

# Flowchart of Resources and Data Products for Health and Air Quality Applications with an Emphasis on Satellite Data

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# Welcome

This resource is for users interested in using satellite data but are new to the data products and their capabilities. The flowchart that will guide users from a general question or need to a specific resource. For brevity this flowchart focuses on the United States, but this resource will be extended to provide data products for global applications. The possible end points include tutorials on the NASA Health and Air Quality Applied Sciences Team (HAQAST) website, Applied Remote Sensing Training (ARSET) tutorials, recommended publications, and websites with more information.

**Audience:** Novice users

**Platform:** Interactive website with clickable boxes

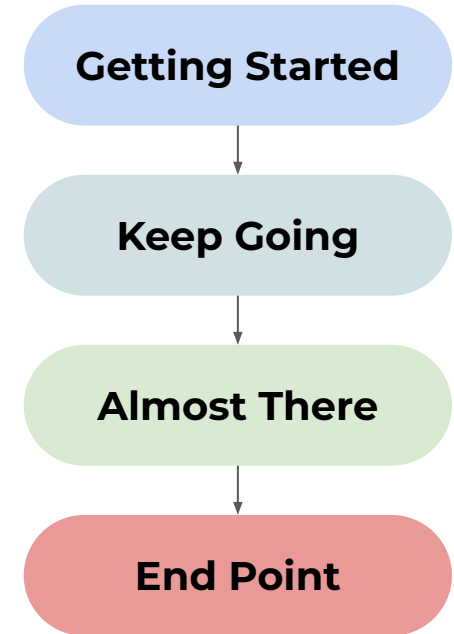
**End Points:** HAQAST tutorials, ARSET tutorials, websites, suggested readings, and publications

**Goal:** Guide users from a general question to a specific resource

**Starting Question Examples:** How can I get started looking at the variation of formaldehyde concentrations in my state? There is a smoke plume out west, where can I go to see it in real time? How can I see the change in aerosol optical depth over a couple of hours? Where can I go to see locations of active fires?

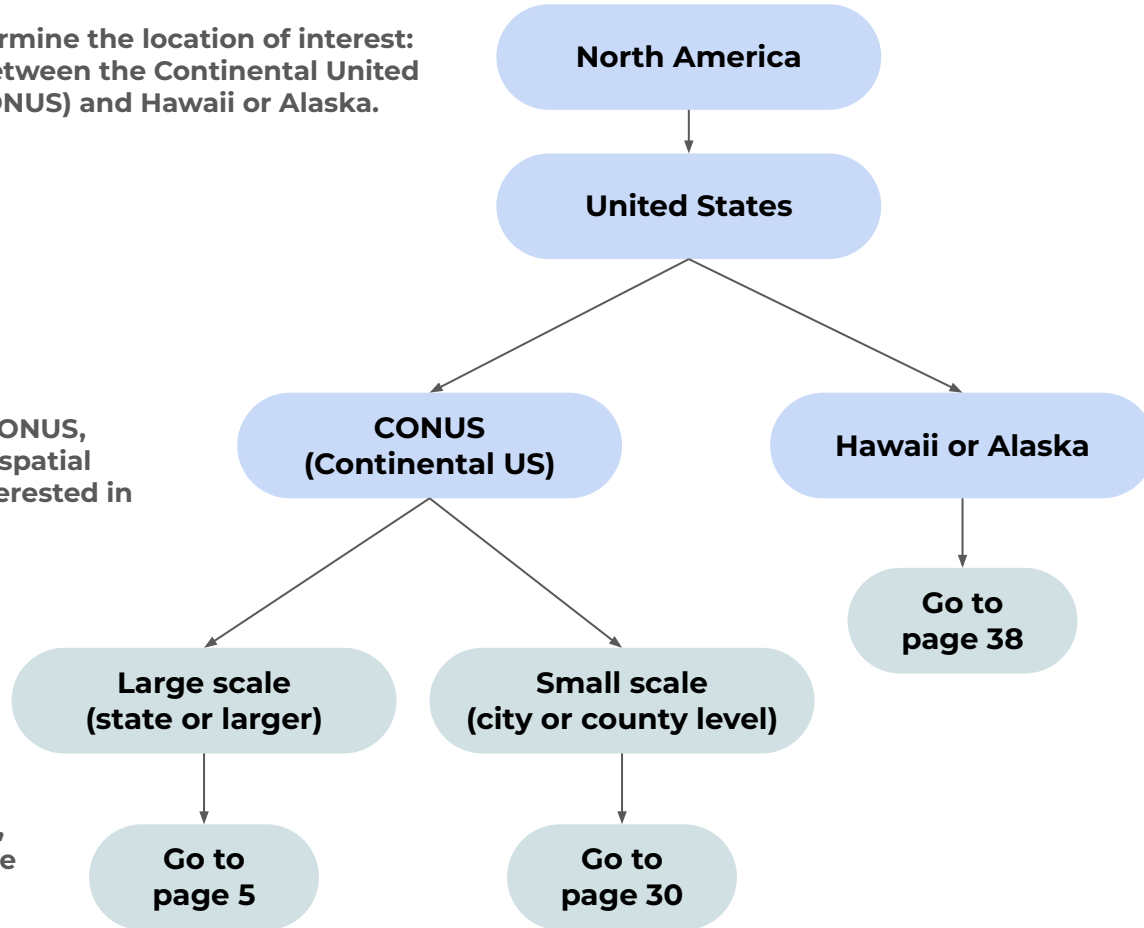
# How to use this Flowchart

1. At the start, you will begin at the darkest shade of blue
2. Follow the best pathway related to your determined interest(s)
3. Based on your choice **click on the bubbles** to advance to the next slide in the series
4. As you advance through the flowchart, the colors will shift to a lighter blue, then green, then red to indicate an **ending point**
5. Once you reach a red bubble, click on it to go to your final slide
6. The end points were selected using the HAQAST website, the ARSET website and the Environmental Protection Agency (EPA) website
7. Links for all end point resources are provided on the last slide and will direct you to an external page

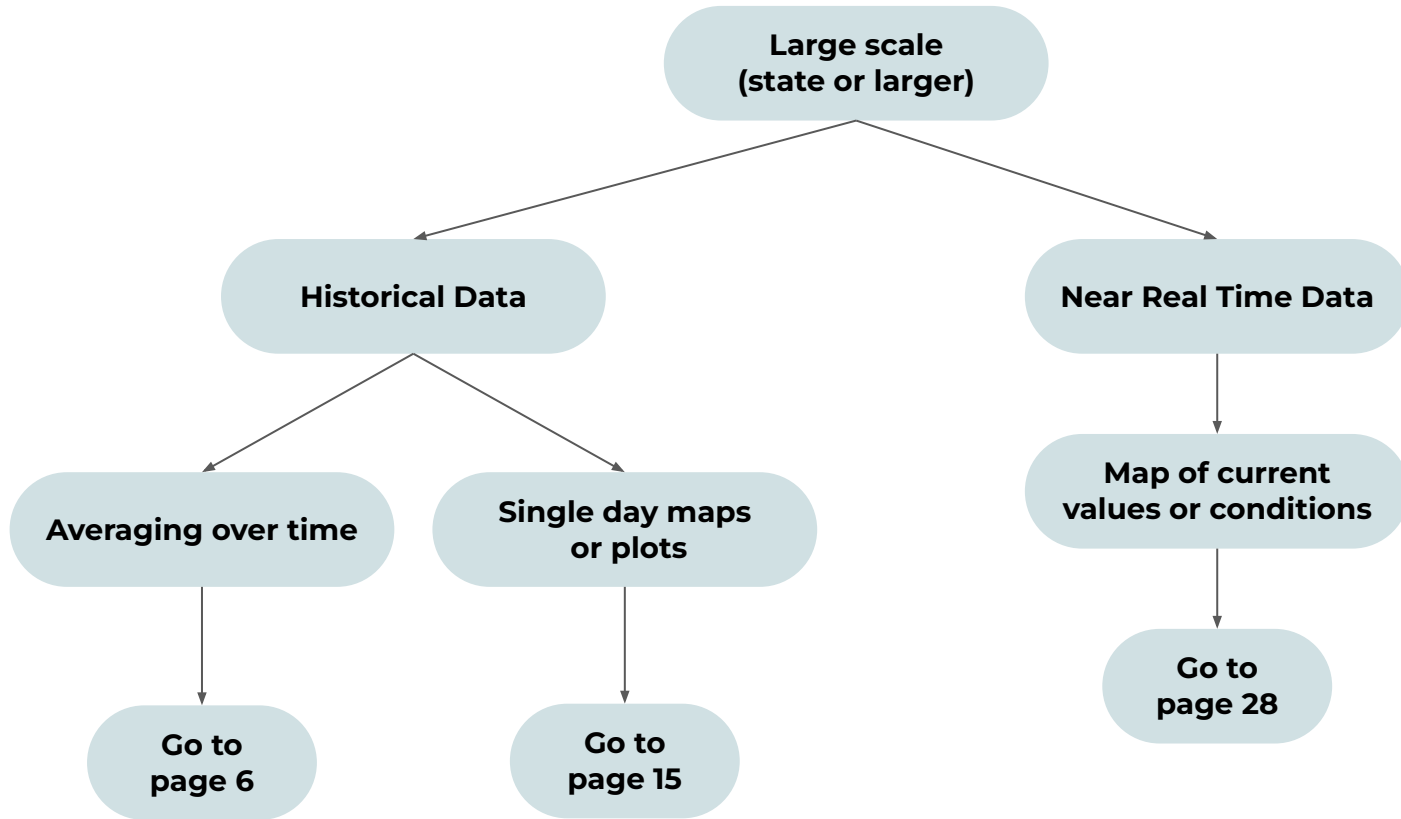


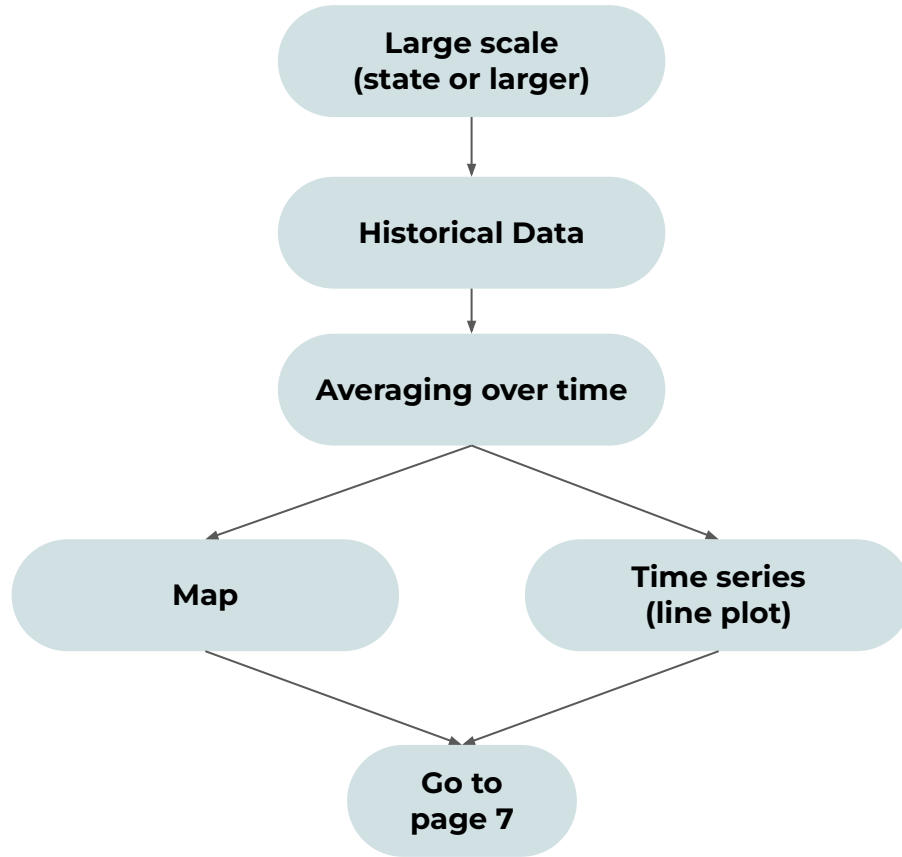
First, determine the location of interest:  
Choose between the Continental United States (CONUS) and Hawaii or Alaska.

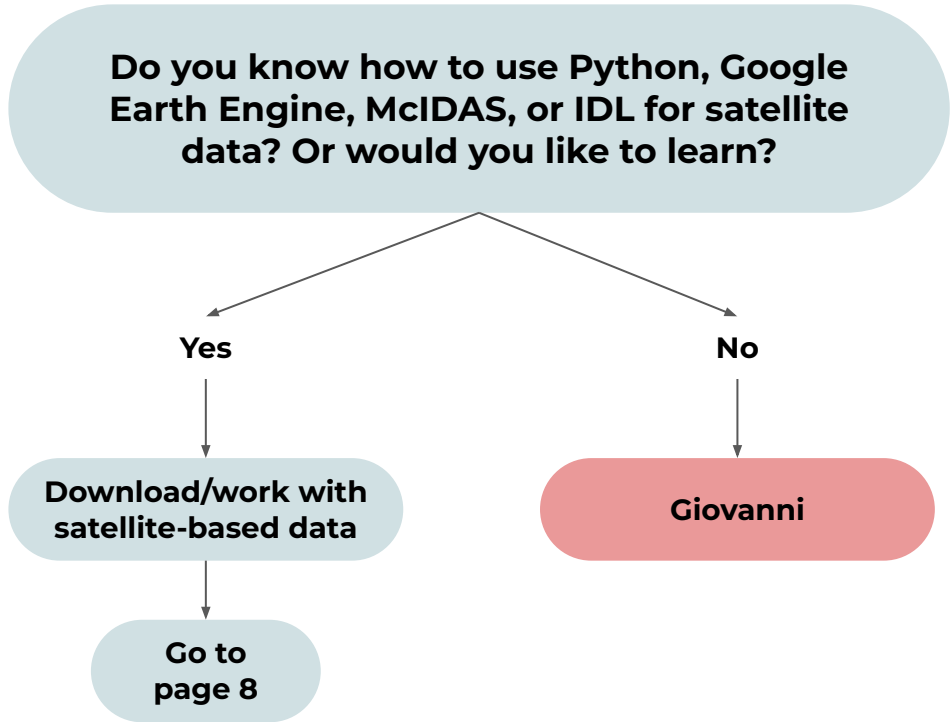
If interested in CONUS,  
determine what spatial  
scale you are interested in



Depending on your choices,  
click on the pathway you are  
interested in to go to the  
next slide







**What pollutant?**

Indicate which pollutant you are interested in

**Particulate Matter**

**Ozone**

**NO<sub>2</sub>**

**SO<sub>2</sub>**

**CO**

**Other**

**Fine  
(PM<sub>2.5</sub>)**

**Coarse  
(PM<sub>10</sub>)**

**Go to  
page 9**

**Go to  
page 10**

**Go to  
page 11**

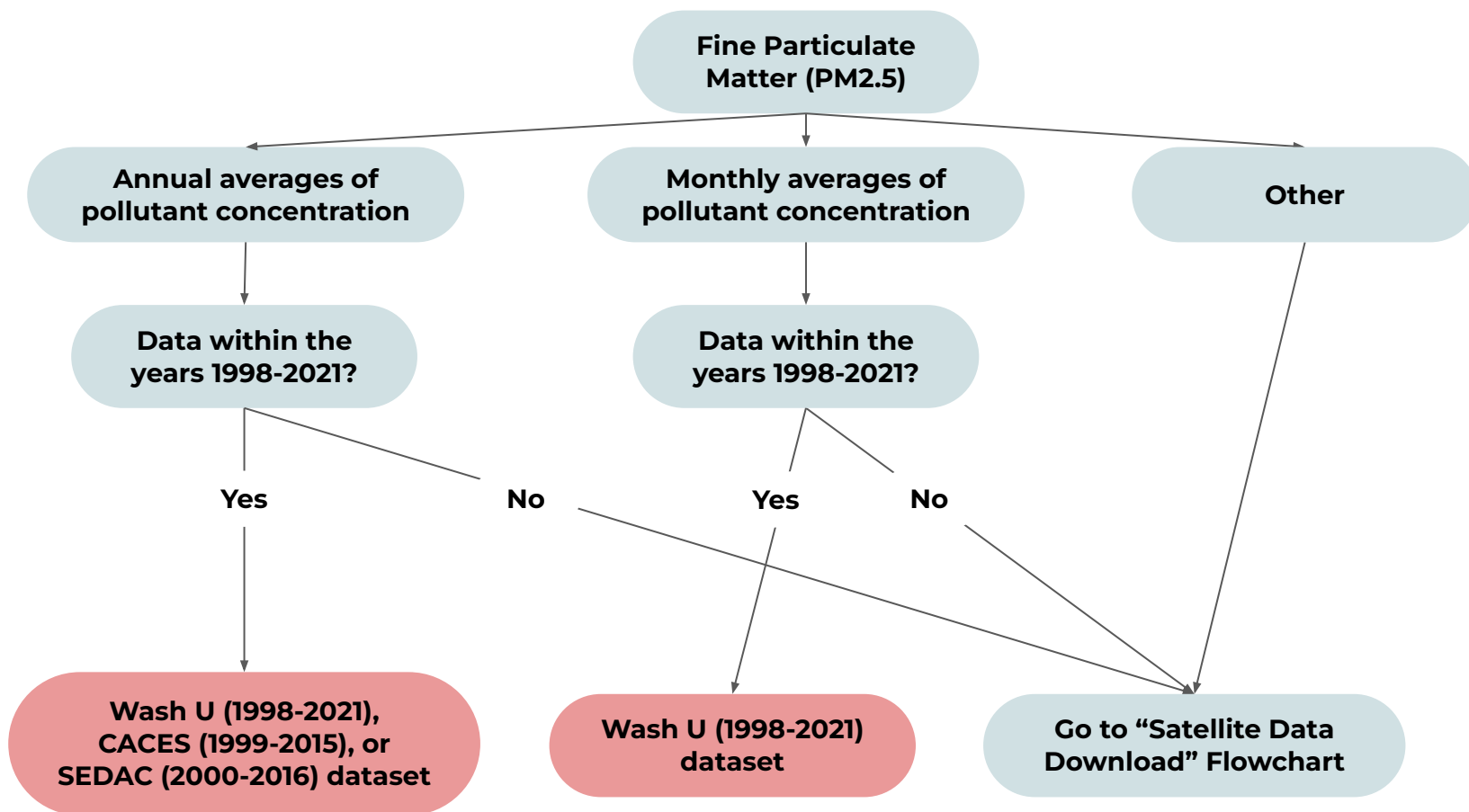
**Go to  
page 12**

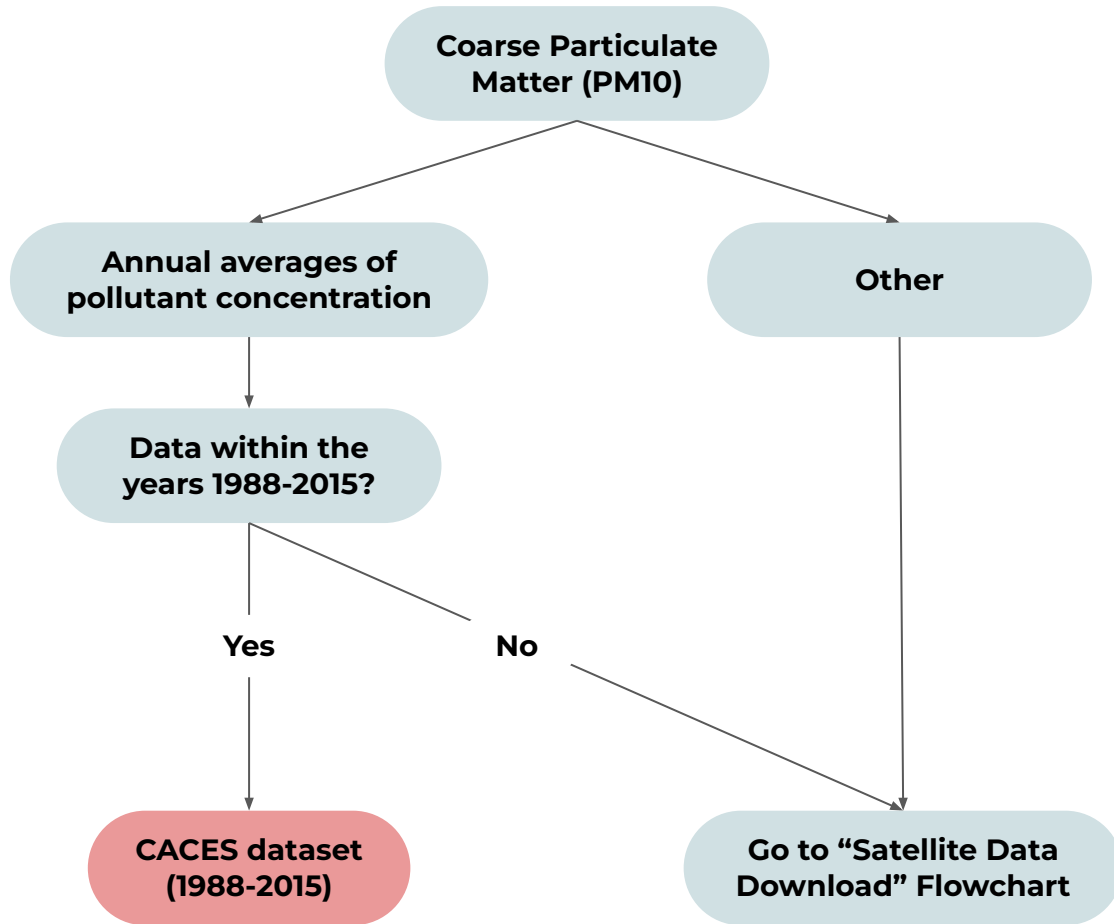
**Go to  
page 13**

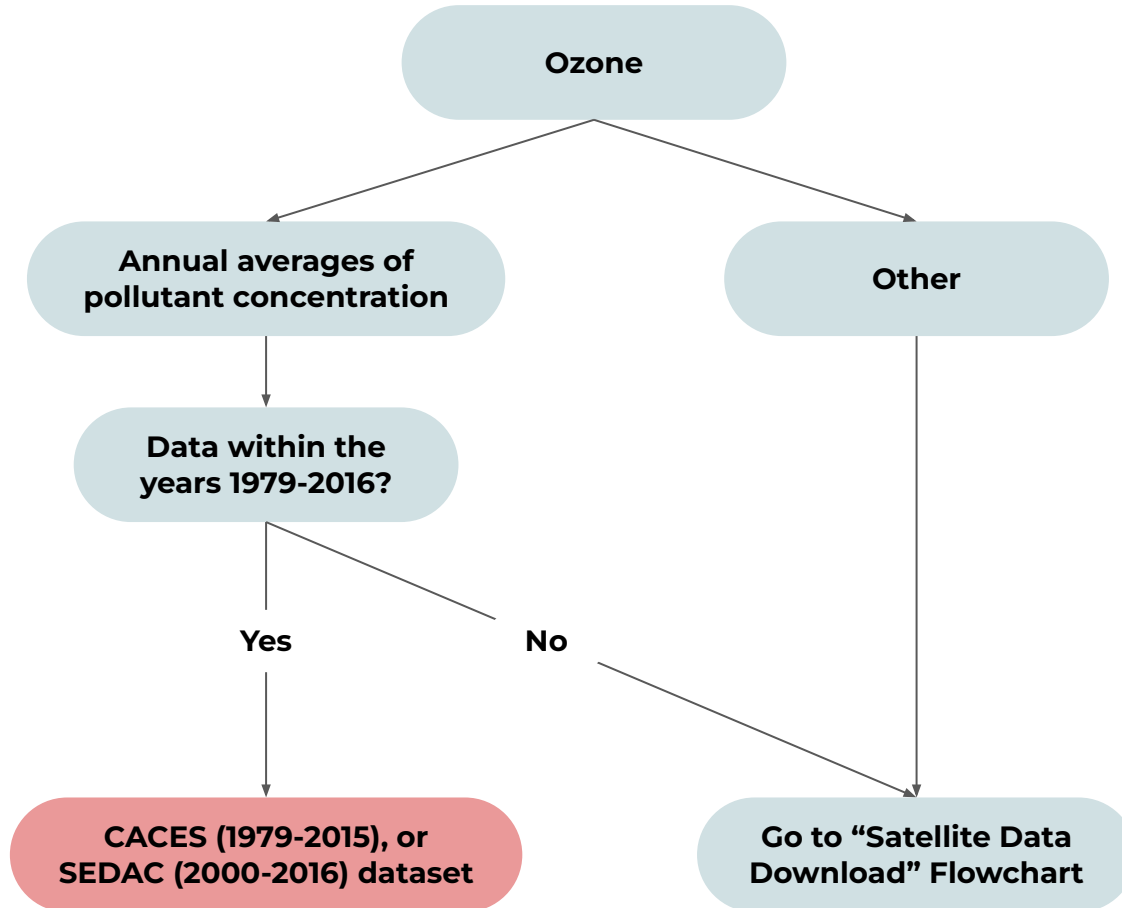
**Go to  
page 14**

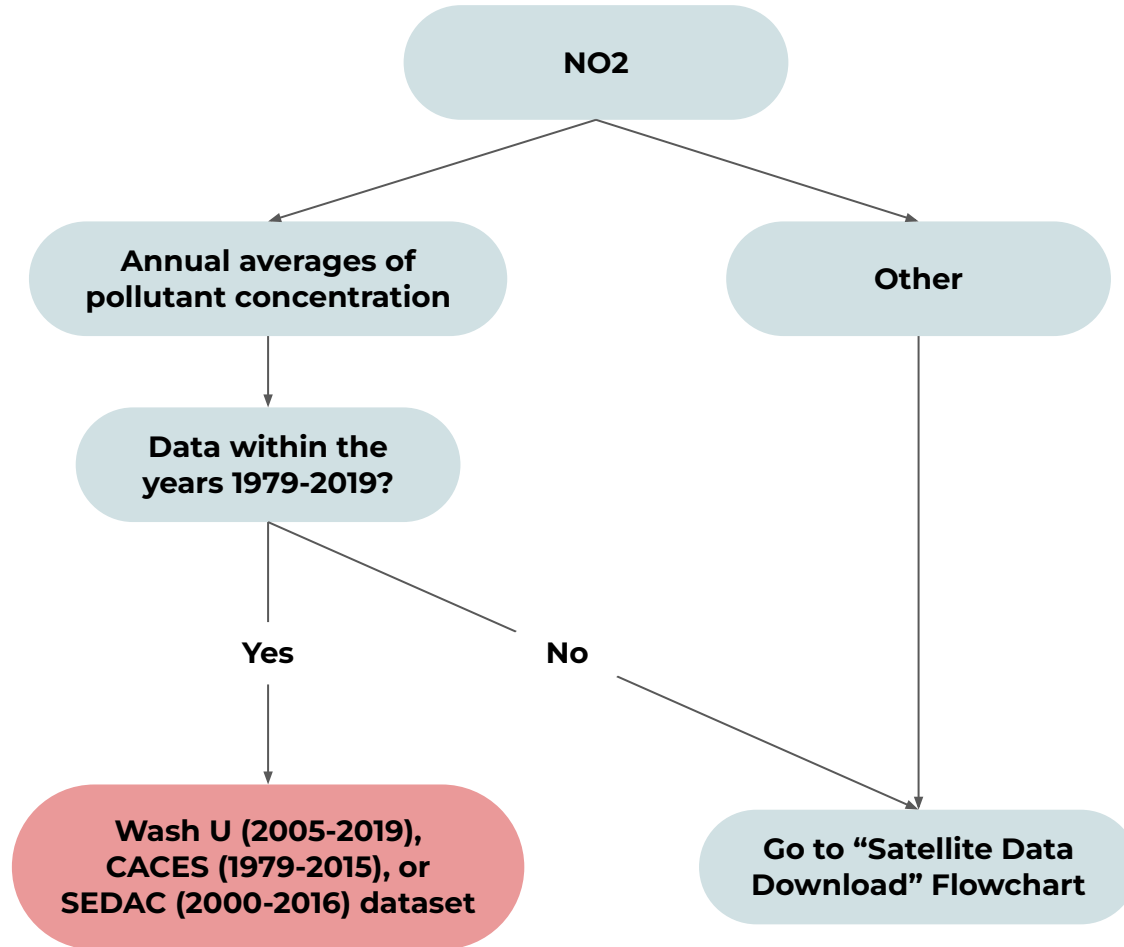
**Go to "Satellite Data Download"  
Flowchart on page 50**

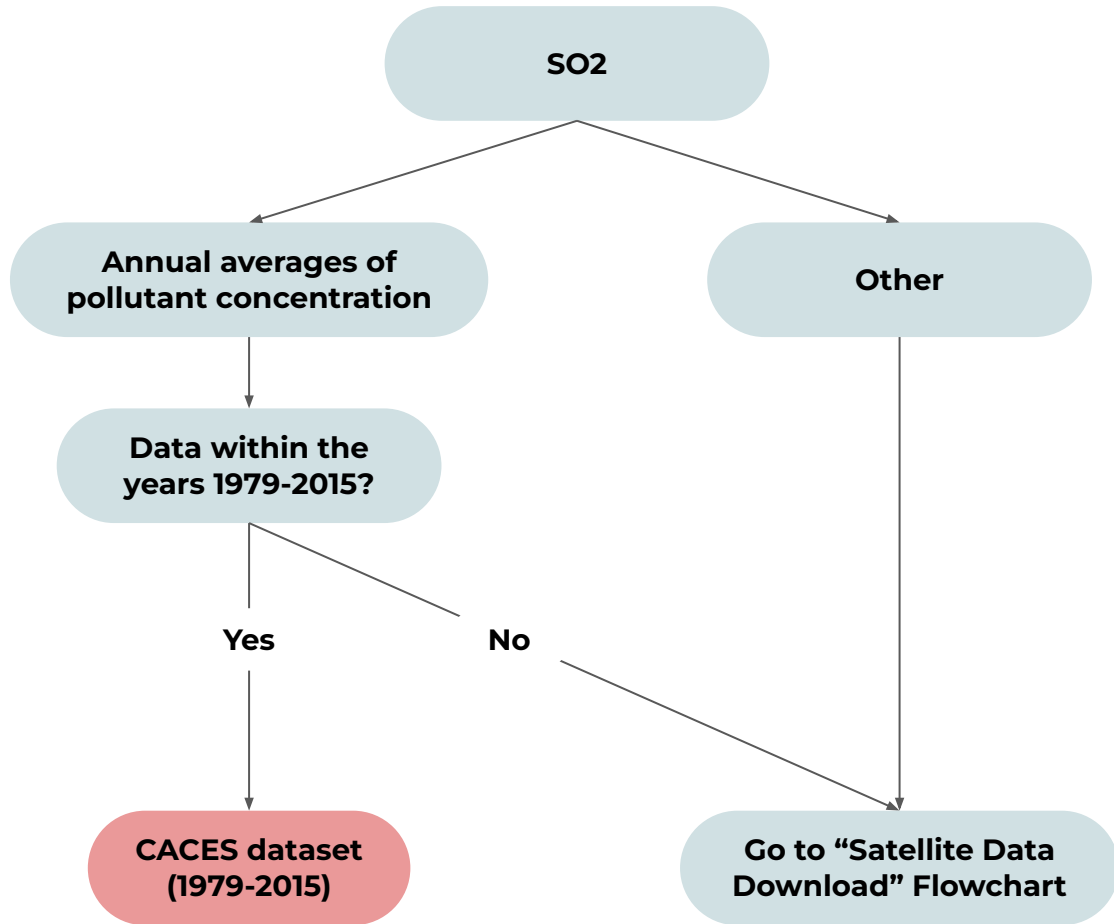


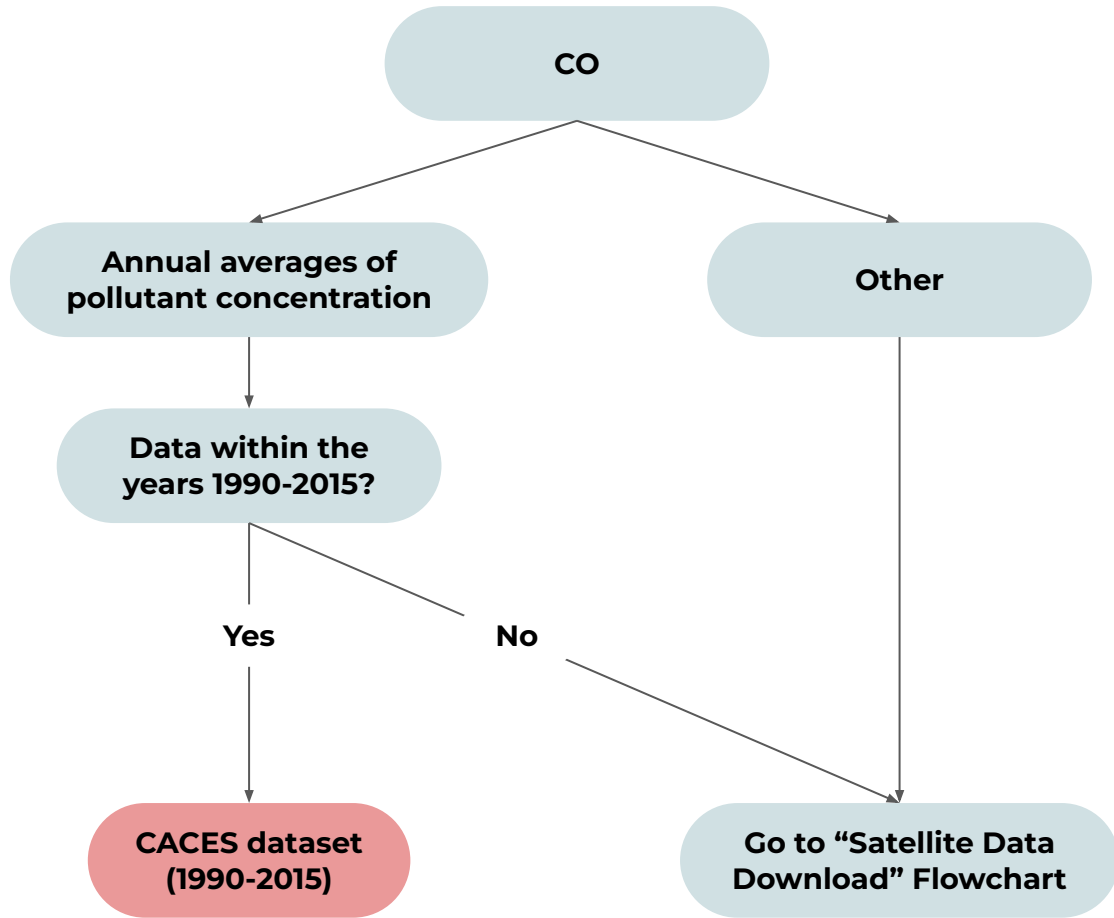


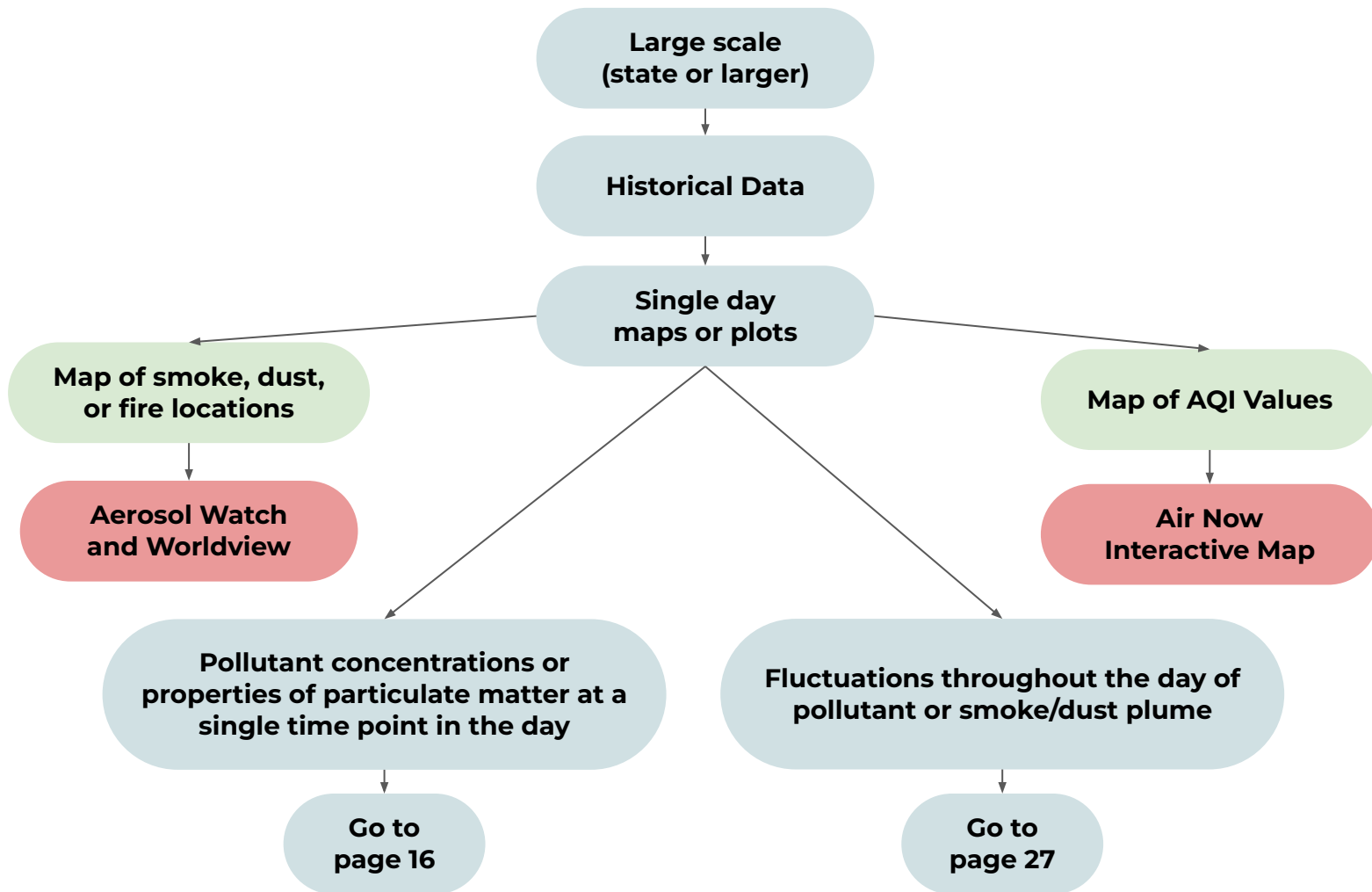


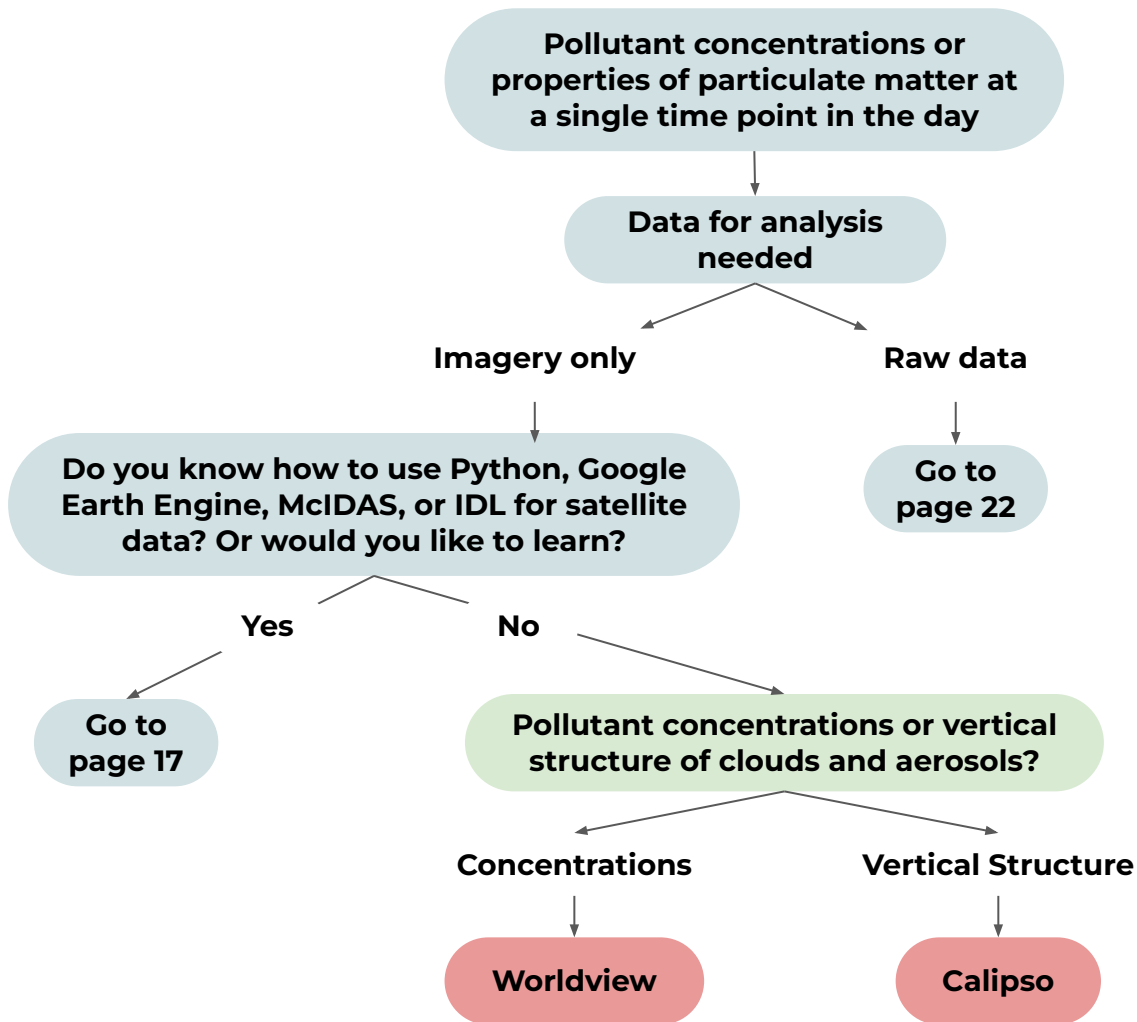




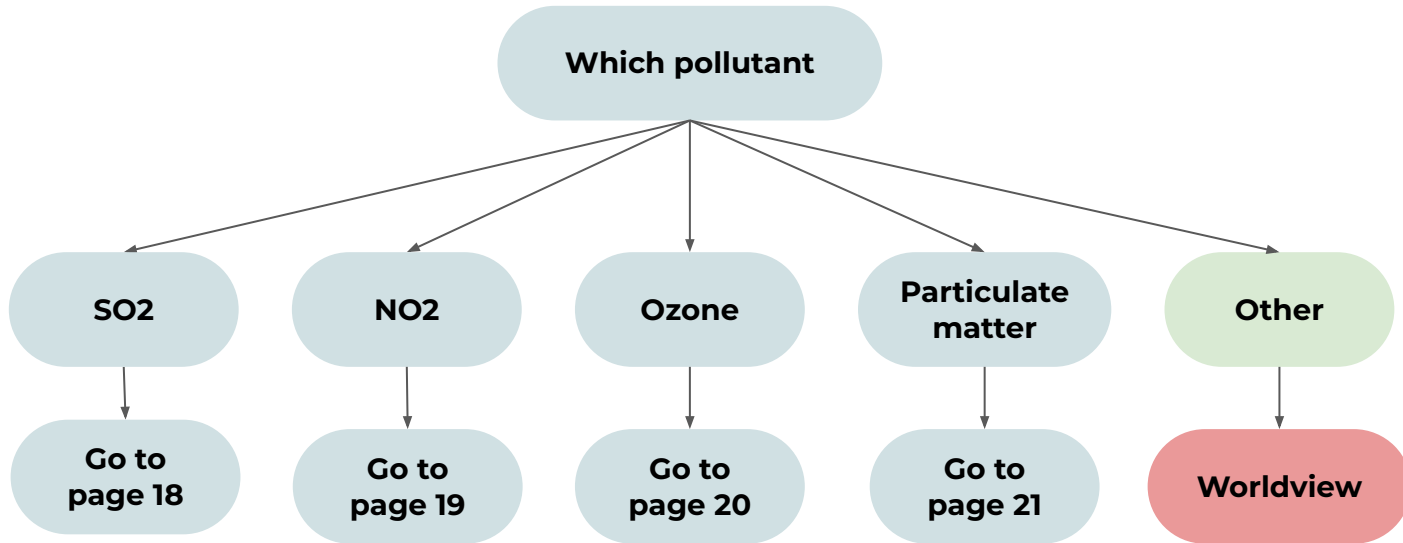


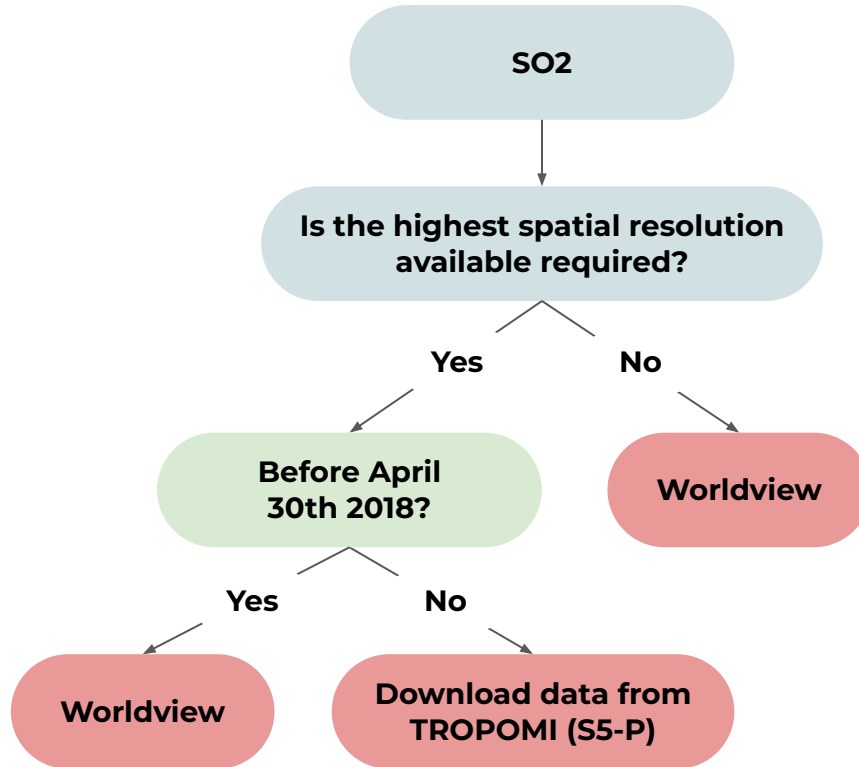


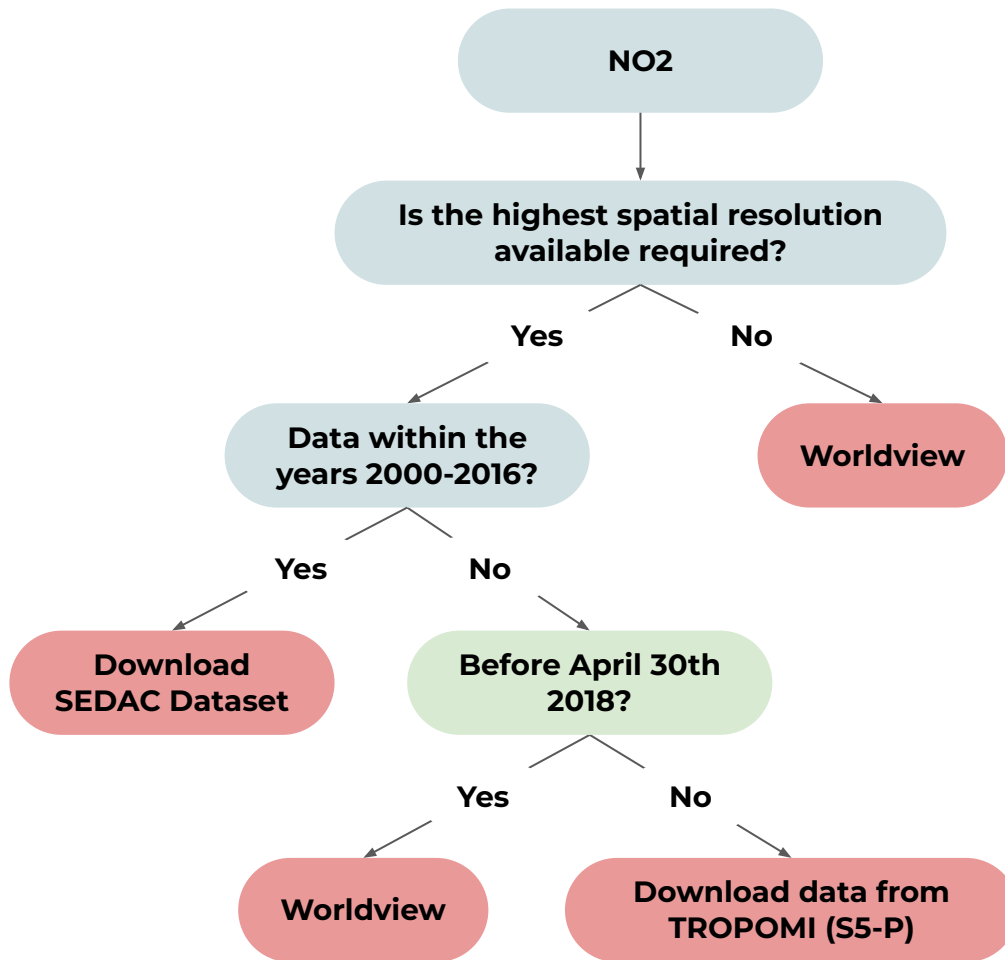


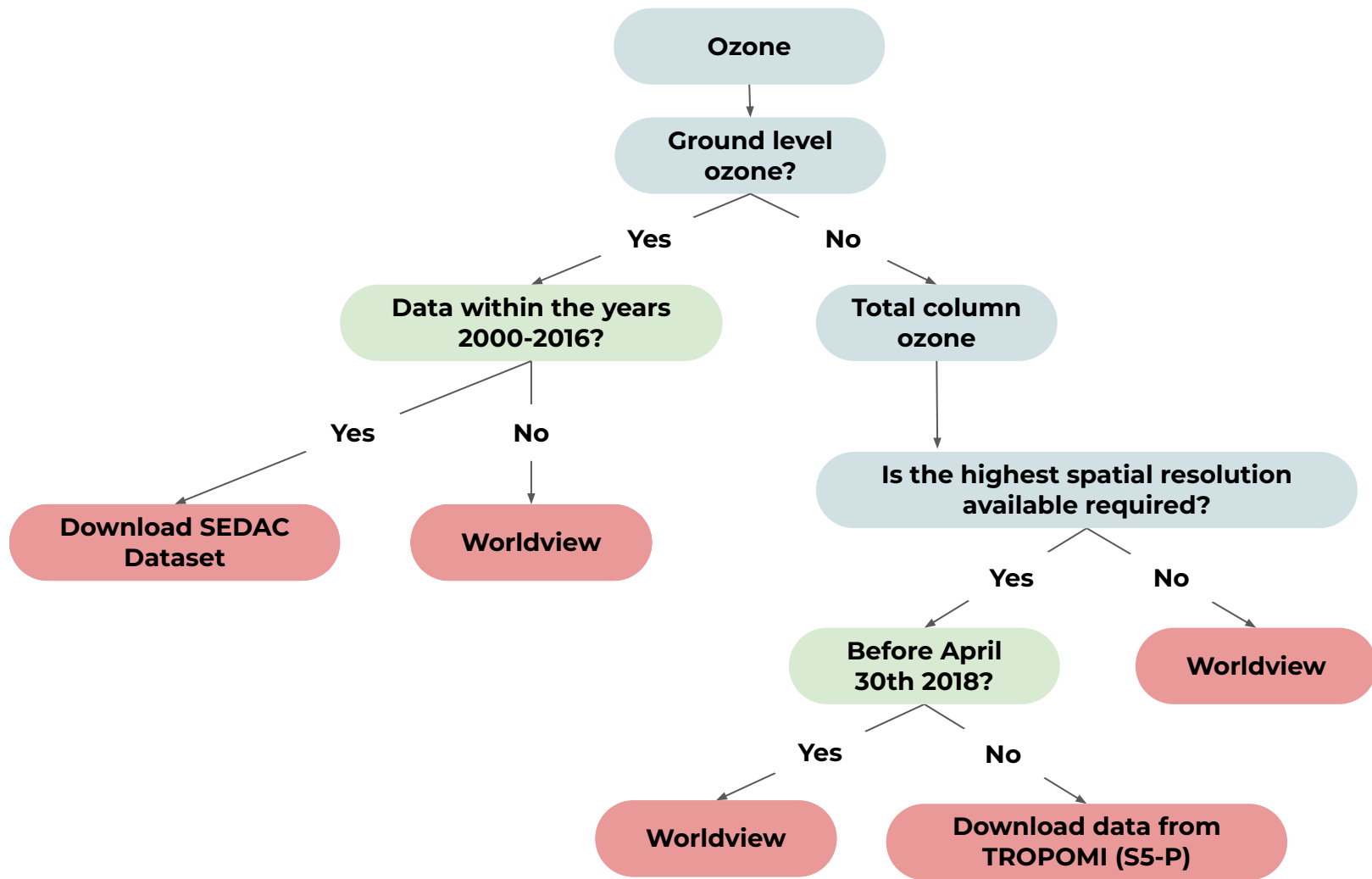


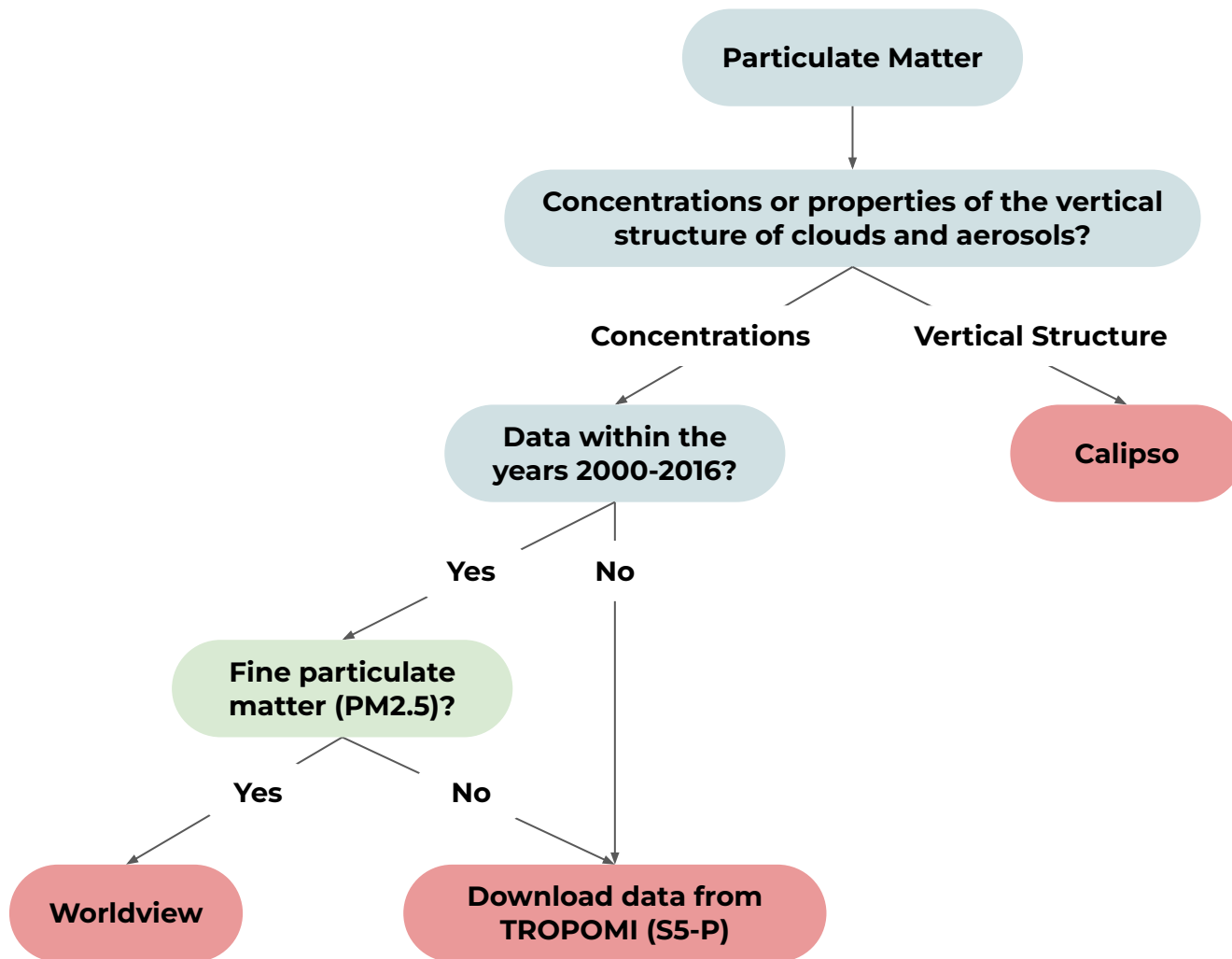


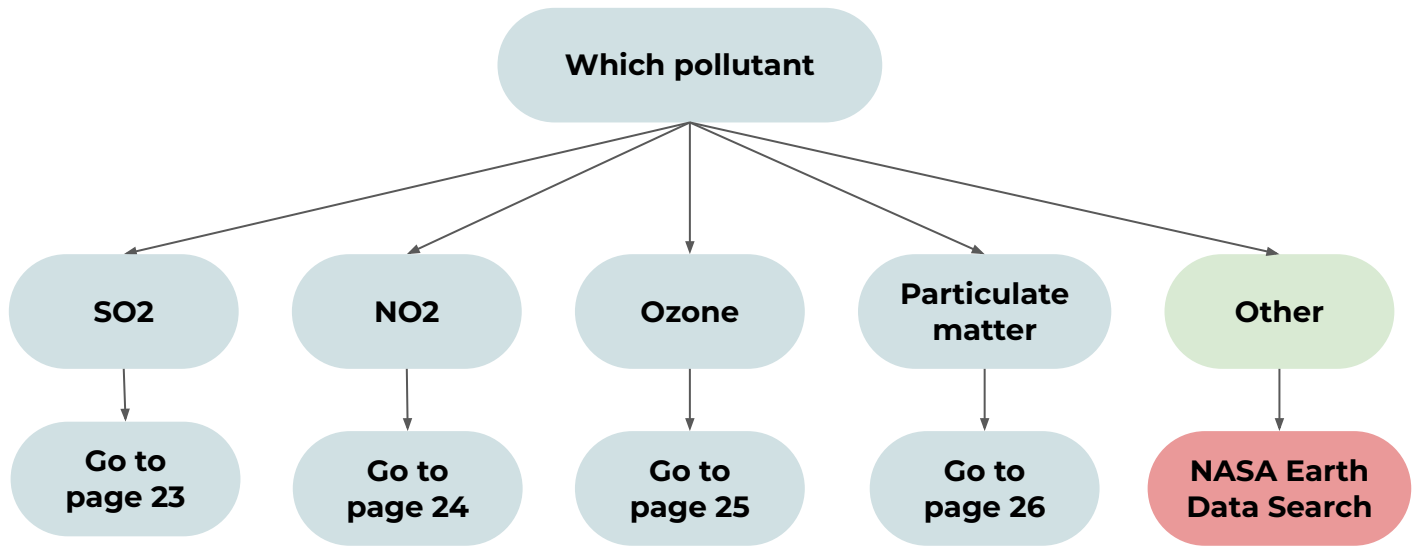


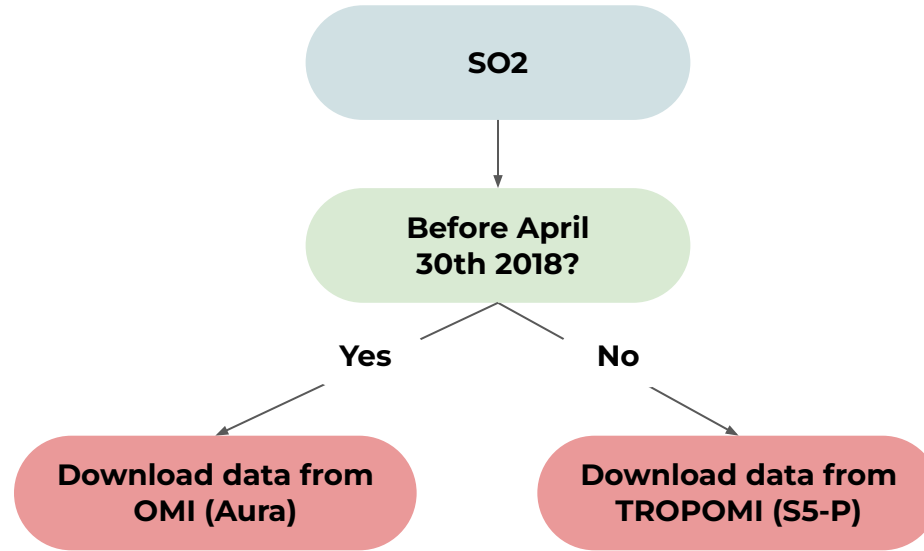


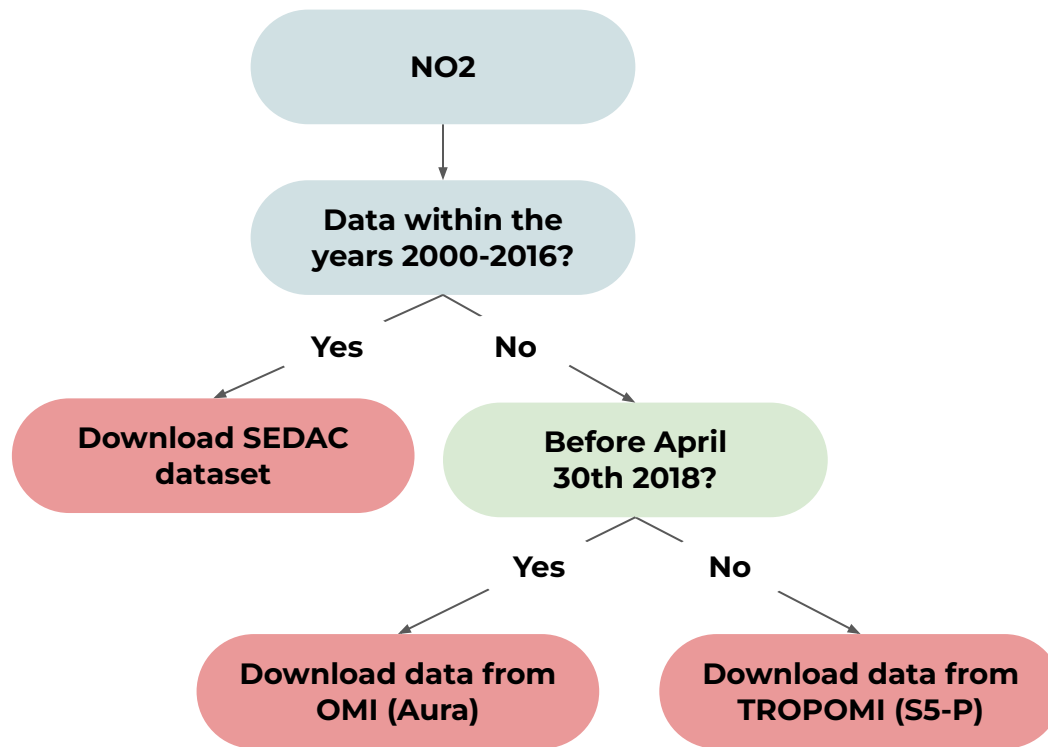




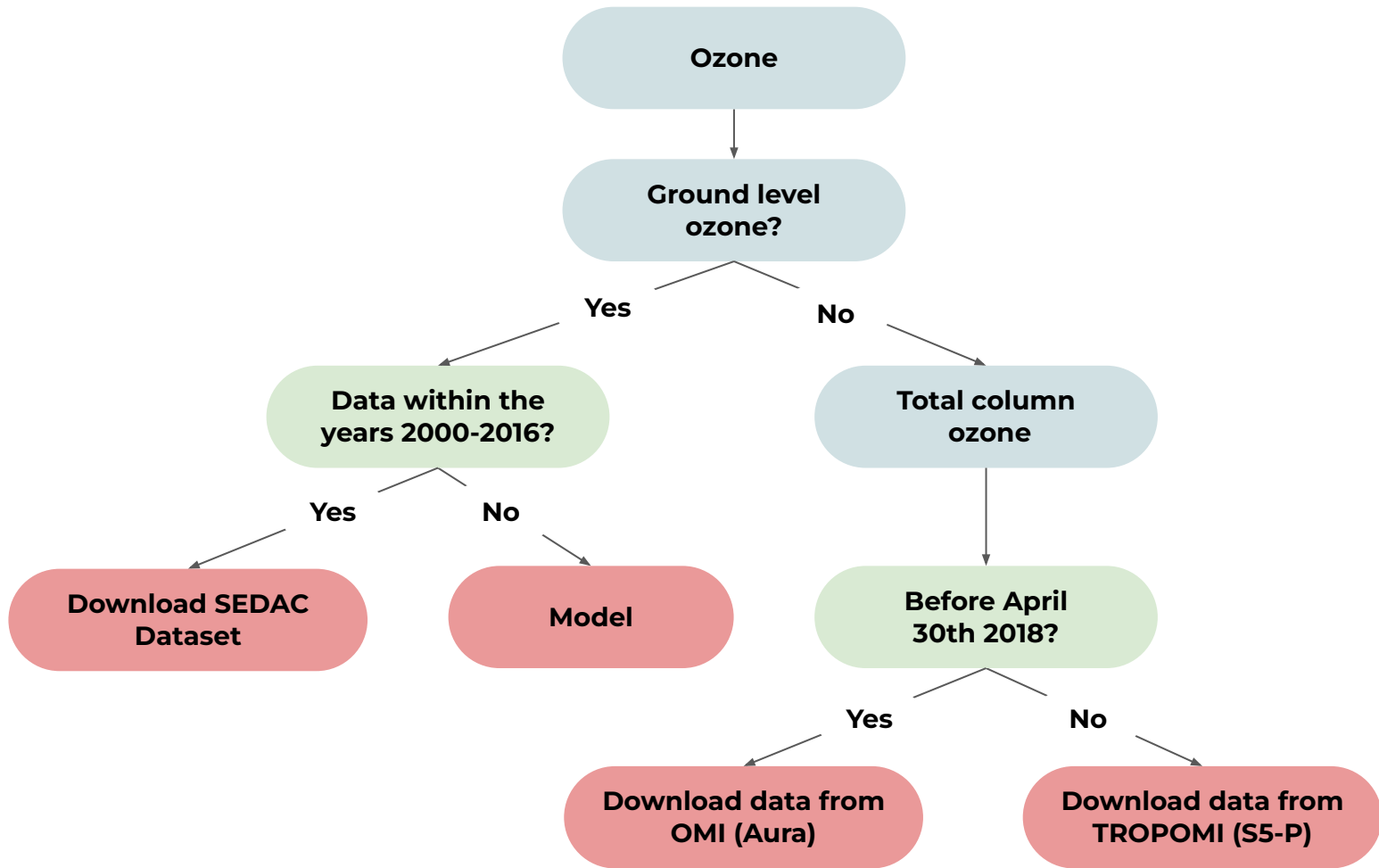


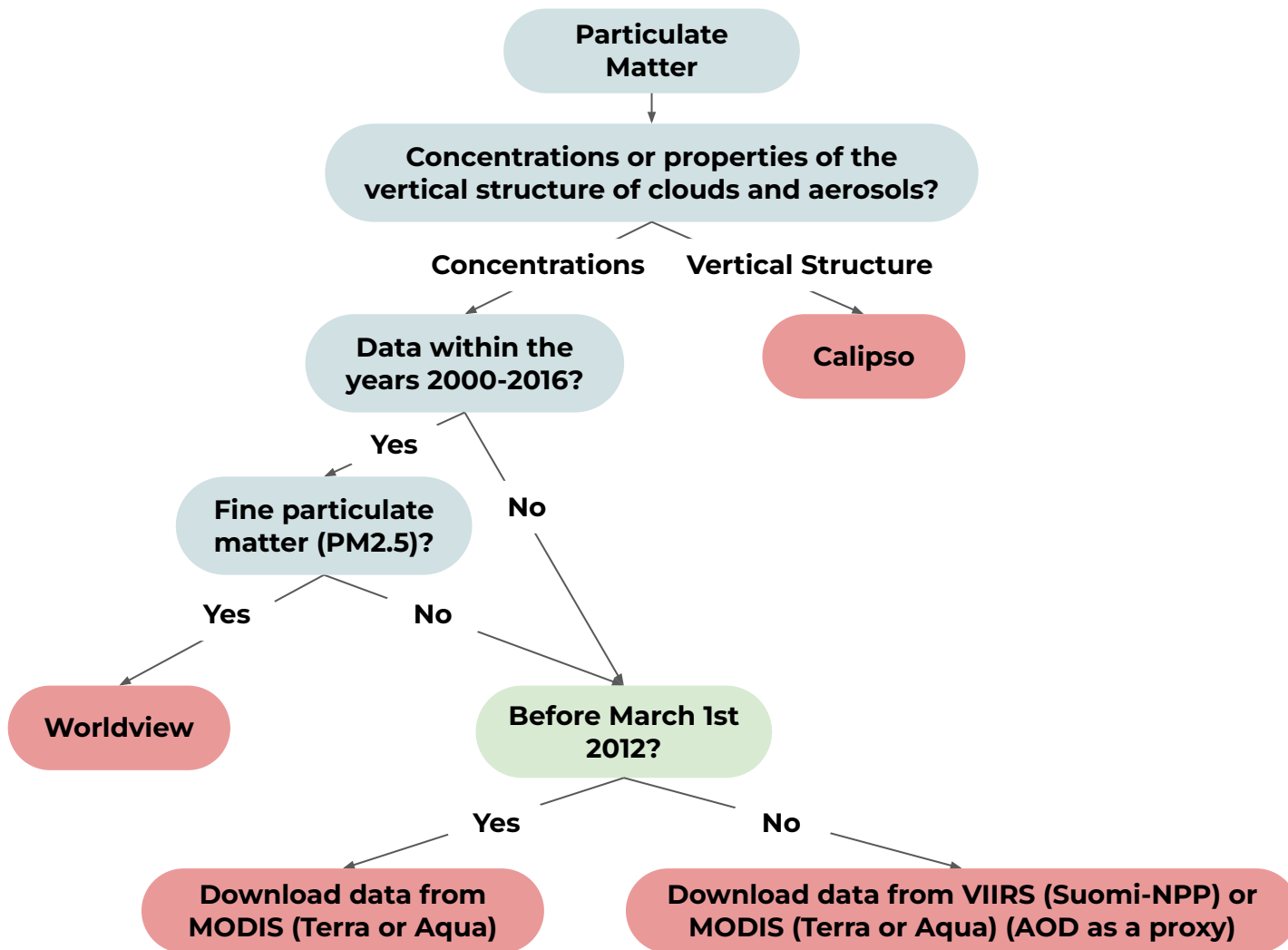


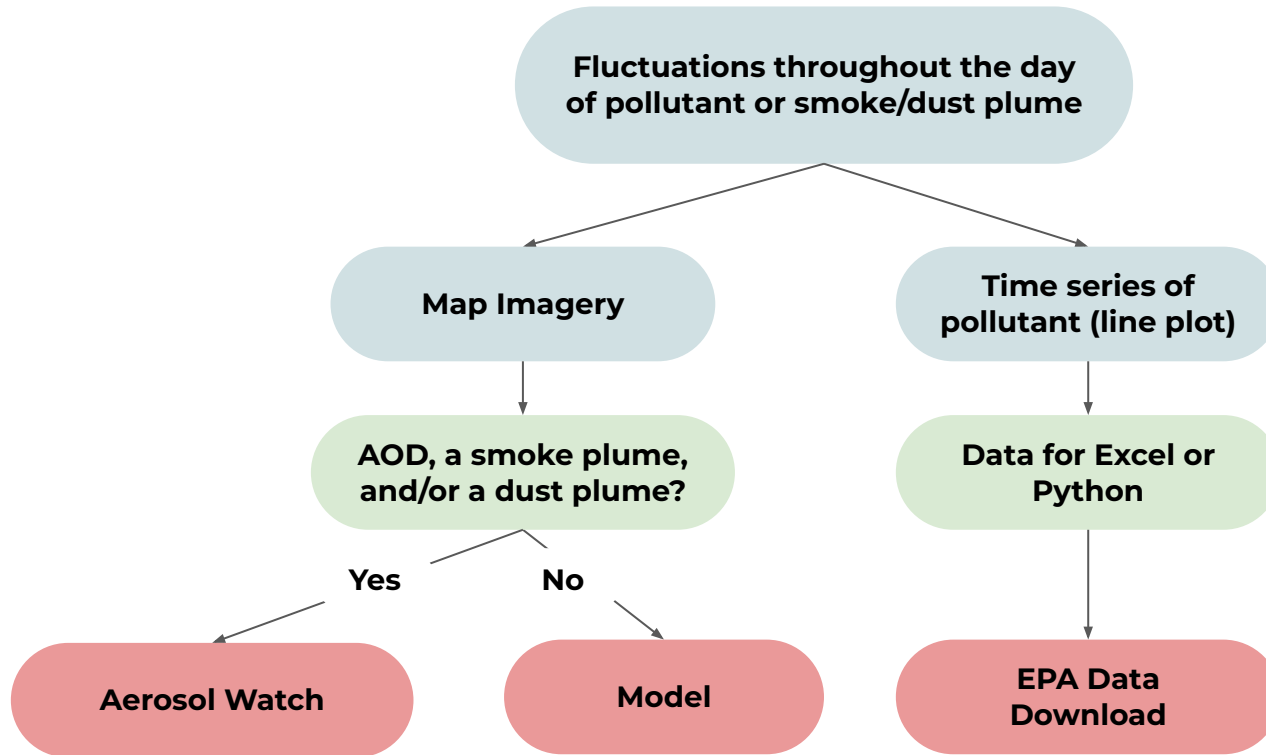


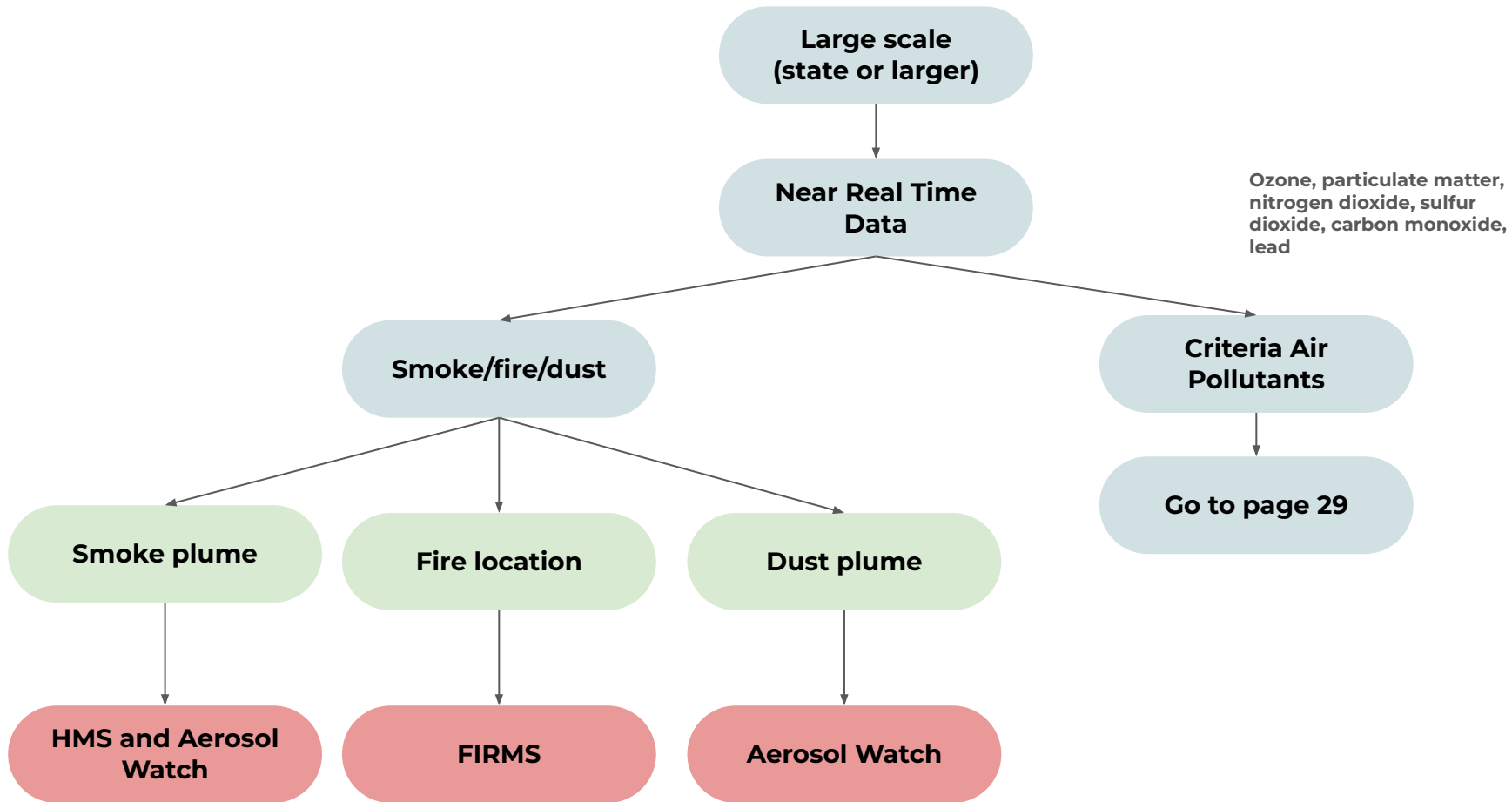


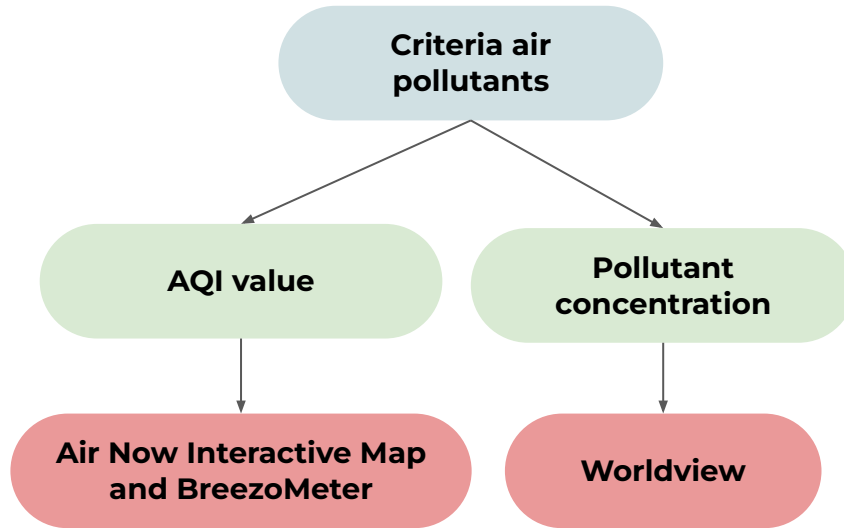


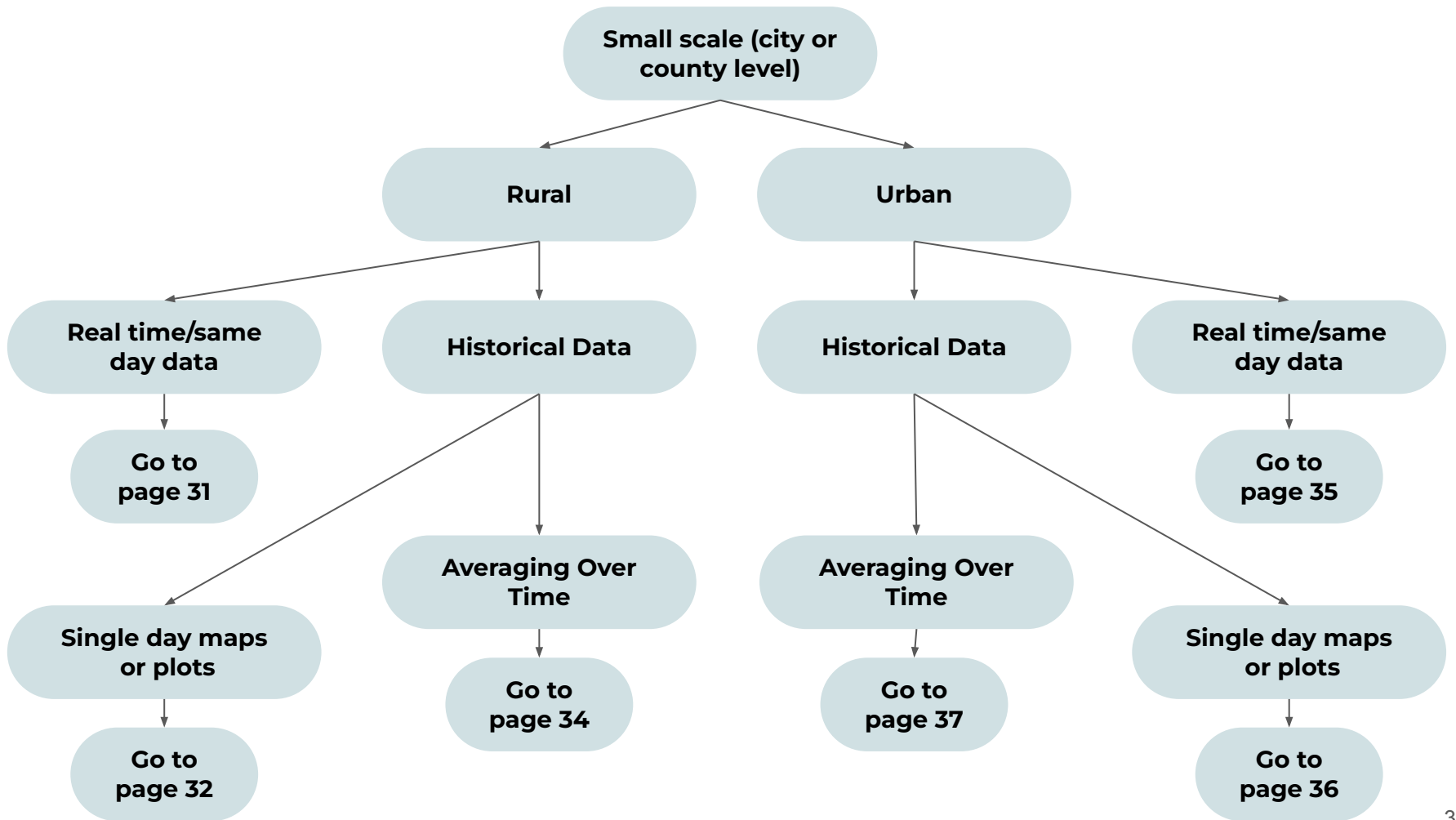


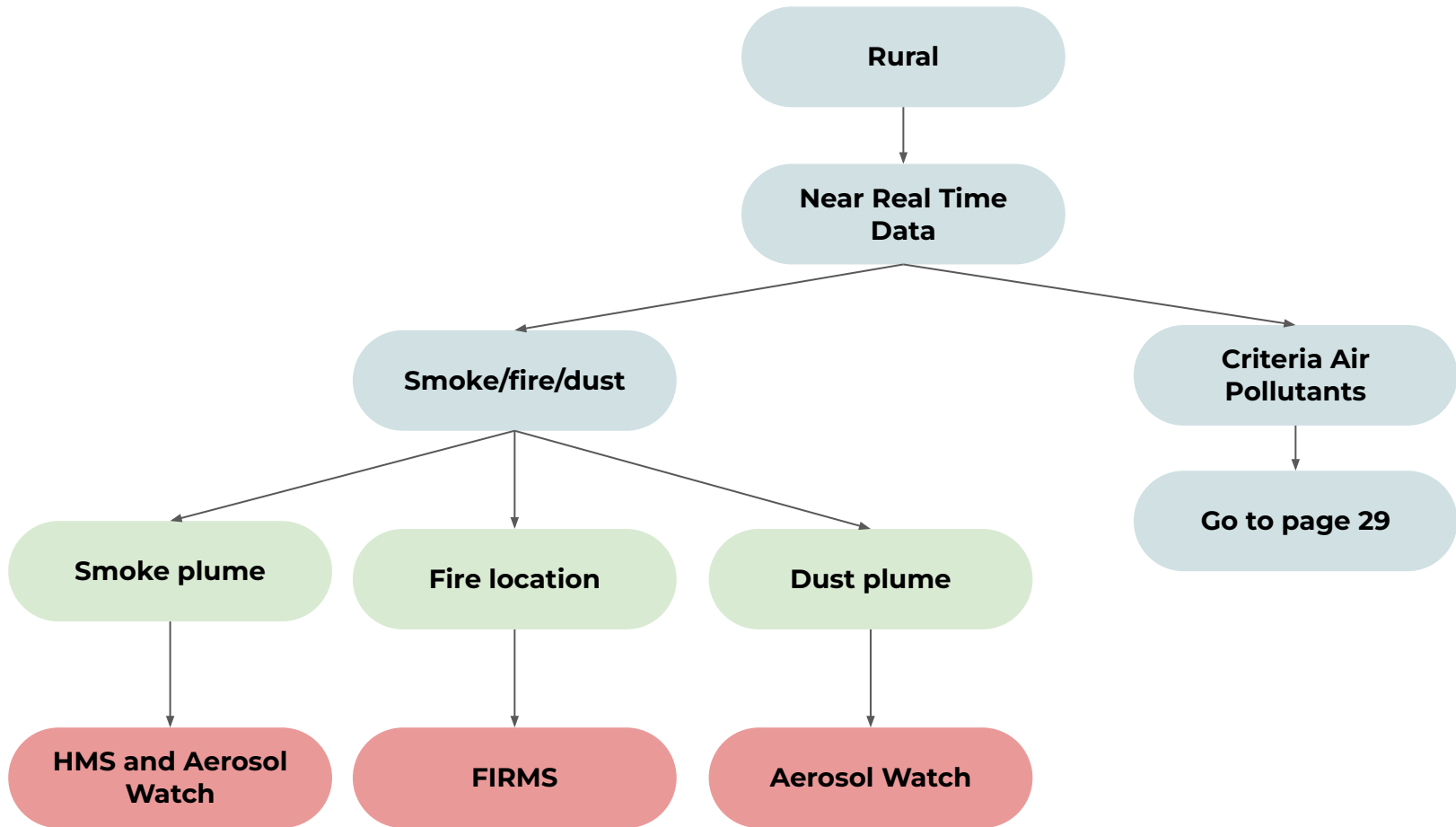


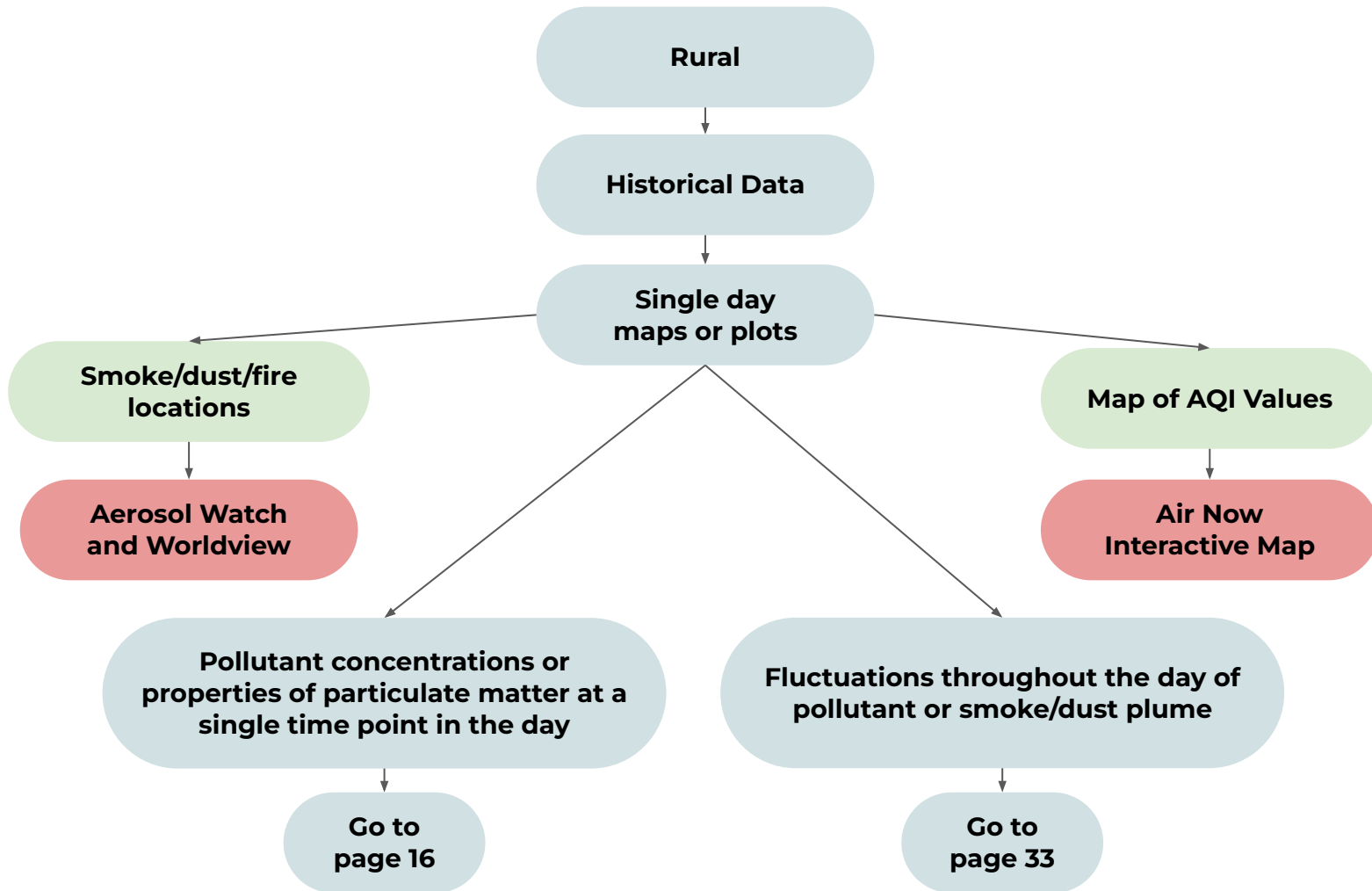




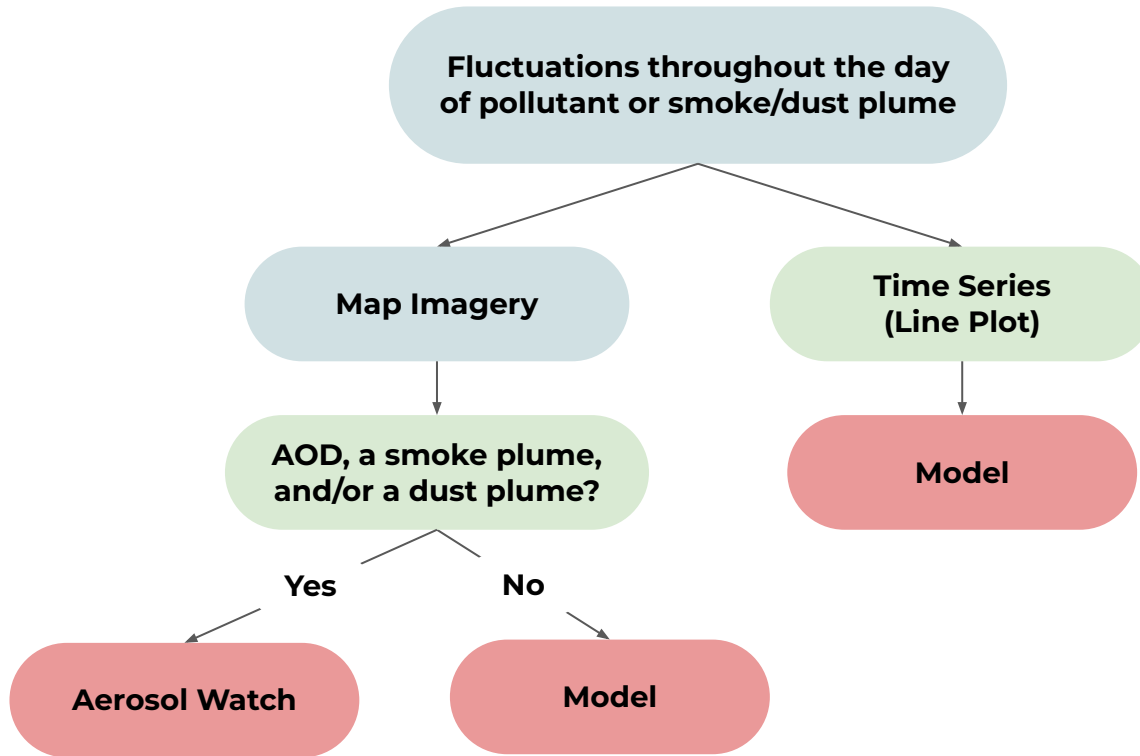


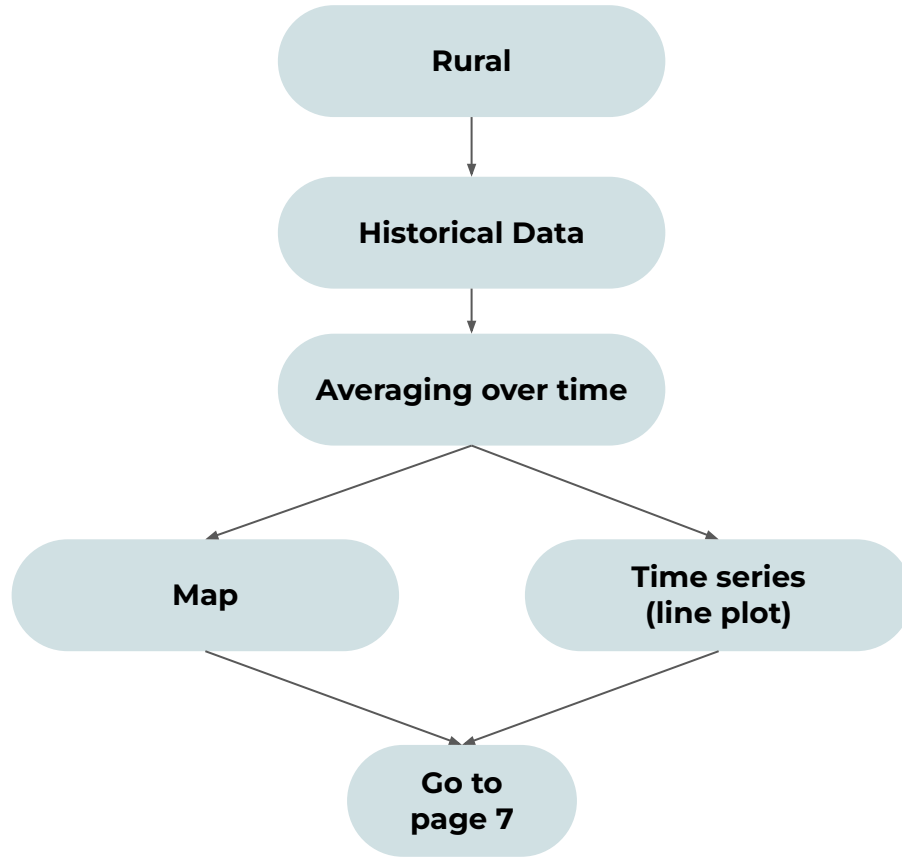


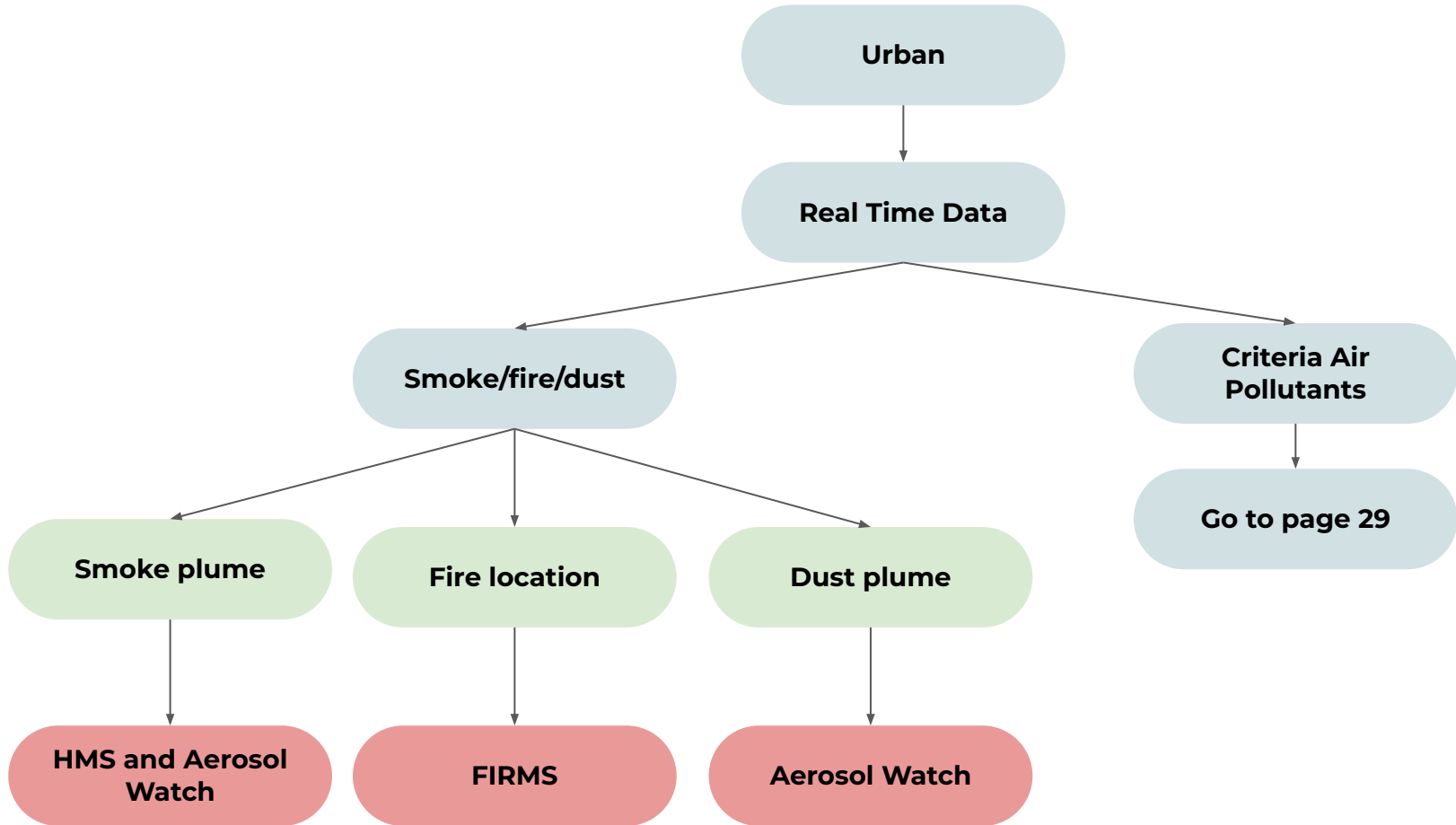


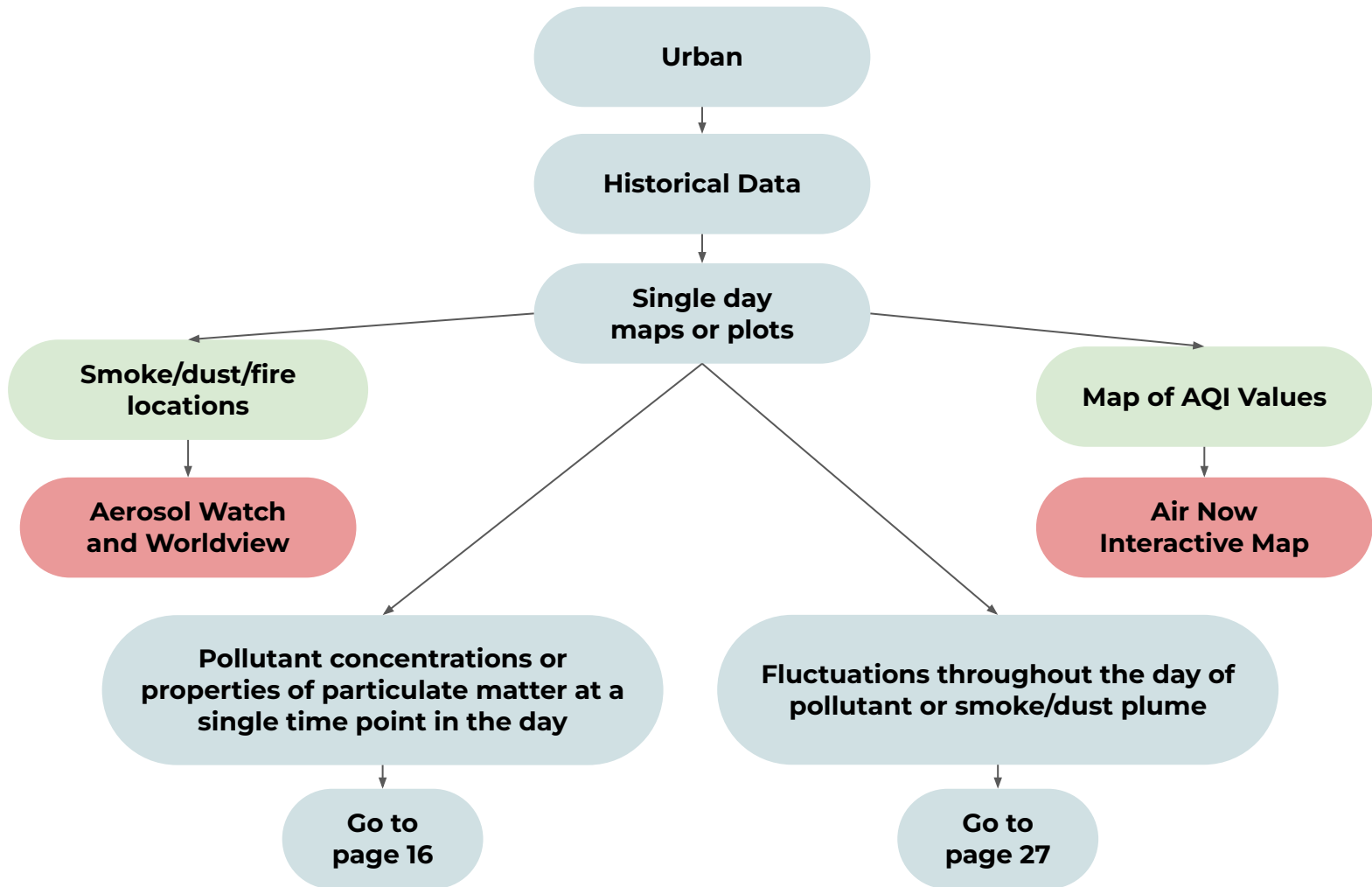


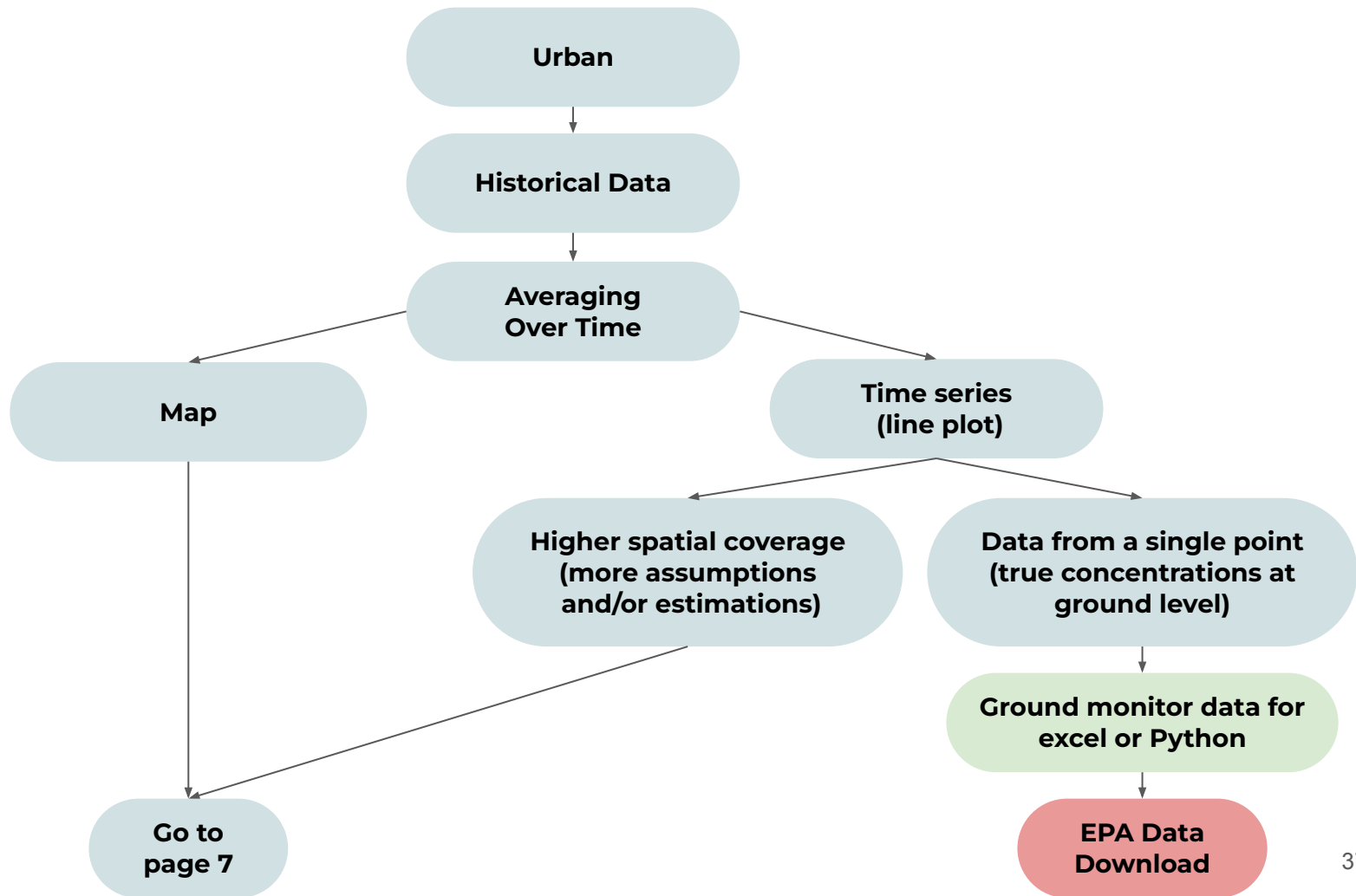


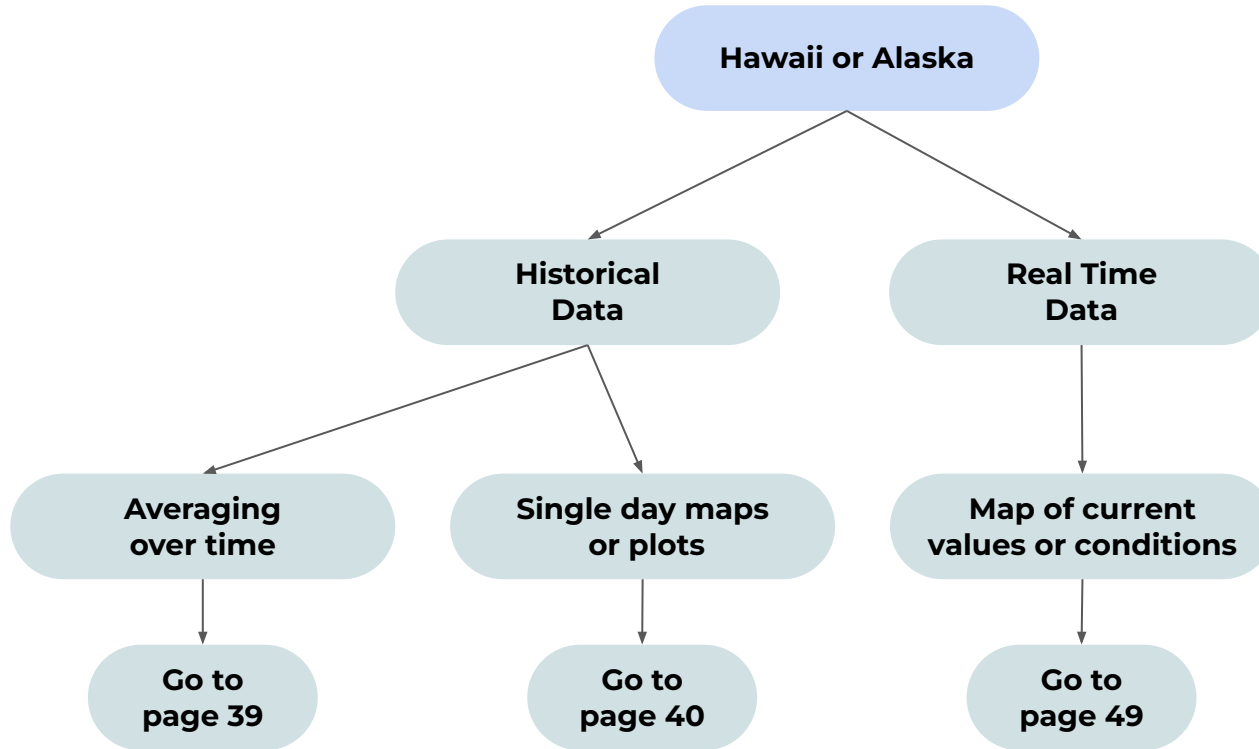


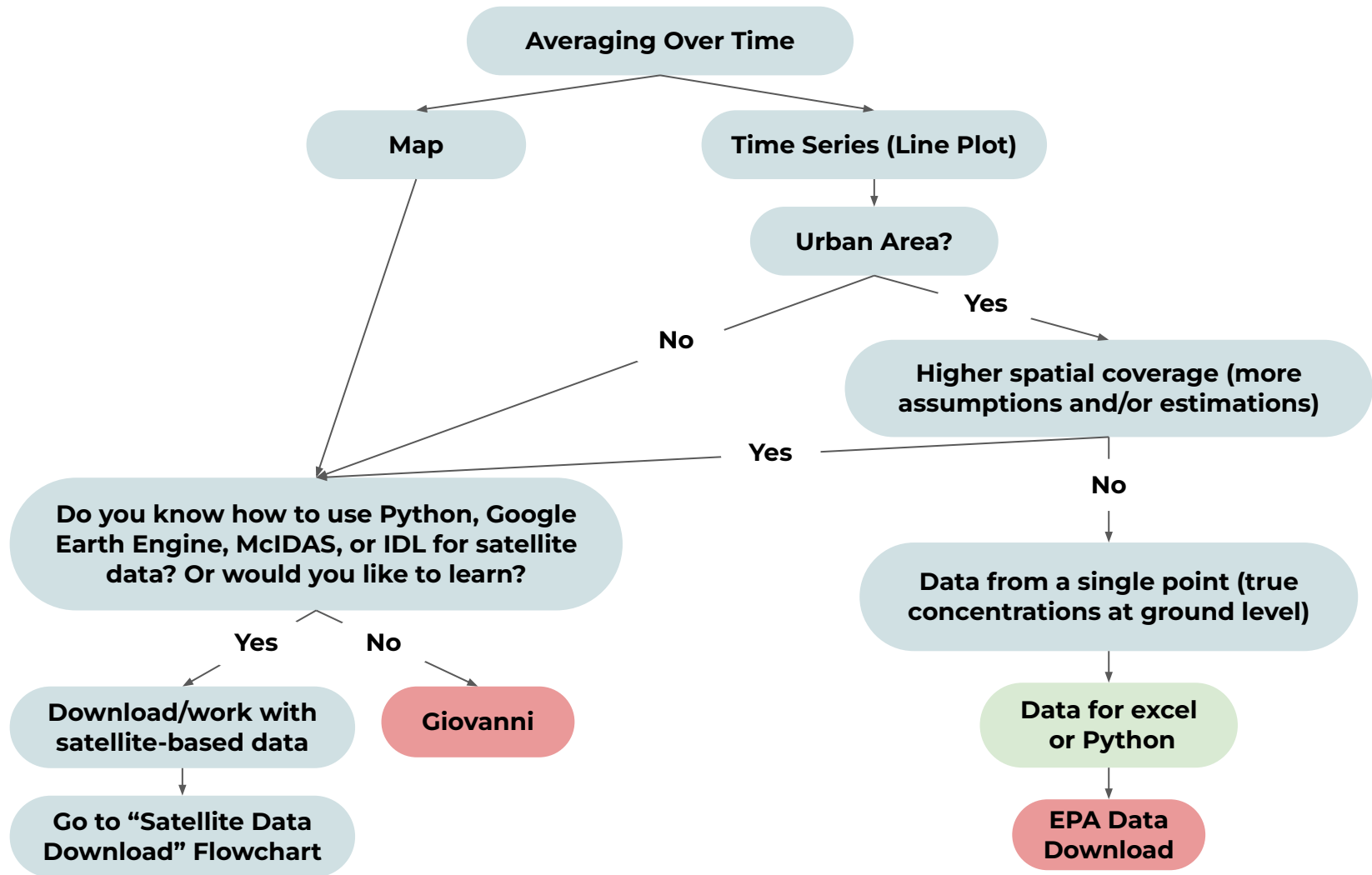


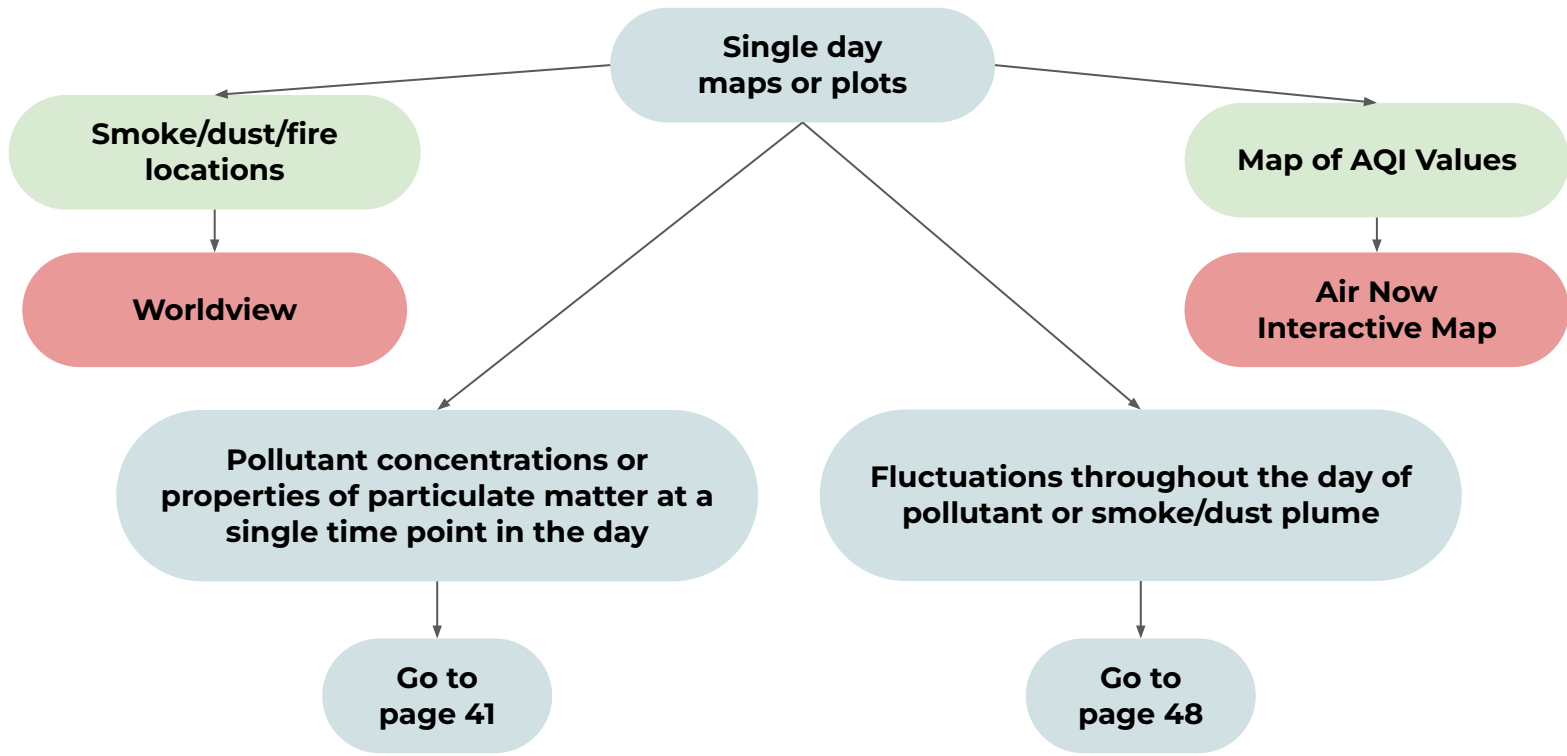




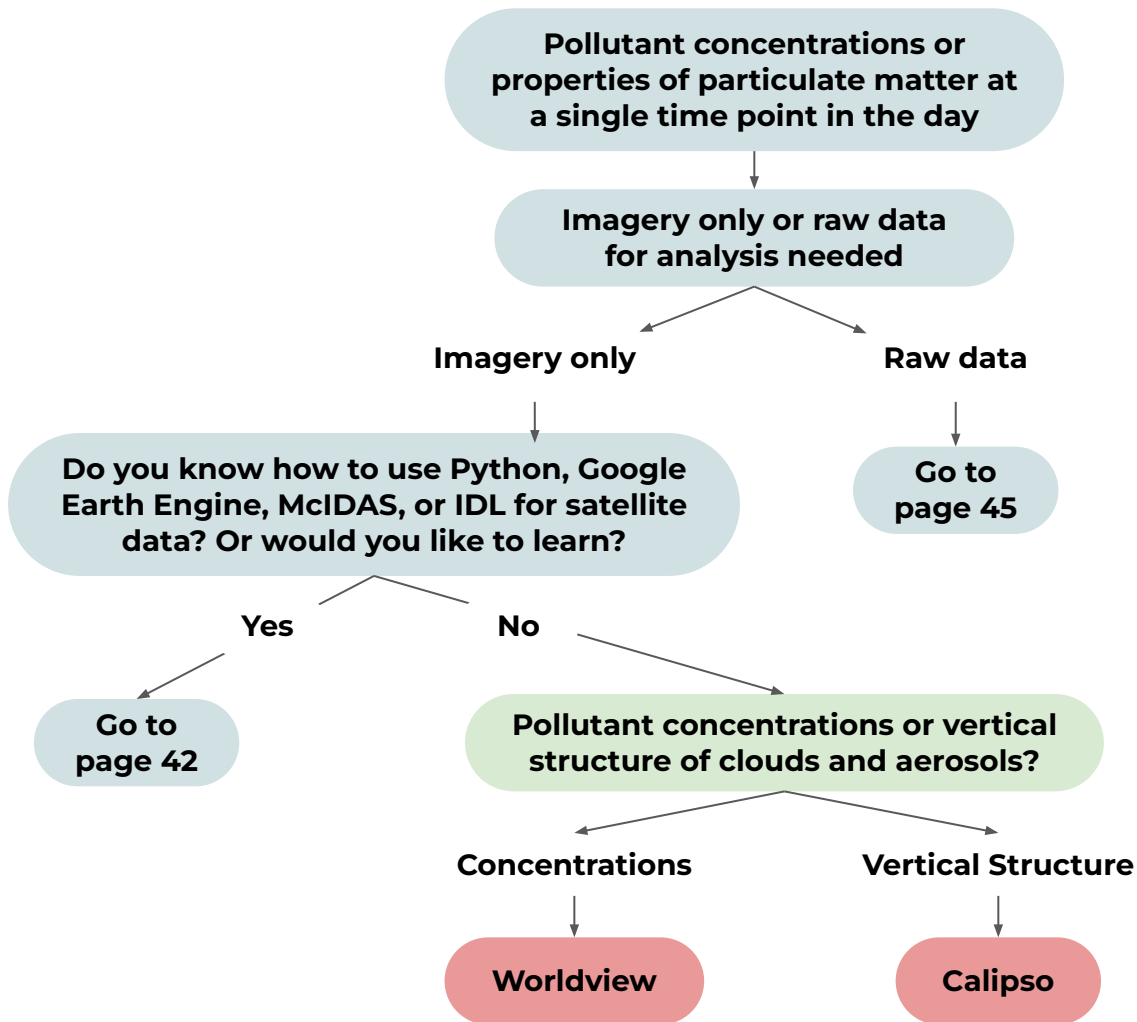


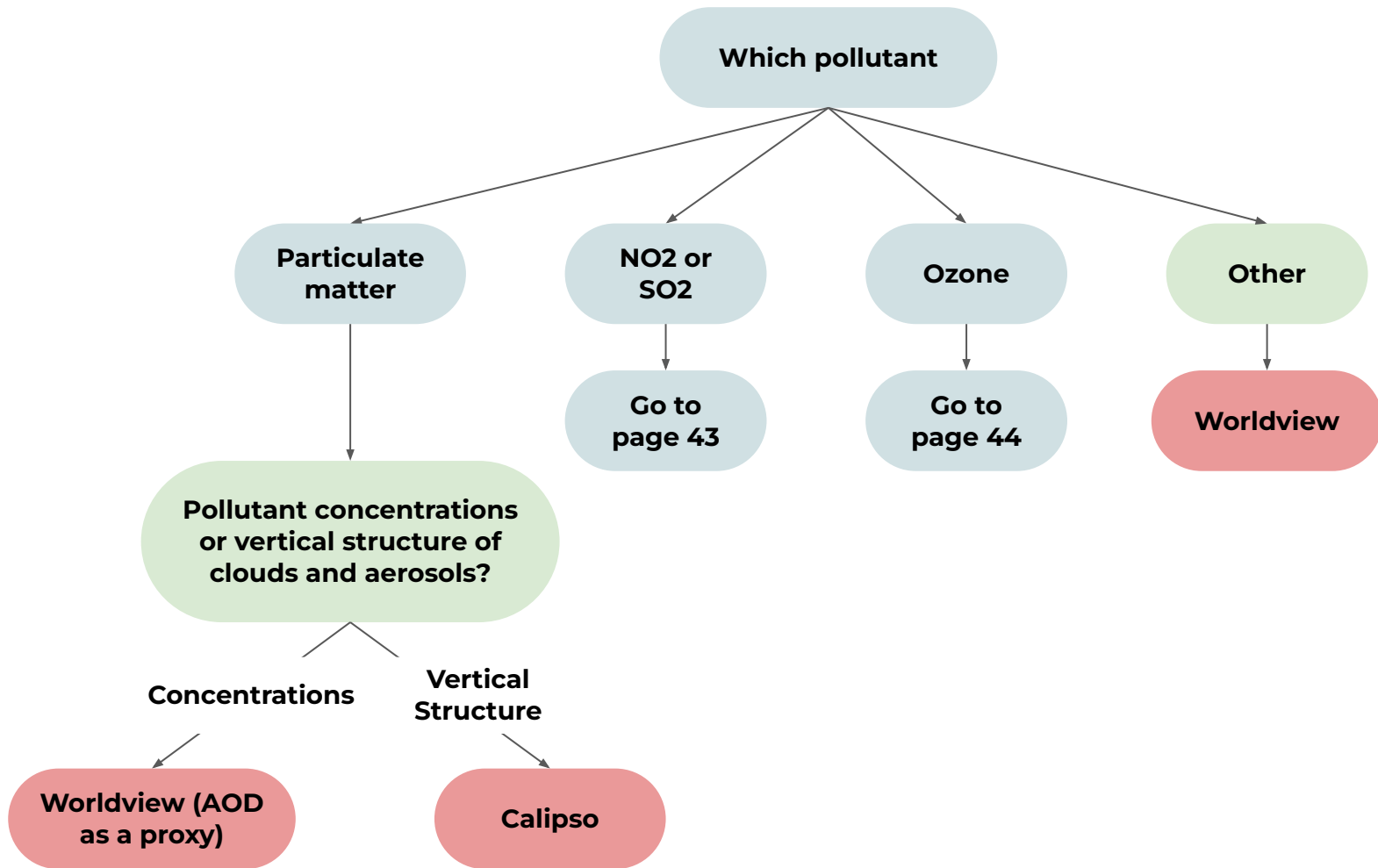


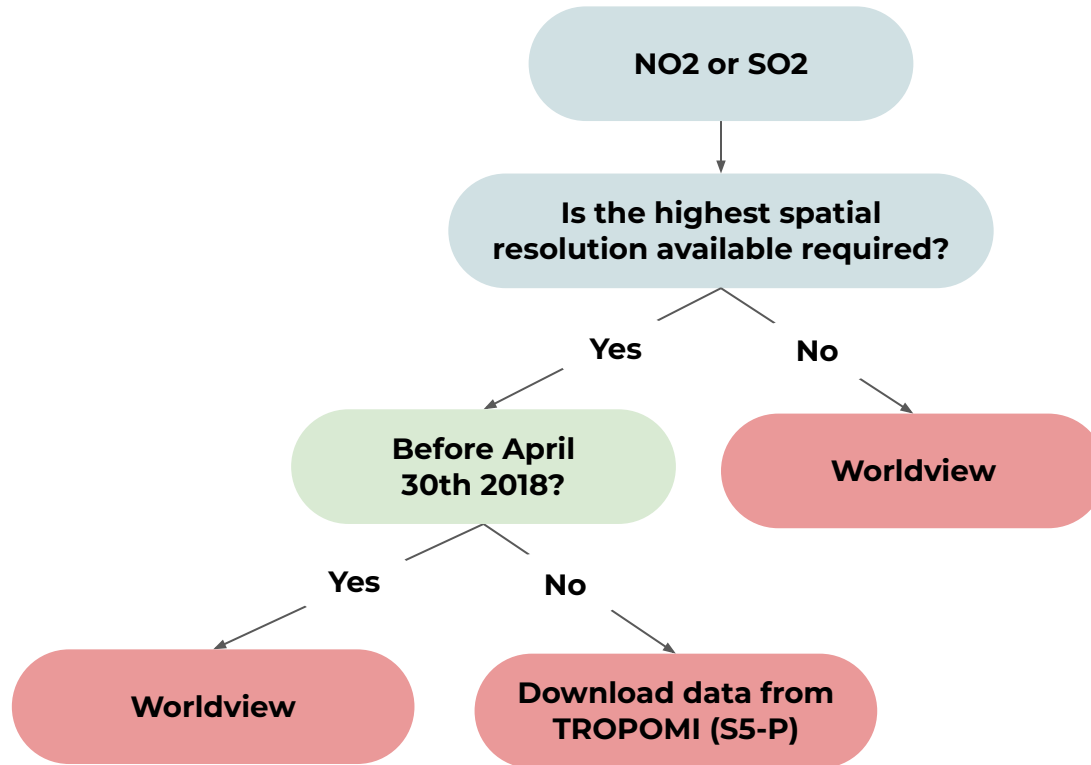


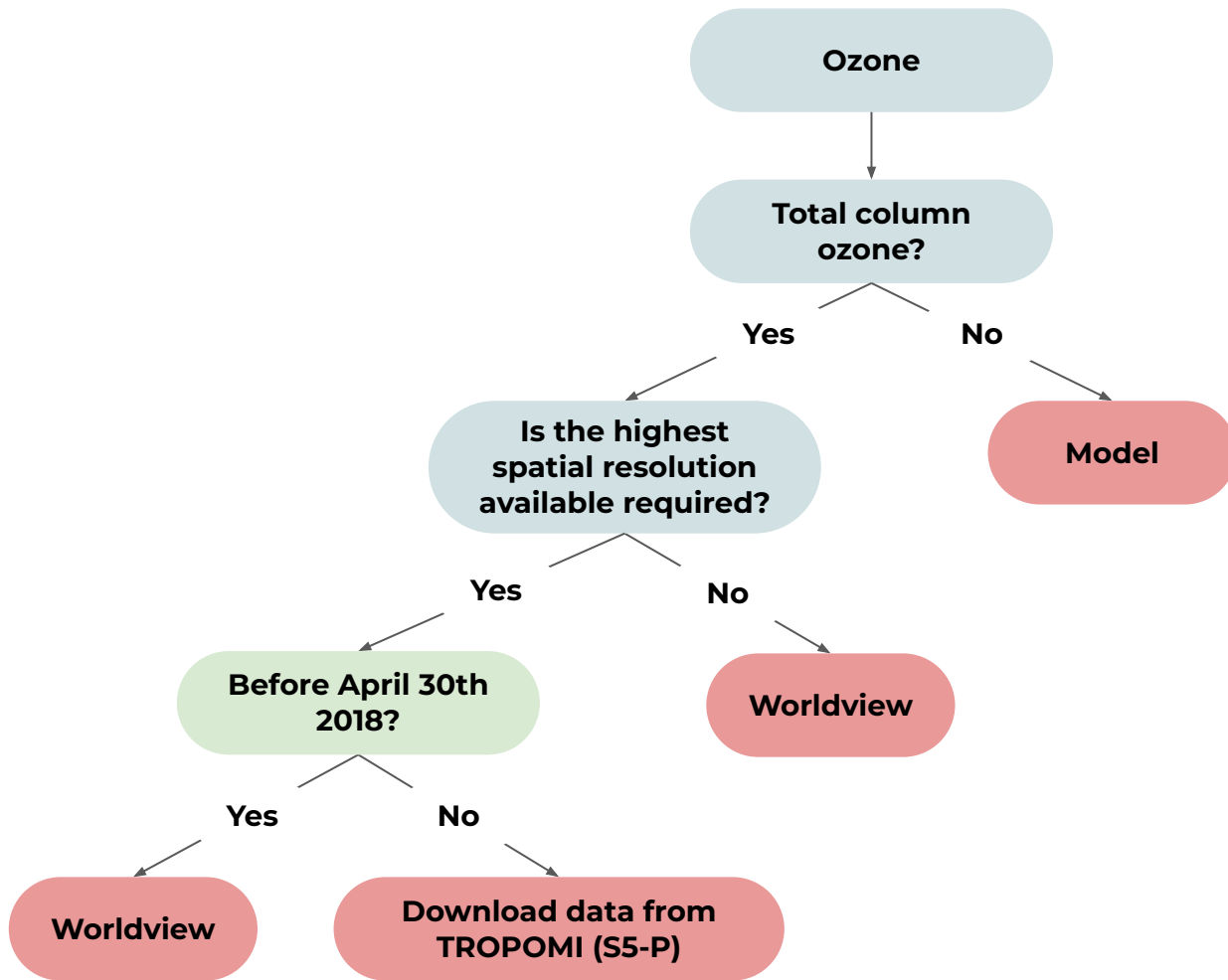


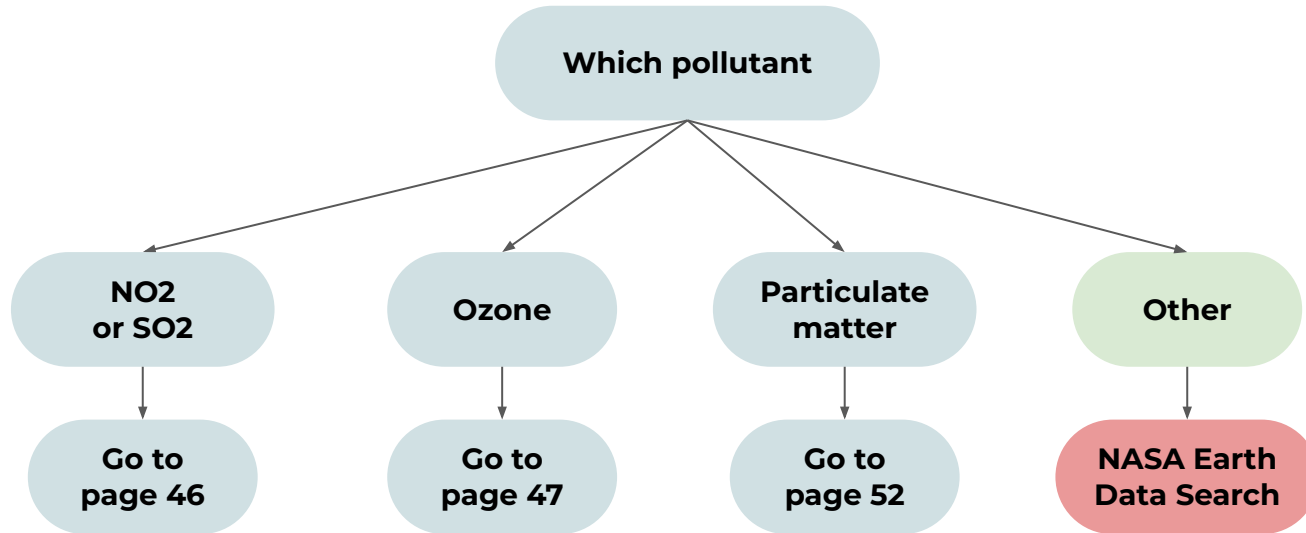


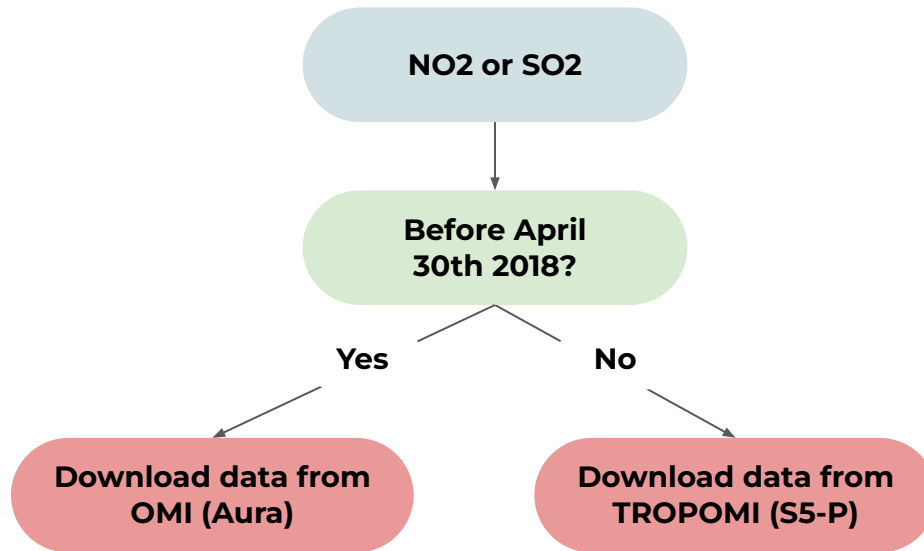


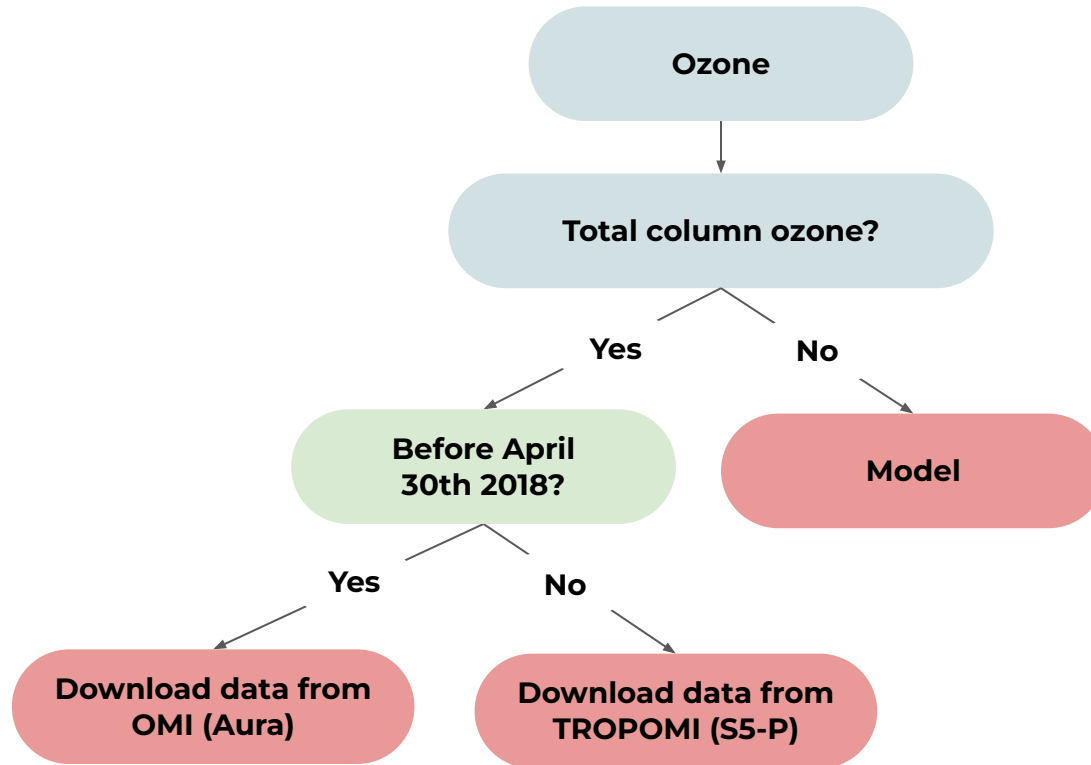


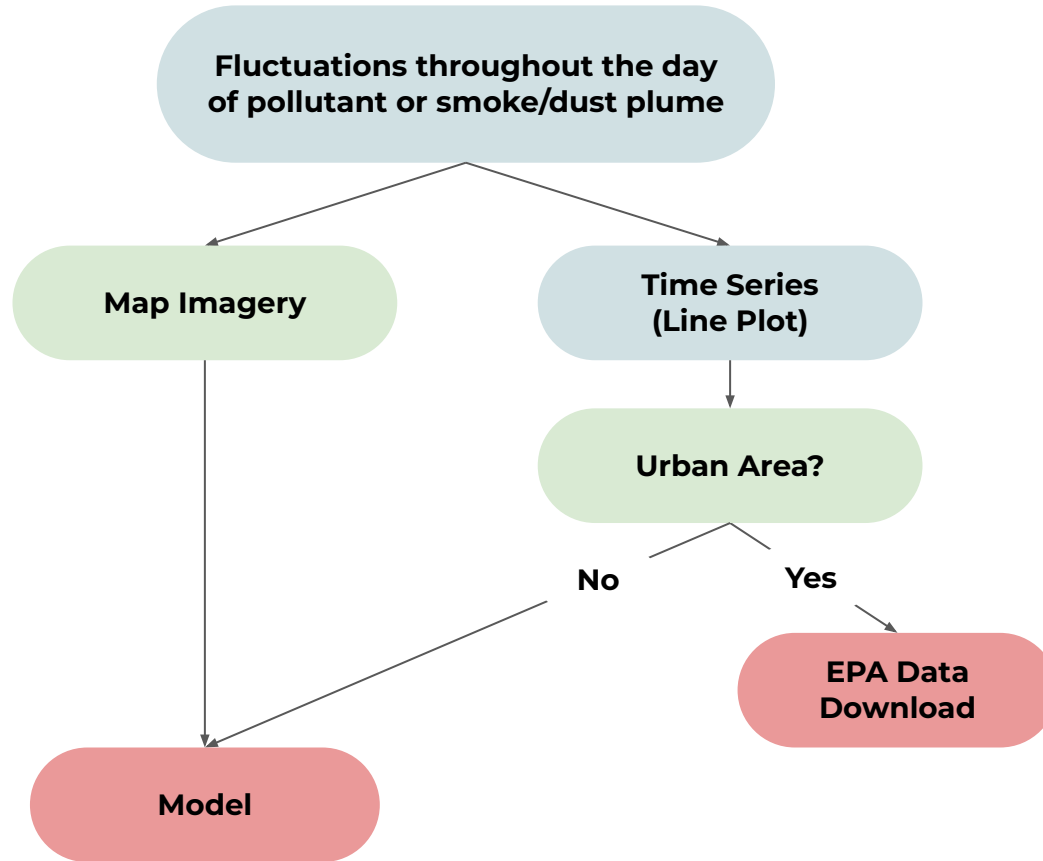




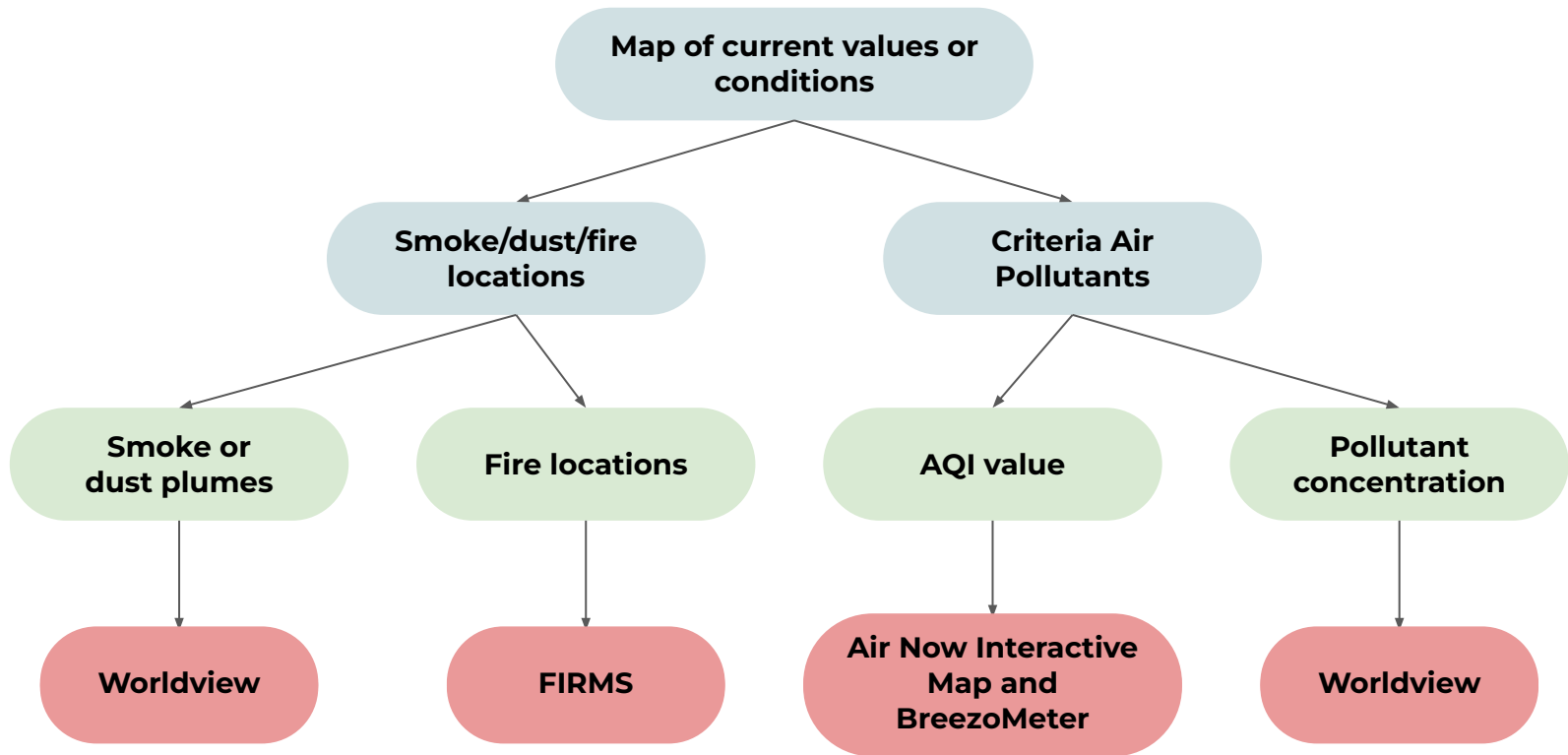




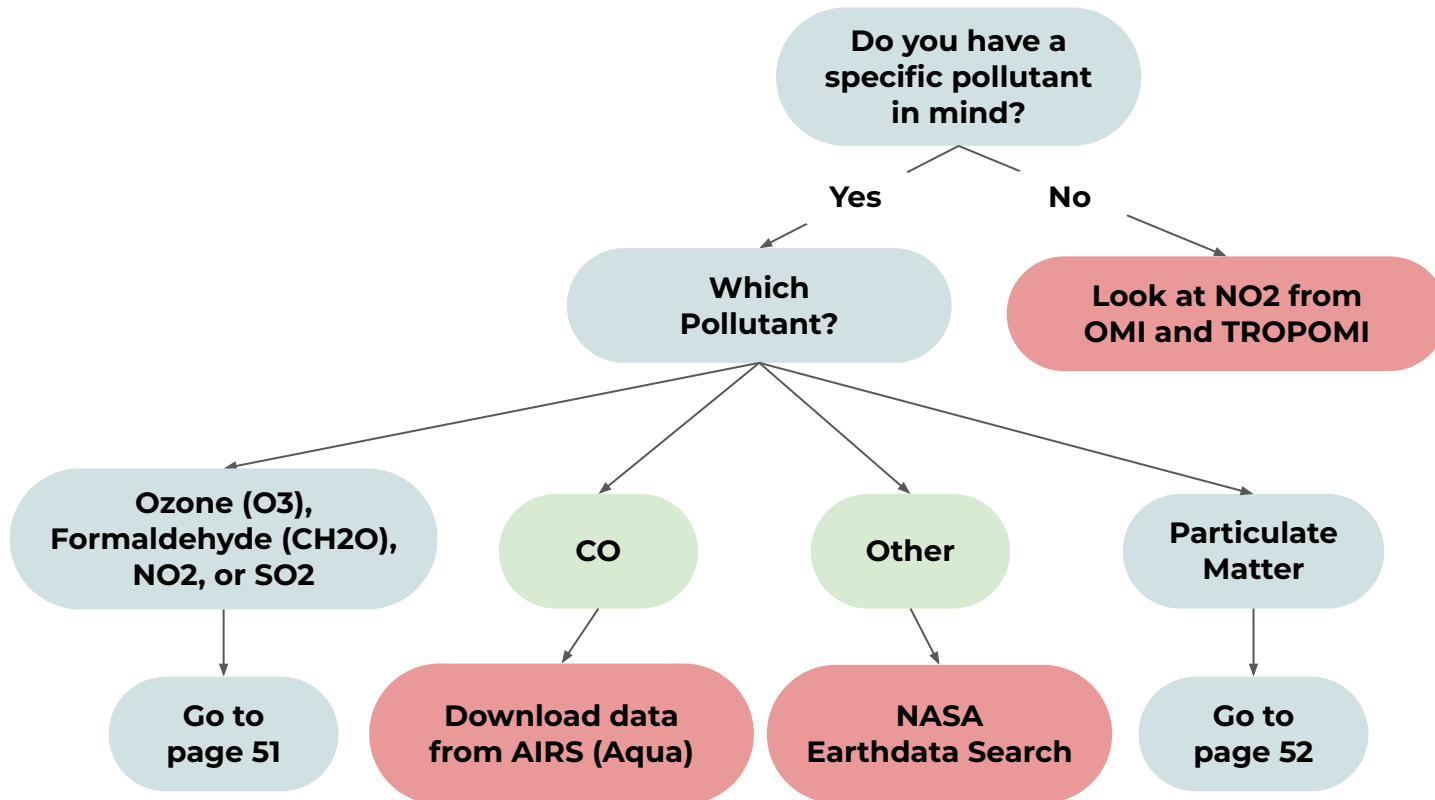


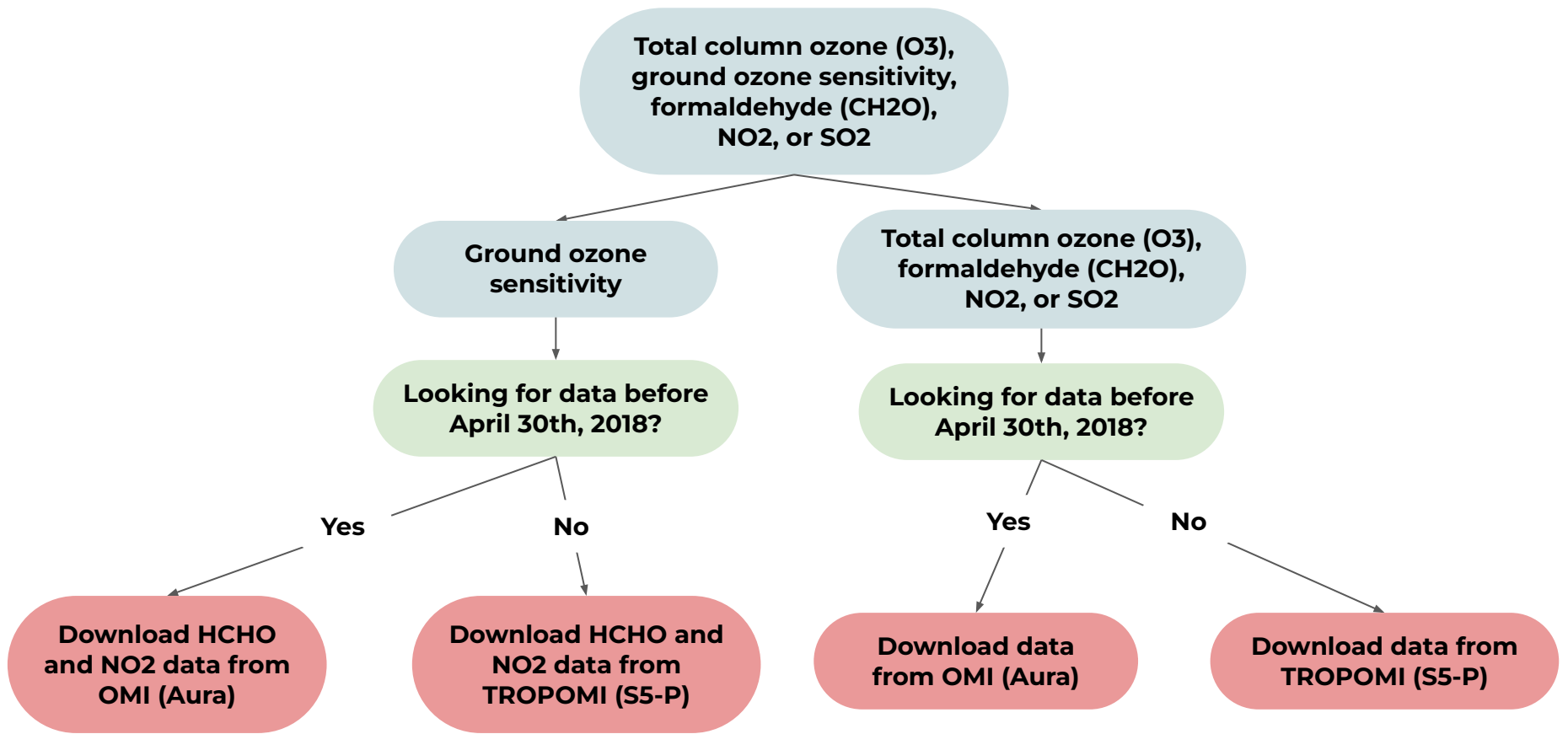


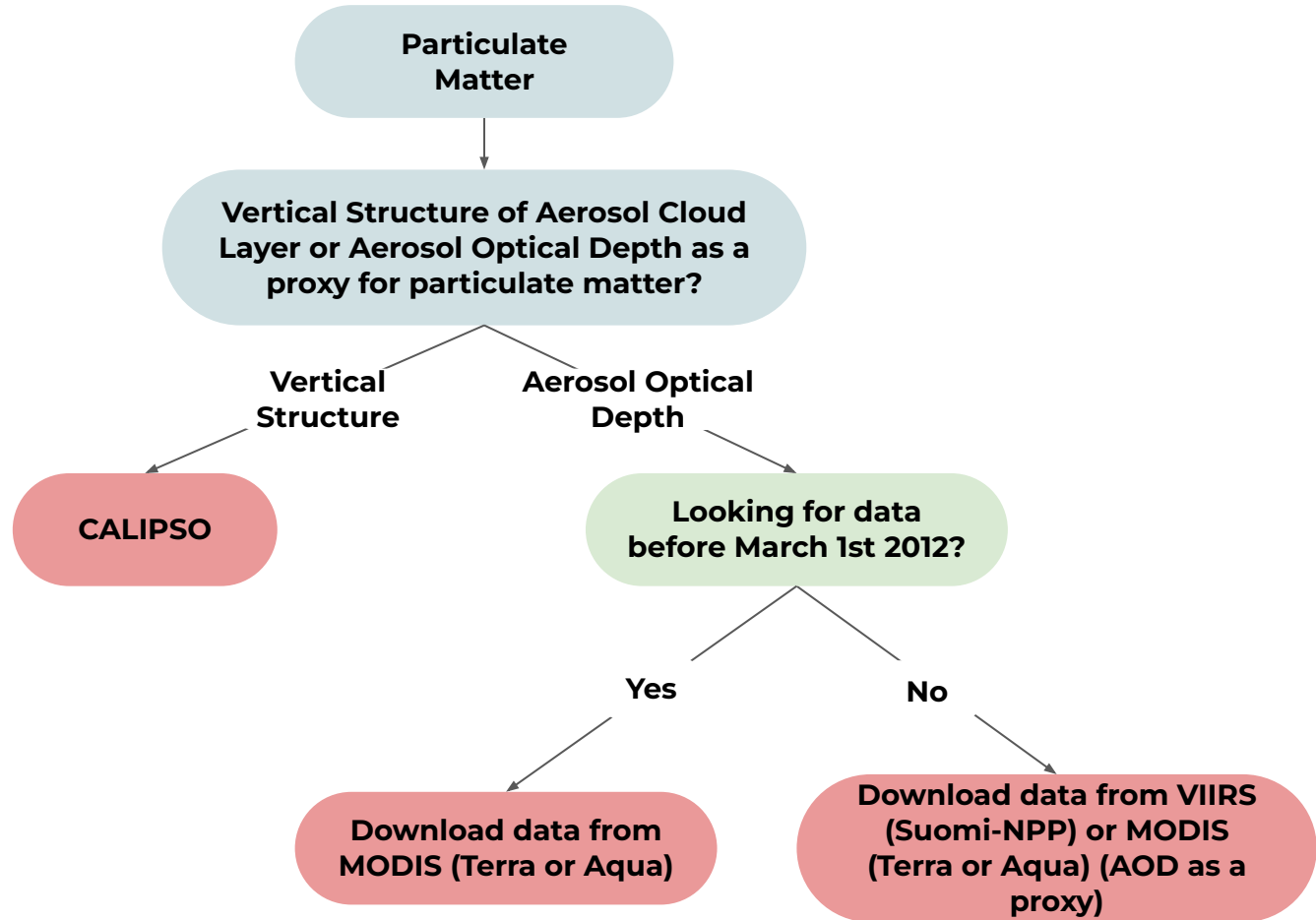




## Satellite Data Download







## **NASA Giovanni** →



Giovanni has the capabilities to create a variety of maps and plots to display satellite imagery without coding skills. Some examples available include a time averaged map, animations, or a time series plot. Additionally, the user can select the time frame and the region of the globe.

There is also a tutorial for Giovanni on the HAQAST website.

## **Giovanni Tutorial** →

**Wash U (1998-2021) dataset** →

**CACES (1999-2015) dataset** →

**SEDAC (2000-2016) dataset** →

The websites of these datasets offer publications that have utilized the datasets. It is recommended to explore these websites for more information.

## **Wash U (1998-2021) dataset** →

The website of this dataset offers publications that have utilized the dataset. It is recommended to explore the website for more information.

## **CACES (1988-2015) dataset** →

The CACES website offers publications that have utilized this dataset. It is recommended to explore this website for more information.



**CACES (1979-2015) dataset** →

**SEDAC (2000-2016) dataset** →

The websites of these datasets offer publications that have utilized the datasets. It is recommended to explore these websites for more information.

**Wash U (2005-2019) dataset** →

**CACES (1979-2015) dataset** →

**SEDAC (2000-2016) dataset** →

The websites of these datasets offer publications that have utilized the datasets. It is recommended to explore these websites for more information.

## **CACES (1979-2015) dataset** →

The website of this dataset offers publications that have utilized the dataset. It is recommended to explore this website for more information.

## **CACES (1990-2015) dataset** →

The website of this dataset offers publications that have utilized the dataset. It is recommended to explore this website for more information.

## Aerosol Watch →

Aerosol Watch is a web-based platform where the user can map satellite imagery and the smoke or dust mask for the day of interest.

## NASA Worldview →



NASA Worldview is a web-based platform that can show satellite detections of fires for any day the user chooses. Additionally, there is a tutorial for Worldview on the HAQAST website.

## Worldview Tutorial →

## Aerosol Watch →

Aerosol Watch is a web-based platform where the user can map satellite imagery and the smoke or dust mask for the day of interest. The user can view satellite data from the GOES-16 and GOES-17 geostationary satellites. A geostationary satellite takes multiple measurements per day of the same area, so it can track changes throughout one day. Both GOES-16 and GOES-17 provide true color imagery (useful for trying to see a smoke or dust plume) and AOD (aerosol optical depth).

## **Air Now Interactive Map** →

The Air Now Interactive Map shows AQI values for ozone and particulate matter using data from monitors in North America.

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The Air Now Interactive Map shows AQI values for ozone and particulate matter using data from monitors in North America.

## **BreezoMeter** →

BreezoMeter shows the overall AQI across the world using ground-based measurements from monitors and satellite data from all 6 of the criteria air pollutants.



## **NASA Worldview** →



NASA Worldview is an interactive web-based platform that displays satellite-based data products related to air quality and health. NASA Worldview displays satellite-based data products providing the pollutant concentration. In this platform, the user can plot aerosol optical depth (AOD) as a proxy for particulate matter. Additionally, there is a tutorial for Worldview on the HAQAST website.

## **Worldview Tutorial** →

## Calipso →

The Calipso website offers profile observation images from the year 2013-present. For information about Calipso, downloading the data, and visualizing the data see sources below

CALIPSO Data User's Guide →

CALIPSO Data →

# Download data from TROPOMI (S5-P)



TROPOMI offers higher resolution SO<sub>2</sub>, NO<sub>2</sub>, and ozone data than what is available on NASA Worldview or the OMI satellite. Data from the TROPOMI instrument is available at NASA Earthdata Search. Additionally, there is an Applied Remote Sensing Training (ARSET) tutorial available for using TROPOMI data

**[NASA Earth Data Search](#)** →

**[ARSET Tutorial](#)** →

# Download HCHO and NO<sub>2</sub> data from TROPOMI (S5-P)



TROPOMI offers higher resolution SO<sub>2</sub> data than what is available on NASA Worldview. A tutorial for ozone sensitivity using HCHO and NO<sub>2</sub> is available through the Holloway Group website. Additionally, see related publications below.

**[Mapping TROPOMI Tutorial](#)** →

**[Publication: Inferring Changes in Summertime Surface Ozone–NO<sub>x</sub>–VOC Chemistry over U.S. Urban Areas from Two Decades of Satellite and Ground-Based Observations](#)** →

**[Publication: Investigating Changes in Ozone Formation Chemistry during Summertime Pollution Events over the Northeastern United States](#)** →

# Download HCHO and NO<sub>2</sub> data from OMI (Aura)



If it is, then they will be guided to downloading data from OMI. Additionally, there are Applied Remote Sensing Training (ARSET) tutorials available for using OMI data.

**ARSET: Data Analysis Tools for High Resolution Air Quality Satellite Datasets** →

**ARSET: Satellite Remote Sensing of Air Quality** →

# Download data from OMI (Aura)



There are Applied Remote Sensing Training (ARSET) tutorials available for using OMI data below

**[ARSET: Data Analysis Tools for High Resolution Air Quality Satellite Datasets](#)** →

**[ARSET: Satellite Remote Sensing of Air Quality](#)** →

# Download data from OMI (Aura)



OMI has data from 2004-present but has a coarser spatial resolution compared to TROPOMI. Data from the OMI instrument is available at NASA Earthdata Search. If the user has yet to work with OMI data, it is recommended to complete the ARSET tutorial. For more information about the capabilities of OMI, view the publications below.

[ARSET Tutorial](#) →

[NASA Earth Data Search](#) →

[Publication: Ambient Formaldehyde over the United States from Ground-Based \(AQS\) and Satellite \(OMI\) Observations](#) →

[Publication: The benefits of lower ozone due to air pollution emission reductions \(2002-2011\) in the Eastern United States during extreme heat](#) →

## **Download SEDAC dataset** →

These datasets provide daily concentrations at the zip code and 1km spatial resolution. The SEDAC website offers publications that have utilized the dataset. It is recommended to explore this website for more information.



## Using a Model

If the day of interest is not between the years 2000-2016, you are recommended to use a model. Publication related to ground level ozone and modeling:

**Publication: An Ensemble Learning Approach for Estimating High Spatiotemporal Resolution of Ground-Level Ozone in the Contiguous United States** →

# Using a Model

If you are not interested in AOD, a smoke plume, or a dust plume, you will be guided towards using a model. This is because there is not currently a satellite that monitors one area multiple times a day for anything other than AOD or true color imagery. To learn more about modeling, see resources below.

**[EPA Support Center for Regulatory Atmospheric Modeling \(SCRAM\)](#)** →

**[EPA Air Quality Modeling](#)** →

**[Publication: Daily, Seasonal, and Spatial Trends in PM2.5 Mass and Composition in Southeast Texas Special Issue of Aerosol Science and Technology on Findings from the Fine Particulate Matter Supersites Program](#)** →

## [NASA Worldview](#) →



NASA Worldview is a web-based platform that can show satellite detections of fires for any day the user chooses. It has aerosol optical depth (AOD) data products that can be used as a proxy for particulate matter. Additionally, there is a tutorial for Worldview on the HAQAST website.

## [Worldview Tutorial](#) →

## [Aerosol Watch](#) →

Aerosol Watch is a web-based platform where the user can map satellite imagery and the smoke or dust mask for the day of interest. It has aerosol optical depth (AOD) data products that can be used as a proxy for particulate matter.

## NOAA HMS →

NOAA Hazard Mapping System (HMS) uses satellite data to show where there are smoke plumes and fire points.

## Aerosol Watch →

Aerosol Watch is a web-based platform where the user can map satellite imagery and the smoke or dust mask for the day of interest. Aerosol Watch plots true color imagery from the GOES-16 and GOES-17 geostationary satellites as well as a smoke mask. Useful when identifying a smoke plume.

## **NASA Earth Data Search →**

NASA Earth Data Search is a website where the user can filter through keywords and data formats to find certain data products and explore pollutants measured by satellite data.

# Download data from MODIS (Terra or Aqua)



Download satellite data from the MODIS sensor aboard the Terra and Aqua satellites. Additionally, there is an Applied Remote Sensing Training (ARSET) tutorial available for using MODIS data. For a publication using MODIS data, see below.

**[ARSET Tutorial](#)** →

**[Publication: Estimating PM2.5 in Southern California using satellite data: Factors that affect model performance](#)** →

# Download data from VIIRS (Suomi-NPP) or MODIS (Terra or Aqua) (AOD as a proxy)



Download satellite data from the VIIRS sensor aboard the Suomi-NPP satellite or the MODIS sensor. Additionally, there is an ARSET tutorial available comparing MODIS and VIIRS data to help the user learn more about the two sensors and choose between the two. Both sensors measure aerosol optical depth (AOD) that can be used as a proxy for particulate matter.

**[ARSET Tutorial](#)** →

**[Publication: Long-term variation of aerosol optical properties associated with aerosol types over East Asia using AERONET and satellite \(VIIRS, OMI\)](#)** →

# EPA Data Download

The EPA offers hourly data, daily data, and pre-generated data files for criteria air pollutants, speciation data, hazardous air pollutants and more. For more information and a related publication, see resources below.

**[EPA Download Daily Data](#)** →

**[EPA Download Pre-Generated Data Files](#)** →

**[Publication: Diurnal Patterns in Global Fine Particulate Matter Concentration](#)** →



## **NASA FIRMS** →

NASA FIRMS is an interactive website that uses data from the Landsat satellite, the VIIRS sensors (aboard the S-NPP and NOAA-20 satellites), and the MODIS sensors (aboard the Aqua and Terra satellites) to indicate the locations of fires and hotspots.

## Download data from AIRS (Aqua)

If you are interested in CO, you can download data from the AIRS sensor. For a tutorial on using satellite data and a related article, see below.

**[ARSET Tutorial](#)** →

**[Article: NASA Monitors Carbon Monoxide From California Wildfires](#)** →

# Look at NO<sub>2</sub> from OMI and TROPOMI



If you do not have a specific pollutant in mind, then look at NO<sub>2</sub> data from the satellite instruments OMI and TROPOMI. These instruments measure various air pollutants such as NO<sub>2</sub> which is a great place to start. Data from these instruments are available through NASA Earthdata Search. To get started, there is an Applied Remote Sensing Training Program (ARSET) tutorial.

**[ARSET Tutorial](#)** →

**[NASA Earth Data Search](#)** →