



# Orbit Prediction Using AGI STK

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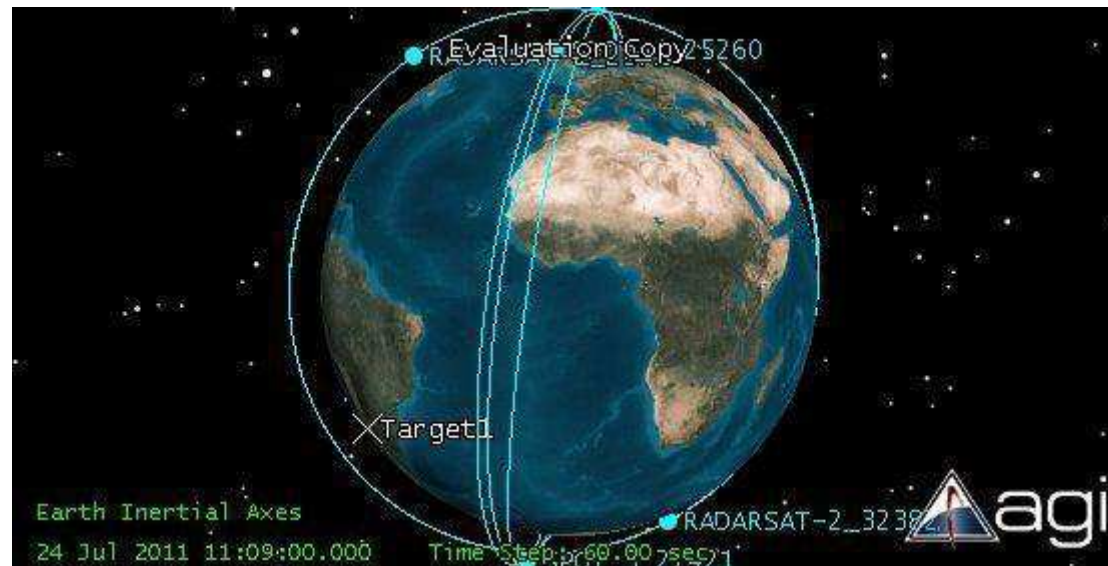
# Overview of Talk

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- The Problem
- The Solution
- Demonstration of Using the Software
- Conclusions

## THE PROBLEM

- Satellites are on a fixed orbit
- Can only image when overhead
- How do you know when the satellites are overhead?



# THE SOLUTION

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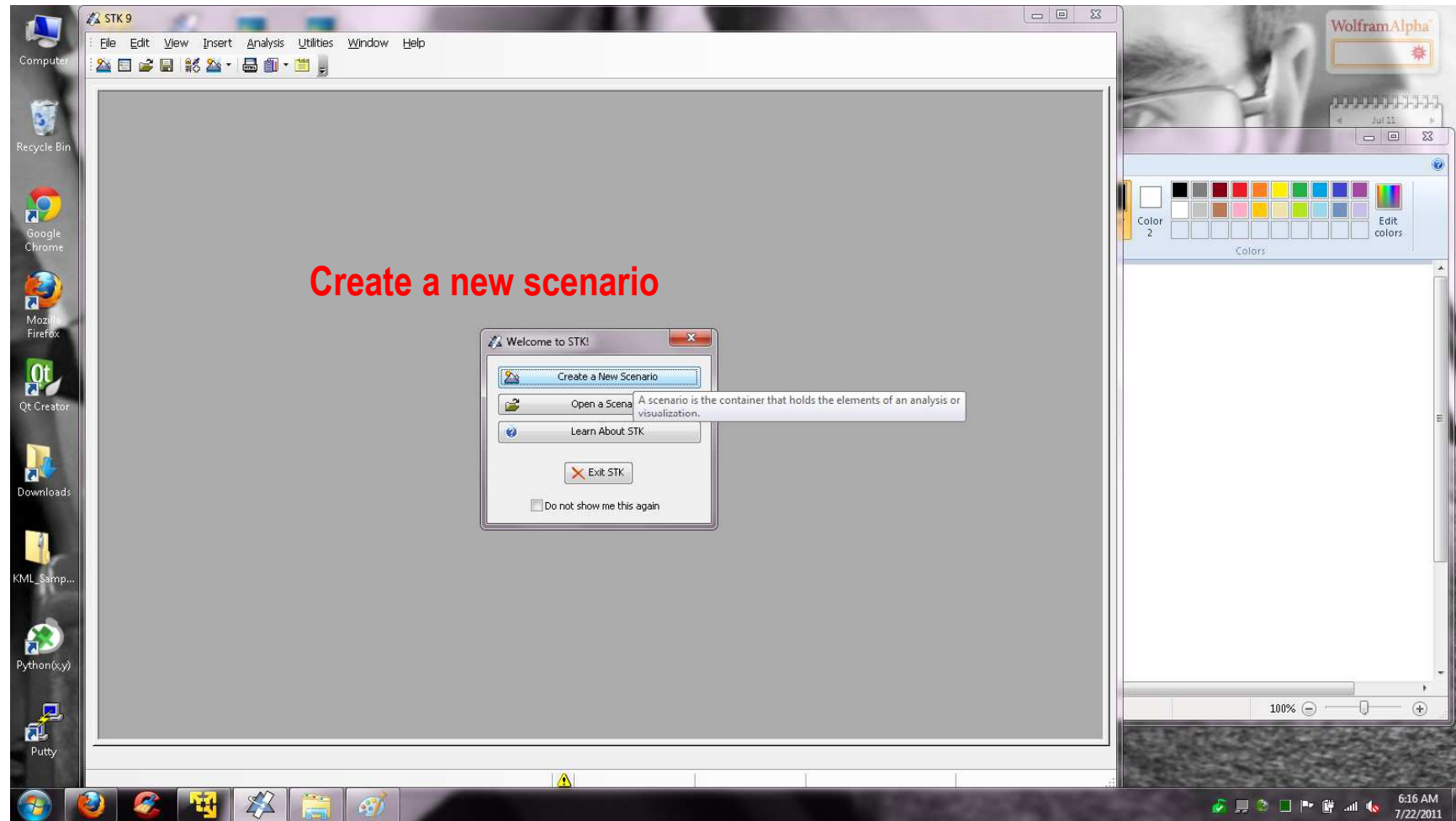
- AGI STK
  - <http://www.agi.com/>
- STK is a system modeling and mission analysis application for space, defense and intelligence engineers and analysts. Use STK to model complex systems (aircraft, satellites, ground vehicles), along with their sensors and communications, in the context of the mission environment.
  - High-fidelity spatial mechanics engine
  - Fully documented API
  - Detailed model and simulation creation
  - Customizable report and graph styles

# THE SOFTWARE

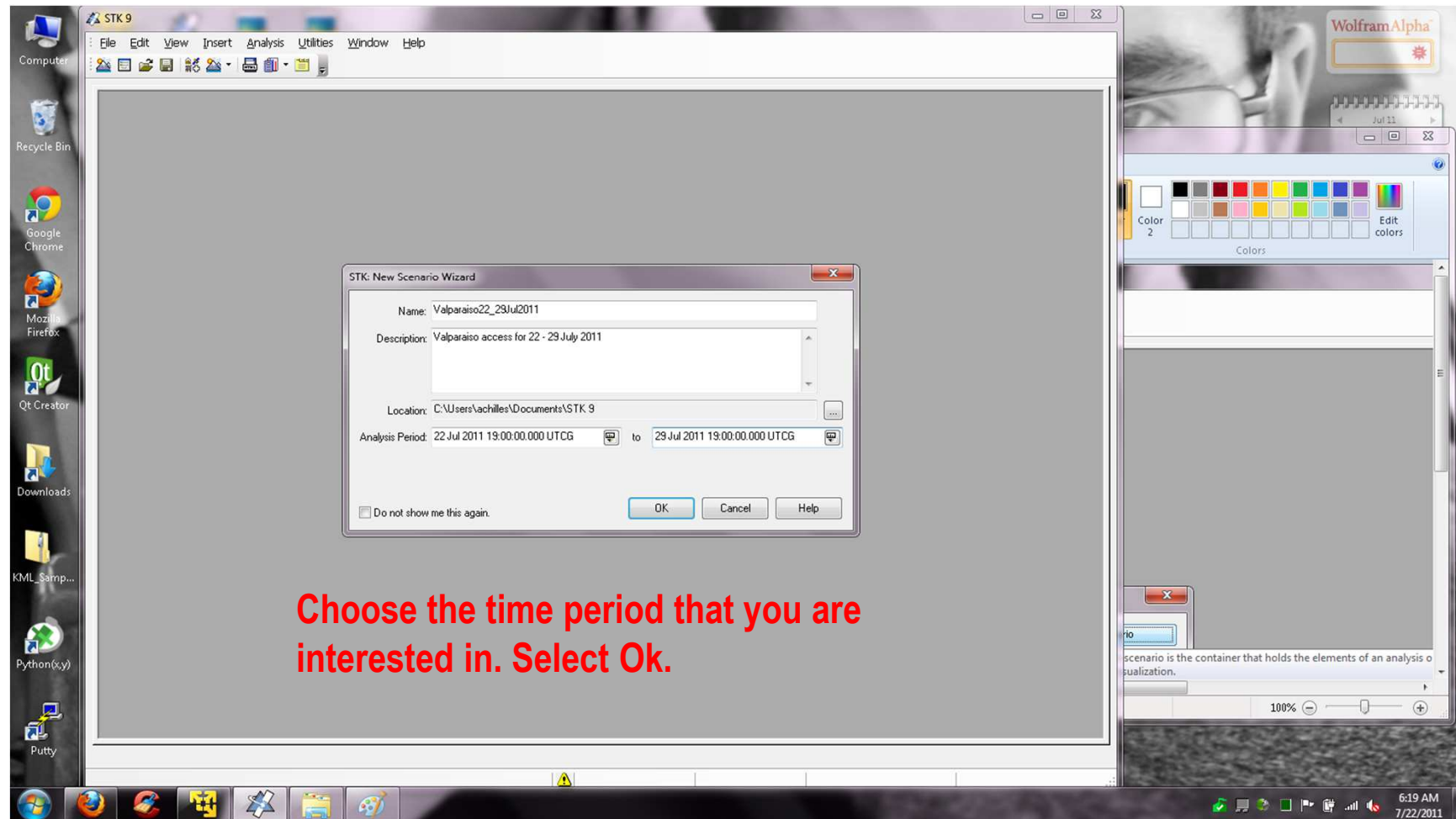
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- There are FREE and paid versions of the software
- For basic satellite access time planning, the free version is sufficient
  - License doesn't expire
  - Compute satellite access to targets with constraints on time and lighting
  - Generate graphical and textual reports
- Does not have all of the functionality of the edition that costs money
  - Area targets
  - Many more features...

# HOW TO COMPUTE ACCESS TIMES USING AGI STK

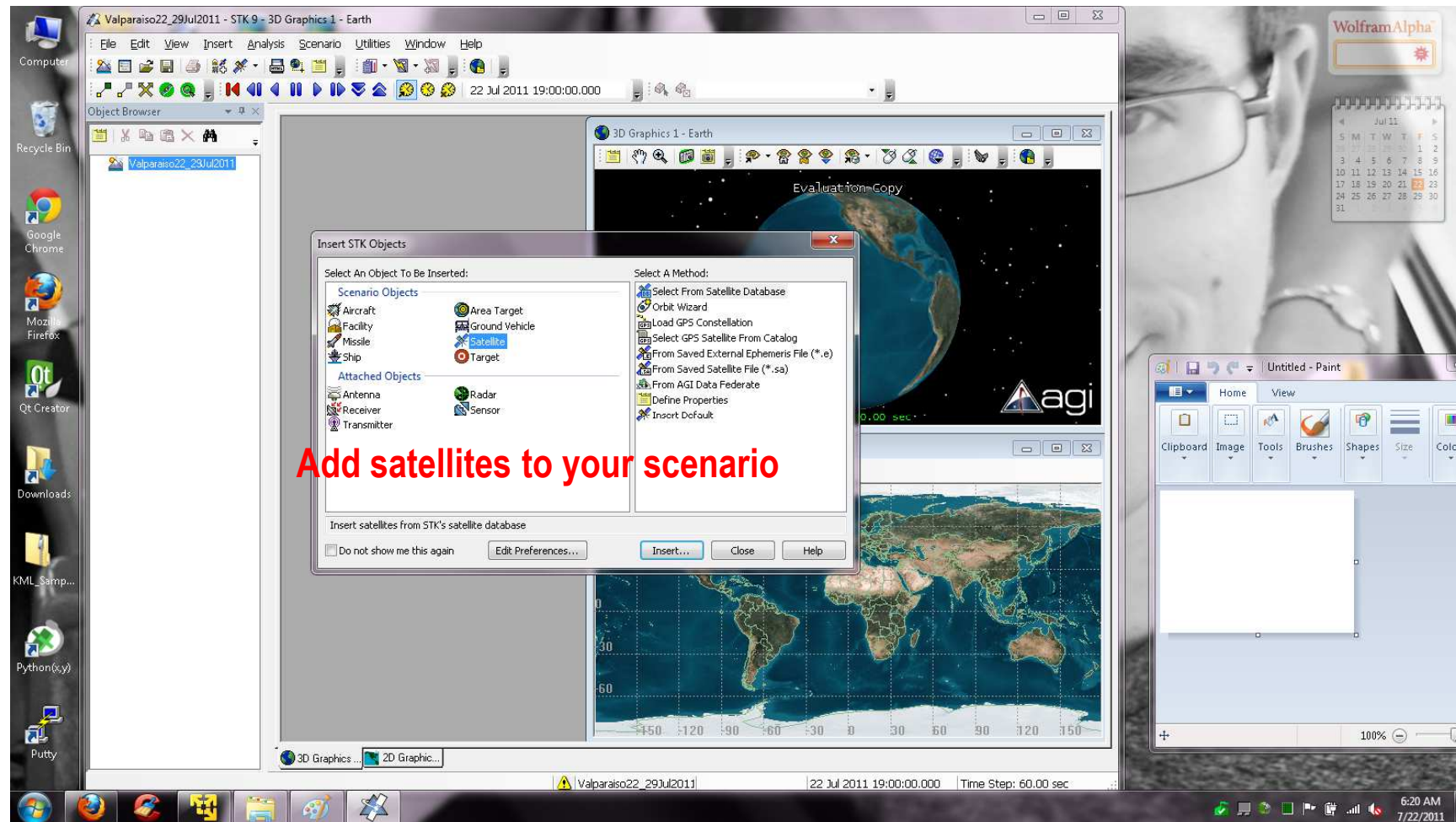


# HOW TO COMPUTE ACCESS TIMES USING AGI STK

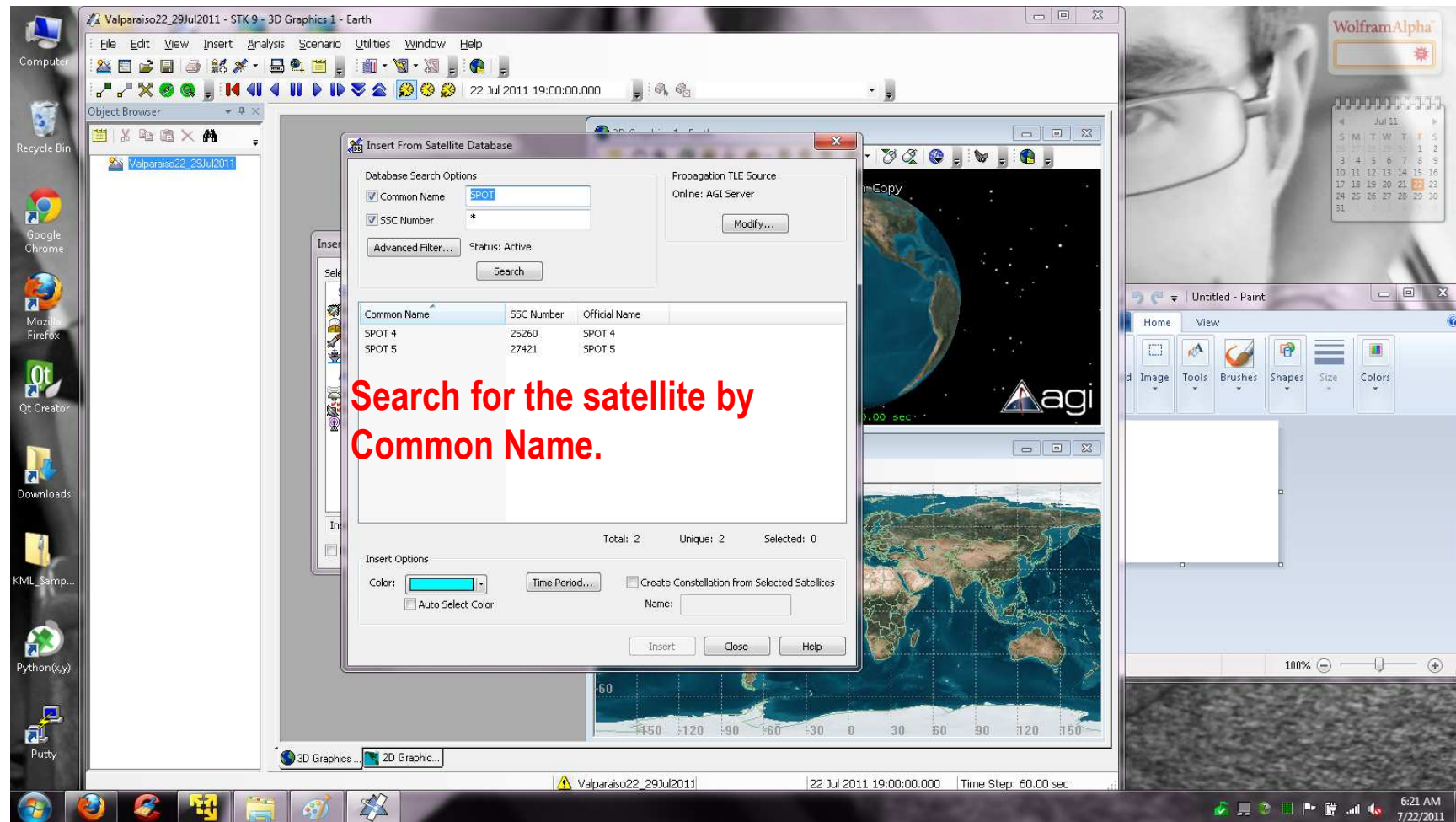




# HOW TO COMPUTE ACCESS TIMES USING AGI STK



# HOW TO COMPUTE ACCESS TIMES USING AGI STK



# HOW TO COMPUTE ACCESS TIMES USING AGI STK

**Select the satellites and choose Insert**

Common Name	SSC Number	Official Name
RADARSAT-1	23710	RADARSAT-1
RADARSAT-2	32362	RADARSAT-2

Total: 2 Unique: 2 Selected: 2

Insert Options:  
 Color: [Blue] Time Period: [ ] Create Constellation from Selected Satellites: [ ]  
 Auto Select Color: [ ] Name: [ ]

Buttons: Insert, Close, Help



# HOW TO COMPUTE ACCESS TIMES USING AGI STK

**You can add multiple satellites to the same scenario**

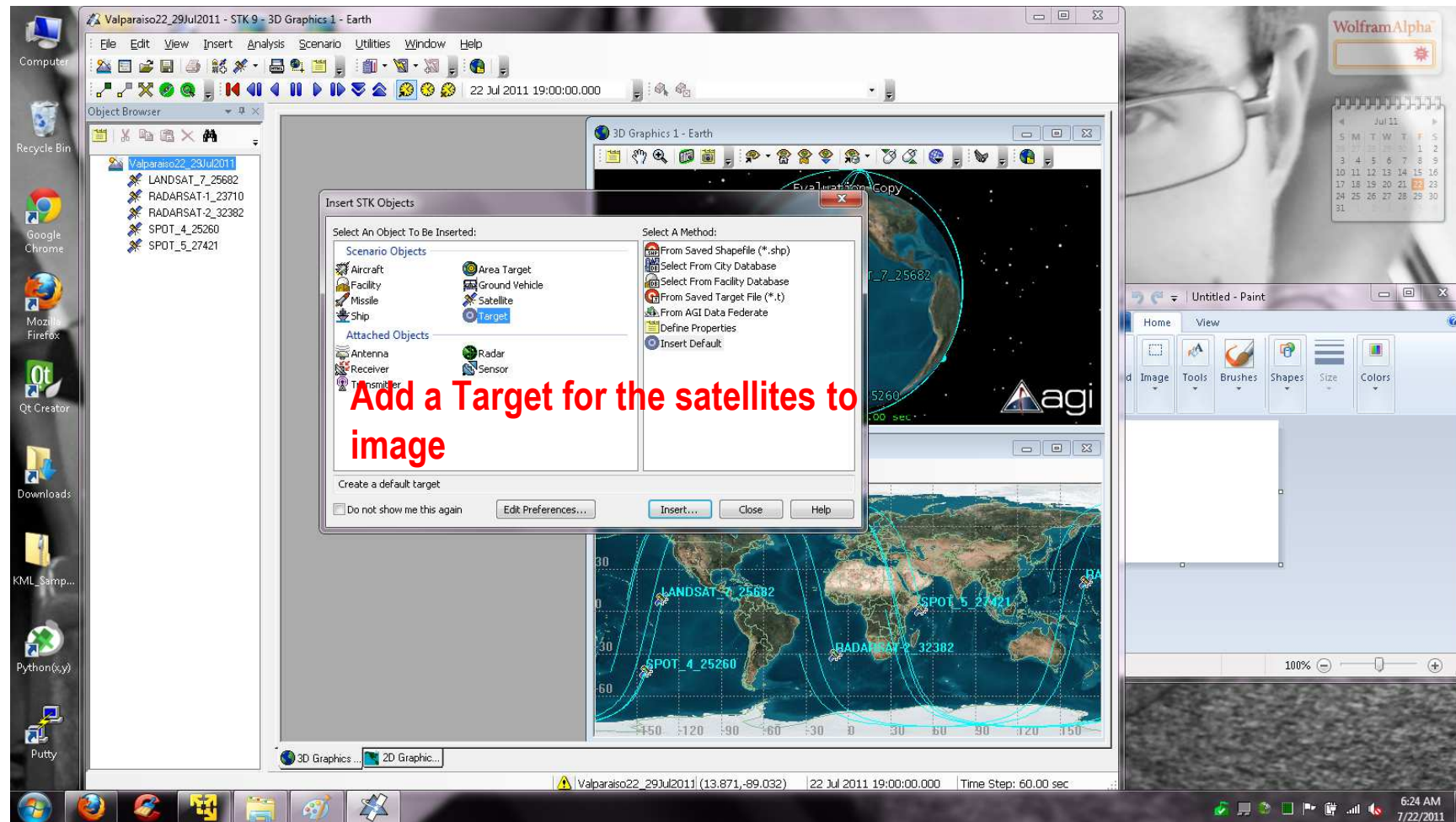
Common Name	SSC Number	Official Name
LANDSAT 5	14780	LANDSAT 5
LANDSAT 7	25682	LANDSAT 7

Total: 2 Unique: 2 Selected: 1

Insert Options:  
 Color: [Blue] Time Period: [ ] Create Constellation from Selected Satellites: [ ]  
 Auto Select Color: [ ] Name: [ ]

Buttons: Insert, Close, Help

# HOW TO COMPUTE ACCESS TIMES USING AGI STK

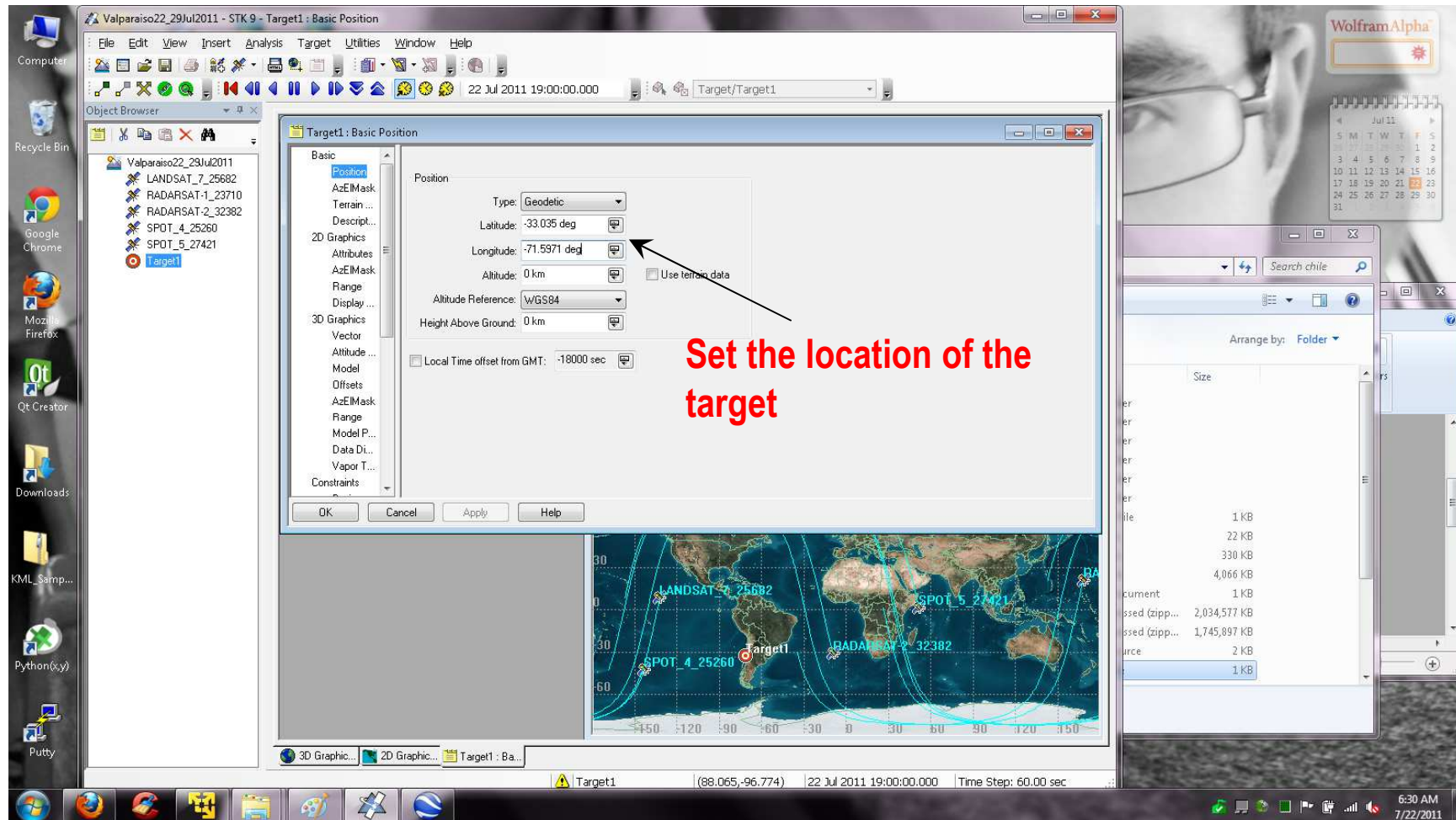




# HOW TO COMPUTE ACCESS TIMES USING AGI STK

The screenshot displays the AGI STK (Systems Tool Kit) software interface. The main window is titled "Valparaiso22\_29Jul2011 - STK 9 - Object Browser". It features a 3D Graphics window showing a satellite's path around Earth, with labels for "RADARSAT-1\_23710", "LANDSAT\_7\_25682", and "SPOT\_4\_25260". A 2D Graphics window below it shows a map of the Pacific Ocean with the same satellite paths. The Object Browser on the left lists the satellites. A context menu is open over the Object Browser, showing options like "Zoom To", "Access...", "Deck Access...", "Coverage...", "Vector Geometry Tool", "Quick Report Manager...", "Report & Graph Manager...", "Target", "Cut", "Copy", "Paste", "Delete", "Hide Toolbar", and "Open the property pages for the selected object or window." A red text overlay reads: "Edit the properties of the target to set its location and constraints". To the right of the STK window, there is a "WolframAlpha" search bar, a calendar for July 2011, and a "Paint" window showing a satellite image. The system tray at the bottom right shows the date and time: "6:24 AM 7/22/2011".

# HOW TO COMPUTE ACCESS TIMES USING AGI STK





# HOW TO COMPUTE ACCESS TIMES USING AGI STK

**Set an elevation angle constraint.**  
Setting these values to Min=60  
and Max=90 will constrain the  
satellite to look at the target  $\leq$   
30 degrees off nadir



# HOW TO COMPUTE ACCESS TIMES USING AGI STK

The screenshot displays the AGI STK (Systems Tool Kit) software interface. The main window is titled "Valparaiso22\_29Jul2011 - STK 9 - Target1: Constraints Sun". The left sidebar shows a list of objects including "Valparaiso22\_29Jul2011", "LANDSAT\_7\_25682", "RADARSAT-1\_23710", "RADARSAT-2\_32382", "SPOT\_4\_25260", "SPOT\_5\_27421", and "Target1". The central panel shows the "Target1: Constraints Sun" configuration window. In this window, the "Lighting" checkbox is checked, and the "Direct Sun" option is selected in the "Additional Central Body Obstruction" dropdown menu. The right sidebar shows a 3D Earth model with satellite tracks for "LANDSAT\_7\_25682", "SPOT\_4\_25260", "RADARSAT-2\_32382", and "SPOT\_5\_27421". A red arrow points from the text overlay to the "Direct Sun" dropdown menu.

**For EO satellites you should set a sun constraint so that you will only compute access when there is light**

# HOW TO COMPUTE ACCESS TIMES USING AGI STK

The screenshot displays the AGI STK (Systems Tool Kit) software interface. The main window shows a 3D Earth model with satellite orbits for RADARSAT-1, LANDSAT-7, and SPOT-4. A menu is open, highlighting the 'Update SGP4/GPS Satellites...' option. A red text overlay states: 'You should periodically update the files that AGI STK uses to compute the orbits. If you haven't done so in over a month, you should update'. The interface also shows a 2D Graphics window with a map view of the same satellite orbits. Other windows visible include 'Object Browser', 'Constraints', and a 'Paint' application.

**You should periodically update the files that AGI STK uses to compute the orbits. If you haven't done so in over a month, you should update**



# HOW TO COMPUTE ACCESS TIMES USING AGI STK

The screenshot displays the AGI STK (Systems Tool Kit) software interface. The main window shows a 3D Earth model with satellite orbits. A dialog box titled "Update SGP4/GPS Satellites" is open, allowing the user to select satellites for updating. The dialog includes a table of satellites and an "Update" button.

**Update SGP4/GPS Satellites**

ID	Name /	Update Mode	Propagator
25682	LANDSAT_7_25682	AGI Server	SGP4
23710	RADARSAT-1_23710	AGI Server	SGP4
32382	RADARSAT-2_32382	AGI Server	SGP4
25260	SPOT_4_25260	AGI Server	SGP4
27421	SPOT_5_27421	AGI Server	SGP4

Buttons: Update, Close, Help

**Choose the satellites and select update.**

# HOW TO COMPUTE ACCESS TIMES USING AGI STK

The screenshot displays the AGI STK (Systems Tool Kit) software interface. The main window is titled 'Valparaíso22\_29Jul2011 - STK 9 - Object Browser'. It features a menu bar (File, Edit, View, Insert, Analysis, Target, Utilities, Window, Help) and a toolbar. The 'Object Browser' panel on the left lists several satellite objects: LANDSAT\_7\_25682, RADARSAT-1\_23710, RADARSAT-2\_32382, SPOT\_4\_25260, and SPOT\_5\_27421. A context menu is open over the 'Target' object, with the 'Access...' option highlighted. The main 3D Graphics window shows a 3D view of Earth with satellite orbits and a target point labeled 'Target1'. The 2D Graphics window below it shows a 2D map view of the same data. A red text overlay reads: 'To compute the access to the target we've created, C]choose the target and select Access.' On the right side of the screenshot, there is a 'WolframAlpha' search bar, a calendar for July 2011, and a file explorer window showing a list of files with their sizes.



# HOW TO COMPUTE ACCESS TIMES USING AGI STK

The screenshot shows the AGI STK software interface. The 'Access' dialog box is open, displaying a list of associated objects: LANDSAT\_7\_25682, RADARSAT-1\_23710, RADARSAT-2\_32382, SPOT\_4\_25260, and SPOT\_5\_27421. The 'Compute' button is highlighted with a red arrow and text overlay. The background shows a 3D Earth model with satellite orbits and a 2D map view. Other windows visible include 'Object Browser', 'WolframAlpha', 'Paint', and 'Object Browser'.

**Select all of the satellites that you're interested in and click "Compute"**

# HOW TO COMPUTE ACCESS TIMES USING AGI STK

**To View a graphical report click  
Access under Graphs**

**To view a textual report click  
Access under Reports**



# HOW TO COMPUTE ACCESS TIMES USING AGI STK

The screenshot displays the AGI STK software interface. The main window shows a report titled "Report: Access - Access". The report details access times for a target (Target1) to three satellites: LANDSAT\_7\_25682, RADARSAT-1\_23710, and RADARSAT-2\_32382. The report includes a table of access events with columns for Access number, Start Time (UTC), Stop Time (UTC), and Duration (sec). Global statistics are also provided, including Min Duration, Max Duration, Mean Duration, and Total Duration. The report concludes with "No Access Found" for RADARSAT-1\_23710 and RADARSAT-2\_32382.

**Target-Target1-To-Satellite-LANDSAT\_7\_25682, Satellite-RADARSAT-1\_23710, Satellite-RADARSAT-2\_32382**

**Target1-To-LANDSAT\_7\_25682**

Access	Start Time (UTC)	Stop Time (UTC)	Duration (sec)
1	25 Jul 2011 14:45:09.988	25 Jul 2011 14:45:50.198	40.210
2	27 Jul 2011 14:32:23.705	27 Jul 2011 14:34:09.753	106.048
3	29 Jul 2011 14:20:22.043	29 Jul 2011 14:21:46.843	84.800

**Global Statistics**

Statistic	Access	Start Time (UTC)	Stop Time (UTC)	Duration (sec)
Min Duration	1	25 Jul 2011 14:45:09.988	25 Jul 2011 14:45:50.198	40.210
Max Duration	2	27 Jul 2011 14:32:23.705	27 Jul 2011 14:34:09.753	106.048
Mean Duration				77.019
Total Duration				231.058

**Target1-To-RADARSAT-1\_23710**

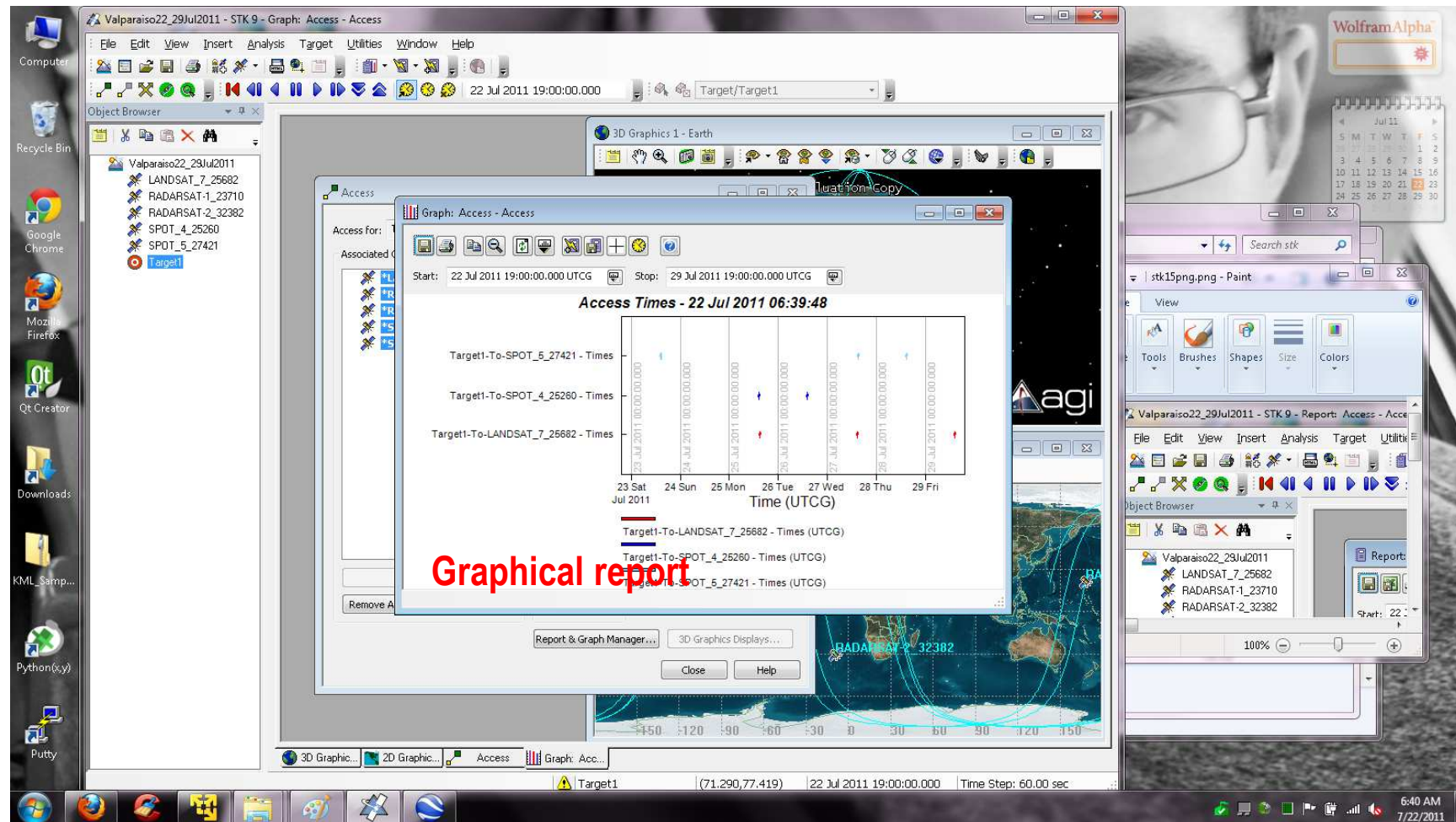
No Access Found

**Target1-To-RADARSAT-2\_32382**

No Access Found

**Textual report**

# HOW TO COMPUTE ACCESS TIMES USING AGI STK

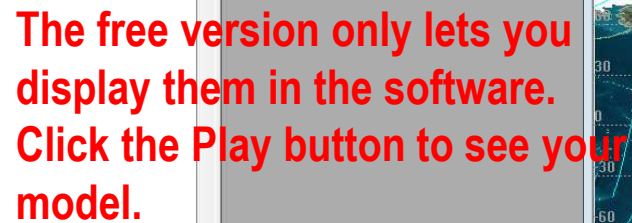




# HOW TO COMPUTE ACCESS TIMES USING AGI STK

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- If you are using a radar satellite such as RadarSat1 or RadarSat2, you can safely remove the daylight constraint. The sunlight will not effect your ability to obtain an image.



## CONCLUSION

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- AGI STK allows a researcher to plan experiments with precise knowledge of the satellites positions
- There is a free version of the software
- The free version is sufficient for many users