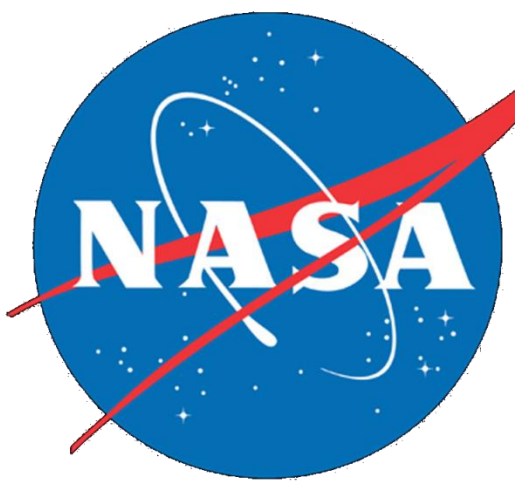




Developing a Cloud-Based ArcGIS Image Service for TROPOMI Level 2 Data: Preprocessing, Transformation, and Publication

AGU/24
IN21C-
2247

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Introduction

The TROPOspheric Monitoring Instrument (TROPOMI), a state-of-the-art satellite sensor onboard the Sentinel-5 Precursor, delivers high spatialtemporal resolution data on a variety of trace gases and atmospheric constituents, including ozone (O₃), nitrogen dioxide (NO₂), sulfur dioxide (SO₂), methane (CH₄), carbon monoxide (CO), and formaldehyde (HCHO), along with cloud and aerosol properties. TROPOMI's spectral range covers ultraviolet, visible, near-infrared, and shortwave infrared wavelengths. TROPOMI data is particularly useful for air quality measurements and is well-suited for monitoring wildfires and assessing their impacts. However, the complexity of its Level 2 (L2) data presents substantial challenges for GIS users and environmental scientists who need efficient access to this valuable information. Integrating TROPOMI L2 data into an ArcGIS Image Service marks following significant advancements:

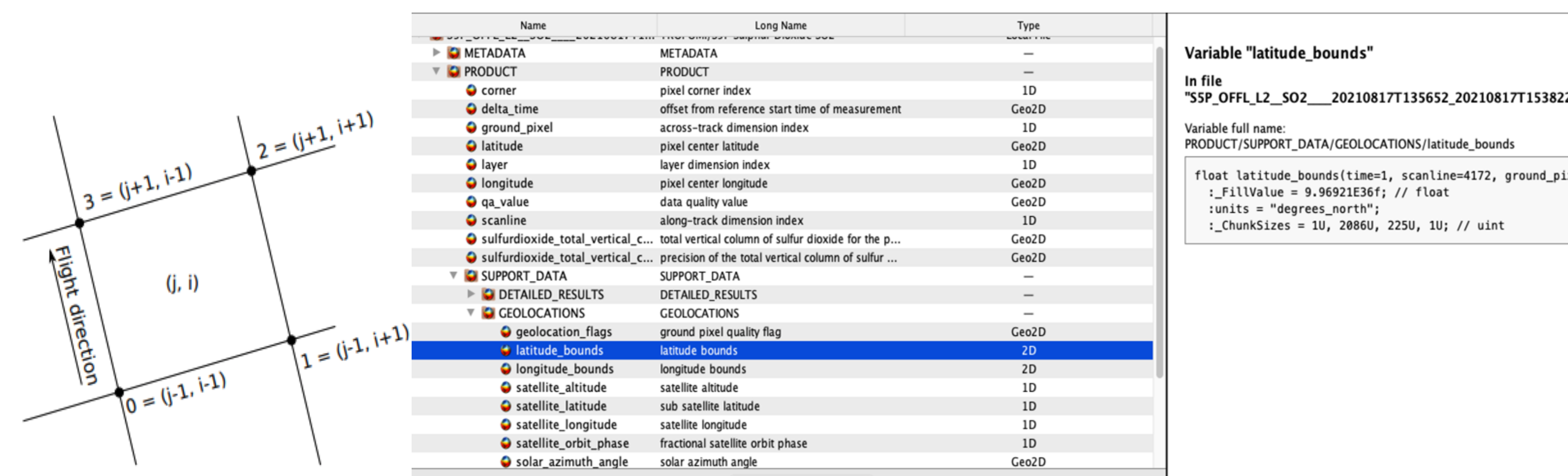
- **Efficient Data Handling:** Manages and hosts large volumes of imagery in the cloud, enabling quick access and efficient analysis of raster datasets
- **Dynamic Rendering:** Supports on-the-fly processing and rendering of images, providing flexibility in data visualization with standard compatibility.
- **Integration with GIS:** Seamlessly integrates with GIS workflows, enabling imagery to be combined with other spatial data for comprehensive analysis in different platforms such as ArcGIS Pro, OGC clients and mobile apps.
- **Sharing and Collaboration:** Facilitates easy sharing and collaboration by providing OGC access to imagery, enabling seamless interoperability across multiple platforms and applications.
- **Customization and Analysis:** Provides server-side raster functions, empowering users to perform advanced analysis, and derive valuable insights from the data.

These capabilities enhance the accessibility, interoperability, and utility of satellite-derived environmental information, making it a powerful tool for GIS applications in environmental monitoring, air quality assessment, and climate studies.

TROPOMI Level 2 Data

TROPOMI Level 2 data is hosted at NASA's Goddard Earth Sciences Data and Information Services Center (GES DISC), provided by the European Space Agency (ESA), and accessible at <https://disc.gsfc.nasa.gov/datasets?keywords=SSP>. Its spectral range covers ultraviolet, visible, near-infrared, and shortwave infrared wavelengths.

- **Format:** netCDF with complex internal structure
- **Spatial Resolution:** 5.5 km × 3.5 km
- **Coverage:** Global (-180°, -90°, 180°, 90°)
- **Temporal Resolution:** Daily updates with 101.5-minute orbit cycle

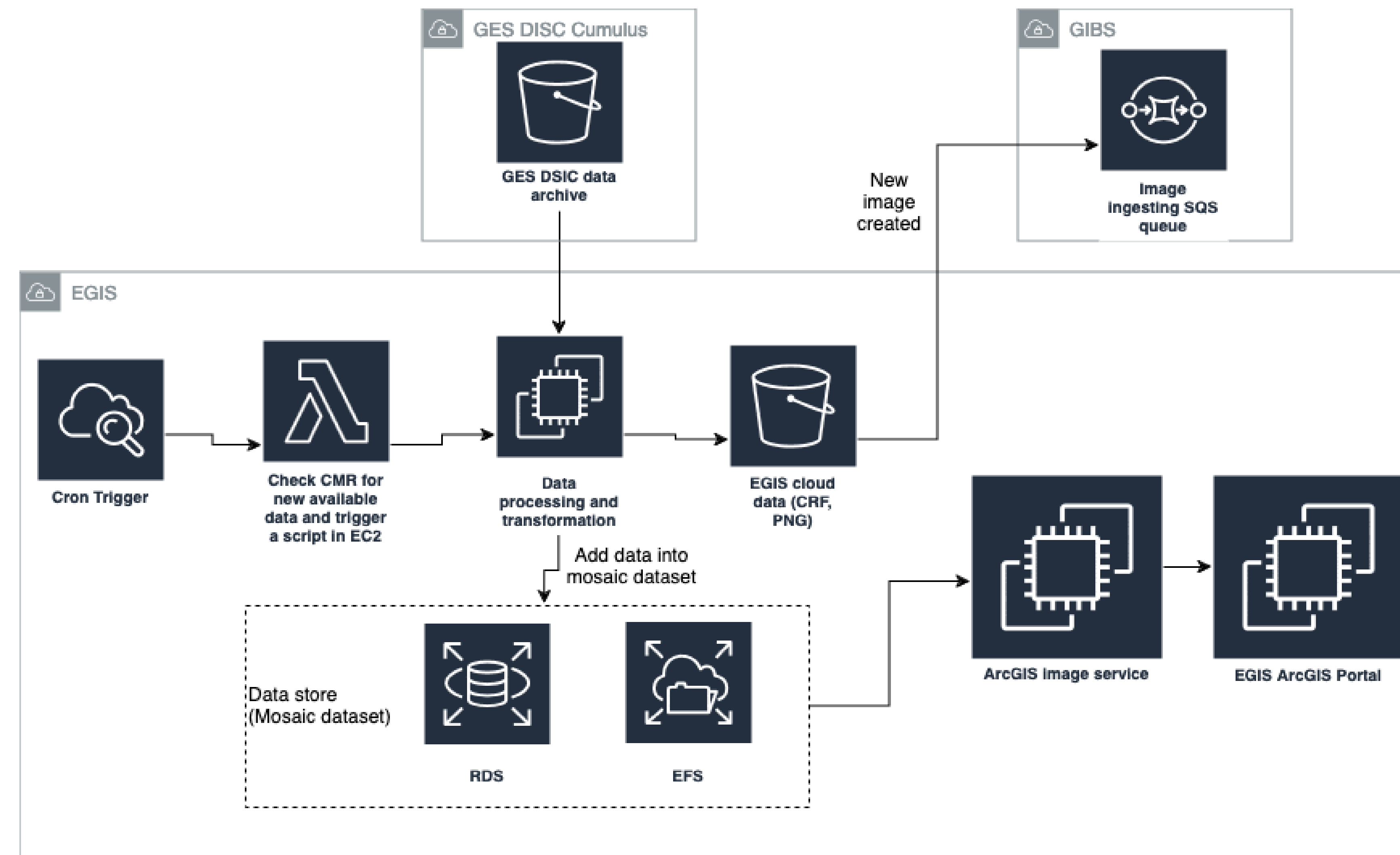


Geolocation Information of TROPOMI Level 2 Data

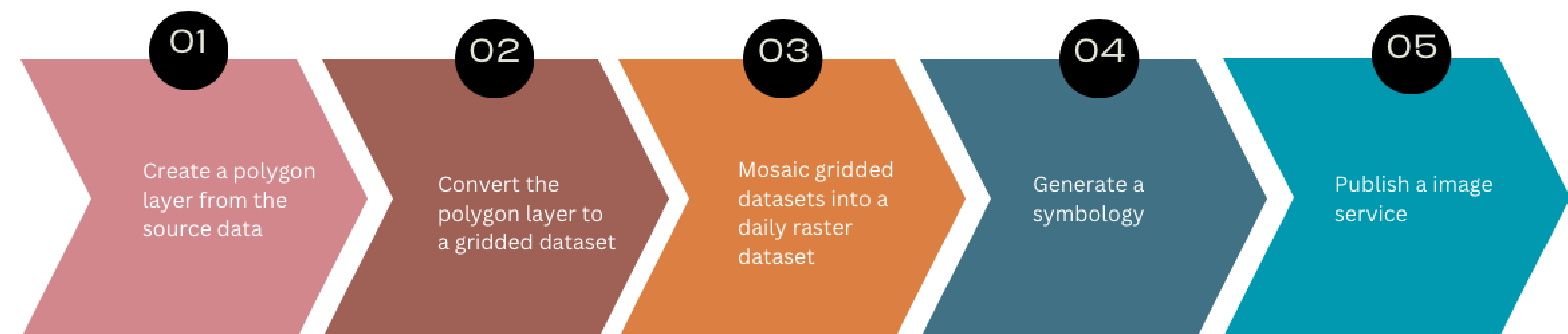
- **Pixel Center Latitude and Longitude (longitude, latitude):** This information provides the coordinates for the center of each pixel. By using these values, the data can be converted into a point layer, where each point represents the center of a pixel. This point layer may not accurately represent the irregular shape of the pixels.
- **Pixel Corner Coordinates (longitude_bounds, latitude_bounds):** These four coordinates define the boundaries of each pixel, as shown in the diagram. With this information, the data can be converted into a polygon layer, where each polygon represents the extent of a pixel. This polygon layer provides a more accurate representation of the pixel shape.

Therefore, converting the data into a polygon layer using the pixel corner information is considered a more accurate approach.

System Workflow



Data Processing with ArcPy



Preprocessing
(Extract pixel boundary)

Transformation
(Cloud Raster Format)

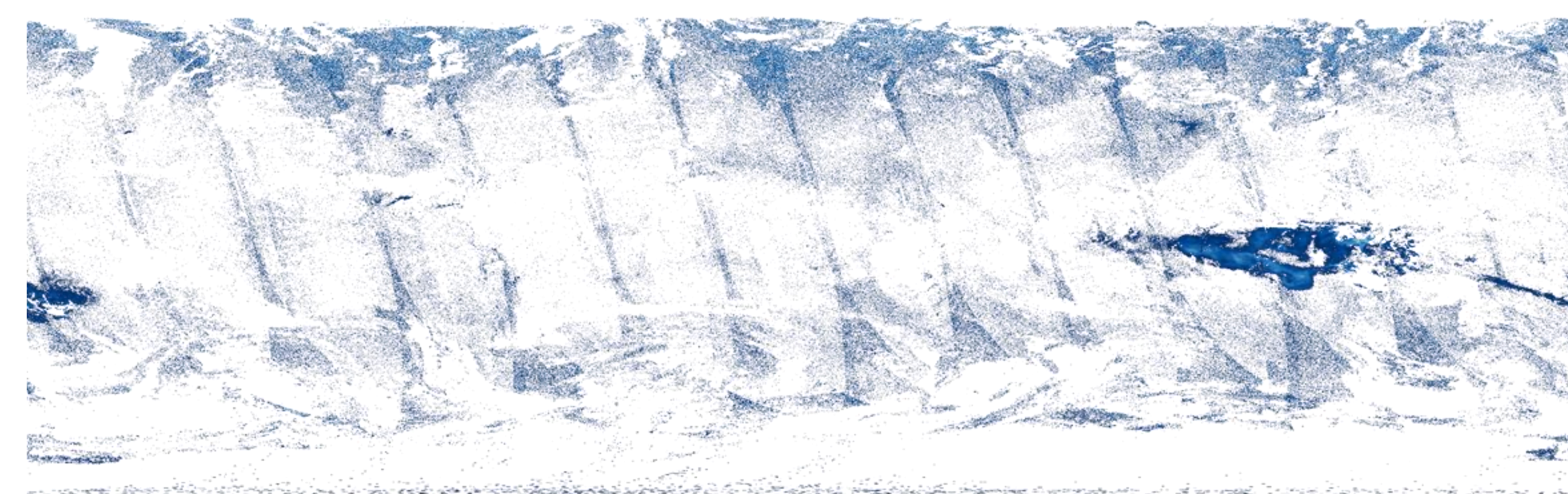
Visualization
(Global Imagery Browse Services
colormaps)

Publication

ArcPy:

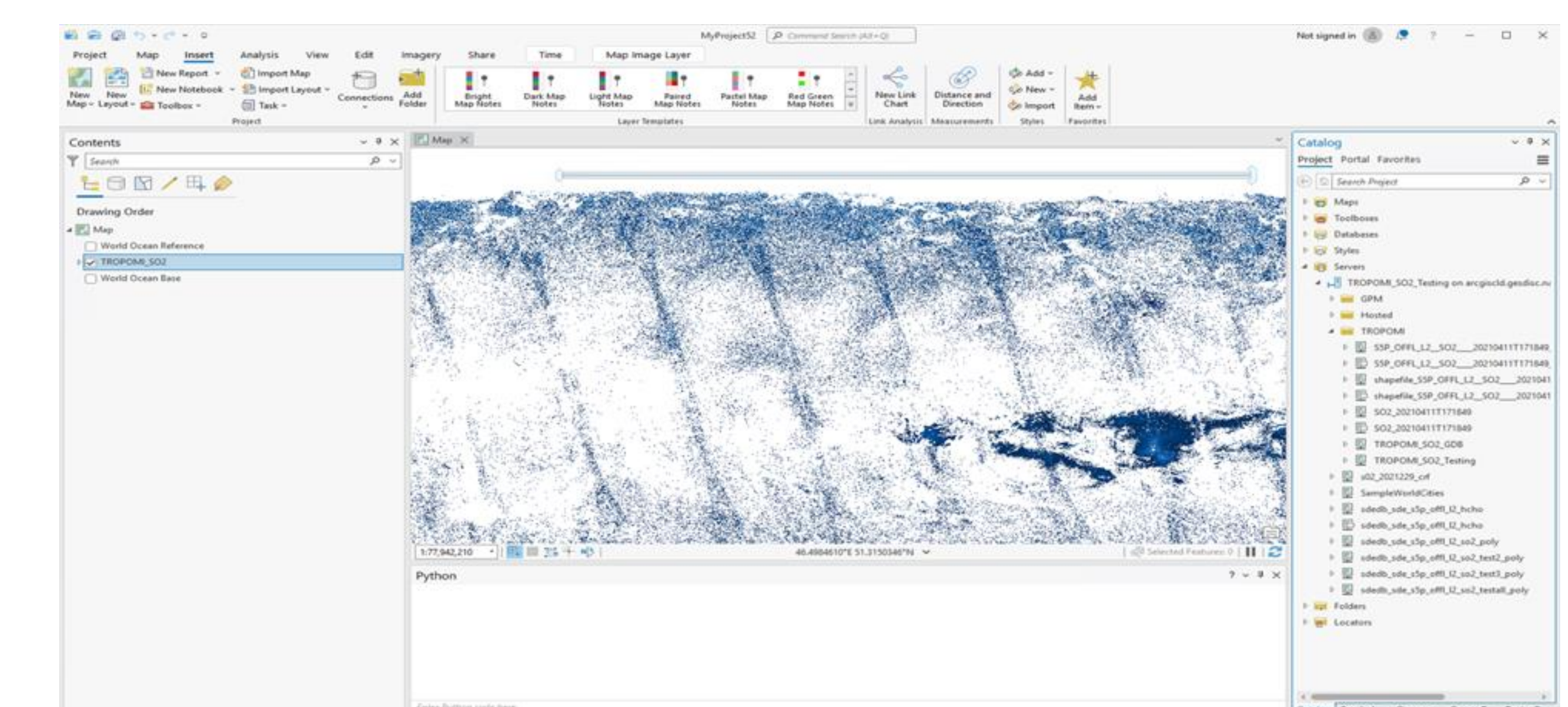
A Python site package specifically designed for geospatial analysis, data conversion, mapping automation, and geoprocessing tasks within Esri's ArcGIS software suite. It allows us to automate the processing and publication of TROPOMI L2 data.

Service Clients



Daily Global Imagery of TROPOMI SO2 Available Through OGC WMS

(https://arcgis.cgd.gesdisc.nasa.gov/server/services/TROPOMI/TROPOMI_SO2_Testing/MapServer/WMServer?SERVICE=WMS&VERSION=1.3.0&REQUEST=GetMap&BBOX=-90,-180,90,180&CRS=EPSG:4326&WIDTH=6000&HEIGHT=3000&LAYERS=1&FORMAT=image/png&styles=default&TRANSPARENT=true&time=2022-01-19)



Retrieving TROPOMI SO2 Data from ArcGIS Image Service in ArcGIS

Pro