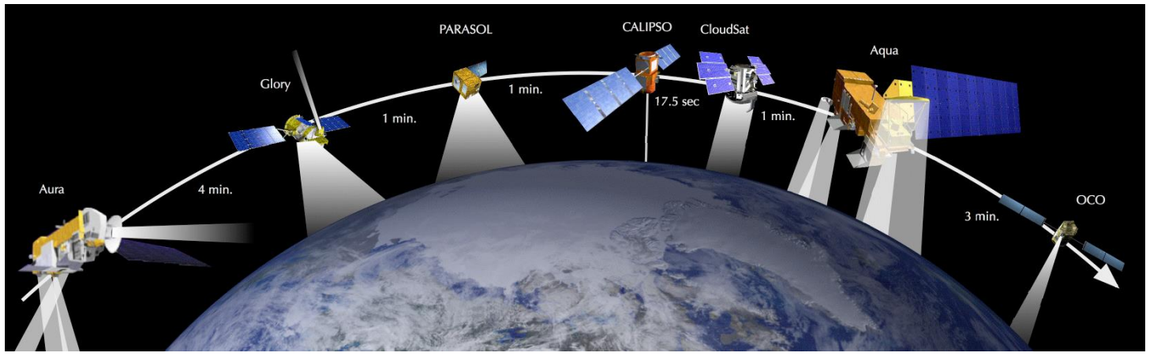
Using STK for Engineering Technology Education

By Andrew G. Bell

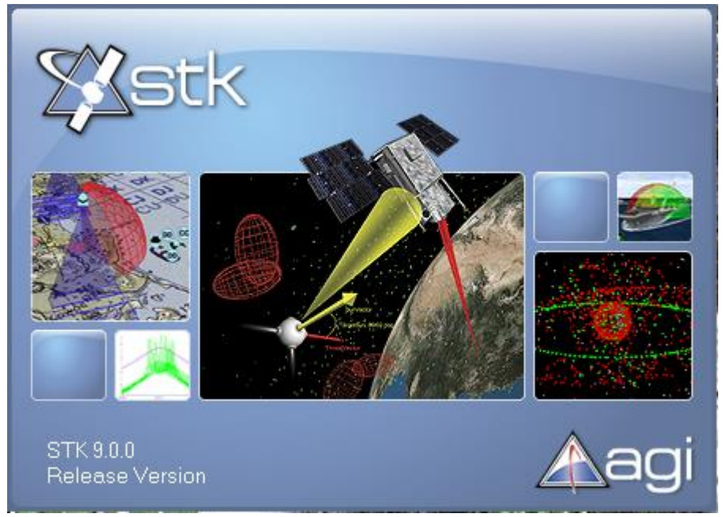
Abstract - Since the start of the Engineering Technology program at Ivy Tech Community College – Northeast in 2011 it has been my goal to introduce numerous educational software package and technology to enhance the skill set of our students. As an STK user in industry I initially attempted to introduce space system design concepts into the classroom using STK. This was successful but we have not developed enough momentum to keep it going in subsequent classes, primary because the course is now being taught by adjuncts instructors without STK experience or supporting course material. This poster will describe the approached used to develop training and course material for using STK to support the education of engineering students.

What is STK (Systems Tool Kit)? STK is a software package that allow the user to design, build and test various space and ground system scenarios using custom or existing databases. It is a graphical program that allows the user to view earth and orbiting satellites from both a 2D and 3D perspective.

Engineering Tasks:
Part 1 – Build the “ideal” A Train constellation in STK
Part 2 – Use global information about the Earth to help define and understand how the A-Train orbits the Earth.
Part 3 - Add a Ground Stations at Fort Wayne, add a sensor to CloudSat and adjust the swath of the CloudSat CPR sensor.
Part 4 - Add 8 AFSCN Ground Stations that support CloudSat.



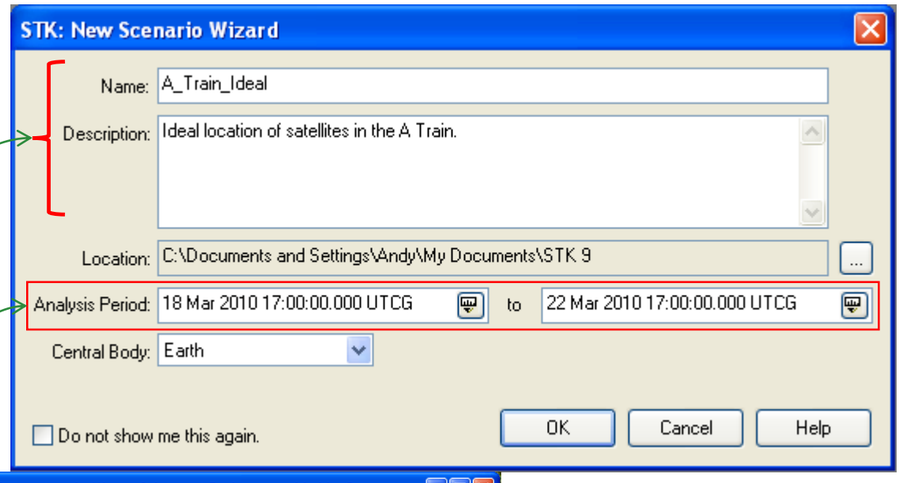
The A-Train is a Leo orbit constellation of satellites that was launched by an international community to study climate changes.

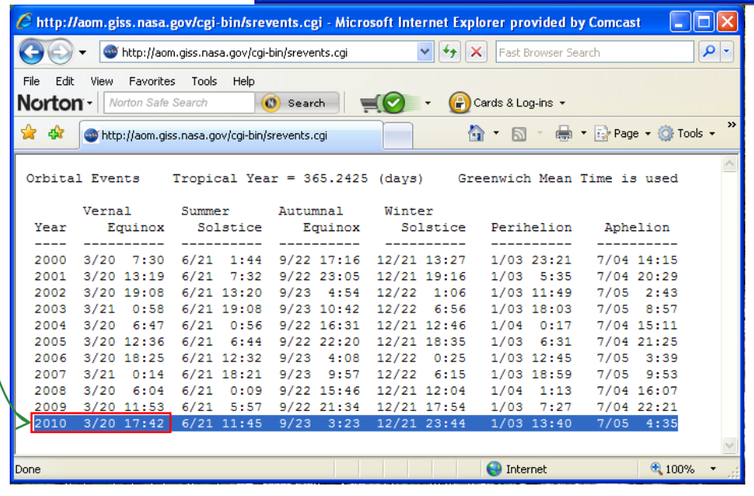


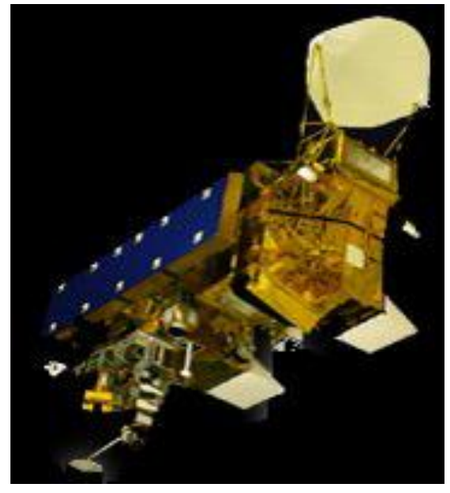
To build the “ideal” A Train constellation we will use STK - ~~Satellite~~ ***Systems*** Tool Kit by AGI

Step 1: Launch STK and create a new Scenario

We will create the Ideal A Train scenario with an Analysis Period of about two days before and after March 20, 2010 the Vernal Equinox

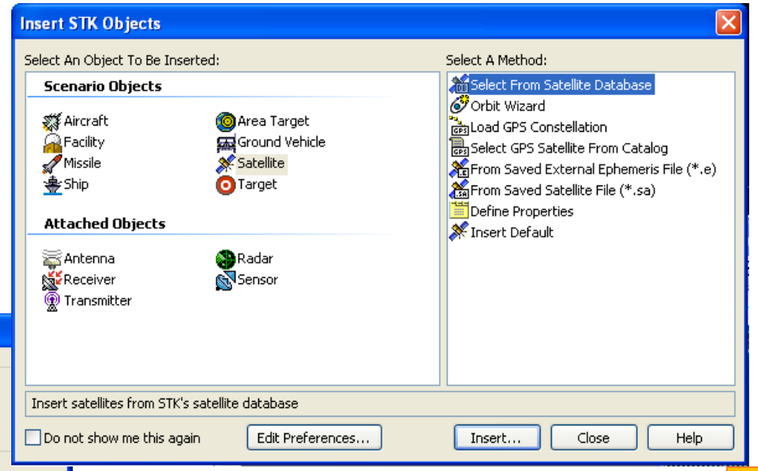


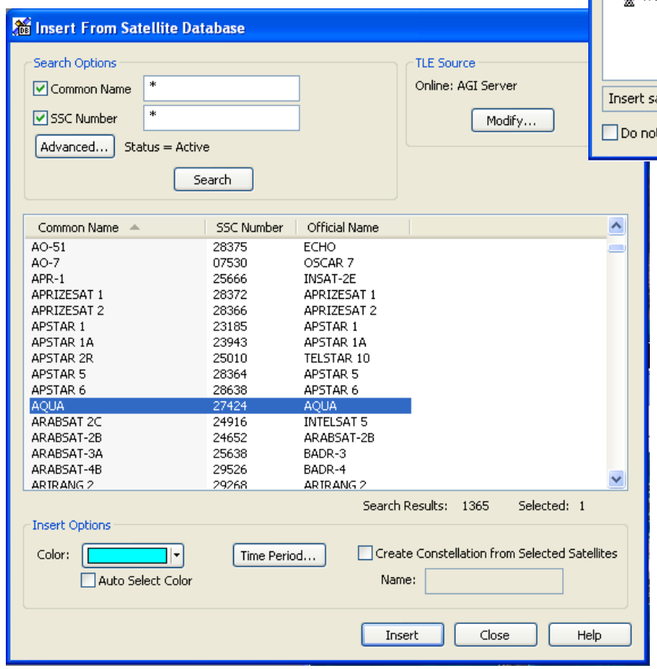


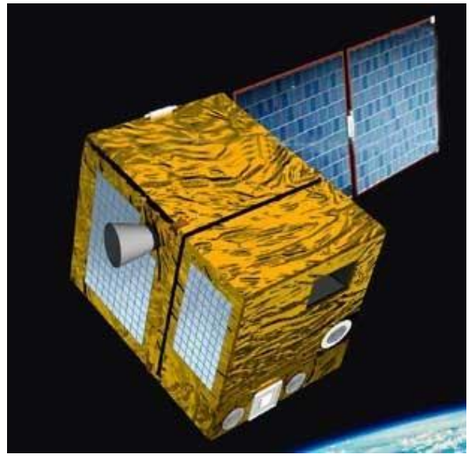


Aqua - Investigates the Earth's water cycle, including evaporation from the oceans, water vapor in the atmosphere, clouds, precipitation, soil moisture, sea ice, land ice, and snow cover on the land and ice.[1]

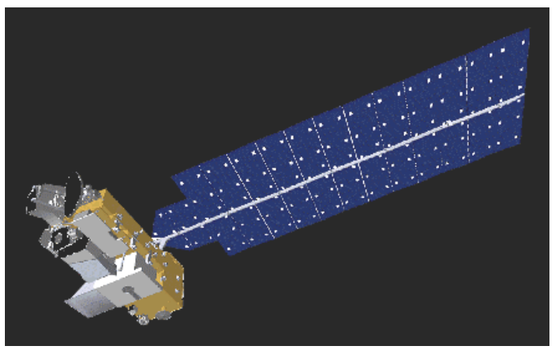
Step 2: Use the STK Satellite Database and “load” the first satellite, Aqua. We will add the other satellites later.





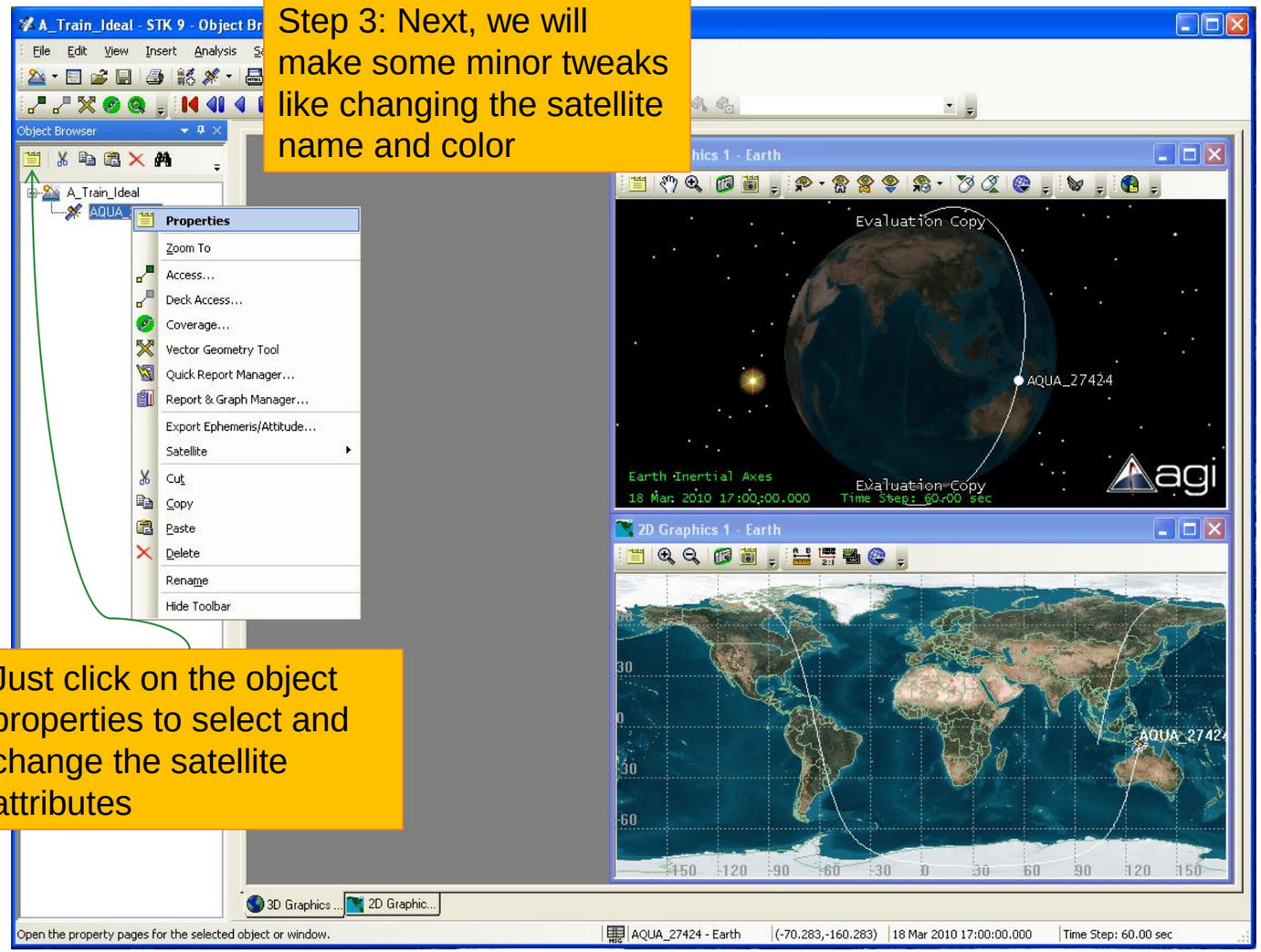


PARASOL - A CNES satellite that studies the role of clouds and aerosols[1]



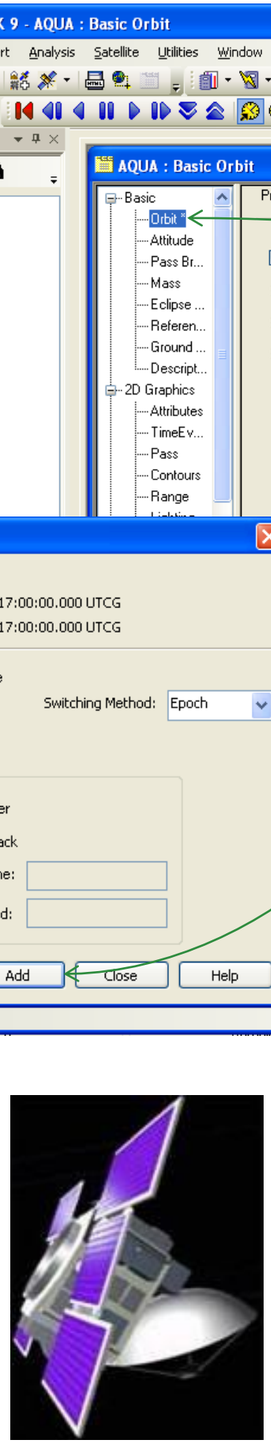
Aura - Researches the composition, chemistry, and dynamics of the Earth’s atmosphere as well as study the ozone, air quality, and climate.[1]

Step 3: Next, we will make some minor tweaks like changing the satellite name and color



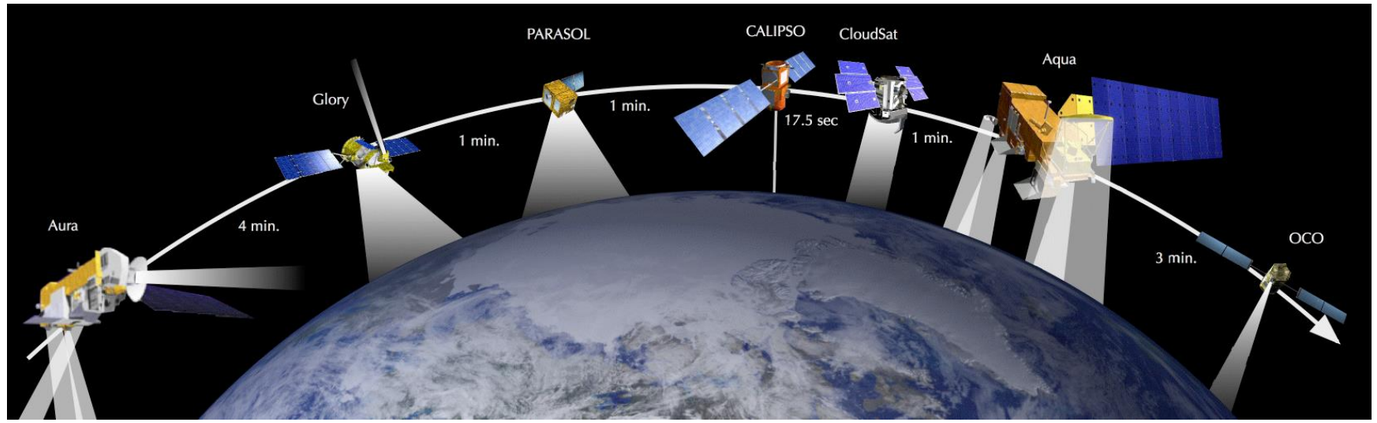
Just click on the object properties to select and change the satellite attributes

Step 4: To determine the orbital elements of the Aqua Satellite we just added. Select Orbit>Define/Import Elements Add>Add in the Add Element form



CloudSat - Measures the power backscattered by clouds as a function of distance from the radar.[1]

Then we Modify the TLE details so we can see the orbital information. We will key in on the Mean Anomaly which is equal to 265.636 degrees.



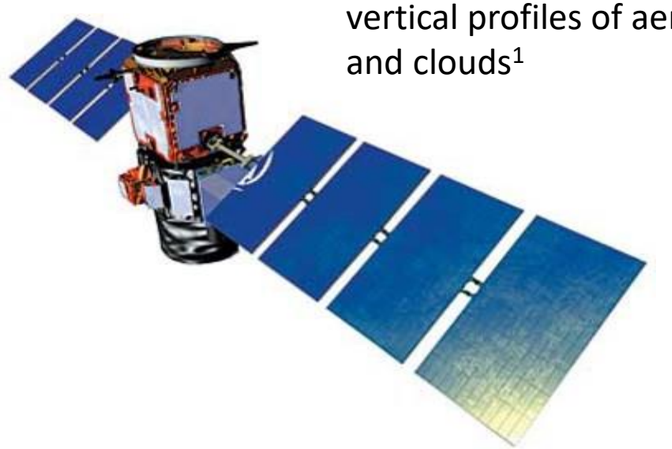
Step 5: Once we determine how “fast” the A Train is moving (3.642 degrees per minute) we can then determine the position (mean anomaly) of each satellite relative to the position of Aqua.

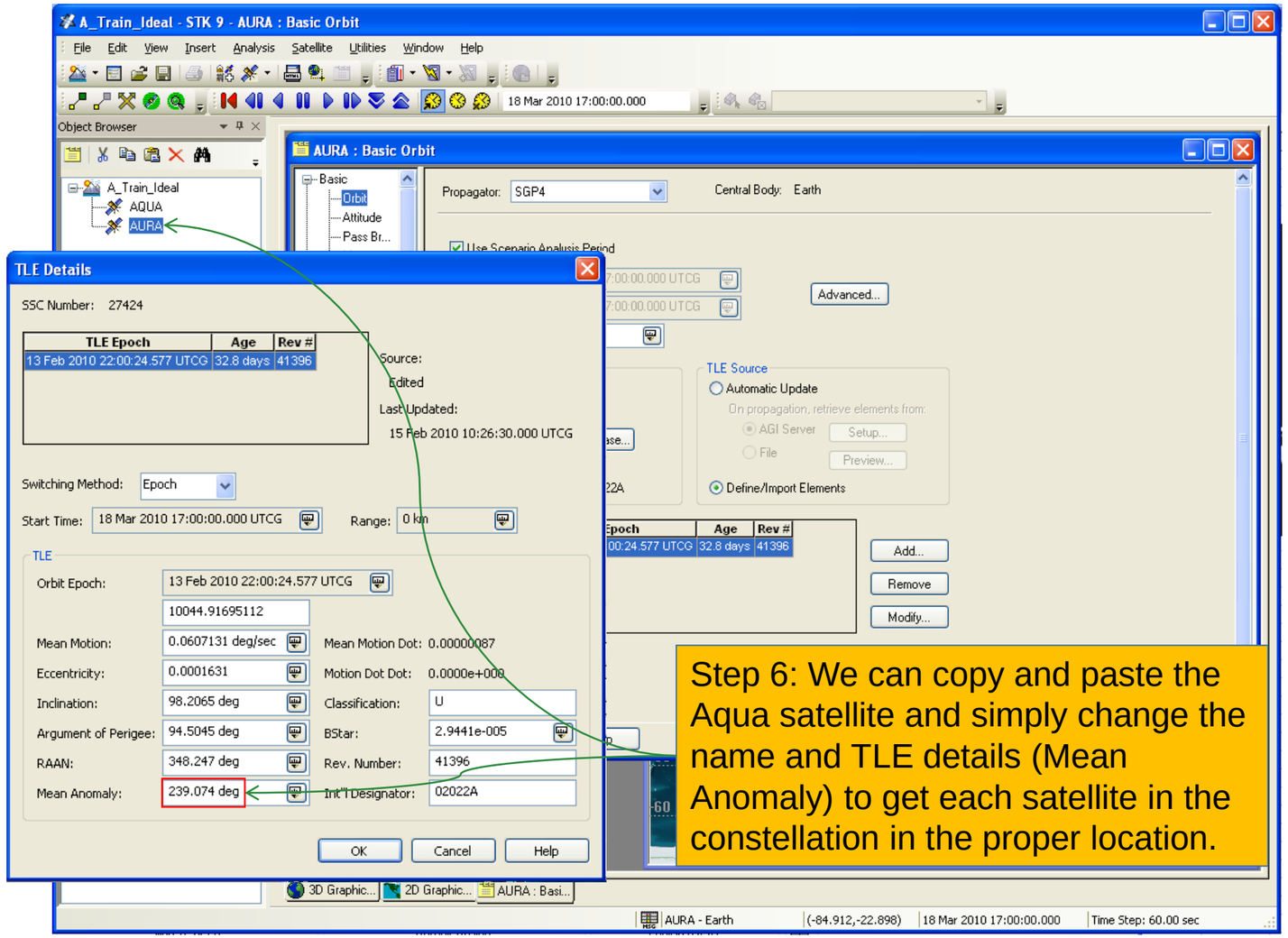
Revs/day	degrees	Degress/day	Degrees/hour	Degrees/minute
14.5712	360	5245.632	218.568	3.6428

	time	Δ time	Δ degrees	Mean Anomaly
OCO	3.00	3.00	10.93	276.564
Aqua	0.00	0.00	0.00	265.636
Cloudsat	1.00	-1.00	-3.64	261.993
Calipso	0.29	-1.29	-4.71	260.931
Parasol	1.00	-2.29	-8.35	257.288
Glory	1.00	-3.29	-11.99	253.645
Aura	4.00	-7.29	-26.56	239.074

A Train Mean Anomalies

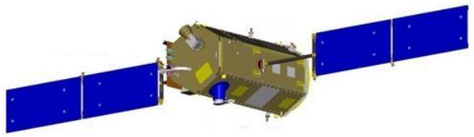
CALIPSO - Two wavelength polarization-sensitive Lidar that provides high resolution vertical profiles of aerosols and clouds[1]

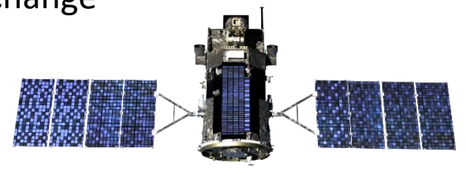




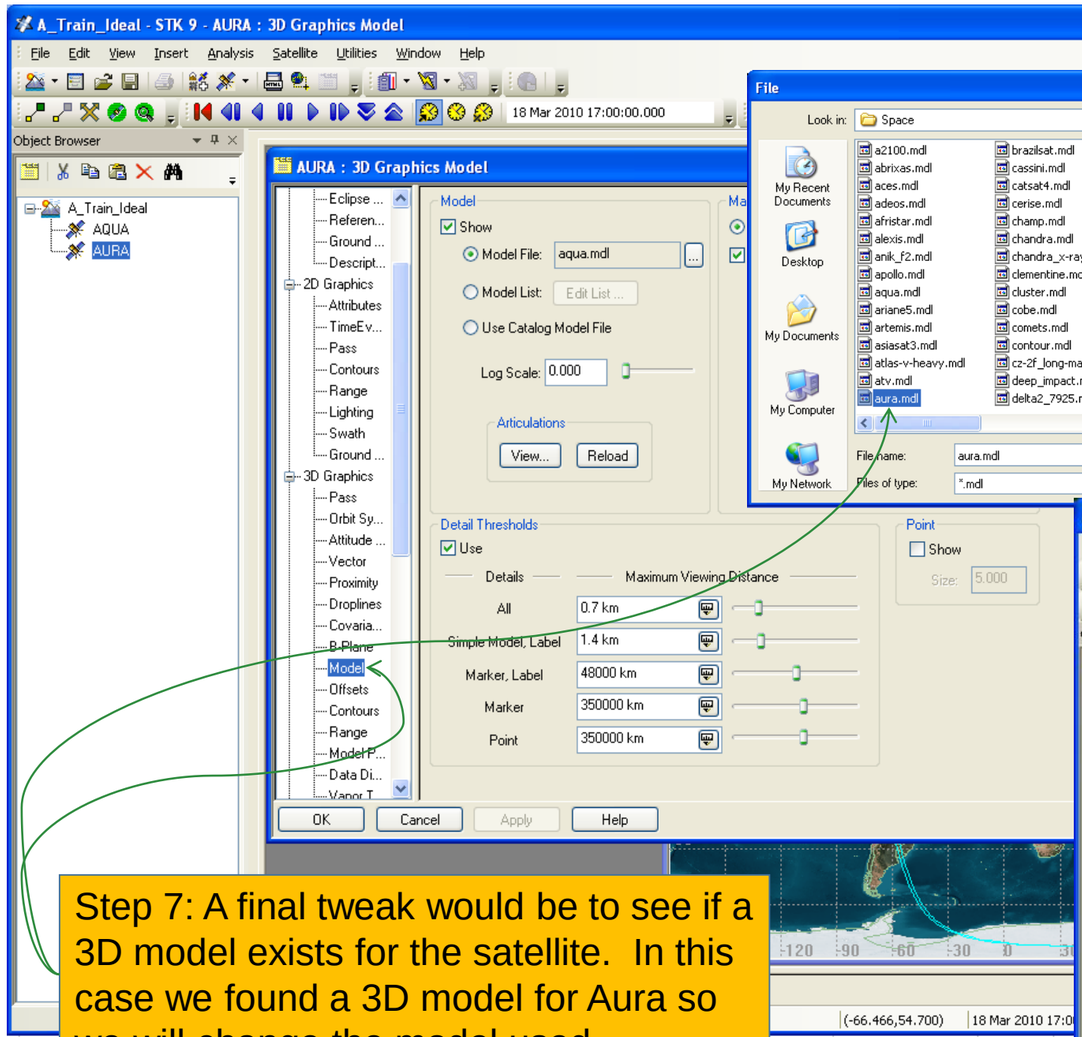
Step 6: We can copy and paste the Aqua satellite and simply change the name and TLE details (Mean Anomaly) to get each satellite in the constellation in the proper location.

OCO - Provide space-based observations of atmospheric carbon dioxide (CO2), the principal human-initiated driver of climate change[1]

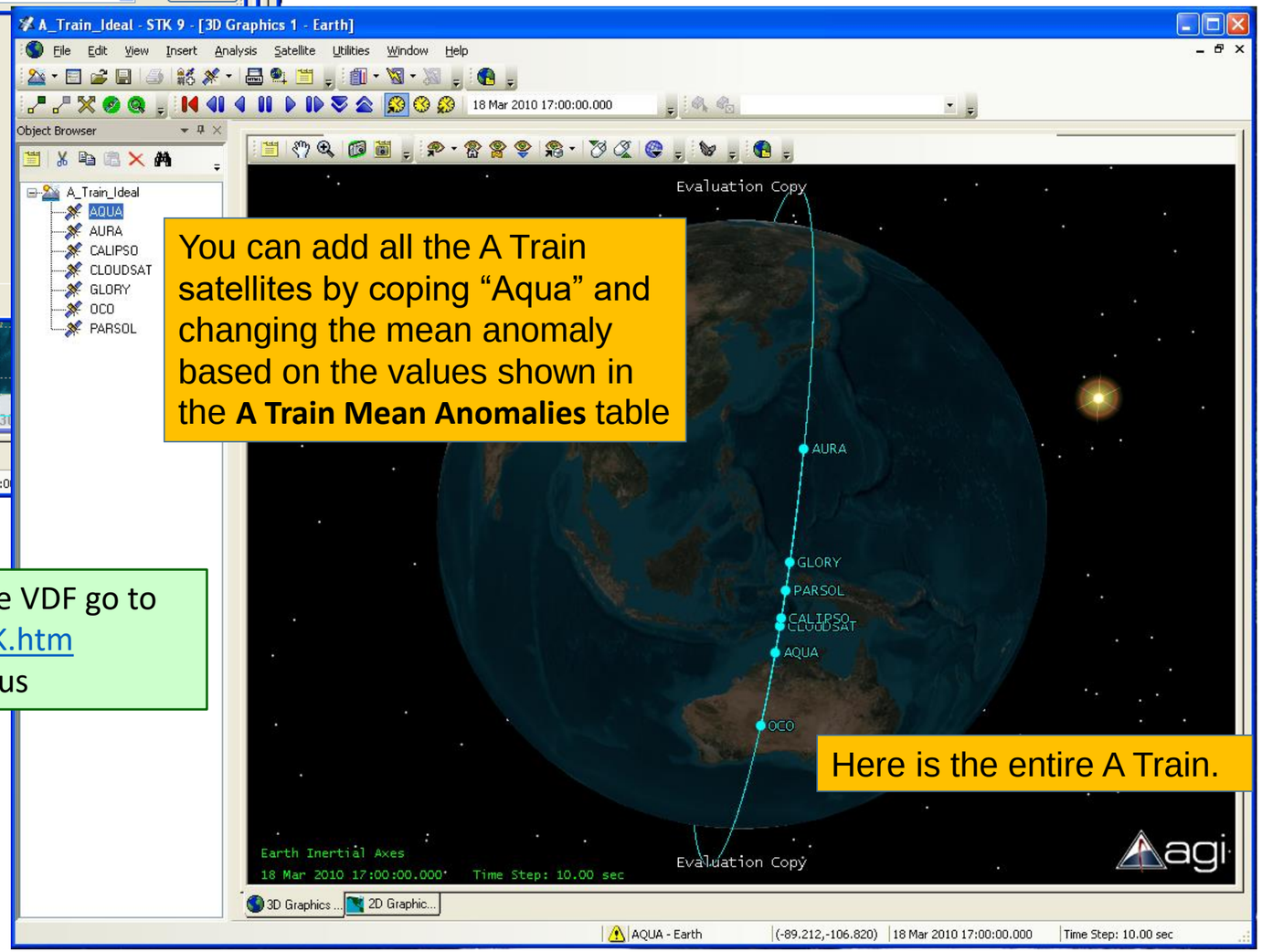




Glory - Collect data on the chemical, microphysical, and optical properties, and spatial and temporal distributions of aerosols, and Continue collection data for the long-term climate record.[1]



Step 7: A final tweak would be to see if a 3D model exists for the satellite. In this case we found a 3D model for Aura so we will change the model used.



You can add all the A Train satellites by coping "Aqua" and changing the mean anomaly based on the values shown in the **A Train Mean Anomalies** table

Here is the entire A Train.

For more information and links to all four parts as well as links to the VDF go to
http://www.robustdesignconcepts.com/files/ATrain/ATrain_and_STK.htm

1 - AMSR-E Science Team Meeting, August 14-16. 2007, A-Train Status

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