COVE User's Guide

The Committee on Earth Observation Satellites (CEOS) Visualization Environment (COVE) is a suite of tools for analyzing satellite sensor coverage for more than 100 Earth-observing satellites developed by the NASA CEOS Systems Engineering Office (SEO). The suite of tools include:

- **Acquisition Forecaster** – A tool that provides users with the ability to predict when a satellite has the ability to image a region of interest, and it includes options to show the nadir track or filter scenes by orbit direction in user controls.
- **Coverage Analyzer** – A tool that provides users with the ability to analyze the historical satellite coverage of a region of interest.
- **Revisits Calculator** – A tool which allows users to analyze estimated satellite coverage and revisits for a region of interest.
- **Coincident Calculator** – A tool which allows users to determine the coincidence of satellite instrument modes and/or custom constellations observing a location in the same day within a region of interest using historical or predicted scene data.
- **Data Browser** – A tool that allows users to view the satellite image archives from multiple CEOS missions.
- **Data Policy** – A database that provides users with information about the data policy and primary archive location for CEOS satellite instruments.
- **Country Coverage** – A tool that allows users to generate and view GFOI Country Coverage reports for over 70 countries and 3 constellations.
- **Utilities** – A set of quick calculation utilities to provide users with a means of estimating various parameters of interest about CEOS satellite missions.

Other COVE features included in this document are:

- **Constellations** – A feature in Coincident Calculator which allows users to create groups of missions/instruments or custom missions/instruments.

- **Custom Missions** – A feature in Acquisition Forecaster, Coincident Calculator, and Revisits Calculator which allows users to create notional or proposed missions.

- **Regions** – A feature in Acquisition Forecaster, Coincident Calculator, Coverage Analyzer, Revisits Calculator, and Data Browser which allows users to create additional regions of interest.

- **Basic Map Functionality** – A guide to navigating maps in Acquisition Forecaster, Coincident Calculator, Coverage Analyzer, Revisits Calculator, Data Browser, and Case Studies.

- **Multiselect Menus** – A guide to explain the functionality of using the collapsible multiselect menus used for missions, custom missions, and regions list.

- **User Accounts** – A feature which allows users to maintain a task history and load successfully completed tasks in Acquisition Forecaster, Coincident Calculator, Coverage Analyzer, Revisits Calculator, and Data Browsers tools.

- **Feedback** – A feature which allows users to reach out to the COVE development team for questions, issues, or satellite mission requests.

Acquisition Forecaster

Acquisition Forecaster is a tool which provides users with the ability to predict when a satellite has the ability to image a region of interest. Acquisition Forecaster models satellite orbits using Two Line Element (TLE) data, and it divides the swath into footprint segments using the width of the field of view (fovc) and the off-nadir pointing angle of each mission/instrument mode. TLE data used to forecast missions is imported daily into COVE from data provided by Space-Track.org.

Acquisition Forecaster can predict up to three months into the future for active missions with TLE data. Custom missions may be created and used in Acquisition Forecaster to predict notional missions up to three months into the future. TLE data will be generated for custom missions. See Custom Missions section for more information.

Acquisition Forecaster tool can be launched from the COVE home page by selecting the Launch COVE button, or from the Tools menu in the title menu bar.

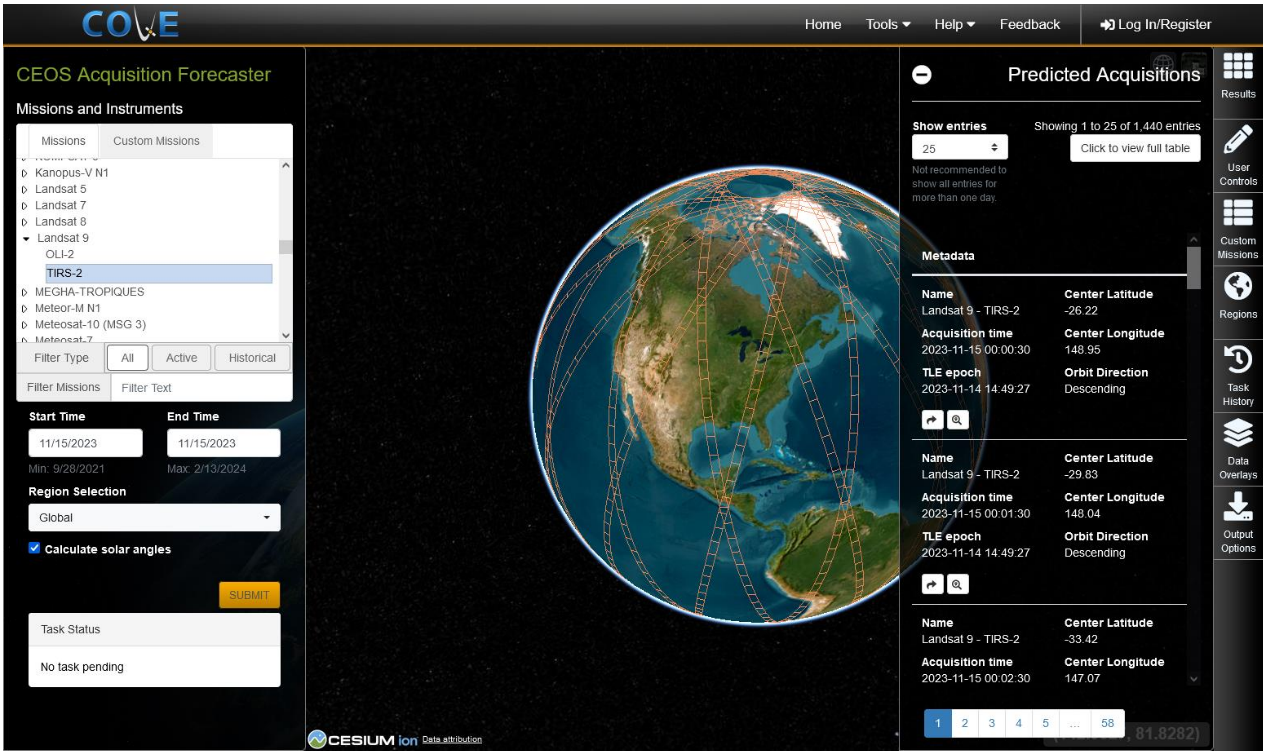


Illustration 1: Acquisition Forecaster tool

Initiating a task

In Acquisition Forecaster in the Missions and Instruments panel, users may select one or more instruments/instrument modes from the missions and/or custom missions tabs. Users may click on a mission or custom mission name to show the instruments/instrument modes available for the mission/custom mission. See Multiselect Menus section for more information on using the collapsible multiselect menus in COVE.

Missions available in the Missions tab in the Missions and Instruments panel in Acquisition Forecaster are limited to missions and instrument modes which have been added to the COVE database and missions for which TLE data exists. Requests may be made to the COVE development team to add additional missions through the Feedback page.

Users may create notional or proposed missions/instruments from the custom missions panel by supplying parameters which will allow COVE to generate a TLE for the custom mission when an Acquisition Forecaster task is submitted. The custom missions panel may be accessed by clicking on the Custom Missions tab on the right side of the Acquisition Forecaster tool. Once created, custom missions will be available in the Custom Missions tab in the Missions and Instruments panel.

Users may enter a start time and end time. Start time defaults to the current date, and end time defaults to tomorrow's date. The start time entered should be no earlier than the most recent satellite mission launch date of the mission/instrument modes selected in the missions tab. The minimum start date allowed will be displayed under the start time field once a mission/instrument mode has been selected. The end time entered should be no later than 90 days from most recent TLE epoch for active missions, 90 days from the current date for custom missions, or no later than the decommissioned date for inactive missions. TLE data is updated daily. The maximum end date allowed will be displayed under the end date field once a mission/instrument mode has been selected.

Users may select a region of interest from the region selection menu. Acquisition Forecaster will zoom in to the region of interest on the map or zoom out to show the full globe if the region Global is selected.

Users may select the calculate solar angles checkbox to include solar elevation, solar azimuth, and solar zenith angles in metadata for all predicted scene results for the task. If users do not select calculate solar angles, the results may still have some scenes with solar angles calculated if the scenes were previously cached by COVE for another task.

Users may initiate an Acquisition Forecaster task by selecting at least one instrument/instrument mode from the missions and/or custom missions tabs, entering a start time and end time, selecting a region from the region selection menu, optionally selecting the calculate solar angles checkbox, and lastly selecting the Submit button.

Once an Acquisition Forecaster task is initiated, the status of the task will be displayed in the Task Status block. The status will show "No task pending" if Acquisition Forecaster is not currently waiting for the results of an initiated task. The status will show "Evaluating request..." while validating user entered parameters, "Please wait while your coverage is computed." while the task is processing, and "Gathering acquisitions..." while retrieving the results. Once the task has completed successfully, the results panel will open on the right side of Acquisition Forecaster and the forecasted scenes will be drawn on the map for the region of interest.

Once a task has been submitted in Acquisition Forecaster, users may select the Cancel button while a task is running. Although be aware that even though the canceled task will not be listed in the Task History panel, the task will continue to run in the background where the data will be cached. If users choose to leave the Acquisition Forecaster tool while a task is running without canceling the task, users may later load the results of the completed task from the Task History. If users wish to return to a task later, they should be logged in to their COVE user account prior to submitting the task or while loading the task from task history. Only tasks which completed without error will be listed in the Task History panel.

Viewing the results of a task

When an active Acquisition Forecaster task has completed or an Acquisition Forecaster task is loaded from task history, the resulting footprints for the swath area in the region of interest will be drawn on the map. A list of individual results for each forecasted scene (forecasted acquisition) will be listed in the results tab on right side of the Acquisition Forecaster tool.

Users are able to view individual forecasted scene details such as the mission-instrument-mode name, estimated acquisition time, TLE epoch time, center latitude/longitude of the scene footprint, and the scene lighting (day or night). Forecasted scene details can be viewed in multiple ways.

- By hovering over a footprint on the map, the corresponding forecasted scene will be highlighted in the results list.
- By hovering over a forecasted scene in the results list, the corresponding footprint will be highlighted on the map. Clicking on a footprint on the map, the forecasted scene details will be displayed in a popup.
- By clicking on the arrow button on an individual scene in the results list, the forecasted scene details will be displayed in a popup.
- By clicking on the magnifying glass button for an individual scene in the results list, Acquisition Forecaster will zoom in to the footprint on the map. Users may then click on the footprint to view the details popup.
- By clicking on the “Click to view full table” button at the top of the results panel, a paginated list of forecasted scenes will be displayed in a popup where users may choose to show 25, 50, 100, 250 entries per page.

Results are shown in a paginated list in the Results panel on the right side of the Acquisition Forecaster tool. Users may choose to display entries in the results list by 25, 50, 100, or 250 entries per page. However, 25 is recommended for quicker transitions in highlighting footprints and scenes.

There is a maximum limit of 25000 scenes generated in the Acquisition Forecaster tool for a task. If a task is reaching this limit, users may choose to reduce the number of instrument/instrument modes, the time span, or reduce the region of interest from Global to a smaller region. Subsequently, users may submit a new task.

Adjusting map results with user controls

Users may choose to adjust the results on the map by changing user options available in the User Controls panel on the right side of the Acquisition Forecaster tool.

Users may change the color of each mode by:

- In the legend, clicking on the color block next to mode number, and choosing a color from the colorpicker. The mode number is an arbitrary sequential index value.
- Clicking on the pencil icon and changing the hex color code. Click the Validate Color Scale button to return to the legend and apply the color change.
- Changing the color scale from the drop-down menu. A limited number of color scales are available. Yellow to red, yellow to green, red to green, blue to green, and spectral. The default color scale is red to green. For one or two modes the color palette shows colors within the color scale. For example, it shows a single selected mode as orange on a red to green color scale. For more than two modes, the color palette will show the outer ranges of the color scale.

Users may change the transparency of all modes by changing the transparency value. In Acquisition Forecaster, transparency defaults to 0.01. The valid range for transparency is 0.01 to 0.99.

Users may select an orbit direction from a drop-down list. Options available are All, Ascending, and Descending. If ascending is selected, scenes shown in the results will be filtered by scenes with an ascending orbit direction. If descending is selected, scenes shown in the results will be filtered by scenes with a descending orbit direction. If all is selected, all scenes will be shown in the results regardless of orbit direction. Ascending orbit direction will be selected by default.

Users may select a swath type from a drop-down list. Options available are All, Footprints, and Nadir Line. If all is selected, forecasted footprints and the nadir track will be shown on the map. If footprints is selected only the forecasted footprints will be shown. If nadir line is selected, only the nadir track will be shown. The nadir line represents the projected mission orbit. Footprints is selected by default.

Creating and managing custom missions

Users may create and manage custom missions and custom instruments from the right-side Custom Missions panel in Acquisition Forecaster, Coincident Calculator, and Revisits Calculator tools. See the Custom Missions section for more information on creating and managing custom missions.

Creating and managing user created regions

Users may create and manage user defined regions from the right-side Regions panel in Acquisition Forecaster, Coincident Calculator, Coverage Analyzer, Revisits Calculator, and Data Browser tools. See the Regions section for more information on creating and managing regions.

Managing and loading completed tasks from task history

A task history may be accessed from the right-side menu tab in the Acquisition Forecaster tool. The task history is a list of Acquisition Forecaster tasks, and the list is limited to successfully completed tasks initiated during the current browser session for users not logged into a COVE user account or initiated while users are logged into a COVE user account. Each task description includes a title (mode - instrument - mission - region from start year-end year), mode selection (mission: mode-instrument-mission), date range (start date, end date), and region selection for the task.

Acquisition Forecaster tasks are a shown in a paginated list. Users may choose to display entries in the results list by 25, 50, 100, or 250 entries per page.

The search capability allows users to search for the sequence of characters in any of the parameters of the task history.

To load a task from the task history, click on the "Load this task" button located directly under the task details.

To delete a task from the task history, click on the red trashcan icon located directly under the task details.

Applying data overlays

Data overlays may be accessed from the right-side menu tab in Acquisition Forecaster tool. Data overlays is not dependent on any forecasted scene data from Acquisition Forecaster.

Users may choose to show/hide political borders on the map by selecting/deselecting the corresponding checkbox.

Users may choose to show/hide a latitude/longitude grid on the map by selecting/deselecting the corresponding checkbox.

Users may choose other data overlay options from a drop-down menu. These drop-down menu options include:

- None – No data overlay
- Elevation – The Terra Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) Global Digital Elevation Model (GDEM) Version 3 (ASTGTM) provides a global digital elevation model (DEM) of land areas on Earth. Source: https://asterweb.jpl.nasa.gov/gdem.asp
- GlobCover – Global Land Cover overlay covers the period December 2004 - June 2006 and was derived by an automatic and regionally tuned classification of a MERIS full resolution surface reflectance time series. GlobCover is a European Space Agency initiative. Source: http://due.esrin.esa.int/page_globcover.php

- Köppen-Geiger – Climate classification overlay.
  Source: http://koeppen-geiger.vu-wien.ac.at/present.htm

- Landsat WRS – Landsat Worldwide Reference System (WRS) overlay mapping path/row footprints. Source: overlay generated from Landsat WRS path/row mapping data within COVE.

- MODIS Land Cover – The Terra Moderate Resolution Imaging Spectroradiometer (MODIS) Vegetation Indices 16-Day (MOD13C1) Version 6.1 product provides a Vegetation Index (VI) value at a per pixel basis.
  Source: https://lpdaac.usgs.gov/products/mod13c1v061/

- Revisit Performance (L7, L8, S2A) – Days until revisit overlay includes Landsat 7, Landsat 8, and Sentinel-2A

- Revisit Performance (L7, L8, S2A, S2B) – Days until revisit overlay includes Landsat 7, Landsat 8, Sentinel-2A, and Sentinel-2B

- Revisit Performance (L8, S2A, S2B) – Days until revisit overlay includes Landsat 8, Sentinel-2A, and Sentinel-2B

- S2Tiling – Sentinel-2 tiling grid. Source: overlay generated from Sentinel-2 granule mapping data within COVE.

Using output options

The forecasted map can be exported and downloaded using the options listed below. Supported formats include PNG, and CSV.

- Download PNG – PNG (portable network graphics) is a common compressed raster graphics file format. PGN output images will contain the current map view.

- Download Abbreviated CSV – CSV (comma separated values) is a common standard spreadsheet format. Output CSV files contain headers and a list of all unique scenes. This will remove any duplicate or overlapping coverages, providing a single list of all acquisitions from this task. CSV columns may include mission (mission-instrument-mode name), acquisition time, TLE epoch, center_latitude, center_longitude, and orbit_direction.

- Download Full CSV – CSV (comma separated values) is a common standard spreadsheet format. Output CSV files contain headers and a list of all unique scenes. This will remove any duplicate or overlapping coverages, providing a single list of all acquisitions from this task. CSV columns may include mission (mission-instrument-mode name), acquisition time, TLE epoch, center_latitude, center_longitude, orbit_direction, sun_elevation, sun_zenith, sun_azimuth, and scene_coords.

Coverage Analyzer

Coverage Analyzer is a tool that provides users with the ability to analyze the historical satellite coverage of a region of interest. Coverage Analyzer generates a discretized area covering a region of interest, and it determines the coincidence of scenes within each discretized block. The coincidence of scenes is determined by the intersection of the footprint of the discretized block and the footprint of the scene. Scene data is extracted from satellite metadata imported into COVE from data providers for select satellite missions.

The missions included in Coverage Analyzer are Landsat 5 (Mar 1964 – Jun 2013), Landsat 7 (Apr 1999 – now), Landsat 8 (Feb 2013 – now), Landsat 9 (Sep 2021 – now), Sentinel-1A (Apr 2017 – now), Sentinel-1B (Apr 2016 – Aug 2022), Sentinel-2A (Jun 2015 – now) and Sentinel-2B (Mar 2017 – now). Sentinel-2A and Sentinel-2B are combined into one dataset from the data provider. Landsat 5, Landsat 7, Landsat 8, and Sentinel-2A & 2B datasets are imported from USGS's Earth Explorer API. Sentinel-1A and Sentinel-1B datasets are imported into COVE from an Alaska Satellite Facility (ASF) API. Other mission datasets may be added in the future.

Coverage Analyzer tool can be launched from the Tools menu in the title menu bar.

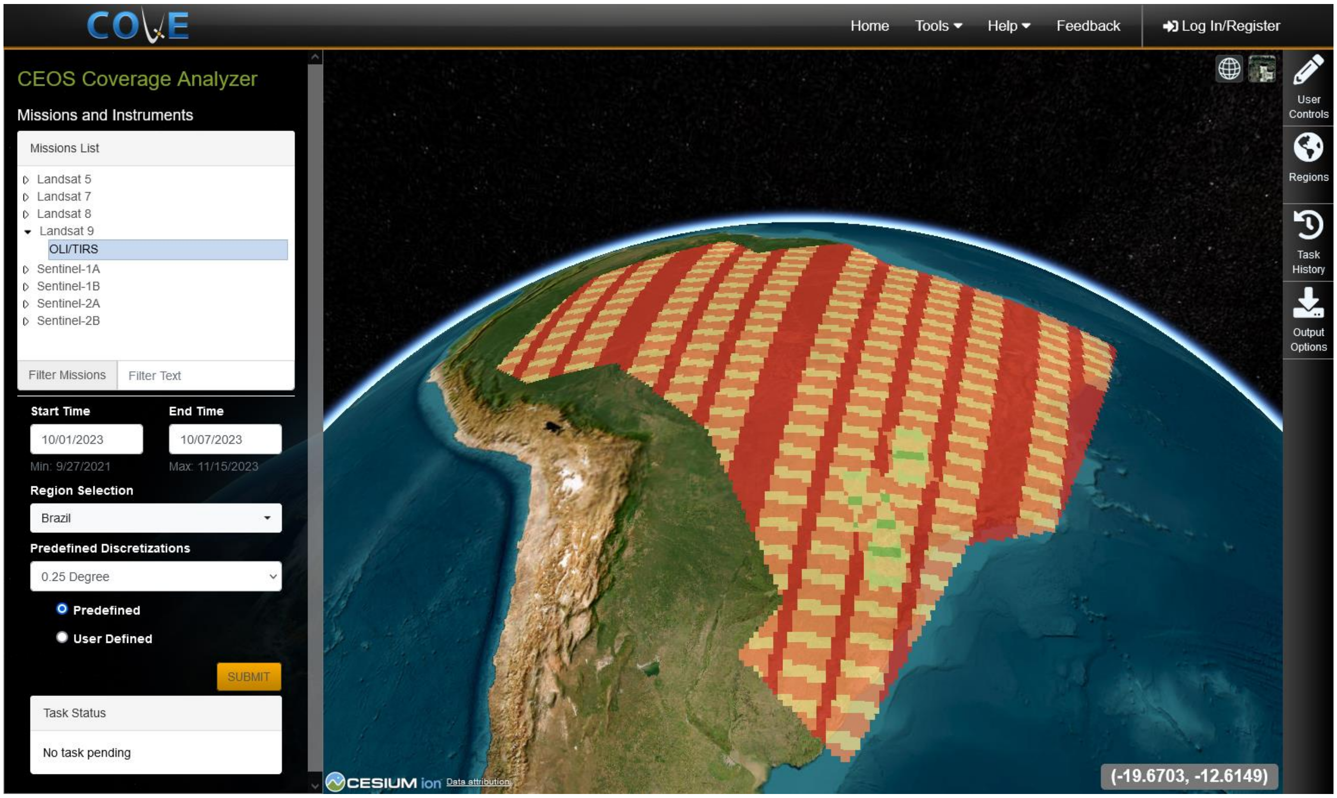


Illustration 2: Coverage Analyzer tool

Initiating a task

In Coverage Analyzer in the Missions and Instruments panel, users may choose from a small selection of missions. Users may click on a mission name to show the instrument modes available for the mission. Users may select one or more instrument modes from the missions list.

Missions available in Coverage Analyzer are limited to missions which have been integrated into COVE in an automated process to acquire datasets from satellite data providers. Scene data is submitted to data providers. The COVE automated acquisitions process runs daily and acquires all scene data submitted within the last thirty days for Sentinel-1 and Sentinel-2 missions and five days for all other missions.

Users may enter a start time and end time. The start time entered should be no earlier than the most recent satellite mission launch date of the mission/instrument modes selected in the missions tab. The minimum start date allowed will be displayed under the start time field once a mission/instrument mode has been selected. The end time entered should be no later than the current date for active missions or no later than the decommissioned date for inactive missions. The maximum end date allowed will be displayed under the end date field once a mission/instrument mode has been selected.

Users may select a region of interest from the region selection menu. Coverage Analyzer will zoom in to the region of interest on the map. Global region is only available for admin users.

Discretization is used to divide a region of interest into blocks. Users may select a discretization method: predefined or user defined discretization. Selecting the predefined discretization method will reveal a drop down of predefined discretization methods: Landsat WRS, S2 Tiling Scheme, 0.10 Degree, 0.25 Degree, 0.5 Degree, or 1 Degree. Landsat WRS is a tiling scheme mapped by path/row. S2 Tiling Scheme is mapped by granule. Selecting the user defined discretization method will reveal the discretization size and units fields. If users choose the Landsat WRS tiling scheme and a Landsat mission was selected, or if users choose the S2 Tiling Scheme and Sentinel-2A & 2B mission was selected, the option to include or not include overlap will appear in a drop down. If overlap is included, a scene may be included in multiple discretization blocks. If users choose user defined discretization, discretization size and units fields will appear. Users may enter a decimal value for discretization size with a minimum possible value of 0.1. Discretization unit may be set to degrees or kilometers. The discretization size is size of the square footprint if each block within the discretized region of interest.

Users may initiate a Coverage Analyzer task by selecting at least one instrument mode from the missions list, entering a start time and end time, selecting a region from the region selection menu, selecting a discretization method and details, and lastly selecting the Submit button.

Once a Coverage Analyzer task is initiated, the status of the task will be displayed in the Task Status block. The status will show “No task pending” if Coverage Analyzer is not currently waiting for the results of an initiated task. The status will show “Calculating coverage...” while validating user entered parameters and check for an excessively large discretization, and “Generating coincidence...” while the task is processing. Once the task has completed successfully, a heatmap of discretized blocks will be drawn on the map in the Coverage Analyzer tool.

Coverage Analyzer may return an error notifying the user that the task is too large. Coverage Analyzer estimates the number of discretized blocks in a region times the number of days in the date range to determine task size. If a task is too large, a user may choose to increase the discretization size, select a smaller region, or decrease the date range.

Once a task has been submitted in Coverage Analyzer, users may select the Cancel button while a task is running. Although be aware that even though the canceled task will not be listed in the Task History panel, the task will continue to run in the background where the data will be cached. If users choose to leave the Coverage Analyzer tool while a task is running without canceling the task, users may later load the results of the completed task from the Task History. If users wish to return to a task later, users should be logged in to their COVE user account prior to submitting the task or while loading the task from task history. Only tasks which completed without error will be listed in the Task History panel.

All tasks in the Task History in Coverage Analyzer are deleted from COVE after one week to clear cached data.

Viewing the results of a task

Results from Coverage Analyzer will appear in a heatmap of discretized blocks.

Hovering over a discretized block will show a title and the number of scenes (acquisitions) within the discretized block. The title varies depending on the discretization method chosen for the task. If the Landsat WRS discretization was chosen for the task, the title will appear like Title: path-row 5-15. If the S2 Tiling discretization was chosen for the task, the title will appear like Title: granule 18LWR. If a discretization size is specified for the discretization method, the title will appear like Title: Region Discretization Longitude -75.0, Latitude -8.5. If no scenes are found within the discretized block, no acquisition value will appear.

Clicking on a discretized block will trigger a popup window with a table of scenes available within the discretized block. The table will contain the columns: Scene ID, Acquisition Date, Mission Name, Order URL, Thumbnail URL, and Additional Metadata. Users may choose to display entries in the table by 25, 50, 100, or 250 entries per page. The search capability allows users to search for the sequence of characters in any of the columns of the table. Users may click on the “View in Data Browser” button to display the Coverage Analyzer task results in the Data Browser tool.

The Sentinel-2A & 2B mission is a combined dataset (SENTINEL_2A) from USGS’s Earth Explorer API. The only way to distinguish Sentinel-2A scenes from Sentinel-2B scenes when viewing scene details in Coverage Analyzer is to look at the thumbnail URL. The thumbnail URL for Sentinel-2A will contain “s2a”, and Sentinel-2B will contain “s2b”. The order URL reflects the dataset name instead of the mission name.

Adjusting map results with user controls

User may choose to adjust the results on the map by changing user options available in the User Controls panel on the right side of the Coverage Analyzer tool.

Users may change the color of each range of images by:

- From the legend, clicking on the color block next to number range of images, and choosing a color from the colorpicker.

- Clicking on the pencil icon and changing the hex color code. Users may also adjust the maximum range of the number of images assigned to each color. Click the Validate Color Scale button to return to the legend and apply the color change.
- Changing the number of colors used in the color scale. Users may choose from a drop-down list of values ranging from three to nine.
- Changing the color scale from the drop-down menu. A limited number of color scales are available. Yellow to red, yellow to green, red to green, blue to green, and spectral. The default color scale is red to green.

Users may change the transparency of the heatmap by changing the transparency value. In Coverage Analyzer, transparency defaults to 0.01. The valid range for transparency is 0.01 to 0.99.

Users may choose to adjust the query results by changing filter options available in the User Controls panel on the right side of the Coverage Analyzer tool. Filter options in user controls will vary depending on the missions selected for the task currently loaded into results. A new Coverage Analyzer task is submitted once users select the “Submit” button to apply the filter options to the original task results. Task details in the Task History will also include any filter options applied. Filter options for each mission are:

- Landsat (5, 7, 8, 9)
    - Cloud cover percentage – Maximum cloud cover percentage allowed in a scene
    - Landsat day or night indicator – Options include any, day, and night (scene lighting)
- Sentinel-1A/1B
    - Sentinel1 ascending or descending – Options include any, ascending, and descending (orbit direction)
    - Sentinel1 processing level – Options include all, GRD (Ground Range Detected), and SLC (Single Look Complex).
- Sentinel-2A/2B
    - Cloud cover percentage – Maximum cloud cover percentage allowed in a scene

Creating and managing user created regions

Users may create and manage user defined regions from the right-side Regions panel in Acquisition Forecaster, Coincident Calculator, Coverage Analyzer, Revisits Calculator, and Data Browser tools. See the Regions section for more information on creating and managing regions.

Managing and loading completed tasks from task history

A task history may be accessed from the right-side menu tab in the Coverage Analyzer tool. The task history is list of Coverage Analyzer tasks, and the list is limited to successfully completed tasks initiated during the current browser session for users not logged into a COVE user account, or initiated while users are logged into a COVE user account. Each task description includes a title (mode – instrument - mission – region from start year-end year), mode selection (mission: mode-instrument-mission), date range (start date, end date), region selection for the task, and discretization details.

Coverage Analyzer tasks are shown in a paginated list. Users may choose to display entries in the results list by 25, 50, 100, or 250 entries per page.

The search capability allows users to search for the sequence of characters in any of the parameters of the task history.

To load a task from the task history, click on the "Load this task" button located directly under the task details.

To delete a task from the task history, click on the red trashcan icon located directly under the task details.

Using output options

The coverage map can be exported and downloaded using the options listed below. Supported formats include PNG, CSV, GEOTIFF, and NetCDF.

- Download PNG – PNG (portable network graphics) is a common compressed raster graphics file format. PGN output images will contain the current map view.
- Download CSV – CSV (comma separated values) is a common standard spreadsheet format. Output CSV files contain headers and a list of all unique scenes. This will remove any duplicate or overlapping coverages, providing a single list of all acquisitions from this task. CSV columns may include mission, name, acquisition_date, browse_url, order_url, start_time, stop_time, center_latitude, center_longitude, orbit_direction, path, frame, orbit_number, processing_level, row, day_or_night, cloud_cover, sensor, sun_elevation, sun_azimuth, granule_name, and scene_coords.
- Download GEOTIFF – GeoTIFF is a public domain metadata standard which allows georeferencing information to be embedded within a TIFF file. GeoTIFF raster data outputs which contains a georeferenced map of the acquisition count for your task. For degree- or kilometer-based tasks, the points will be the upper left of the discretization. For WRS based tasks, your task will be resampled to a 2-degree square and displayed as a normal square discretization.

- Download NETCDF – NetCDF (Network Common Data Form) is a machine independent data format developed by University Corporation for Atmospheric Research and allows for the sharing of array-oriented scientific data. NetCDF raster data outputs which contains a georeferenced map of the acquisition count for your task. For degree- or kilometer-based tasks, the points will be the upper left of the discretization. For WRS based tasks, your task will be resampled to a 2-degree square and displayed as a normal square discretization.
- Open in Data Browser – Push a task to the Data Browser to allow users to see the acquisition footprint on the globe and inspect thumbnail images.

Revisits Calculator

Revisits Calculator is a tool which allows users to analyze estimated total coverage and satellite revisits for a discretized region of interest within a span of time. The Revisits Calculator tool utilizes orbit modeling capability of Acquisition Forecaster, generates a discretized area covering a region of interest, and determines the coincidence of forecasted scene acquisitions within each discretized block. The coincidence of forecasted scenes is determined by the intersection of the footprint of the discretized block and the footprint of the forecasted scene.

Revisits Calculator tool can be launched from the Tools menu in the title menu bar.

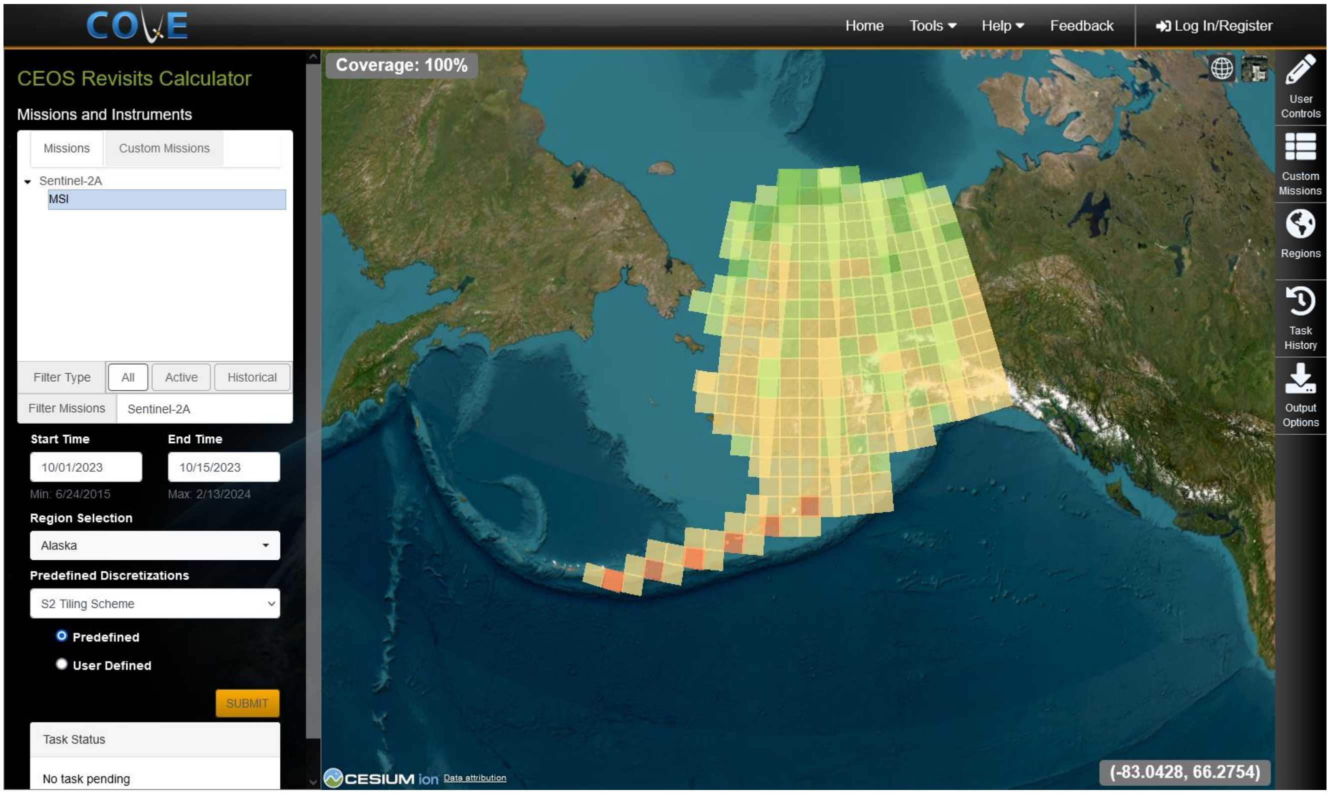


Illustration 3: Revisits Calculator tool

Initiating a task

In Revisits Calculator in the Missions and Instruments panel, users may select one or more instruments/instrument modes from the missions and/or custom missions tabs. Users may click on a mission or custom mission name to show the instruments/instrument modes available for the mission/custom mission. See Multiselect Menus section for more information on using the collapsible multiselect menus in COVE.

Missions available in the Missions tab in the Missions and Instruments panel in Revisits Calculator are limited to missions and instrument modes which have been added to the COVE database and missions for which TLE data exists. Requests may be made to the COVE development team to add additional missions through the Feedback page.

Users may create notional or proposed missions/instruments from the custom missions panel by supplying parameters which will allow COVE to generate a TLE for the custom mission when a Revisits Calculator task is submitted. The custom missions panel may be accessed by clicking on the Custom Missions tab on the right side of the Revisits Calculator tool. Once created, custom missions will be available in the Custom Missions tab in the Missions and Instruments panel.

Users may enter a start time and end time. Start time defaults to the current date, and end time defaults to tomorrow's date. The start time entered should be no earlier than the most recent satellite mission launch date of the mission/instrument modes selected in the missions tab. The minimum start date allowed will be displayed under the start time field once a mission/instrument mode has been selected. The end time entered should be no later than 90 days from most recent TLE epoch for active missions, 90 days from the current date for custom missions, or no later than the decommissioned date for inactive missions. TLE data is updated daily. The maximum end date allowed will be displayed under the end date field once a mission/instrument mode has been selected.

Users may select a region of interest from the region selection menu. Revisits Calculator will zoom in to the region of interest on the map. Global region is only available for admin users.

Discretization is used to divide a region of interest into blocks. Users may select a discretization method: predefined or user defined discretization. Selecting the predefined discretization method will reveal a drop down of predefined discretization methods: Landsat WRS, S2 Tiling Scheme, 0.10 Degree, 0.25 Degree, 0.5 Degree, or 1 Degree. Revisits Calculator tasks using Landsat WRS or S2 Tiling Scheme discretization methods will include overlap. Selecting the user defined discretization method will reveal the discretization size and units fields. Users may enter a decimal value for discretization size with a minimum possible value of 0.1. Discretization unit may be set to degrees or kilometers. The discretization size is size of the square footprint if each block within the discretized region of interest.

Users may initiate a Revisits Calculator task by selecting at least one instrument/instrument mode from the missions and/or custom missions tabs, entering a start time and end time, selecting a region from the region selection menu, and lastly selecting the Submit button. If tasks with multiple instrument modes are submitted, any intersecting footprints with an acquisition time difference less or equal than two minutes will be counted as one revisit. Otherwise, the intersection of the footprints will be counted as two revisits.

Once a Revisits Calculator task is initiated, the status of the task will be displayed in the Task Status block. The status will show "No task pending" if Revisits Calculator is not currently waiting for the results of an initiated task. The status will show "Evaluating task size..." while validating user entered parameters, "Forecasting acquisitions..." while generating the forecasted scene data, "Discretizing region..." while the region is divided into discretized blocks, and "Generating coincidence..." while the task computes the intersection of the footprint of the forecasted scenes and the footprint of the discretized blocks. Once the task has completed successfully, a heatmap of discretized blocks and the total percentage of coverage for the region will be drawn on the map of the Revisits Calculator tool.

Revisits Calculator may return an error notifying the user that the task is too large. Revisits Calculator estimates the number of discretized blocks in a region times the number of days in the date range to determine task size. If a task is too large, a user may choose to increase the discretization size, select a smaller region, or decrease the date range.

Once a task has been submitted in Revisits Calculator, users may select the Cancel button while a task is running. Although be aware that even though the canceled task will not be listed in the Task History panel, the task will continue to run in the background where the data will be cached. If users choose to leave the Revisits Calculator tool while a task is running without canceling the task, users may later load the results of the completed task from the Task History. If users wish to return to a task later, users should be logged in to their COVE user account prior to submitting the task or while loading the task from task history. Only tasks which completed without error will be listed in the Task History panel.

Revisits Calculator tool utilizes the Acquisition Forecaster tool to forecast scenes. Once a Revisits Calculator task completes, users will also find the corresponding task in Task History in Acquisition Forecaster. Users may load the Acquisition Forecaster task from Task History in Acquisition Forecaster or from Output Options in Revisits Calculator.

All tasks in the Task History in Revisits Calculator are deleted from COVE after one week to clear cached data.

Viewing the results of a task

Results from Revisits Calculator will appear in a heatmap of discretized blocks.

The coverage value displayed in the upper left corner of the map is the percentage of forecasted scene coverage for the region of interest. Coverage is calculated by the total number of discretized blocks with at least one revisit divided by the total number of discretized blocks times 100 for the region of interest.

Hovering over a discretized block will show a title and the number of revisits within the discretized block. The title will appear like Title: Region Discretization Longitude -75.0, Latitude -8.5. If no estimated revisits exist within the discretized block, no revisits value will appear. User controls option for revisits time metrics details may also be visible.

Adjusting map results with user controls

Users may choose to adjust the results on the map by changing user options available in the User Controls panel on the right side of the Revisits Calculator tool.

Users may change colors on the heatmap by:

- From the legend, clicking on the color block next to number range of revisits, and choosing a color from the colorpicker.

- Clicking on the pencil icon and changing the hex color code. Users may also adjust the maximum range of the number of ranges assigned to each color. Click the Validate Color Scale button to return to the legend and apply the color change.

- Changing the number of colors used in the color scale. Users may choose from a drop-down list of values ranging from three to nine.

- Changing the color scale from the drop-down menu. A limited number of color scales are available. Yellow to red, yellow to green, red to green, blue to green, and spectral. The default color scale is red to green.

Users may change the transparency of the heatmap by changing the transparency value. In Revisits Calculator, transparency defaults to 0.75. The valid range for transparency is 0.01 to 0.99.

Users may select an orbit direction from a drop-down list. Options available are All, Ascending, and Descending. If ascending is selected, scenes shown in the results will be filtered by scenes with an ascending orbit direction. If descending is selected, scenes shown in the results will be filtered by scenes with a descending orbit direction. If all is selected, all scenes will be shown in the results regardless of orbit direction. Ascending orbit direction will be selected by default.

Users may choose to display revisits time metrics by selecting an option from a drop-down list. The metrics are visible when hovering over a discretized block. If revisits calculated is less than two in a block, no time metric will be displayed in the hover block. Time metrics are calculated based on lapses of time between each revisit. Therefore, if revisits is less than two, elapsed time is zero. Revisits time metrics options are:

- <u>None</u> – Do not display revisits time metrics. Default option.

- <u>Minimum</u> – Calculated as the least estimated time elapsed between distinct acquisition times of forecasted scenes for all revisits between the start and end time of the task. The hover block will include a label like Minimum Time Between Revisits: 22:21:00.

- <u>Maximum</u> – Calculated as the greatest estimated time elapsed between distinct acquisition times of forecasted scenes for all revisits between the start and end time of the task. The hover block will include a label like Maximum Time Between Revisits: 7 days, 14:12:00.

- <u>Mean</u> – Calculated as the average estimated time elapsed between distinct acquisition times of forecasted scenes for all revisits between the start and end time of the task. The hover block will include a label like Mean Time Between Revisits: 3 days, 22:36:00.

- Median – Calculated as the median estimated time elapsed between distinct acquisition times of forecasted scenes for all revisits between the start and end time of the task. The hover block will include a label like Median Time Between Revisits: 1 day, 14:18:00.

Creating and managing custom missions

Users may create and manage custom missions and custom instruments from the right-side Custom Missions panel in Acquisition Forecaster, Coincident Calculator, and Revisits Calculator tools. See the Custom Missions section for more information on creating and managing custom missions.

Creating and managing user created regions

Users may create and manage user defined regions from the right-side Regions panel in Acquisition Forecaster, Coincident Calculator, Coverage Analyzer, Revisits Calculator, and Data Browser tools. See the Regions section for more information on creating and managing regions.

Managing and loading completed tasks from task history

A task history may be accessed from the right-side menu tab in the Revisits Calculator tool. The task history is a list of Revisits Calculator tasks, and the list is limited to successfully completed tasks initiated during the current browser session for users not logged into a COVE user account or initiated while users are logged into a COVE user account. Each task description includes a title (mode – instrument - mission – region from start year-end year), mode selection (mission: mode-instrument-mission), date range (start date, end date), region selection for the task, and discretization details.

Revisits Calculator tasks are shown in a paginated list. Users may choose to display entries in the results list by 25, 50, 100, or 250 entries per page.

The search capability allows users to search for the sequence of characters in any of the parameters of the task history.

To load a task from the task history, click on the “Load this task” button located directly under the task details.

To delete a task from the task history, click on the red trashcan icon located directly under the task details.

Using output options

Users may select from the following output options:

- Download PNG – PNG (portable network graphics) is a common compressed raster graphics file format. PGN output images will contain the current map view.
- Open in Acquisition Forecaster – Push a task to the Acquisition Forecaster to allow users to visualize the forecasted acquisition footprints on the globe.

Coincident Calculator

Coincident Calculator is a tool which allows users to determine the coincidence of satellite instrument modes observing a location within a region of interest using historical or predicted scene data within the specified number of seconds (seconds between coincidence). The Coincident Calculator tool utilizes orbit modeling capability of Acquisition Forecaster for forecasted missions or the acquisition gathering capability of Data Browser for archived missions, generates a discretized area covering a region of interest, and determines the coincidence and coincidence dates of instrument modes intersecting each discretized block. The coincidence is determined by identifying dates where scenes from pairs of instrument modes intersect a discretized block. The coincidence is the total number of coincidence dates for all instrument mode pair combinations. Users should note, however, pairs of instrument modes intersecting the same block within the same day without intersecting each other will be included as a coincidence. For more accurate results, users may choose to reduce the discretization size.

Coincident Calculator tool can be launched from the Tools menu in the title menu bar.

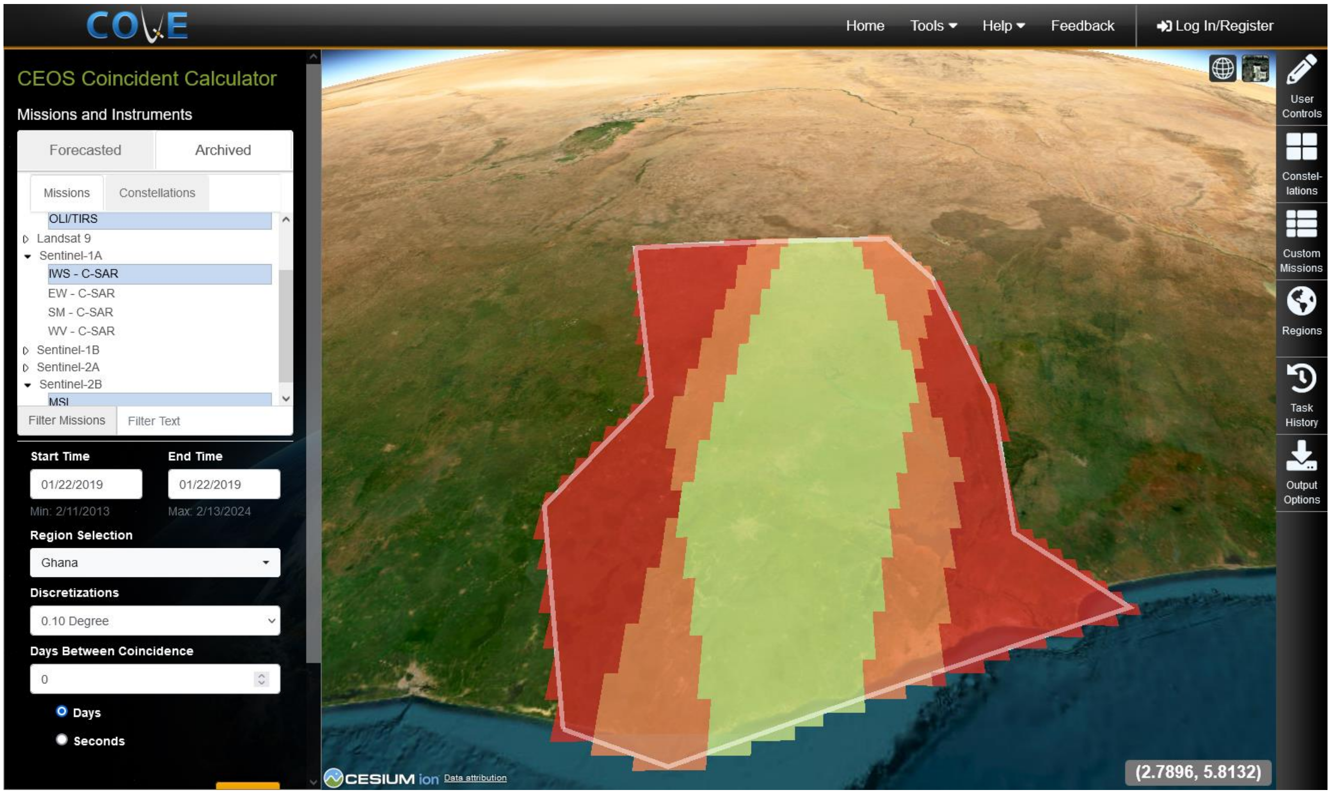


Illustration 4: Coincident Calculator tool

Initiating a task

In Coincident Calculator in the Missions and Instruments panel, users may select two or more instruments/instrument modes from the missions, custom missions, and/or constellations tabs under the forecasted tab or from the missions and/or constellations tabs under the archived tab. Users may click on a mission or custom mission name to show the instruments/instrument modes available for the mission/custom mission. See Multiselect Menus section for more information on using the collapsible multiselect menus in COVE.

Missions available in the Missions tab in the Missions and Instruments panel in Coincident Calculator are limited to missions and instrument modes which have been added to the COVE database and missions for which TLE data exists. Requests may be made to the COVE development team to add additional missions through the Feedback page.

Users may create notional or proposed missions/instruments from the custom missions panel by supplying parameters which will allow COVE to generate a TLE for the custom mission when a Coincident Calculator task is submitted. The custom missions panel may be accessed by clicking on the Custom Missions tab on the right side of the Coincident

Calculator tool. Once created, custom missions will be available in the Custom Missions tab in the Forecasted tab in the Missions and Instruments panel.

Users may create custom groups of missions/instruments from the constellations panel. The constellations panel may be accessed by clicking on the Constellations tab on the right side of the Coincident Calculator tool. Once created, constellations will be available in the Constellations tabs in the Forecasted and Archived tabs in the Missions and Instruments panel.

Users may enter a start time and end time. Start time defaults to the current date, and end time defaults to tomorrow's date. The start time entered should be no earlier than the most recent satellite mission launch date of the mission/instrument modes selected in the missions tab. The minimum start date allowed will be displayed under the start time field once a mission/instrument mode has been selected. The end time entered for forecasted missions should be no later than 90 days from most recent TLE epoch for active missions, 90 days from the current date for custom missions, or no later than the decommissioned date for inactive missions. TLE data is updated daily. The end time entered for archived missions should be no later than the current date for active missions or no later than the decommissioned date for inactive missions. For constellations, minimum start date and maximum end date will be evaluated based on the missions or custom missions selected. The maximum end date allowed will be displayed under the end date field once a mission/instrument mode has been selected.

Users may select a region of interest from the region selection menu. Coincident Calculator will zoom in to the region of interest on the map. Global region is only available for admin users.

Discretization is used to divide a region of interest into blocks. Users may select a discretization size: 0.10 Degree, 0.25 Degree, 0.5 Degree, or 1 Degree.

Users may choose to calculate coincidence using days between coincidence or seconds between coincidence by selecting the Days or Seconds radio button. Results are restricted to scenes within the start and end time. Tasks using seconds between coincidence by take significantly longer to calculate.

Days between coincidence allows Coincident Calculator to find coincidences with a difference in the number of days between scenes. Days between coincidence is an integer value with a range limit of 0 to 5, defaulting to 0. If days between coincidence is 0, coincidences will be calculated per day. If days between coincidence is 1, coincidences will be calculated where scene dates are within two days.

Seconds between coincidence allows Coincident Calculator to find coincidences with a difference in the number of seconds between scenes. Seconds between coincidence is an integer value with a range limit of 0 to 432000 (5 days), defaulting to 0. If seconds between coincidence is 0, coincidences will be calculated with overlapping scene start and end times. If seconds between coincidence is 21600 (6 hours), coincidences will be calculated with scene start and end times up to 6 hours apart.

Users may initiate a Coincident Calculator task by selecting from the forecasted tab at least two instrument/instrument modes/constellations from the missions, custom missions, and/or constellations tabs or from the archived tab at least two instrument modes/constellations from the missions and/or constellations tabs. Users will also need to enter a start time and end time, selecting a region from the region selection menu, selecting a discretization size, selecting seconds between coincidence, and lastly selecting the Submit button.

Once a Coincident Calculator task is initiated, the status of the task will be displayed in the Task Status block. The status will show “No task pending” if Coincident Calculator is not currently waiting for the results of an initiated task. The status will show “Evaluating task size...” while validating user entered parameters, “Forecasting acquisitions...” while generating the forecasted scene data if forecasted missions are selected or “Gathering acquisitions...” while collecting acquisition data for archived missions, “Discretizing region...” while the region is divided into discretized blocks, and “Generating coincidence...” while the task computes the intersection of the footprint of the forecasted scenes and the footprint of the discretized blocks. Once the task has completed successfully, a heatmap of discretized blocks will be drawn on the map of the Coincident Calculator tool.

Coincident Calculator may return an error notifying the user that the task is too large. Coincident Calculator estimates the number of discretized blocks in a region times the number of days in the date range times the number of instrument modes selected to determine task size. If a task is too large, a user may choose to increase the discretization size, choose a smaller region, decrease the date range, or reduce the number of instrument modes selected.

Once a task has been submitted in Coincident Calculator, users may select the Cancel button while a task is running. Although be aware that even though the canceled task will not be listed in the Task History panel, the task will continue to run in the background where the data will be cached. If users choose to leave the Coincident Calculator tool while a task is running without canceling the task, users may later load the results of the completed task from the Task History. If users wish to return to a task later, users should be logged in to their COVE user account prior to submitting the task or while loading the task from task history. Only tasks which completed without error will be listed in the Task History panel.

Coincident Calculator tool utilizes the Acquisition Forecaster tool to predict scene acquisitions for forecasted missions. Once a Coincident Calculator task for forecasted missions completes, users will also find the corresponding task in Task History in Acquisition Forecaster. Users may load the Acquisition Forecaster task from Task History in Acquisition

Forecaster or from Output Options in Coincident Calculator. Coincident Calculator tool also utilizes the Data Browser tool to gather acquisitions for archived missions. Once a Coincident Calculator task for archived missions completes, users will also find the corresponding task in Task History in Data Browser. Users may load the Data Browser task from Task History in Data Browser or from Output Options in Coincident Calculator.

An error will popup indicating there are no coincidences for the given parameter set if no coincidences are found.

All tasks in the Task History in Coincident Calculator are deleted from COVE after one week to clear cached data.

Viewing the results of a task

Results from Coincident Calculator will appear in a heatmap of discretized blocks.

Hovering over a discretized block will show a title and the number of coincidence dates within the discretized block. The title will appear like Title: Region Discretization Longitude -75.0, Latitude -8.5. If no estimated coincidence exists within the discretized block, no coincidence value will appear. User controls option to show coincidence dates may also be visible. If a task has only two instrument modes, the discretized block label will show Coincidence Dates followed by a list of dates, if any coincidences in the block are found. If a task has more than two instrument modes, the discretized block label will show Coincidence Dates followed by a list of pairs instrument modes where coincidences were found and the dates of the coincidences.

Adjusting map results with user controls

Users may choose to adjust the results on the map by changing user options available in the User Controls panel on the right side of the Coincident Calculator tool.

Users may change colors on the heatmap by:

- From the legend, clicking on the color block next to number range of revisits, and choosing a color from the colorpicker.
- Clicking on the pencil icon and changing the hex color code. Users may also adjust the maximum range of the number of ranges assigned to each color. Click the Validate Color Scale button to return to the legend and apply the color change.
- Changing the number of colors used in the color scale. Users may choose from a drop-down list of values ranging from three to nine.
- Changing the color scale from the drop-down menu. A limited number of color scales are available. Yellow to red, yellow to green, red to green, blue to green, and spectral. The default color scale is red to green.

Users may change the transparency of the heatmap by changing the transparency value. In Coincident Calculator, transparency defaults to 0.75. The valid range for transparency is 0.01 to 0.99.

Users may select an orbit direction from a drop-down list. Options available are All, Ascending, and Descending. If Ascending is selected, scenes shown in the results will be filtered by scenes with an ascending orbit direction. If Descending is selected, scenes shown in the results will be filtered by scenes with a descending orbit direction. If All is selected, all scenes will be shown in the results without orbit direction filtering. As a result, "All" includes scene coincidences with opposing orbit direction, where a scene from instrument mode A may be ascending and a scene from instrument mode B may be descending. Ascending orbit direction will be selected by default.

Users may select the show coincidence dates checkbox to list the coincidence dates in labels for each discretized block on the map. Unselecting the show coincidence dates checkbox will hide the coincidence dates information from the label. Show coincidence dates is selected by default.

Creating and managing constellations

Users may create and manage constellations from the right-side Constellations panel in the Coincident Calculator tool. See the Constellations section for more information on creating and managing constellations.

Creating and managing custom missions

Users may create and manage custom missions and custom instruments from the right-side Custom Missions panel in Acquisition Forecaster, Coincident Calculator, and Revisits Calculator tools. See the Custom Missions section for more information on creating and managing custom missions.

Creating and managing user created regions

Users may create and manage user defined regions from the right-side Regions panel in Acquisition Forecaster, Coincident Calculator, Coverage Analyzer, Revisits Calculator, and Data Browser tools. See the Regions section for more information on creating and managing regions.

Managing and loading completed tasks from task history

A task history may be accessed from the right-side menu tab in the Coincident Calculator tool. The task history is a list of Coincident Calculator tasks, and the list is limited to successfully completed tasks initiated during the current browser session for users not logged into a COVE user account or initiated while users are logged into a COVE user account. Each task description includes a title (mode – instrument - mission – region list from start year-end year), mode selection (mission: mode-instrument-mission), date range (start date, end date), region selection for the task, discretization size, and acquisition type (Forecasted or Archived).

Coincident Calculator tasks are shown in a paginated list. Users may choose to display entries in the results list by 25, 50, 100, or 250 entries per page.

The search capability allows users to search for the sequence of characters in any of the parameters of the task history.

To load a task from the task history, click on the "Load this task" button located directly under the task details.

To delete a task from the task history, click on the red trashcan icon located directly under the task details.

Using output options

Users may select from the following output options:

- Download PNG – PNG (portable network graphics) is a common compressed raster graphics file format. PGN output images will contain the current map view.
- Open in Acquisition Forecaster – Push a task to the Acquisition Forecaster to allow users to visualize the forecasted acquisition footprints on the globe.
- Open in Data Browser – Push a task to the Data Browser to allow users to visualize the acquisition footprint on the globe and inspect thumbnail images.

Data Browser

Data Browser is a tool that allows users to view the satellite image archives from multiple CEOS missions. Data Browser plots the footprint for scenes within a region of interest for a specific time span. Scene data is extracted from satellite metadata imported into COVE from data providers for select satellites.

Data Browser tool can be launched from the Tools menu in the title menu bar.

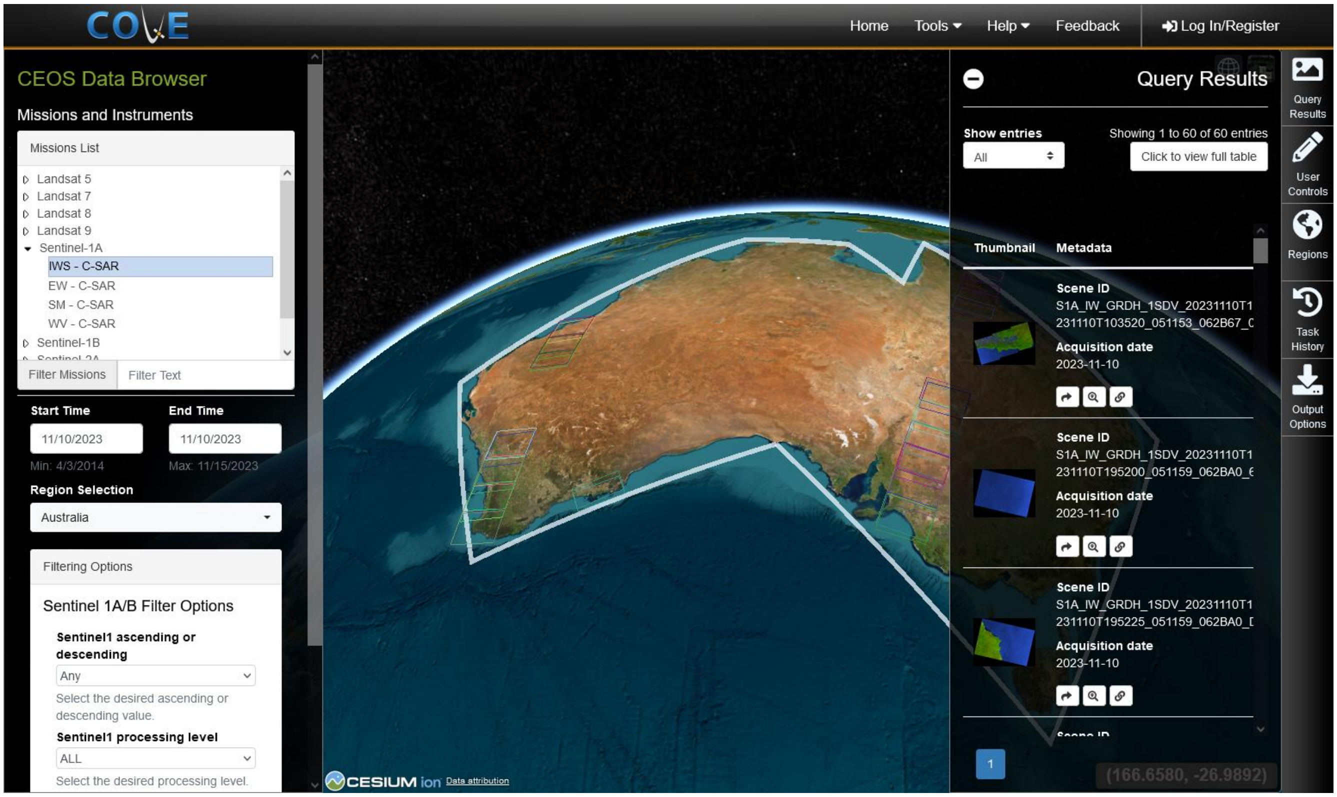


Illustration 5: Data Browser tool

Initiating a task

In Data Browser in the Missions and Instruments panel, users may choose from a small selection of missions. Users may click on a mission name to show the instrument modes available for the mission. Users may select one or more instrument modes from the missions list.

Missions available in Data Browser are limited to missions which have been integrated into COVE in an automated process to acquire datasets from satellite data providers. Scene data is submitted to data providers. The COVE automated acquisitions process runs daily and acquires all scene data submitted within the last thirty days for Sentinel-1 and Sentinel-2 missions and five days for all other missions.

Users may enter a start time and end time. The start time entered should be no earlier than the most recent satellite mission launch date of the mission/instrument modes selected in the missions tab. The minimum start date allowed will be displayed under the start time field once a mission/instrument mode has been selected. The end time entered should be no later than the current date for active missions or no later than the decommissioned date for inactive missions. The maximum end date allowed will be displayed under the end date field once a mission/instrument mode has been selected.

Users may select a region of interest from the region selection menu. Data Browser will zoom in to the region of interest on the map or zoom out to show the full globe if the region Global is selected.

Filter options in the missions and instruments panel will vary depending on the missions selected in the missions list. Refer to the filter options in the section below Adjusting map results with user controls.

Users may initiate a Data Browser task by selecting at least one instrument mode from the missions list, entering a start time and end time, selecting a region from the region selection menu, selecting optional filtering options, and lastly selecting the Submit button.

Once a Data Browser task is initiated, the status of the task will be displayed in the Task Status block. The status will show "No task pending" if Data Browser is not currently waiting for the results of an initiated task. The status will show "Evaluating request..." while validating user entered parameters, and "Please wait while your coverage is computed." while the task is processing. Once the task has completed successfully, acquisition footprints will be drawn on the map and the query results panel will open in the Data Browser tool.

Once a task has been submitted in Data Browser, users may select the Cancel button while a task is running. Although be aware that even though the canceled task will not be listed in the Task History panel, the task will continue to run in the background where the data will be cached. If users choose to leave the Data Browser tool while a task is running without canceling the task, users may later load the results of the completed task from the Task History. If users wish to return to a task later, users should be logged in to their COVE user account prior to submitting the task or while loading the task from task history. Only tasks which completed without error will be listed in the Task History panel.

All tasks in the Task History in Data Browser are deleted from COVE after one week to clear cached data.

Viewing the results of a task

When an active Data Browser task has completed or a Data Browser task is loaded from task history, a subset of the resulting footprints for the scenes in the region of interest will be drawn on the map. A list of individual query results for each scene acquisition will be listed in the Query Results panel on right side of the Data Browser tool. The subset of results drawn on the map is limited to the scenes listed in the query results for each page of results.

Users may view individual scene metadata. Scene acquisition details can be viewed in multiple ways.

- By hovering over a footprint on the map, the corresponding scene acquisition will be highlighted in the results list.

- By hovering over a scene acquisition in the results list, the corresponding footprint will be highlighted on the map. If users click on a footprint on the map, the scene acquisition details will be displayed in a popup.
- By clicking on the arrow button on an individual scene acquisition in the results list, the scene metadata will be displayed in a popup.
- By clicking on the magnifying glass button for an individual scene in the results list, Data Browser will zoom in to the footprint on the map. Users may then click on the footprint to view the scene metadata popup.
- By clicking on the "Click to view full table" button at the top of the query results panel, a paginated list of scene acquisitions will be displayed in a popup where users may choose to show All, 25, 50, 100, 250 entries per page.

Query results are shown in a paginated list. Users may choose to display entries in the query results list by All, 25, 50, 100, or 250 entries per page. All footprints are shown by default. However, 25 may allow for quicker transitions in highlighting footprints and scenes.

There is a maximum limit of 25000 scenes loaded in the Data Browser tool for a task. If a task is reaching this limit, they user may choose to reduce the number of instrument/instrument modes, the time span, or reduce the region of interest from Global to a smaller region, change filtering options, and submit a new task.

The Sentinel-2A & 2B mission is a combined dataset (SENTINEL_2A) from USGS's Earth Explorer API. The only way to distinguish Sentinel-2A scenes from Sentinel-2B scenes when viewing scene details in Data Browser is to look at the thumbnail URL. The thumbnail URL for Sentinel-2A will contain "s2a", and Sentinel-2B will contain "s2b". The order URL reflects the dataset name instead of the mission name.

Adjusting map results with user controls

Users may choose to adjust the query results by changing filter options available in the User Controls panel on the right side of the Data Browser tool. Filter options in user controls will vary depending on the missions selected for the task currently loaded into results. A new Data Browser task is submitted once users select the "Submit" button to apply the filter options to the original task results. Task details in the Task History will also include any filter options applied. Filter options for each mission are:

- <u>Landsat (5, 7, 8, 9)</u>
    - Cloud cover percentage – Maximum cloud cover percentage allowed in a scene
    - Landsat day or night indicator – Options include any, day, and night (scene lighting)

- Sentinel-1A/1B
  - Sentinel1 ascending or descending – Options include any, ascending, and descending (orbit direction)
  - Sentinel1 processing level – Options include all, GRD (Ground Range Detected), and SLC (Single Look Complex).
- Sentinel-2A/2B
  - Cloud cover percentage – Maximum cloud cover percentage allowed in a scene

Creating and managing user created regions

Users may create and manage user defined regions from the right-side Regions panel in Acquisition Forecaster, Coincident Calculator, Coverage Analyzer, Revisits Calculator, and Data Browser tools. See the Regions section for more information on creating and managing regions.

Managing and loading completed tasks from task history

A task history may be accessed from the right-side menu tab in the Data Browser tool. The task history is a list of Data Browser tasks, and the list is limited to successfully completed tasks initiated during the current browser session for users not logged into a COVE user account or initiated while users are logged into a COVE user account. Each task description includes a title (mode – instrument - mission – region from start year-end year), mode selection (mission: mode-instrument-mission), date range (start date, end date), region selection for the task, and if the task was pushed from Coverage Analyzer, will include discretization id.

Data Browser tasks are shown in a paginated list. Users may choose to display entries in the results list by 25, 50, 100, or 250 entries per page.

The search capability allows users to search for the sequence of characters in any of the parameters of the task history.

To load a task from the task history, click on the “Load this task” button located directly under the task details.

To delete a task from the task history, click on the red trashcan icon located directly under the task details.

Using output options

Users may select from the options listed below. Supported formats include PNG (portable network graphics), and CSV (comma separated values).

- Download PNG – PNG is a common compressed raster graphics file format. PGN output images will contain the current map view.
- Download Abbreviated CSV – Output CSV files contain headers and a list of all unique scenes. This will remove any duplicate or overlapping coverages, providing a single list of all acquisitions from this task. The abbreviated CSV version contains an abbreviated metadata set. The CSV columns include mission, name, acquisition_date, browse_url, order_url, start_time, stop_time, center_latitude, and center_longitude.
- Download Full CSV – Output CSV files contain headers and a list of all unique scenes. This will remove any duplicate or overlapping coverages, providing a single list of all acquisitions from this task. The full CS version will contain a full metadata set. The CSV columns may include mission, name, acquisition_date, browse_url, order_url, start_time, stop_time, center_latitude, center_longitude, orbit_direction, path, frame, orbit_number, processing_level, row, day_or_night, cloud_cover, sensor, sun_elevation, sun_azimuth, granule_name, and scene_coords.
- Open in Coverage Analyzer – Pushing a task to the Coverage Analyzer allows users to easily see a coverage map of all acquisitions covering the selected region. Please note that the default coverage map is of an unfiltered query and any desired filters must be applied in the user controls panel. The default discretization method for Landsat 5, 7, and 8 missions will be Landsat WRS discretization without overlap (1:1). For all other missions, the default discretization size used will be 1.0 degrees.

Data Policy

Data Policy is a database that provides users with information about the data policy and primary archive location for CEOS satellite instruments.

Data Policy database can be launched from the Tools menu in the title menu bar.

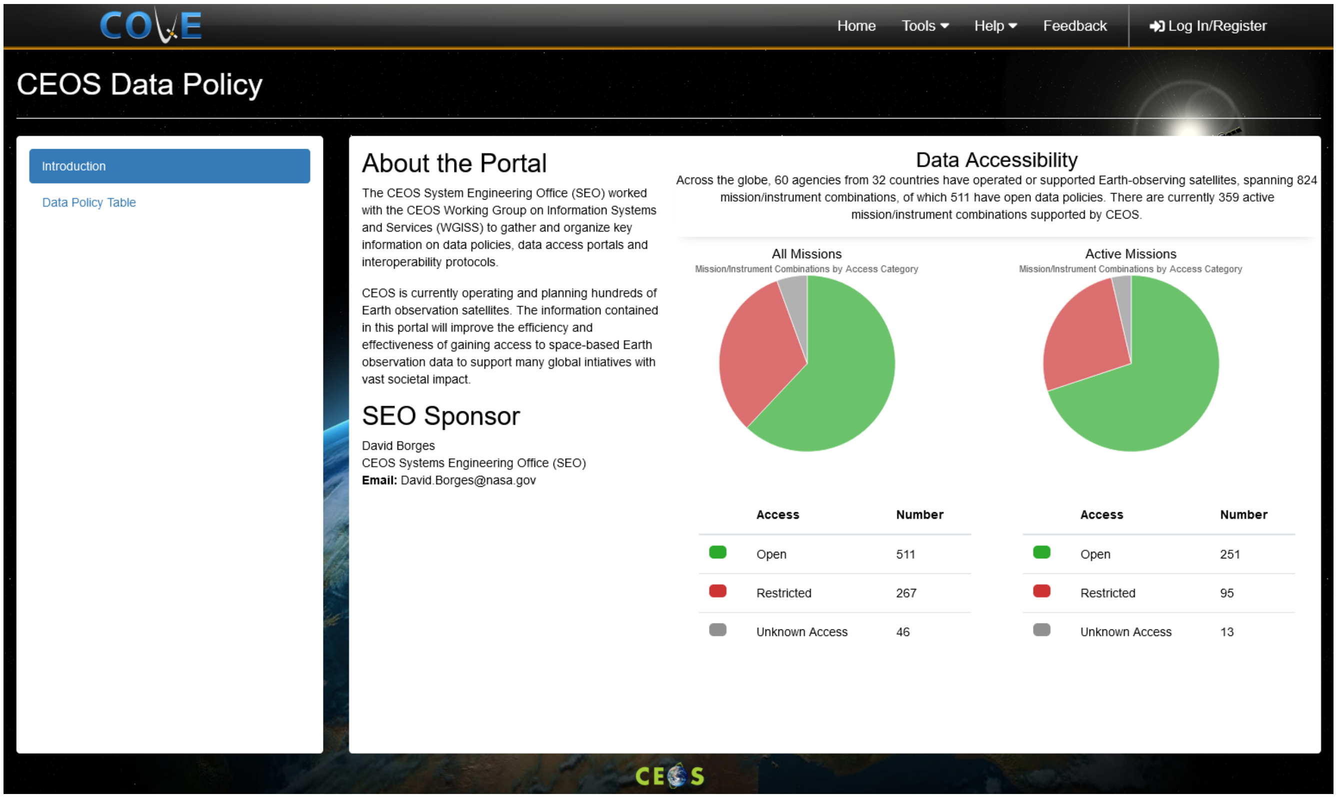


Illustration 6: Data Policy tool

Introduction

Users may access an overview of the portal and data accessibility for CEOS supported missions/instruments from the menu on the left of the Data Policy tool.

Data Policy Table

Users may access the data policy table for CEOS supported missions/instruments from the menu on the left of the Data Policy tool.

The data policy table lists the mission, mission agency, launch date, mission status, orbit type, instrument, instrument full name, instrument agencies, access, IDN link, client portal, and access comments. Users may choose to show/hide columns in the data policy table. Users may click on a row in the data policy table to display a popup of the data policy information for the instrument.

The data policy table is in a paginated list. Users may choose to display entries in the results list by 25, 50, 100, or 250 entries per page.

The search capability allows users to search for the sequence of characters in any of the columns of the data policy table.

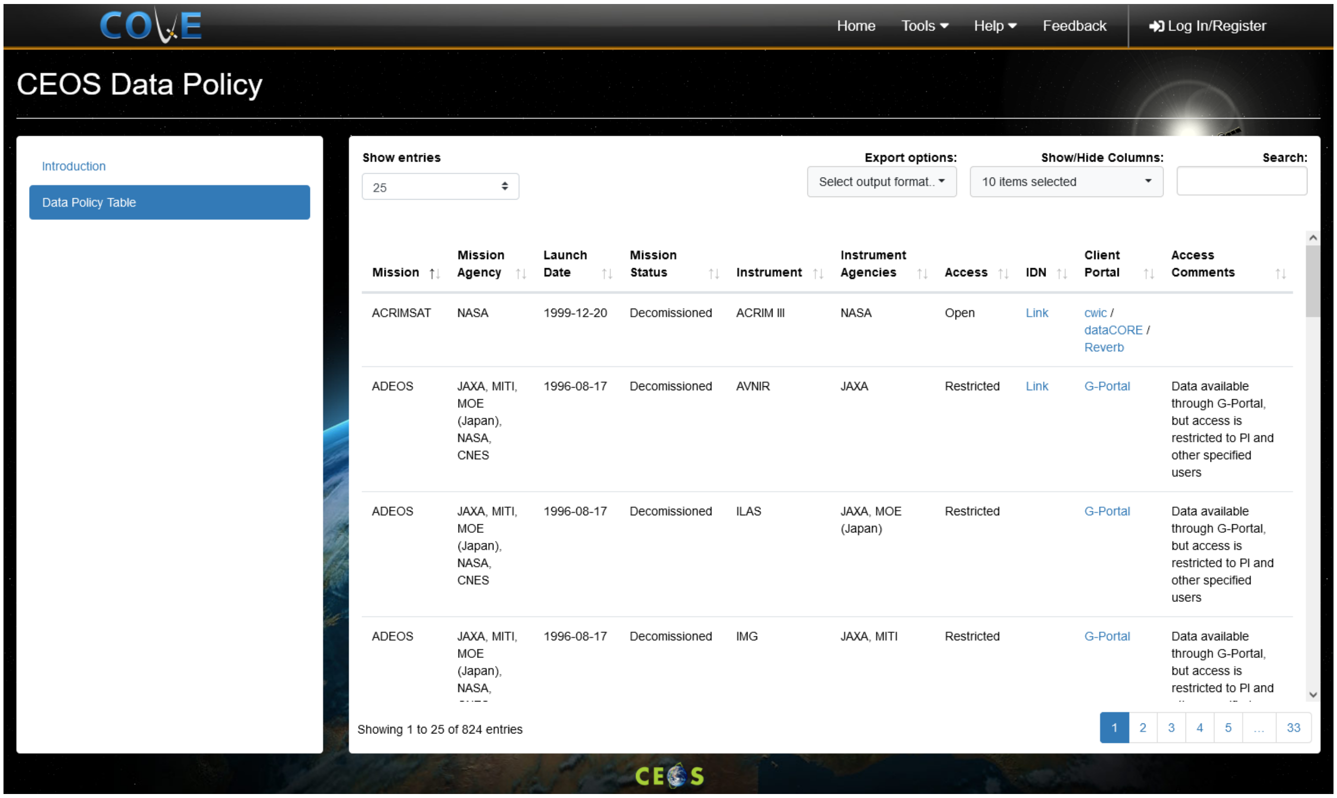


Illustration 7: Data Policy Table

Users may choose to download the full data policy table into a pdf or csv from the export options drop down. Selecting the desired option will automatically trigger the download.

Data Policy can be launched from the Tools menu in the title menu bar.

Country Coverage

Country Coverage is a tool which allows users to generate and view GFOI Country Coverage values and graphs and download reports.

Country Coverage can be launched from the Tools menu in the title menu bar.

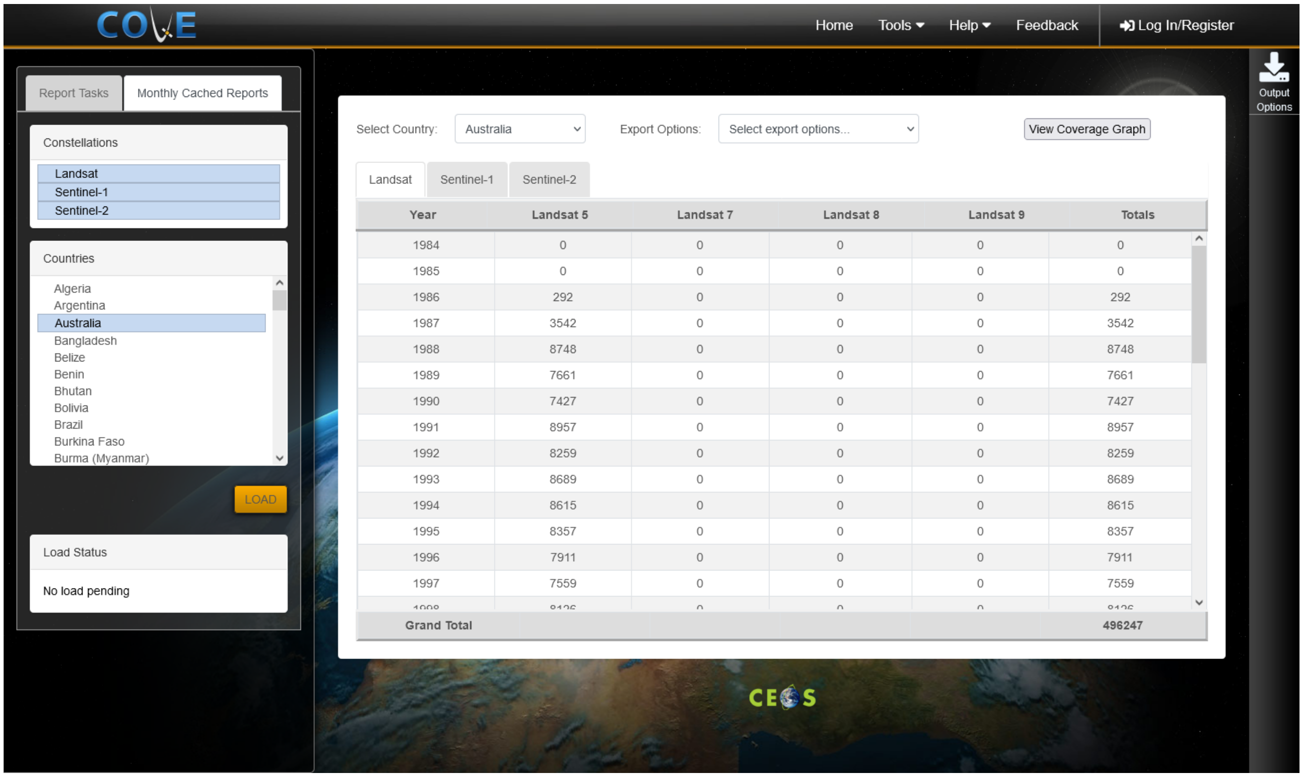


Illustration 8: GFOI Country Coverage Task Results for Monthly Cached Reports

Introduction

Users may access an overview of the GFOI Country Coverage Reports by selecting Country Coverage from the Tools menu. The overview will also be visible when users submit tasks to generate reports.

Initiating a task

In the Country Coverage tool in the Task Options panel, users may select one or more constellations and countries. Users may choose from three constellations: Landsat, Sentinel-1, and Sentinel-2. Users may also choose from over 70 GFOI countries. Users may choose to initiate a task to generate reports based on current data, or to load monthly cached reports. Once at least one constellation and country are selected, users may click the Submit button to initiate the task or click Load to load monthly cached reports.

COVE imports new acquisition data daily. Therefore, for report tasks Country Coverage reports generated are cached for only one day (UTC time). Monthly cached reports cover data through the end of the current month minus two. For example, if the current month is October, monthly cached reports would cover through the end of August.

There is no longer a limit to the number of constellations and countries per task.

Larger countries take longer to generate reports. A task progress bar will appear below the task status while tasks are running to indicate the task progress percentage. The task progress bar only appears for report tasks.

Viewing the results of a task

Results from Country Coverage tasks will appear in a tabbed table.

Users may select a country from the drop-down menu to view results for the selected country. Users may click on the constellation tabs to view results for the currently selected country and constellation.

The results table lists the total scenes imported into COVE for each mission in the constellation and country selected and for each year of the missions. A grand total of all scenes for all missions for the currently selected country and constellation will be displayed at the bottom of the table.

Users have the option to view graphs or download coverage results for the currently selected country and constellation. Users may click on the View Coverage Graph button to view a graph illustrating the coverage. Users may download scene metadata in a CSV file format or a report of the coverage summary including graphs in PDF file format from the Export Options drop down menu.

Using output options

The “Download ZIP” button allows users to download a report in a ZIP file format. Output ZIP files contain a CSV file and a PDF file for each constellation and country selected in the current task. The CSV files will contain a list of scene metadata. The PDF files will contain a summary of scene totals for each year for each mission in a constellation, and a graph illustrating the coverage.

Utilities

Utilities is a set of quick calculation utilities to provide users with a means of estimating various parameters of interest about CEOS satellite missions. Utilities for repeating orbits and swath calculators are provided. Under the Repeating Orbit tab, users may estimate the Ground Track Interval, Period/Velocity, and Sun Synchronous Orbit. Under the Swath Calculator tab, users may estimate the Incidence to Pointing angle, Swath/FOV, Swath from Incidence and Swath/Off-nadir.

Utilities can be launched from the Tools menu in the title menu bar.

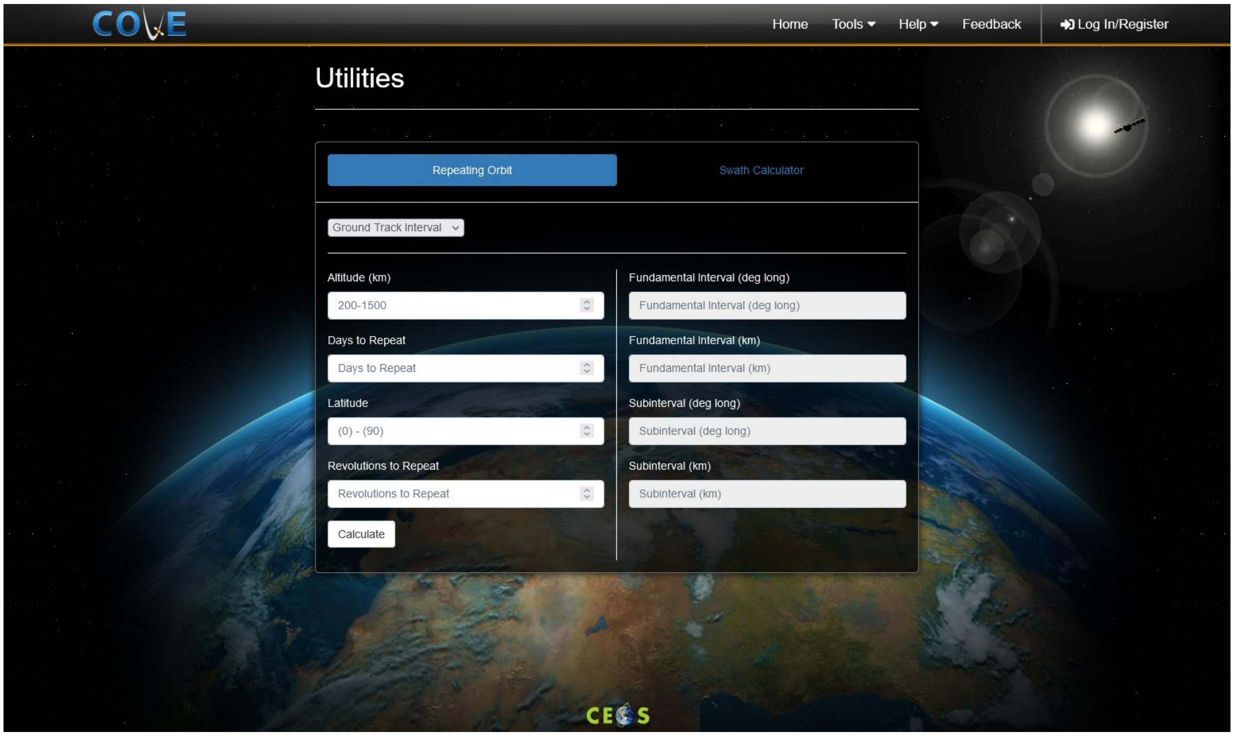


Illustration 9: Utilities tool

Ground track interval calculator

Ground track interval may be calculated by providing altitude or revolutions to repeat, days to repeat, and latitude, and clicking "Calculate". Fundamental interval and subinterval will be displayed in degrees longitude and kilometers. The following calculations are used:

- Revolutions to repeat: $d(24 \cdot 60^2/a/60)$where *d* is the days to repeat and *a* is the orbital period
- Fundamental interval (in deg long): 360 / (revolutions to repeat / days to repeat)
- Subinterval (in deg long): fundamental interval / days to repeat
- Convert fundamental interval/subinterval (deg long) to km:

  $radius * distance$where$radius = \frac{\sqrt{(R_e^2\cos(\varphi))^2+(p^2\cos(\varphi))^2}}{((R_e\cos(\varphi))^2+R_e\sin(\varphi))^2}$and $distance =$ $\arctan(\sqrt{(\cos(\varphi)\sin(i))^2 + (\cos(\varphi)\sin(\varphi) - (\sin(\varphi)\cos(\varphi)\cos(i))^2}))$
  R_e is is the earth equatorial radius constant (6378.13649), *p* is a polar radius constant (6356.7523), φ is latitude, $i = \frac{interval}{\pi}$

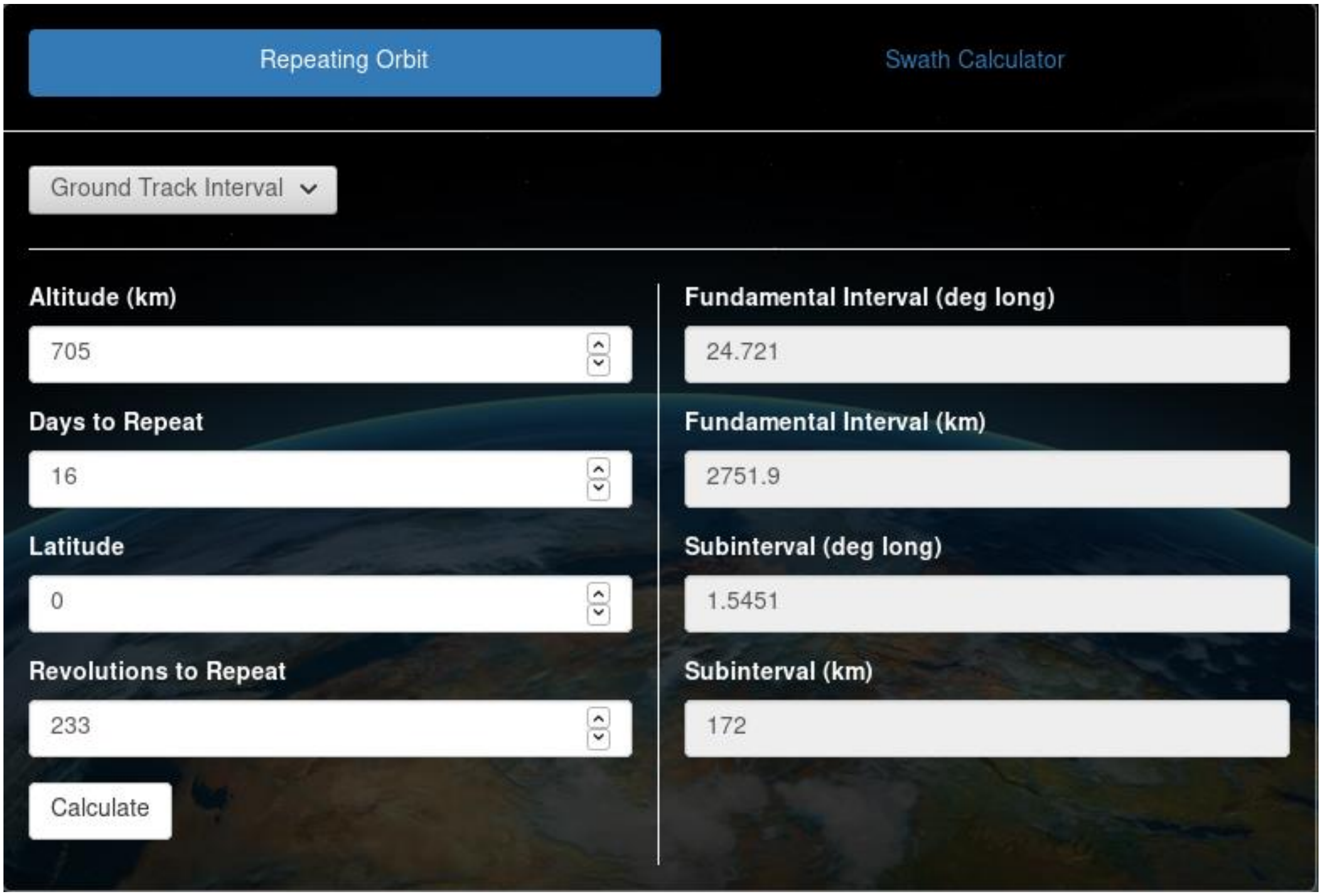


Illustration 10: Ground track interval calculator

Period/Velocity calculator

Period/Velocity may be calculated by providing altitude and clicking “Calculate”. Orbital period (min) and velocity (km/s) will be displayed. The following calculations are used:

- Period: $T = \sqrt{\frac{\mu}{(R_e+h)^3}}$where μ is the gravitational parameter (398600.4415), *r* is earth equatorial radius constant (6378.13649), *h* is altitude
- Velocity: $v = \sqrt{\frac{\mu}{R_e+h}}$where μ is the gravitational parameter (398600.4415), *r* is earth equatorial radius constant (6378.13649), *h* is altitude

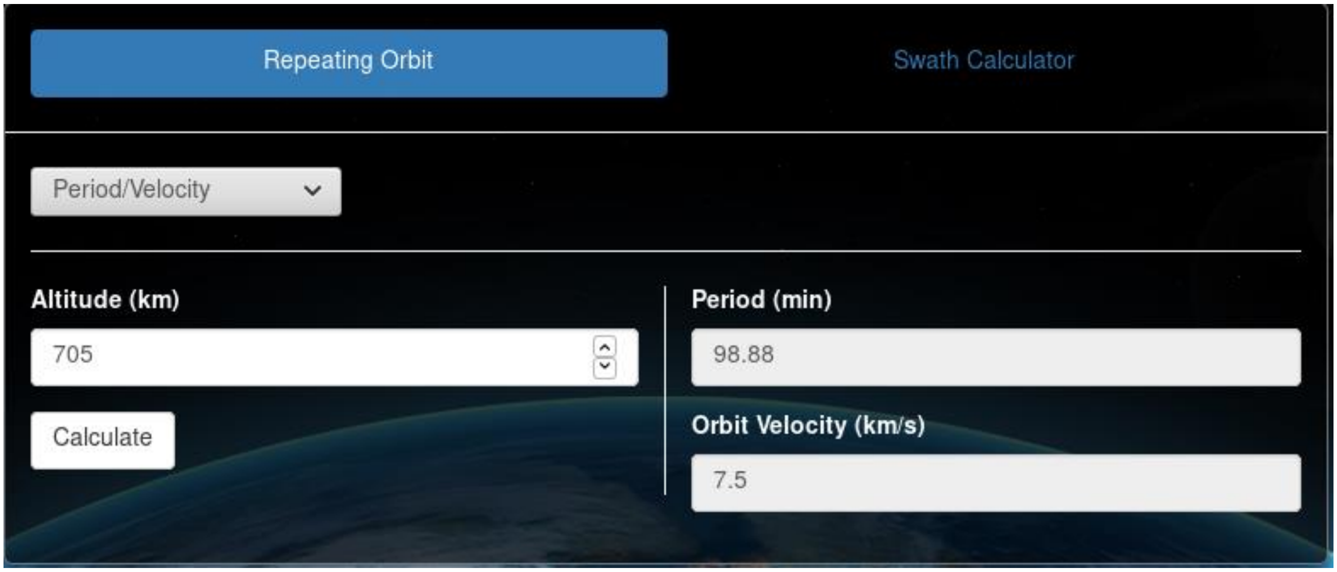


Illustration 11: Period/Velocity calculator

Sun Synchronous Orbit calculator

Sun Synchronous Orbit may be calculated by providing altitude and revolutions to repeat, days to repeat (optional), and clicking “Calculate”. Days to repeat may be calculated from altitude and revolutions to repeat if not provided. Orbit parameters may also be loaded from select reference missions in COVE. The reference missions available are ALOS-2, Landsat 8, NPP, Sentinel-1A, Sentinel-1B. If users choose to use parameters from reference missions, click “Load Parameters” to retrieve mission parameters from COVE. Once the “Calculate” button is clicked, the estimated altitude and estimated inclination will be displayed. The following calculations are used:

- Days to repeat: $r/24 \cdot 60^2/T/60$where *r* is revolutions to repeat and *T* is the orbital period (using period calculation above)
- Estimated altitude: $\sqrt[3]{\mu\left(\frac{1}{r\cdot(W_e-(\frac{-n}{2}\cdot(\frac{Re}{a})^2\cdot\cos(i)))-(\frac{n}{4}\cdot(\frac{Re}{a})^2\cdot(2-3\cdot\sin(i)^2)+\frac{n}{4}\cdot(\frac{Re}{a})^2\cdot(4-5\cdot\sin(i)^2))}\right)^2}$where *a* is altitude, *r* is revolutions per day (revolutions to repeat / days to repeat), *i* is inclination, *μ* is the gravitational parameter (398600.4415),$n = 3r \cdot W_e \cdot j2$, $W_e = 360.9856235\frac{\frac{\pi}{180}}{24\cdot 60^2}$, and *j2* is a zonal harmonic constant (0.001082626335439)
- Estimated inclination: $\frac{\frac{\frac{\omega\cdot\pi}{180}}{24}\cdot 60^2}{\frac{-3}{2}\cdot j2\cdot\frac{(\frac{R_e}{R_e+a})^2\cdot\sqrt{(\frac{\mu}{(R_e+a)^3})}}{(1-e^2)^2}}$where R_e is the earth equatorial radius constant (6378.13649), *a* is altitude, *j2* is a zonal harmonic constant

(0.001082626335439), μ is the gravitational parameter (398600.4415), e is eccentricity (value is 0), and $\omega = 360/365.242199$

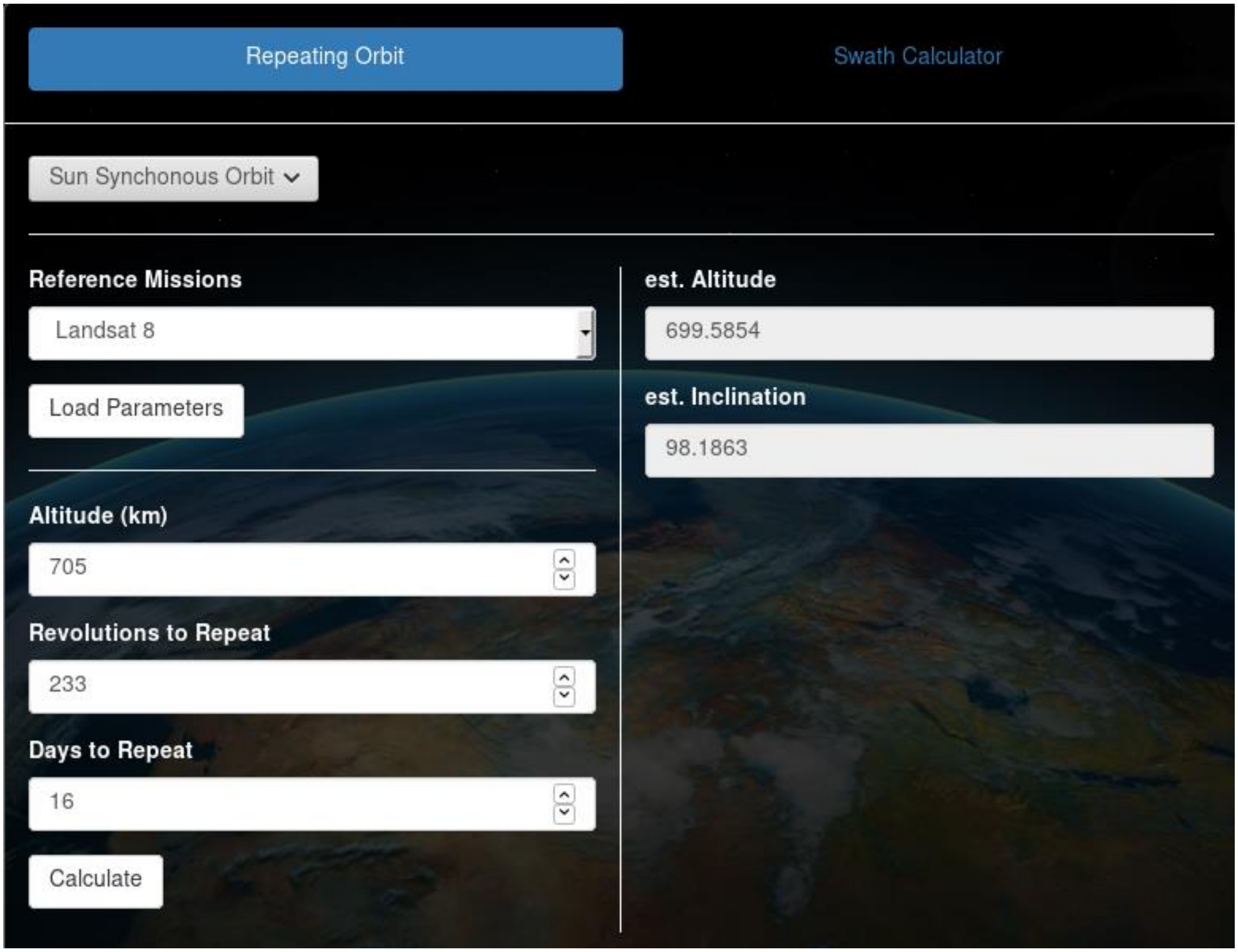


Illustration 12: Sun Synchronous Orbit calculator

Incidence to Pointing calculator

Incidence to Pointing may be calculated by providing altitude (km), incidence angle (deg), and clicking "Calculate". Off-nadir pointing angle (deg) will be displayed. The following calculation is used:

- Pointing angle: $\frac{180 \cdot \arcsin(\frac{R_e}{(R_e+a)} \cdot \sin(\frac{(180-i)}{180}\pi))}{\pi}$ where R_e is the earth equatorial radius constant (6378.13649), a is altitude, and i is inclination

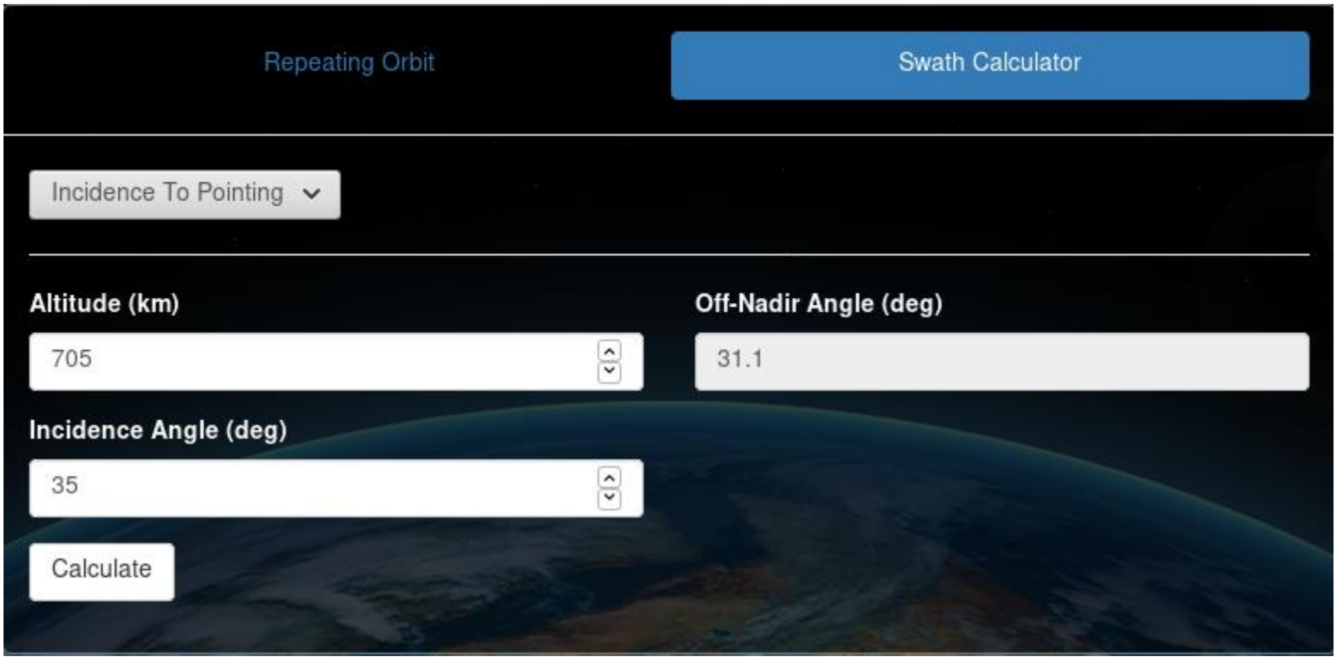


Illustration 13: Incidence To Pointing calculator

Swath/FOV calculator

Swath/FOV allows users to calculate ground swath width or field of view (FOV). Swath width may be calculated by providing altitude (km), half-FOV (deg), and clicking “Calculate Swath Width from FOV”. FOV is calculated when half-FOV is entered. Swath width will be displayed. FOV/half-FOV may be calculated by providing altitude (km), swath width, and clicking “Calculate”. FOV and half-FOV will be displayed.

- Ground swath: $R_e(2\arcsin(\frac{R_e+a}{R_e\sin(f\frac{\pi}{180})}) - 2f)$where R_e is the earth equatorial radius constant (6378.13649), *a* is altitude, *f* is half-FOV
- half-FOV from swath: $|\arctan(\frac{-\cos(\frac{\pi}{2}-\gamma)}{(\frac{R_e+a}{R_e}-\sin(\frac{\pi}{2}-\gamma))})| \cdot 180/\pi$where R_e is the earth equatorial radius constant (6378.13649), *a* is altitude, and$\gamma = w/R_e/2$where *w* is swath width

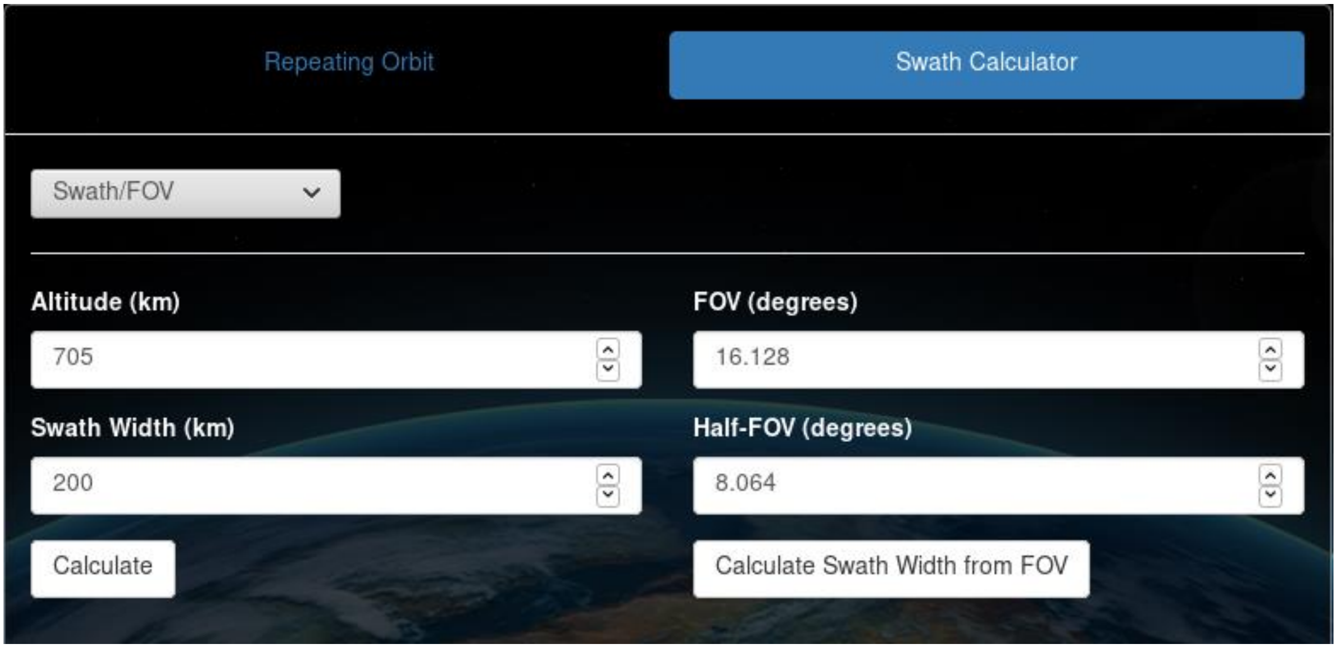


Illustration 14: Swath/FOV calculator

Swath from Incidence calculator

Swath from Incidence may be calculated by providing altitude (km), minimum and maximum incidence angles (deg), and clicking "Calculate". Off-nadir pointing angle from swath center (deg), FOV (deg), half-FOV (deg), and swath width (km) will be displayed. The following calculation is used:

- Convert incidence angle to off-nadir angle: $\theta = \frac{180 \cdot \arcsin(\frac{R_e}{R_e+a} \cdot \sin(\frac{180-i}{180}\pi))}{\pi}$ where R_e is the earth equatorial radius constant (6378.13649), *a* is altitude, and *i* is the incidence angle (min or max).
- Off-nadir pointing angle from swath center: $\beta = \frac{(\theta_{min}-\theta_{max})}{2} + \theta_{min}$ where θ_{min} is the minimum off-nadir angle and θ_{max} is the maximum off-nadir angle.
- Half-FOV: $f = \frac{\theta_{min}-\theta_{max}}{2}$ where θ_{min} is the minimum off-nadir angle and θ_{max} is the maximum off-nadir angle. Full-FOV is f * 2.
- Swath width: $R_e(-\beta_{max} - \arcsin(\frac{R_e+a}{R_e}\sin(\frac{\beta_{max}}{180}\pi))) - R_e(-\beta_{min} - \arcsin(\frac{R_e+a}{R_e}\sin(\frac{\beta_{min}}{180}\pi)))$ where R_e is the earth equatorial radius constant (6378.13649), *a* is altitude, β_{min} is β - *f*, and β_{max} is β + *f.*

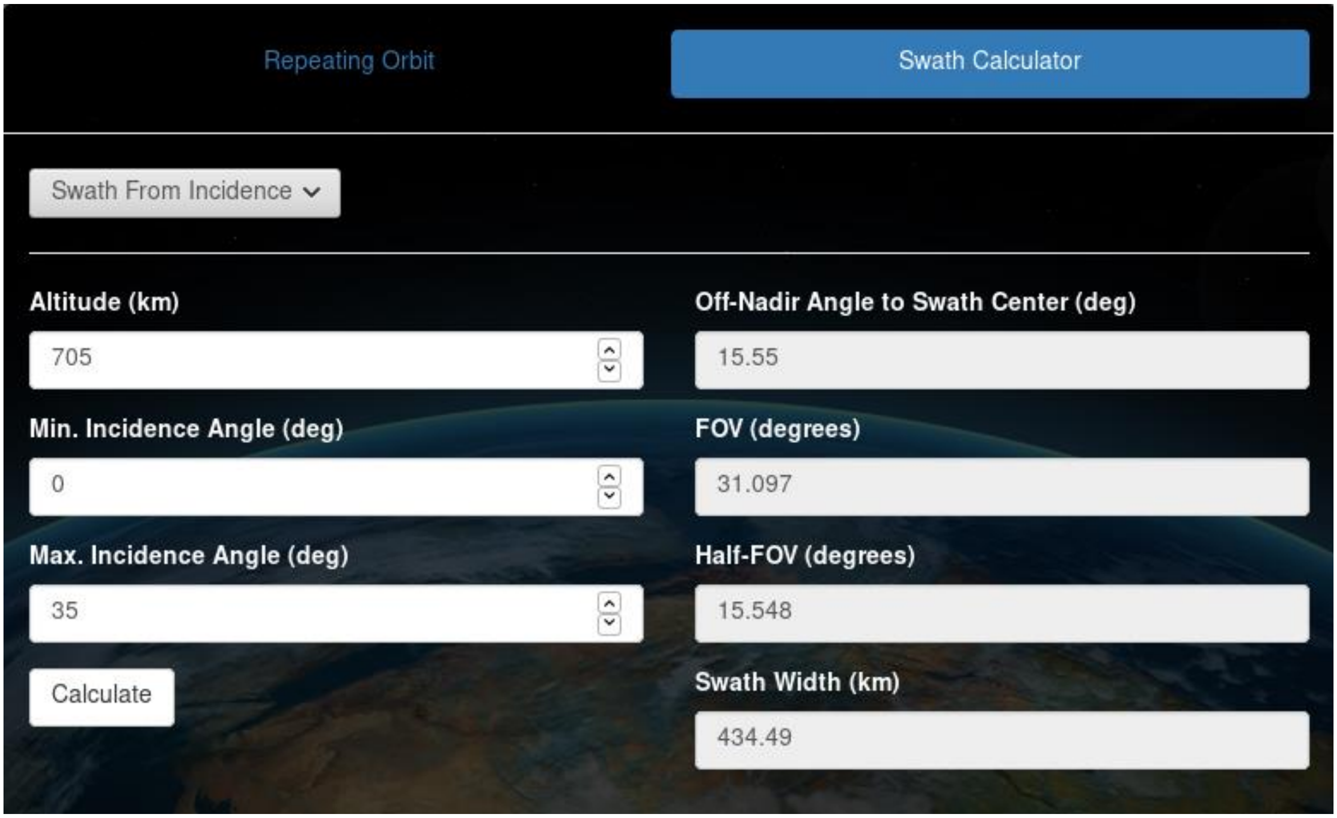


Illustration 15: Swath From Incidence calculator

Swath from Off-nadir calculator

Swath from Off-nadir may be calculated by providing altitude (km), off-nadir pointing angle (deg), full FOV (deg), and clicking "Calculate". Swath width (km) will be displayed. The following calculation is used:

- Swath width: $R_e(-\beta_{max} - \arcsin(\frac{R_e+a}{R_e}\sin(\frac{\beta_{max}}{180}\pi))) - R_e(-\beta_{min} - \arcsin(\frac{R_e+a}{R_e}\sin(\frac{\beta_{min}}{180}\pi)))$ where R_e is the earth equatorial radius constant (6378.13649), *a* is altitude, β_{min} is β - *f*, and β_{max} is β + *f*.

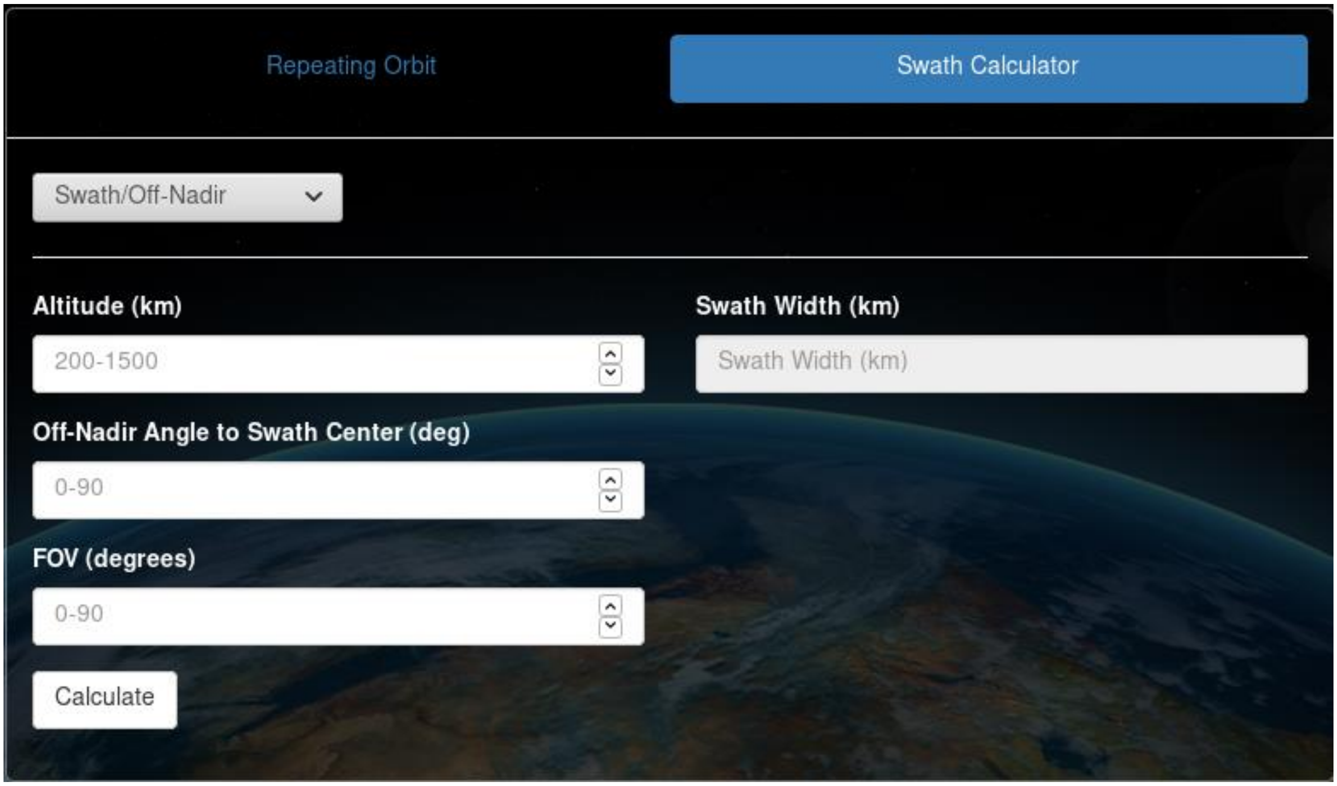


Illustration 16: Swath from Off-nadir calculator

Constellations

Users may create and manage constellations from the right-side Constellations panel in Coincident Calculator tool. Constellations should be created/managed while logged into a COVE user account. If a constellation is created while not logged in to a COVE user account, the constellation will only temporarily be available.

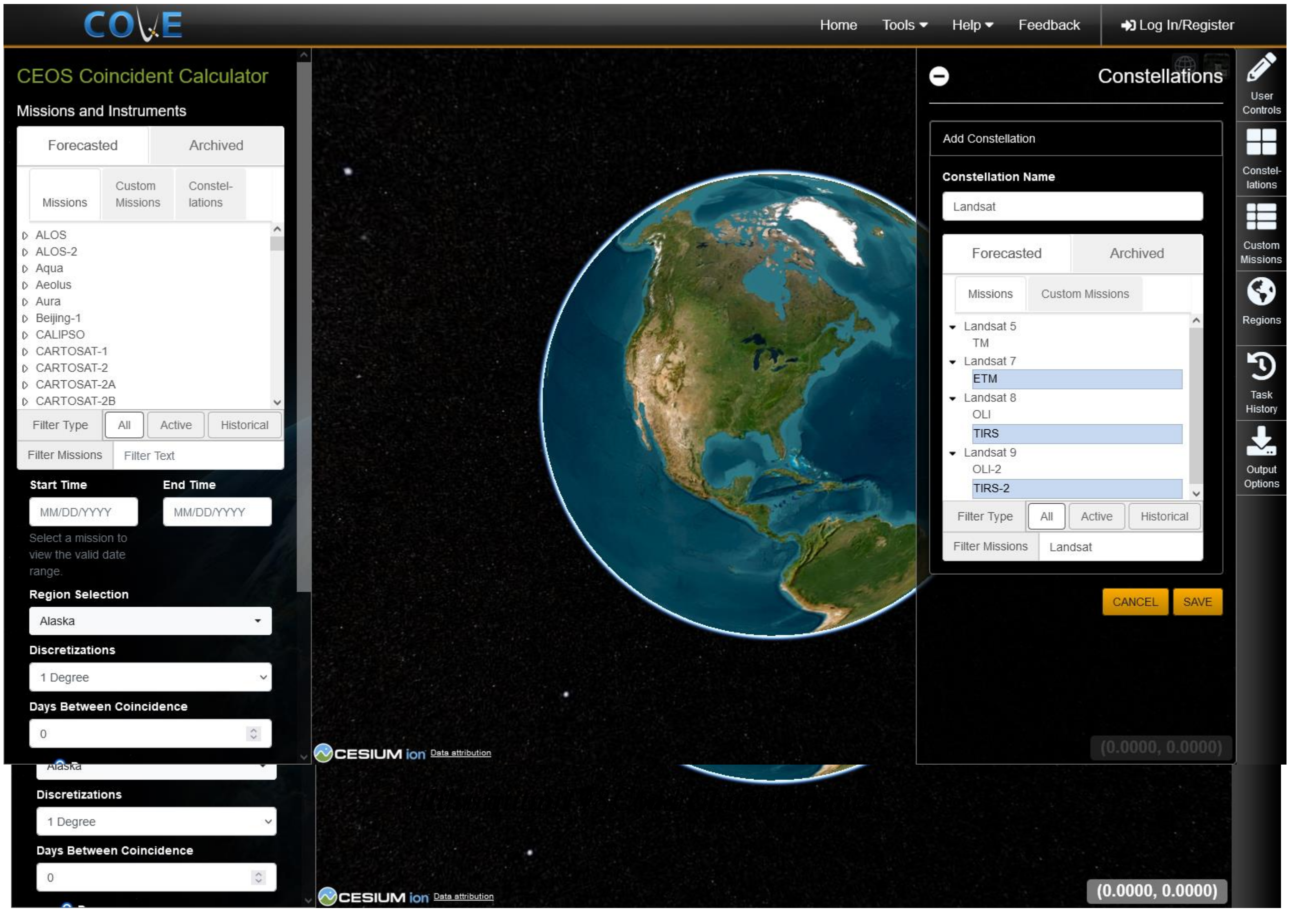


Illustration 17: Right-side tab to open/close the Constellations panel.

Creating Constellations

After clicking on the Add Constellation button, users may enter a constellation name, and select at least two missions/instruments and/or custom missions/instruments under the Forecasted tab, or at least two missions/instruments under the Archived tab. After the selections have been made, users can save the constellation by selecting the Save button.

Maintaining constellations

In the Constellations panel, a list of user-created custom constellations will be displayed. Users may click on a constellation name to open/close a list of missions instruments included in the constellation. Users may click on a mission instrument to view additional information. In the additional information, mission type may be Forecasted Mission, Forecasted Custom Mission, or Archived Mission. Users may click on the trashcan icon next to the constellation name which allow the user to delete the constellation.

Using user created constellations

Once a constellation has been created, it is available for use in COVE in the Coincident Calculator tool. To utilize any of the user defined constellations, users may select the Constellations tab under the Forecasted or Archived tabs in the Missions and Instruments panel.

Custom Missions

Users may create and manage custom mission from the right-side Custom Missions panel in Acquisition Forecaster, Coincident Calculator, and Revisits Calculator tools. Custom mission should be created/managed while logged into a COVE user account. If a custom mission is created while not logged in to a COVE user account, the custom mission will only temporarily be available.

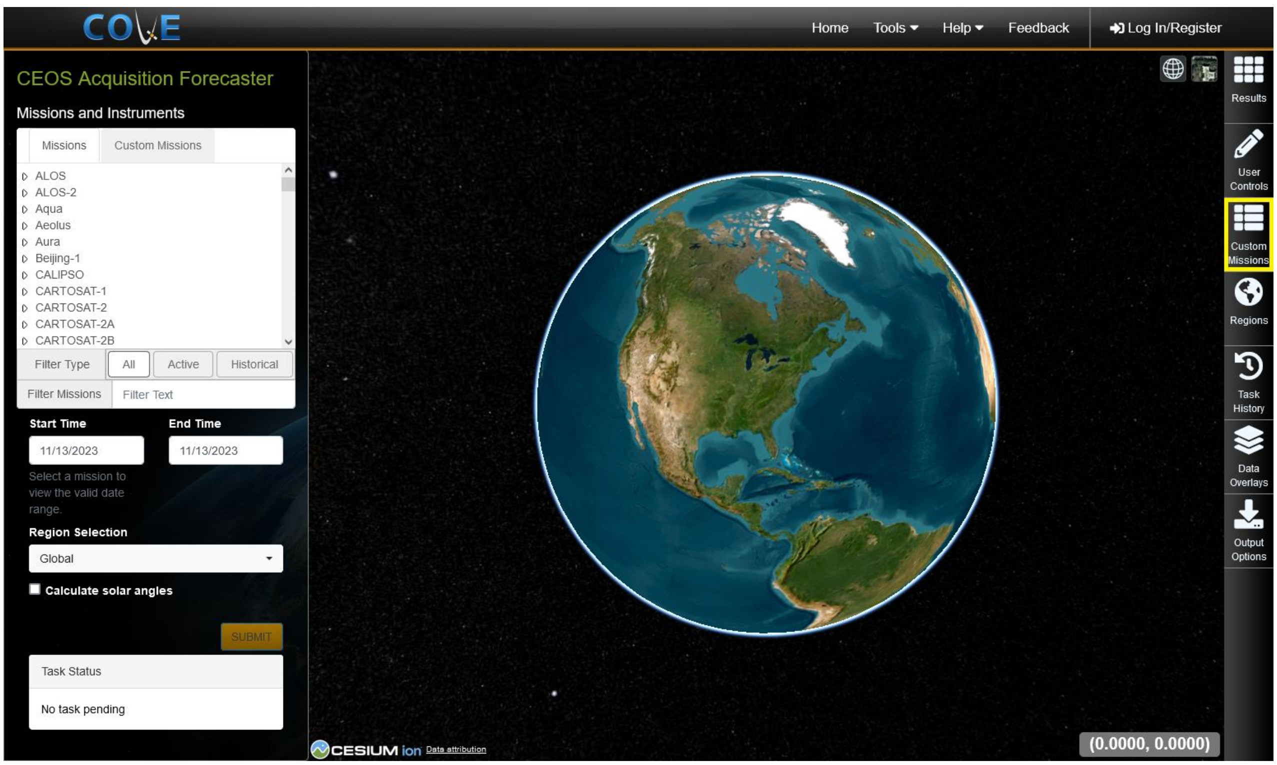


Illustration 20: Right-side tab to open/close the Custom Missions panel.

Custom missions and instruments follow the same hierarchy as the primary COVE mission and instruments in that mission defines the spacecraft orbit and the instrument defines the optical parameters to create the ground swath. Instruments exist as a component of a mission since the calculation of the mean ground swath depends on the orbit of the host mission and this dependence prevents an instrument from being useful on its own within the COVE framework.

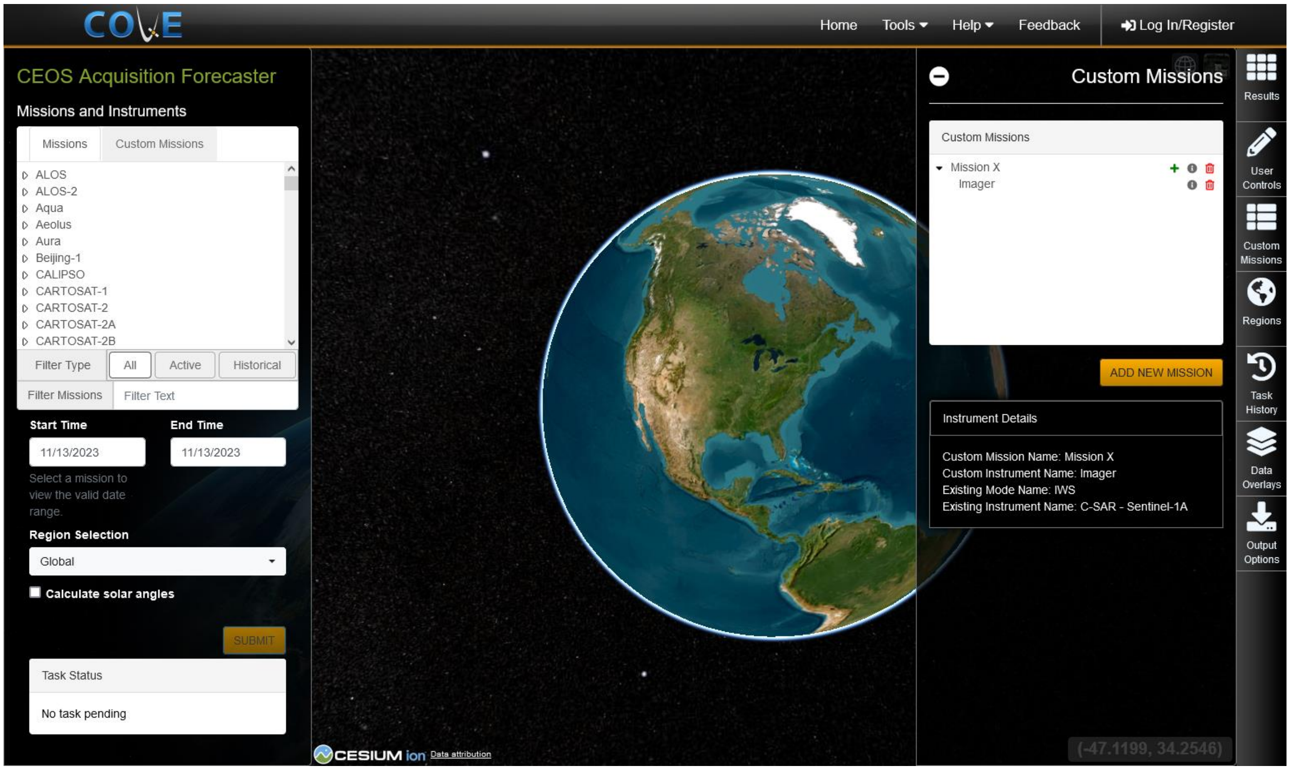


Illustration 21: Custom Missions panel.

Creating Custom Missions and Instrument Combinations

Users have two basic options when creating new missions and instruments. Users may choose to either replicate an existing item from the COVE database or to specify the parameters to create a new one. Users can combine existing and custom items in any combination desired to create new mission and instrument combinations.

To create a new Custom Mission, users will select the Add New Mission button at the bottom of the Custom Mission panel. Once a mission has been created, users may add additional instruments. Selecting the + icon next to the mission will enable users to create an instrument for the mission. Clicking on that button will allow users to either add a new instrument. A detailed description of each process is provided below.

Creating a Mission

After clicking on the Add New Mission button, users are presented with the option to use an existing mission's orbit or custom defined orbit. To make a selection, users may click on the radial button at the left edge of tab. The specifics of each selection are discussed below.

Selecting an existing mission's orbit

When this option is selected, users are required to select a mission from the COVE database and provide a new name for the mission. After the selections have been made, users can save the mission by selecting the Save button.

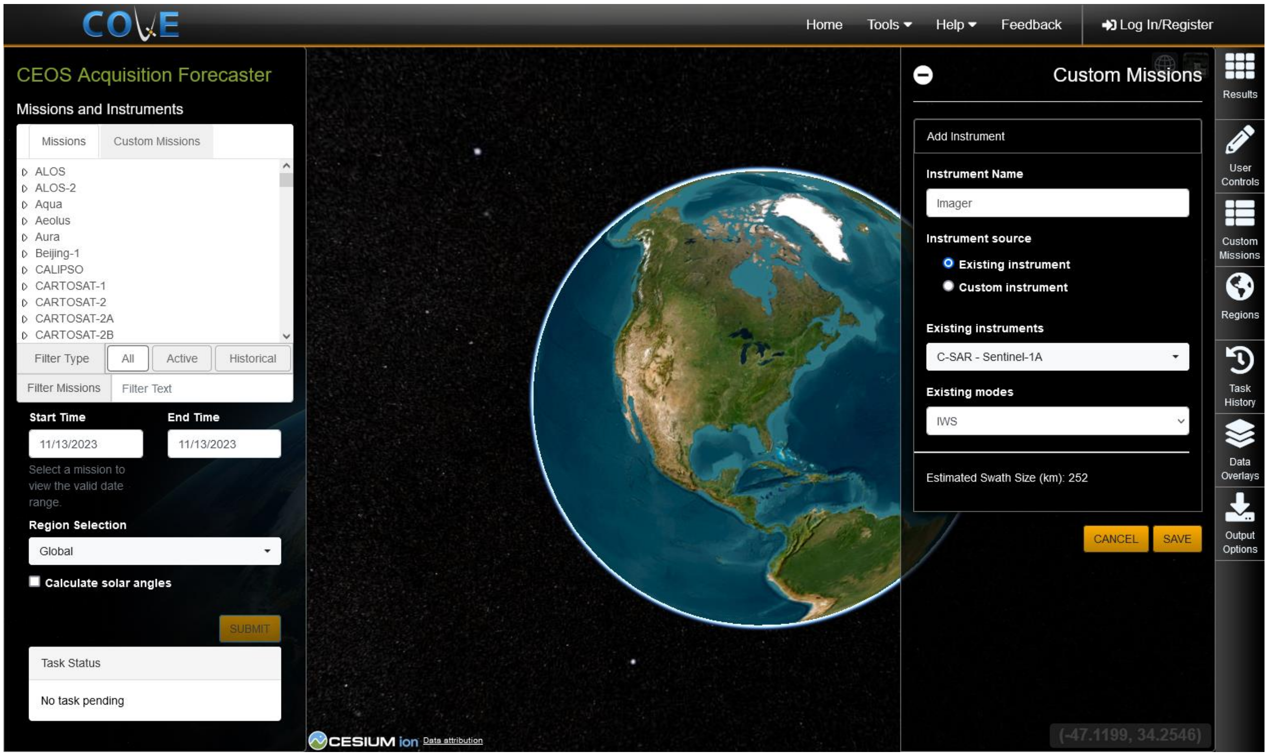


Illustration 22: Add a custom mission for an existing orbit.

Creating a custom defined orbit

When this option is selected, users must specify the name of the new mission and select one of three methods for determining the orbit of the mission. The three methods vary in complexity and are designed to offer helpful functionality for the novice and complete control for the advanced user. The three methods are Circular Orbit, Repeating Sun-Synchronous Orbit, and Advanced Orbit Designer. All orbital elements must be provided in the J2000 reference frame and failure to use the proper reference frame may have significant negative consequences on the usefulness of any COVE analysis using the mission.

Circular Orbit

This method represents the most simplistic orbit definition. Users are required to provide the orbit altitude, inclination, and the longitude of the first ascending node. The altitude is specified as the mean orbit height (in km) above the equatorial radius of the Earth. The inclination is specified in degrees and represents the orientation of the orbit plane relative to the J2000 X-Y plane. The longitude is also specified in degrees and defines where on the Earth the orbit propagation is to begin.

To reduce complexity for the novice users, the other orbital parameters (argument of perigee, true anomaly, and eccentricity) are hidden and use pre-defined values. For circular orbits, the eccentricity is always equal to 0 and the argument of perigee is an undefined value as a unique point does not exist within the orbit. To address this issue, COVE arbitrarily sets the value to be 0 which when coupled with a true anomaly value of 0 forces the orbit propagation to always start at the equator.

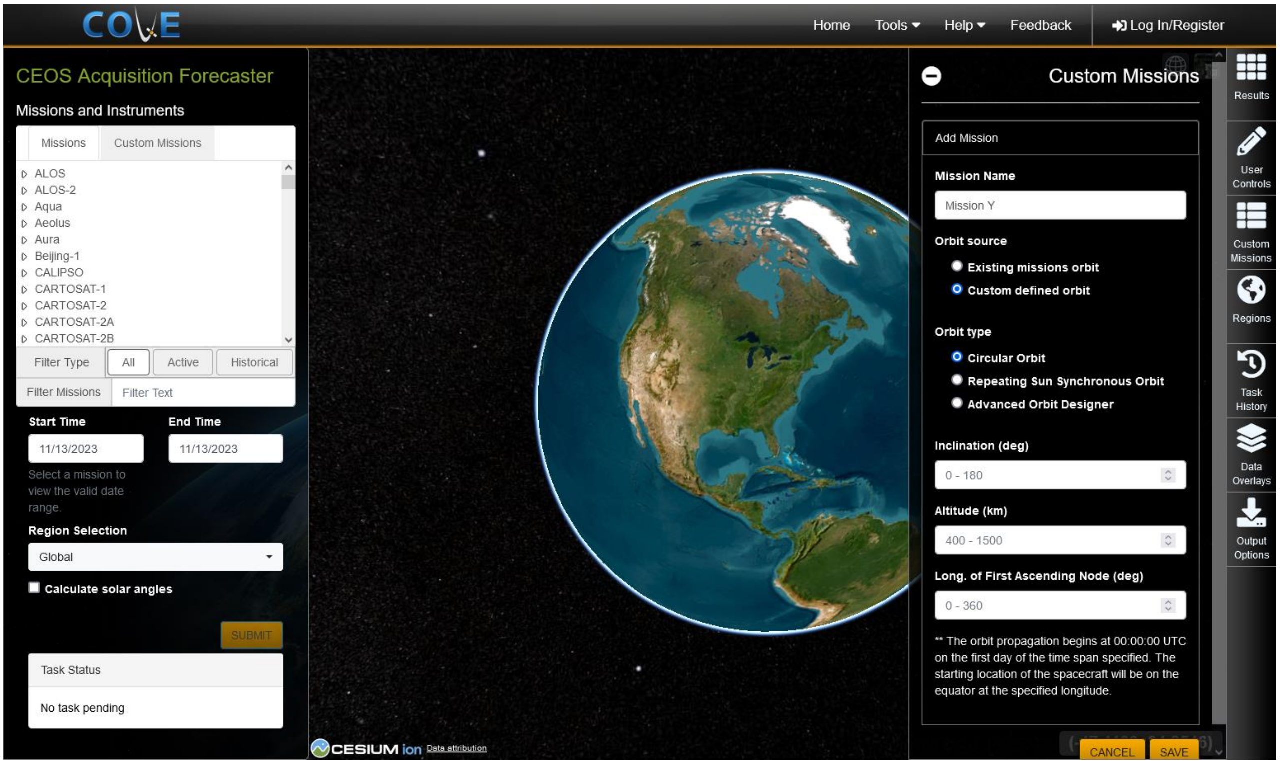


Illustration 23: Add a custom mission with a circular orbit.

Repeating Sun Synchronous Orbit

This method is used to calculate the orbital parameters that define a repeating sun-synchronous orbit from a set of orbit design criteria that is provided by users. Users are required to provide information on the orbit altitude, the number of orbits in the repeat cycle, the location on the Earth where the orbit propagation is to begin, and the local time of either the ascending or descending node. This type of orbit is sub-class of the basic circular orbit discussed above and is subject to the same limitations with the addition of the limitation RAAN is defined as 0 at UTC.

For altitude, users can either input the initial guess at altitude directly or through the provision of the number of orbits that the satellite completes in a single day. Like the circular orbit option, the altitude is expressed as the mean orbit height above the Earth’s equatorial radius. The revolutions to repeat parameter defines how long it takes the satellite to return to the same point on the Earth’s surface. The longitude of the first ascending node defines where on the Earth’s equator the orbit propagation begins and is specified in degrees. The local time of the ascending/descending node (LTAN/LTDN) is specified as the mean solar time at the equator when the satellite crosses during either the ascending or descending pass, whichever has been specified. The time should be expressed in the 24-hour system with the format restricted to HH:MM.

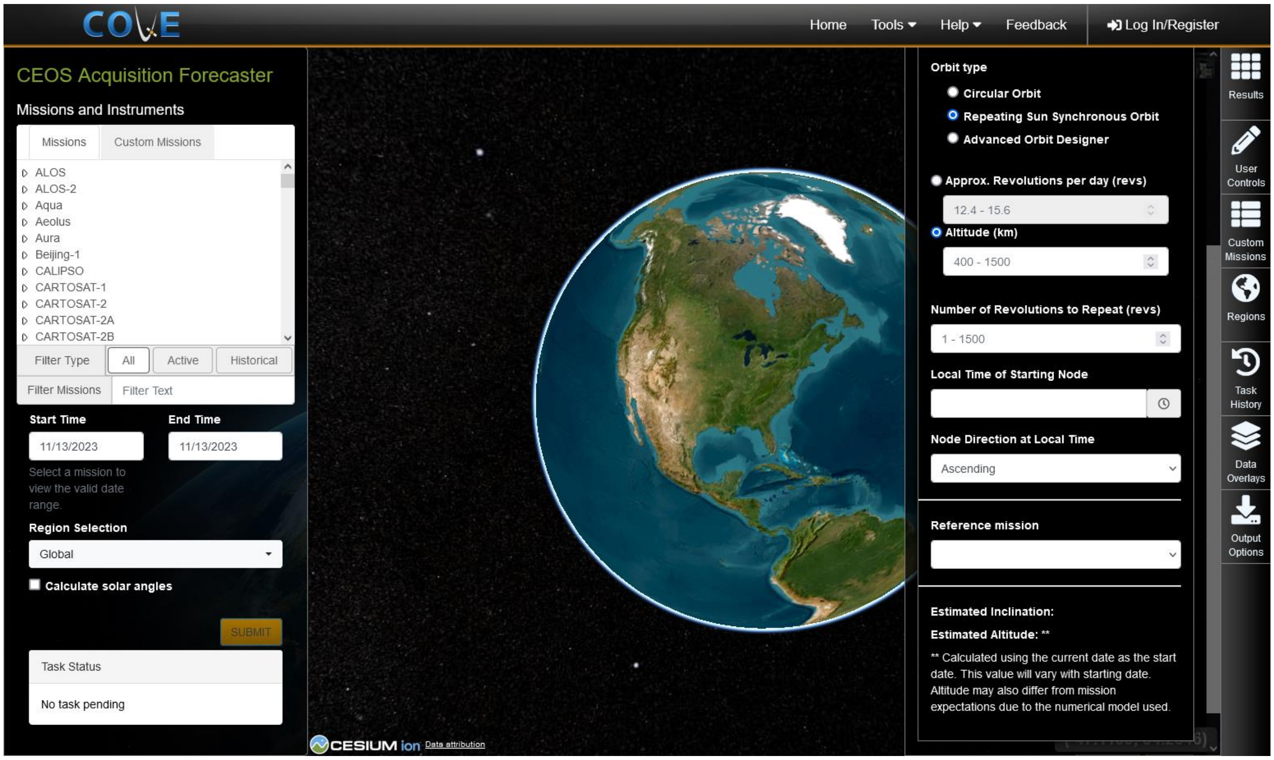


Illustration 24: Add a custom mission with a repeating sun synchronous orbit.

Several reference missions have been defined for users and can be accessed from the drop down below the user input fields. Use of a reference mission will create a new orbit that has the same repeat pattern as the original, but the specific daily performance will differ from the original due to the update made to the initial conditions of the orbit and the differences between COVE's generated TLE and general numerical propagation routines.

After all necessary inputs have been supplied, an estimate of the inclination and altitude of the calculated orbit will be displayed. These values are intended to provide users with a sanity check to ensure that the returned values are similar to the expected results and most likely will not match the actual orbit parameters of the true mission. The background calculations are attempting to determine the orbit parameters which will produce a repeating orbit under the propagation assumptions being utilized by the COVE tool which do not account for all effects acting on an actual satellite. If the returned altitude is not close to the expected value, users should adjust the altitude input and redo the calculation. The methodology for determining the altitude does not necessarily have a single unique solution and by changing the initial starting point, the algorithm may converge on a different solution.

The altitude and inclination values provided to users are based on the current date and are given as an estimate due to the potential for the solution to vary slightly with time. Due to the user specification of the local time and the starting longitude of the propagation, this orbit method has to determine the initial orbital elements each time users wish to change the analysis start date. The estimated values are displayed in order avoid the case where the epoch, or orbit starting time, is significantly far away from the requested analysis start date which would result in a long propagation to determine the orbit state at the start of the analysis thereby making the system less responsive to users and potentially reducing the accuracy of the results due to buildup of numerical precision errors. This methodology also has an impact on the starting time of the propagation. Normally, COVE propagations begin at the start of the day (00:00:00 UTC), but for this method, the start of the propagation is determined by using the combination of the mean local time and starting longitude to determine the starting time in UTC.

Advanced Orbit Designer

This method is intended to provide full control over the orbital elements of the mission orbit and should only be used by users who are familiar with orbital mechanics or who already have the necessary orbital elements. Users must provide the value of each of the six orbital elements as shown in the figure below.

NOTE: Due to computational constraints, the COVE tool is limited in the complexity of the force model that can be used during the numerical propagation of the satellite orbits. A reduced gravity model (degree 2, rank 0) which accounts only for the first order J2 term is used and all other sources of perturbation that would normally affect a satellite's orbit (solar and lunar gravity effects, drag, and solar radiation pressure) are neglected. b*drag in Custom

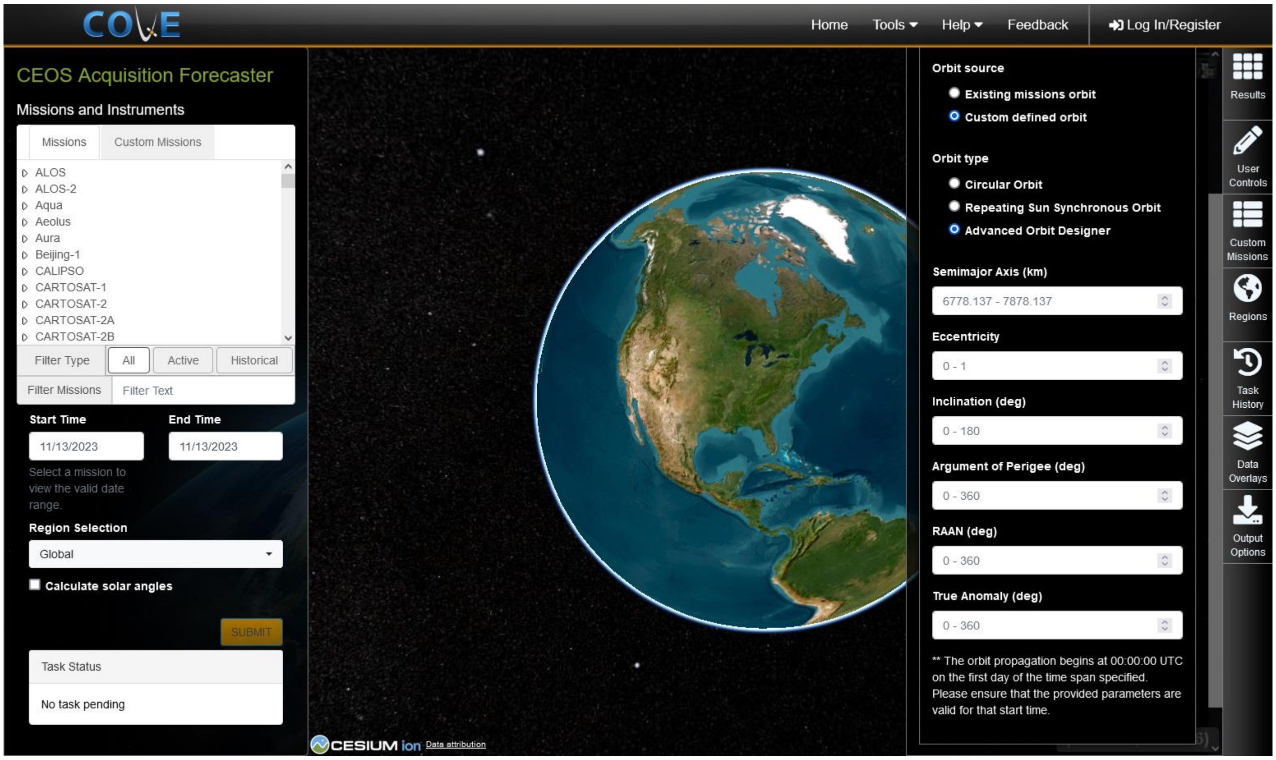


Illustration 25: Add a custom mission using advanced orbit parameters.

Missions is defined as 20000-0.

Creating an instrument and operating mode

After users have saved a custom mission, users should click on the + icon next to the mission name in the missions list in the Custom Missions panel to create an instrument for the mission. There users are presented with the option to select from: Existing Instrument and Mode or Custom Instrument.

Selecting an existing instrument and operating mode

When this option is selected, users are provided with a list of instruments and their associated modes to select from. Begin by providing a name for the instrument and the operating mode that is being defined. After an instrument has been selected, COVE will calculate the estimated size of the instrument's ground swath using either the reference altitude (if an existing mission was selected) or the user provided altitude (if a new mission was created) and display the result to users. Clicking the "Save" button saves the custom instrument and makes it available to users for use within COVE.

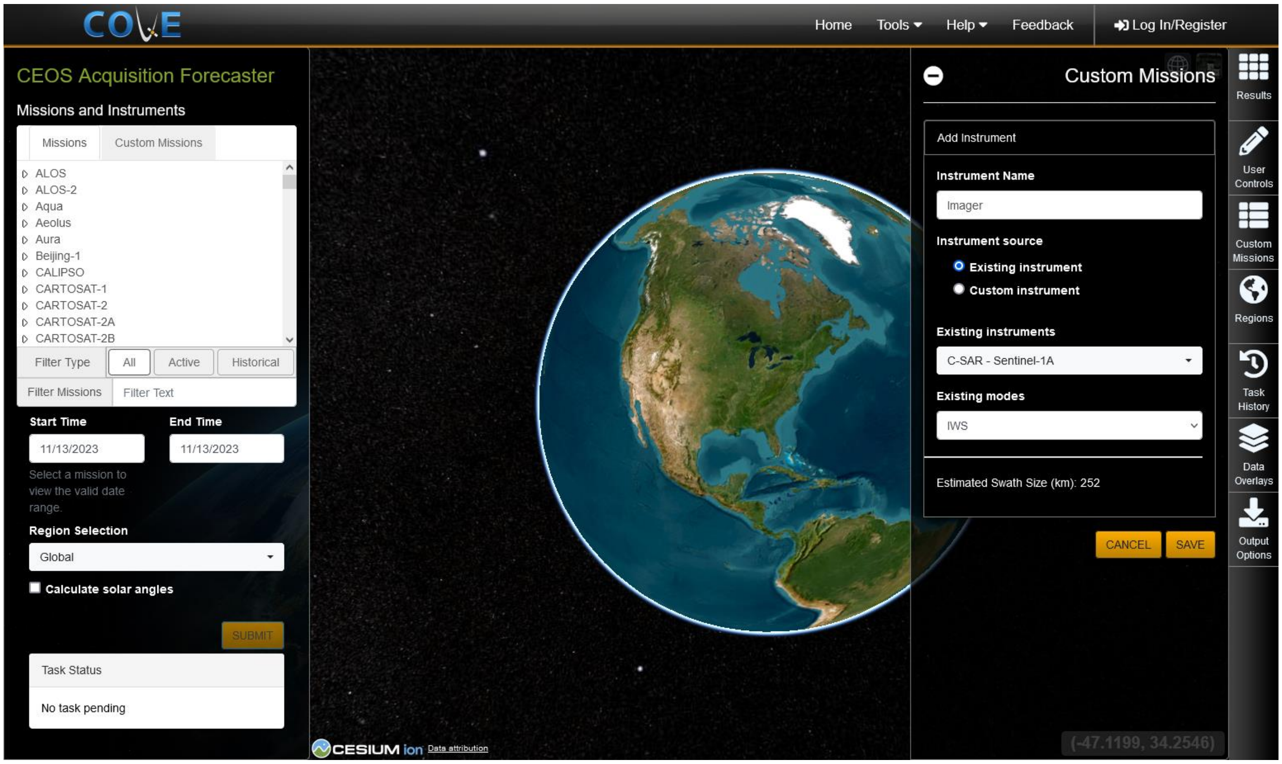


Illustration 26: Add an instrument to a custom mission using parameters from an instrument from an existing mission.

Creating a custom instrument/additional instruments

When this option is selected, users are prompted to specify the field of view and pointing angle of the operating mode and provide the name of the instrument being defined. Users are prompted to provide the field of view and pointing orientation of the instrument.

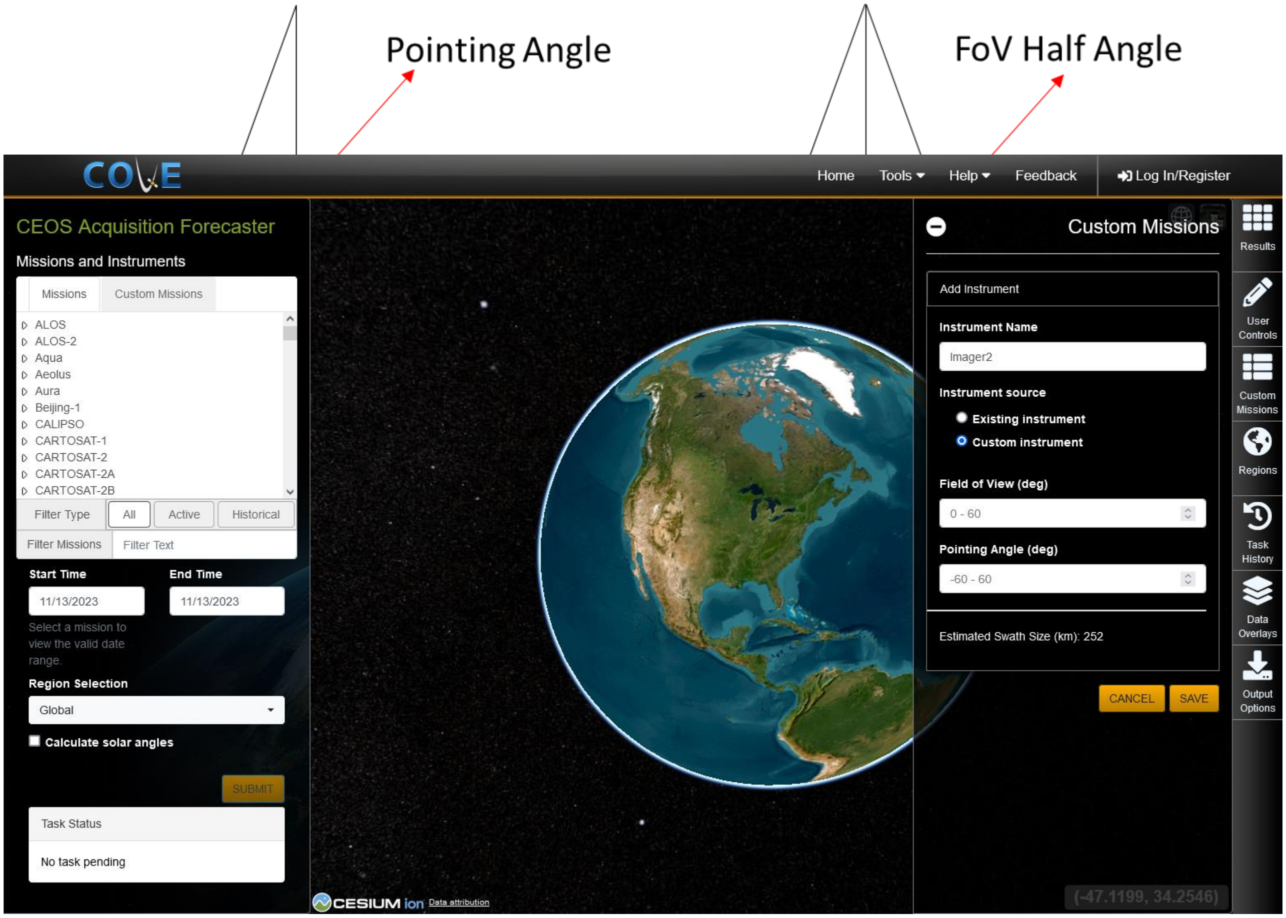


Illustration 27: Add a custom instrument for a custom mission.

The field of view is defined as the angle between the vector connecting the instrument and the center of the ground swath and the vector connecting the instrument and the outer edge of the swath. The field of view is then oriented by the pointing angle which represents the amount of rotation (away from nadir) that has been applied to the instrument boresight. Both the field of view and the pointing angle are specified in degrees. Diagrams are provided below to illustrate how to determine the field of view and pointing angles.

Using user created mission/instrument combinations

Once a mission and instrument combination has been created, it is available for use in COVE in the Acquisition Forecaster, and Revisits Calculator tools. To utilize any of the user defined missions and instruments, users select the Custom Missions tab from the Missions and Instruments panel.

Regions

Users may create and manage user defined regions from the right-side Regions panel in Acquisition Forecaster, Coincident Calculator, Coverage Analyzer, Revisits Calculator, and Data Browser tools. User defined regions should be created/managed while logged into a COVE user account. Once created user regions will appear in the region selection drop down list in the missions and instruments panel on the left side of COVE.

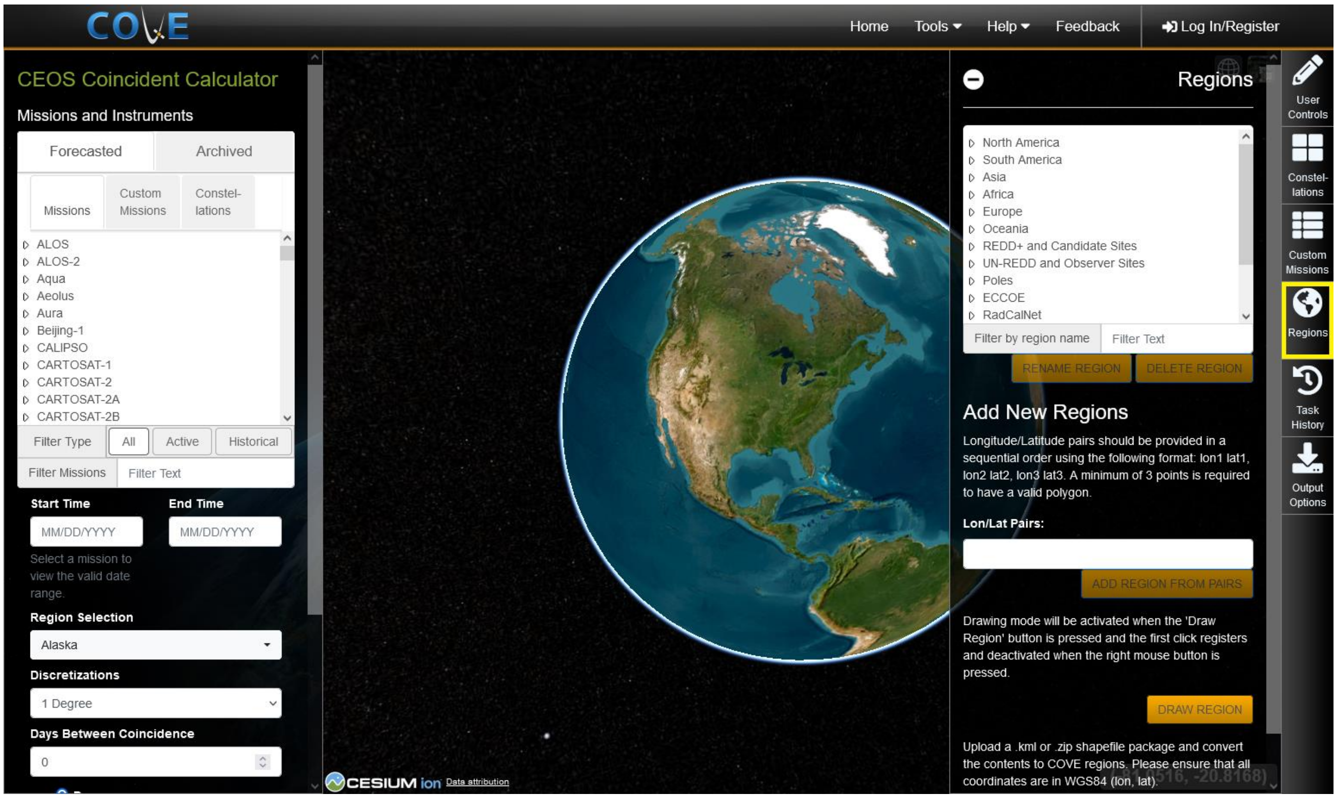


Illustration 29: Regions panel

Viewing regions on the map

Regions and user defined regions may be viewed on the map by selecting a region from the region selection drop down list on in the missions and instruments panel of COVE, or by selecting an option from the regions list in the Regions panel on the right side of COVE. COVE will zoom in on the map to the region selected.

Creating user defined regions

Users may add new regions to COVE from the right-side Regions panel. The custom region will appear under the heading User Regions in the region selection list in the right-side regions panel and in the left-side missions and instruments panel. Regions may be added by:

- Longitude/Latitude pairs – Longitude/Latitude pairs should be provided in a sequential order using the following format: lon1 lat1, lon2 lat2, lon3 lat3. A minimum of 3 points is required to have a valid polygon. Enter the lon/lat pairs in the space provided and click on the “Add Region From Pairs” button to save.
- Draw Region – Drawing mode will be activated when the 'Draw Region' button is pressed. The first click registers and deactivated when the right mouse button is pressed.
- KML – Upload a .kml to convert the contents to COVE regions. Please ensure that all coordinates are in WGS84 (lon, lat). KML may contain multiple regions. The region name is derived from the name tag within placemark and coordinates tags.
- Shapefile – Upload a .zip shapefile package to convert the contents to COVE regions. Please ensure that all coordinates are in WGS84 (lon, lat). Shapefiles must contain shp and dbf files in the root of the ZIP file. Shapefiles may contain multiple regions. The region name is derived from the dbf file from a column from one of the following header lists with precidence from left to right: NAME, COUNTRY, STATE, PROVINCE, CITY, PLACE, or REGION. If no column exists in the dbf file with a header from the list, the region name is derived from the ZIP file name.

Managing user defined regions

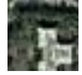
Users may manage user defined regions from the right-side regions panel. Only user defined regions listed under the User Regions heading can be renamed or deleted.

To rename a user defined region, select a user region from the list, and click the “Rename Region” button. A popup will appear asking for a new name for the region. Click the OK button to save the new region name. Click cancel to return to COVE without renaming the region.

To delete a user defined region, select a user region from the list, and click the “Delete Region” button. A popup will appear to confirm deletion of the region selected. Click the Delete button to permanently delete the region. Click cancel to return to COVE without deleting the region.

Basic Map Functionality

The map may be viewed in 2D, 3D or Columbus View. In the upper right corner of the map, users will either see a grid or globe icon. The rectangular grid icon indicates the map is in 2D viewing mode, the globe indicates the map is in 3D viewing mode, and the trapezoid grid icon indicates the map is in Columbus View. The default viewing mode is 3D. Clicking on the icon will reveal both options and allow users the select a viewing mode.



The map camera viewing angle and zoom may be adjusted as follows in 2D, 3D, or Columbus View mode.

- Left click and drag - Pans the camera over the surface of the globe.
- Right click and drag - Zooms the camera in and out.
- Middle wheel scrolling - Also zooms the camera in and out.
- Middle click and drag - Rotates the camera around the point on the surface of the globe.

In 3D mode, users may shift the placement of the globe on the map vertically. To shift the vertical placement, zoom in until the sides of the globe are near or slightly over to the edges of the map. Next, pan up or down while left clicking on the area outside of the globe. Zoom back out as needed.

In 3D mode, users may rotate the globe on the vertical axis. To rotate the globe, zoom in until the sides of the globe are near or slightly over to the edges of the map. Next, pan left or right while left clicking on the area outside of the globe, for counterclockwise or clockwise rotation, respectively. Zoom back out as needed.

If users load a task in 3D mode, and switch to Columbus View mode, the polygon label may appear under the polygon making the label difficult to read. If users load or reload a task in Columbus View mode, the label will appear above the polygon. The polygon label is always displayed above the polygon in 2D and 3D modes.

Globe Imagery

Users may change the basemap overlayed on the globe by choosing from a selection of imagery options. The options include: ESRI World Imagery (default), ESRI World Street Map, ESRI National Geographic, and OpenStreetMap.

Multiselect Menus

Multiselect menus in COVE include the missions, and custom missions lists in the missions and instruments left-side panel, custom missions right-side panel, and regions right-side panel in Acquisition Forecaster, Coincident Calculator, Coverage Analyzer, Revisits Calculator, and Data Browser tools.

Multiselect menus in COVE are collapsible lists. Collapsed sections are identified by a right pointing triangle. Clicking on a section header will open or close the section. The section header will be mission, custom mission, or region name. Open sections are identified by a downward pointing triangle. Closing a section will deselect all items selected in the section.

In the missions and instruments lists in Acquisition Forecaster, Revisits Calculator, Coincident Calculator for forecasted missions, and Add Constellation panel in the right-side menu of Coincident Calculator for forecasted missions, users may select a filter type. Filter types are All, Active, and Historical. Filter type All includes both active and historical missions. Filter type Active includes missions which have current TLE data. Filter type Historical includes missions which do not have current TLE data. Current TLE data is defined as missions with new TLE data imported within the last three months in COVE.

Filter text may be entered in the filter missions search bar in missions and instruments lists in the left-side panel, in regions list in the regions right-side panel, and in missions list in the add constellations panel in the right-side menu of Coincident Calculator. Filter text is used to search missions, instruments, and modes, or regions. If searching missions lists, the filter is applied to short names and long names of missions, instruments, and modes. For example, it will search against both alos-2 and advanced land observing satellite 2. If filter text is entered, all matching sections will open and the section header will not be collapsible. Filter missions and filter type may be combined to narrow mission search results.

There are three selection modes available for selecting items in a multiselect menu: single selection, control, and shift mode. Only one mode can be activated at a time. The modes function like a toggle switch. Users should not hold ctrl-key or shift-key down while selecting items. Items in the list are selected using the left mouse button.

- Single selection – Select /deselect only one item in a list. Single selection is a default mode when control and shift are deactivated. If multiple items are selected, clicking on a selected item will clear all selections in the list, and clicking on a deselected item will clear all other selections in the list.
- Control – Select/deselect multiple items in list one at a time. Activated/deactivated control mode with the ctrl-key.
- Shift – Select multiple adjacent items in a section in a list. Activated/deactivated shift mode with the shift-key. If no items in a section are selected, the first selection will only select a single item. The next selection will select everything between the last selection. Clicking on a selected item will deselect the one item. With items selected, clicking on an deselected item in the section will select the single item and deselect all other items in the section.

Selection modes are set from the scope of the tool, not the individual multiselect menus. For example, if the user turns on control mode while working in the missions and instruments panel, selection mode will also be set to control in the regions, and custom missions panels.

However, if the user launches Revisits Calculator and subsequently launches Acquisition Forecaster, the selection mode will revert to single selection mode.

In Acquisition Forecaster and Revisits Calculator, users should use the control selection mode to choose instruments/instrument modes from both missions and custom missions list. Shift selection mode will not allow users to select items in both tabs since shift mode is designed to select groups of items within the same section of a list. However, if users only wish to select from items in one of the tabs, any selection mode may be used. Clicking on a missions or custom missions tab in the missions and instruments panel will close all sections except for sections with selected items, and it will scroll to the first section in the list with a selected item. The multiselect functionality allows users to easily initiate a task with both missions and custom missions.

User Accounts

Users may register to create a COVE user account. To register for an account, click on the “Log In/Register” link on the title menu bar. Next click on the “Don’t have an account? Register here.” link at the bottom. Registering for an account only requires a username, password, and email address. Once these parameters are entered, click the “Register and Log In” button.

While logged into a COVE user account, COVE maintains a task history for the user, which may allow results of tasks to be reloaded in the future. User accounts are also recommended for creating, maintaining, and submitting tasks with user regions and custom missions. To log into a COVE user account, click on the “Log In/Register” link on the title menu bar. While a user is logged into an account, the title menu bar will show “Logged in as:” username next to a “Log out” link.

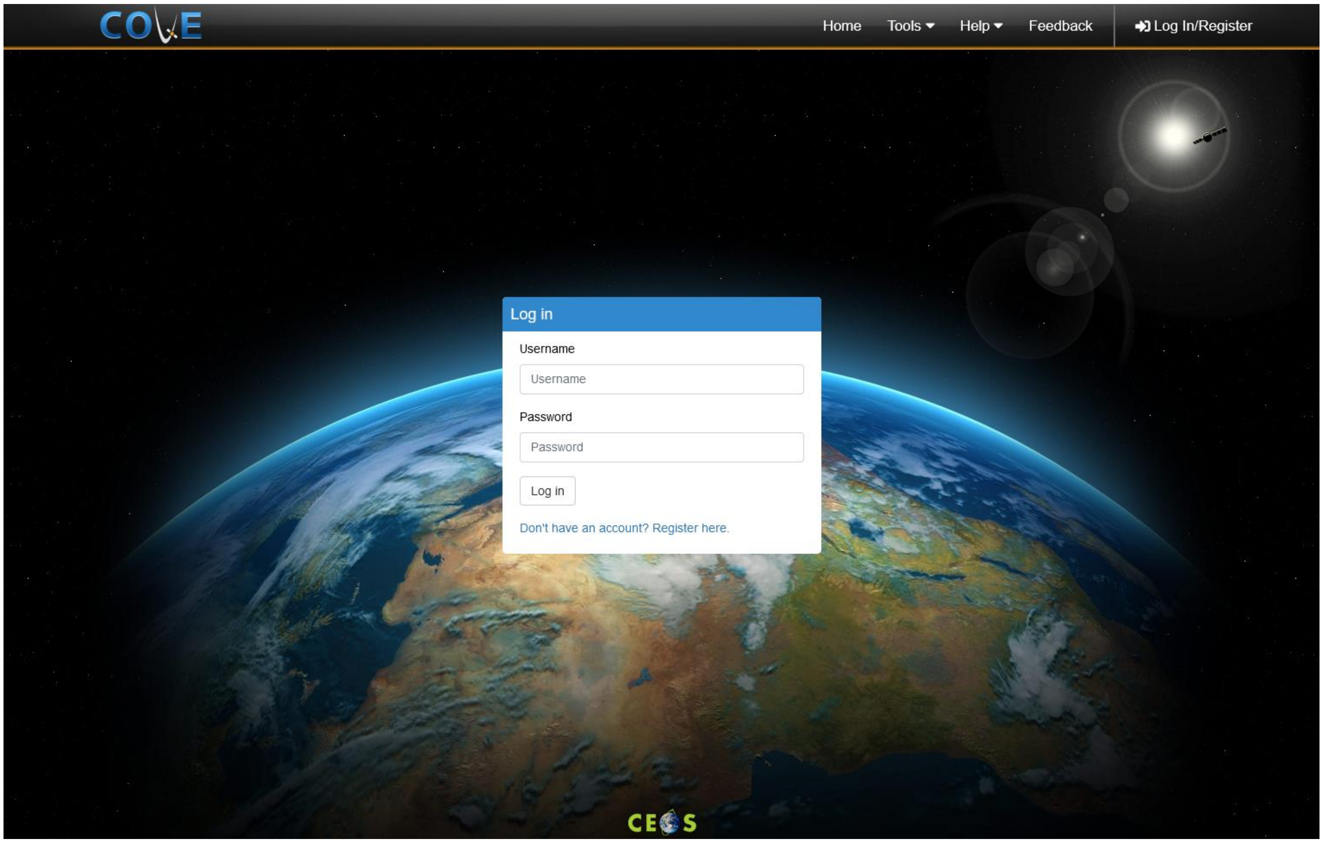


Illustration 30: Log into a COVE user account

Feedback

On occasion, users may need to contact the COVE development team when questions or problems with the various tools arise. Users may also submit a request to add a mission/instrument combination to the COVE database. The feedback link is located on the title menu bar.

Contact form submissions require users to enter a name (first and last), email address, and a description of the request. Also, enter the captcha string and click the Submit button to send the request. A copy of the request will be emailed to the user, and the COVE development team. The team will evaluate and respond to the request as soon as possible.

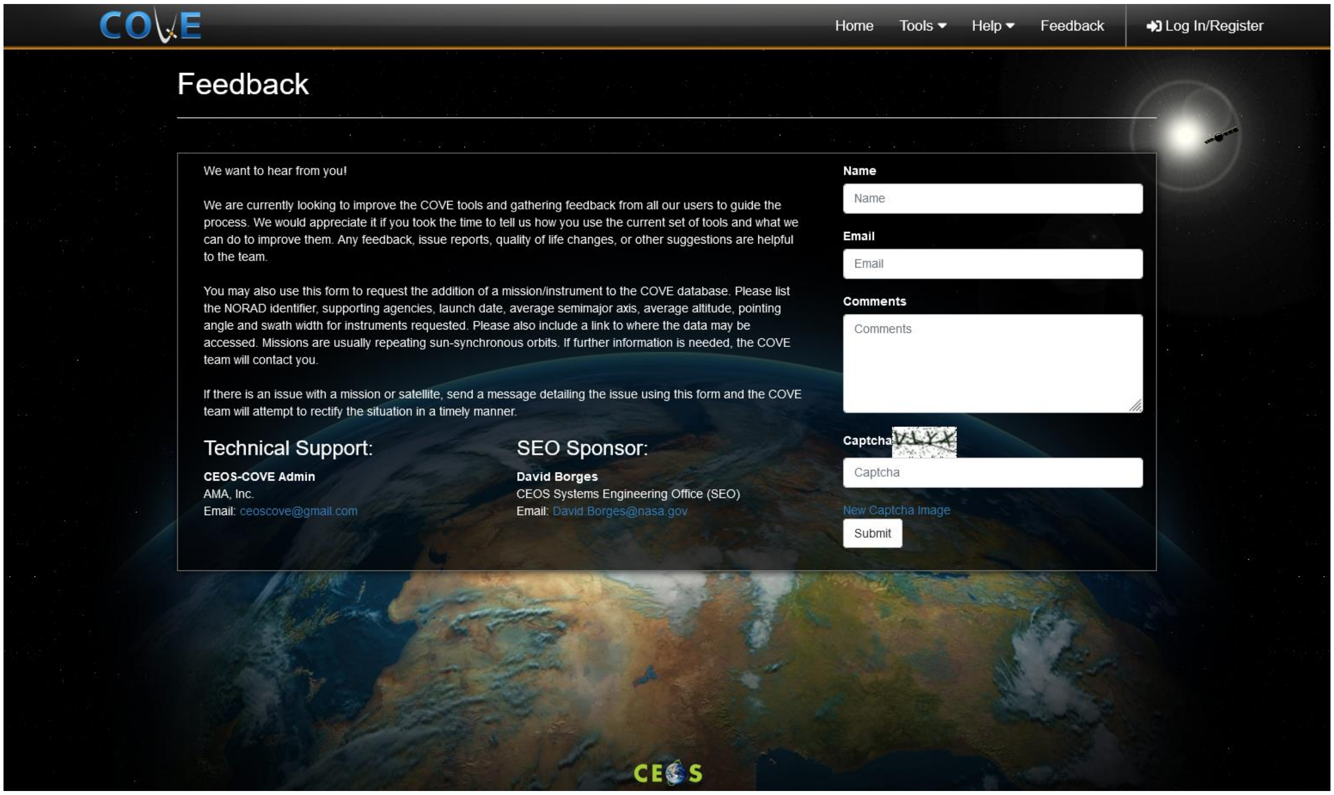


Illustration 31: Feedback