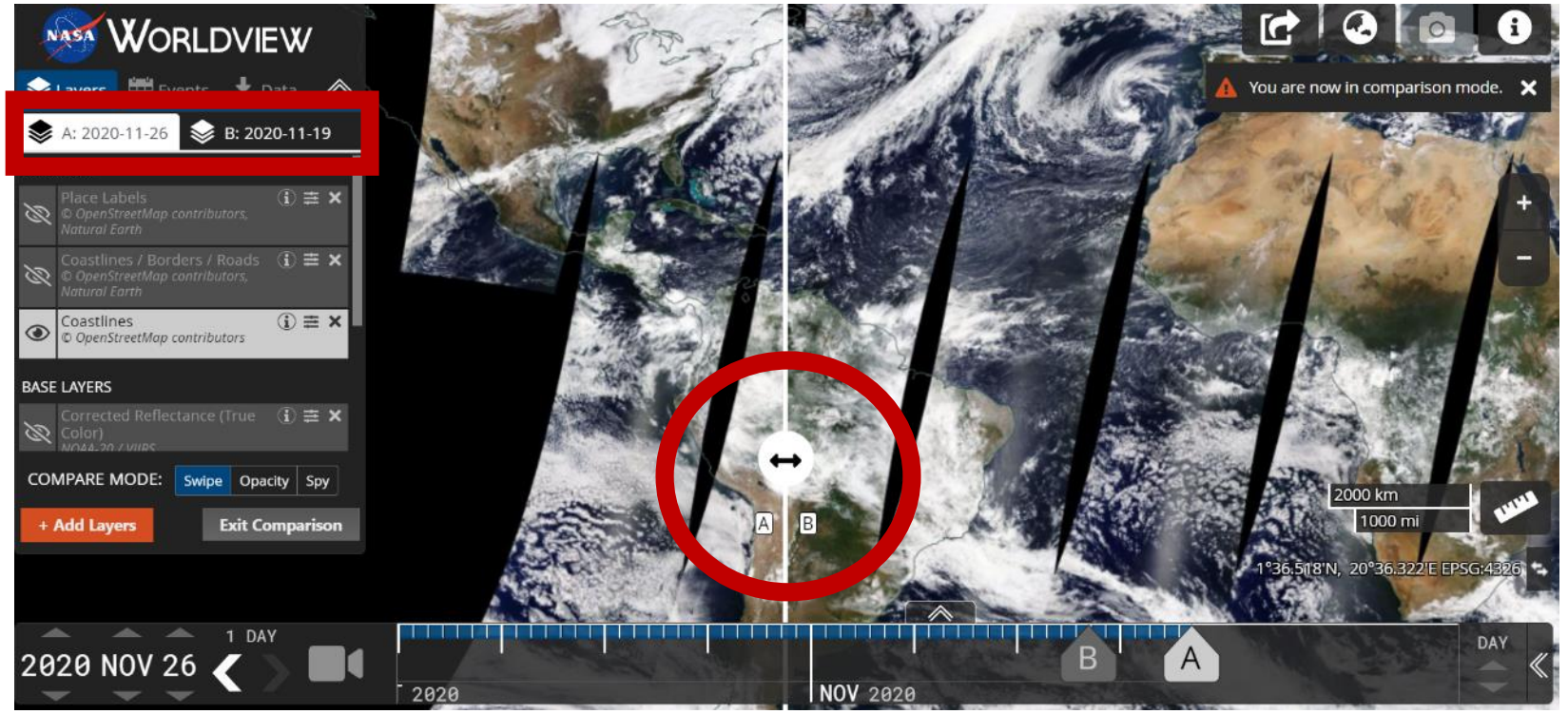


If you are stuck on understanding what the satellite you picked as a potential layer does, you can search up the satellite or instrument and click on the option you want and NASA's Worldview will provide you with additional information about the purpose of the satellite or instrument alongside a link for more information!

Image Credits: NASA

Application 1: Urban Heat/Land Surface Temperature Mapping

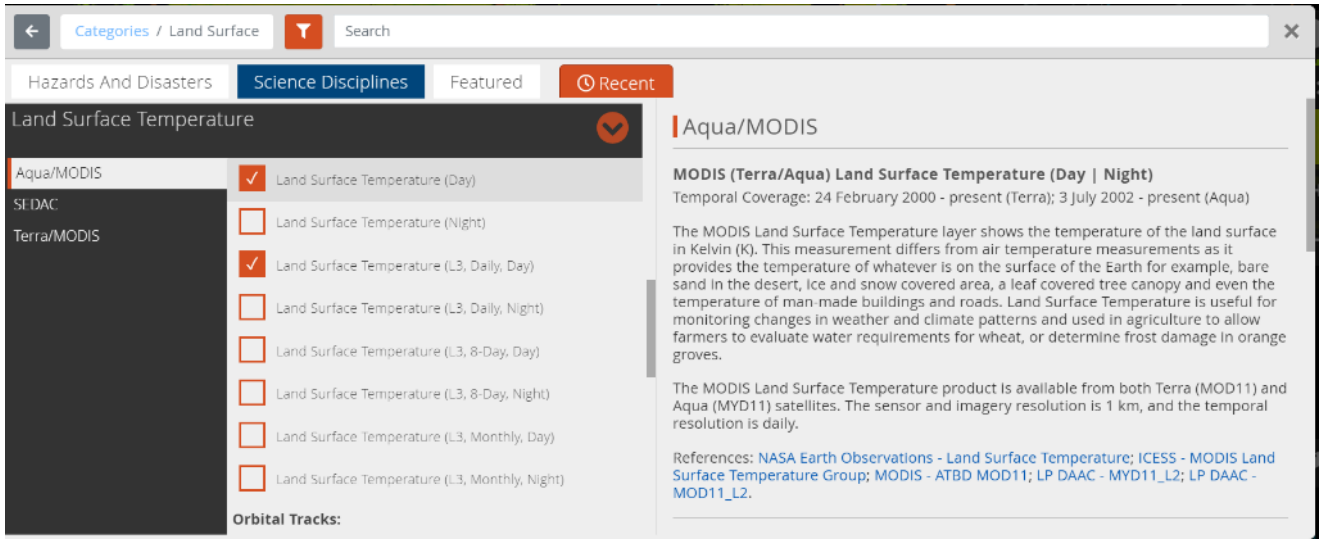


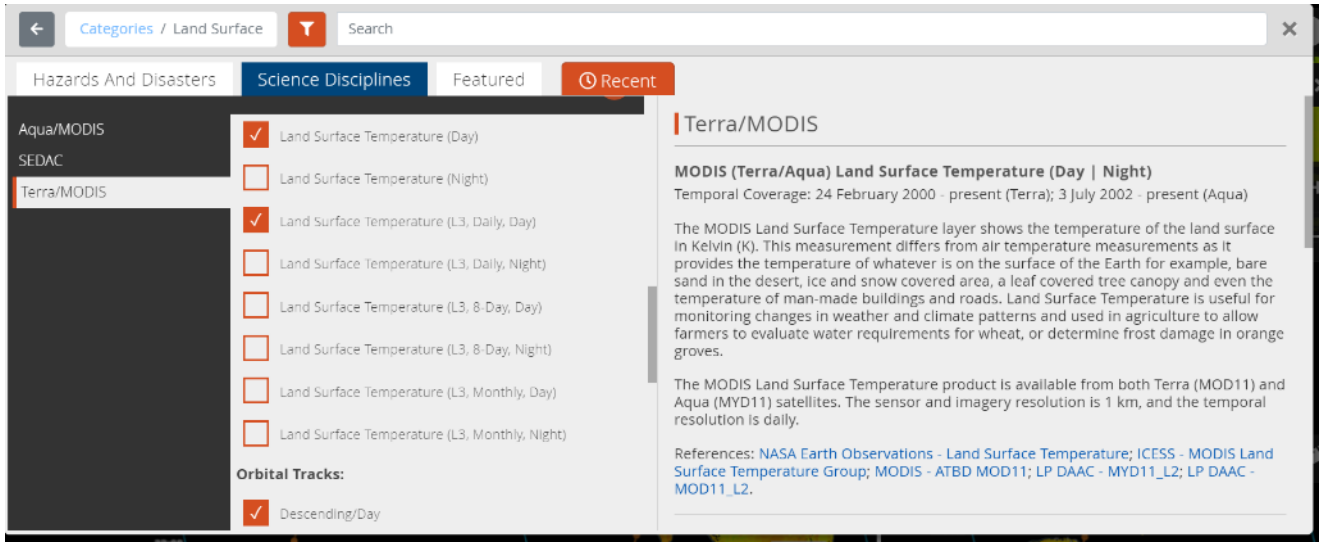


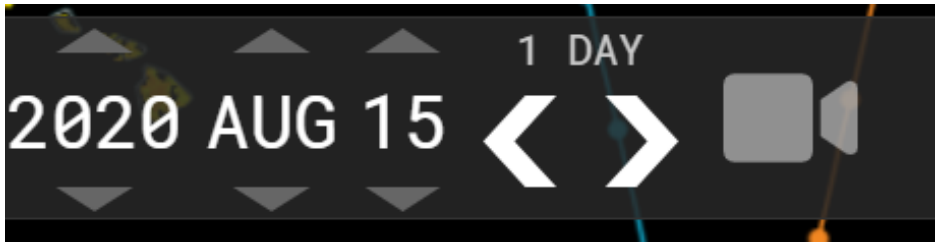
For our first application, we will start by using the comparison tool in order to compare one date set to another. In this comparison mode, we will search for the Urban Heat layer dataset of summer 2013 and compare that data with summer of 2020 to see what surface changes have occurred.

Image Credits: NASA

Application 1: Urban Heat/Land Surface Temperature Mapping







For comparison A, we will switch the dates to the year 2013 and for comparison B to the year 2020. Both will have the same day and month as well as the satellite layers we pick will be under land surface temperature, pick Aqua and Terra Modis. Both comparisons should have the same layers, day, and month but different years!

Image Credits: NASA

Application 1: Urban Heat/Land Surface Temperature Mapping

Make sure all of your open layers are on and base layers turned off and the map below is land surface temperature data for comparison A. August 15th, 2013.

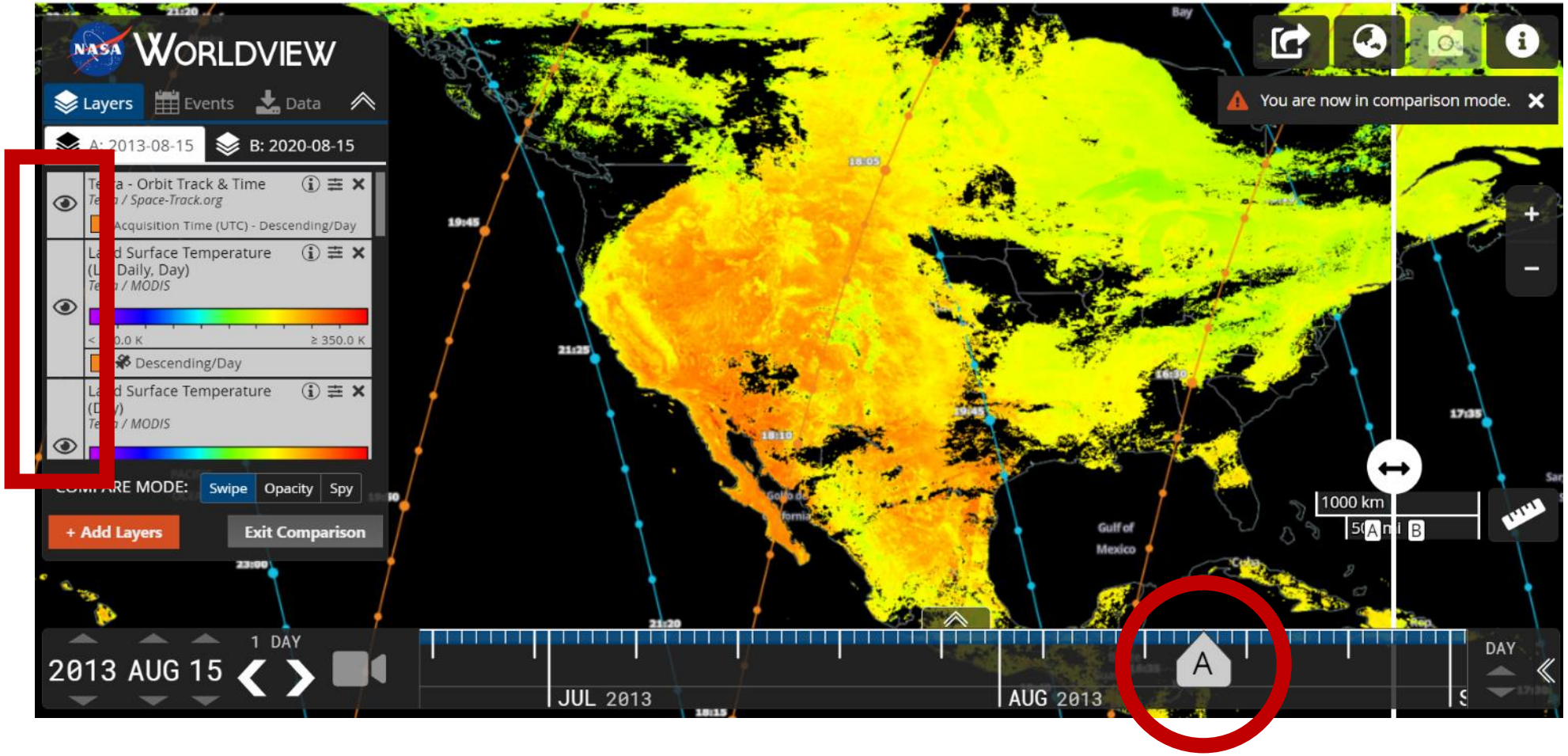


Image Credits: NASA

Application 1: Urban Heat/Land Surface Temperature Mapping

Make sure all of your open layers are on and base layers turned off and the map below is land surface temperature data for comparison B. August 15th, 2020.

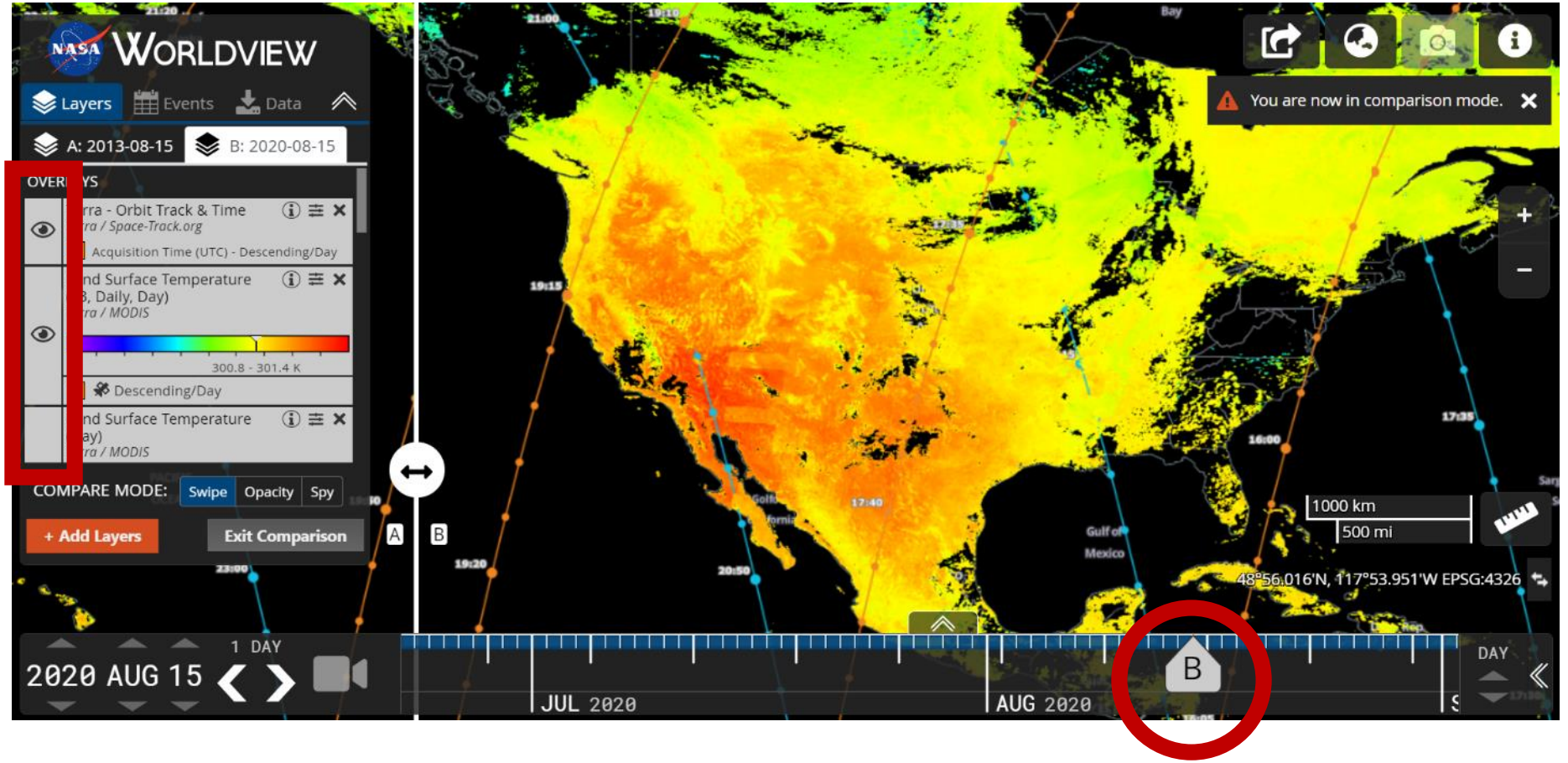
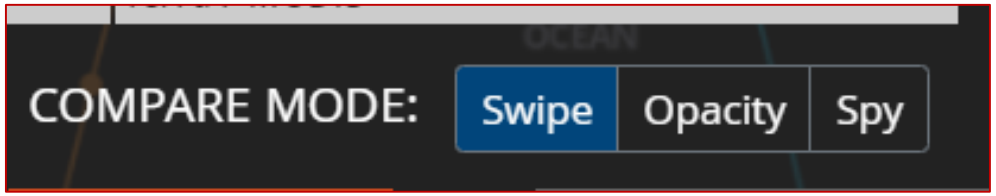


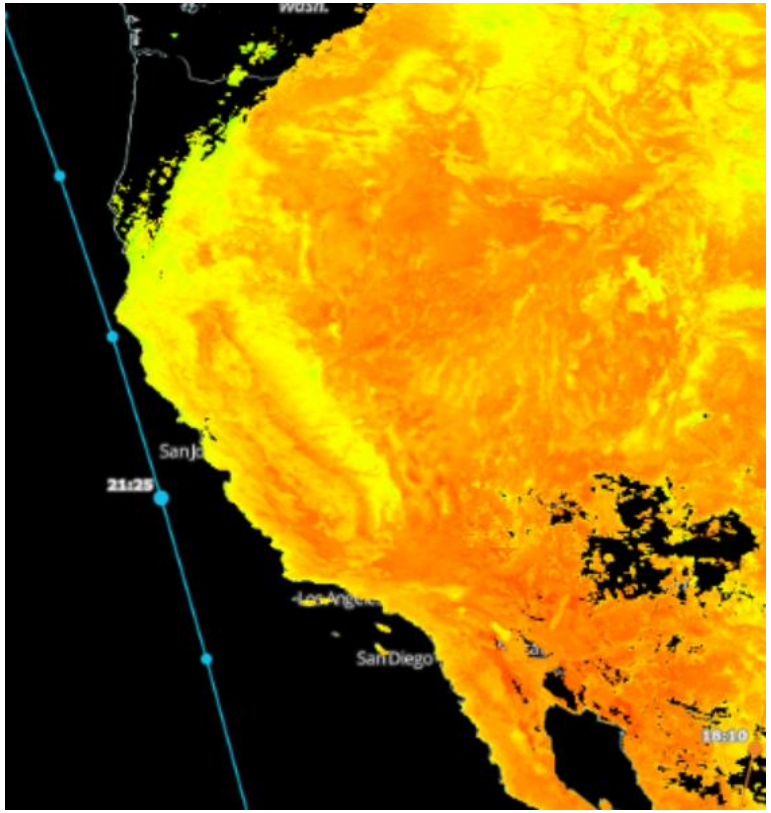
Image Credits: NASA

Application 1: Urban Heat/Land Surface Temperature Mapping

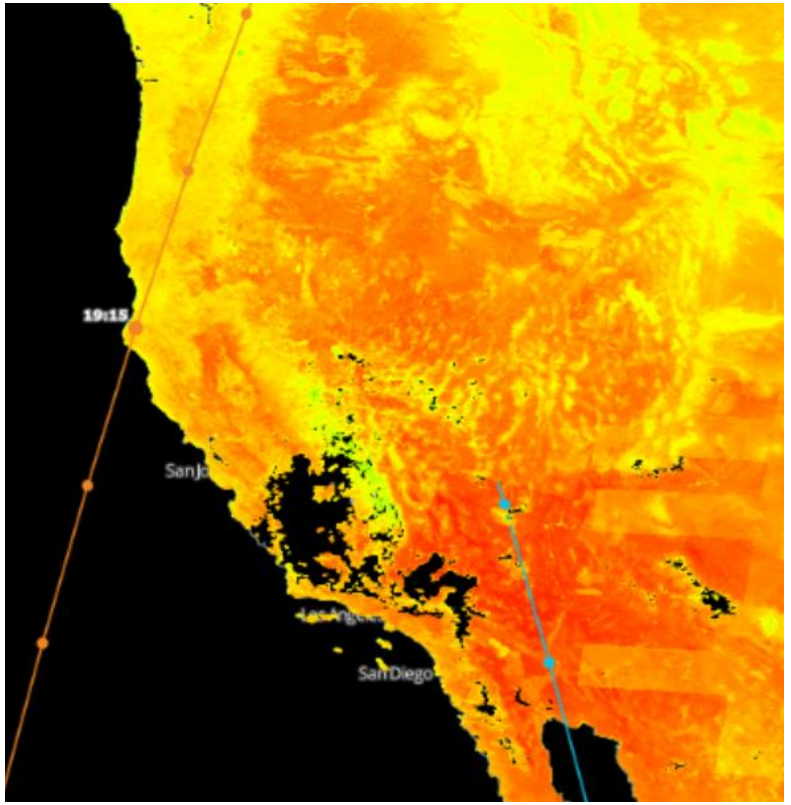


Go through all the compare mode options to see what trends you may notice in land temperature. I recommend using opacity to slowly see the changes occurring on the west coast of the United States.

2013, Aug 15th



2020, Aug 15th



What are some changes do you see occurring between the year 2013 to 2020?

Did land temperatures increase? If yes, think about how you can describe these changes by looking at this map!

Image Credits: NASA

Application 1: Urban Heat/Land Surface Temperature Mapping

Try and locate your city on this map and see what land surface temperature trends you notice between 2013 and 2020!

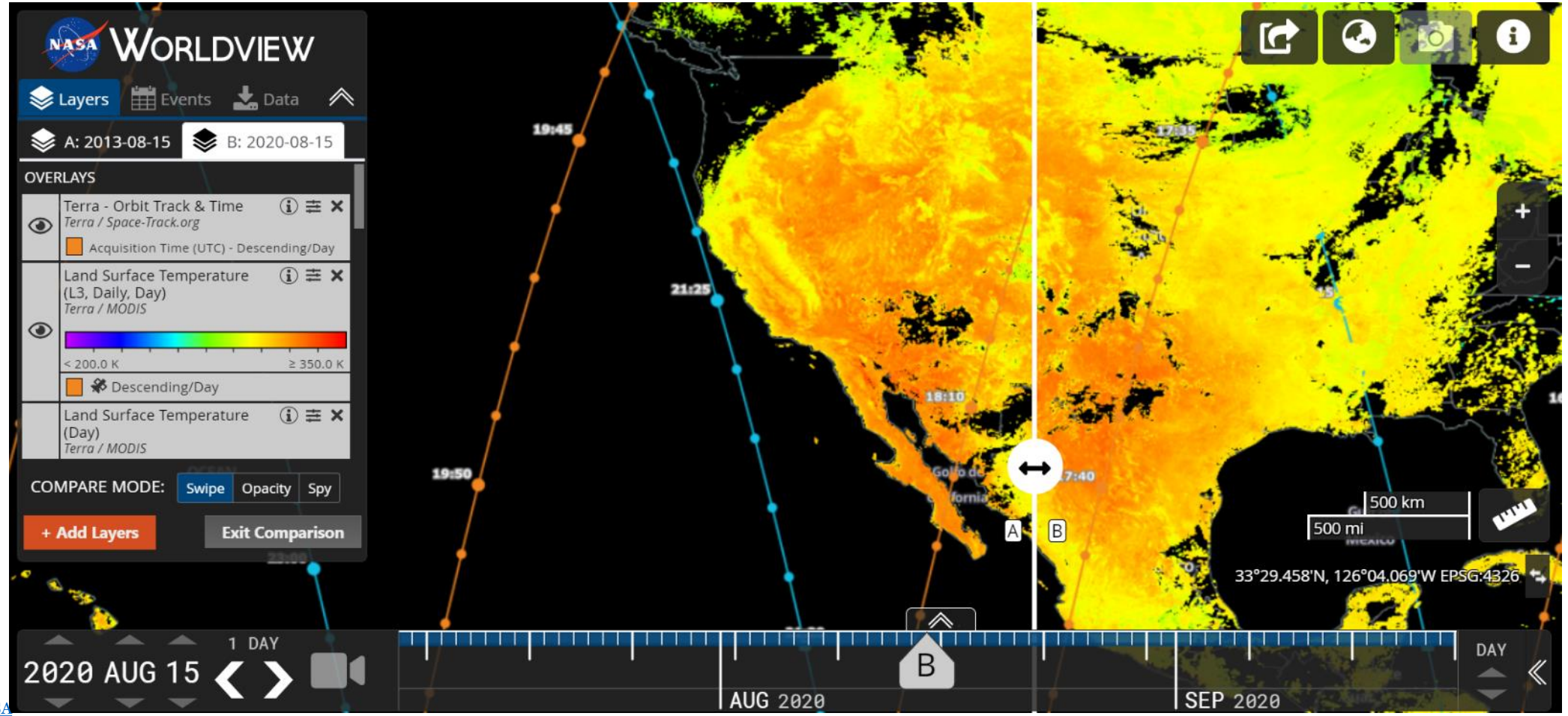
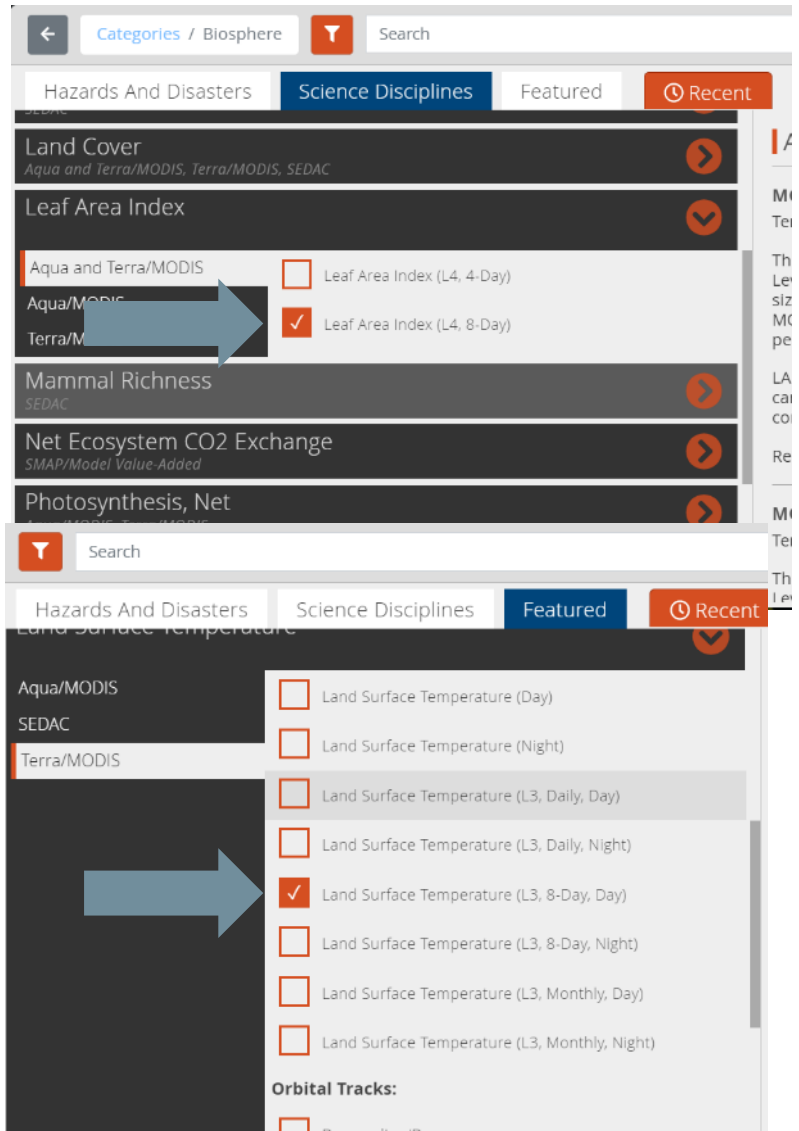
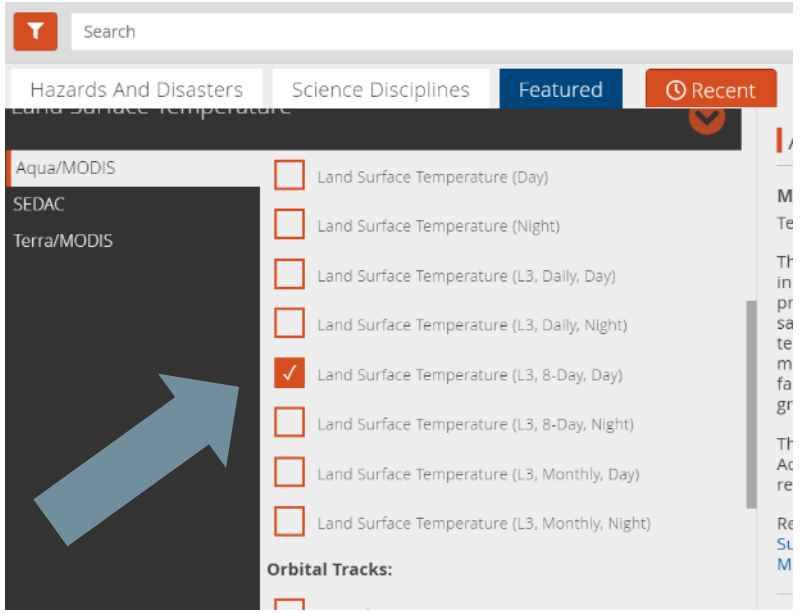


Image Credits: NASA

Application 2: Urban Canopy Mapping





In application 2, we will focus on Urban Canopy. You will need to create another comparison and for both A and B, we will start by adding the Land Cover layer>Leaf Area Index>Land Surface Temperature> the date A will start 06/15/2019 and B will end at 12/15/2019.

Image Credits: NASA

Application 2: Urban Canopy Mapping

Make sure all of your open layers are on and base layers and the map below is leaf area index and land surface temperature data for comparison A. June 15th, 2019.

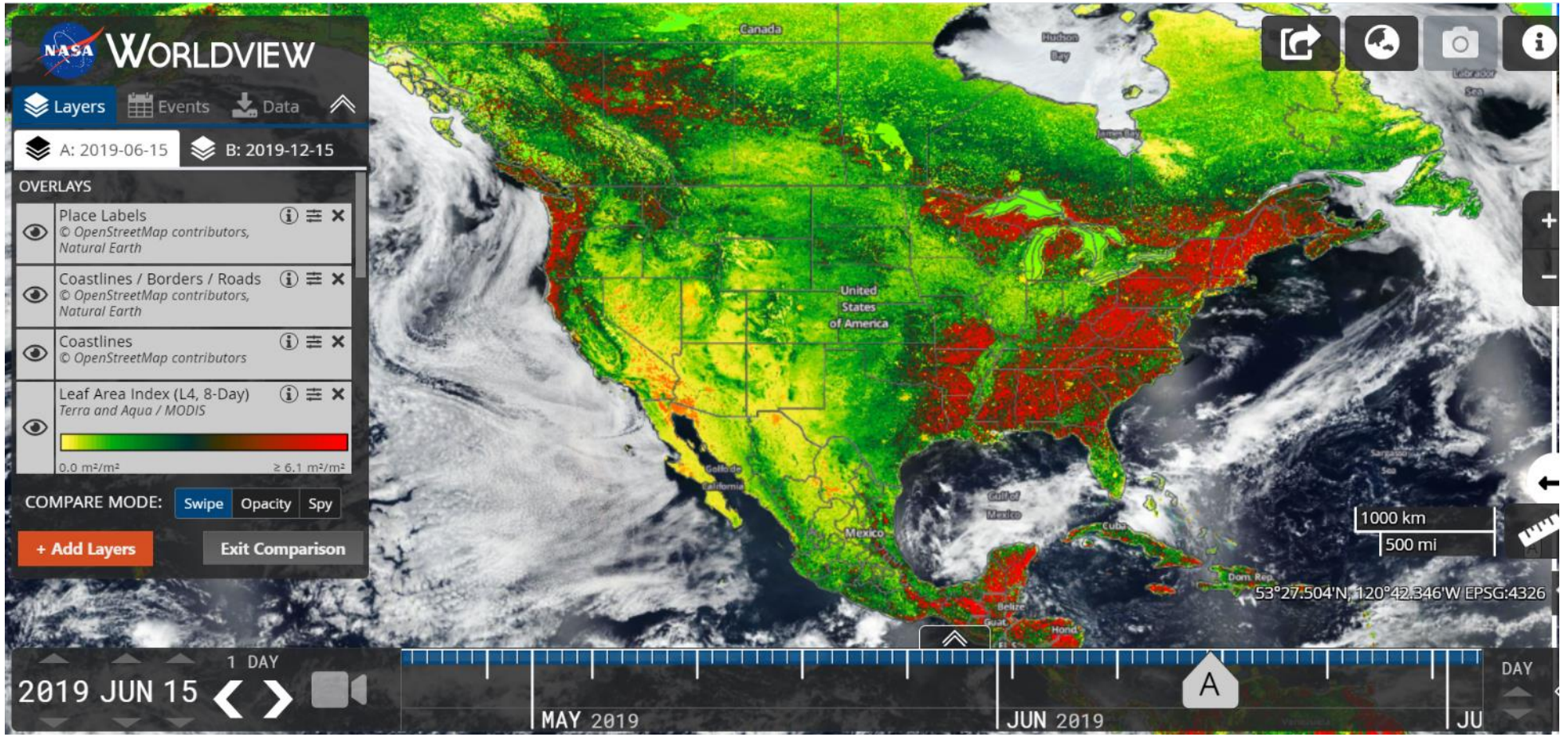


Image Credits: NASA

Application 2: Urban Canopy Mapping

Make sure all of your open layers are on and base layers and the map below is leaf area index and land surface temperature data for comparison B. December 15th, 2019.

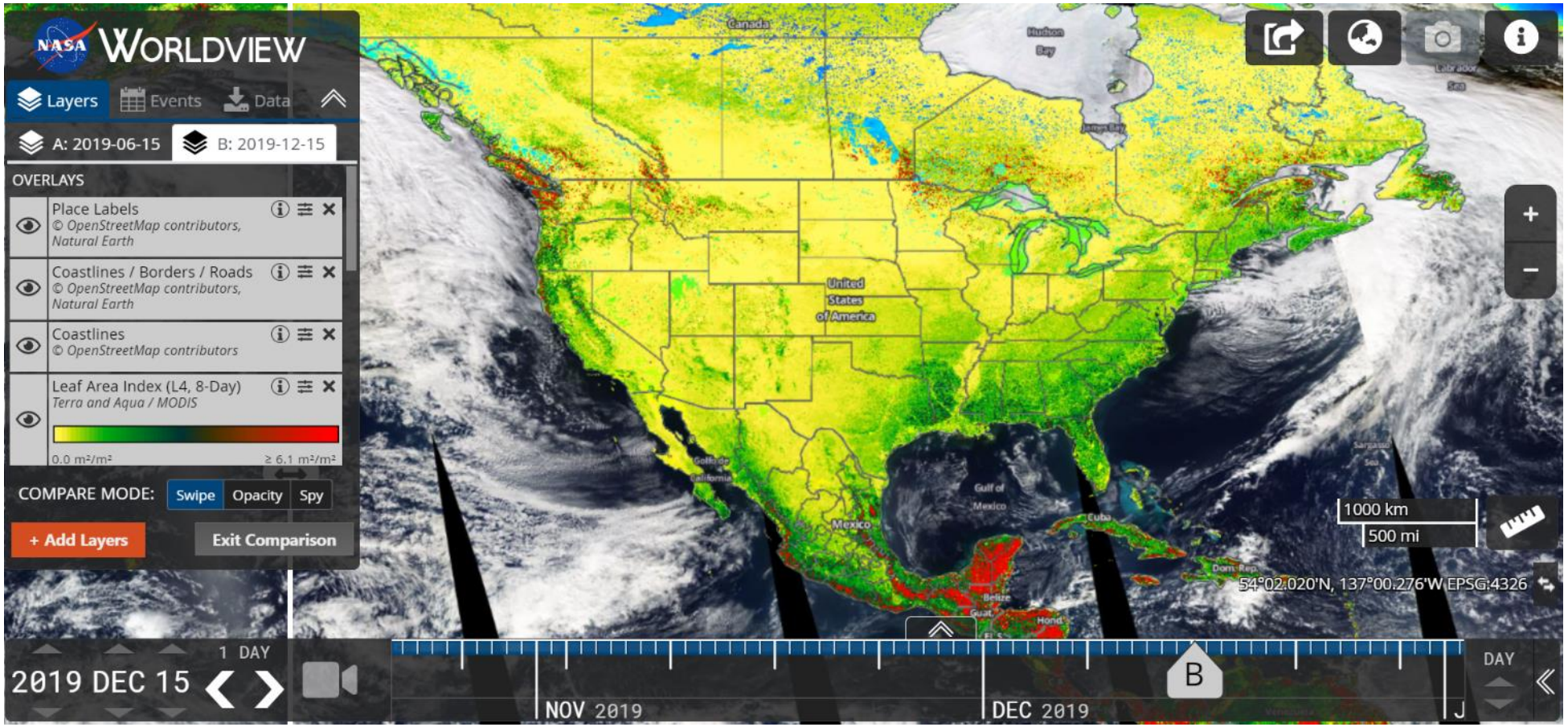
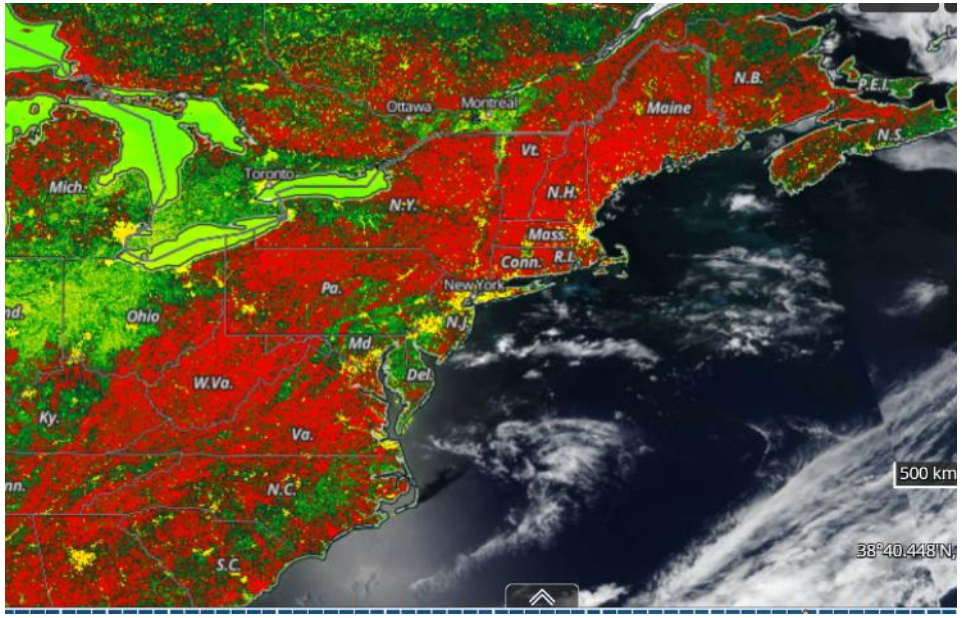


Image Credits: NASA

Application 2: Urban Canopy Mapping

Go through all the compare mode options to see what trends you may notice in leaf area index and land temperature. I recommend using opacity to slowly see the changes occurring on the east coast of the United States.

2019, June 15th



2019, Dec 15th

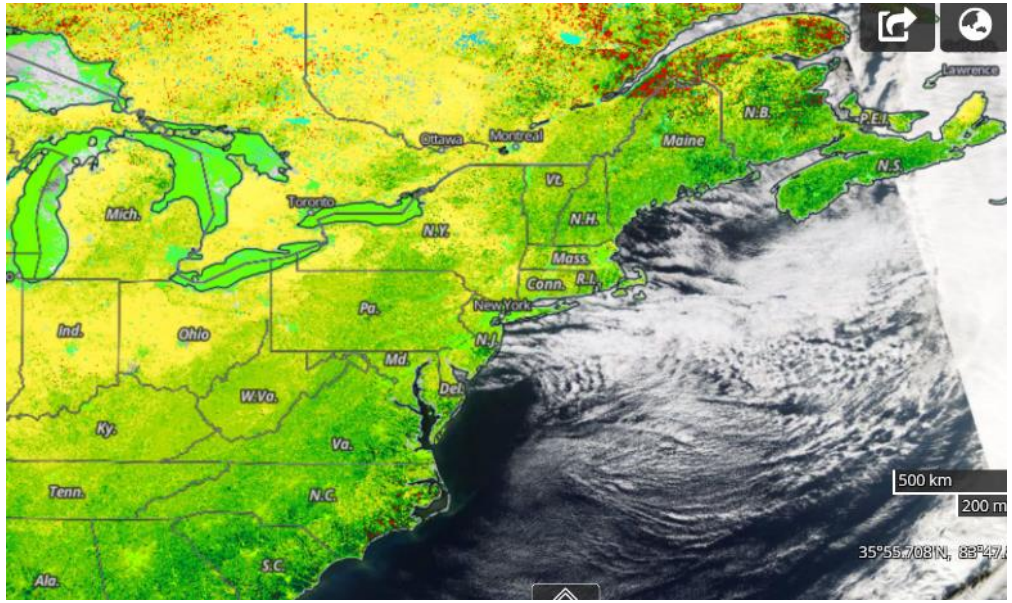


Image Credits: NASA

Application 2: Urban Canopy Mapping

Try and locate your city on this map and see what land surface temperature and leaf area index trends you notice between June and December of 2019!

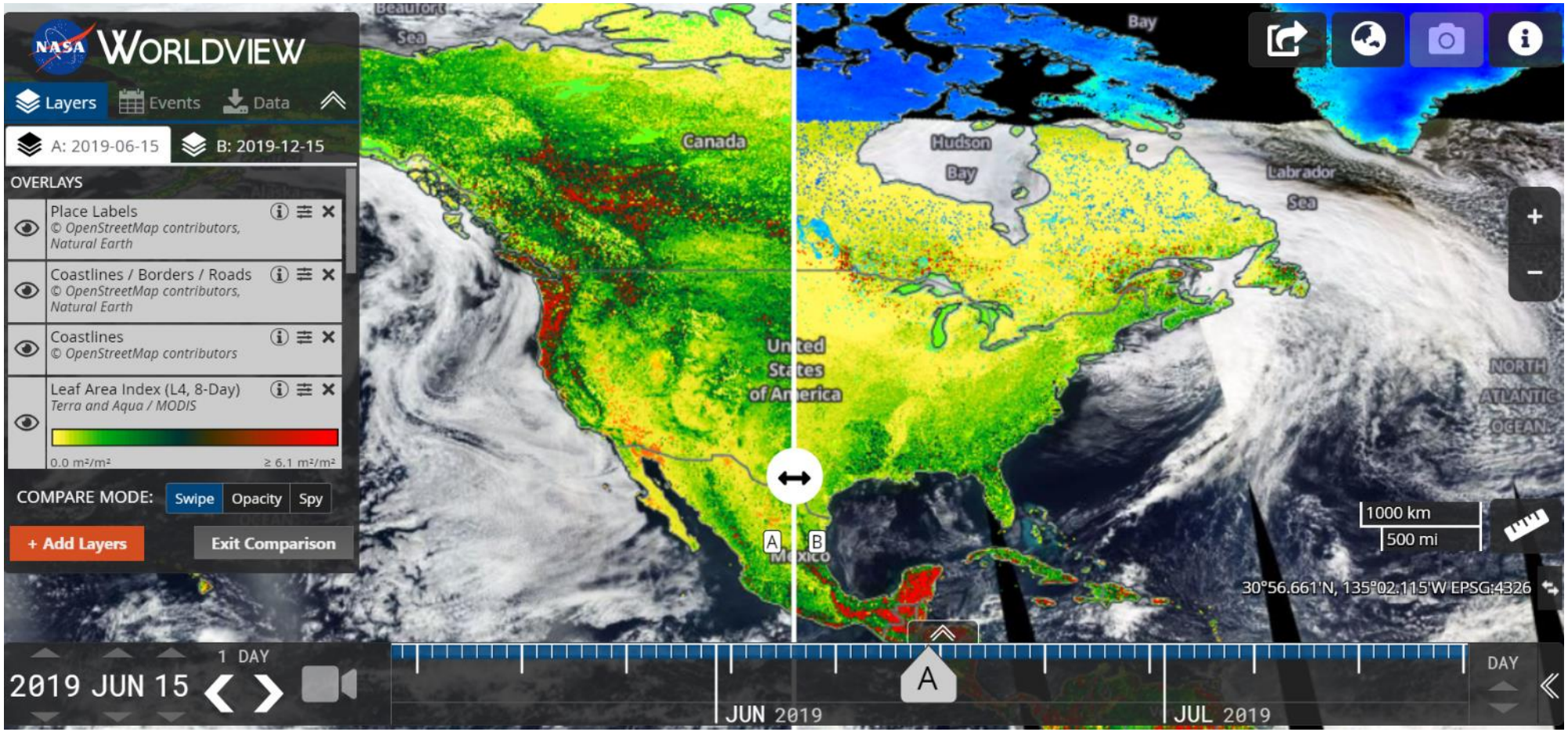


Image Credits: NASA

Application 3: Urban Flooding Mapping

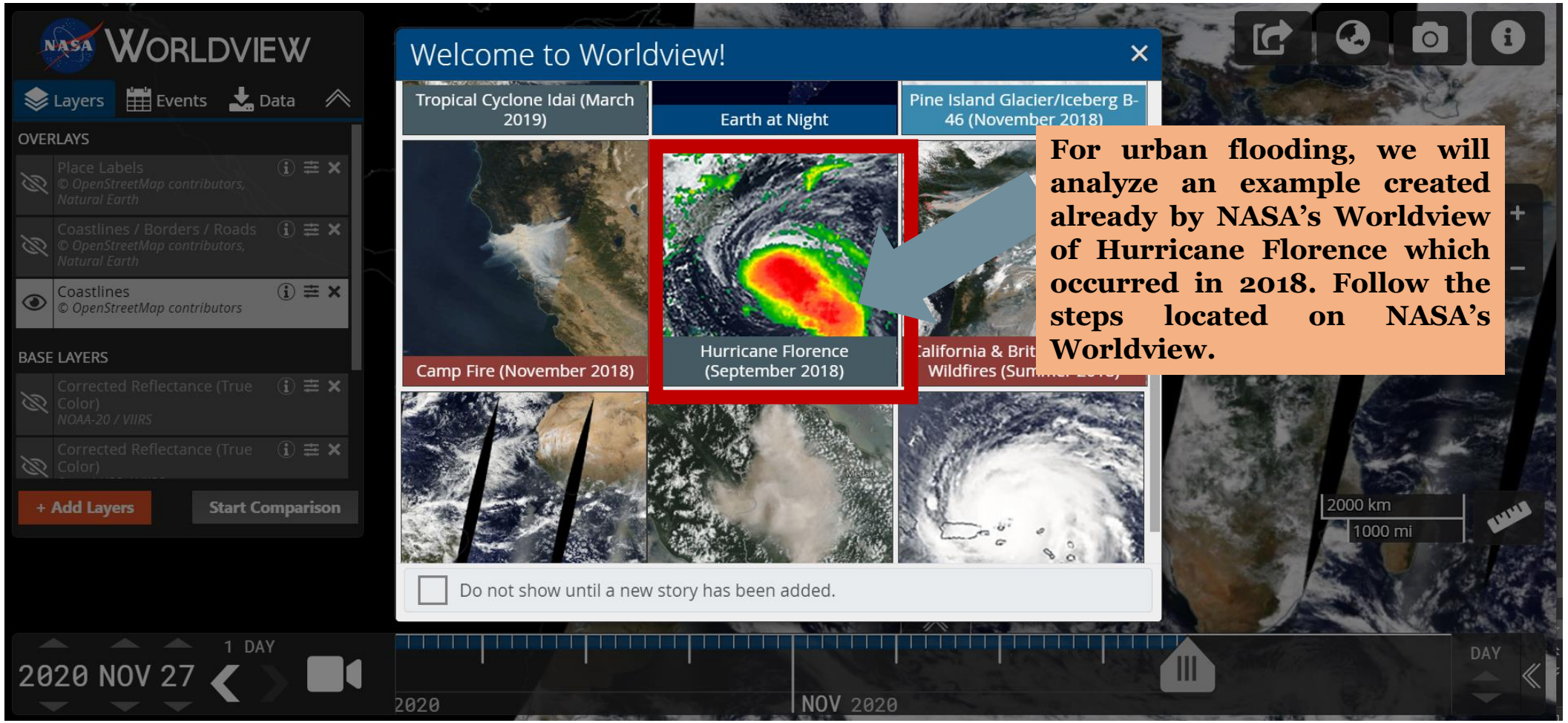


Image Credits: NASA

Application 3: Urban Flooding Mapping

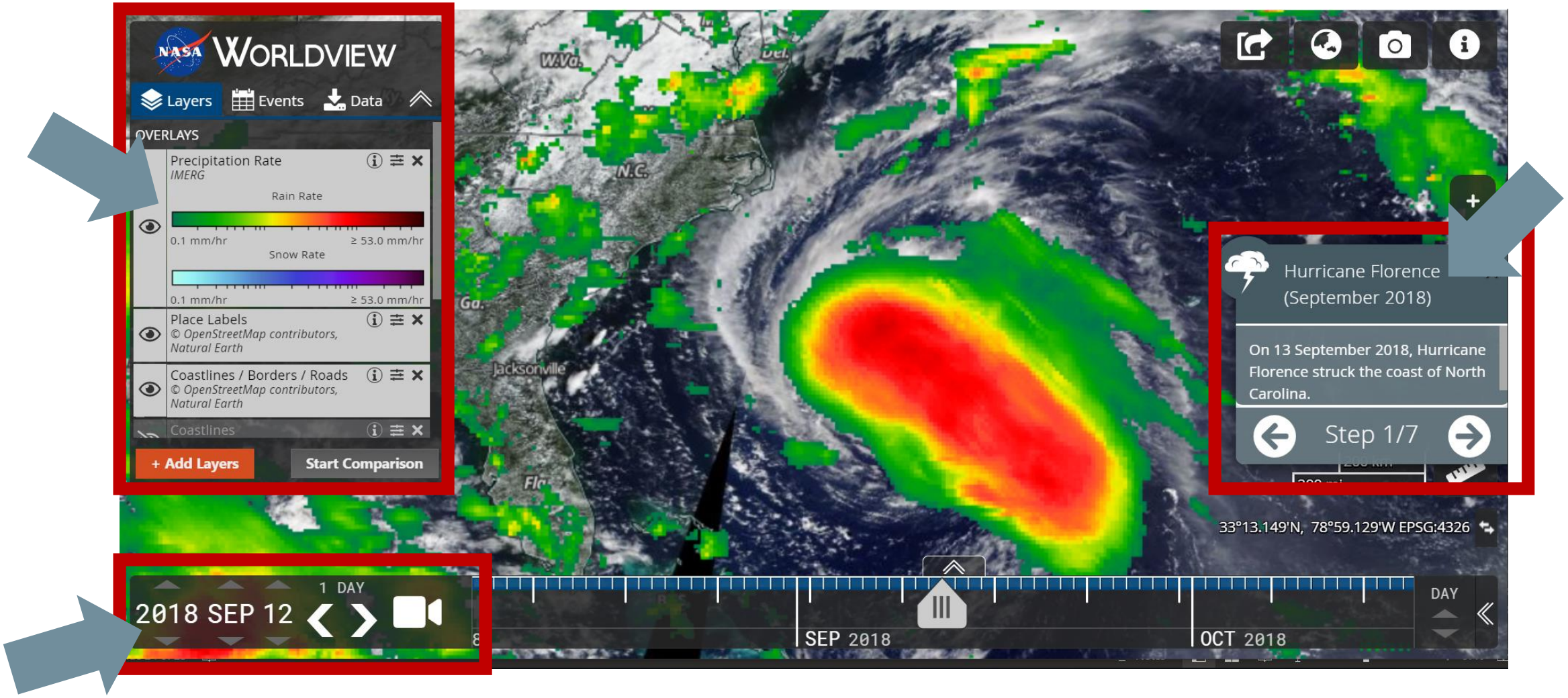


Image Credits: NASA

Application 3: Urban Flooding Mapping

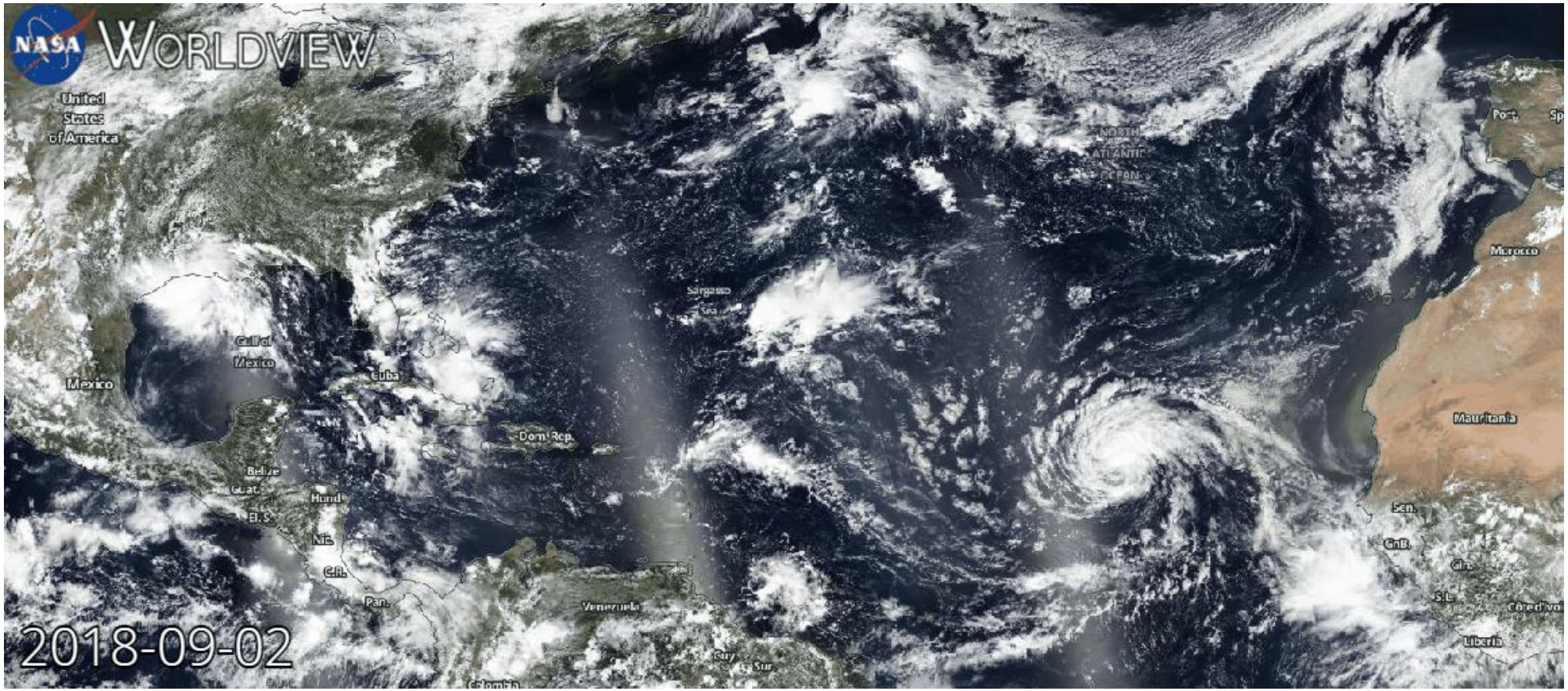
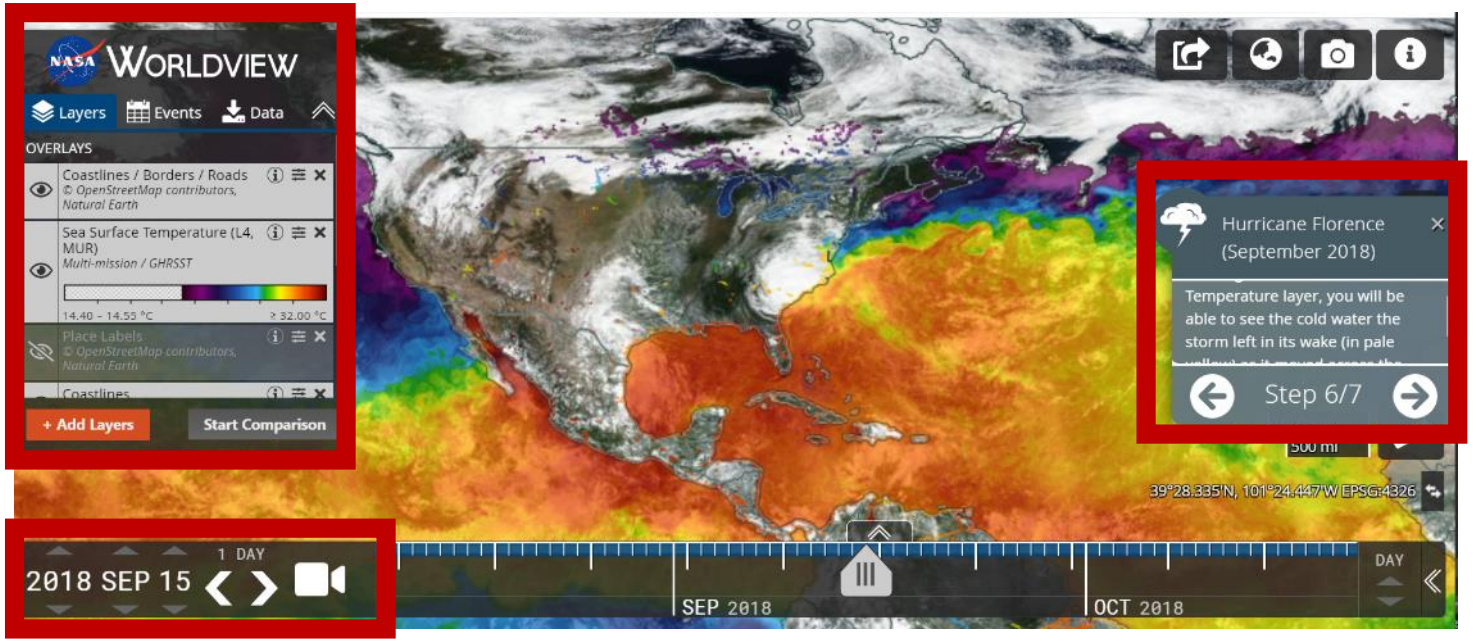


Image Credits: NASA

Application 3: Urban Flooding Mapping



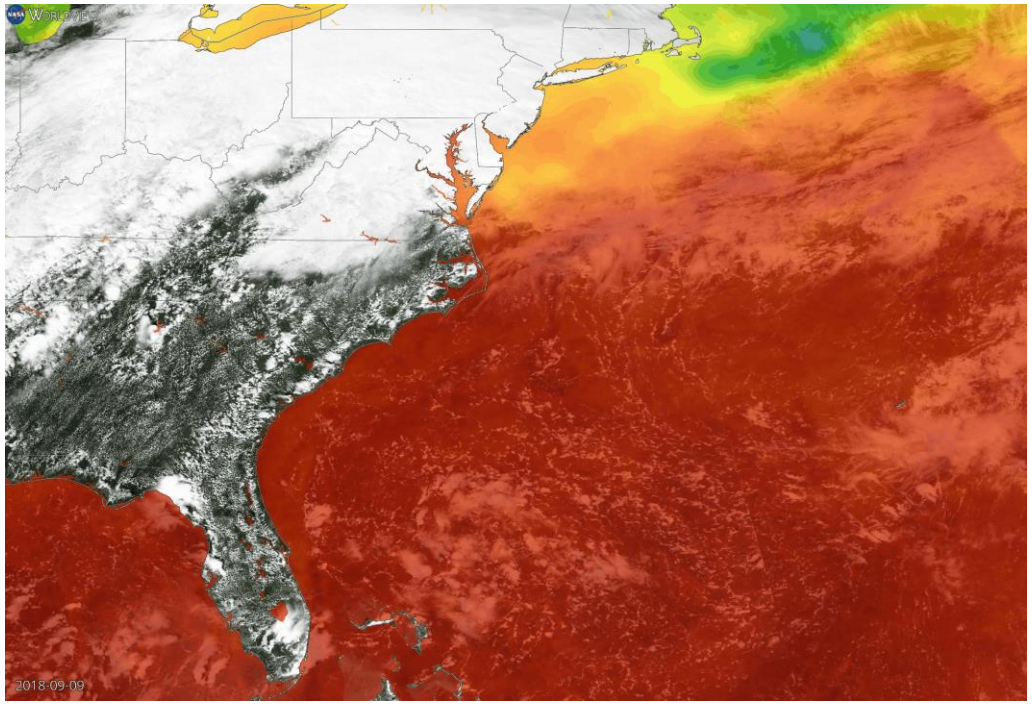


Image Credits: NASA

Application 3: Urban Flooding Mapping

2020 Atlantic hurricane season

Mon, Jun 1, 2020 – Mon, Nov 30, 2020

The 2020 Atlantic hurricane season is the most active Atlantic hurricane season on record. A total of 31 tropical and subtropical depressions, 30 named storms, 13 hurricanes, and 6 major hurricanes have formed throughout the season. Wikipedia

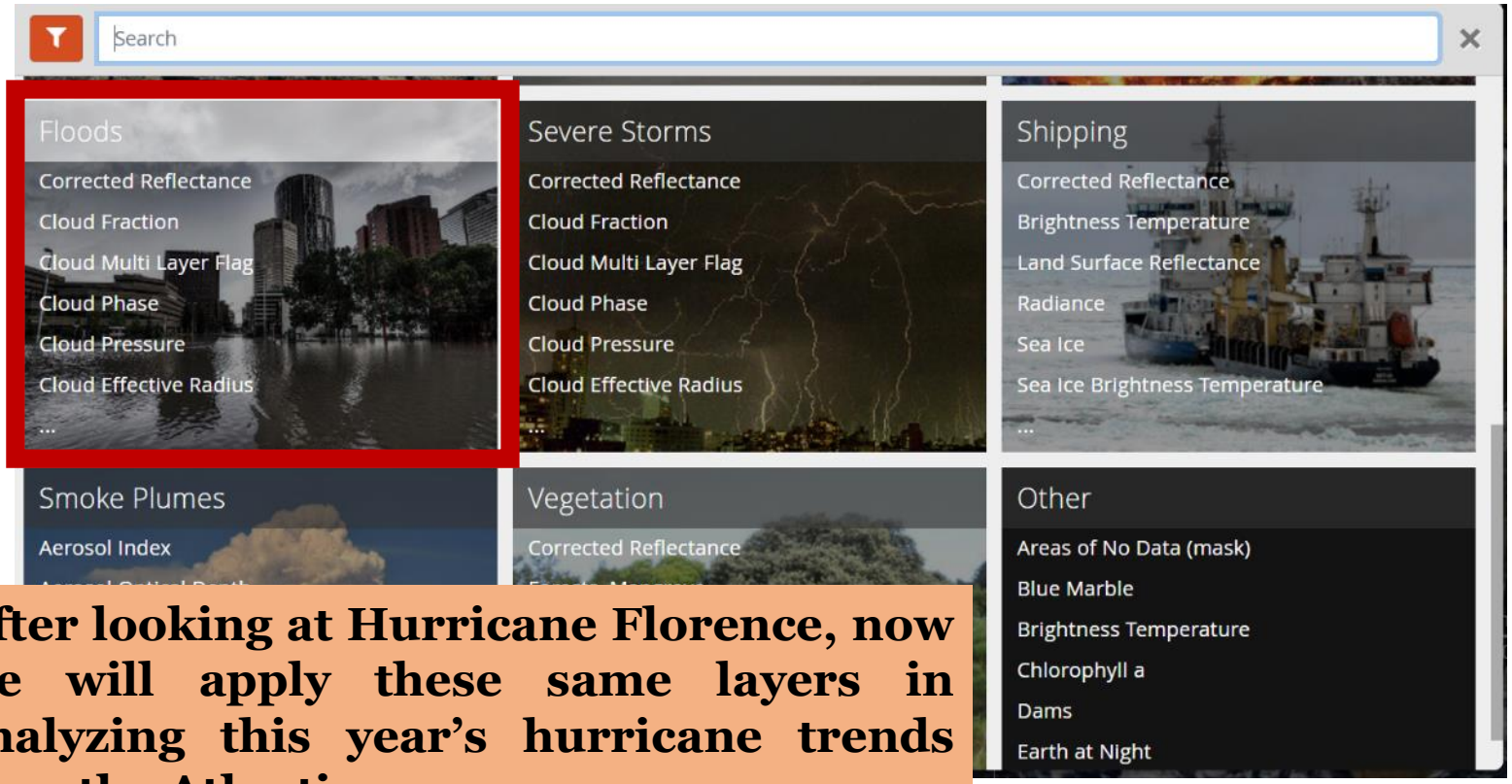
Dates: Mon, Jun 1, 2020 – Mon, Nov 30, 2020

Location: Atlantic Ocean

Total storms: 28 (record high, tied with 2005)

Last system dissipated: Season ongoing

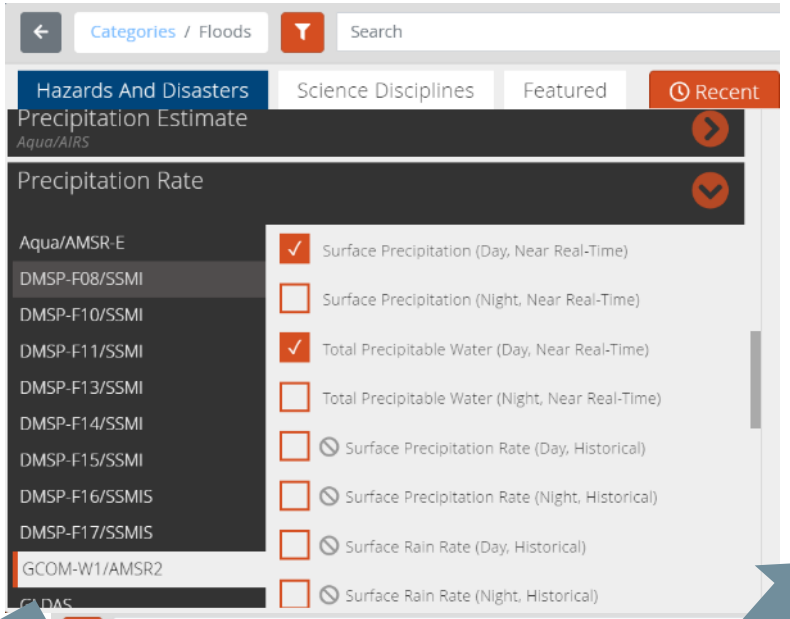
First system formed: May 16, 2020

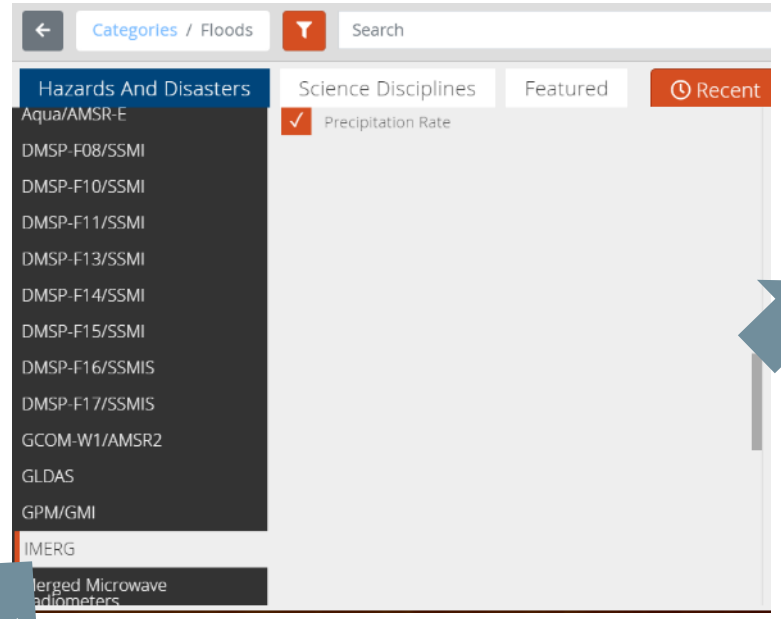


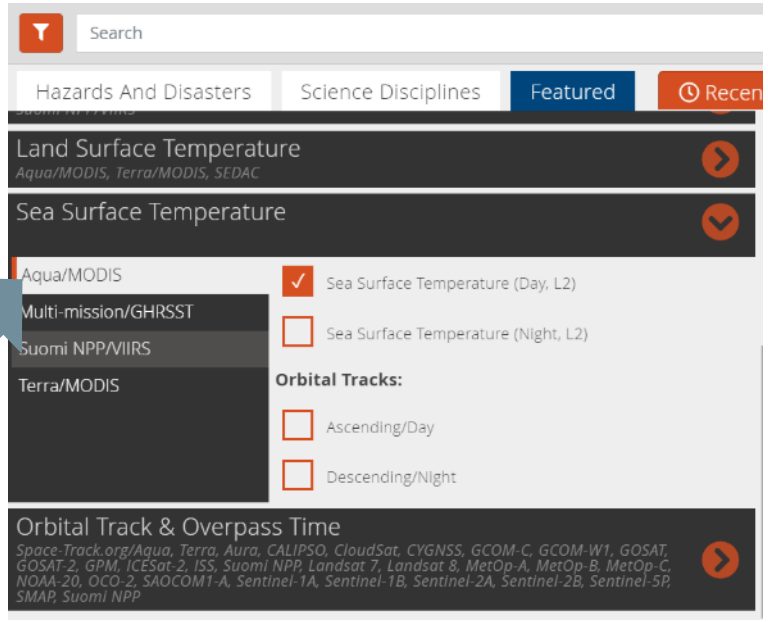
After looking at Hurricane Florence, now we will apply these same layers in analyzing this year's hurricane trends near the Atlantic oceans.

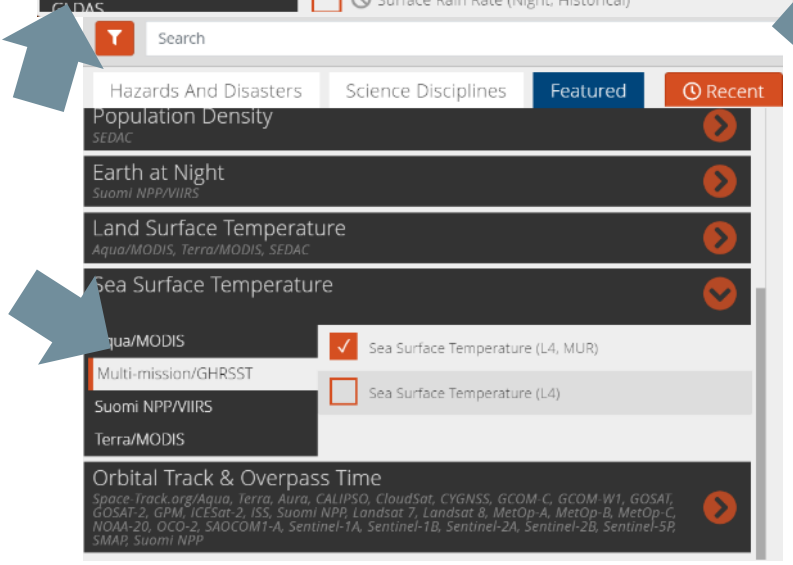
Image Credits: NASA

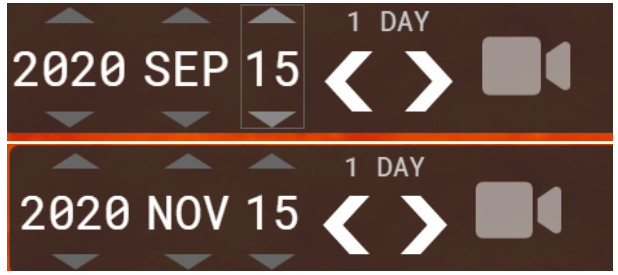
Application 3: Urban Flooding Mapping











We will create another comparison model of A and B where visual A set date is 09/15/2020 and visual B is set at 11/15/2020. These dates highlight time frames in which the hurricane season is very active for the East coast/Atlantic ocean. Click these filters/layers for both A and B just make sure the dates are set differently.

Image Credits: NASA

Application 3: Urban Flooding Mapping

Make sure all of your open layers are on and for the base layers, just turn on Corrected Reflectance (True Color) and you will see precipitation trends, land sea surface trends and other layers in the map below for comparison A. September 15th, 2020.

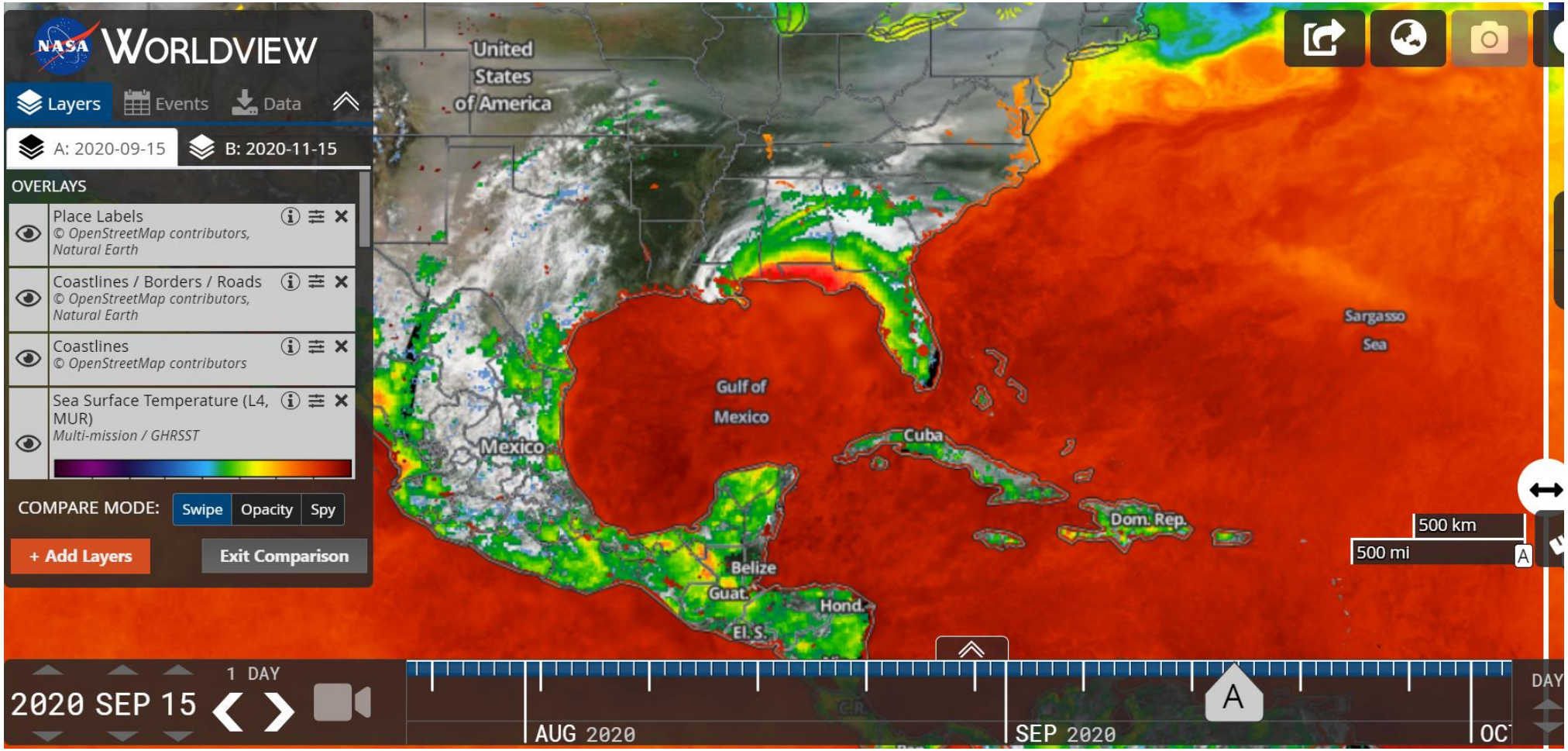


Image Credits: NASA

Application 3: Urban Flooding Mapping

Make sure all of your open layers are on and for the base layers, just turn on Corrected Reflectance (True Color) and you will see precipitation trends, land sea surface trends and other layers in the map below for comparison B. November 15th, 2020.

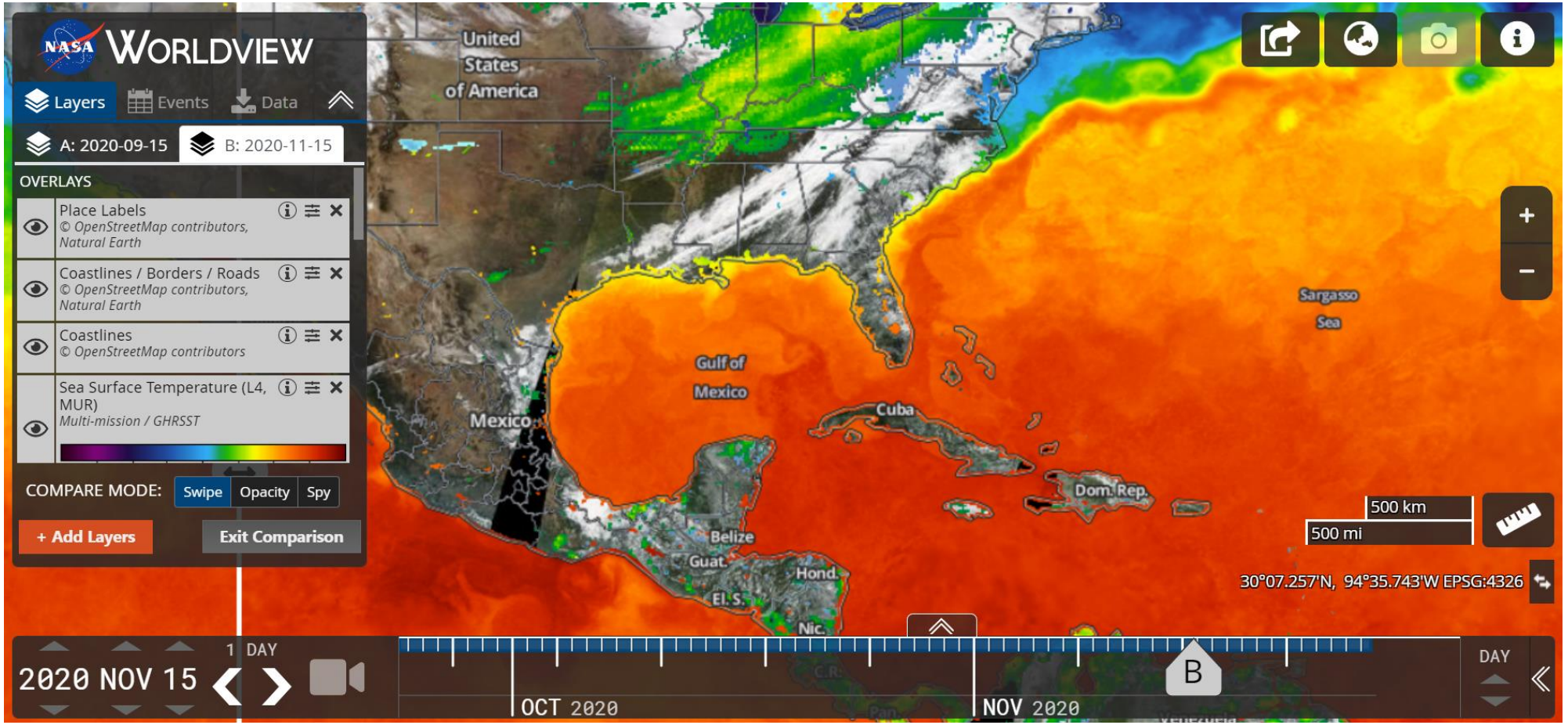
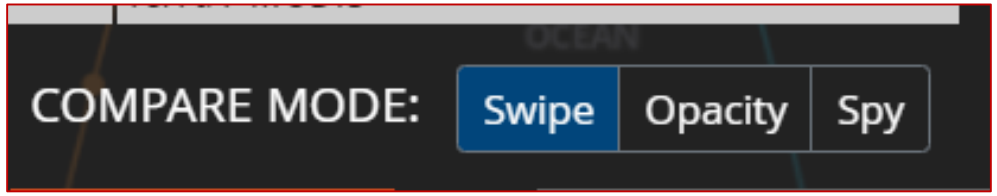


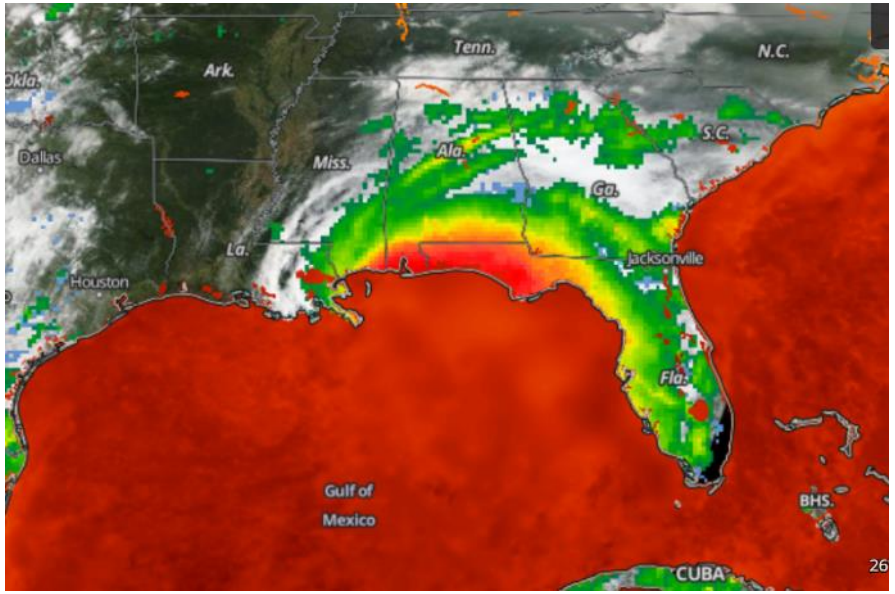
Image Credits: NASA

Application 3: Urban Flooding Mapping

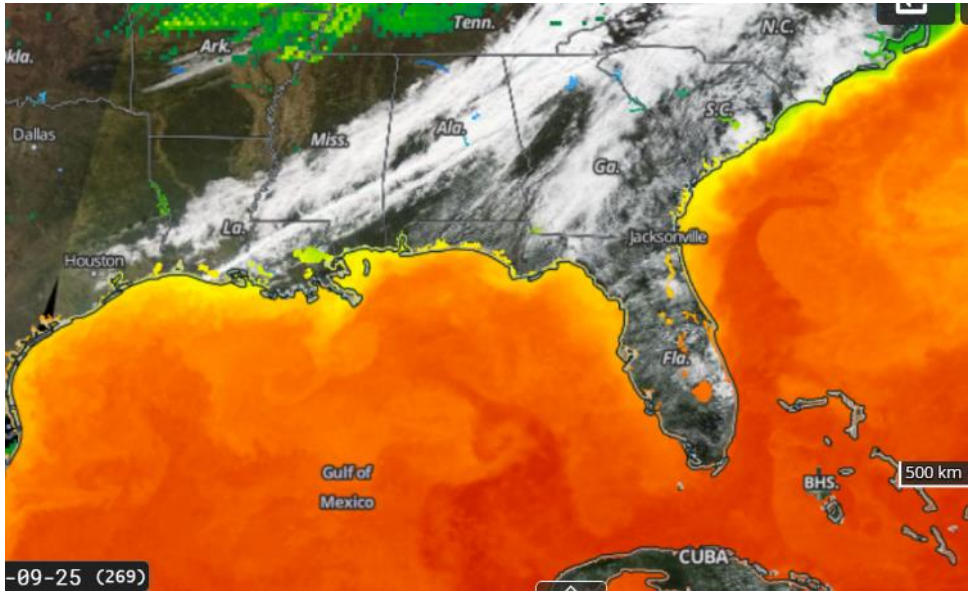


Go through all the compare mode options to see what trends you may notice. I recommend using opacity to slowly see the changes occurring on the east coast of the United States.

2020, Sep 15th



2020, Nov 15th



What are some changes do you see occurring this year from September-November?

Did sea surface temperatures increase or decrease? Perception? Describe any visual trends on both the maps!

Image Credits: NASA

Application 3: Urban Flooding Mapping

Try and locate your city on this map and see how sea surface temperatures and perception levels effect your city/community using the same features/layers!

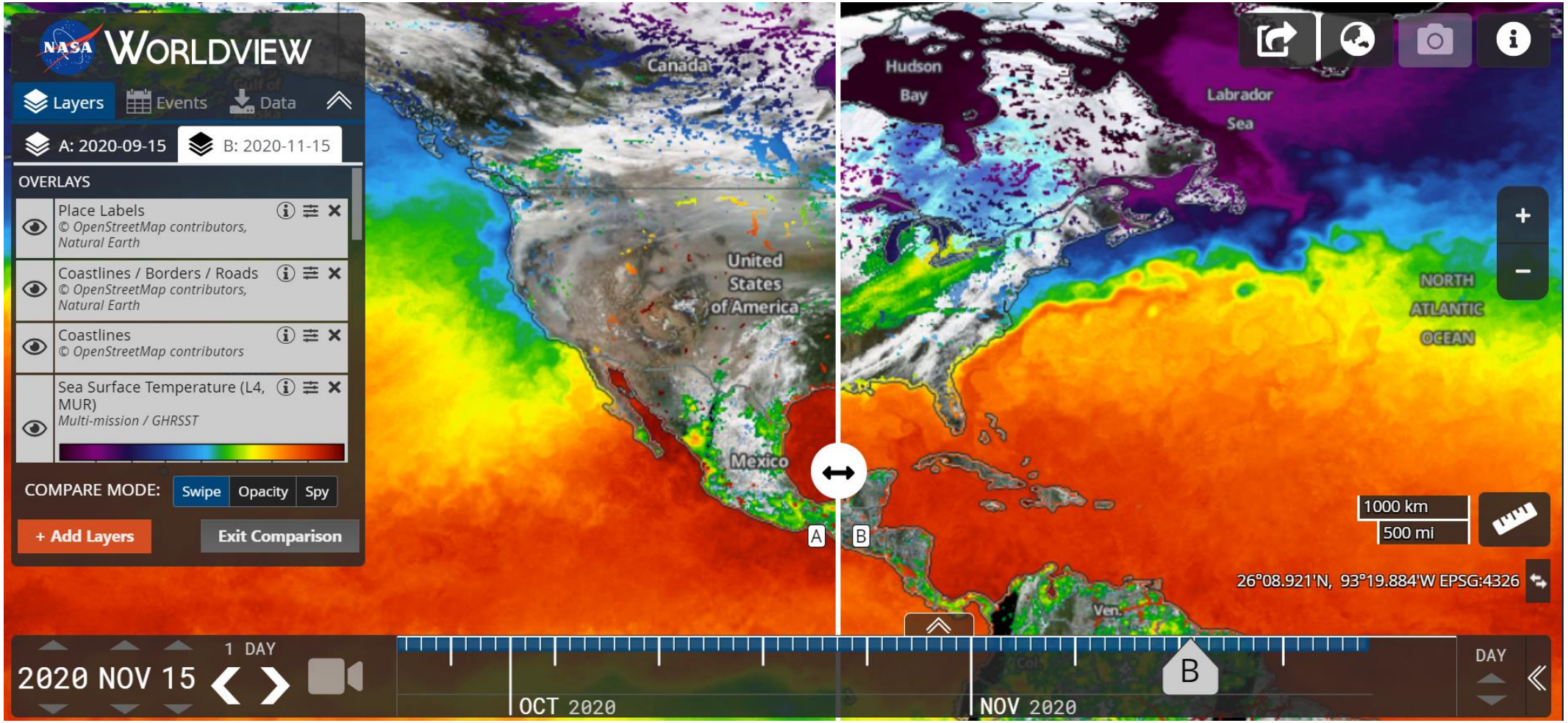


Image Credits: NASA

Takeaways

- Satellites
- NASA's Worldview
- Applications of Urban heat, canopy, and flooding

EARTH SCIENCE
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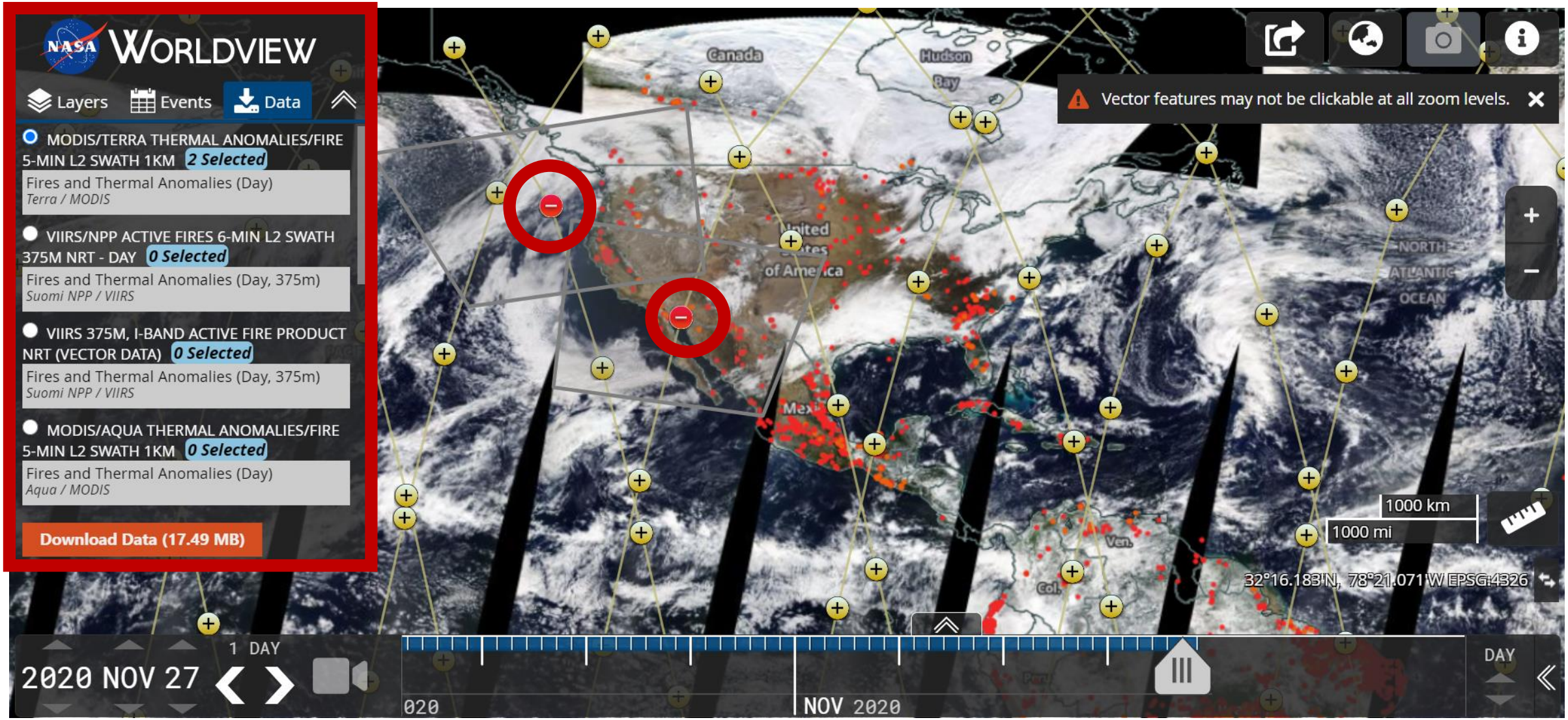

Image Credits: NASA

Thank You.

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