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

Jennifer McGinnis, Tracey Holloway, Jenny Bratburd,
Olivia Goins, Carl Malings, Aaron Naeger

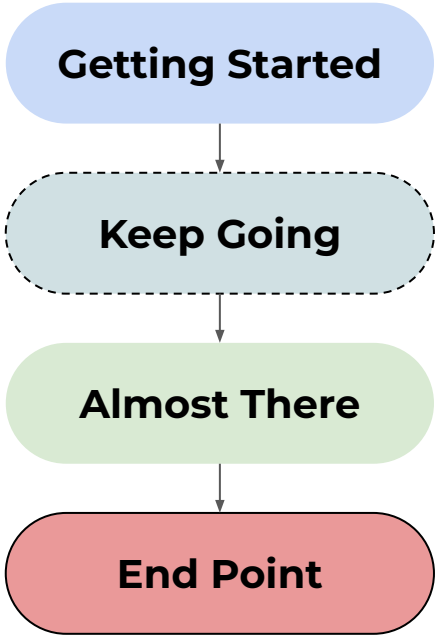
Welcome

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

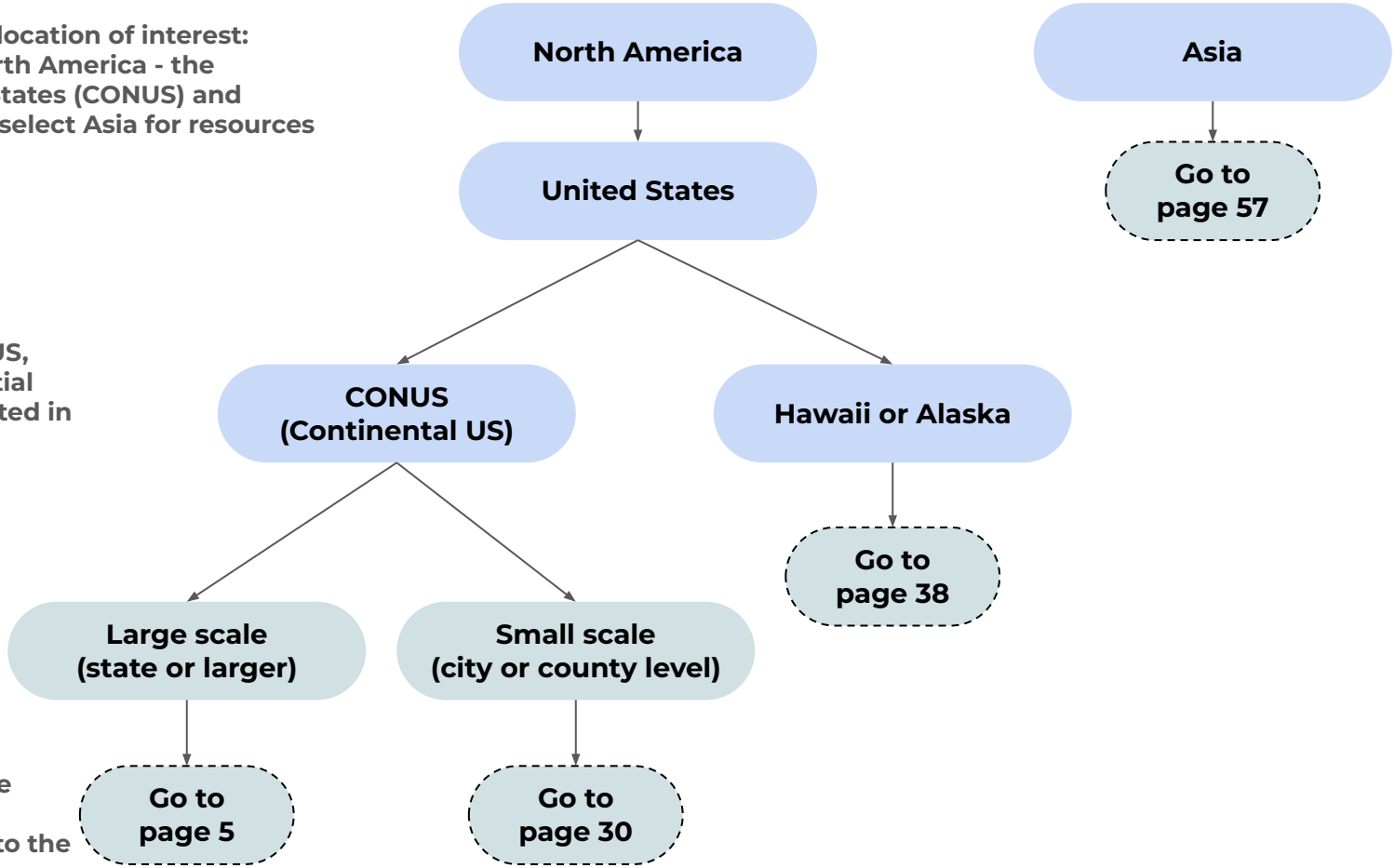
1. At the start, you will begin at the darkest shade of blue
2. Follow the best pathway related to your determined interest(s)
3. Based on your choice **click on the bubbles** to advance to the next slide in the series
4. As you advance through the flowchart, the colors will shift to a lighter blue, 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

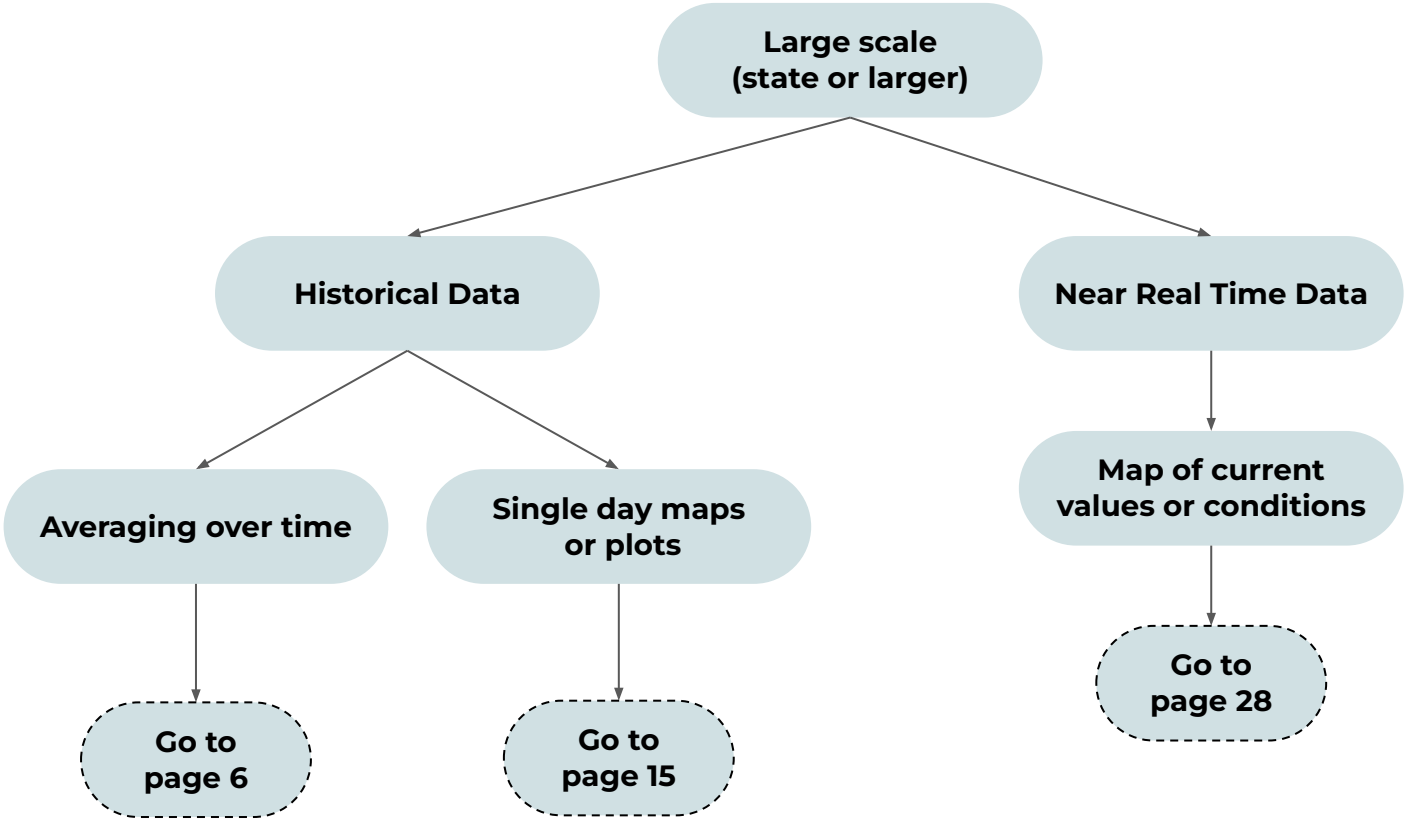


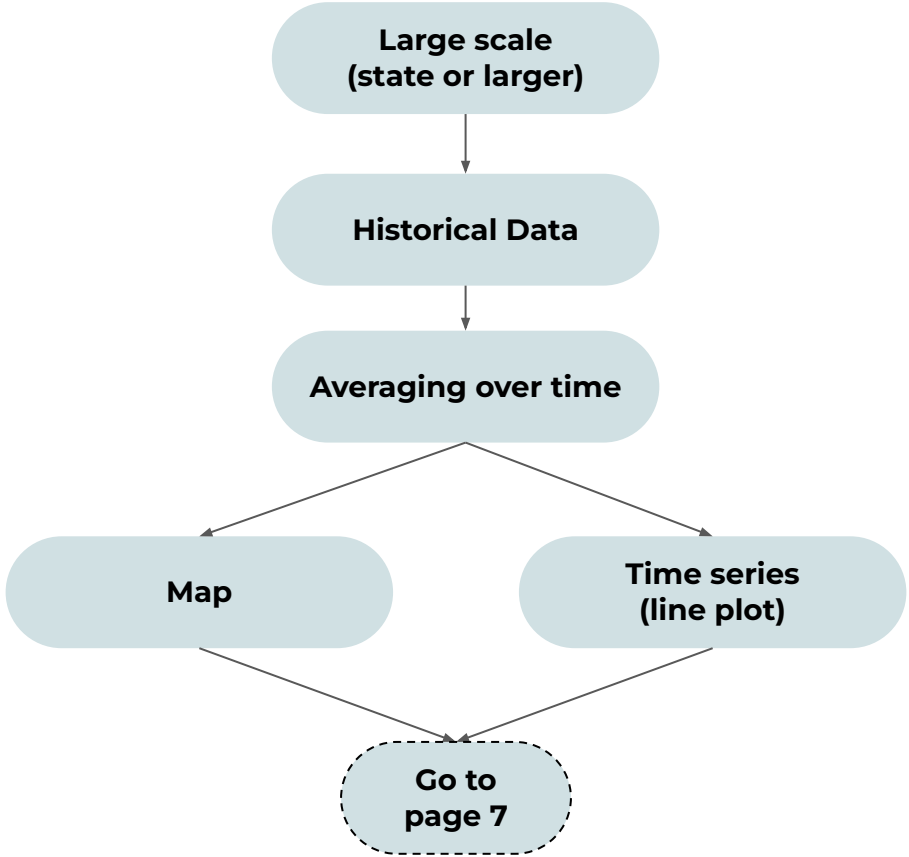
First, determine the location of interest: Choose between North America - the Continental United States (CONUS) and Hawaii or Alaska. Or select Asia for resources specific to Asia only.

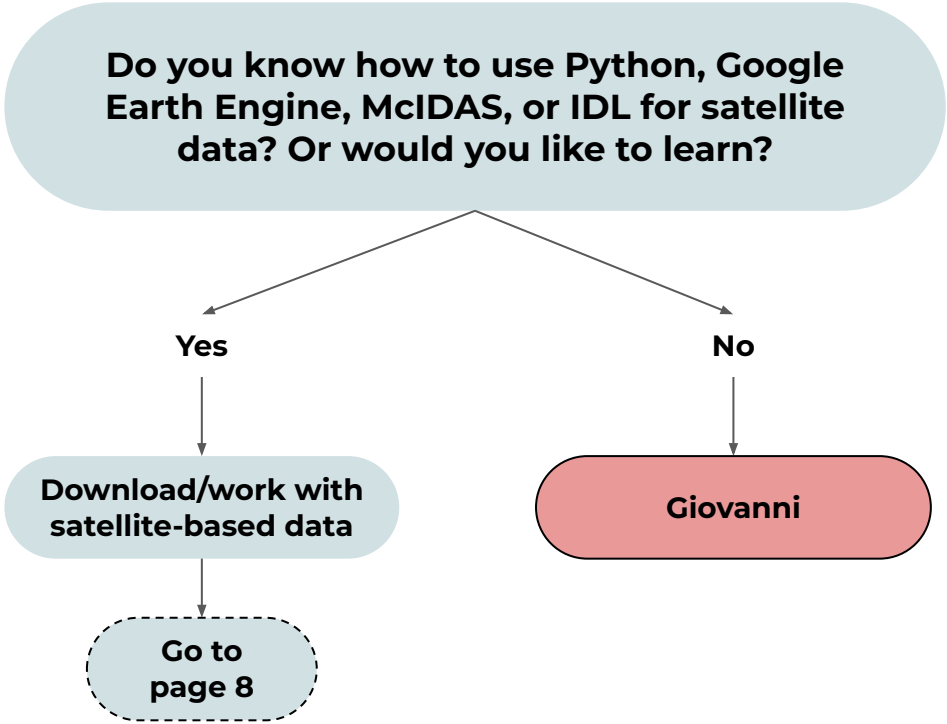
If interested in CONUS, determine what spatial scale you are interested in

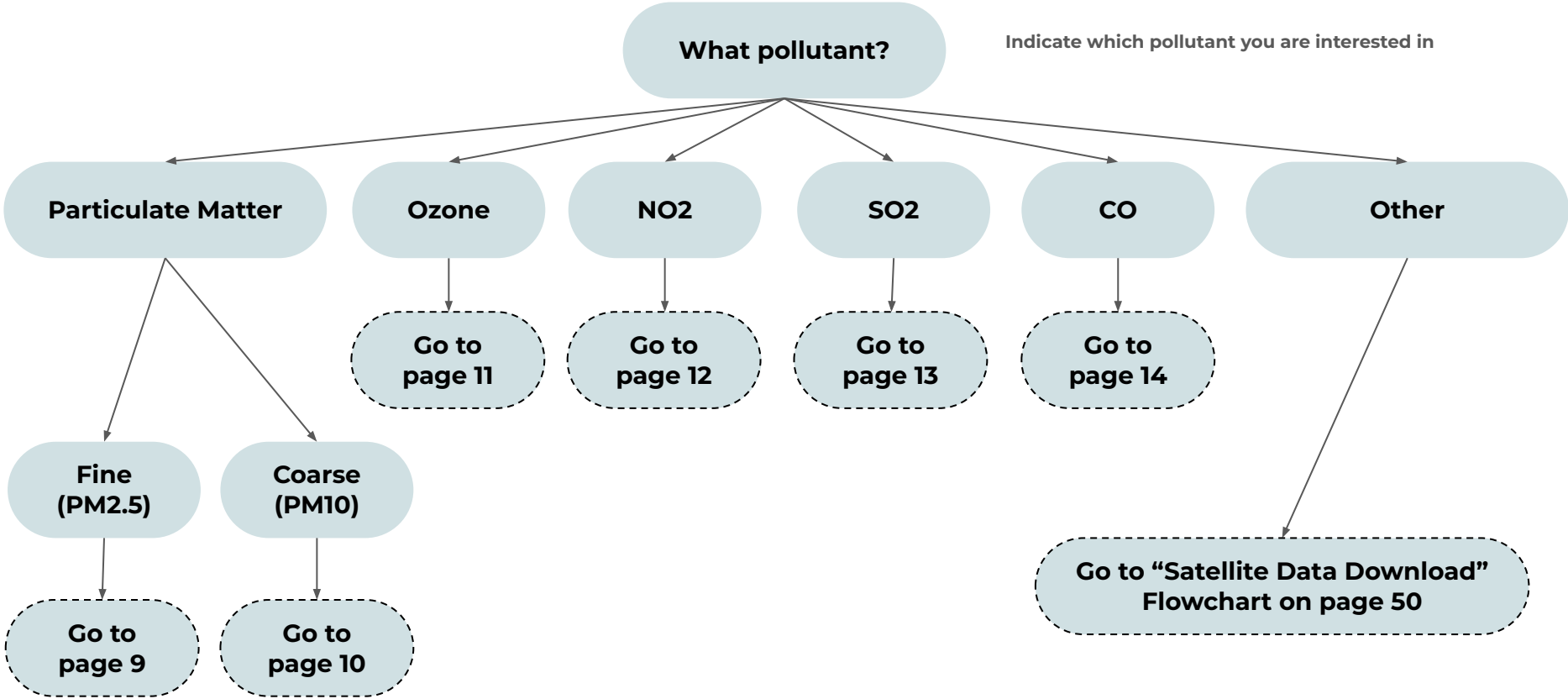
Depending on your choices, click on the pathway you are interested in to go to the next slide

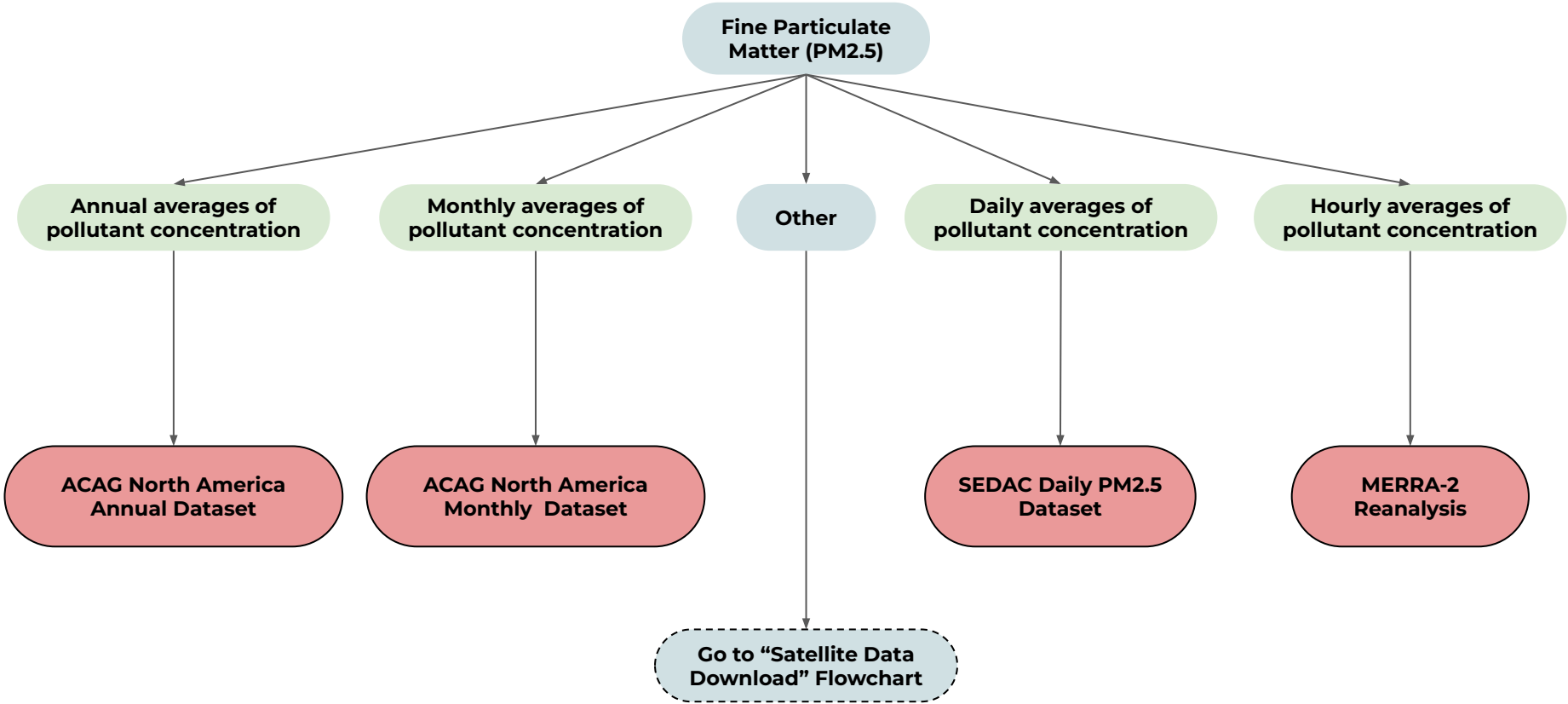


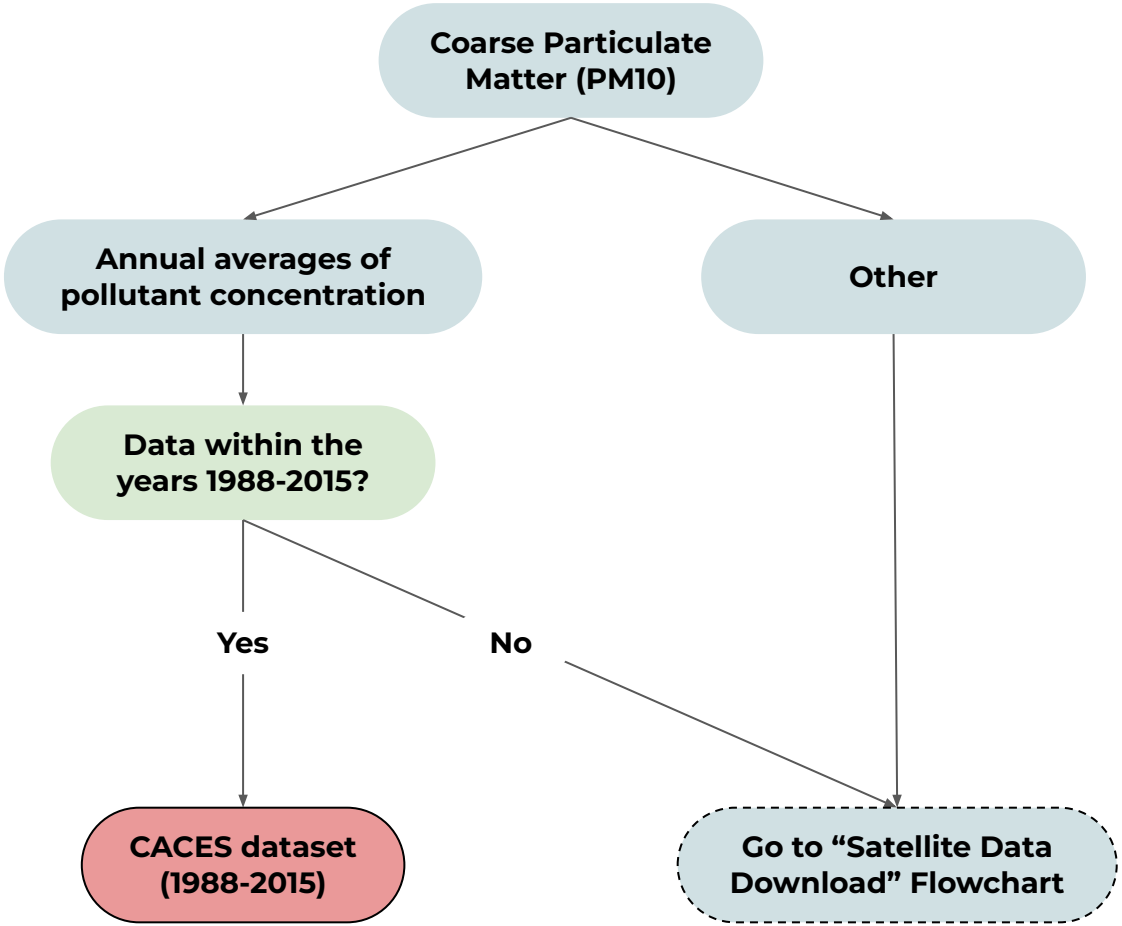

Large scale
(state or larger)
Historical Data
Near Real Time Data
Averaging over time
Single day maps
or plots
Map of current
values or conditions
Go to
page 6
Go to
page 15
Go to
page 28

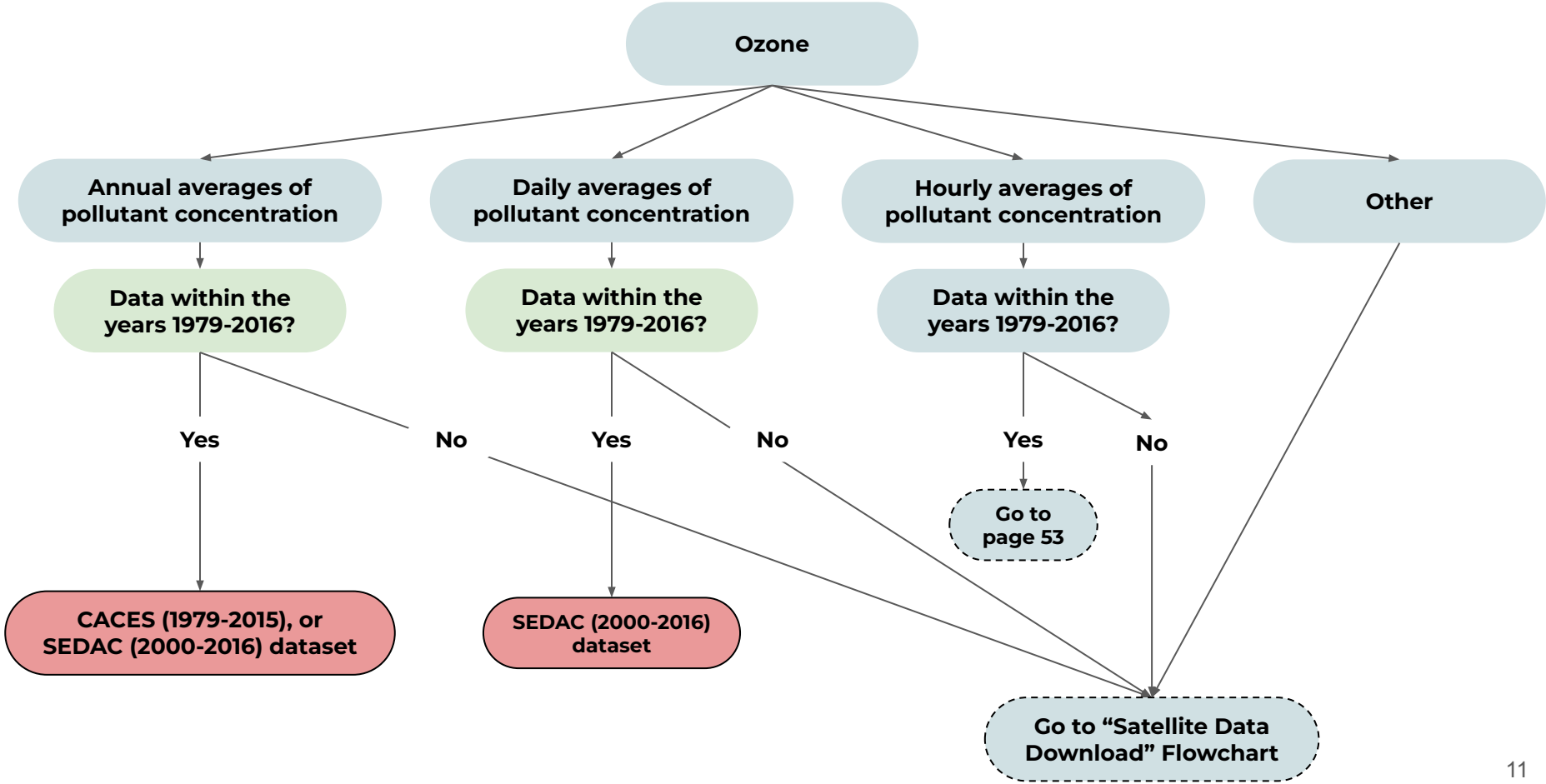

Large scale
(state or larger)
Historical Data
Averaging over time
Map
Time series
(line plot)
Go to
page 7

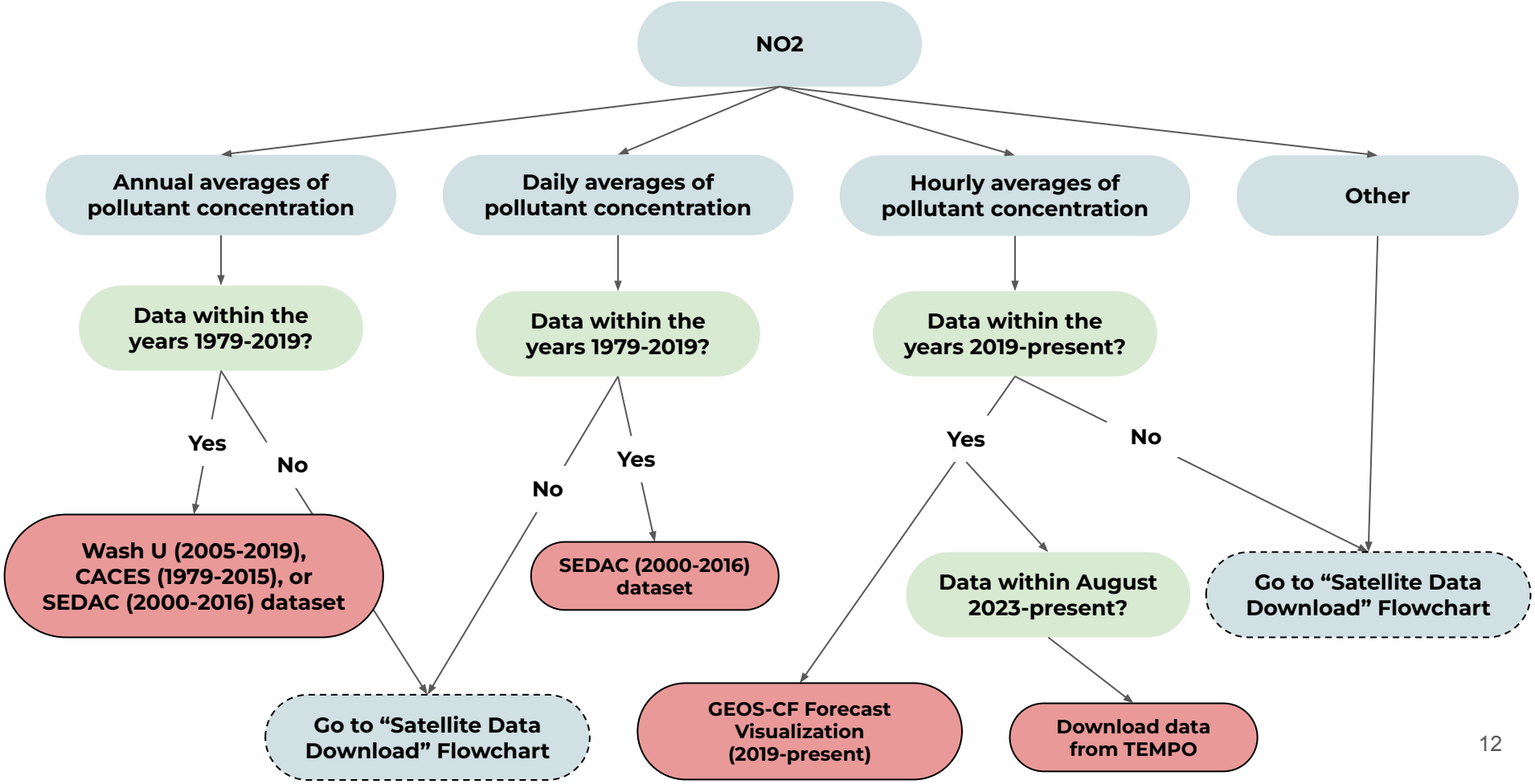

Do you know how to use Python, Google Earth Engine, McIDAS, or IDL for satellite data? Or would you like to learn?
Yes
No
Download/work with satellite-based data
Giovanni
Go to page 8

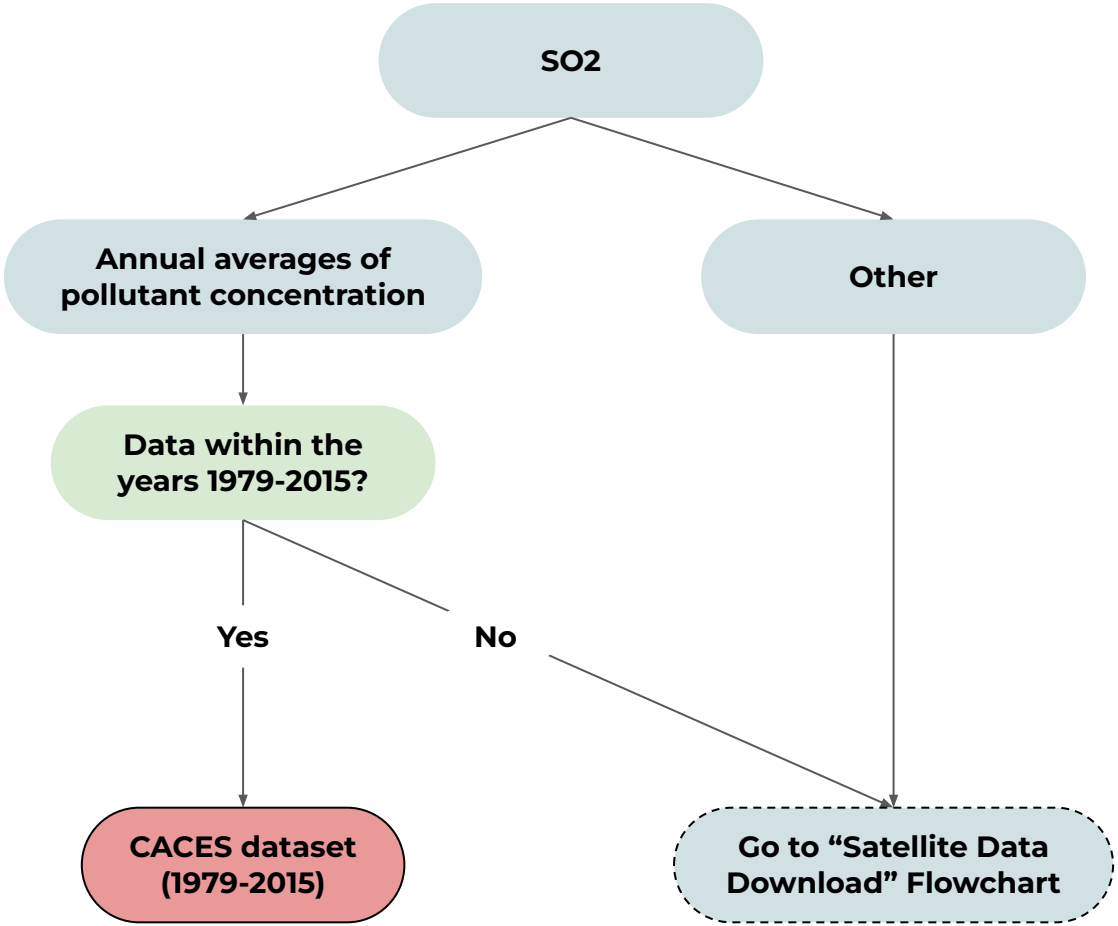

What pollutant?
Indicate which pollutant you are interested in
Particulate Matter
Ozone
NO2
SO2
CO
Other
Fine (PM2.5)
Coarse (PM10)
Go to page 9
Go to page 10
Go to page 11
Go to page 12
Go to page 13
Go to page 14
Go to “Satellite Data Download” Flowchart on page 50

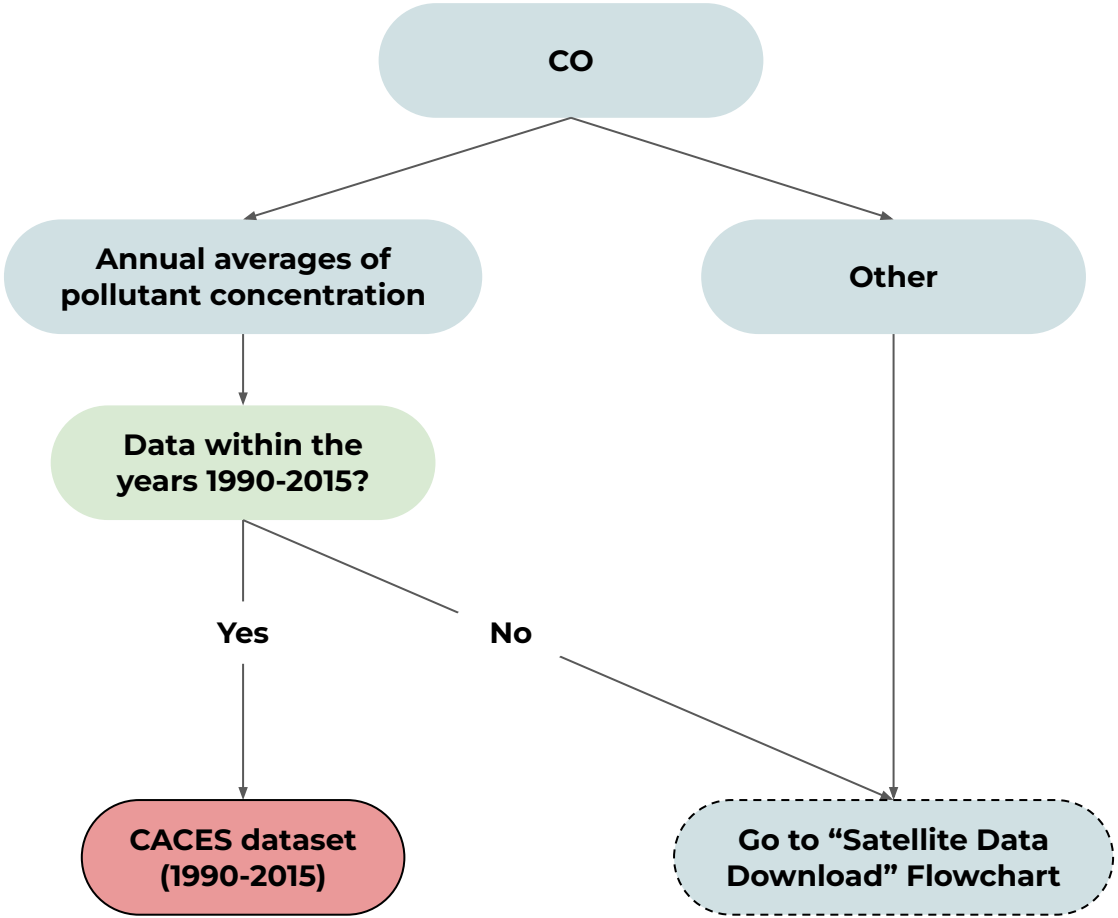

Fine Particulate Matter (PM2.5)
Annual averages of pollutant concentration
Monthly averages of pollutant concentration
Other
Daily averages of pollutant concentration
Hourly averages of pollutant concentration
ACAG North America Annual Dataset
ACAG North America Monthly Dataset
SEDAC Daily PM2.5 Dataset
MERRA-2 Reanalysis
Go to “Satellite Data Download” Flowchart

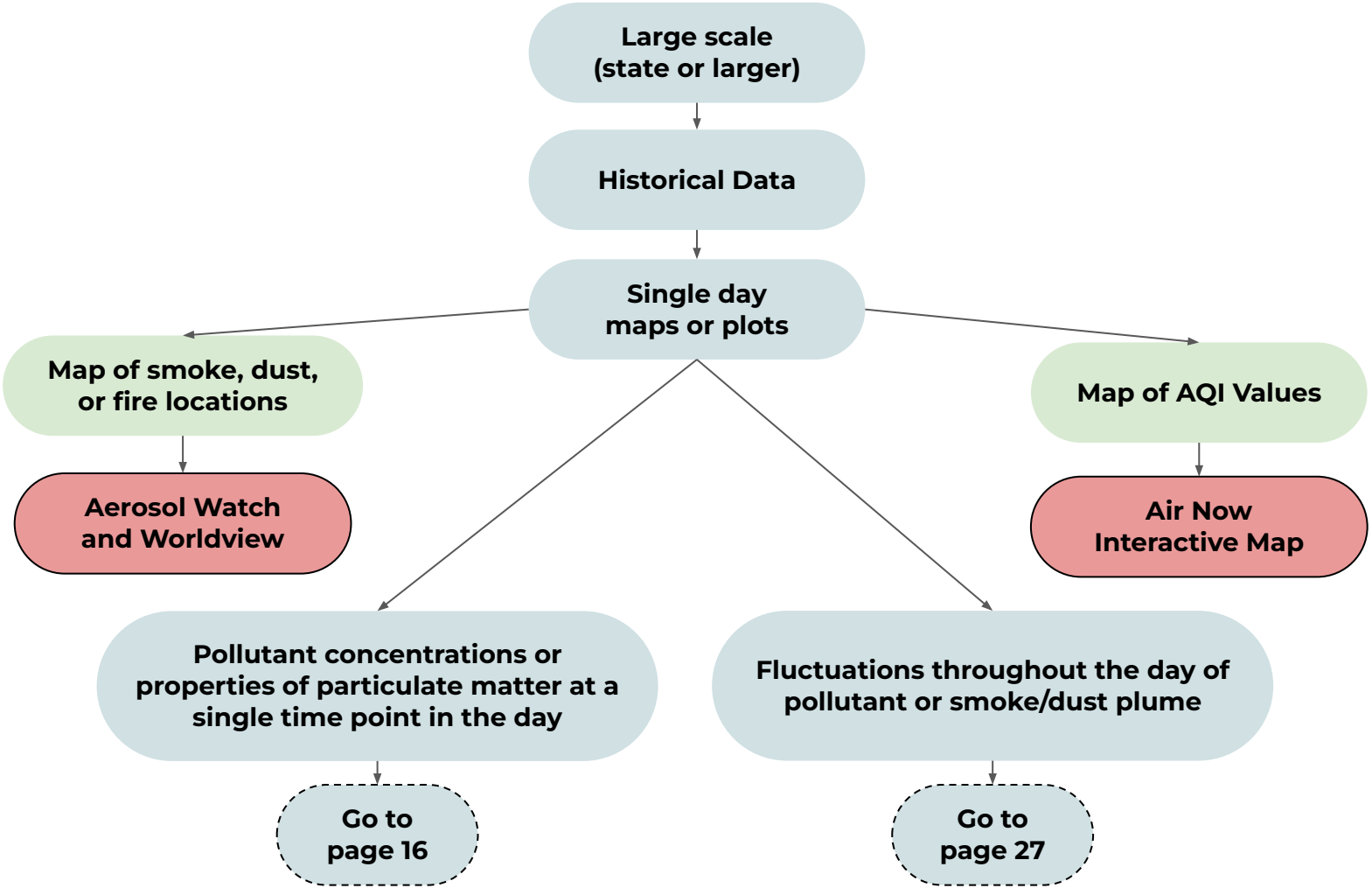

Coarse Particulate Matter (PM10)
Annual averages of pollutant concentration
Other
Data within the years 1988-2015?
Yes
No
CACES dataset (1988-2015)
Go to “Satellite Data Download” Flowchart

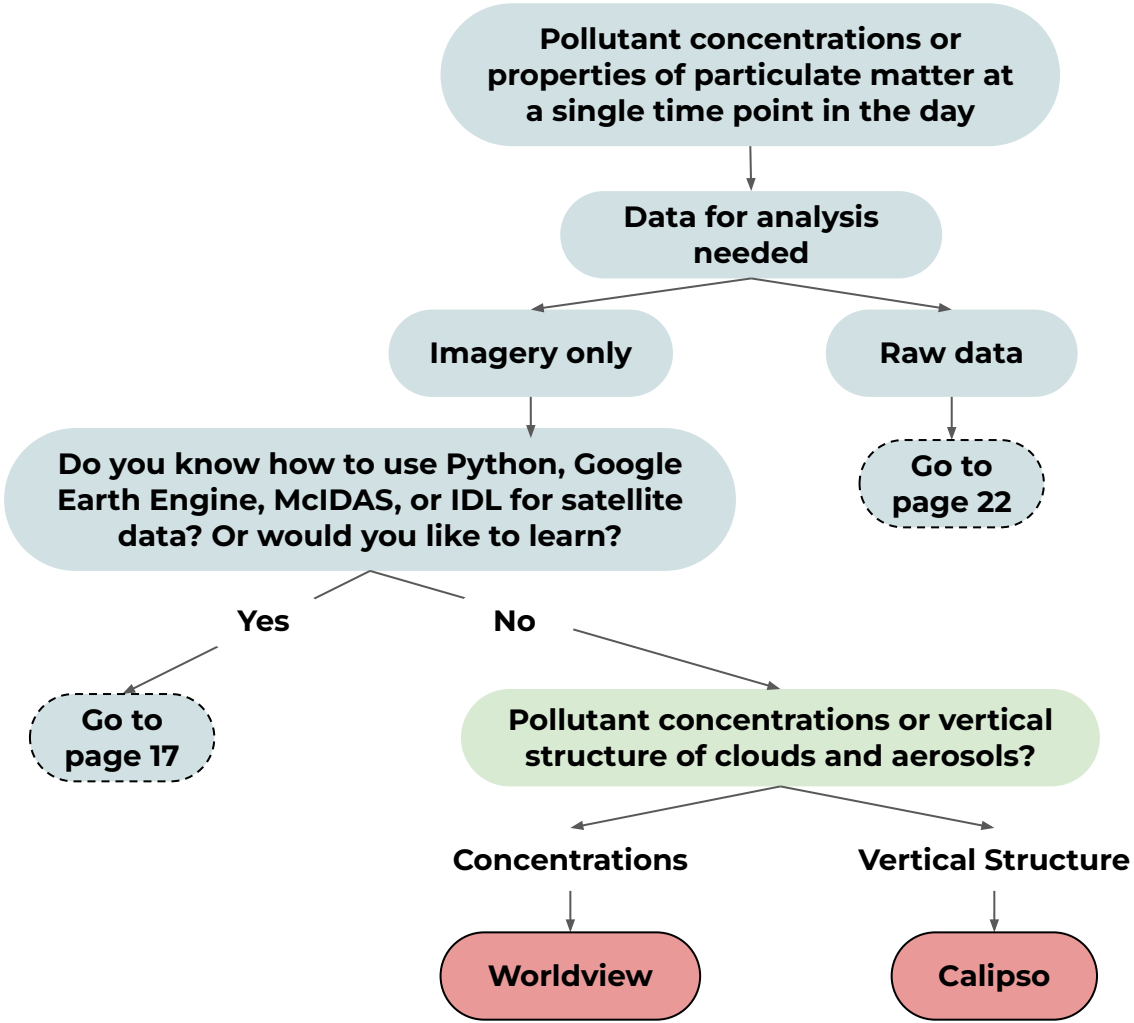

Ozone
Annual averages of pollutant concentration
Daily averages of pollutant concentration
Hourly averages of pollutant concentration
Other
Data within the years 1979-2016?
Data within the years 1979-2016?
Data within the years 1979-2016?
Yes
No
Yes
No
Yes
No
Go to page 53
CACES (1979-2015), or SEDAC (2000-2016) dataset
SEDAC (2000-2016) dataset
Go to “Satellite Data Download” Flowchart

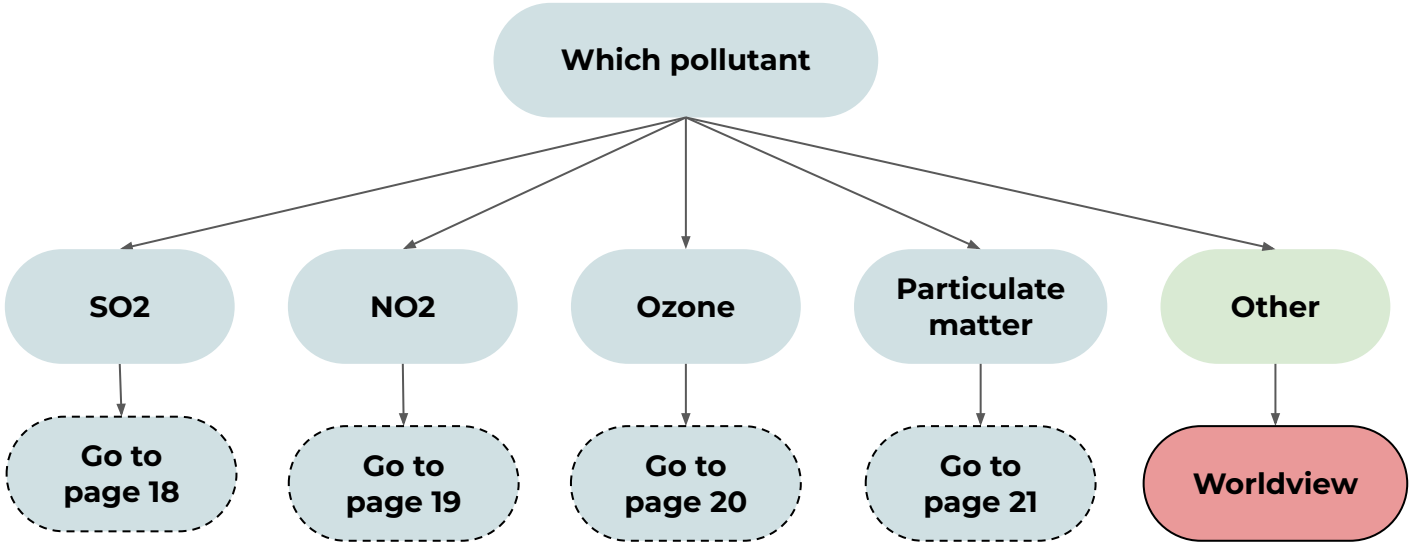

NO2
Annual averages of pollutant concentration
Daily averages of pollutant concentration
Hourly averages of pollutant concentration
Other
Data within the years 1979-2019?
Data within the years 1979-2019?
Data within the years 2019-present?
Yes
No
Yes
No
Yes
No
Wash U (2005-2019), CACES (1979-2015), or SEDAC (2000-2016) dataset
SEDAC (2000-2016) dataset
Data within August 2023-present?
Go to "Satellite Data Download" Flowchart
Go to "Satellite Data Download" Flowchart
GEOS-CF Forecast Visualization (2019-present)
Download data from TEMPO

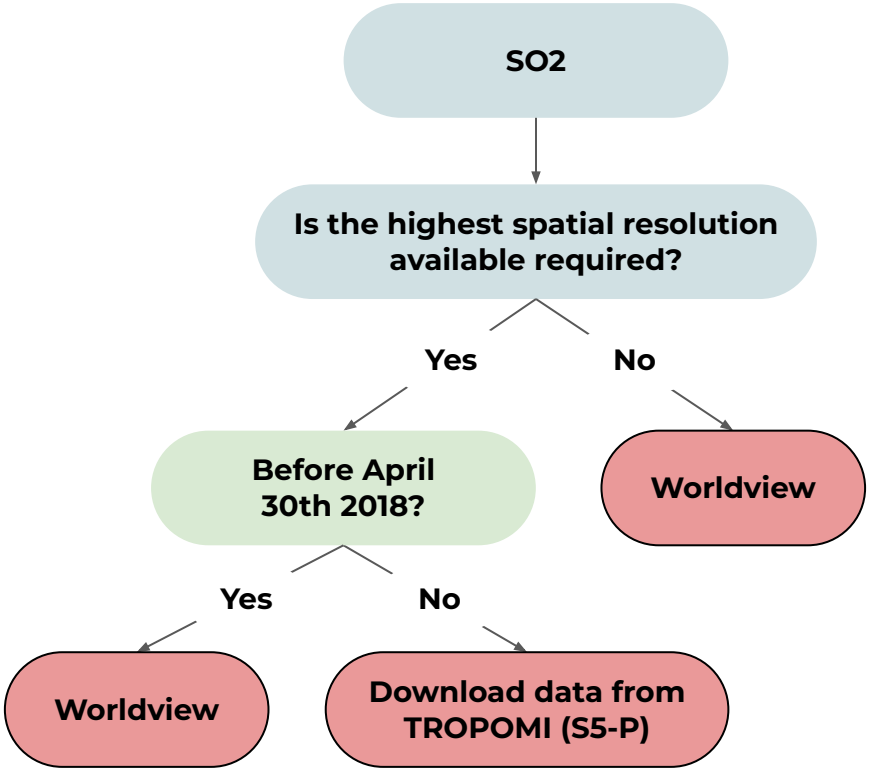

SO2
Annual averages of pollutant concentration
Other
Data within the years 1979-2015?
Yes
No
CACES dataset (1979-2015)
Go to “Satellite Data Download” Flowchart

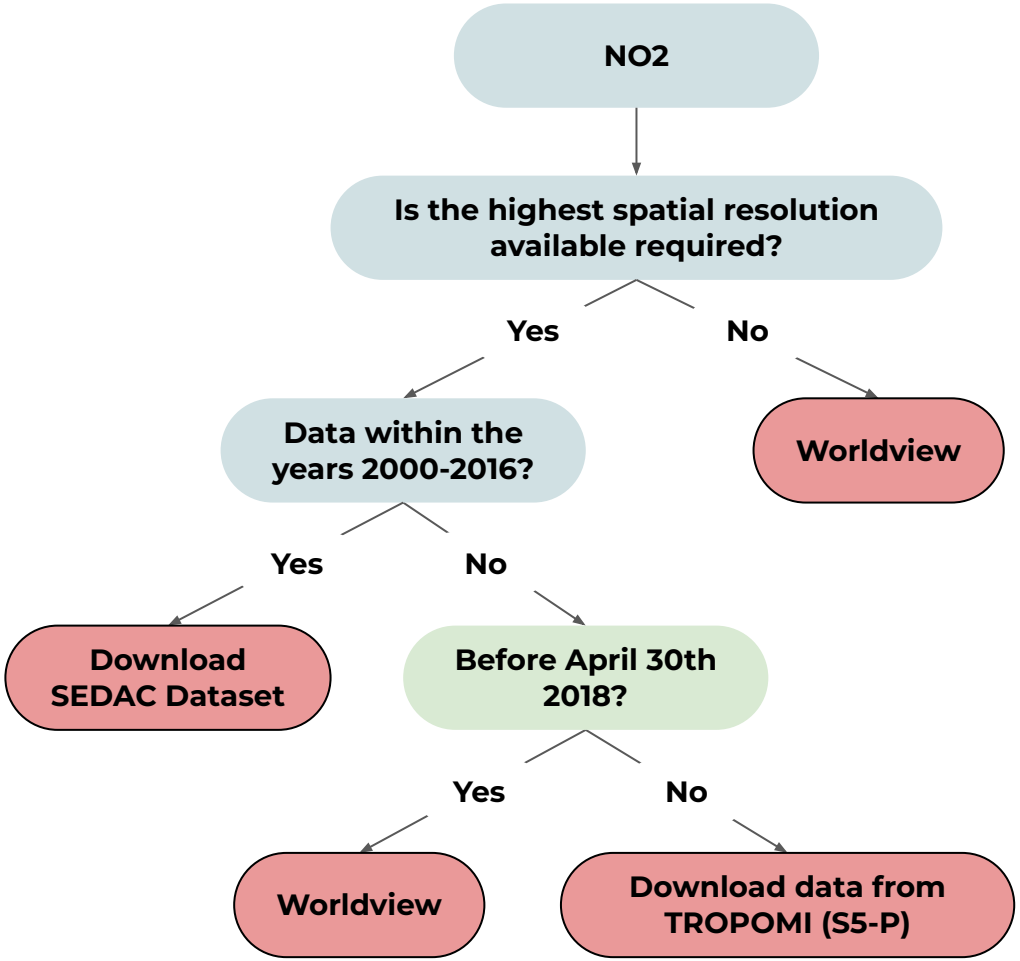

CO
Annual averages of pollutant concentration
Other
Data within the years 1990-2015?
Yes
No
CACES dataset (1990-2015)
Go to “Satellite Data Download” Flowchart

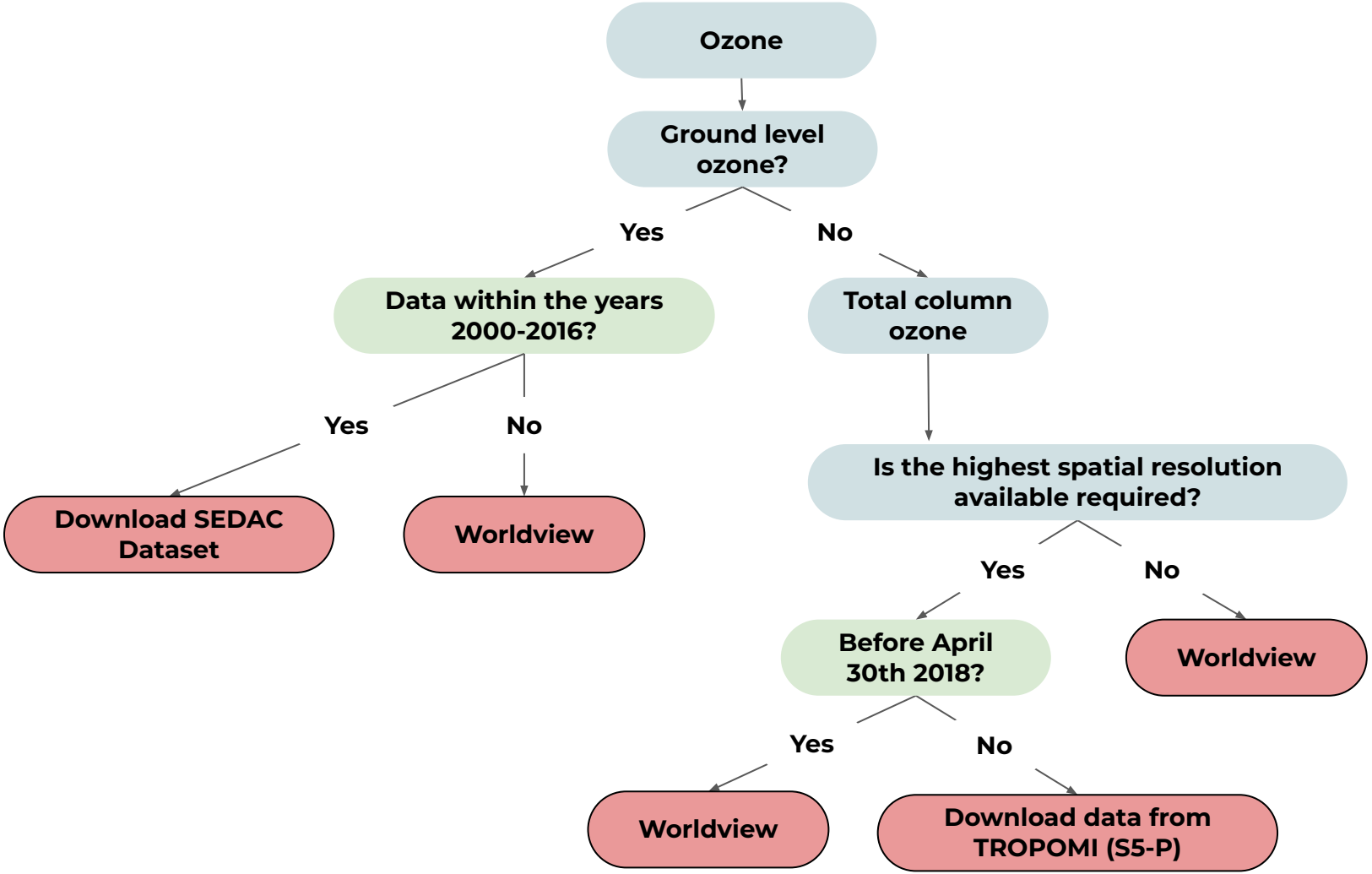

Large scale
(state or larger)
Historical Data
Single day
maps or plots
Map of smoke, dust,
or fire locations
Aerosol Watch
and Worldview
Map of AQI Values
Air Now
Interactive Map
Pollutant concentrations or
properties of particulate matter at a
single time point in the day
Go to
page 16
Fluctuations throughout the day of
pollutant or smoke/dust plume
Go to
page 27

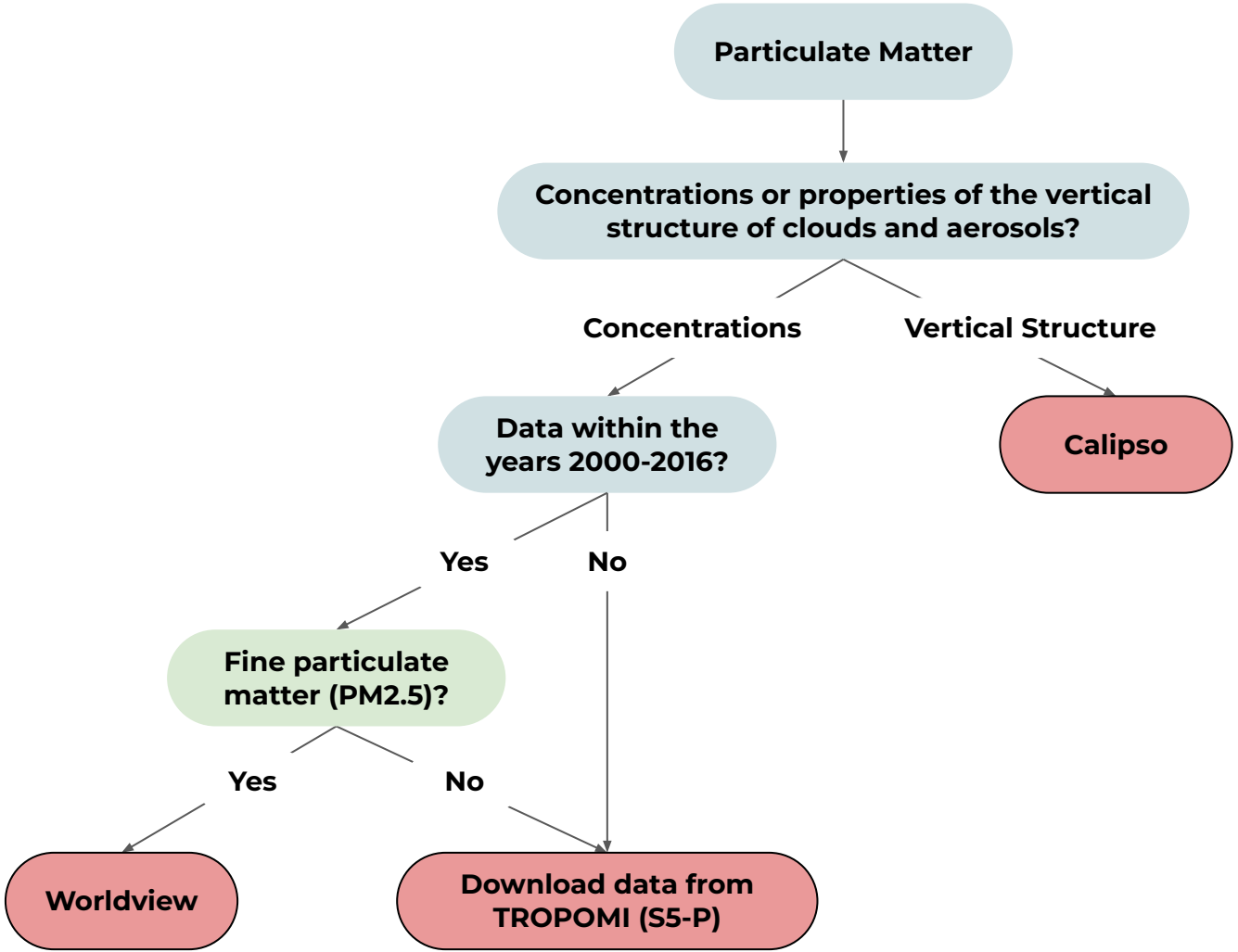

Pollutant concentrations or properties of particulate matter at a single time point in the day
Data for analysis needed
Imagery only
Raw data
Do you know how to use Python, Google Earth Engine, McIDAS, or IDL for satellite data? Or would you like to learn?
Go to page 22
Yes
No
Go to page 17
Pollutant concentrations or vertical structure of clouds and aerosols?
Concentrations
Vertical Structure
Worldview
Calipso

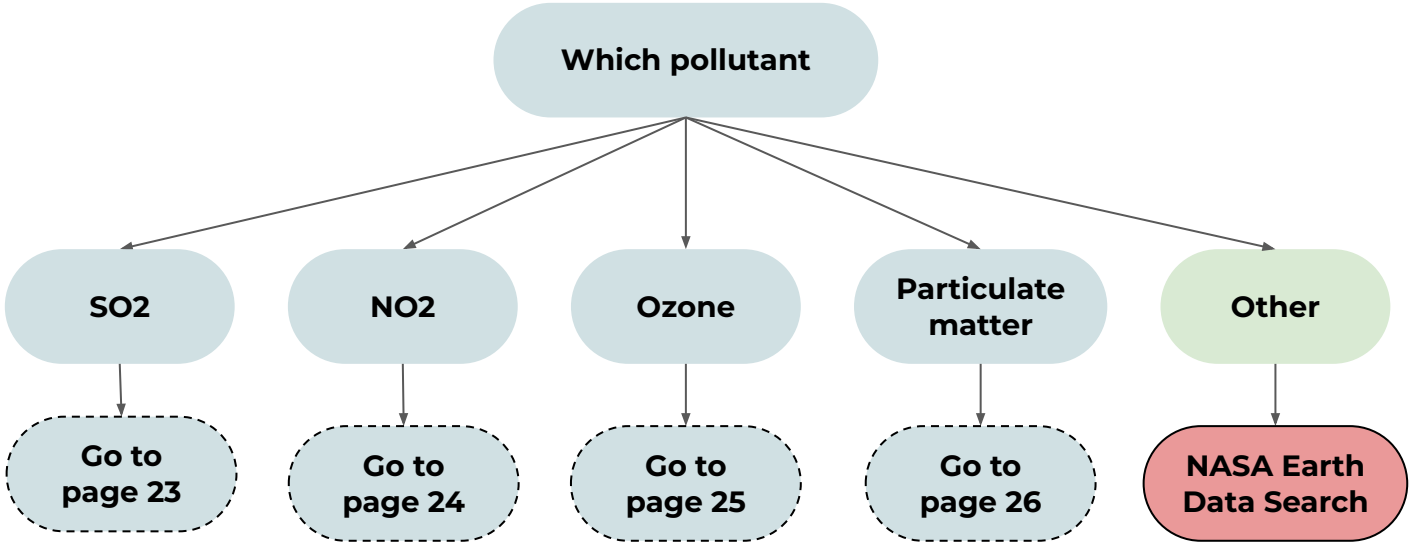

Which pollutant
SO2
NO2
Ozone
Particulate matter
Other
Go to page 18
Go to page 19
Go to page 20
Go to page 21
Worldview

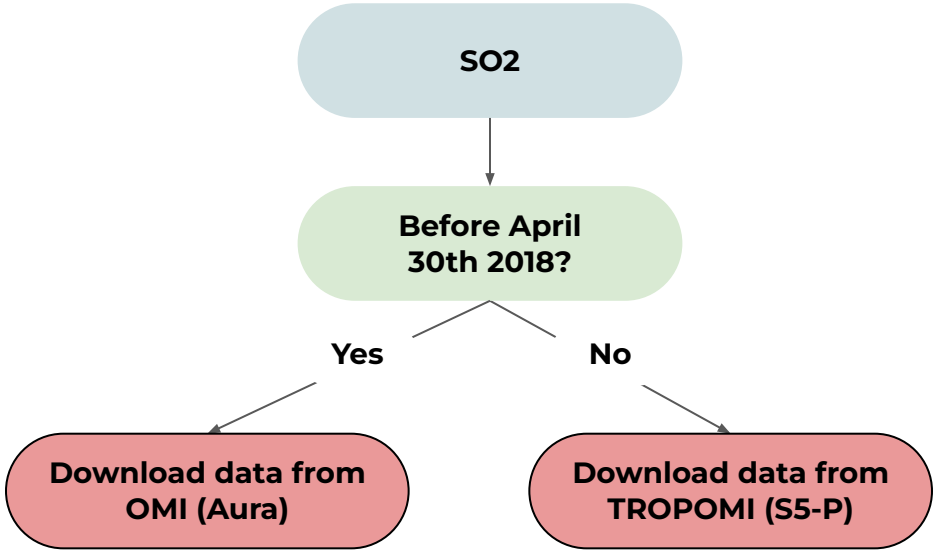

SO2
Is the highest spatial resolution available required?
Yes
No
Before April 30th 2018?
Worldview
Yes
No
Worldview
Download data from TROPOMI (S5-P)

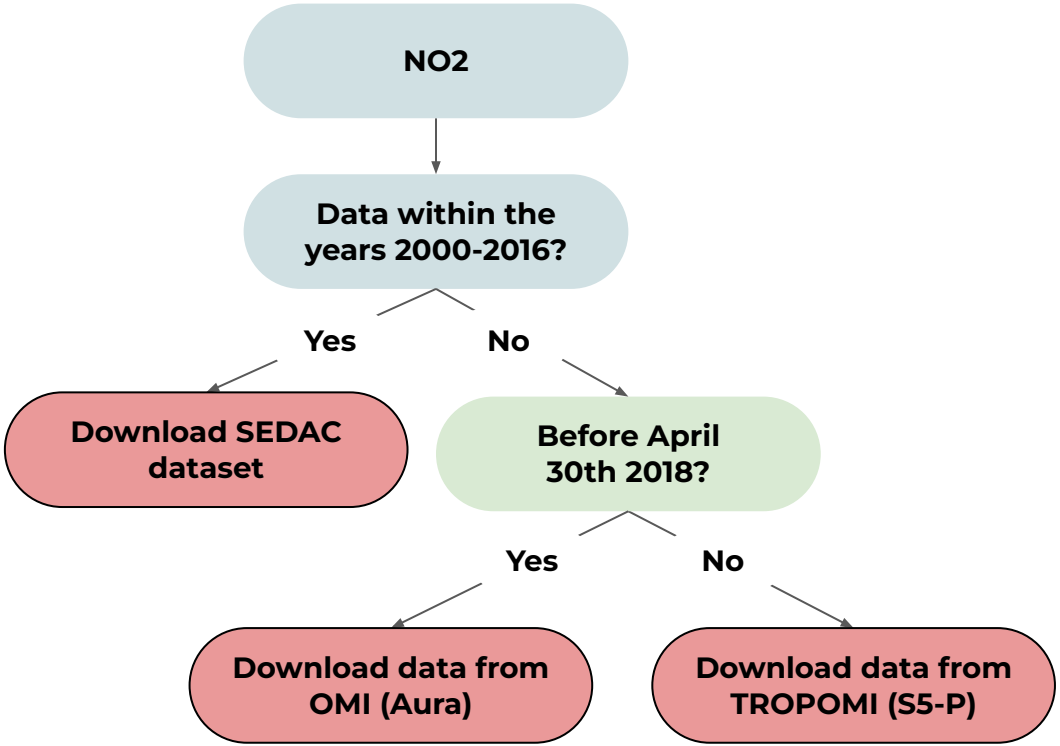

NO2
Is the highest spatial resolution available required?
Yes
No
Data within the years 2000-2016?
Worldview
Yes
No
Download SEDAC Dataset
Before April 30th 2018?
Yes
No
Worldview
Download data from TROPOMI (S5-P)

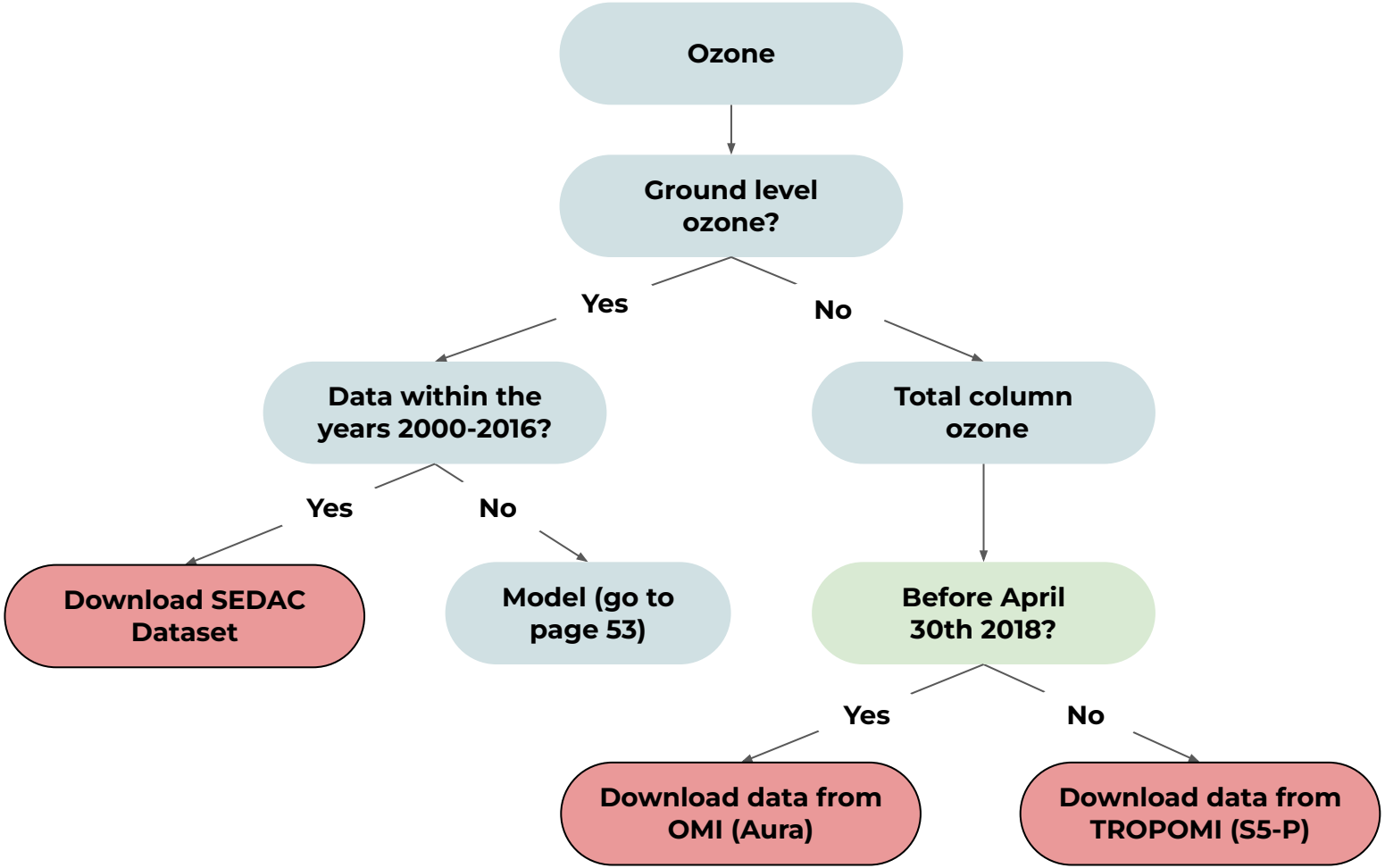

Ozone
Ground level ozone?
Yes
No
Data within the years 2000-2016?
Total column ozone
Yes
No
Download SEDAC Dataset
Worldview
Is the highest spatial resolution available required?
Yes
No
Before April 30th 2018?
Worldview
Yes
No
Worldview
Download data from TROPOMI (S5-P)

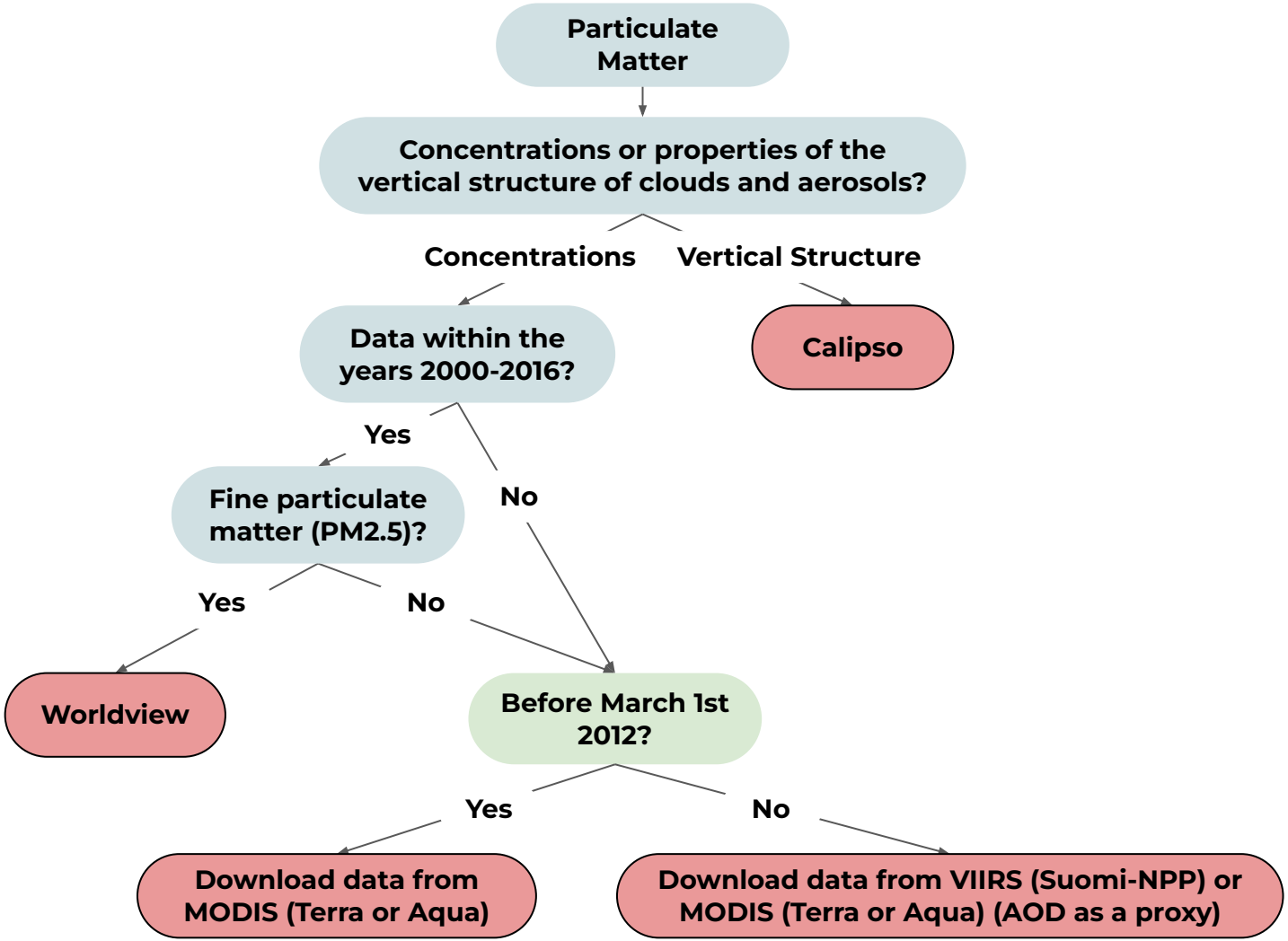

Particulate Matter
Concentrations or properties of the vertical structure of clouds and aerosols?
Concentrations
Vertical Structure
Data within the years 2000-2016?
Calipso
Yes
No
Fine particulate matter (PM2.5)?
Yes
No
Worldview
Download data from TROPOMI (S5-P)

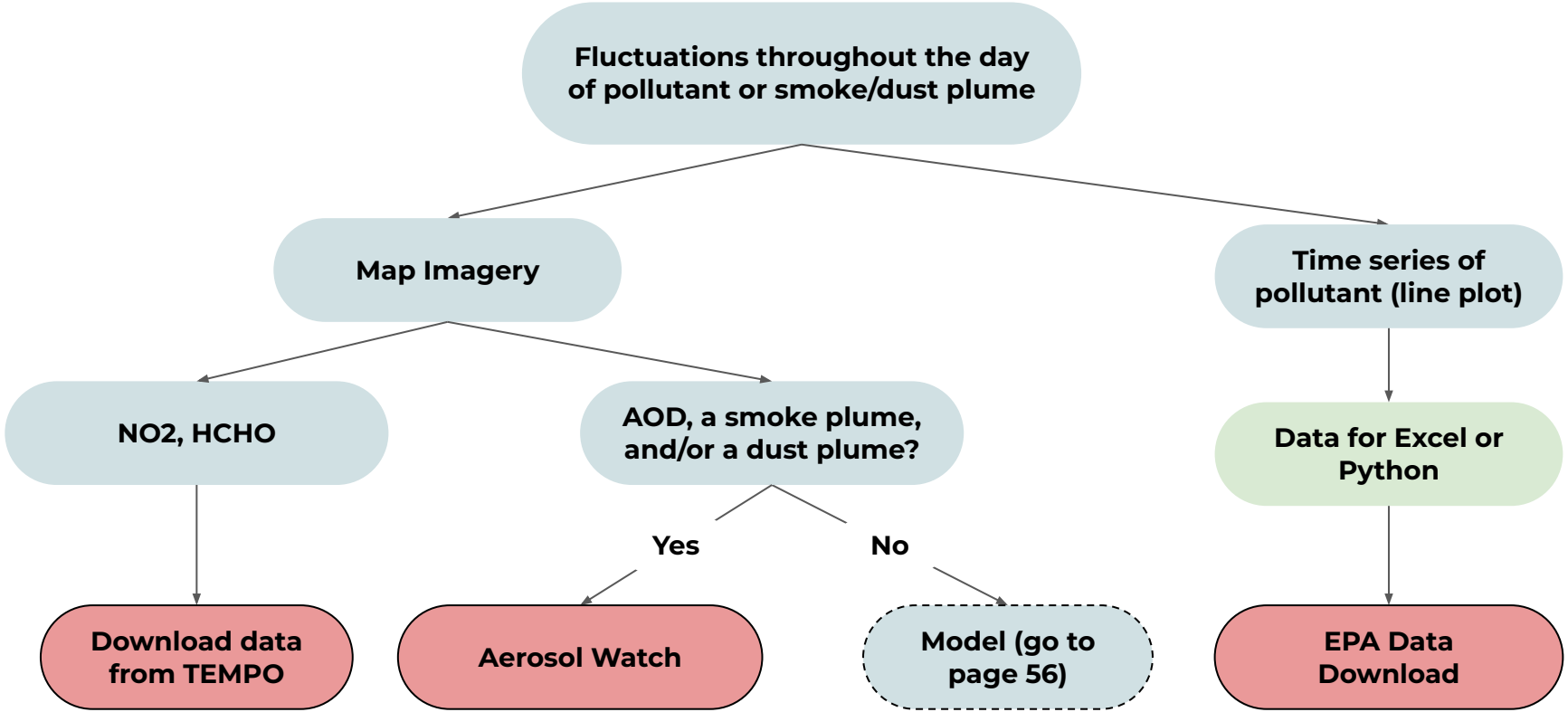

Which pollutant
SO2
NO2
Ozone
Particulate matter
Other
Go to page 23
Go to page 24
Go to page 25
Go to page 26
NASA Earth Data Search

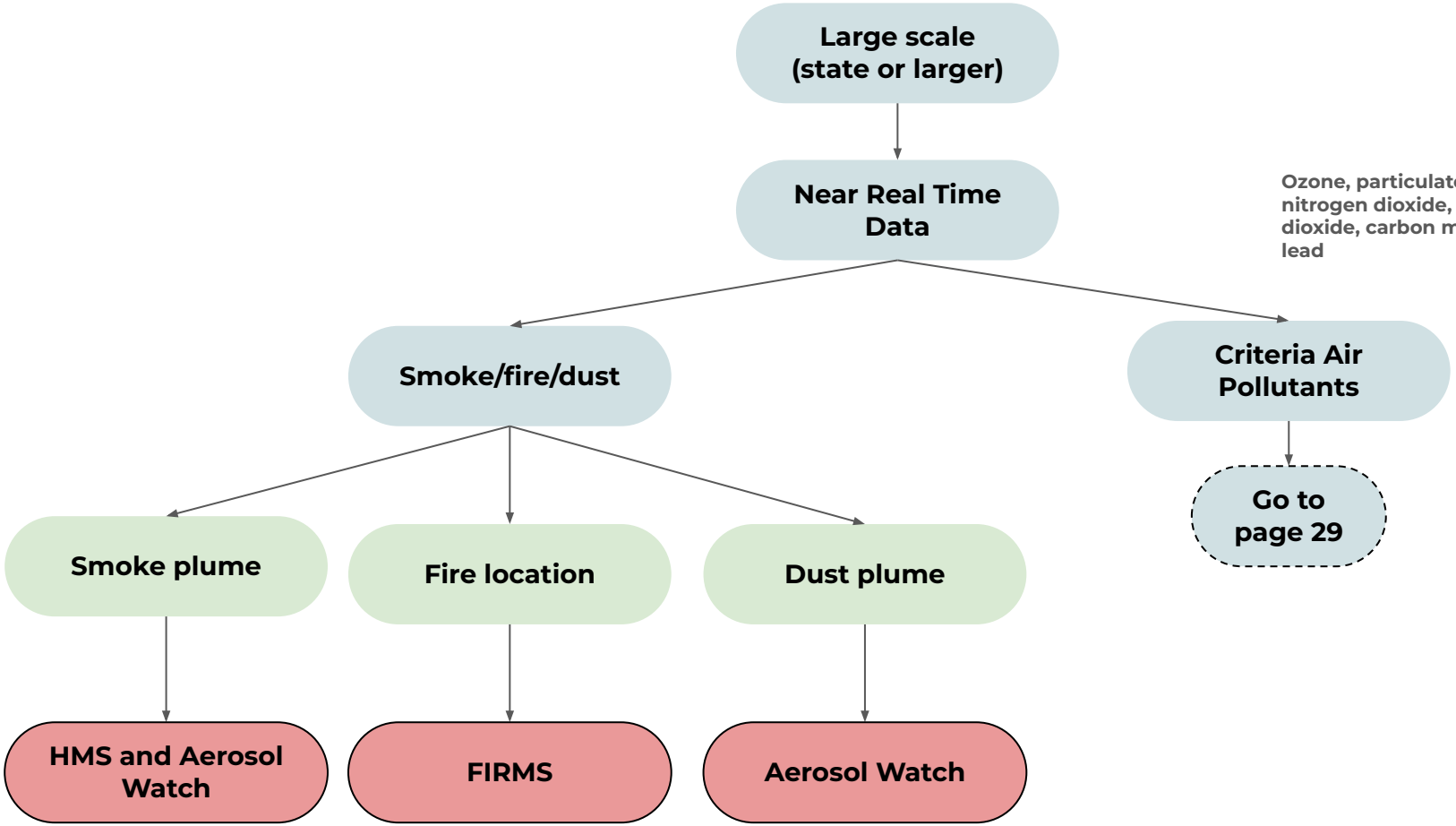

SO2
Before April 30th 2018?
Yes
No
Download data from OMI (Aura)
Download data from TROPOMI (S5-P)

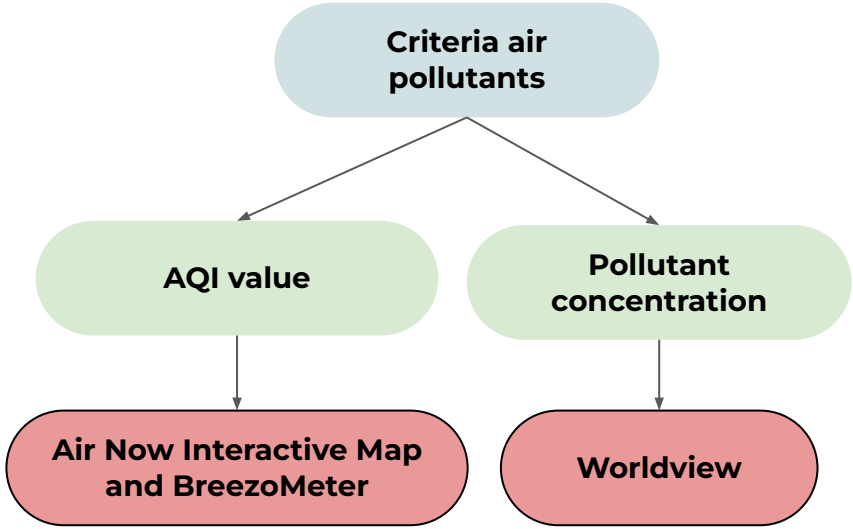

NO2
Data within the years 2000-2016?
Yes
No
Download SEDAC dataset
Before April 30th 2018?
Yes
No
Download data from OMI (Aura)
Download data from TROPOMI (S5-P)

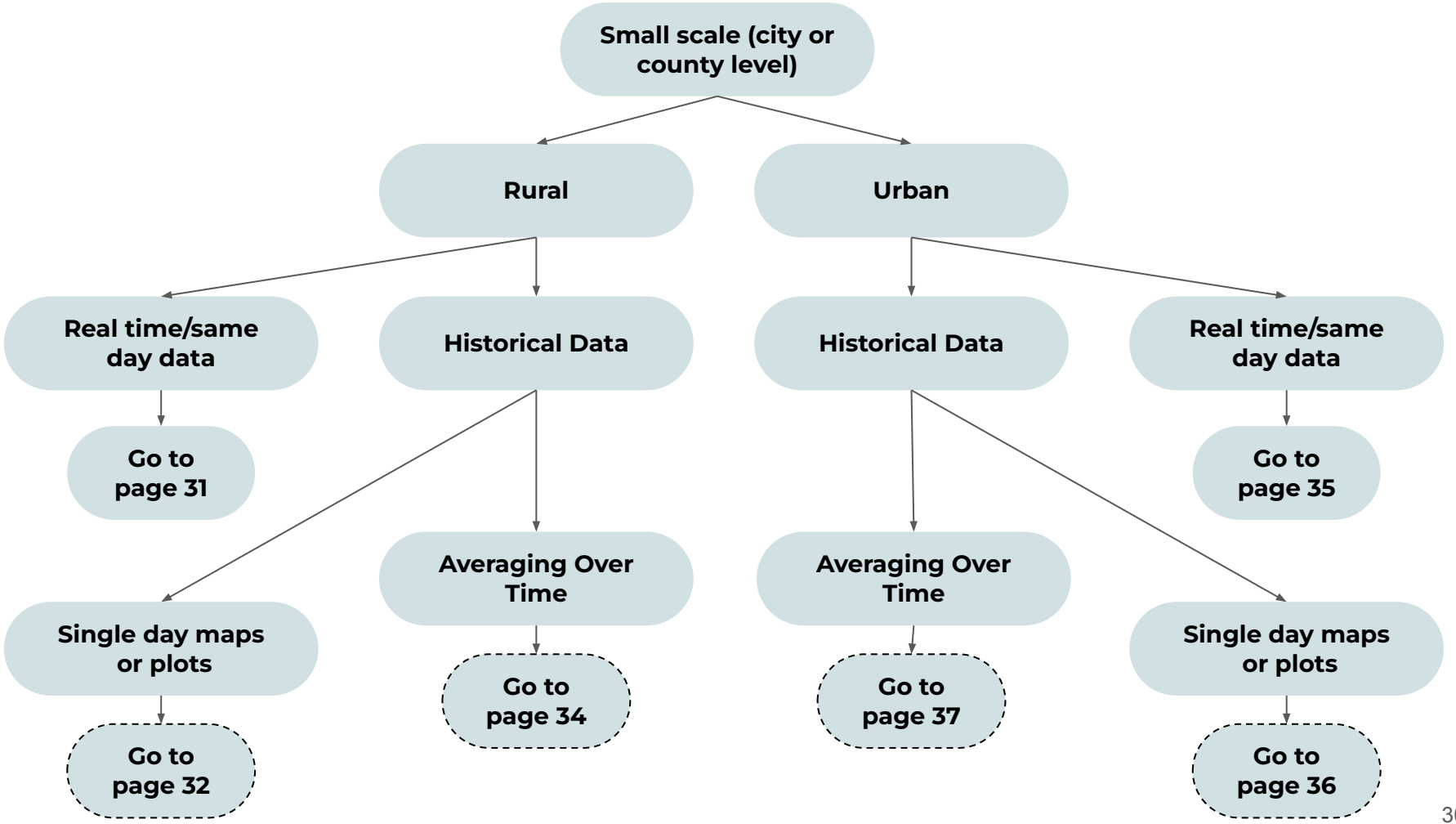

Ozone
Ground level ozone?
Yes
No
Data within the years 2000-2016?
Total column ozone
Yes
No
Download SEDAC Dataset
Model (go to page 53)
Before April 30th 2018?
Yes
No
Download data from OMI (Aura)
Download data from TROPOMI (S5-P)

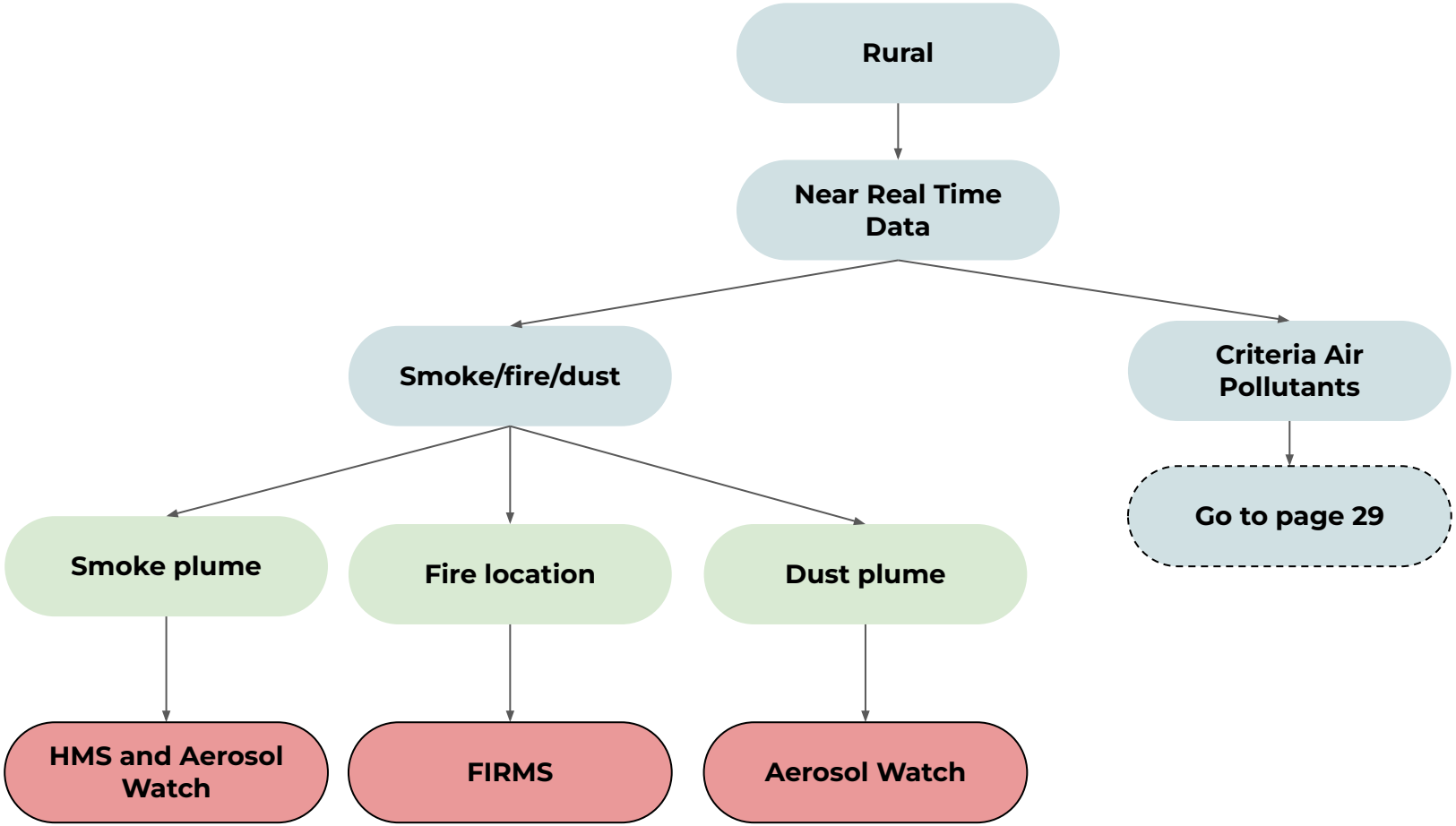

Particulate Matter
Concentrations or properties of the vertical structure of clouds and aerosols?
Concentrations
Vertical Structure
Data within the years 2000-2016?
Calipso
Yes
No
Fine particulate matter (PM2.5)?
Yes
No
Worldview
Before March 1st 2012?
Yes
No
Download data from MODIS (Terra or Aqua)
Download data from VIIRS (Suomi-NPP) or MODIS (Terra or Aqua) (AOD as a proxy)

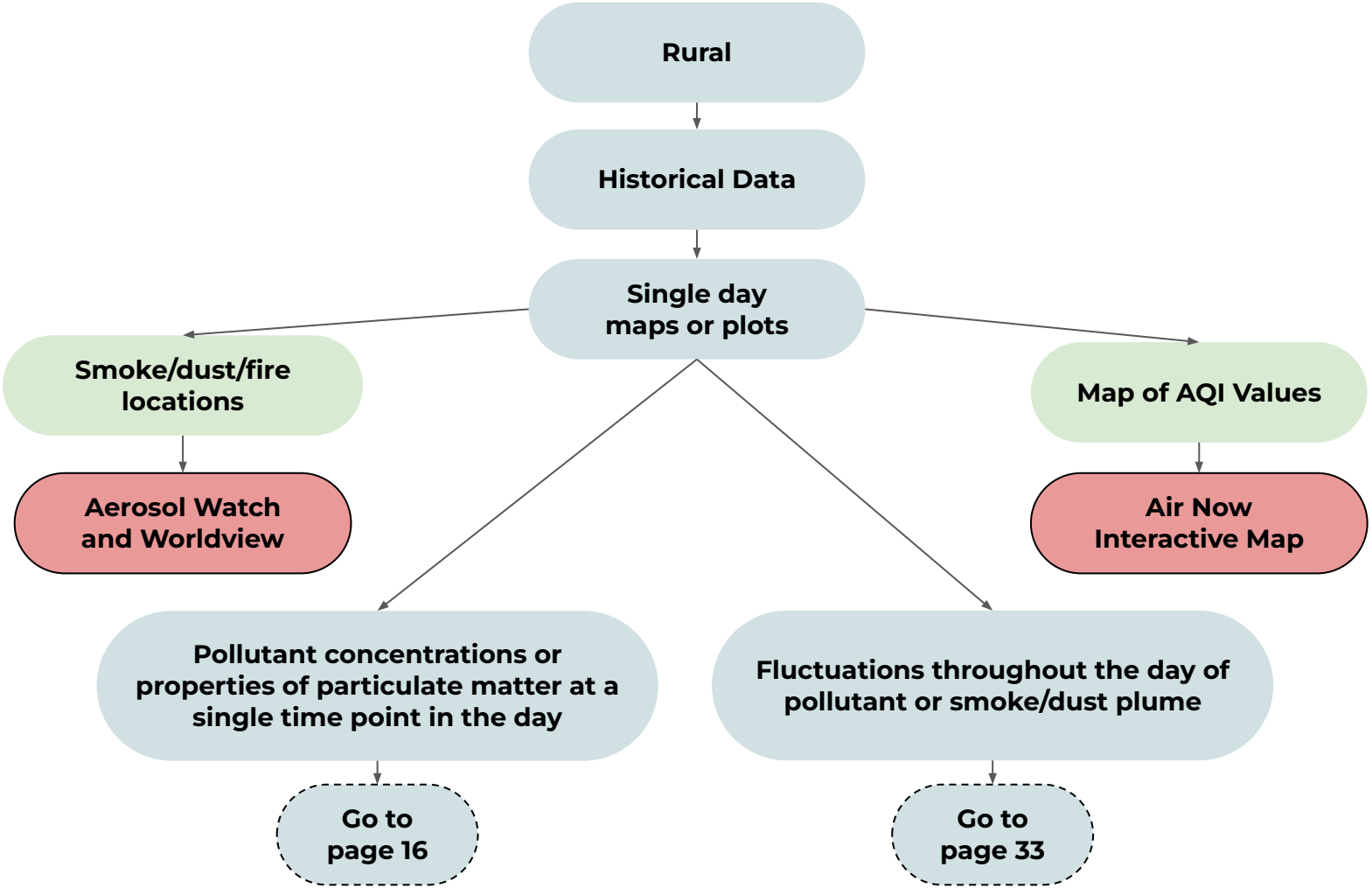

Fluctuations throughout the day of pollutant or smoke/dust plume
Map Imagery
Time series of pollutant (line plot)
NO2, HCHO
AOD, a smoke plume, and/or a dust plume?
Data for Excel or Python
Yes
No
Download data from TEMPO
Aerosol Watch
Model (go to page 56)
EPA Data Download

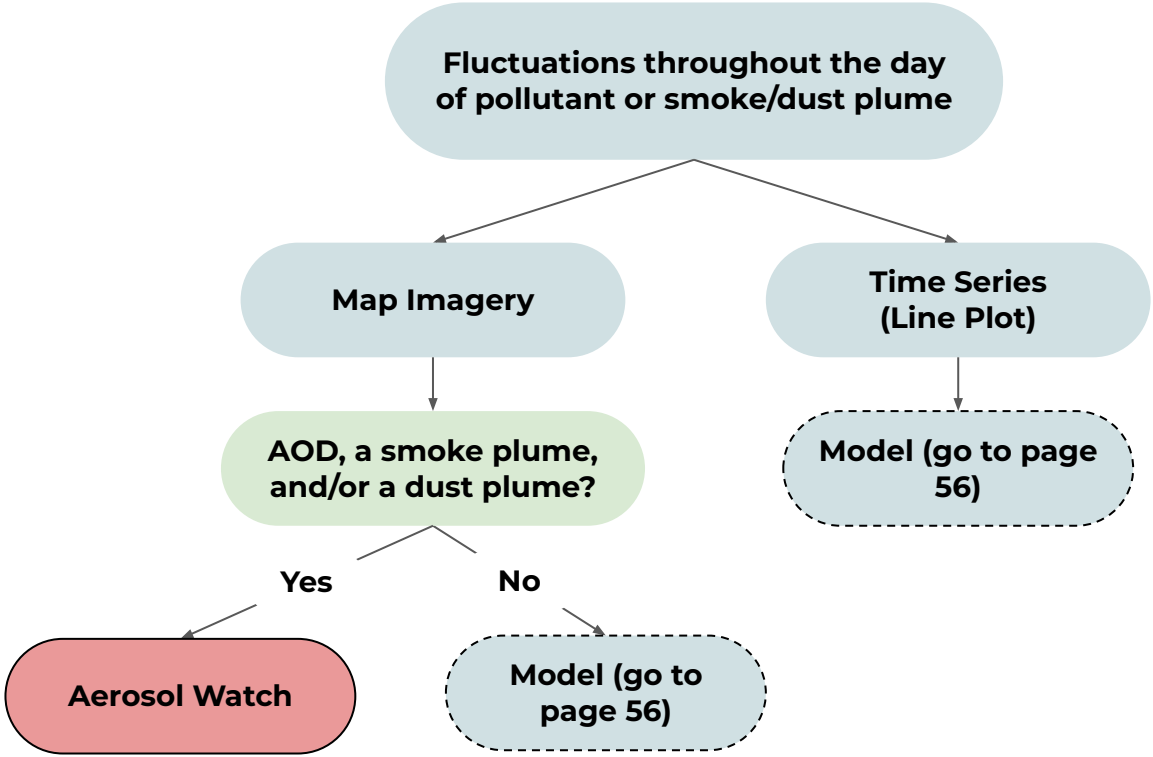

Large scale (state or larger)
Near Real Time Data
Ozone, particulate matter, nitrogen dioxide, sulfur dioxide, carbon monoxide, lead
Smoke/fire/dust
Criteria Air Pollutants
Go to page 29
Smoke plume
Fire location
Dust plume
HMS and Aerosol Watch
FIRMS
Aerosol Watch

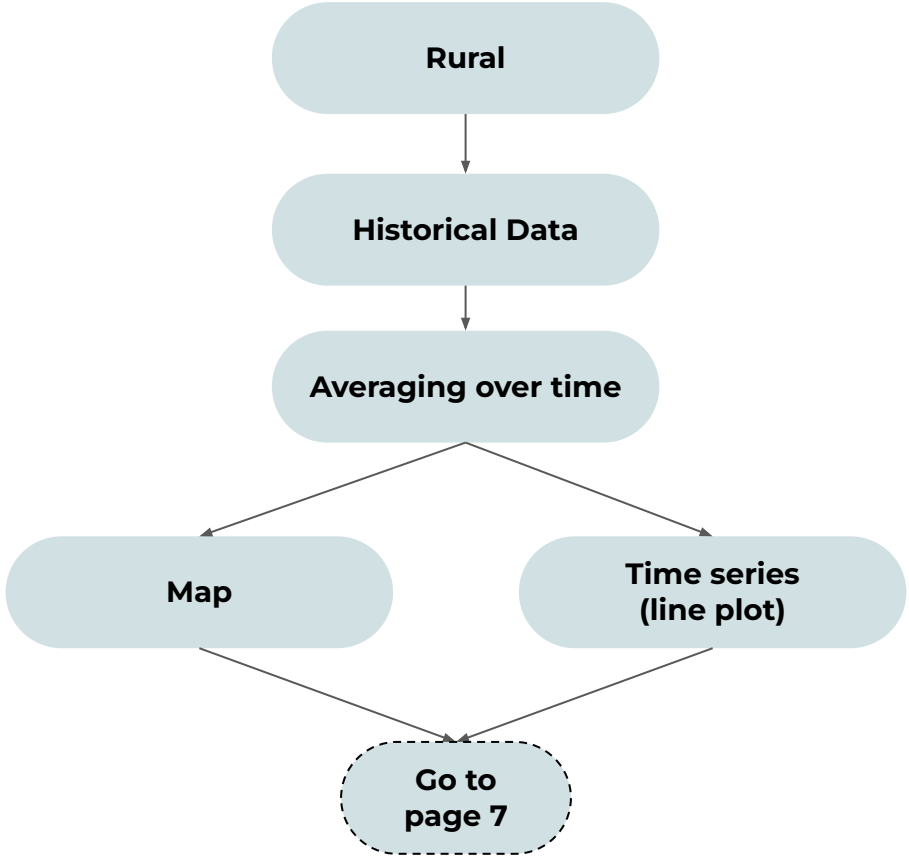

Criteria air pollutants
AQI value
Pollutant concentration
Air Now Interactive Map and BreezoMeter
Worldview

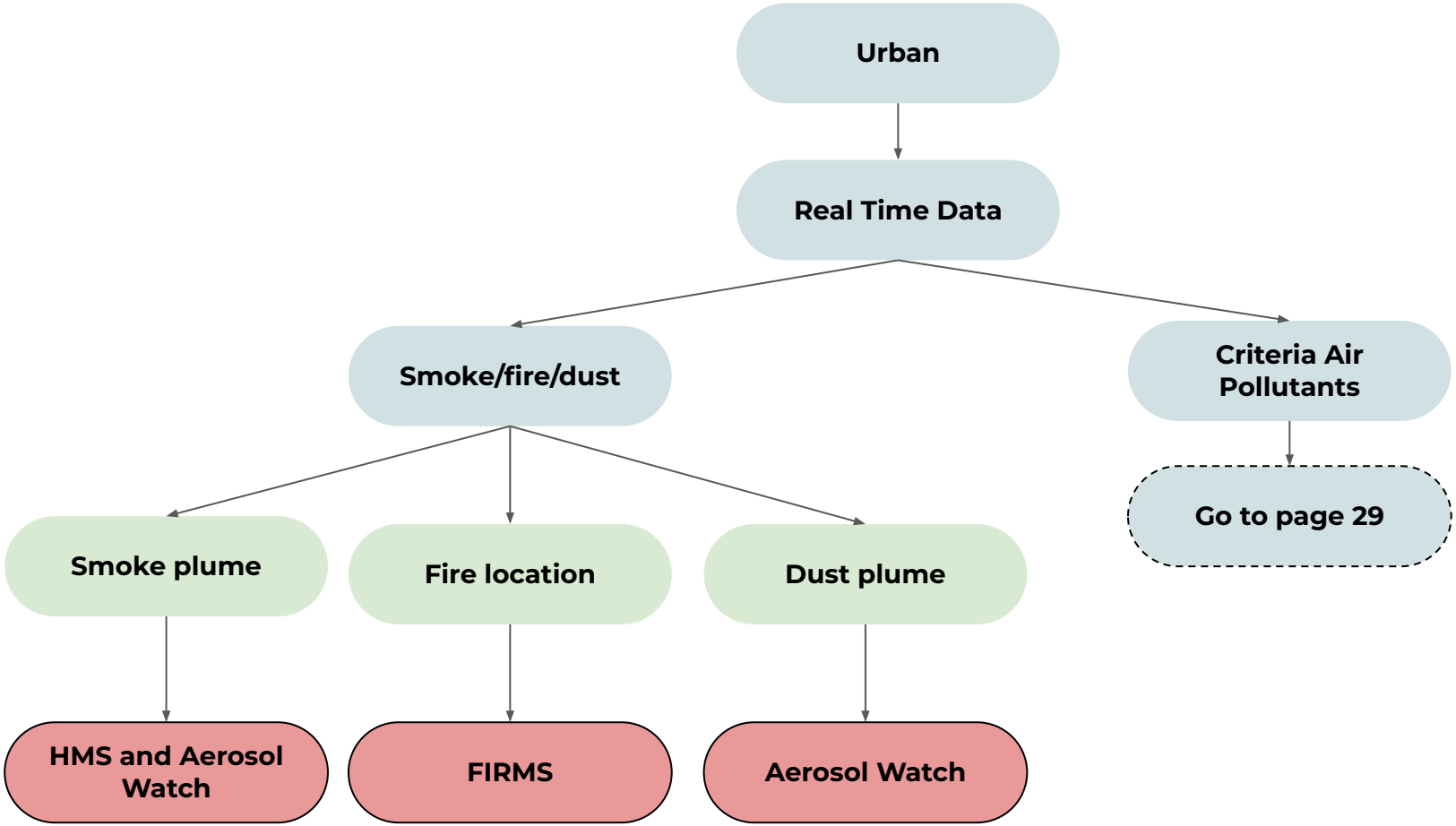

Small scale (city or county level)
Rural
Urban
Real time/same day data
Historical Data
Historical Data
Real time/same day data
Go to page 31
Go to page 35
Averaging Over Time
Averaging Over Time
Single day maps or plots
Single day maps or plots
Go to page 34
Go to page 37
Go to page 32
Go to page 36

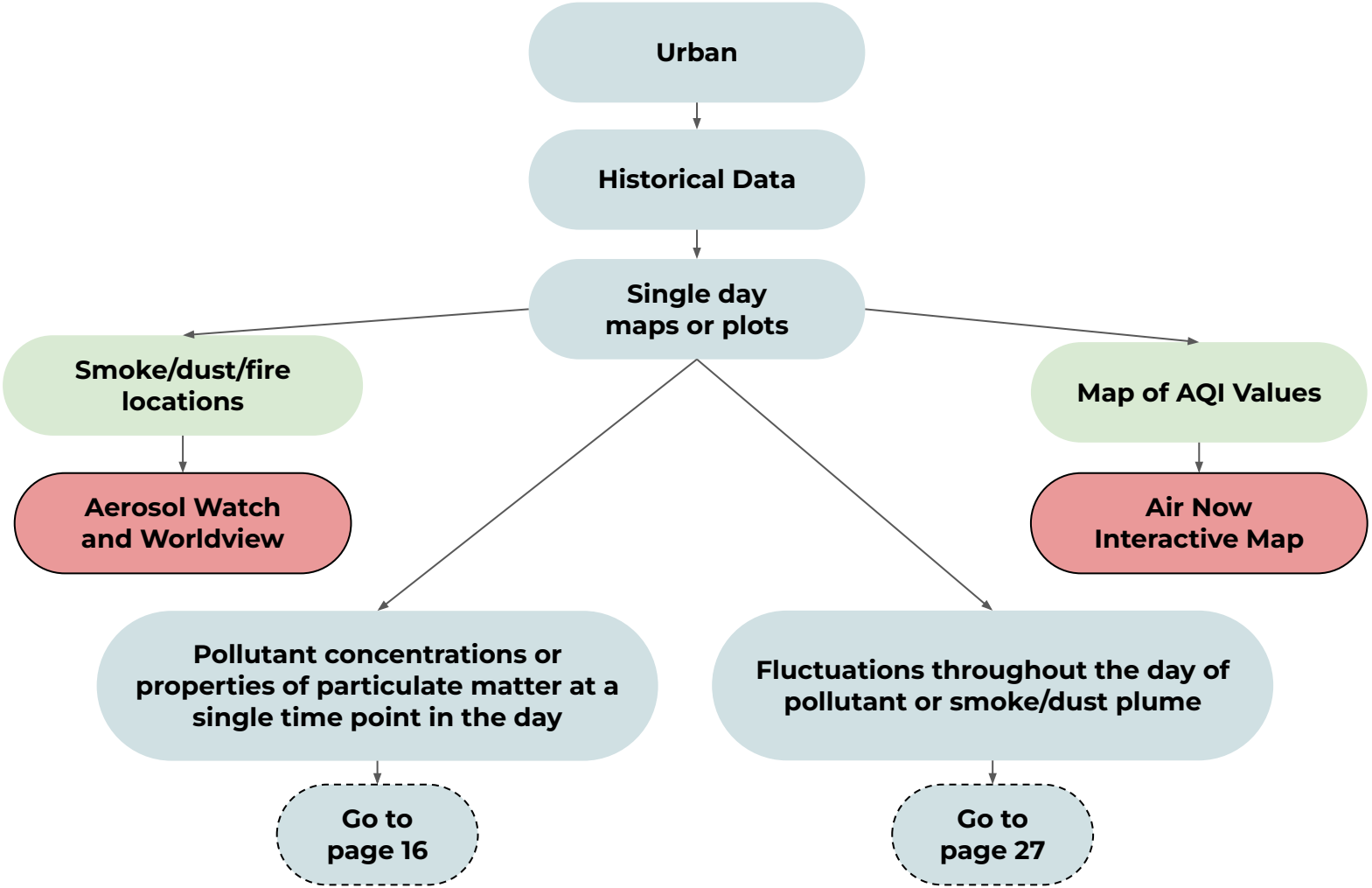

Rural
Near Real Time Data
Smoke/fire/dust
Criteria Air Pollutants
Go to page 29
Smoke plume
Fire location
Dust plume
HMS and Aerosol Watch
FIRMS
Aerosol Watch

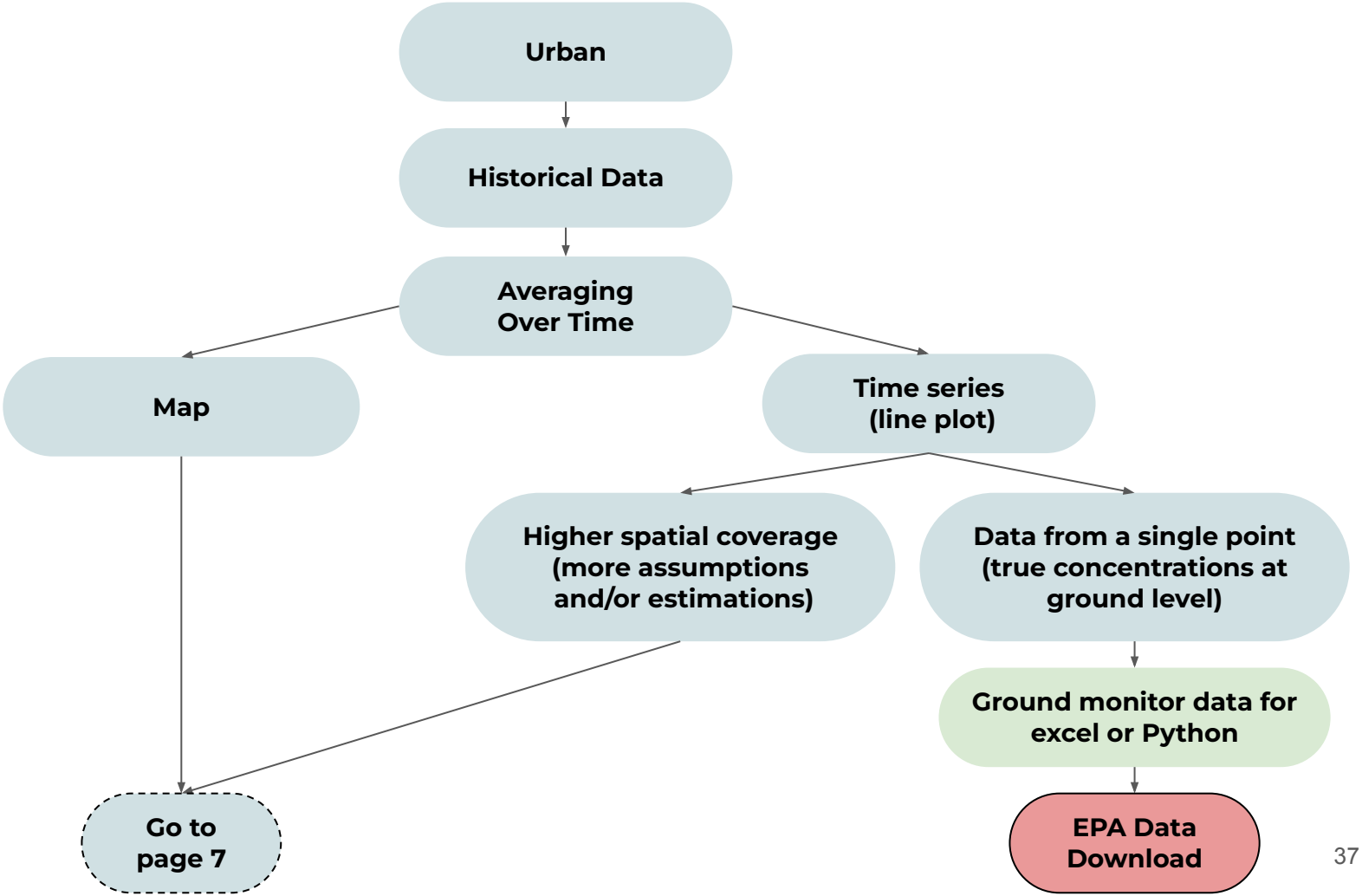

Rural
Historical Data
Single day maps or plots
Smoke/dust/fire locations
Aerosol Watch and Worldview
Map of AQI Values
Air Now Interactive Map
Pollutant concentrations or properties of particulate matter at a single time point in the day
Go to page 16
Fluctuations throughout the day of pollutant or smoke/dust plume
Go to page 33

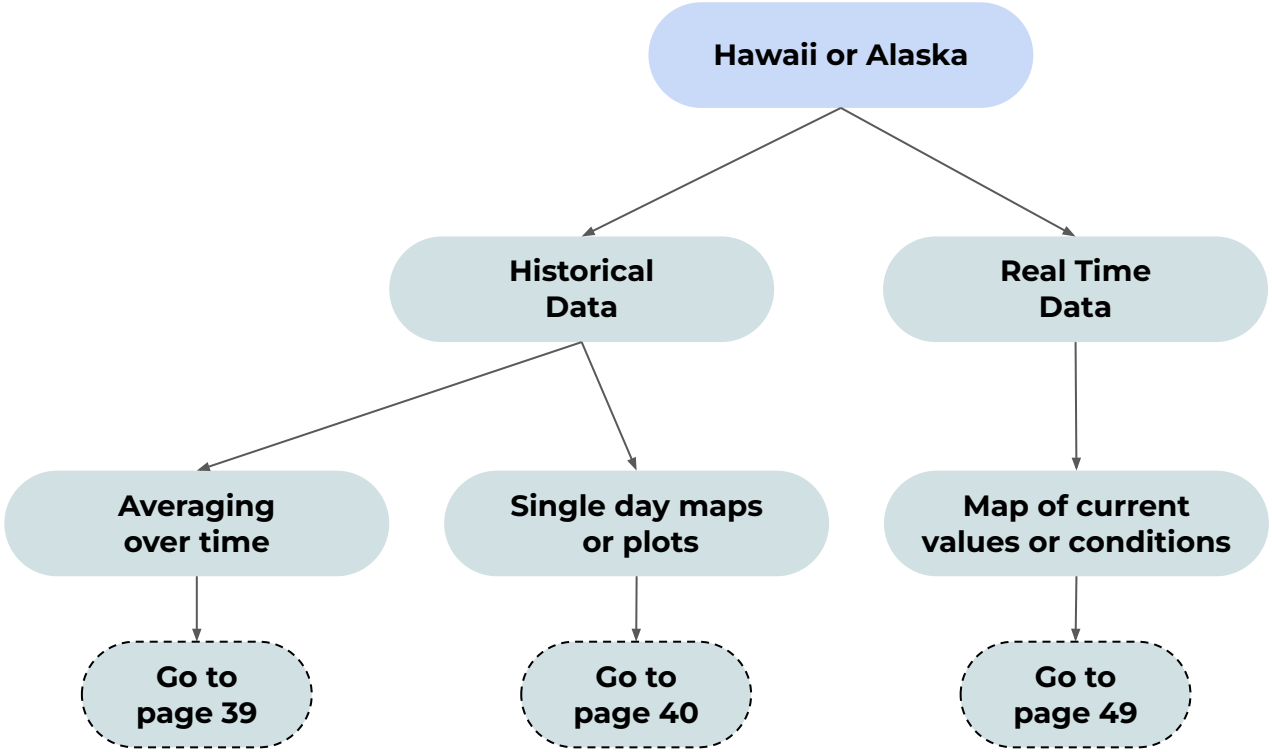

Fluctuations throughout the day of pollutant or smoke/dust plume
Map Imagery
Time Series (Line Plot)
AOD, a smoke plume, and/or a dust plume?
Model (go to page 56)
Yes
No
Aerosol Watch
Model (go to page 56)

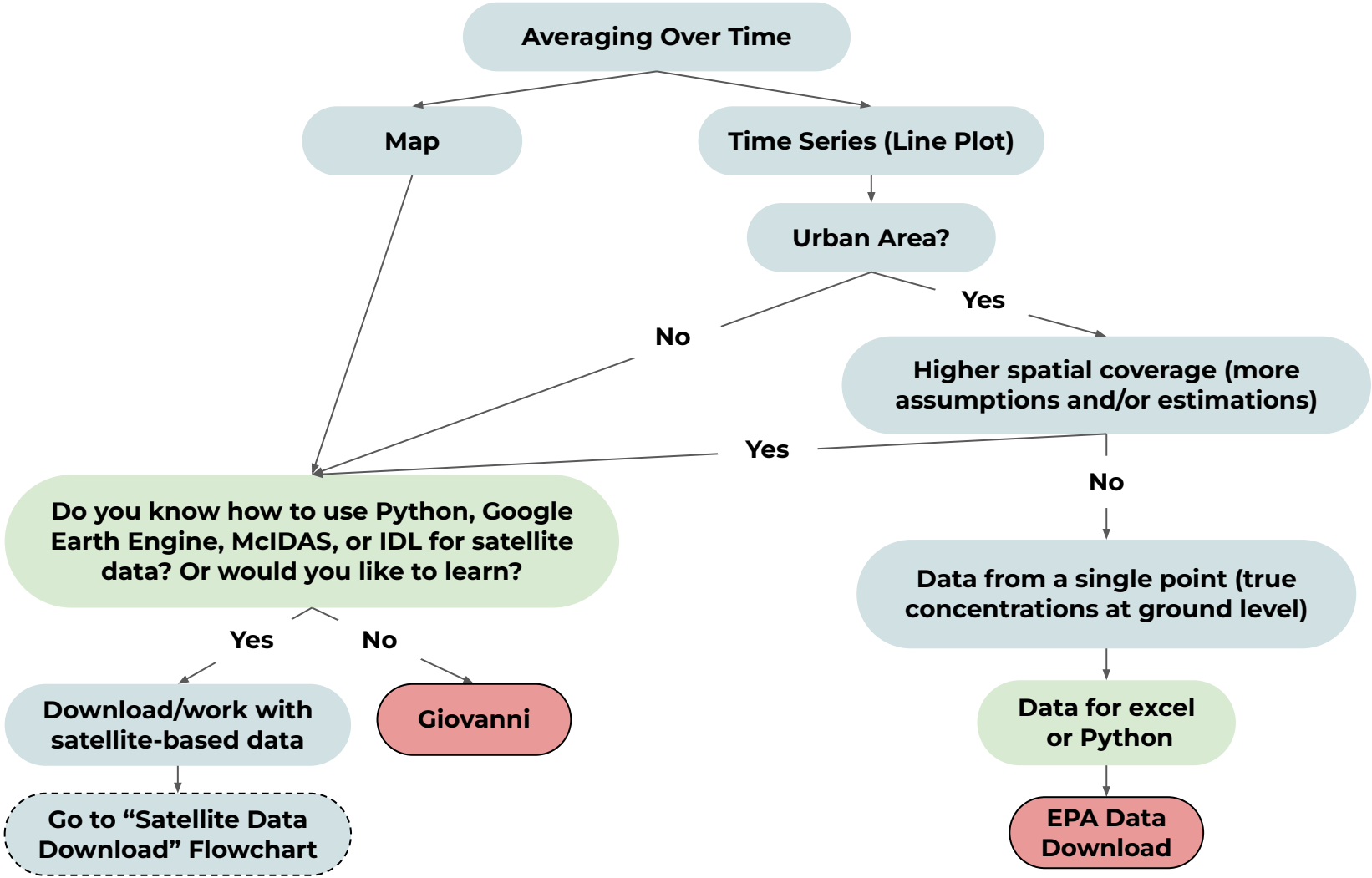

Rural
Historical Data
Averaging over time
Map
Time series
(line plot)
Go to
page 7

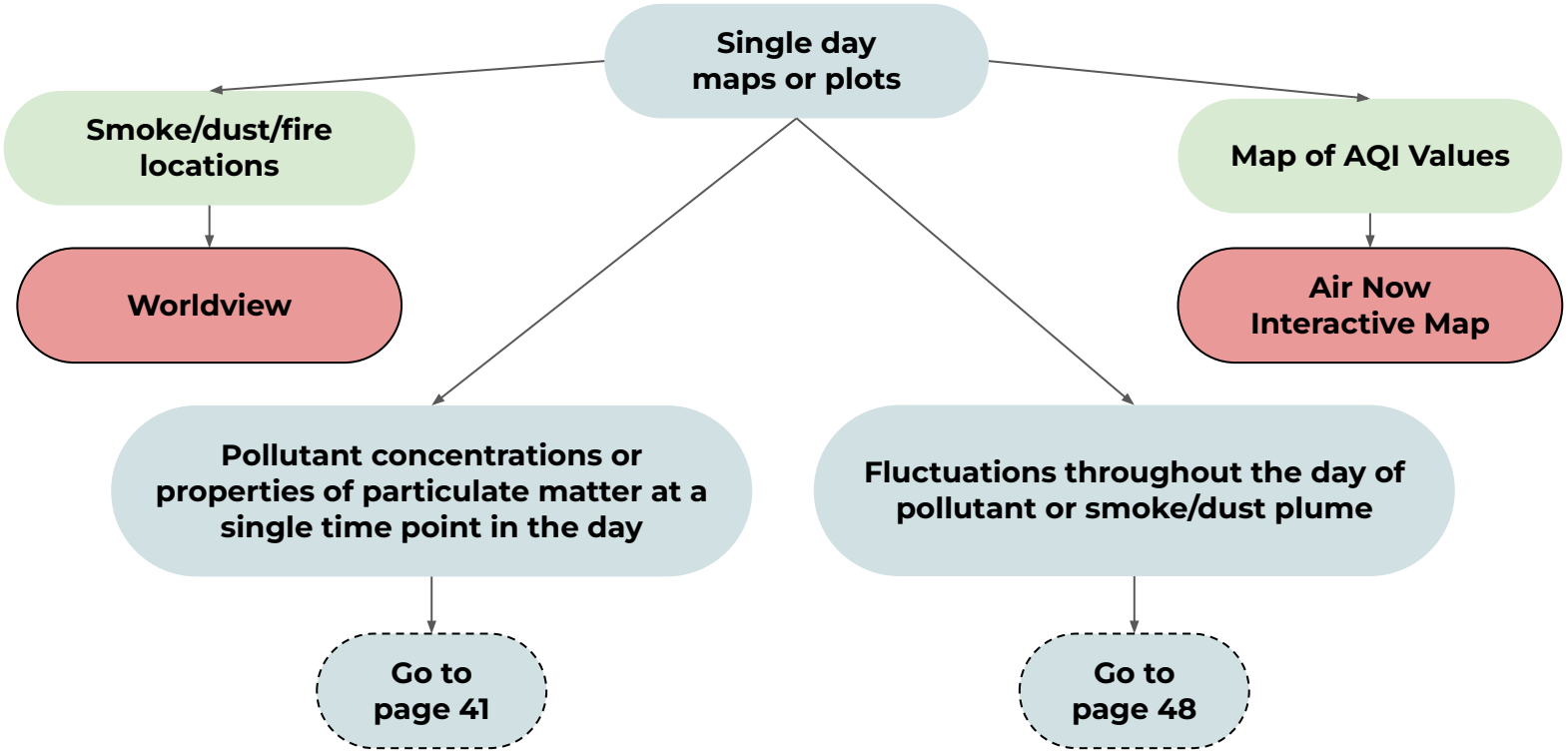

Urban
Real Time Data
Smoke/fire/dust
Criteria Air Pollutants
Go to page 29
Smoke plume
Fire location
Dust plume
HMS and Aerosol Watch
FIRMS
Aerosol Watch

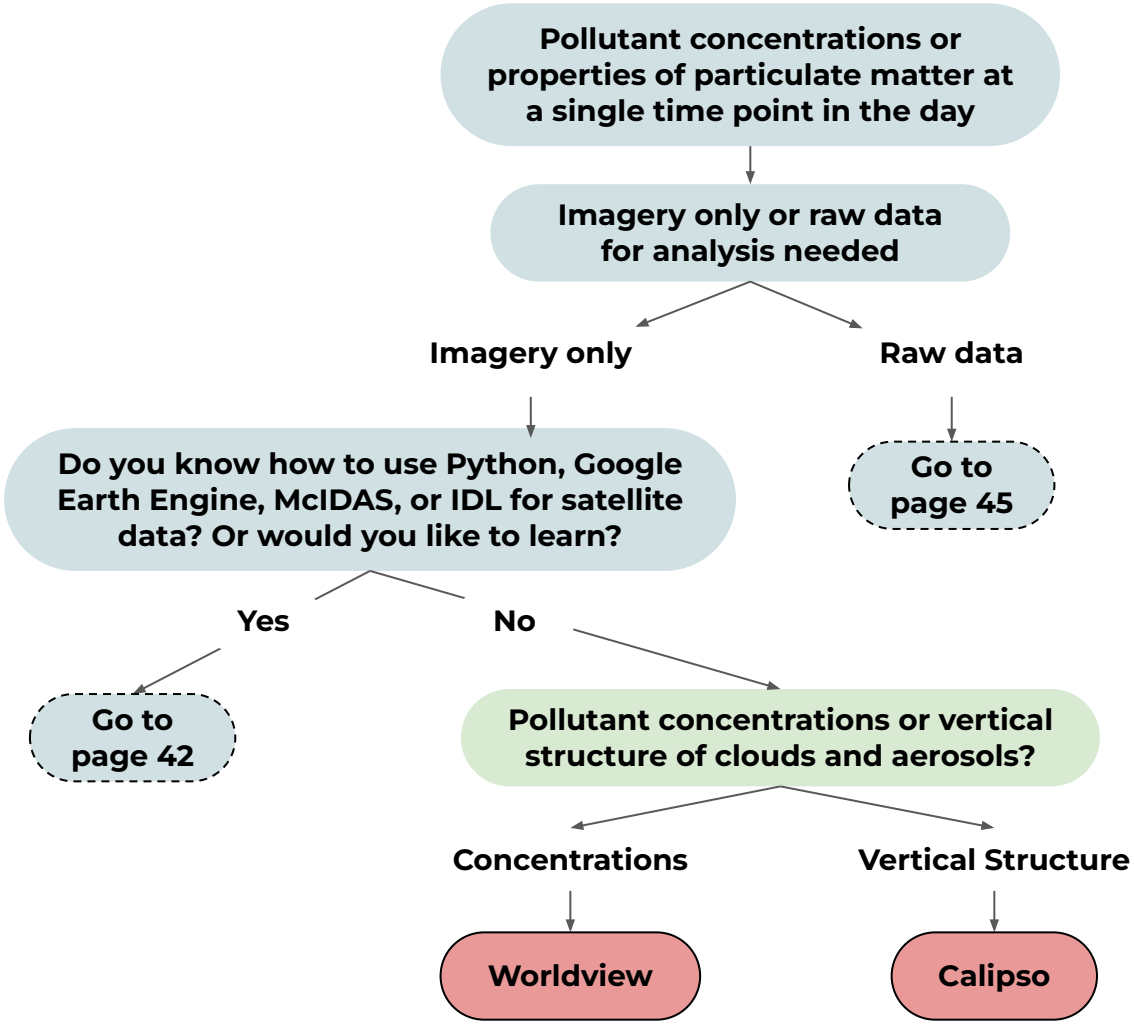

Urban
Historical Data
Single day maps or plots
Smoke/dust/fire locations
Aerosol Watch and Worldview
Map of AQI Values
Air Now Interactive Map
Pollutant concentrations or properties of particulate matter at a single time point in the day
Go to page 16
Fluctuations throughout the day of pollutant or smoke/dust plume
Go to page 27

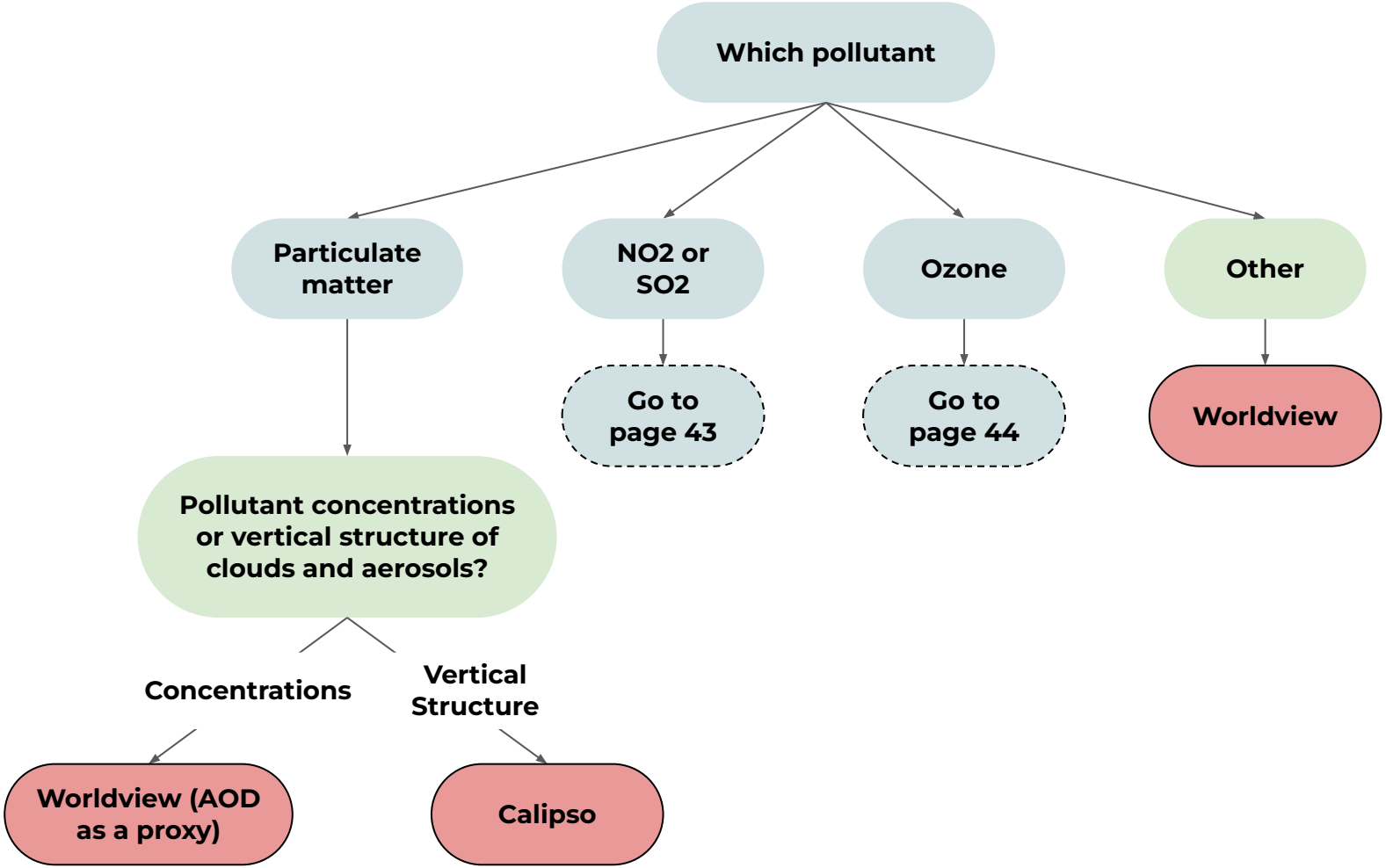

Urban
Historical Data
Averaging Over Time
Map
Time series (line plot)
Higher spatial coverage (more assumptions and/or estimations)
Data from a single point (true concentrations at ground level)
Ground monitor data for excel or Python
Go to page 7
EPA Data Download

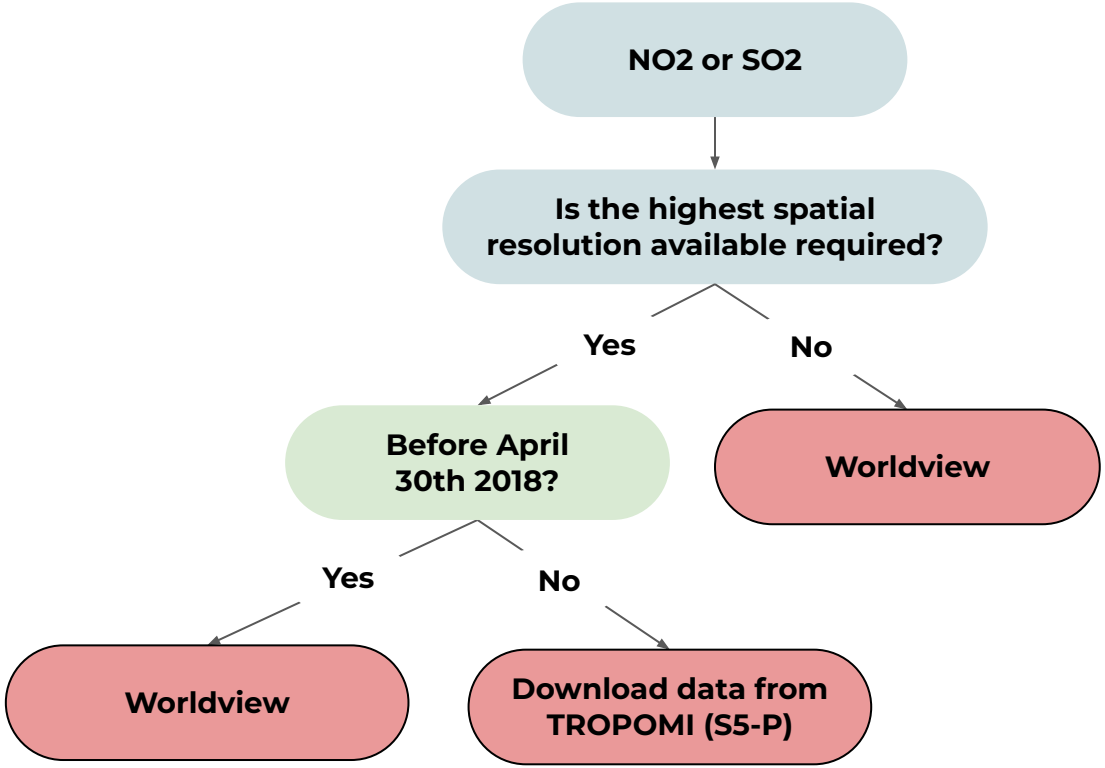

Hawaii or Alaska
Historical Data
Real Time Data
Averaging over time
Single day maps or plots
Map of current values or conditions
Go to page 39
Go to page 40
Go to page 49

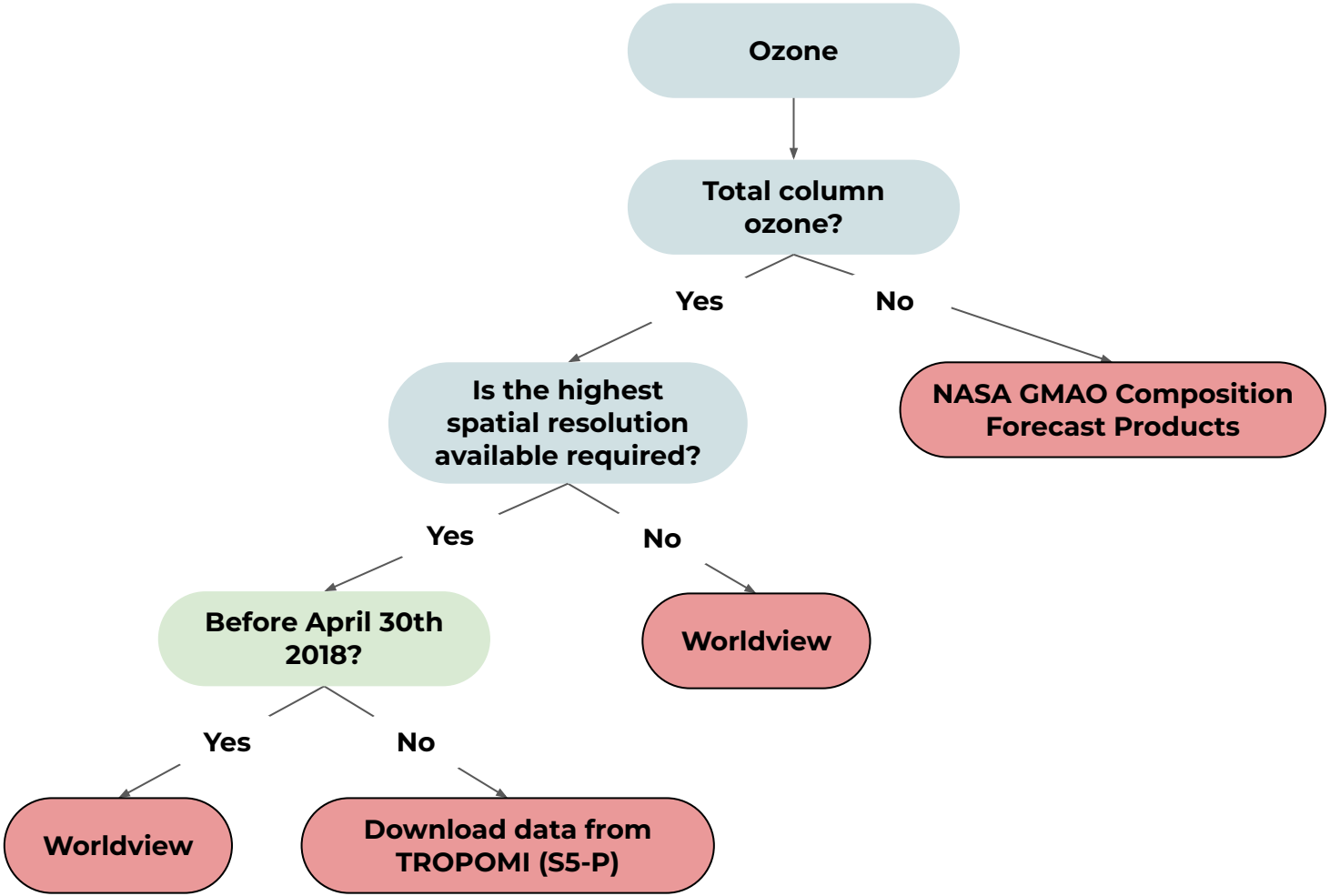

Averaging Over Time
Map
Time Series (Line Plot)
Urban Area?
Yes
No
Higher spatial coverage (more assumptions and/or estimations)
Yes
No
Do you know how to use Python, Google Earth Engine, McIDAS, or IDL for satellite data? Or would you like to learn?
Data from a single point (true concentrations at ground level)
Yes
No
Download/work with satellite-based data
Giovanni
Data for excel or Python
Go to “Satellite Data Download” Flowchart
EPA Data Download

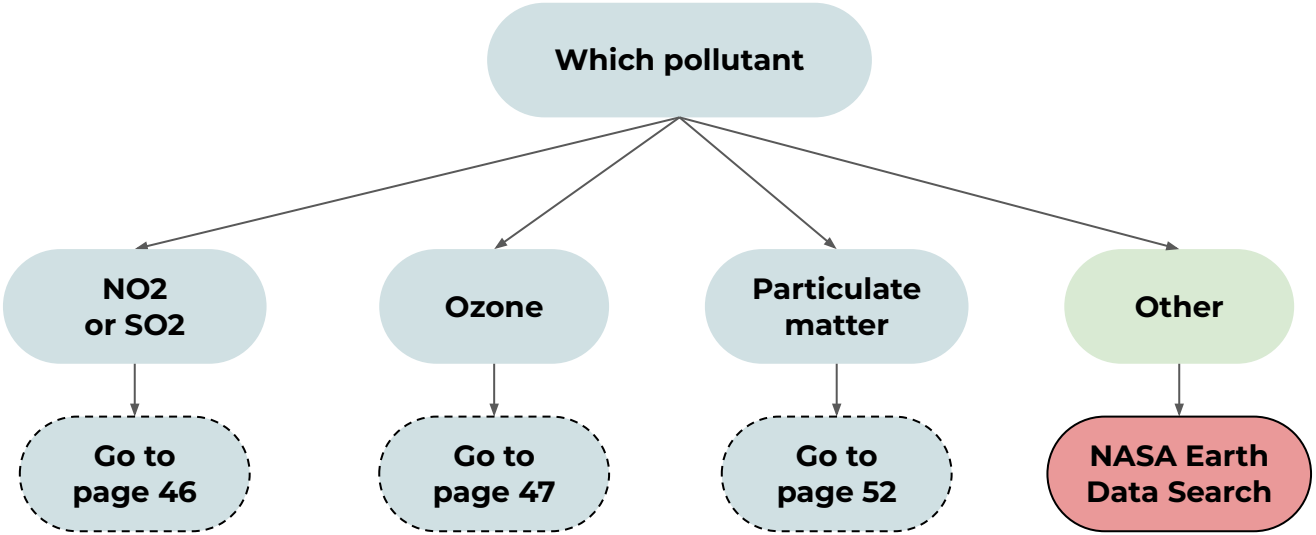

Single day maps or plots
Smoke/dust/fire locations
Worldview
Map of AQI Values
Air Now Interactive Map
Pollutant concentrations or properties of particulate matter at a single time point in the day
Go to page 41
Fluctuations throughout the day of pollutant or smoke/dust plume
Go to page 48

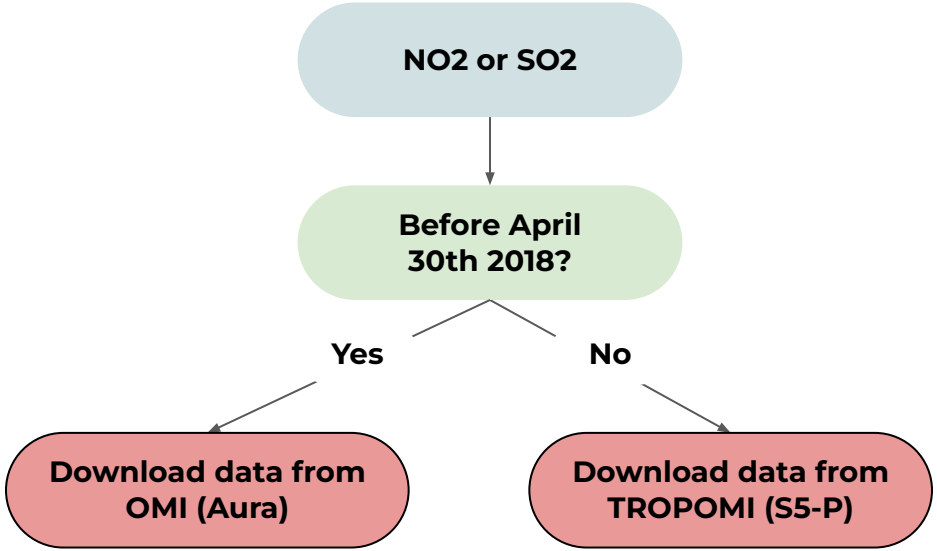

Pollutant concentrations or properties of particulate matter at a single time point in the day
Imagery only or raw data for analysis needed
Imagery only
Raw data
Do you know how to use Python, Google Earth Engine, McIDAS, or IDL for satellite data? Or would you like to learn?
Go to page 45
Yes
No
Go to page 42
Pollutant concentrations or vertical structure of clouds and aerosols?
Concentrations
Vertical Structure
Worldview
Calipso

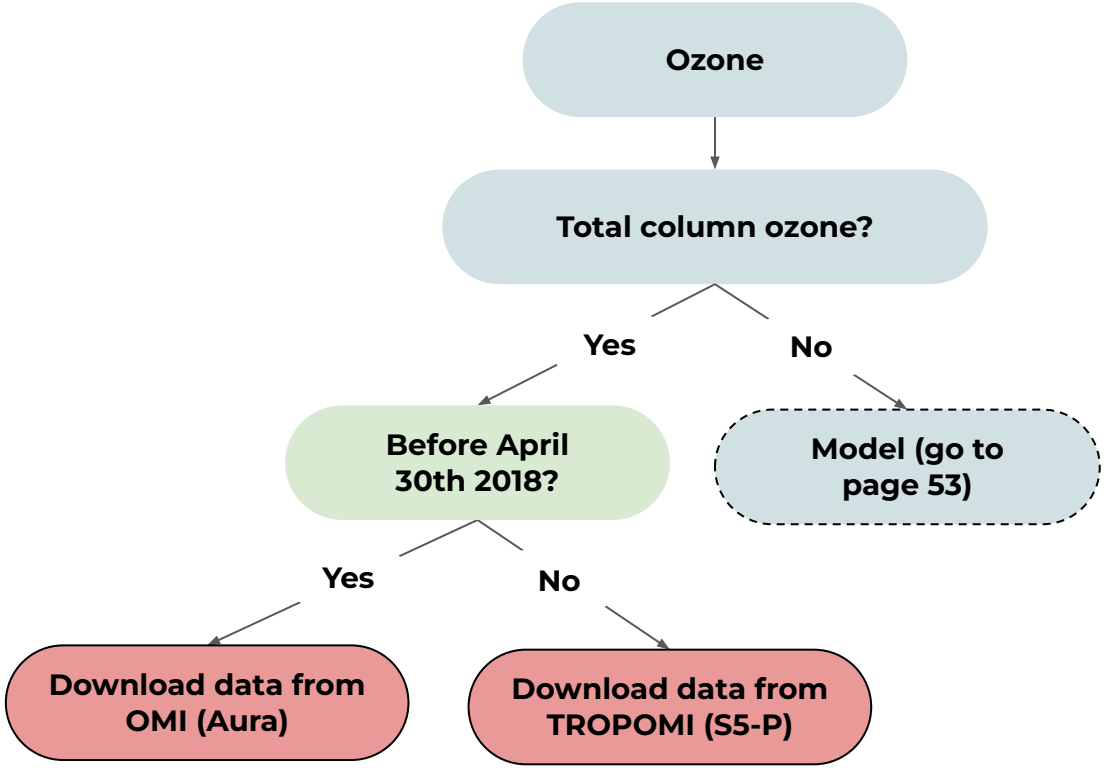

Which pollutant
Particulate matter
NO2 or SO2
Ozone
Other
Go to page 43
Go to page 44
Worldview
Pollutant concentrations or vertical structure of clouds and aerosols?
Concentrations
Vertical Structure
Worldview (AOD as a proxy)
Calipso

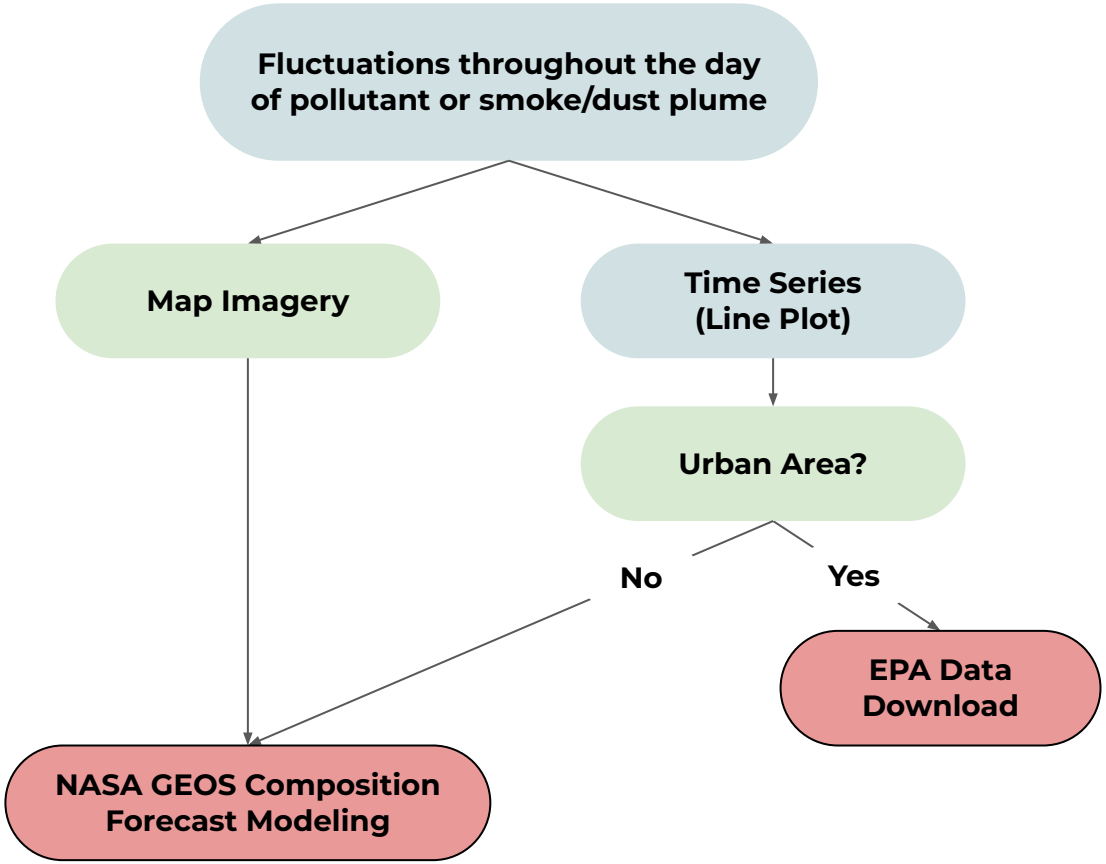

NO2 or SO2
Is the highest spatial resolution available required?
Yes
No
Before April 30th 2018?
Worldview
Yes
No
Worldview
Download data from TROPOMI (S5-P)

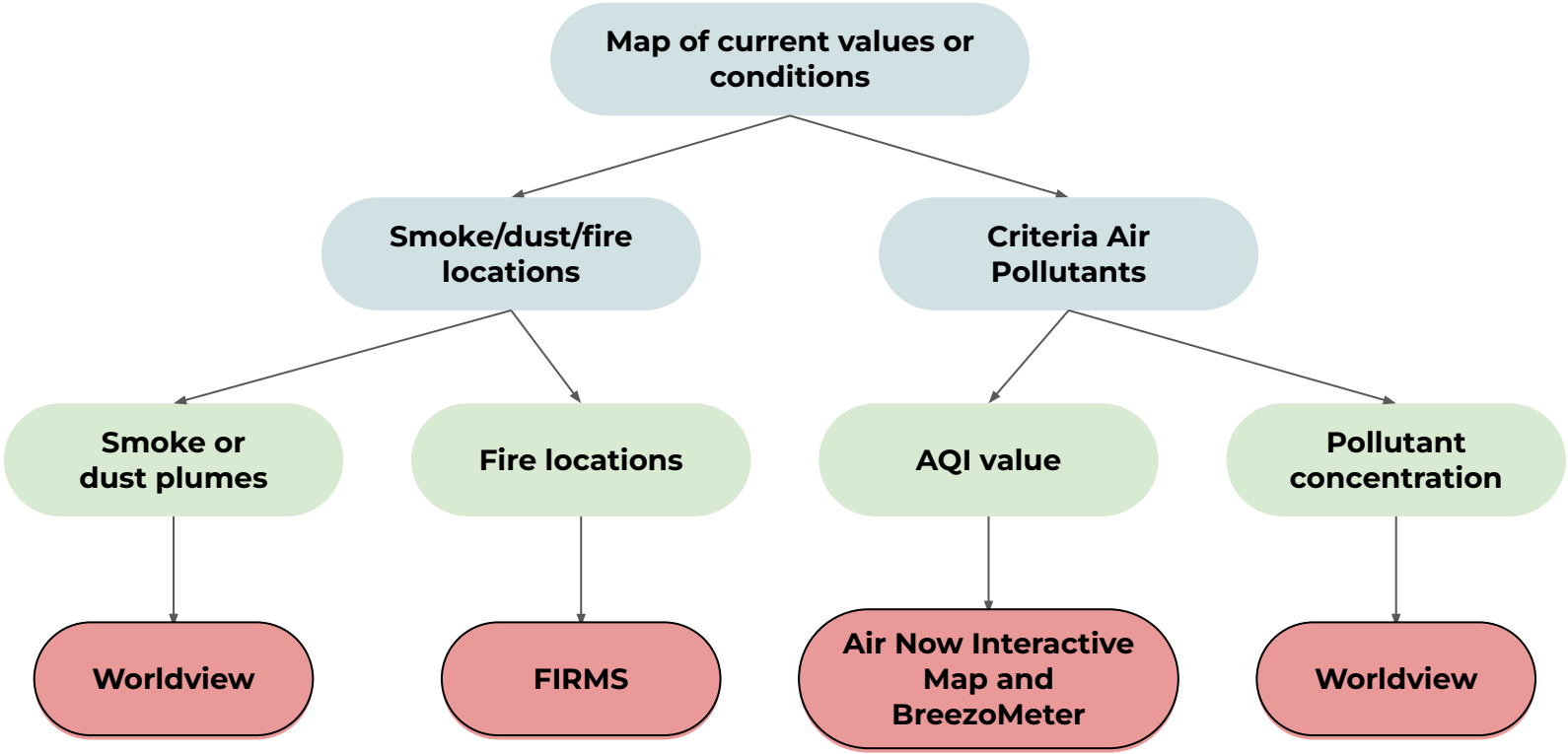

Ozone
Total column ozone?
Yes
No
Is the highest spatial resolution available required?
NASA GMAO Composition Forecast Products
Yes
No
Before April 30th 2018?
Worldview
Yes
No
Worldview
Download data from TROPOMI (S5-P)


Which pollutant
NO2 or SO2
Ozone
Particulate matter
Other
Go to page 46
Go to page 47
Go to page 52
NASA Earth Data Search

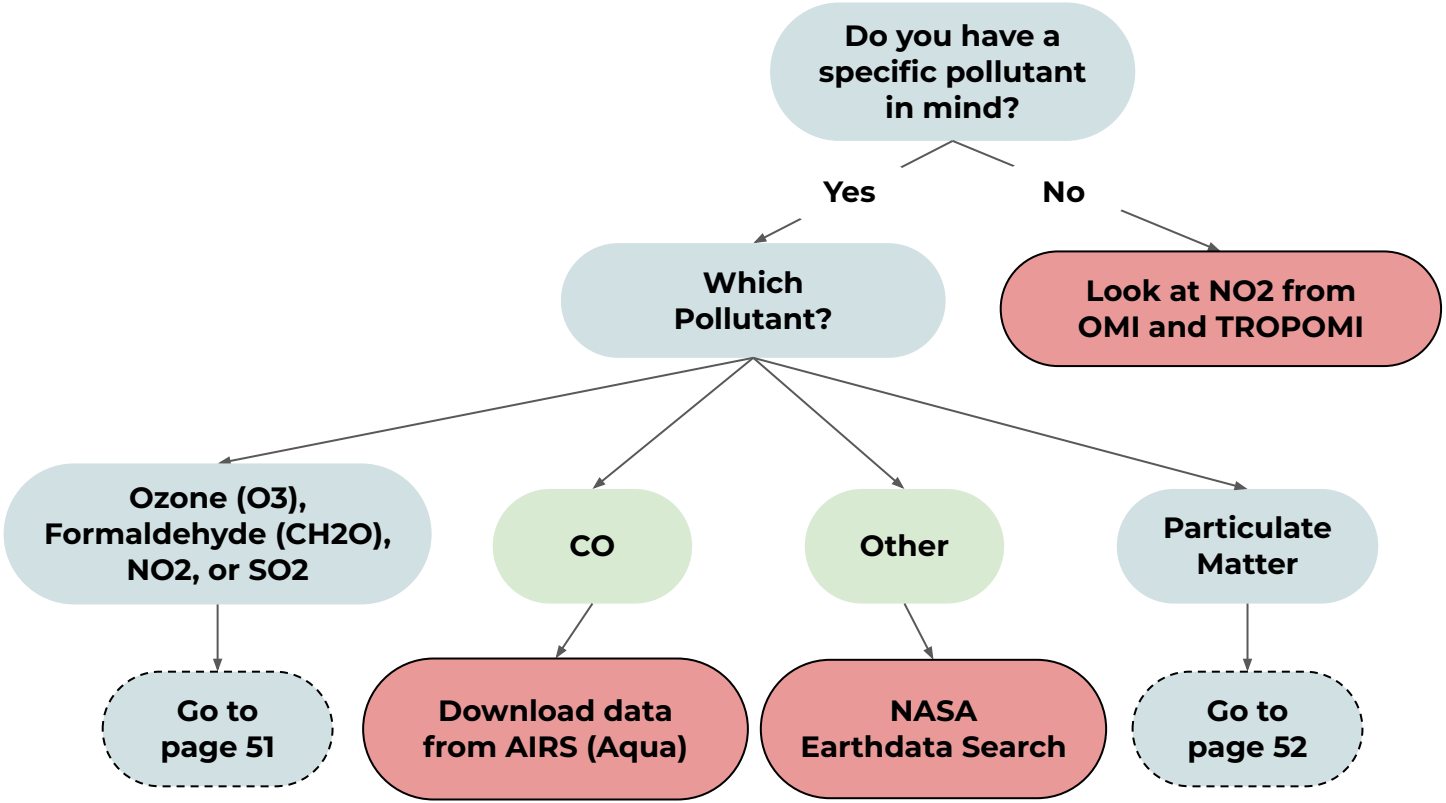

NO2 or SO2
Before April 30th 2018?
Yes
No
Download data from OMI (Aura)
Download data from TROPOMI (S5-P)

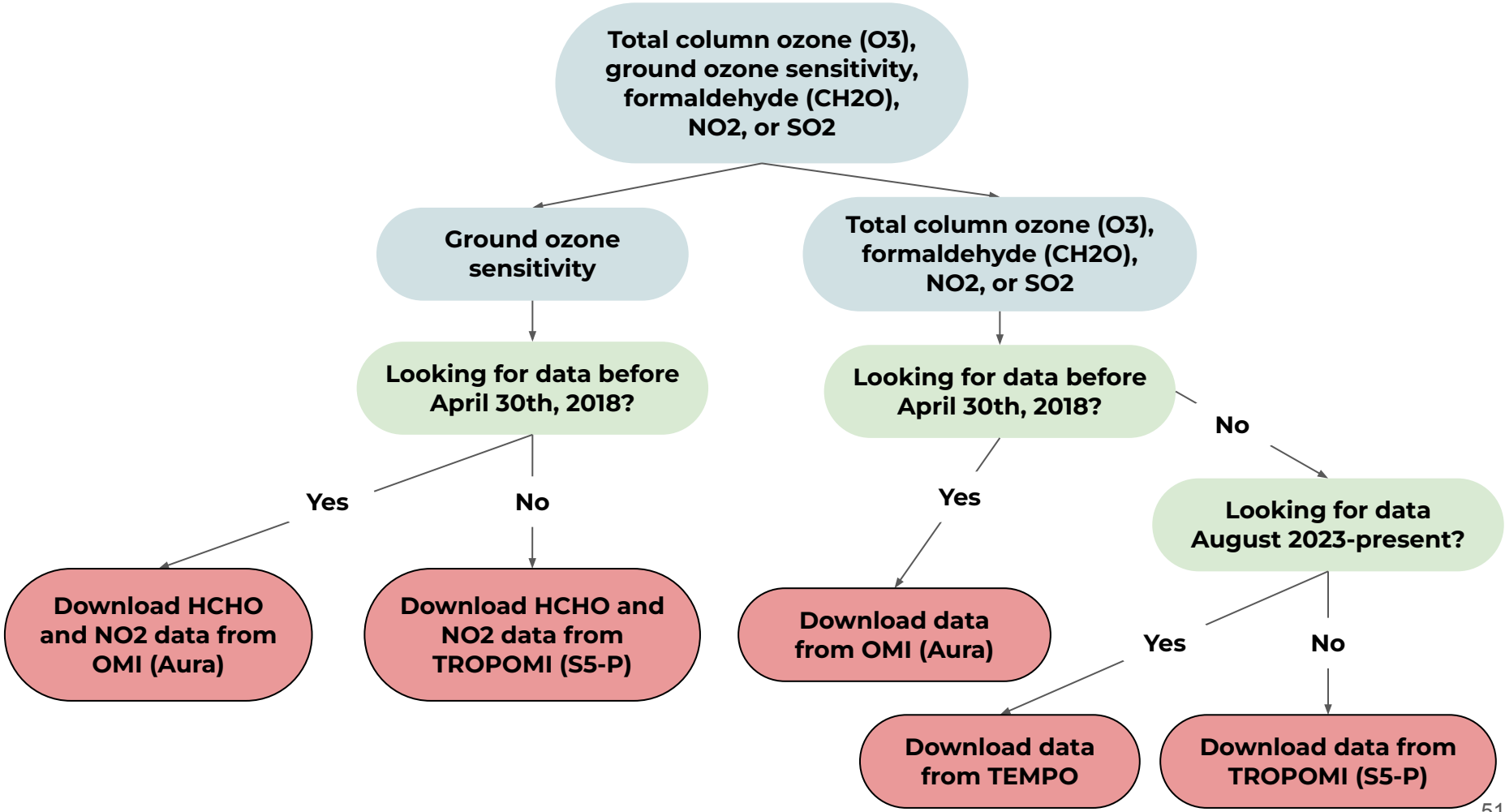

Ozone
Total column ozone?
Yes
No
Before April 30th 2018?
Model (go to page 53)
Yes
No
Download data from OMI (Aura)
Download data from TROPOMI (S5-P)

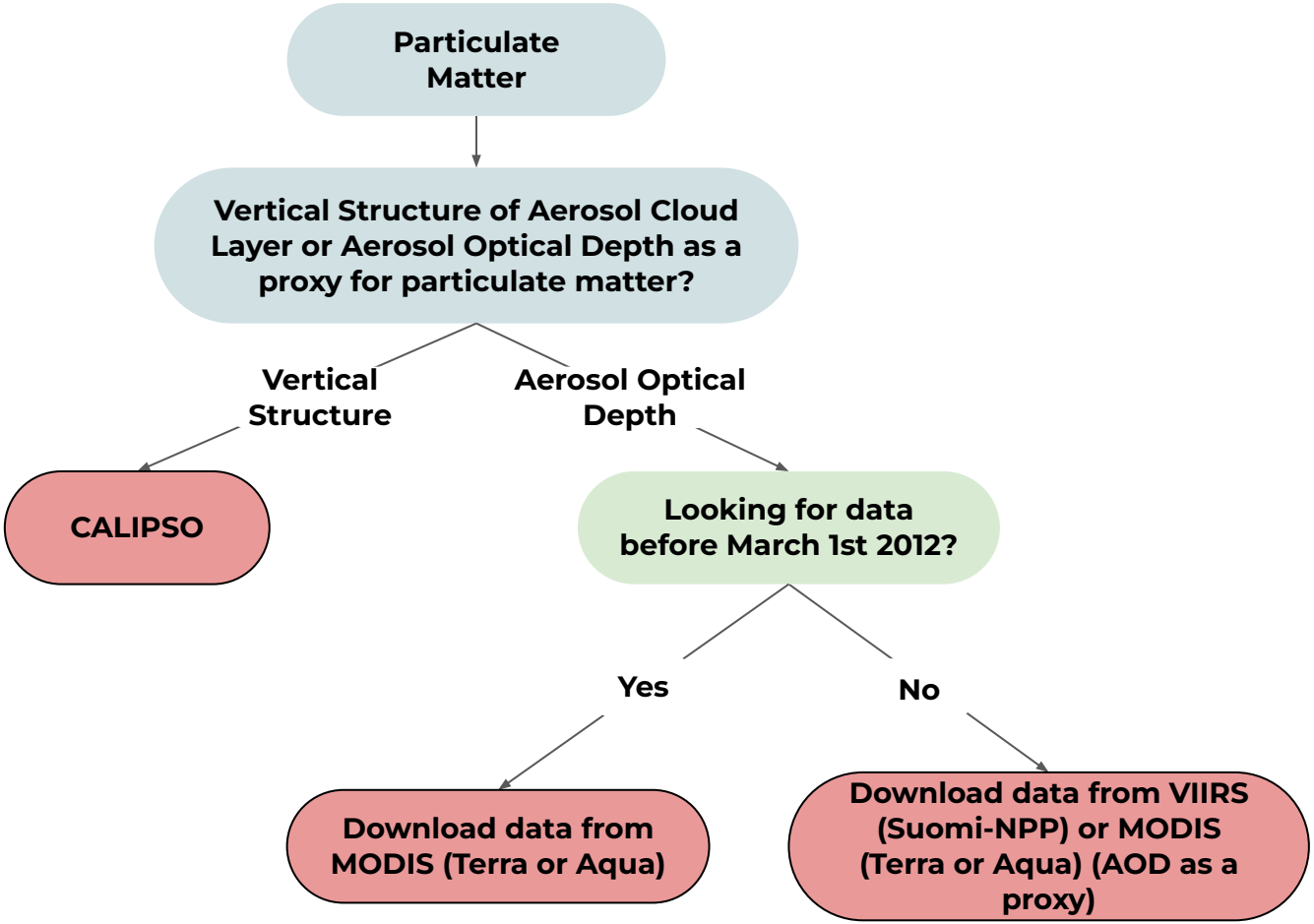

Fluctuations throughout the day of pollutant or smoke/dust plume
Map Imagery
Time Series (Line Plot)
Urban Area?
No
Yes
EPA Data Download
NASA GEOS Composition Forecast Modeling

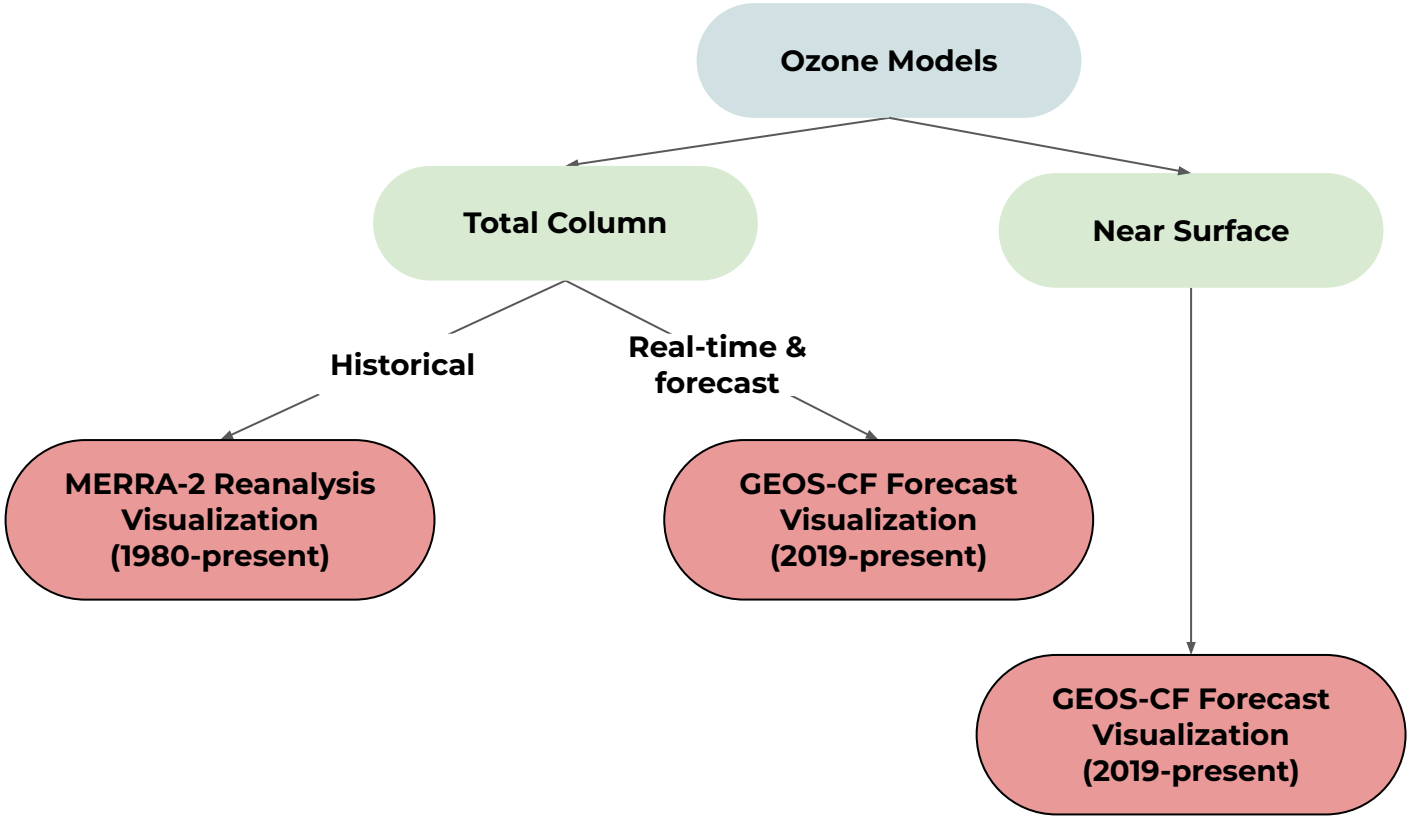

Map of current values or conditions
Smoke/dust/fire locations
Criteria Air Pollutants
Smoke or dust plumes
Fire locations
AQI value
Pollutant concentration
Worldview
FIRMS
Air Now Interactive Map and BreezoMeter
Worldview

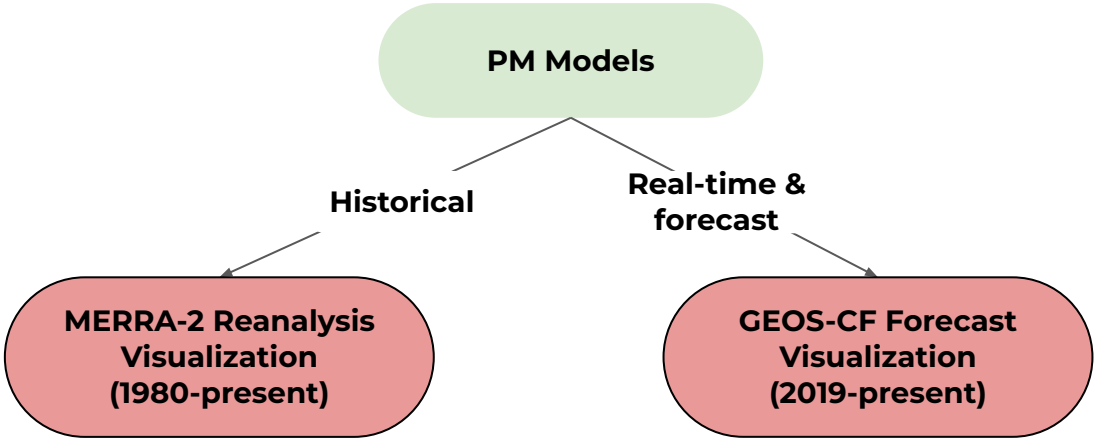
Satellite Data Download

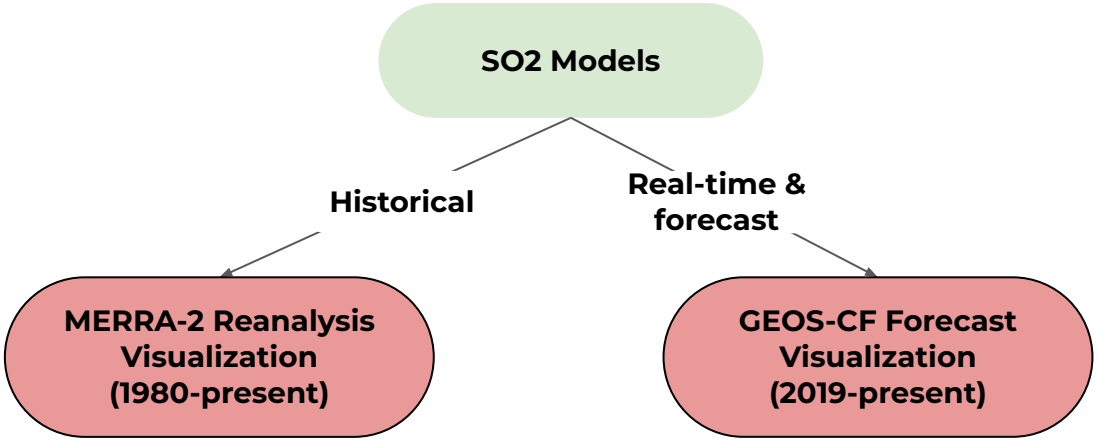


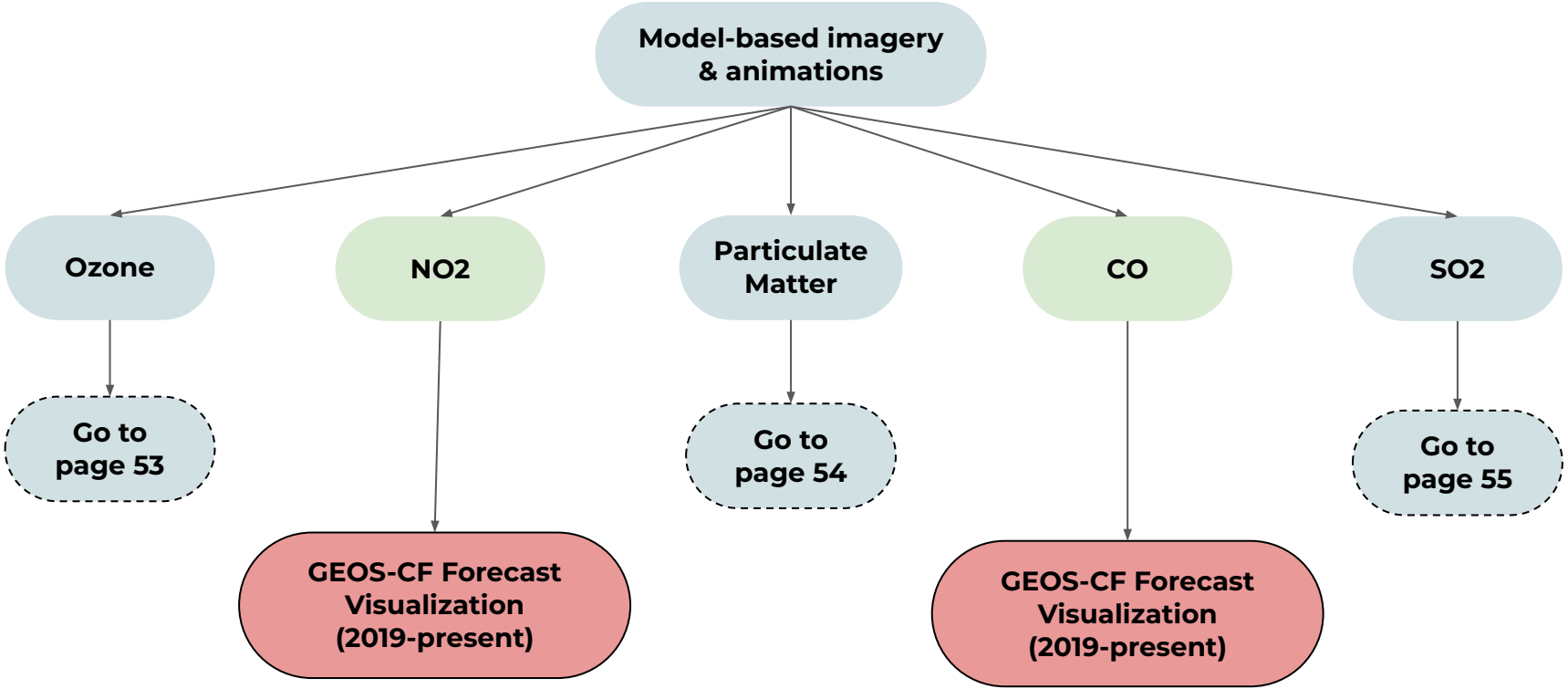

Total column ozone (O3), ground ozone sensitivity, formaldehyde (CH2O), NO2, or SO2
Ground ozone sensitivity
Total column ozone (O3), formaldehyde (CH2O), NO2, or SO2
Looking for data before April 30th, 2018?
Looking for data before April 30th, 2018?
No
Yes
No
Yes
Looking for data August 2023-present?
Download HCHO and NO2 data from OMI (Aura)
Download HCHO and NO2 data from TROPOMI (S5-P)
Download data from OMI (Aura)
Yes
No
Download data from TEMPO
Download data from TROPOMI (S5-P)

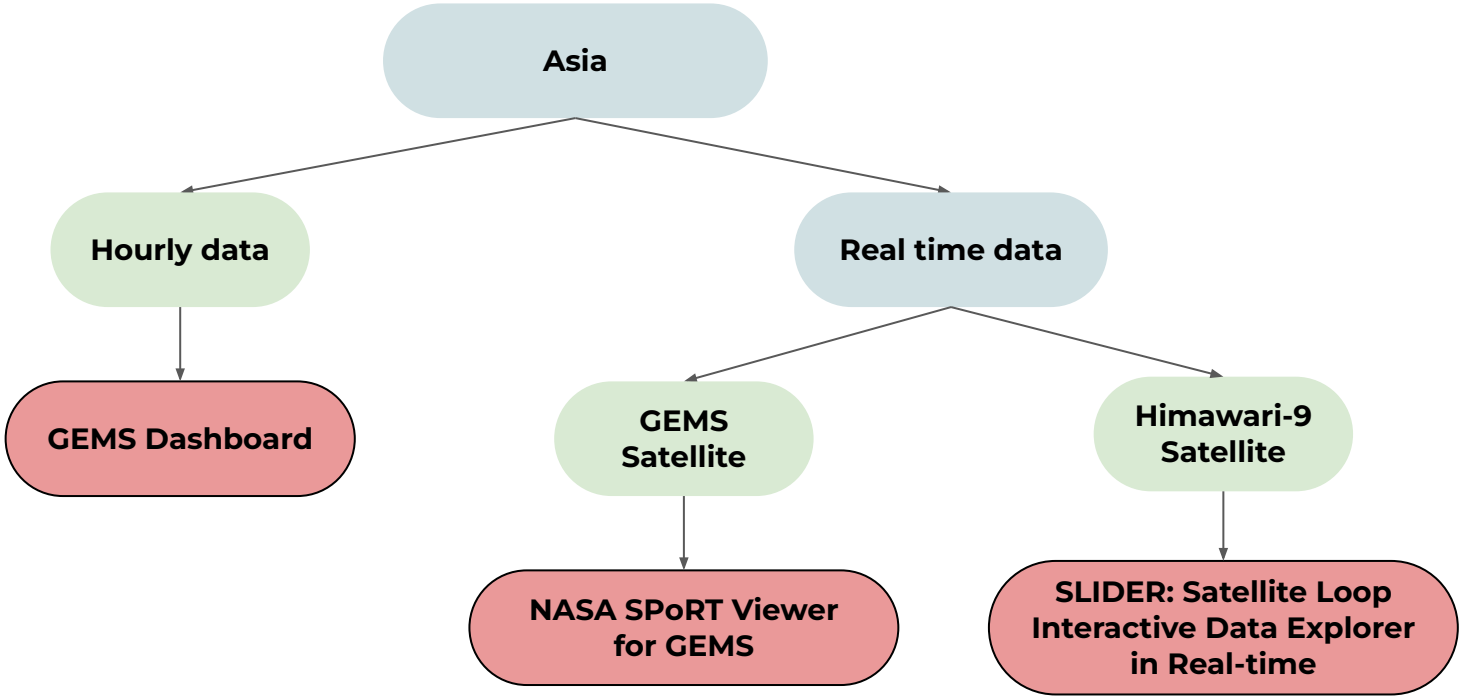

Particulate Matter
Vertical Structure of Aerosol Cloud Layer or Aerosol Optical Depth as a proxy for particulate matter?
Vertical Structure
Aerosol Optical Depth
CALIPSO
Looking for data before March 1st 2012?
Yes
No
Download data from MODIS (Terra or Aqua)
Download data from VIIRS (Suomi-NPP) or MODIS (Terra or Aqua) (AOD as a proxy)


Ozone Models
Total Column
Near Surface
Historical
Real-time & forecast
MERRA-2 Reanalysis Visualization (1980-present)
GEOS-CF Forecast Visualization (2019-present)
GEOS-CF Forecast Visualization (2019-present)


PM Models
Historical
Real-time & forecast
MERRA-2 Reanalysis Visualization (1980-present)
GEOS-CF Forecast Visualization (2019-present)


SO2 Models
Historical
Real-time & forecast
MERRA-2 Reanalysis Visualization (1980-present)
GEOS-CF Forecast Visualization (2019-present)


Model-based imagery & animations
Ozone
NO2
Particulate Matter
CO
SO2
Go to page 53
GEOS-CF Forecast Visualization (2019-present)
Go to page 54
GEOS-CF Forecast Visualization (2019-present)
Go to page 55


Asia
Hourly data
Real time data
GEMS Dashboard
GEMS Satellite
Himawari-9 Satellite
NASA SPoRT Viewer for GEMS
SLIDER: Satellite Loop Interactive Data Explorer in Real-time

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. Additionally, there is an Applied Remote Sensing Training (ARSET) tutorial available for using Giovanni.

HAQAST Giovanni Tutorial →

ARSET Giovanni Tutorial →

NASA GMAO Composition Forecast Products →

NASA's Global Modeling and Assimilation Office offers a series of Composition Forecast Products to help visualize model products.

GMAO Datagrams Ozone →

NASA GMAO Composition Forecast Maps →

NASA's Global Modeling and Assimilation Office offers a series of Composition Forecast Products to help visualize model products. This composition forecast map shows total column Ozone.

NASA GMAO Composition Forecast Maps →

NASA's Global Modeling and Assimilation Office offers a series of Composition Forecast Products to help visualize model products. This composition forecast map shows surface Ozone.

NASA GMAO Composition Forecast Maps →

NASA's Global Modeling and Assimilation Office offers a series of Composition Forecast Products to help visualize model products. This composition forecast map shows surface NO2.

NASA GMAO Composition Forecast Maps →

NASA's Global Modeling and Assimilation Office offers a series of Composition Forecast Products to help visualize model products. This composition forecast map shows surface CO.

NASA GMAO Composition Forecast Maps →

NASA's Global Modeling and Assimilation Office offers a series of Composition Forecast Products to help visualize model products. This composition forecast map shows surface PM2.5.

NASA GMAO Composition Forecast Maps →

NASA's Global Modeling and Assimilation Office offers a series of Composition Forecast Products to help visualize model products. This composition forecast map shows surface SO2.

NASA GMAO Atmospheric Composition (2D) Maps →

NASA's Global Modeling and Assimilation Office offers a series of Composition Forecast Products to help visualize model products. This atmospheric composition map shows total Ozone.

NASA GMAO Atmospheric Composition (2D) Maps →

NASA's Global Modeling and Assimilation Office offers a series of Composition Forecast Products to help visualize model products. This atmospheric composition map shows total PM2.5.

NASA GMAO Atmospheric Composition (2D) Maps →

NASA's Global Modeling and Assimilation Office offers a series of Composition Forecast Products to help visualize model products. This atmospheric composition map shows SO2 Surface Mass [10^{12} molecules cm^{-3}].

Wash U (1998-2021) 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.

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 →

CACES

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. There is also an ARSET Training on accessing and analyzing air quality data from geostationary satellites.

ARSET Training →

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.

There is also an ARSET training on Satellite Data for Air Quality Environmental Justice and Equity Applications

Worldview Tutorial →

HAQAST

ARSET Training →

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).

There is also an ARSET training on accessing and analyzing air quality data from geostationary satellites.

ARSET Training →

Air Now Interactive Map →

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

Air Now Interactive Map →

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.

There is also an ARSET training on Satellite Data for Air Quality Environmental Justice and Equity Applications.

Worldview Tutorial →

ARSET Training →

Calipso →

The Calipso website offers profile observation images from the year 2013-2023. For information about Calipso, downloading the data, and visualizing the data see sources below. There is also an ARSET Training for Satellite Remote Sensing of Dust, Fires, Smoke, and Air Quality available.

CALIPSO Data User's Guide →

CALIPSO Data →

ARSET Tutorial →

Download data from TROPOMI (S5-P)

TROPOMI offers higher resolution SO2, NO2, 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 NO2 data from TROPOMI (S5-P)

TROPOMI offers higher resolution SO2 data than what is available on NASA Worldview. A tutorial for ozone sensitivity using HCHO and NO2 is available through the Holloway Group website. Additionally, see related publications below.

Mapping TROPOMI Tutorial →

Publication: Inferring Changes in Summertime Surface Ozone–NOx –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 NO2 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 data from TEMPO

TEMPO has data from August 2023-present over North America, including hourly data. Data from the TEMPO instrument is available at NASA Earthdata Search. Several tutorials are available on working with geostationary data. For more information about the capabilities of TEMPO, view the publications below.

ARSET Tutorial →

NASA Earth Data Search →

Webinar: Finding Your TEMPO: An Introduction to the Mission, Products, and Data Services for Air Quality Observations over North America →

Up to Date Information on TEMPO data product →

Download HCHO and NO2 data from TEMPO

TEMPO has data from August 2023-present over North America, including hourly HCHO and NO2 data.

NASA SPoRT Viewer →

Data Documentation →

Webinar Tutorial →

Download SEDAC dataset (Daily and Annual PM2.5, O3 and NO2) →

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.

Download SEDAC dataset (Daily 8-Hour Max and Annual O3) →

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.

Download SEDAC dataset (Daily and Annual NO2) →

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 (ozone)

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 →

There is also an ARSET Training for analyzing NASA air quality model output.

ARSET Tutorial →

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 →

ARSET Tutorial →

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.

There is also an ARSET training on Satellite Data for Air Quality Environmental Justice and Equity Applications

Worldview Tutorial →

ARSET Training →

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.

ARSET Training →

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.

There is also an ARSET Training on accessing and analyzing air quality data from geostationary satellites.

ARSET Training →

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. There is also an ARSET Training for Satellite Data for Air Quality Environmental Justice and Equity Applications available.

ARSET Training →

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.

There is also an ARSET Training for Satellite Observations and Tools for Fire Risk, Detection, and Analysis available.

ARSET Tutorial →

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 NO2 from OMI and TROPOMI

If you do not have a specific pollutant in mind, then look at NO2 data from the satellite instruments OMI and TROPOMI. These instruments measure various air pollutants such as NO2 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 →

ACAG North America Dataset Annual (1998-2022)

Annual datasets from the Atmospheric Composition Analysis Group at Washington University in St. Louis for state, gridded (0.1°), and gridded (0.01°) data between 1998-2022.

Annual State Data →

Annual 0.1 Degree Data →

Annual 0.01 Degree Data →

ACAG North America Dataset Monthly (1998-2022)

Monthly datasets from the Atmospheric Composition Analysis Group at Washington University in St. Louis for gridded (0.1°), and gridded (0.01°) data between 1998-2022.

Monthly 0.1 Degree Data →

Monthly 0.01 Degree Data →

SEDAC Daily PM2.5 Dataset (2000-2016)

Daily datasets for gridded (1km) and ZIP Code between 2000-2016.

Daily Gridded PM2.5 Dataset →

Daily ZIP Code PM2.5 Dataset →

MERRA-2 Reanalysis

NASA's Modern-Era Retrospective analysis for Research and Applications, Version 2.

MERRA-2 Reanalysis Data Download (1980-2024) →

For downloading gridded (0.5°x0.625) PM2.5 data

MERRA-2 Reanalysis Visualization (1980-2024) →

For plotting a map of gridded (0.5°x0.625) PM2.5 data of all CONUS.

MERRA-2 Reanalysis in NASA Giovanni (1980-2024) →

For plotting a map of gridded (0.5°x0.625) PM2.5 data of all CONUS.

GEMS Dashboard →

국립환경과학원
National Institute of Environmental Research

The GEMS Dashboard created by the Environmental Satellite Center of the Republic of Korea is tool that displays both satellite image display and satellite video of aerosols across Asia using the Geostationary Environment Monitoring Spectrometer (GEMS).

There is also an ARSET Tutorial available on accessing and analyzing air quality data from geostationary satellite such as GEMS.

ARSET Tutorial →

NASA SPoRT Viewer for GEMS →

The NASA SPoRT viewer is an interactive tool that displays dynamic imagery. This specific animation displays data from the Geostationary Environment Monitoring Spectrometer (GEMS) across Asia.

There is also an ARSET Tutorial available on accessing and analyzing air quality data from geostationary satellite such as GEMS.

ARSET Tutorial →

SLIDER: Satellite Loop Interactive Data Explorer in Real-time →

SLIDER provides full-resolution, standard and value-added imagery products from GOES-16 and Himawari-8 to both the scientific community and the general public.

There is also an ARSET Tutorial available on accessing and analyzing air quality data from geostationary satellite such as Himawari-8.

ARSET Tutorial →