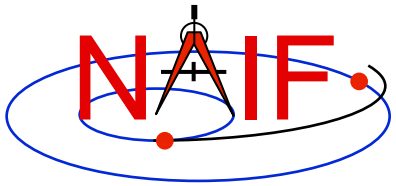

Navigation and Ancillary Information Facility

WebGeocalc: Web Interface to SPICE

B.V. Semenov[1], C.H. Acton[1], N.J. Bachman[1], M.E.Rose[2], and E.D. Wright[1],
[1]Jet Propulsion Laboratory/California Institute of Technology
[2]Ames Research Center/National Aeronautics and Space Administration

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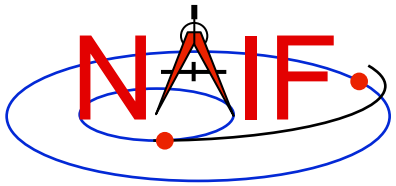
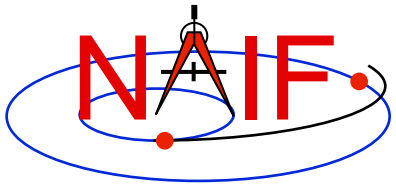


What is WebGeocalc?

- **WGC provides a Graphical User Interface (GUI) front end to a SPICE server running a geometry computation engine**

- **WGC makes it "easy" to do many kinds of SPICE computations**
  - **You need not write a program using SPICE Toolkit software**
  - **Instead, just use a web browser**
  - **Your results, possibly including some plots, appear in your browser window**



Purpose

- **WGC can support planetary mission science and engineering in several ways**
  - **Help a user check his/her own SPICE-based program under development**
  - **Help a user quickly solve a one-time space geometry problem**
  - **Allow those unable to write a SPICE-based program to nevertheless make some kinds of space geometry computations**
  - **Help a science data peer reviewer do spot checks of geometry parameters contained in an archive about to be submitted to an archive center**

WGC Architecture

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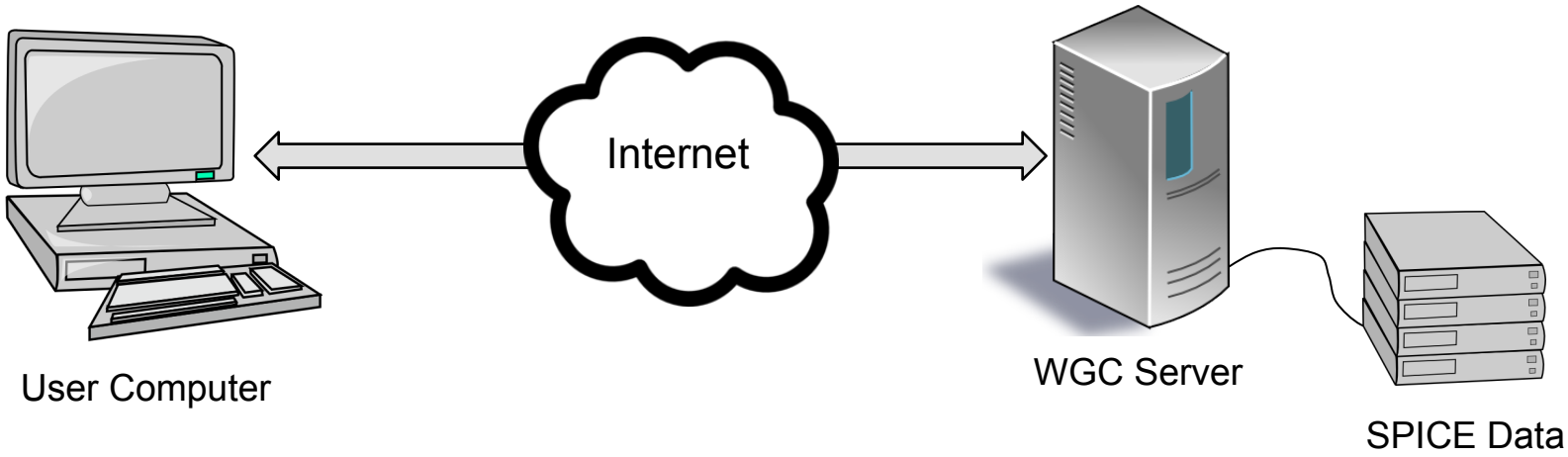
- **WGC uses a client-server architecture**
  - **The user only needs a computer running a web browser**
  - **The browser connects via Internet to a WGC "computation engine" running on a server**
    - » **The WGC server has access to a variety of SPICE kernel files**



Kinds of WGC Computations

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1. **Geometry Calculator**
   - » **Compute a parameter value at a given time, or over a time range**
     - **Example: Compute the angular size of Phobos as seen from the SPIRIT Mars rover from 2009 March 10 12:00:00 to 2009 March 10 14:00:00**
2. **Geometric Event Finder**
   - » **Within a specified time bounds (the confinement window)…**
     - **Find time intervals when a particular geometric condition exists**
       - **Example: Find time intervals when Phobos is occulted by Mars as seen from Mars Odyssey within the period 2010 June 01 to 2010 June 02**
     - **Find time intervals when a parameter is within a given range**
       - **Example: Find time intervals when the spacecraft altitude is between 300 and 400 km**
     - **Find time intervals when a parameter has reached a local or global maximum or minimum**
       - **Example: Find time intervals when the angular separation of a satellite from a planet, as seen from a spacecraft, has reached its minimum value**
3. **Time conversion calculator**
   - » **Convert between various time systems and time formats**

Computation Menu

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Geometry Calculator

State Vector	Position and velocity of target relative to observer.
Angular Separation	Angle between 2 targets as seen from an observer.
Angular Size	Apparent size of a target as seen from an observer, as an angle.
Frame Transformation	Transformation between 2 reference frames.
Illumination Angles	Sunlight incidence, emission, and phase angles at a point on a target body as seen from an observer.
Sub-solar Point	Sub-solar point on a target body as seen from an observer.
Sub-observer Point	Closest point on a target body to an observer.
Surface Intercept Point	Coordinates of the intercept point of a ray in a reference frame, as seen from an observer.
Orbital Elements	Orbital parameters of a target body relative to a central observing body.

Geometric Event Finder

Position Finder	Find time intervals when target coordinate satisfies a condition.
Angular Separation Finder	Find time intervals when the angle between 2 bodies, as seen by an observer, satisfies a condition.
Distance Finder	Find time intervals when the distance between a target and observer satisfies a condition.
Sub-Point Finder	Find time intervals when the sub-observer point on a target satisfies a condition.
Occultation Finder	Find time intervals when a target is occulted by, or is in transit across, another body.
Surface Intercept Finder	Find time intervals when the surface intercept of a ray in a reference frame satifies a coordinate condition.
Target in Field of View	Find time intervals when a target is within the field of view of an instrument.
Ray in Field of View	Find time intervals when a specified ray is within the field of view of an instrument.

Time Calculator

Time Conversion	Convert time values from one time system to another.

Typical Geometry Calculator Input

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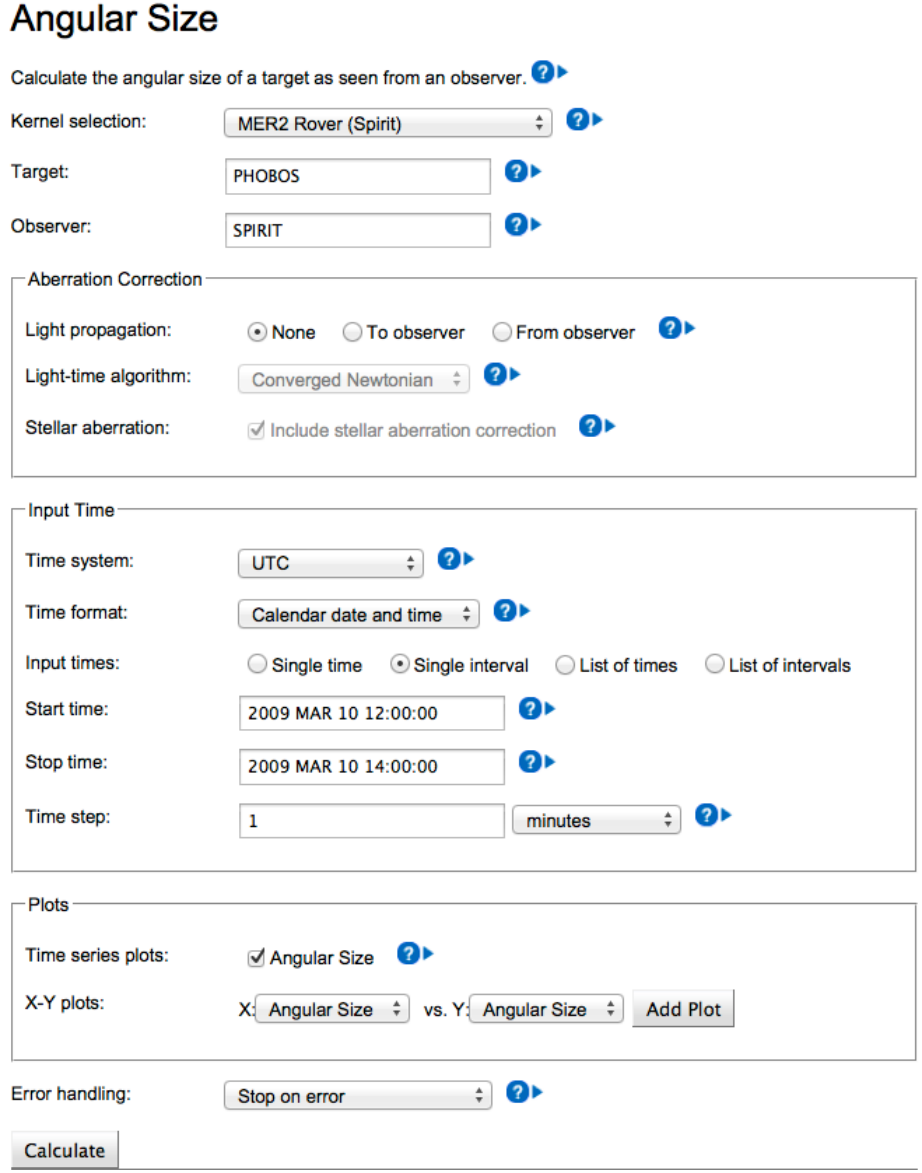

- **Compute the angular size of Phobos as seen from the Mars rover "SPIRIT" over a two hour period on 2009 March 10**
- **Use typical GUI drop-down menus, fill-in boxes, radio buttons and check boxes to specify the details of the computation you wish to make**

Typical Geometry Calculator Output

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Input Values

Calculation type	Angular Size
Target	PHOBOS
Observer	SPIRIT
Light propagation	No correction
Time system	UTC
Time format	Calendar date and time
Time range	2009 MAR 10 12:00:00 to 2009 MAR 10 14:00:00, step 1 minutes

Summary of your input

Angular size of Phobos as seen from the Mars rover "SPIRIT"

Tabular Results

Click a value to save it for a subsequent calculation.

	UTC calendar date	Angular Size (deg)
1	2009-03-10 12:00:00.000000 UTC	0.20212256
2	2009-03-10 12:01:00.000000 UTC	0.20294481
3	2009-03-10 12:02:00.000000 UTC	0.20377024
4	2009-03-10 12:03:00.000000 UTC	0.20459871
5	2009-03-10 12:04:00.000000 UTC	0.20543007
6	2009-03-10 12:05:00.000000 UTC	0.20626418
7	2009-03-10 12:06:00.000000 UTC	0.20710088
8	2009-03-10 12:07:00.000000 UTC	0.20794000
9	2009-03-10 12:08:00.000000 UTC	0.20878138
10	2009-03-10 12:09:00.000000 UTC	0.20962484
11	2009-03-10 12:10:00.000000 UTC	0.21047019
12	2009-03-10 12:11:00.000000 UTC	0.21131725
13	2009-03-10 12:12:00.000000 UTC	0.21216581
14	2009-03-10 12:13:00.000000 UTC	0.21301567

Tabular results

Typical Geometry Calculator Plot

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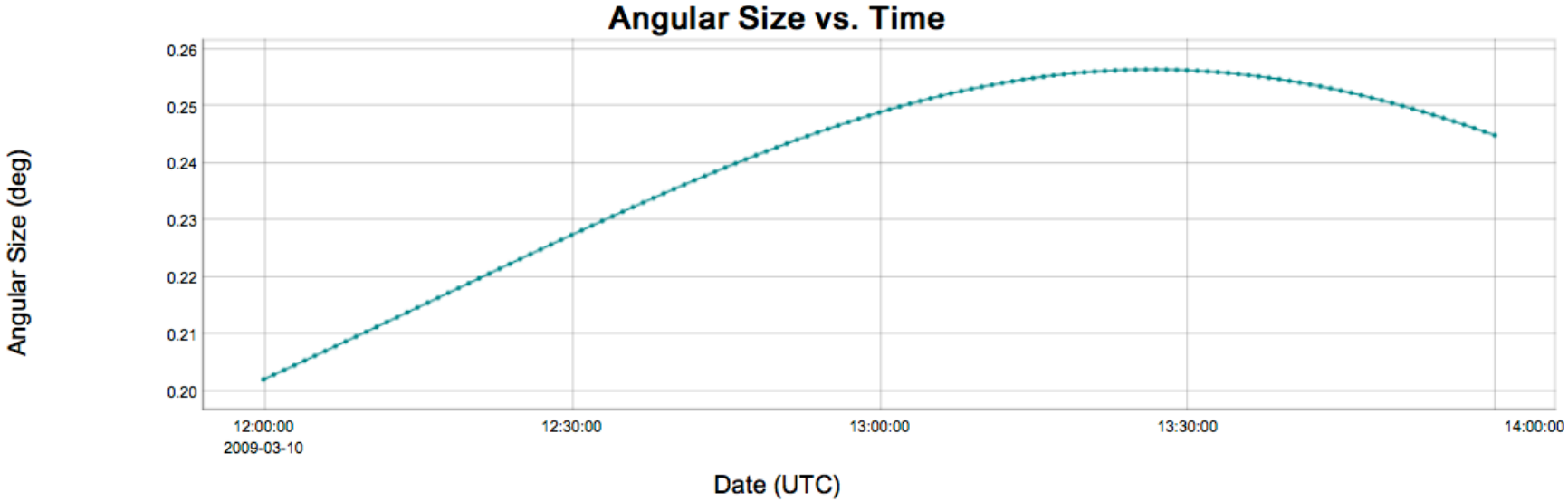
- **Some Geometry Calculator computations offer optional plots**
- **Output quantities can be plotted vs. time or each other**



Angular size of Phobos as seen from the Mars rover "SPIRIT"

Typical Geometric Event Finder Input

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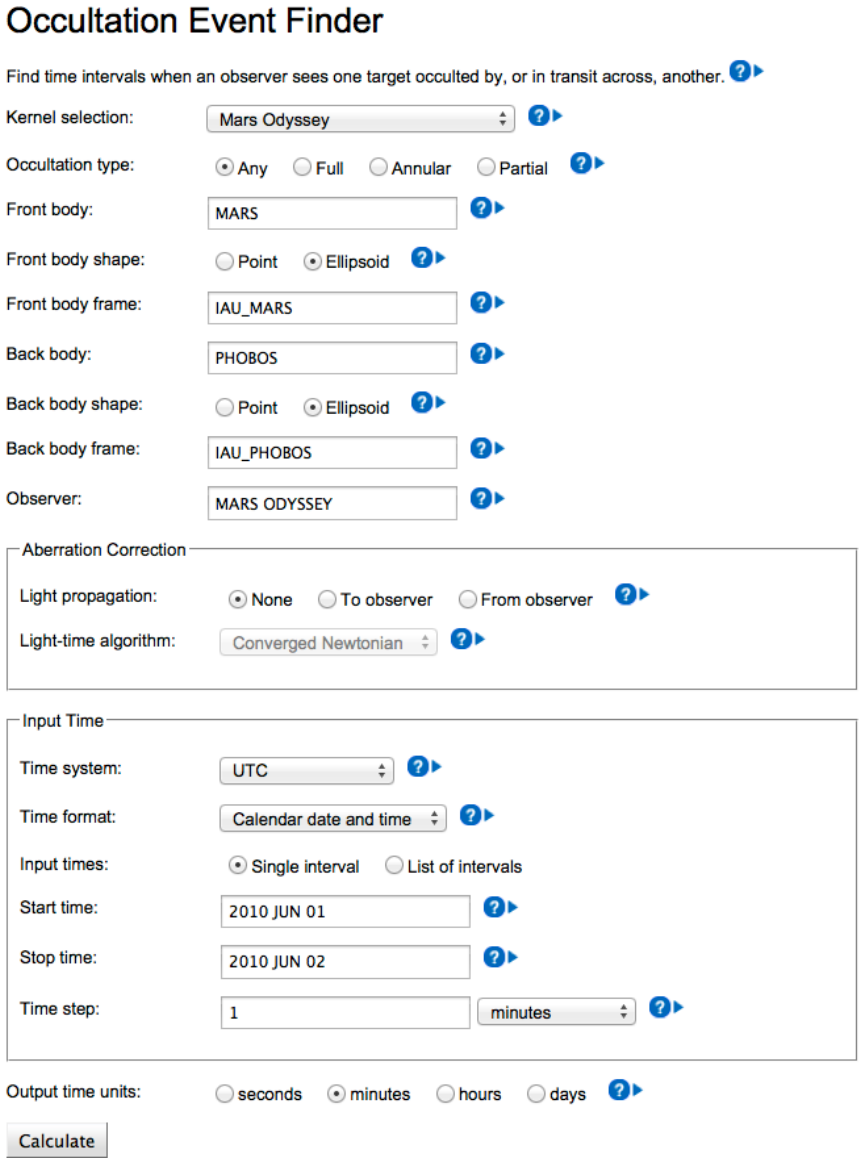

- **Find the times when Phobos is occulted by Mars as viewed from the Mars Odyssey spacecraft, during the period 2010 JUN 01 to 2010 JUN 02**

- **Use typical GUI drop-down menus, fill-in boxes, radio buttons and check boxes to specify the details of the computation you wish to make**

Typical Geometric Event Finder Output

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Input Values

Calculation type	Occultation Event Finder
Occultation type	Any
Front body	MARS
Front body shape	Ellipsoid
Front body frame	IAU_MARS
Back body	PHOBOS
Back body shape	Ellipsoid
Back body frame	IAU_PHOBOS
Observer	MARS ODYSSEY
Light propagation	No correction
Time system	UTC
Time format	Calendar date and time
Time range	2010 JUN 01 to 2010 JUN 02, step 1 minutes
Output time units	minutes

Summary of your input

When is Phobos occulted by Mars as seen from Mars Odyssey?

Tabular Results

Click a value to save it for a subsequent calculation.

Save All Intervals

	Start Time	Stop Time	Duration (mins)
1	2010-06-01 00:04:26.021732 UTC	2010-06-01 00:51:10.264641 UTC	46.737381
2	2010-06-01 01:24:29.613301 UTC	2010-06-01 02:00:24.470706 UTC	35.914290
3	2010-06-01 03:03:10.407364 UTC	2010-06-01 03:57:18.126849 UTC	54.128658
4	2010-06-01 06:01:49.736199 UTC	2010-06-01 06:55:34.722424 UTC	53.749770
5	2010-06-01 07:58:43.095947 UTC	2010-06-01 08:39:21.182114 UTC	40.634769
6	2010-06-01 09:10:48.846727 UTC	2010-06-01 09:54:44.492005 UTC	43.927421
7	2010-06-01 10:57:18.630420 UTC	2010-06-01 11:50:49.343214 UTC	53.511879
8	2010-06-01 13:55:36.186600 UTC	2010-06-01 14:49:37.827064 UTC	54.027341
9	2010-06-01 15:53:04.642891 UTC	2010-06-01 16:24:27.068718 UTC	31.373763
10	2010-06-01 17:00:06.149085 UTC	2010-06-01 17:48:55.474342 UTC	48.822087
11	2010-06-01 18:51:22.462322 UTC	2010-06-01 19:43:35.637833 UTC	52.219591
12	2010-06-01 20:25:04.806659 UTC	2010-06-01 20:44:18.076413 UTC	19.221162
13	2010-06-01 21:49:30.099608 UTC	2010-06-01 22:43:34.010176 UTC	54.065176

Tabular results

Typical Geometric Event Finder Plot

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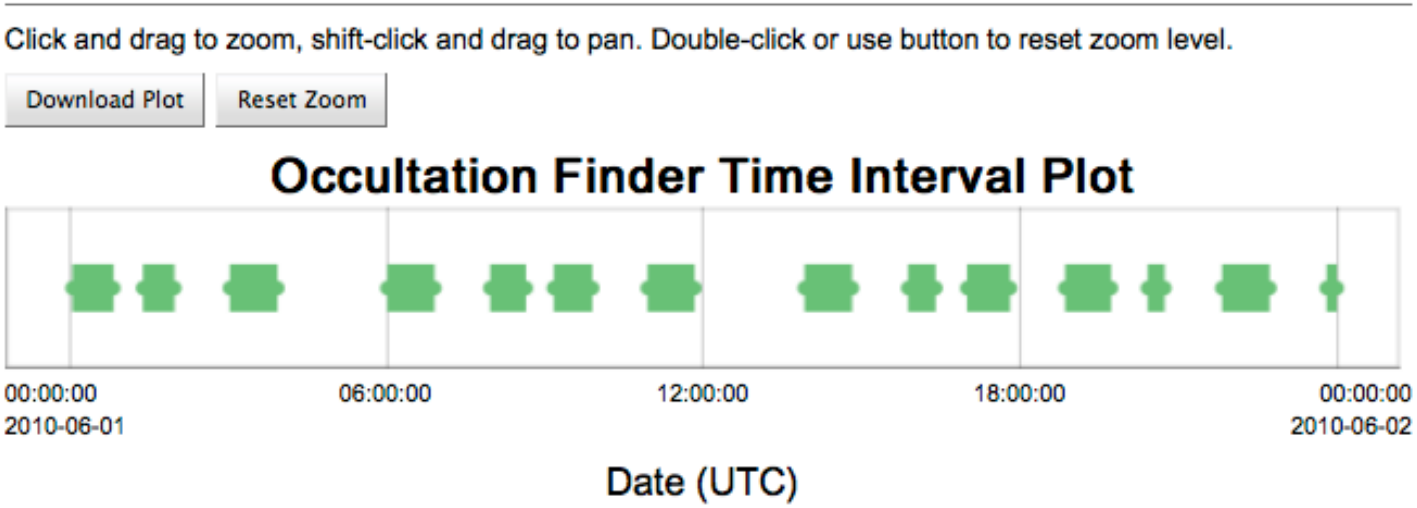
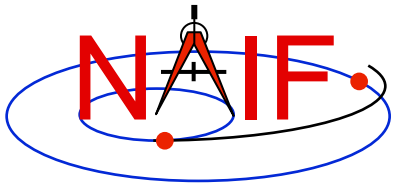
- **Geometric Event Finder computations all produce "plots" of the time intervals that satisfy search constraints**



Between June 1, 2010 and June 2, 2010, find times when Phobos is occulted by Mars, as viewed from the Mars Odyssey spacecraft



Downloading Results

- **Tabular results can be downloaded to the user's computer by clicking the "Download Results" button, then selecting the format desired:**
  - **Excel**
  - **Comma separated values**
  - **Plain text**

- **Any plots can be downloaded by clicking on the "Download Plot" button**
  - **Plots are saved in PNG format with a transparent background**
    - » **Easily pasted into a document or presentation**

Saving Results for Use as New Inputs

- **Numeric outputs or an event finder intervals' start and stop times can be saved for future use in WGC by clicking on the values**
  - **The saved value will appear in a "Saved Values" panel on the right side of the browser window**
  - **This value can then be dragged to an input widget in a subsequent calculation**
- **The complete set of event finder output interval start and stop times can be saved by clicking the "Save All Intervals" button**
  - **These can then be used as part of the input for a subsequent geometric event finder or geometry calculator computation by selecting "List of intervals" for the "Input times" selection and drag-n-dropping the saved interval list into that window**
  - **Saving intervals allows cascading searches and computing various geometric parameters within search output intervals**

WGC at NAIF

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- **As of March 2016 only the JPL/NAIF Group is operating a WGC server**

  http://wgc.jpl.nasa.gov:8080/webgeocalc

  - This server provides access to three categories of SPICE data (kernels)
    - » **Generic** SPICE data, not specifically tied to a single planetary mission
    - » **Archived** SPICE data, from planetary missions that have been formally ingested into NASA's Planetary Data System
      - This includes a few non-NASA missions for which NAIF provides a shadow archive
    - » **"Operations"** SPICE data, for JPL-operated planetary missions, for three ESA planetary missions, and for a few past missions for which an archive does not exist
  - Important details regarding each of the three categories are described in "*About the data*" page linked from the tool

WGC at NAIF: Kernel Selection

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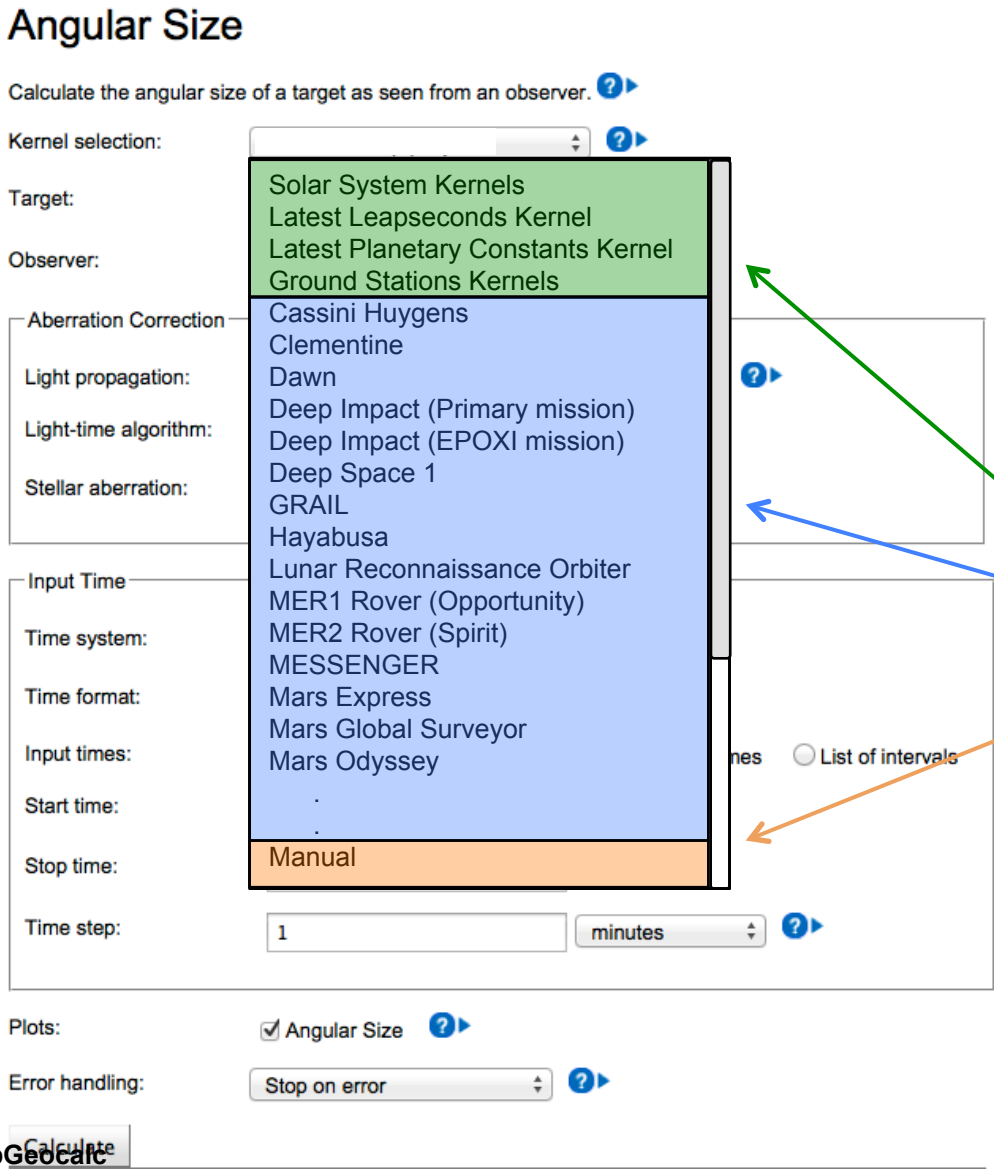


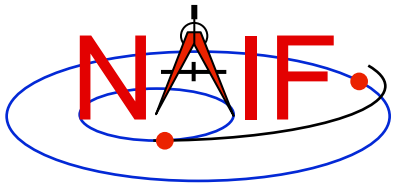
A scrollable drop-down menu is used to select the kernel set(s) to be used in your calculation.

Use the menu to select:

- generic kernel sets

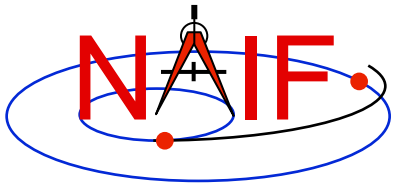
- archived mission kernel sets (includes relevant generic kernels)

- manual selection of individual kernels from operations collections



WGC Programmatic Interface

- The most recent addition to the WGC capabilities is a programmatic interface (API)
- The API allows access to all WGC calculations over HTTP using RESTful request URLs with JSON payloads and results
- Any programming tool capable of sending and receiving HTTP(S) data can call WGC APIs over the network to use the full WGC functionality, including
  - Retrieving a list of kernel sets available to WGC
  - requesting details about each kernel set
  - requesting, monitoring the progress of, and retrieving results from any calculation available in WGC



WGC Installation

- The WGC server is a Web application that runs inside a Tomcat J2EE web container and makes use of a MySQL database
- The server can be installed on any workstation that has
  - Java
  - Apache Tomcat
  - MySQL Community Server
- The server installation and configuration process includes
  - Creating meta-kernels used by “named” kernel sets
  - Creating CSV configuration file defining “named” kernel sets
  - Creating a text properties file defining WGC deployment attributes
  - Creating and loading MySQL database with kernel set information
  - Configuring WGC WAR file and deploying it to the Tomcat server

WGC Server Distribution

- **NAIF does not plan to distribute the WGC server software to the general public**

- **But NAIF might make the WGC server software available to organizations involved in planetary exploration, with significant experience with SPICE and a clear need to manage their own kernel sets used by WGC.**
  - **In this case NAIF will provide the WGC server binary WAR file together with installation and kernel database configuration instructions**

- **If interested, contact NAIF manager Charles Acton to discuss this possibility**
  - **Charles.Acton(at)jpl.nasa.gov**