



Orbit Prediction Using AGI STK

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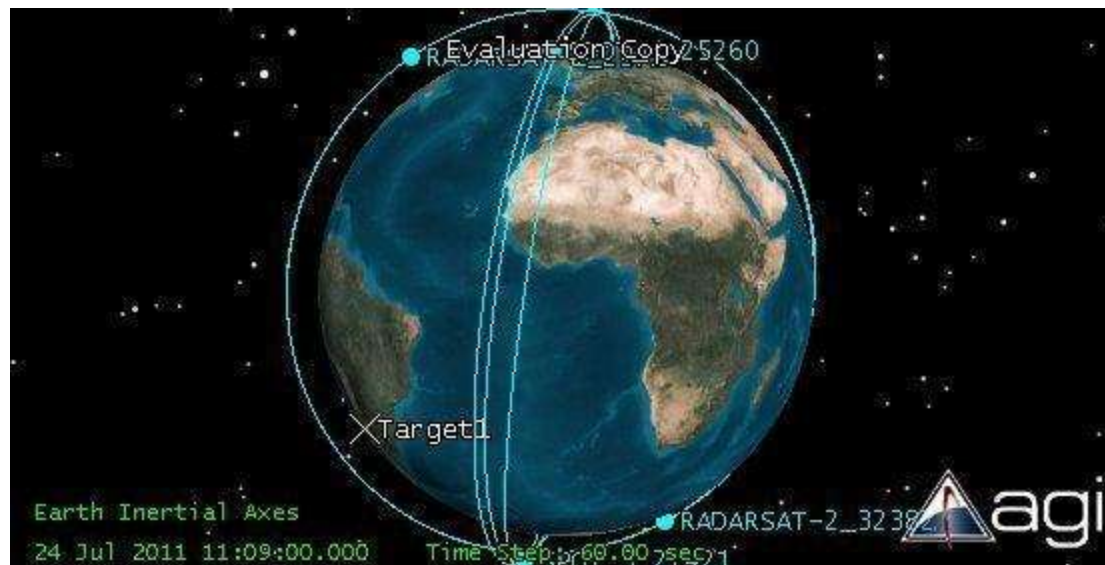
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Overview of Talk

- 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?



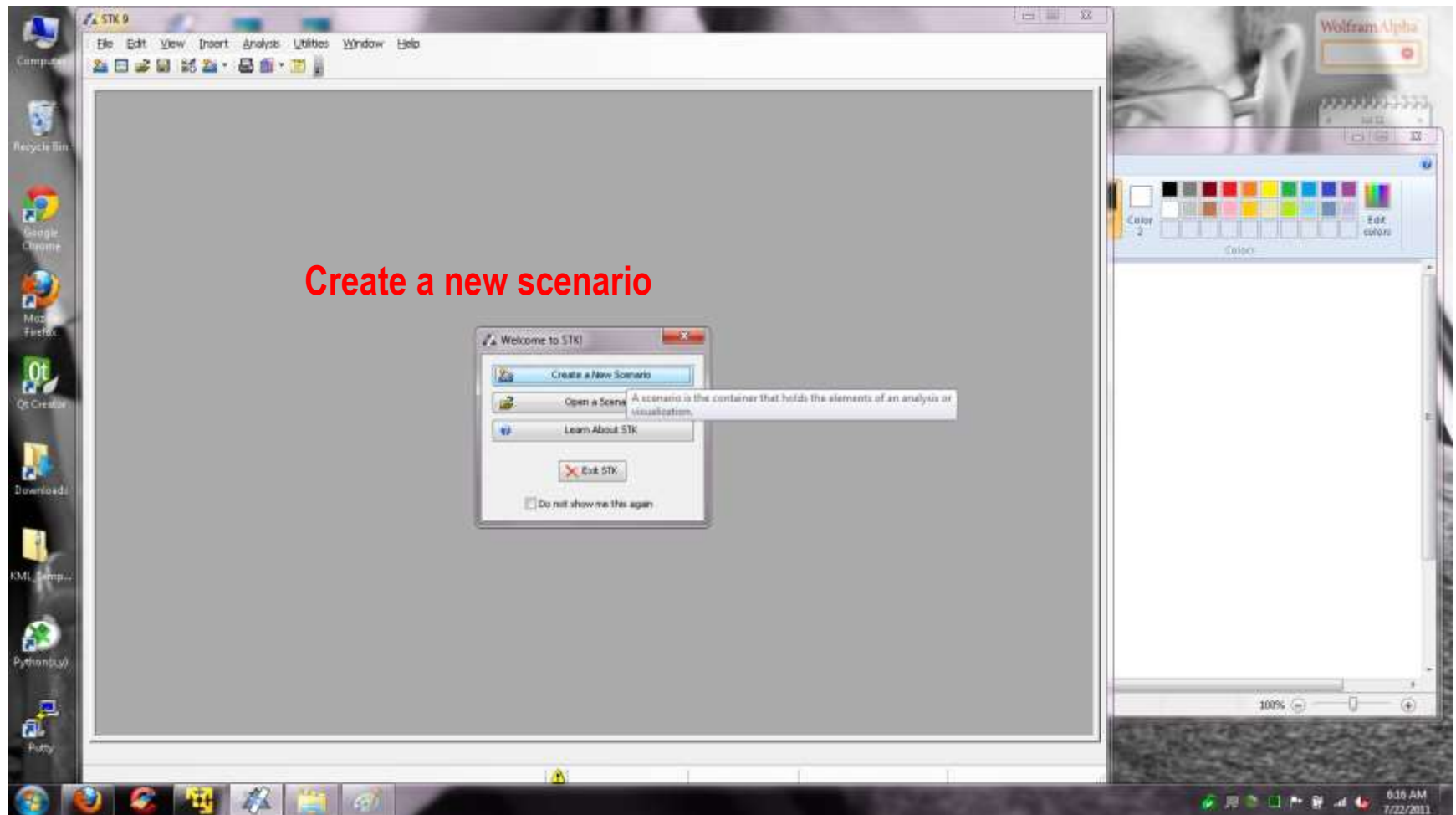
THE SOLUTION

- 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

- 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...

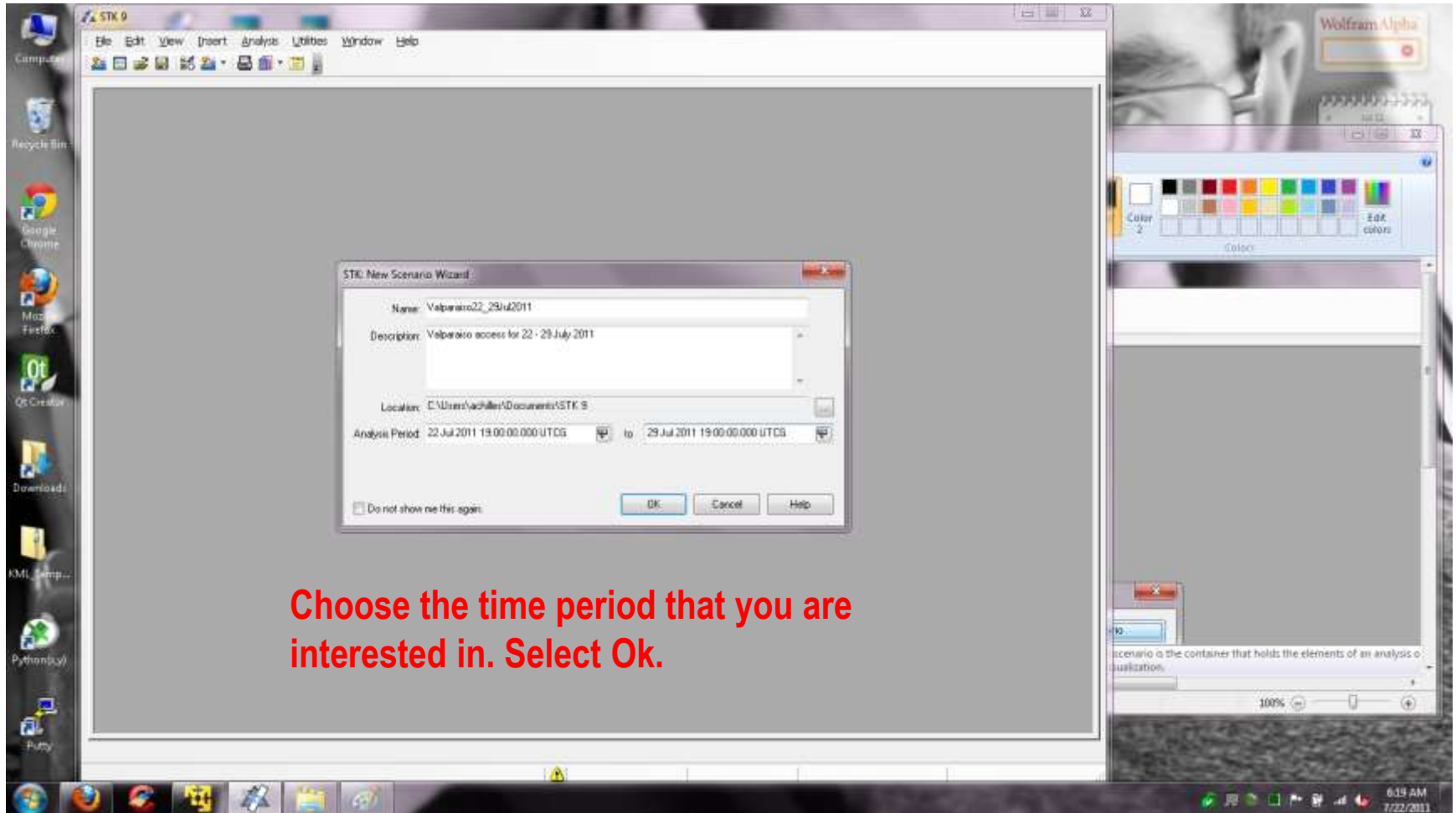
HOW TO COMPUTE ACCESS TIMES USING AGI STK



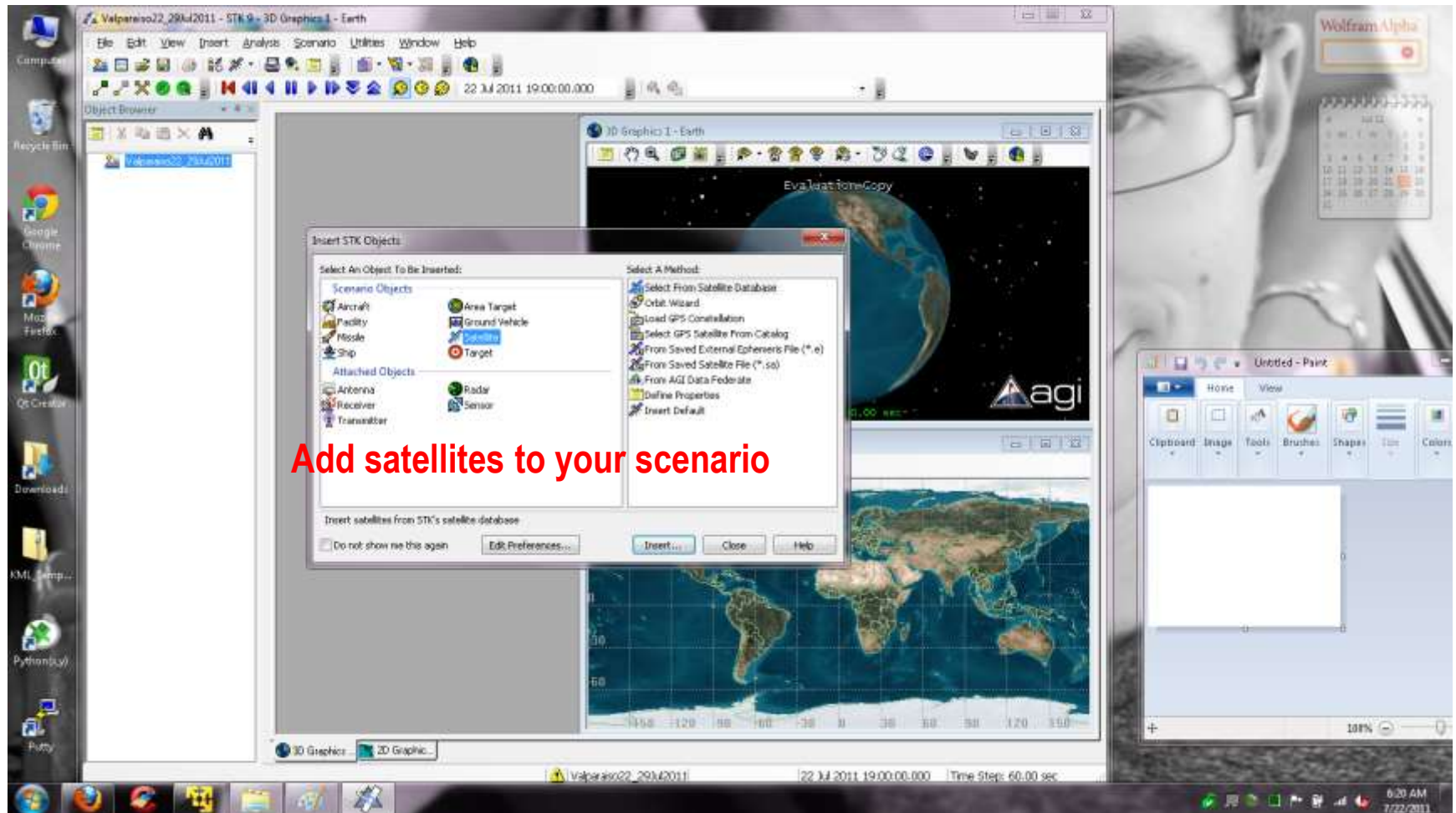
Create a new scenario



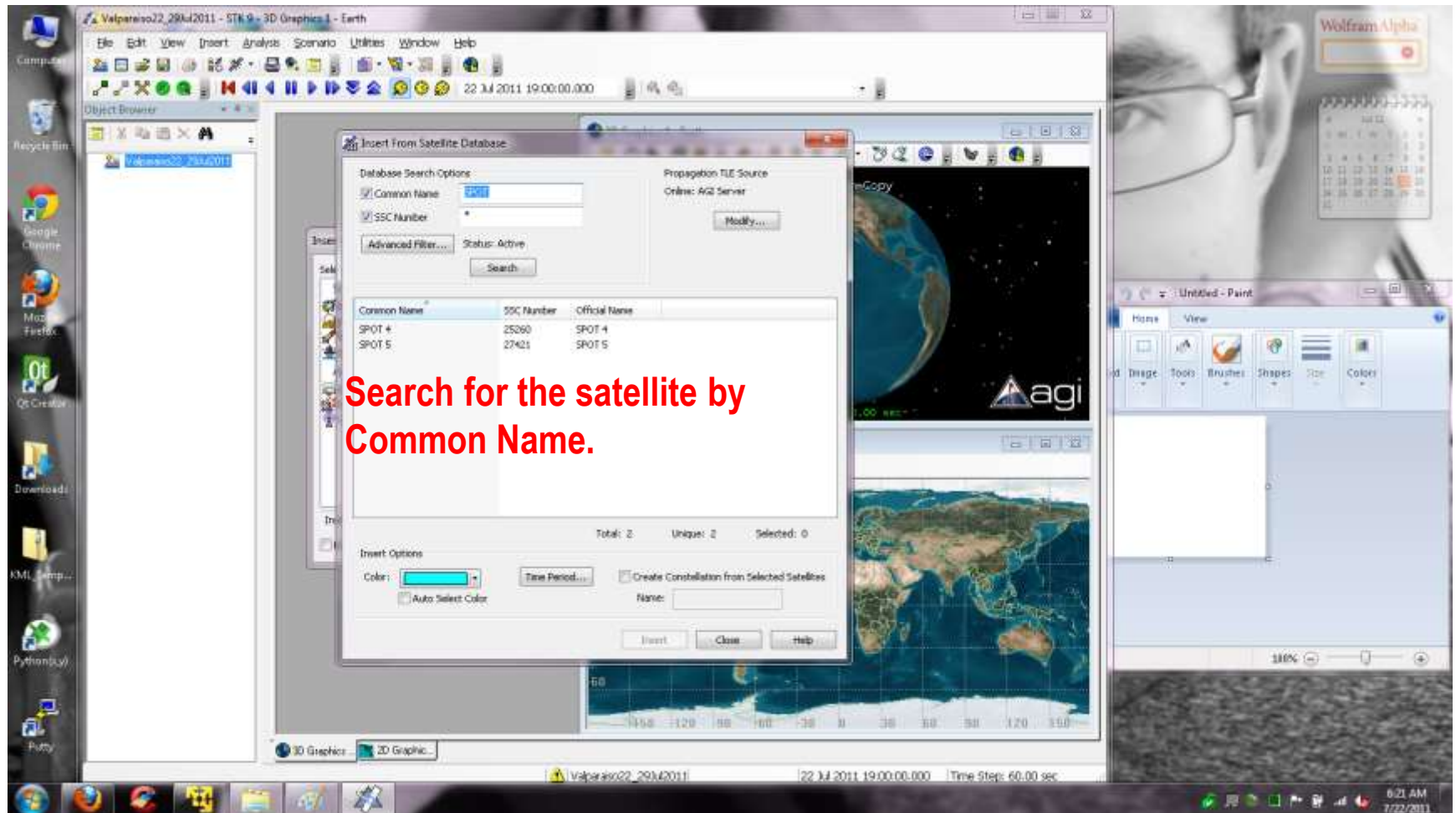
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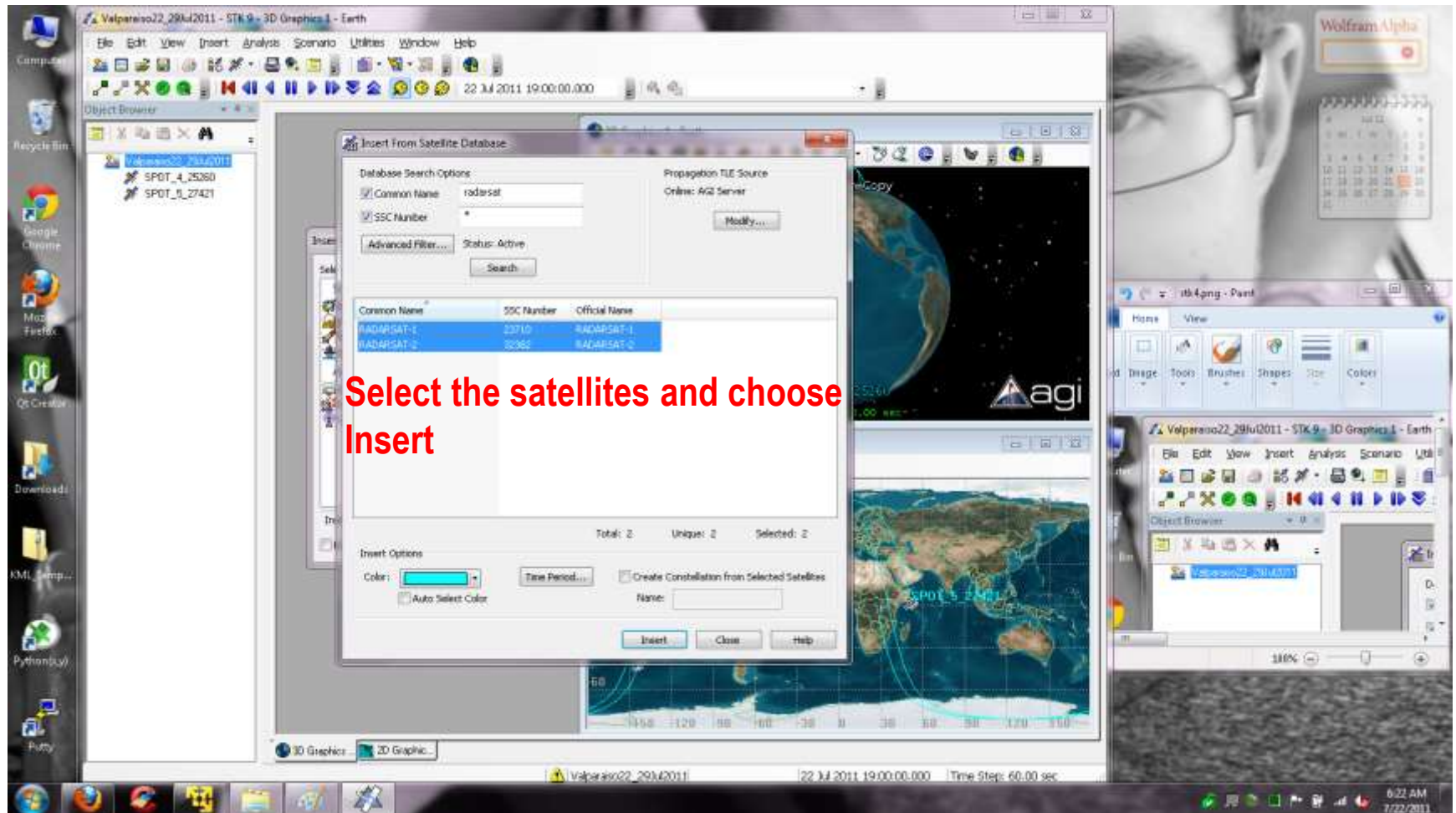
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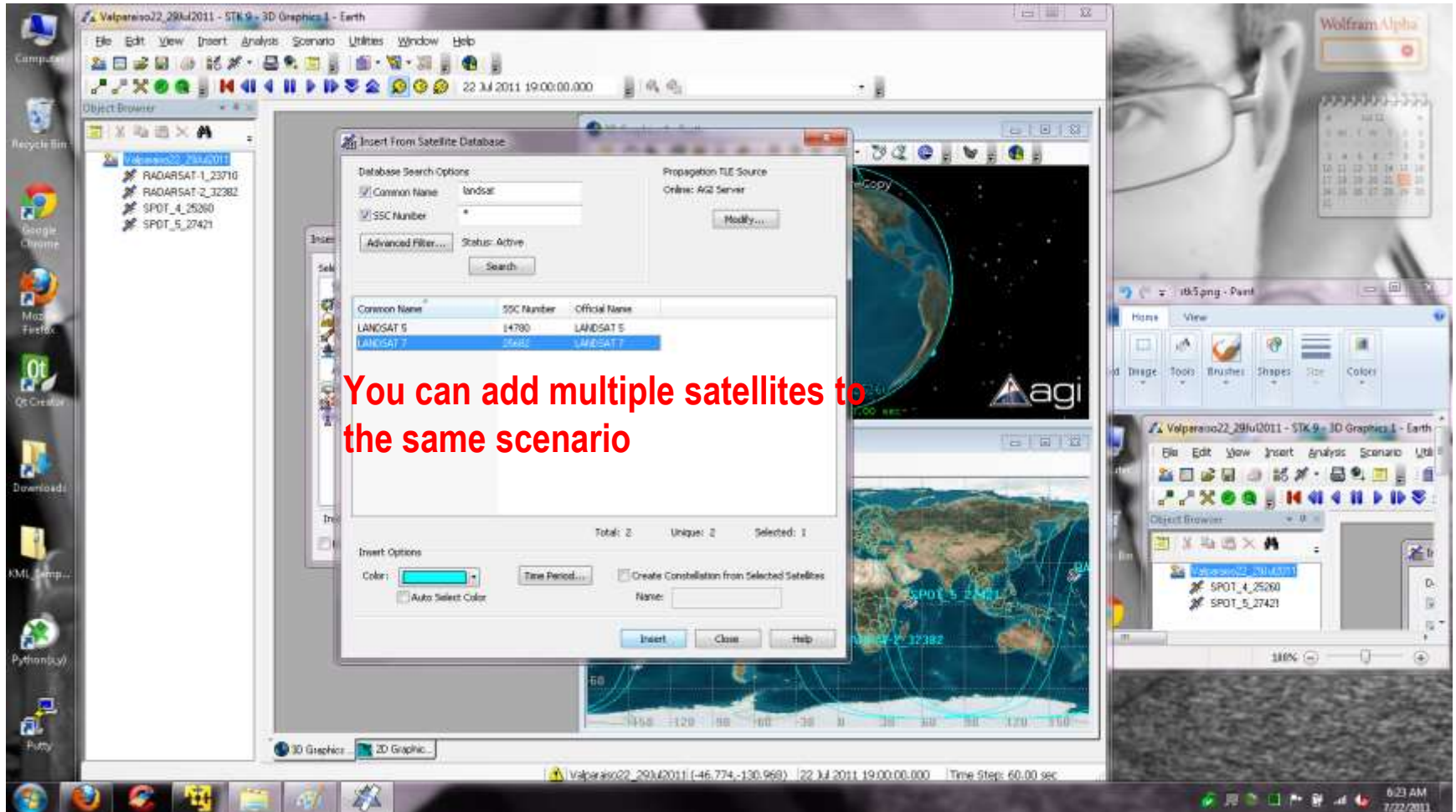
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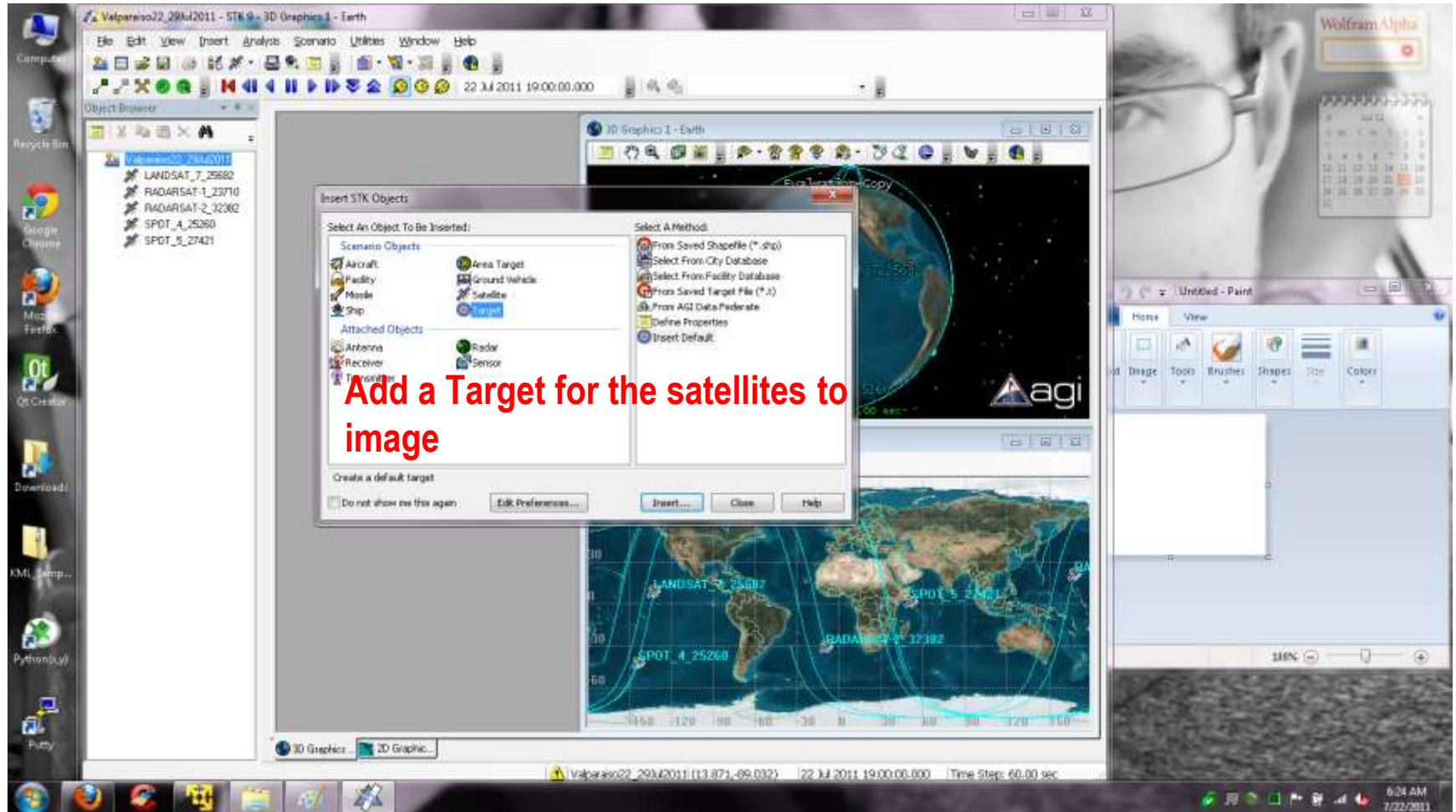
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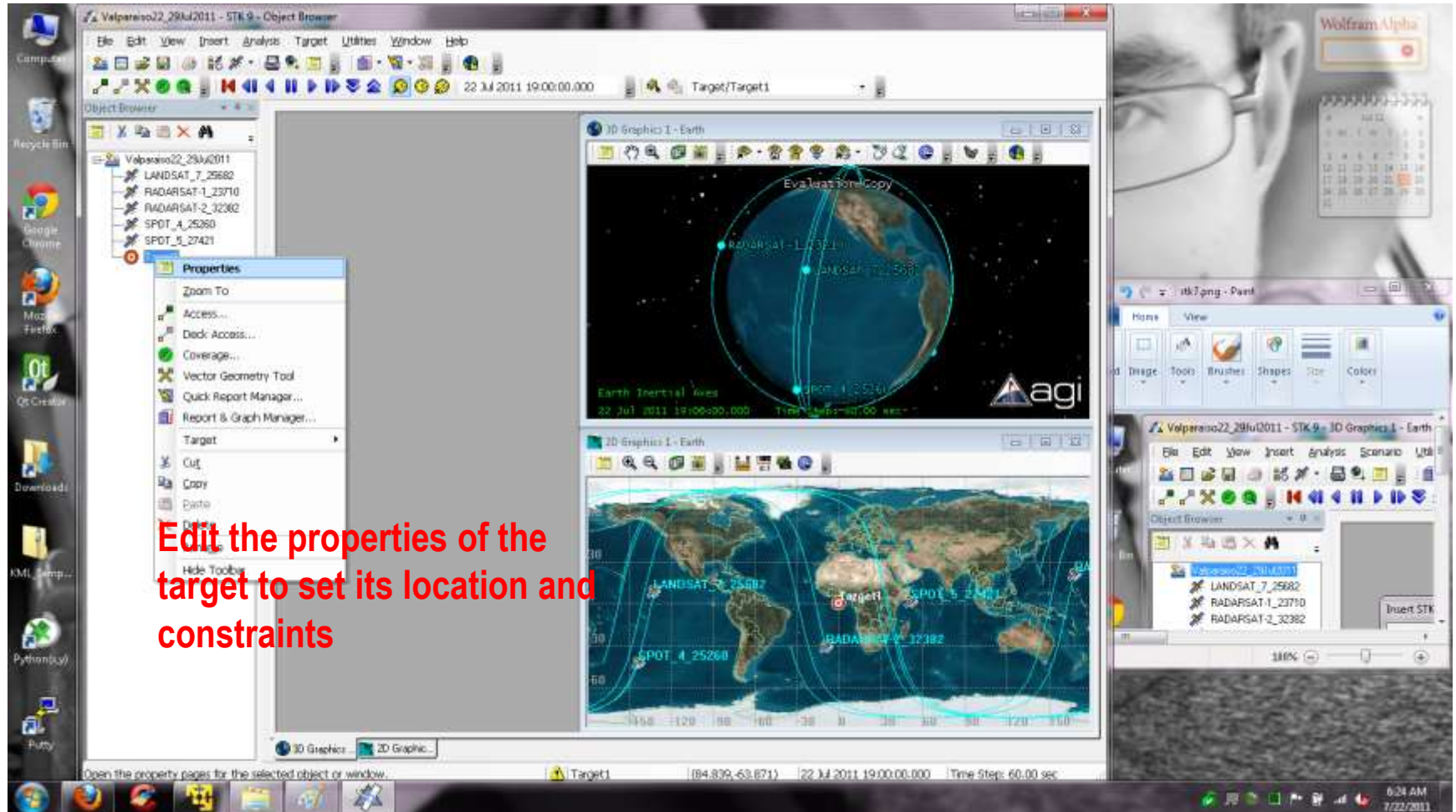
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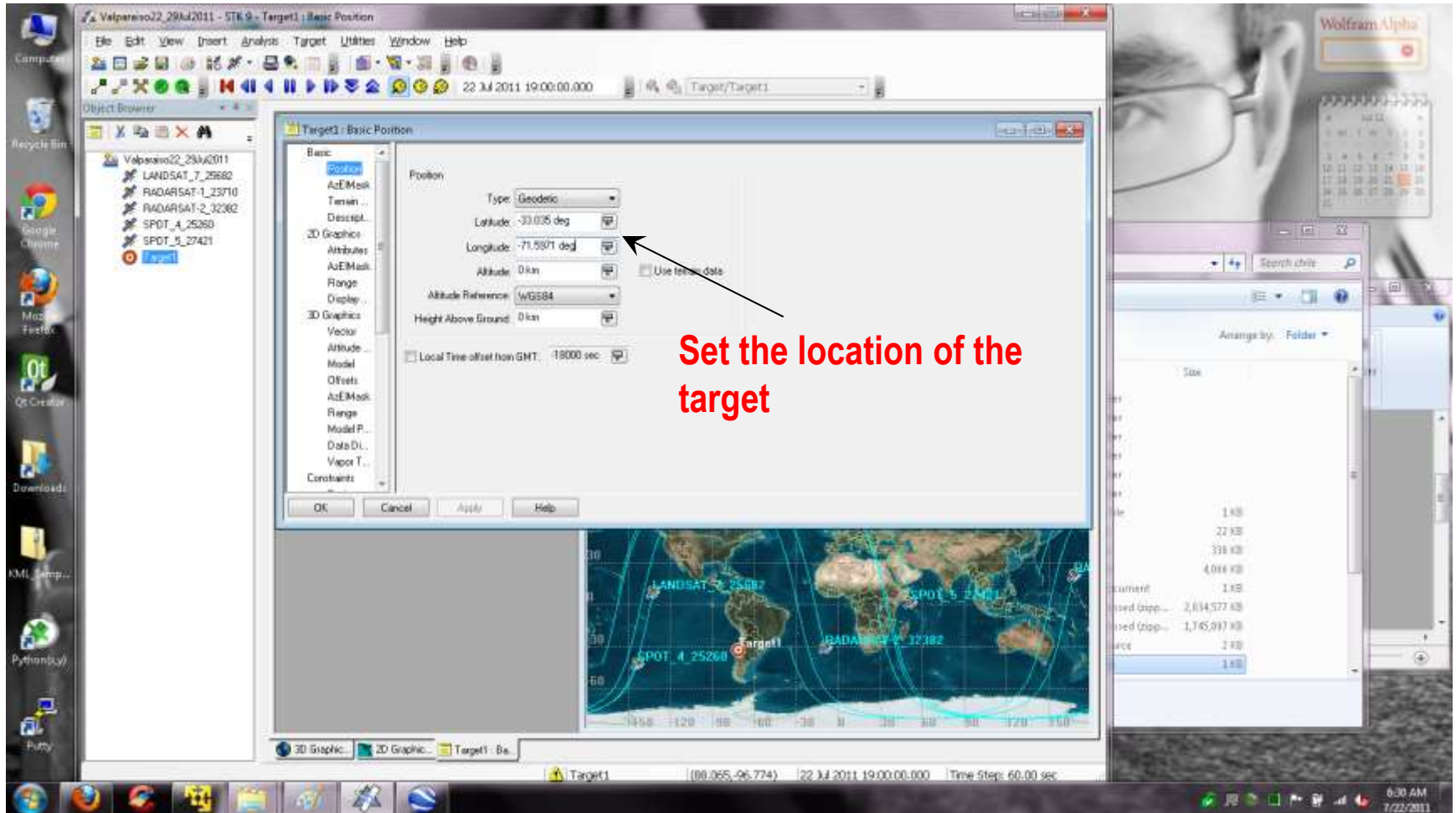
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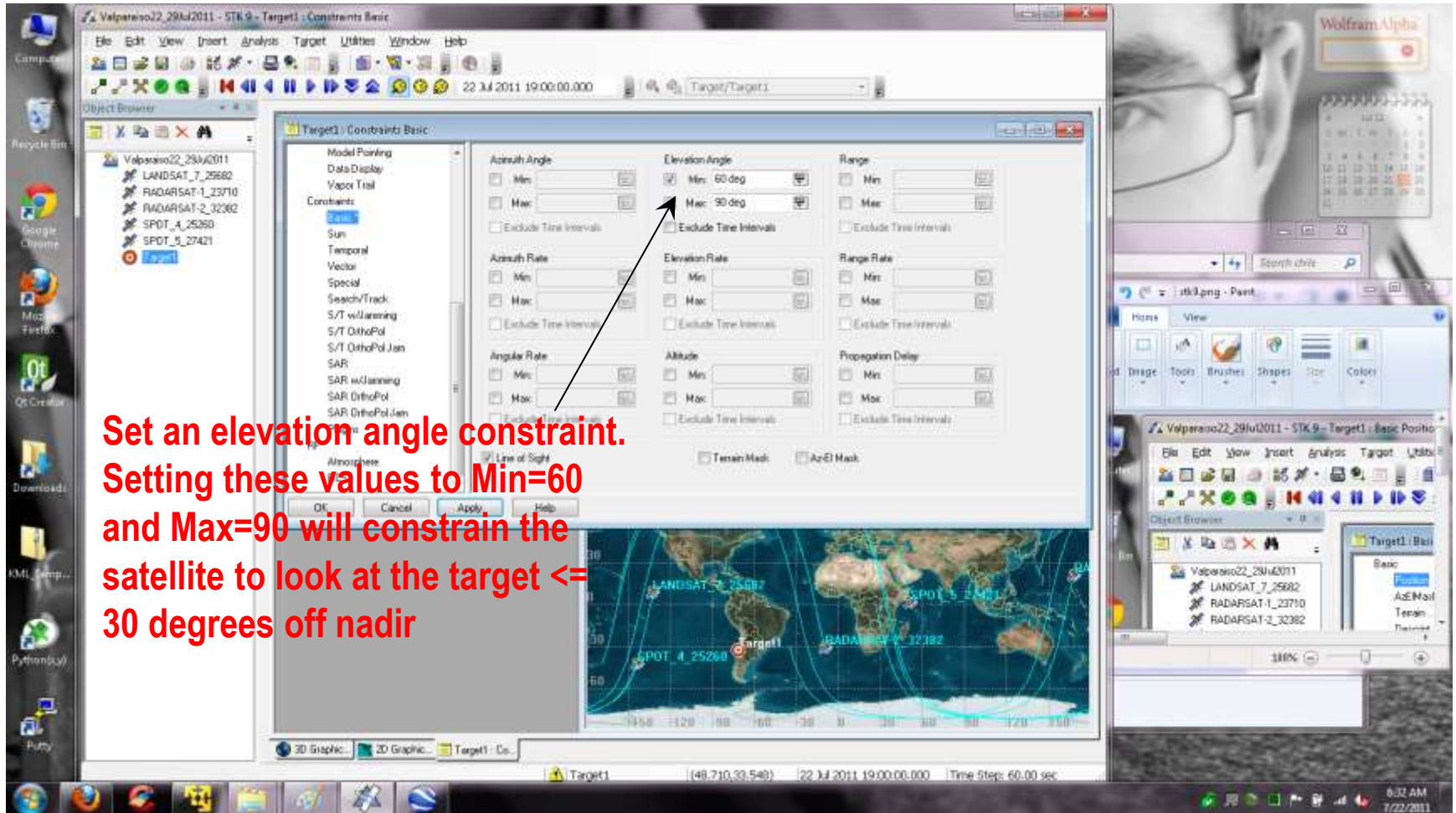
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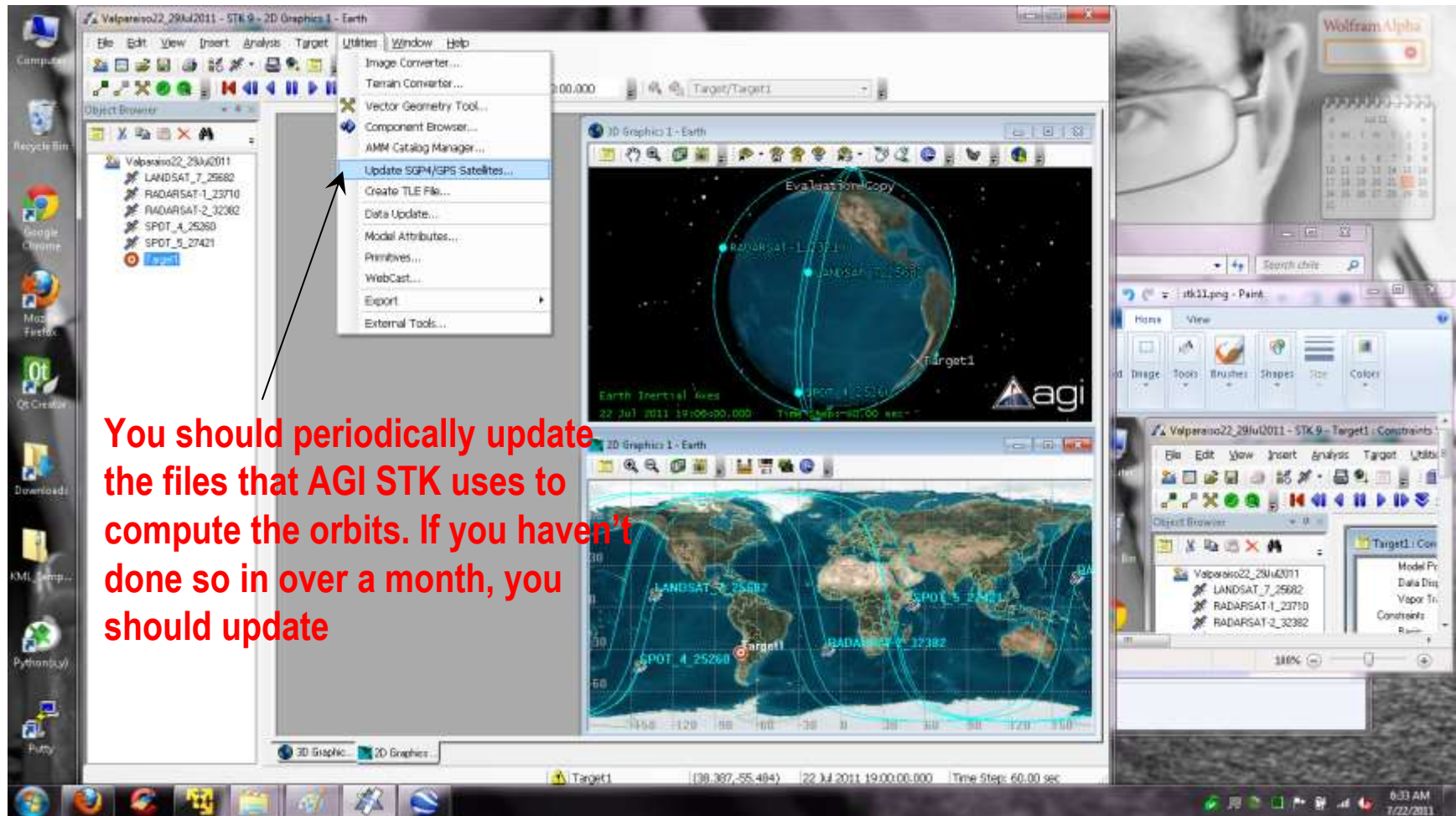


Set an elevation angle constraint.
Setting these values to Min=60 and Max=90 will constrain the satellite to look at the target ≤ 30 degrees off nadir

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

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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, showing a list of satellites to be updated. The list includes:

| ID | Name | Update Mode | Propagator |
|-------|------------------|-------------|------------|
| 25682 | LANDSAT_7_25682 | AGI Service | SGP4 |
| 23710 | RADARSAT_1_23710 | AGI Service | SGP4 |
| 23382 | RADARSAT_2_23382 | AGI Service | SGP4 |
| 25260 | SPOT_4_25260 | AGI Service | SGP4 |
| 27421 | SPOT_5_27421 | AGI Service | SGP4 |

The "Update" button is highlighted. A red text overlay on the left side of the image reads: "Choose the satellites and select update." The background shows the STK interface with a 3D Earth model and a 2D map view. The status bar at the bottom indicates the target is "Target1" at coordinates (130.367, -55.494) on 22 Jul 2011 at 19:00:00.000, with a time step of 60.00 sec.

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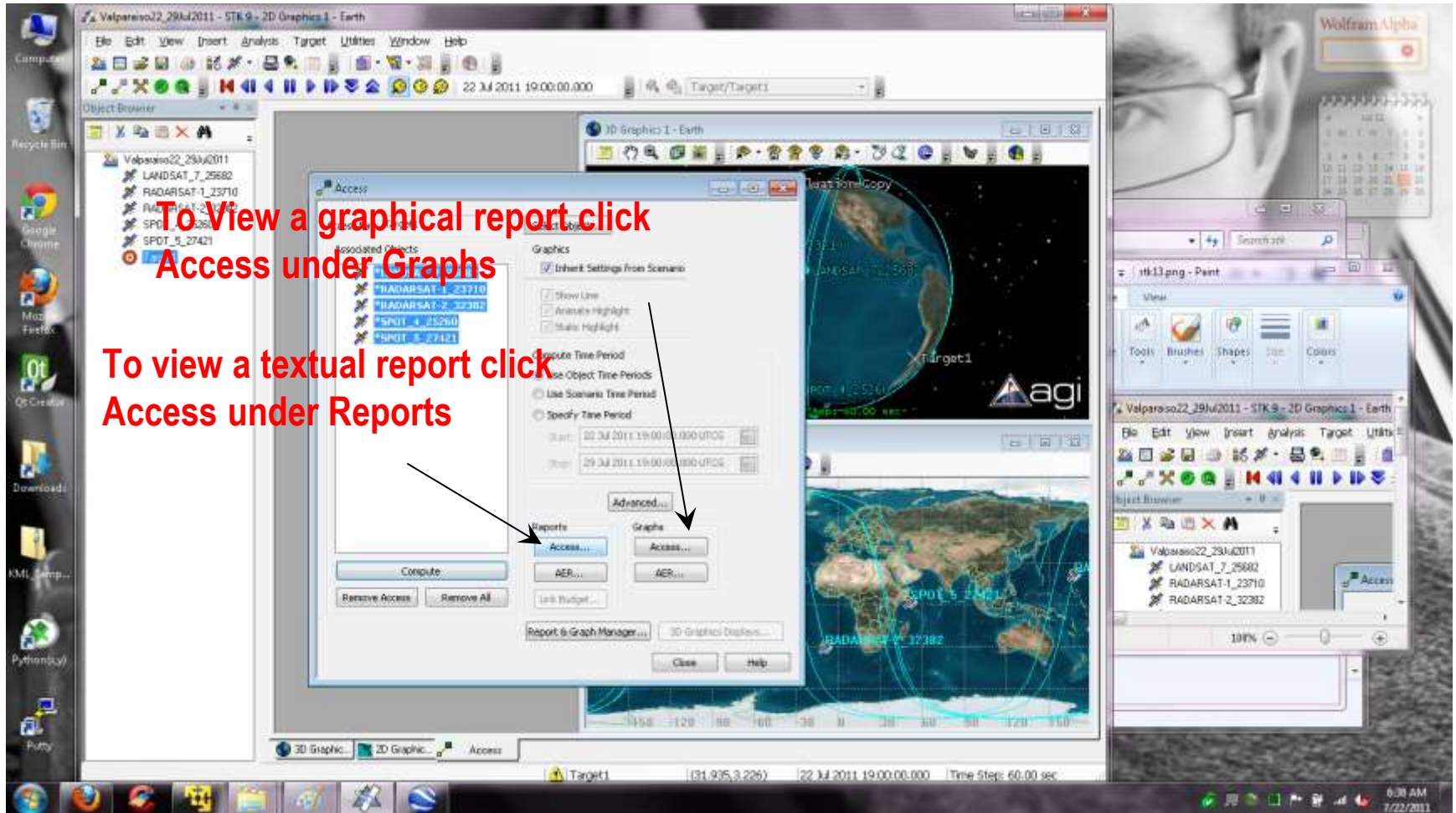
To compute the access to the target we've created, C]choose the target and select Access.

The screenshot displays the AGI STK (Systems Tool Kit) interface. On the left, the 'Object Browser' lists several satellite objects: 'Valparaiso22_29Jul2011', 'LANDSAT_7_25682', 'RADARSAT-1_123710', 'RADARSAT-1_2_32362', '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 globe with satellite orbits and a target. The 2D Graphics window shows a map view of the same data. A WolframAlpha search window is visible on the right.

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The screenshot shows the AGI STK software interface. The 'Access' dialog box is open, displaying a list of 'Associated Objects' including LANDSAT_7_25682, RADARSAT-1_23710, RADARSAT-2_32382, SPOT_4_25260, and SPOT_5_27421. All these objects are selected. The 'Compute' button is highlighted. A red arrow points to the 'Compute' button with the text 'Select all of the satellites that you're interested in and click "Compute"'. The background shows a 3D Earth model with satellite orbits and a 2D map view.

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HOW TO COMPUTE ACCESS TIMES USING AGI STK

The screenshot displays the AGI STK software interface. The main window, titled 'Report: Access - Access', shows a textual report for a target named 'Target1-Target1-To-Satellite-LANDSAT_7_25682'. The report includes a table of access events and global statistics.

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 14:45:09.908 | 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 14:45:09.908 | 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

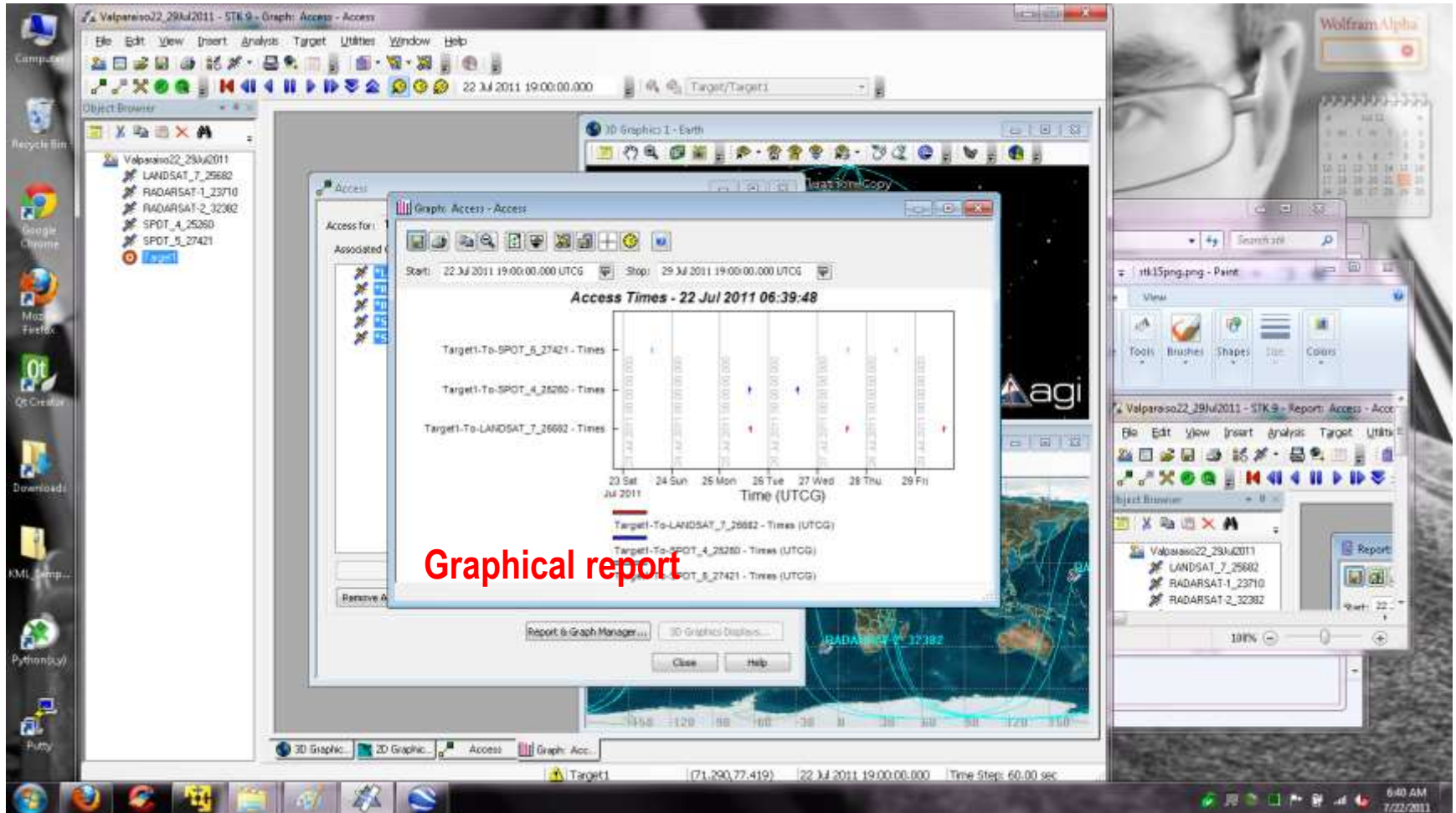
No Access Found

Target1-To-RADARSAT-2_32382

No Access Found

The text 'Textual report' is overlaid in red on the report content.

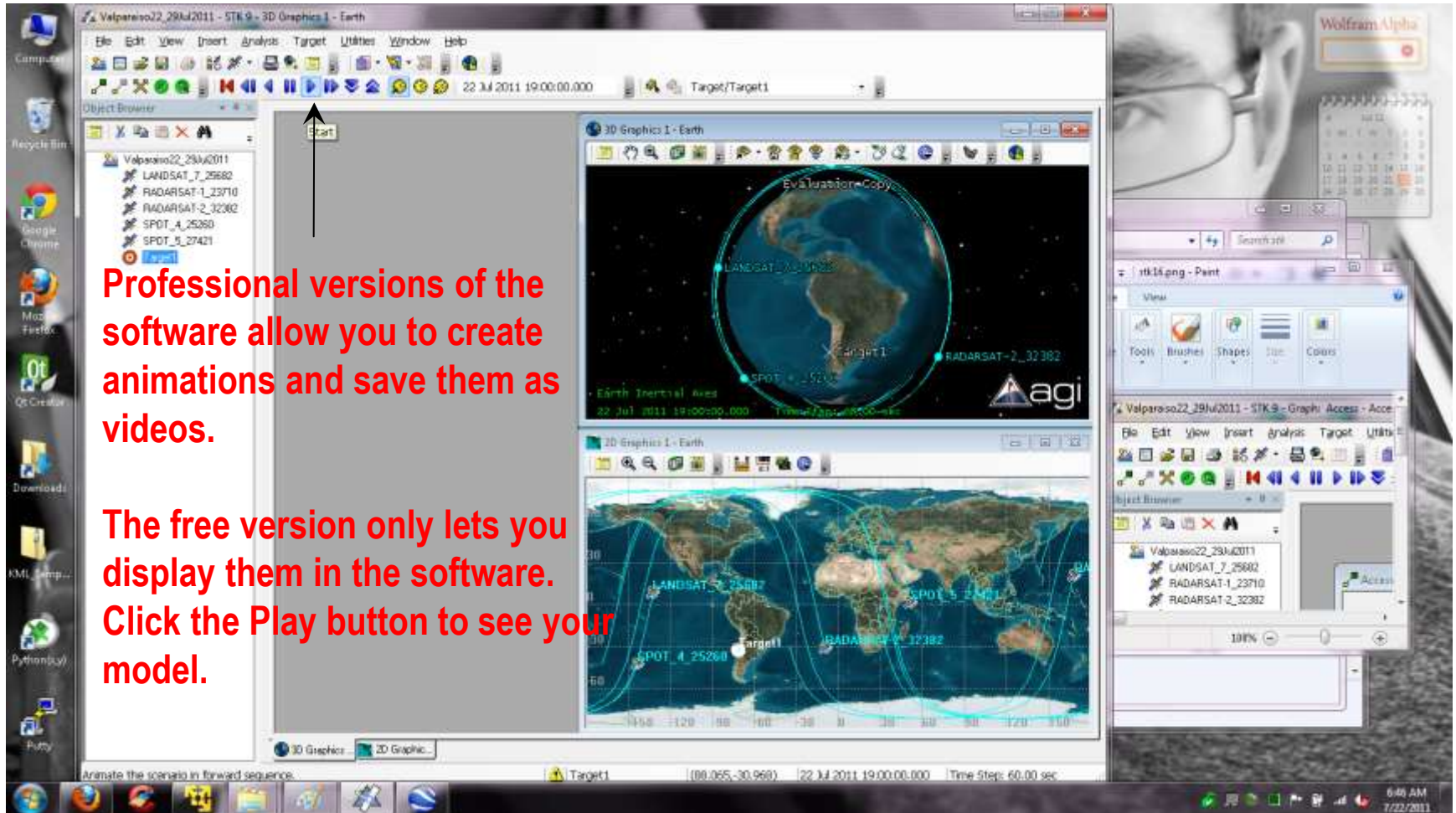
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HOW TO COMPUTE ACCESS TIMES USING AGI STK

- 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.

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CONCLUSION

- 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