



The Jupiter Environment Tool

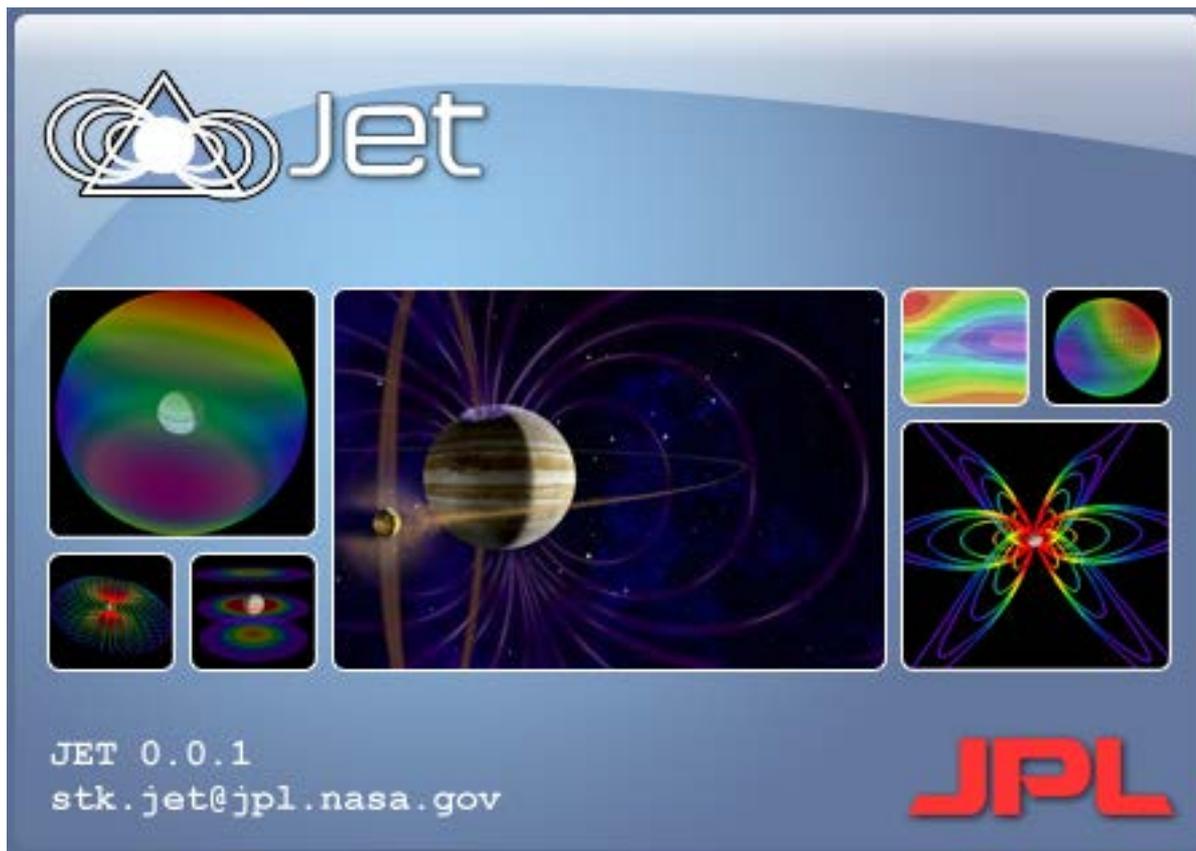
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Erick.J.Sturm@jpl.nasa.gov

The Jupiter Environment Tool (JET)

Custom User Interface Plugin for STK



The Europa Jupiter System Mission wanted:

- Geometric analysis with respect to:
 - & Visualization of:
 - Magnetosphere
 - Radiation Field
 - Plasma & Neutral Tori
 - Rings / Dust / Small Bodies
 - Satellite Atmospheres
- Fast turn-around Jovian tour radiation dose estimation

AGI / AER released the Space Environment and Effects Tool (SEET)

- Modules
 - Magnetic Field
 - Radiation Environment
 - South Atlantic Anomaly
 - Particle Impacts
 - Vehicle Temperature
- Only for the Earth, with no planned extensions to other planets

Development History

- **Development started in July 2010, all in-house at JPL**
- **Primary goal: integrate Jovian magnetic field models into STK as a proof-of-concept for further environment model integration**
- **Small team of 3 JPL employees & 3 summer hires**
 - Erick Sturm, JPL
Team Lead & Developer – Fortran/C# Translation, GUI Design
 - Michael Kokorowski, JPL
Magnetic Field Model Expert – Model Validation
 - James Biehl, JPL
Developer – XML Schema, GUI Save/Load Routines
 - Kenneth Donahue, MIT (though now at JPL)
Developer – Plugin Architecture, Primitive Renderers
 - Jordan Boedeker, Iowa State University
Developer – Custom Vectors
 - Cedrick Ngalande, USC (though now at Microcosm, Inc.)
Developer – Plugin-FORTRAN Interface

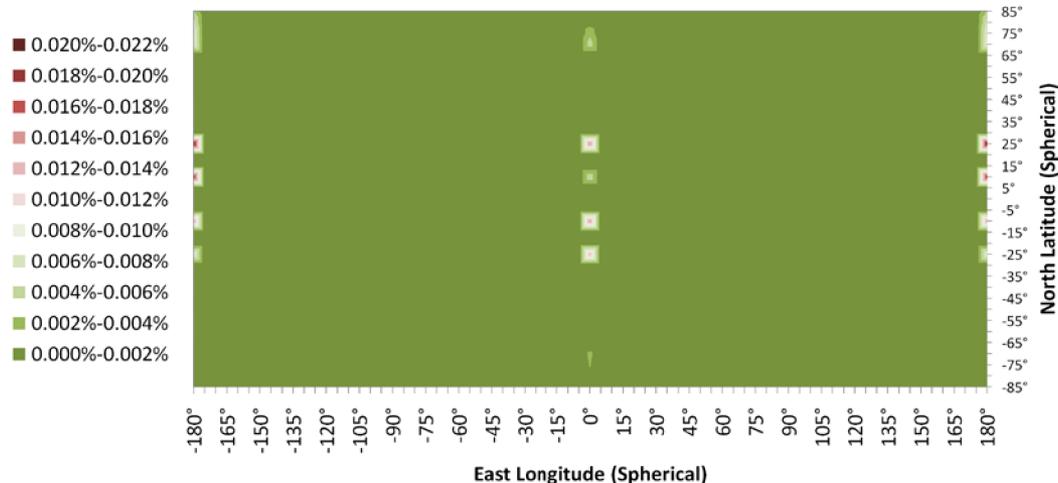
Development Status (After ~1 Year)

- **Three magnetic field models integrated into Plugin**
 - Simple dipole model
 - VIP4 model (original Fortran code)
 - VIP4 model (translated into C#)
- **Integrated user interface window, toolbar, & context menu**
- **Four visualization types rendered in the 3D Window**
 - Field lines
 - Flux-tube footprint ovals (auroral ovals)
 - Plane contours
 - Spherical-sector contours
- **Area & line target generation from footprint oval primitives**
- **Addition of three custom vectors in the VGT**
 - Magnetic field vector
 - Field-line/central-body intersection vectors (North & South)
- **Custom report & graph templates**
- **Compiled Help chm file with context-sensitive access from GUI**
- **Packaged as an msi file for quick & easy installation**

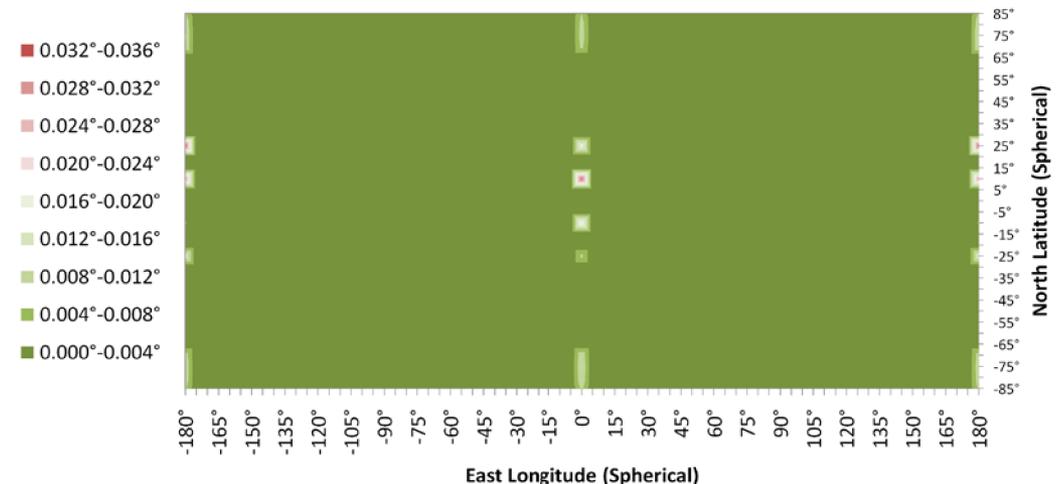
Magnetic Field Model Validation

- Validated Plugin VIP4 C# & F models against original F code
- Sampled points on a 5° Lat/Lon Grid
- Sampled at 1, 1.1, 1.25, 1.5, 2, 5, & 10 R_J
- Calculated error in magnitude & direction of magnetic field vector
- Max Errors:
 - 0.022% Magnitude
 - 0.036° Direction

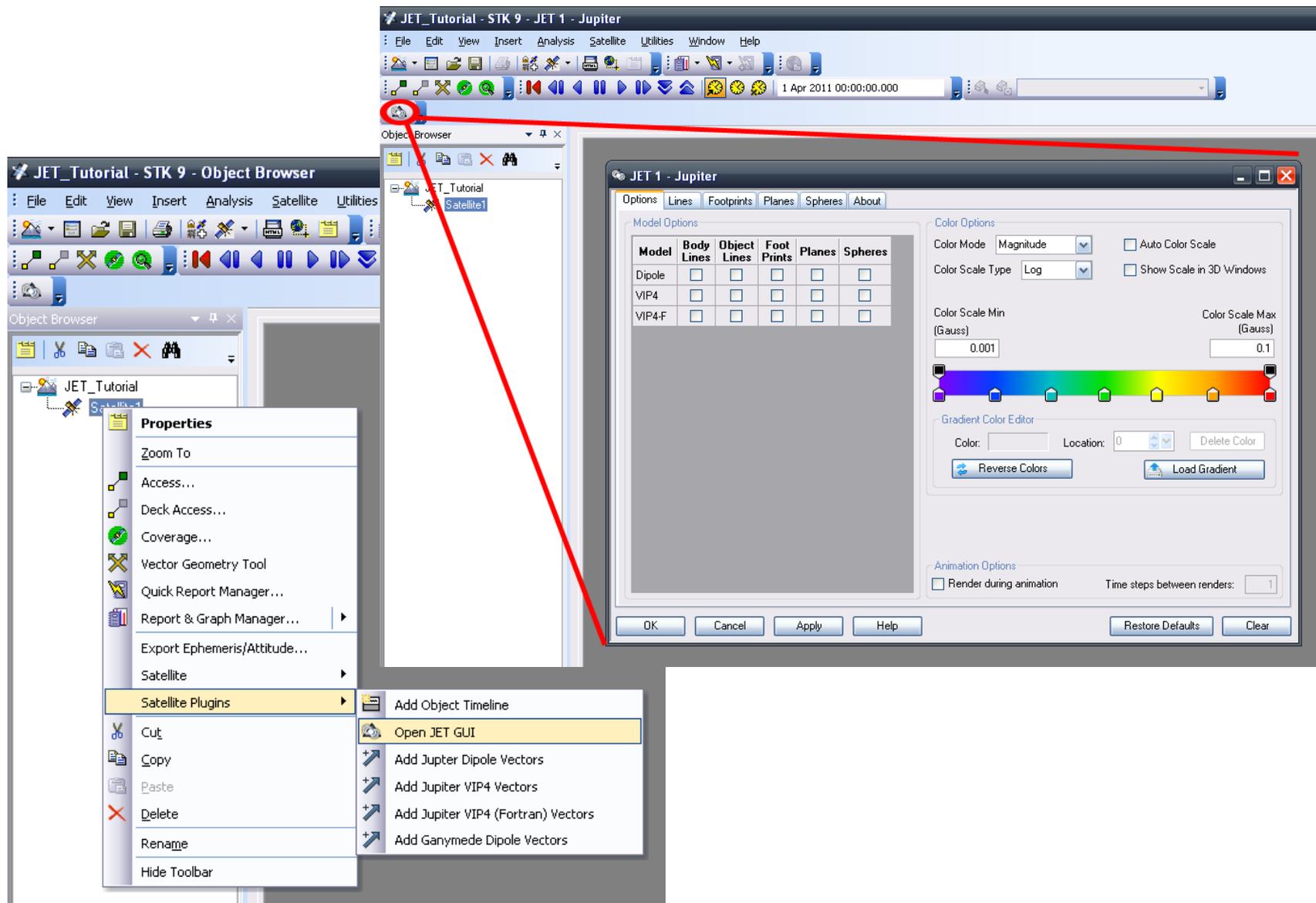
Magnitude Error between JET VIP4 (C#) and MATLAB VIP4 (FORTRAN)



Direction Error between JET VIP4 (C#) and MATLAB VIP4 (FORTRAN)



JET User Interfaces within STK



JET Tutorial - STK 9 - JET 1 - Jupiter

File Edit View Insert Analysis Satellite Utilities Window Help

1 Apr 2011 00:00:00.000

Object Browser

JET Tutorial

- Satellite
- Satellite Plugins**
 - Add Object Timeline
 - Open JET GUI**
 - Add Jupiter Dipole Vectors
 - Add Jupiter VIP4 Vectors
 - Add Jupiter VIP4 (Fortran) Vectors
 - Add Ganymede Dipole Vectors
- Cut
- Copy
- Paste
- Delete
- Rename
- Hide Toolbar

JET 1 - Jupiter

Options Lines Footprints Planes Spheres About

Model Options

Model	Body Lines	Object Lines	Foot Prints	Planes	Spheres
Dipole	<input type="checkbox"/>				
VIP4	<input type="checkbox"/>				
VIP4-F	<input type="checkbox"/>				

Color Options

Color Mode: Magnitude Auto Color Scale

Color Scale Type: Log Show Scale in 3D Windows

Color Scale Min (Gauss): 0.001 Color Scale Max (Gauss): 0.1

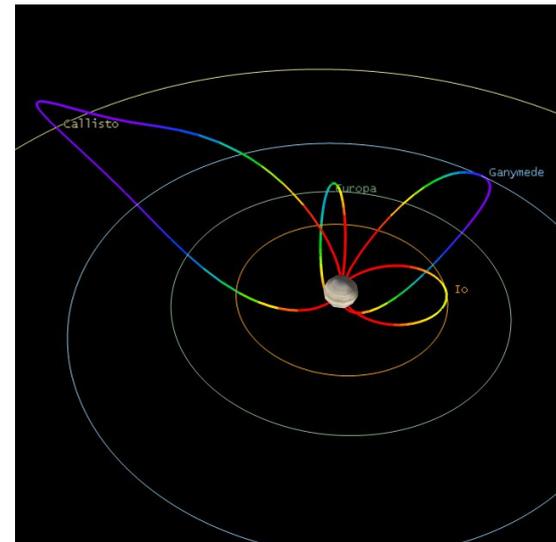
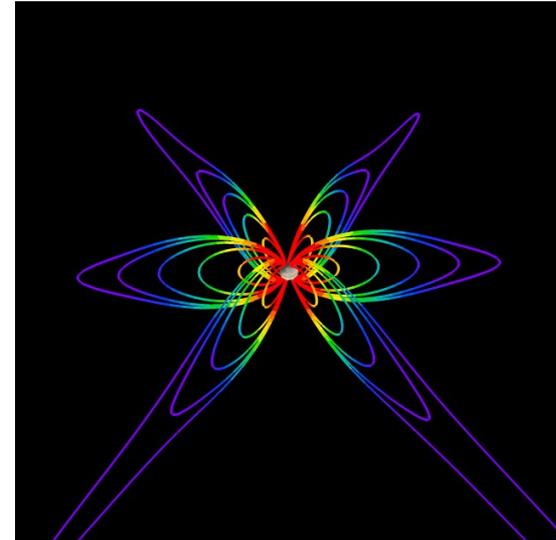
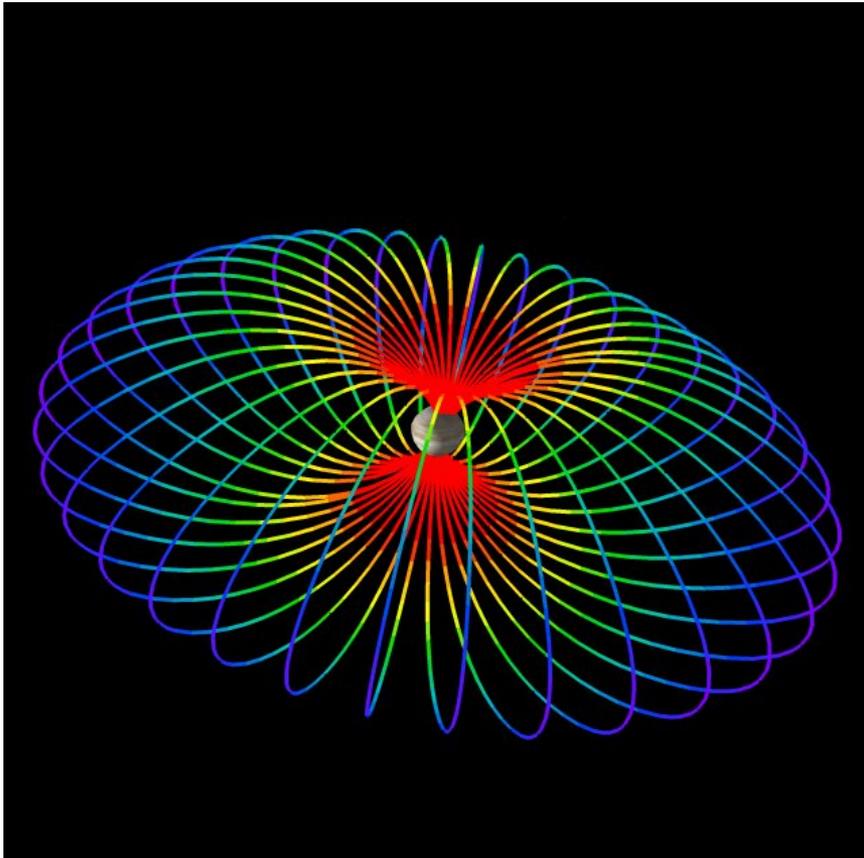
Gradient Color Editor

Color: Location: 0 Delete Color

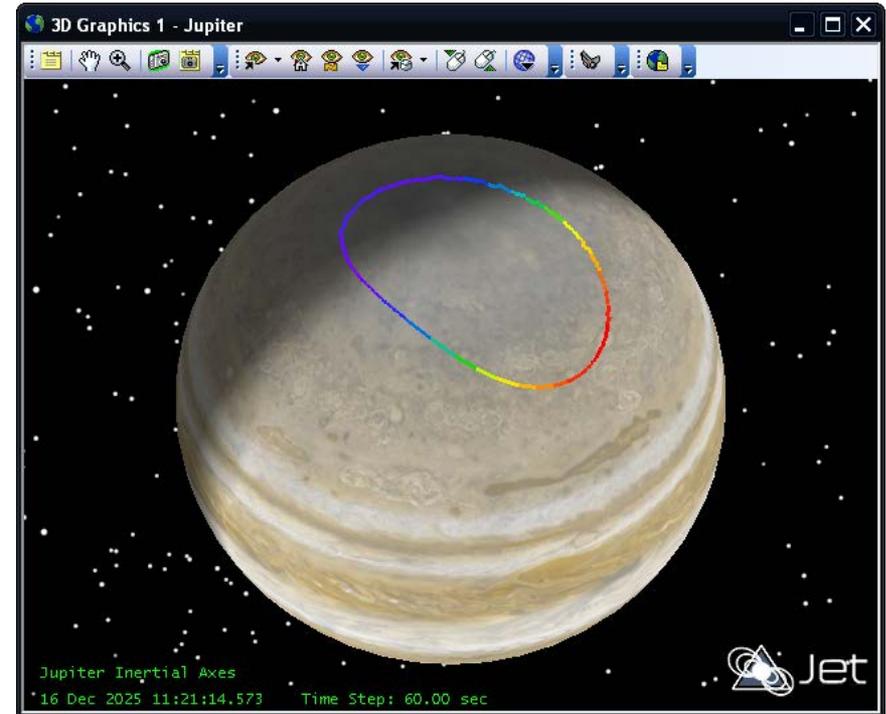
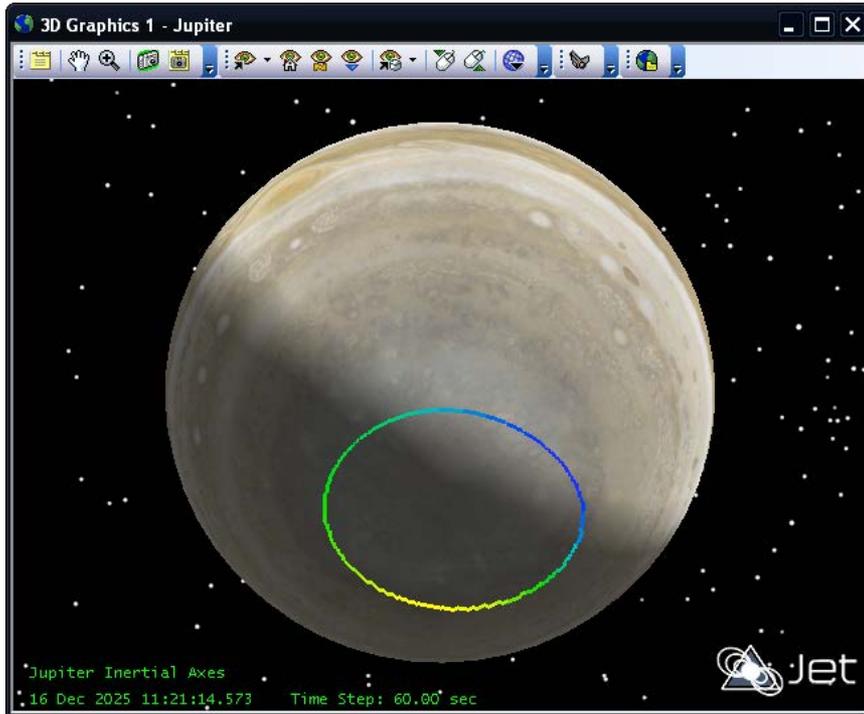
Animation Options

Render during animation Time steps between renders: 1

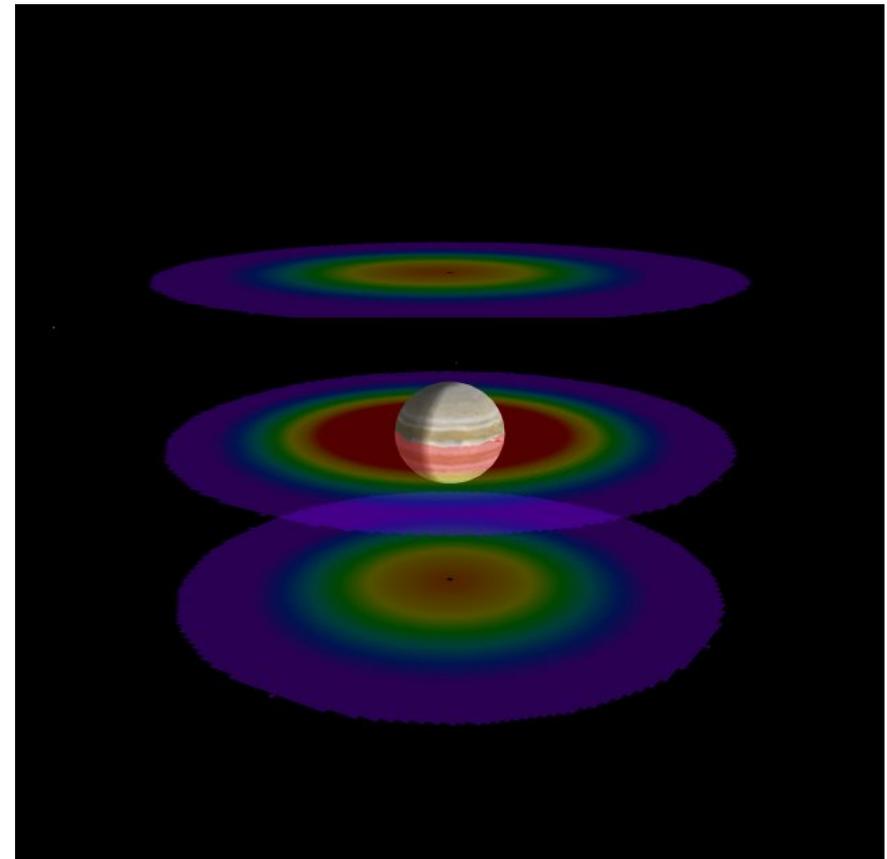
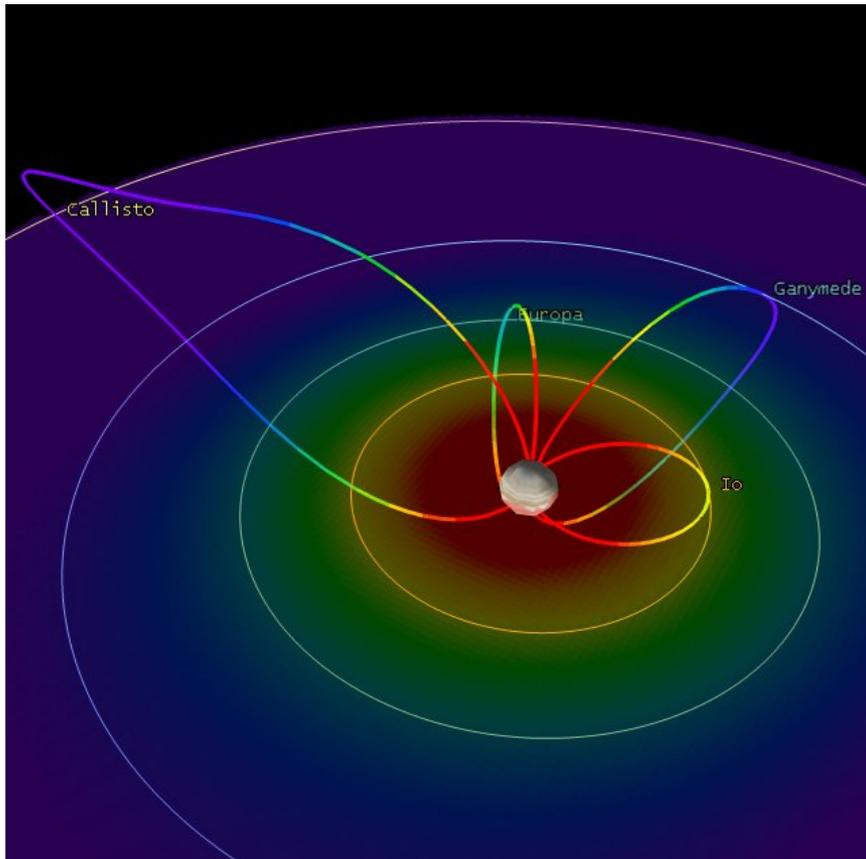
Visualization: Field Lines



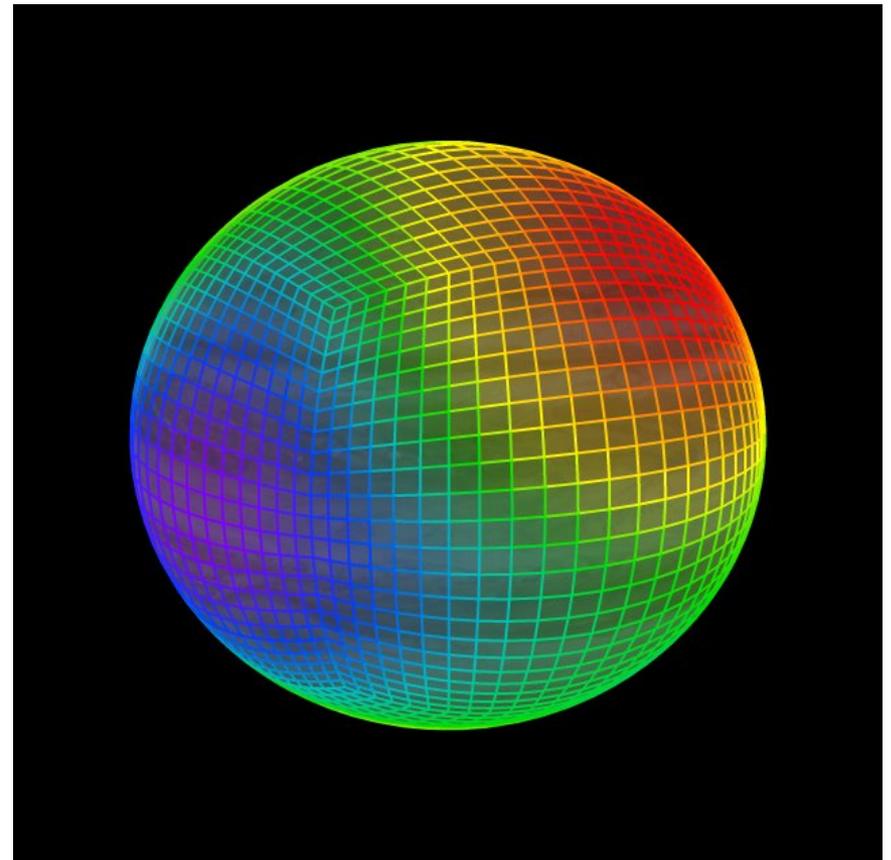
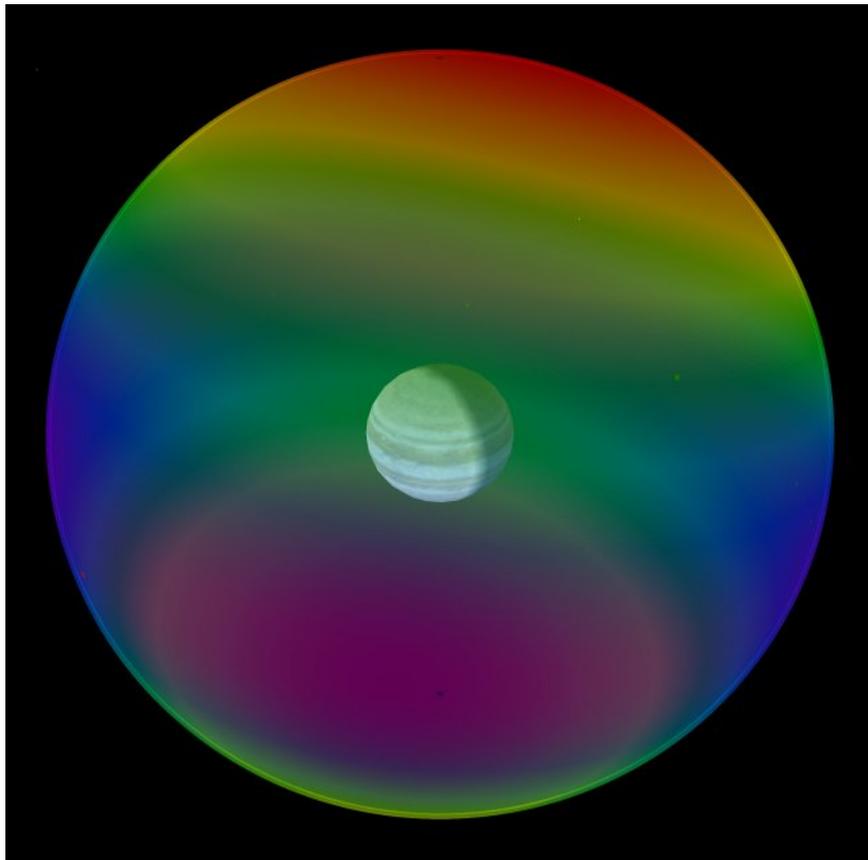
Visualization: Footprint Ovals



Visualization: Planar Contours



Visualization: Spherical Contours



Visualization: Options

JET 1 - Jupiter

Options | Lines | Footprints | Planes | Spheres | About

Model Options

Model	Body Lines	Object Lines	Foot Prints	Planes	Spheres
Dipole	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
VIP4	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
VIP4-F	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Color Options

Color Mode: Magnitude Auto Color Scale

Color Scale Type: Log Show Scale in 3D Windows

Color Scale Min (Gauss): 0.001

Color Scale Max (Gauss): 0.1

Color Scale: 

Gradient Color Editor

Color: Location: 0

Magnitude

- Magnitude
- Equatorial Xing
- Latitude Xing
- Altitude

Gradient Editor

Presets



Load... Save... Load Default Delete

Name: New

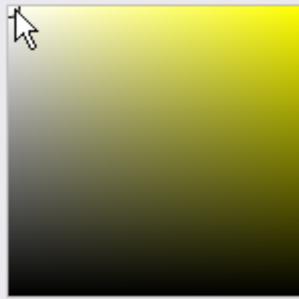
Gradient

Gradient Color Editor

Color: Location: 0

OK Cancel Help

Color Picker



H 60 ° S 0 % V 100 %

R 255 G 255 B 255

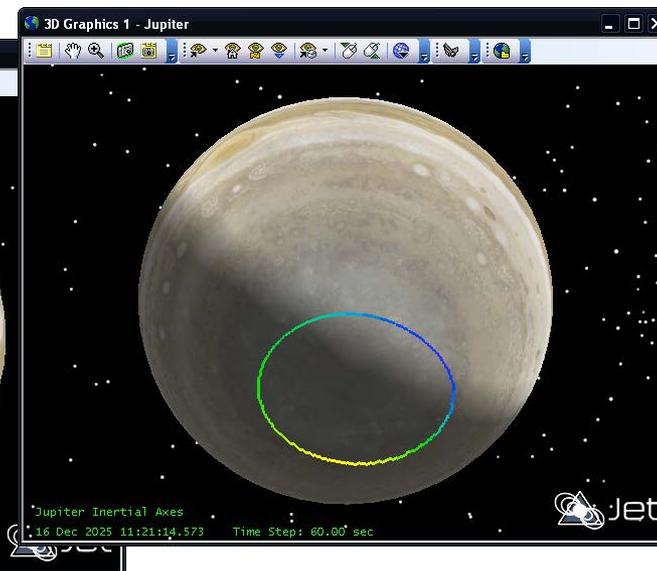
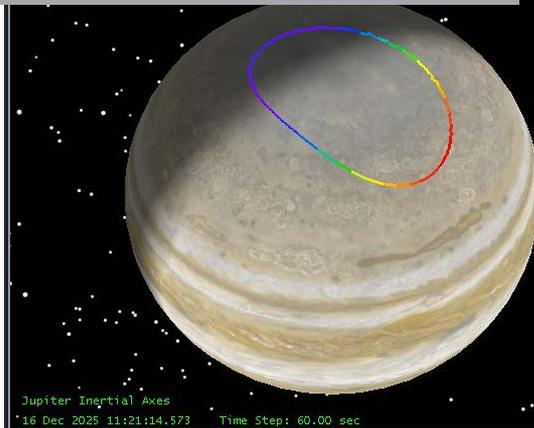
FFFFFF FFFF00

OK Cancel

Footprint Oval Area & Line Targets

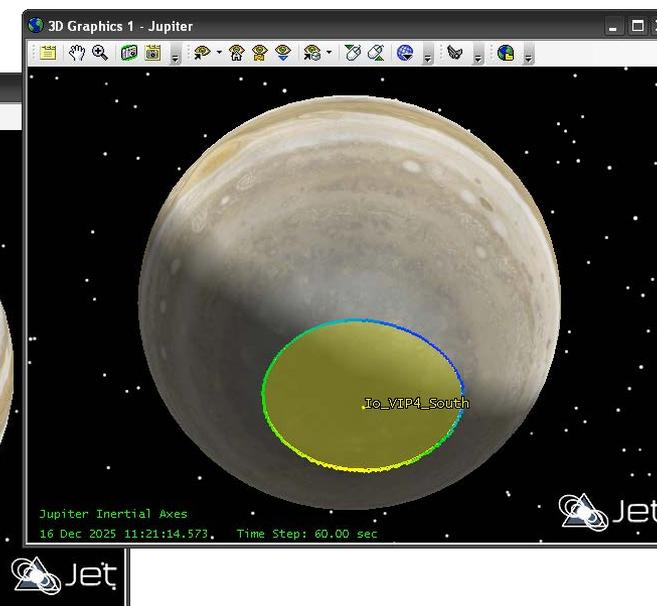
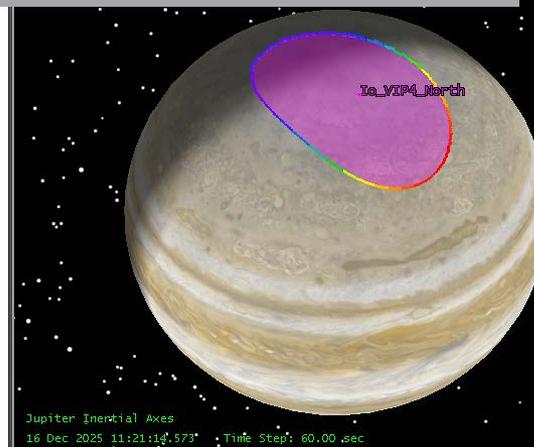
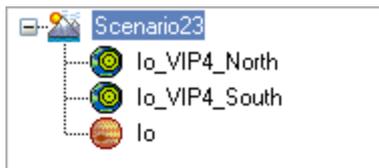
Object Footprints

Objects	Track		Show	Color	Line Width	Line Style	Line Res.	Color Res.
Planet: Io	Lead		<input checked="" type="checkbox"/>	<input type="checkbox"/>	Medium	Solid	Medium	Medium

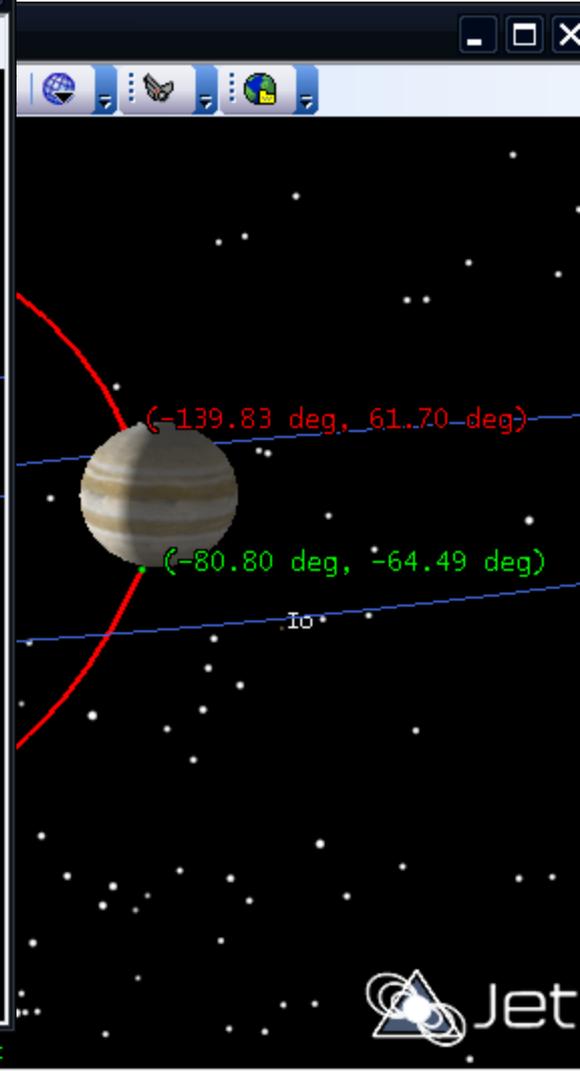
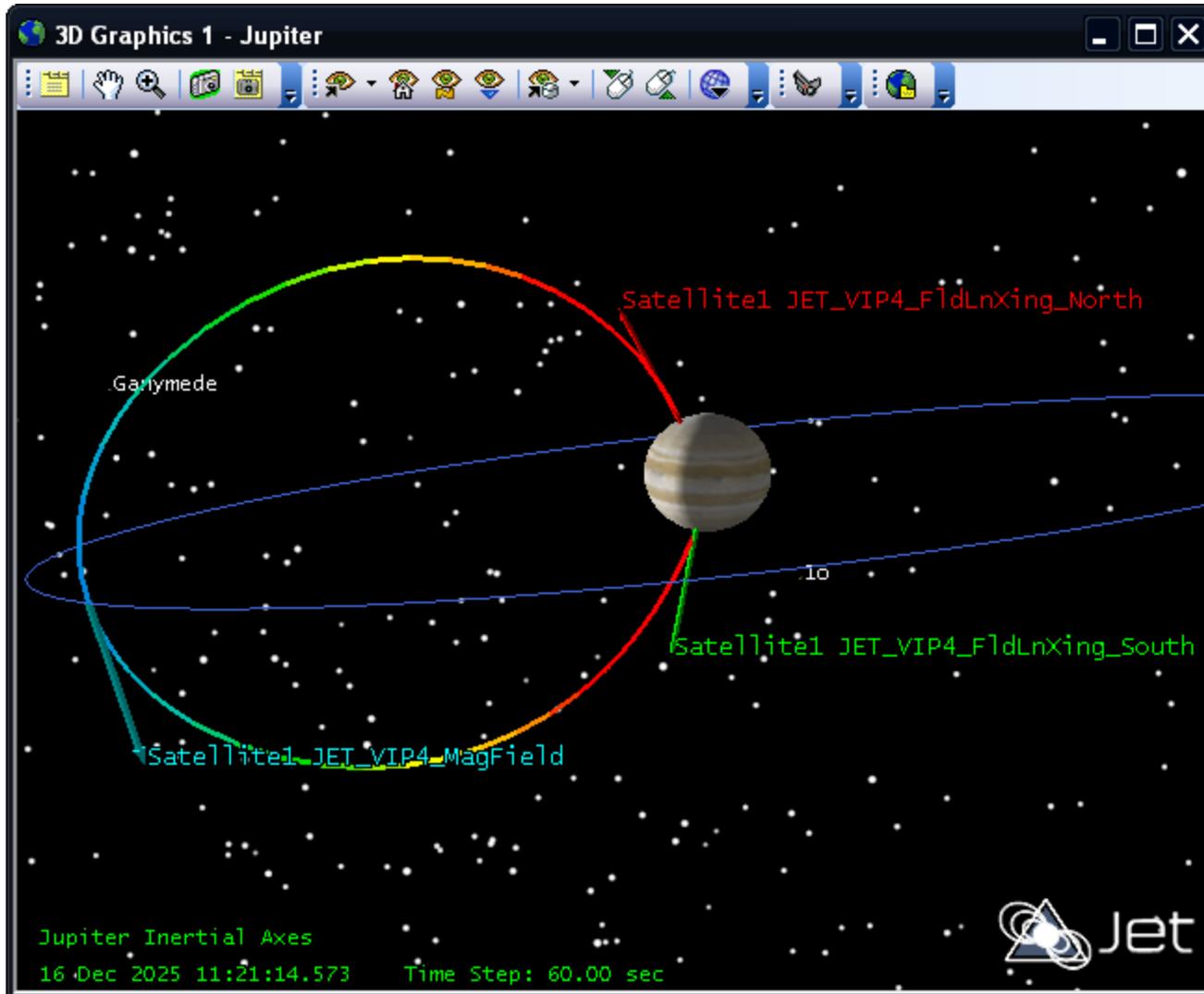


Object Footprints

Objects	Track		Show	Color	Line Width	Line Style	Line Res.	Color Res.
Planet: Io	Lead		<input type="checkbox"/>	<input type="checkbox"/>	Medium	Solid	Medium	Medium



Custom Magnetic Field Vectors



16 Dec 2025 11:21:14.573 Time Step: 60.00 sec

Custom Report & Graph Templates

Report & Graph Manager

Object Type: **Satellite**

Satellite1

Styles

Show Reports Show Graphs



Satellite

- My Styles
- JET_HelpFileTutorial Styles
 - JET
 - Jupiter Templates
 - VIP4_NorthSurface...
 - VIP4_SurfaceXings
 - VIP4_Vector
 - VIP4_Vector
- Installed Styles

Time Properties

Use object properties

Use advanced Advanced...

Specify properties

Start: 1 Apr 2011 00:00:00.000 UTCG

Stop: 2 Apr 2011 00:00:00.000 UTCG

Use default/ephemeris steps

Use step size: 300.000 sec

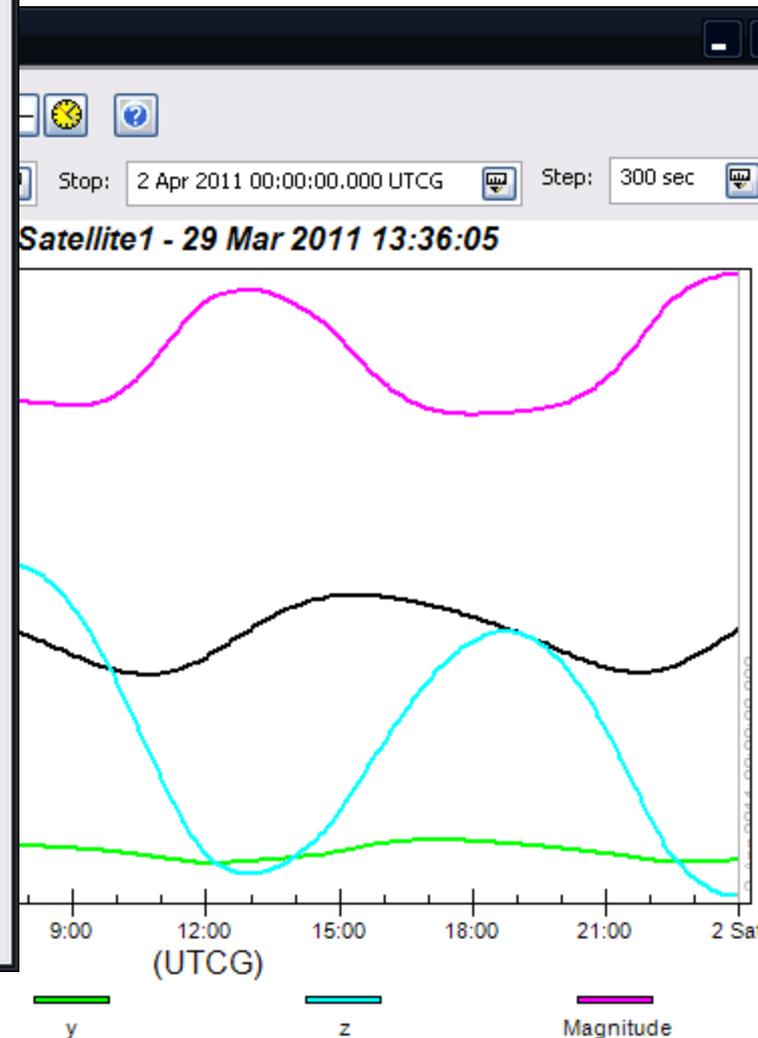
Generate As:

Report/Graph

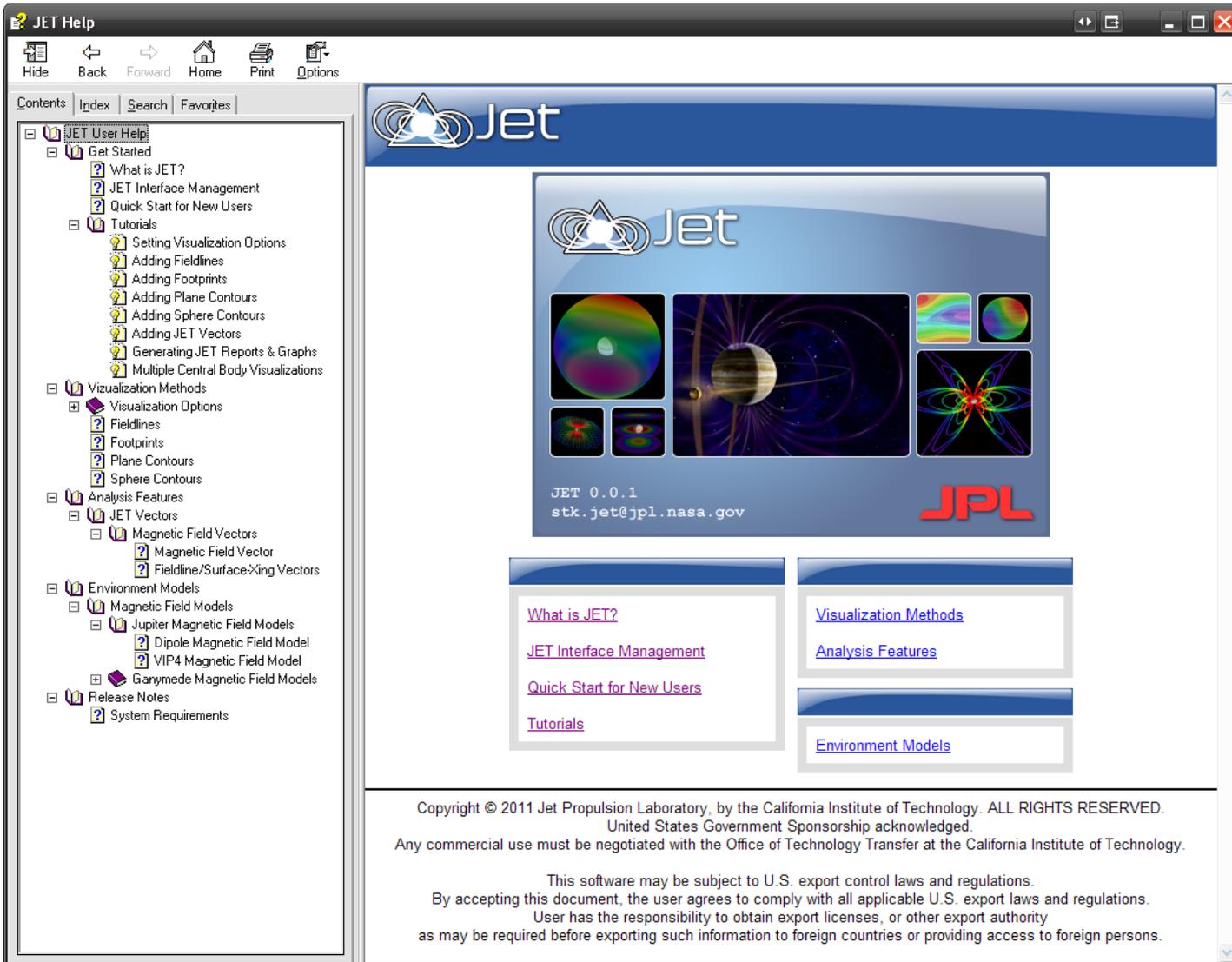
Dynamic Display/Strip Chart

Generate

Close Help



Compiled Help File



The screenshot shows the JET Help application window. The title bar reads "JET Help". The menu bar includes "Hide", "Back", "Forward", "Home", "Print", and "Options". Below the menu bar are tabs for "Contents", "Index", "Search", and "Favorites". The left sidebar contains a tree view of the help content:

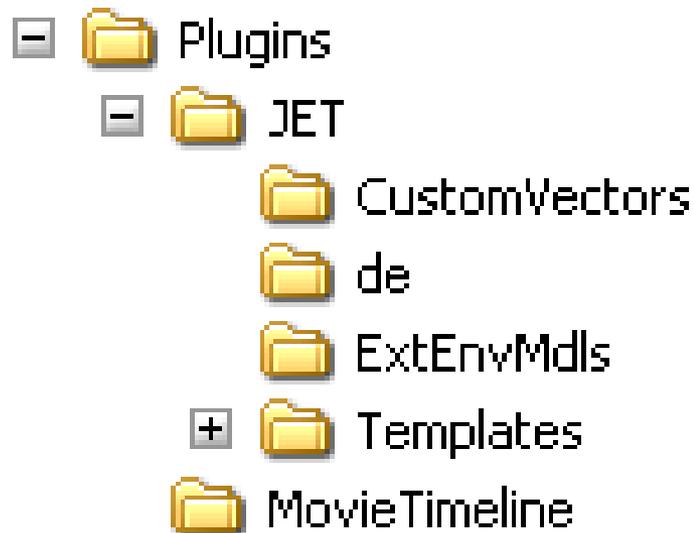
- JET User Help
 - Get Started
 - What is JET?
 - JET Interface Management
 - Quick Start for New Users
 - Tutorials
 - Setting Visualization Options
 - Adding Fieldlines
 - Adding Footprints
 - Adding Plane Contours
 - Adding Sphere Contours
 - Adding JET Vectors
 - Generating JET Reports & Graphs
 - Multiple Central Body Visualizations
 - Visualization Methods
 - Visualization Options
 - Fieldlines
 - Footprints
 - Plane Contours
 - Sphere Contours
 - Analysis Features
 - JET Vectors
 - Magnetic Field Vectors
 - Magnetic Field Vector
 - Fieldline/Surface-Xing Vectors
 - Environment Models
 - Magnetic Field Models
 - Jupiter Magnetic Field Models
 - Dipole Magnetic Field Model
 - VIP4 Magnetic Field Model
 - Ganymede Magnetic Field Models
 - Release Notes
 - System Requirements

The main content area features the JET logo at the top left. Below it is a large image showing various JET visualizations, including a rainbow-colored sphere, a Jupiter-like planet with fieldlines, and a complex fieldline structure. Below the image, the text reads "JET 0.0.1" and "stk.jet@jpl.nasa.gov". The JPL logo is in the bottom right corner of the image. Below the image are several blue buttons with white text, each containing a link to a specific help topic: "What is JET?", "JET Interface Management", "Quick Start for New Users", "Tutorials", "Visualization Methods", "Analysis Features", and "Environment Models".

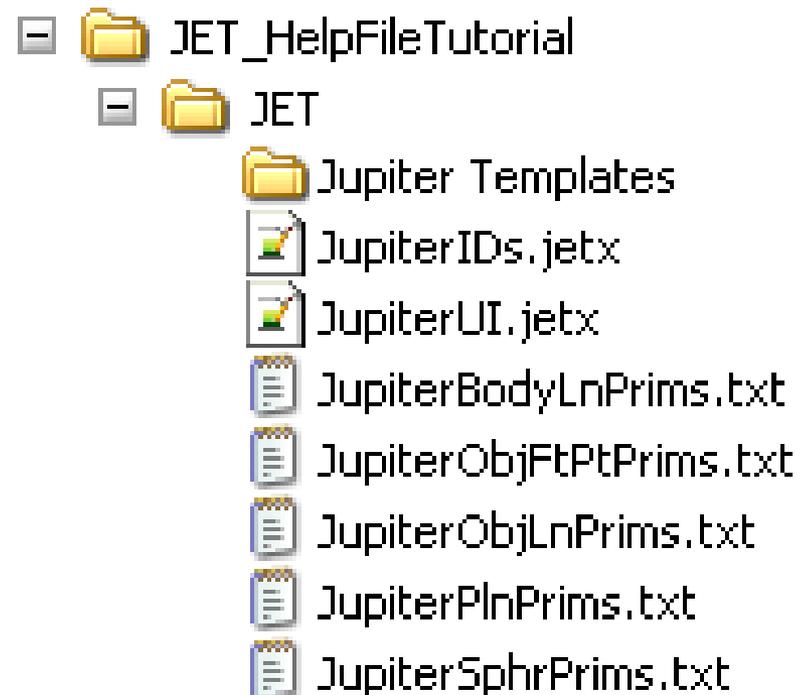
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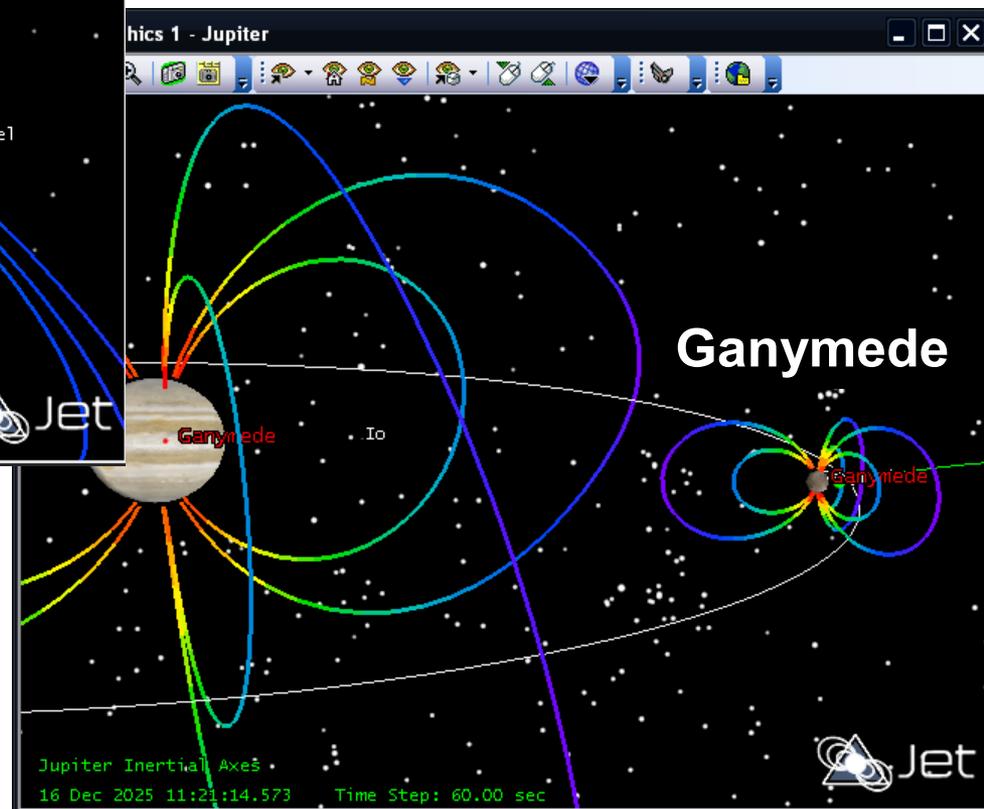
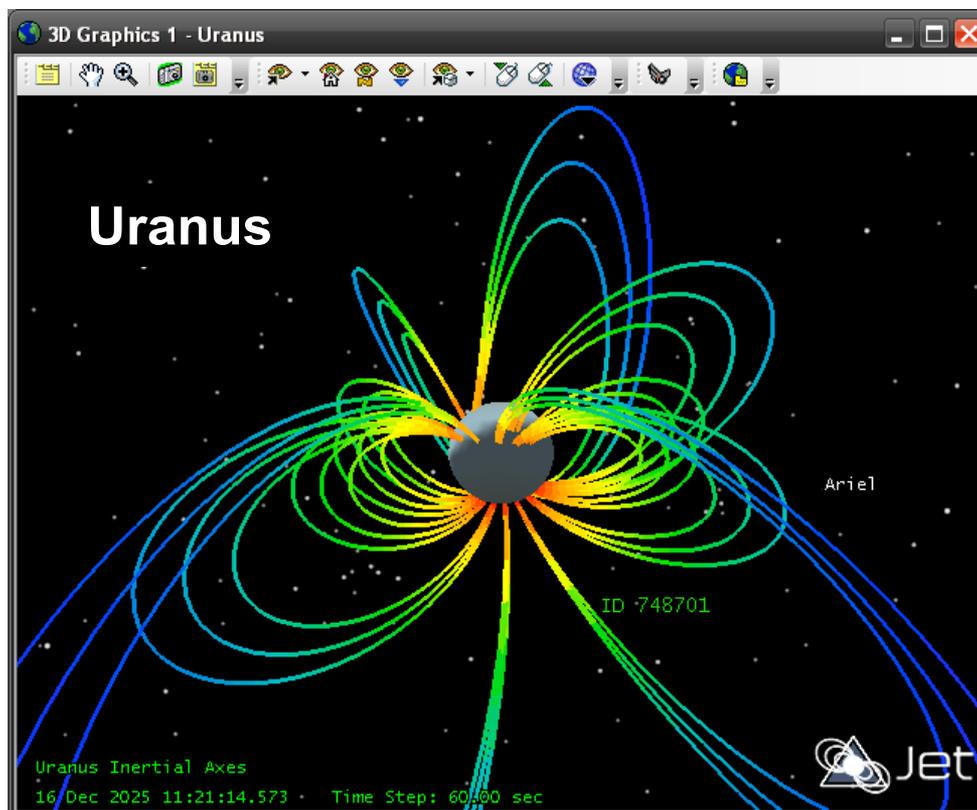
STK Install Directory



Scenario Directory



Beyond Jupiter

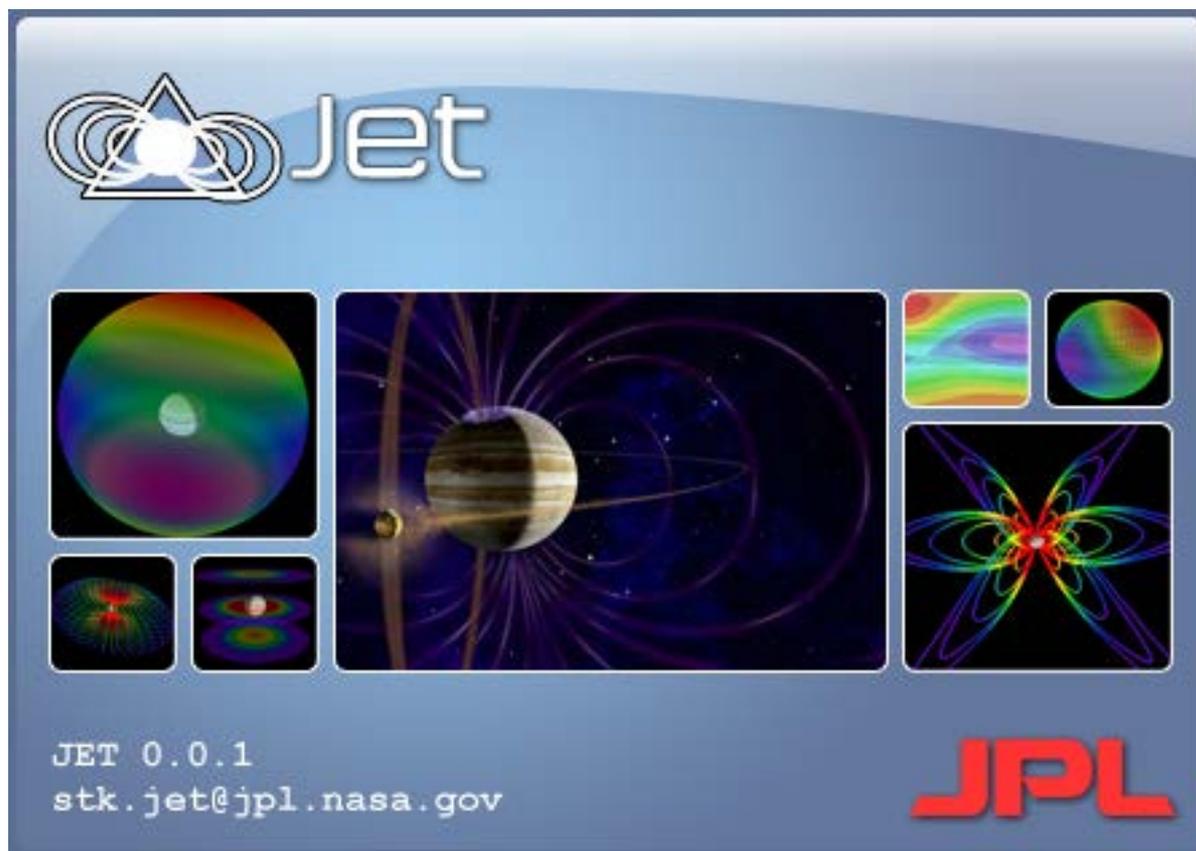


- **Extend to other environment models**
 - Radiation Field
 - Plasma & Neutral Tori
 - Rings / Dust / Small Bodies
 - Satellite Atmospheres

- **Extend to other planets**

- **Clear for public release**
 - Currently releasable on a case-by-case basis
 - For more information on obtaining a copy email:
stk.jet@jpl.nasa.gov

Questions?



The image displays the 'Jet' software interface. At the top left is a logo consisting of a white triangle with a central white circle and several overlapping white circles. To its right is the word 'Jet' in a white, stylized font. Below the logo and text are several visualization windows. The largest window in the center shows a 3D model of Jupiter with its characteristic bands and a complex system of purple magnetic field lines. To the left of this window is a large circular plot with a rainbow color gradient. To the right are two smaller circular plots, one with a rainbow gradient and one with a purple gradient. Below the large Jupiter window are two more small circular plots, one with a rainbow gradient and one with a purple gradient. At the bottom left, the text 'JET 0.0.1' and 'stk.jet@jpl.nasa.gov' is displayed. At the bottom right is the JPL logo in red.

JET 0.0.1
stk.jet@jpl.nasa.gov

JPL