



Orbcomm View ver. 2.0

User's Manual

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N o r t h e r n L i g h t s S o f t w a r e
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Orbcomm View

User's Manual

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ORBCOMM

Introduction

Orbcomm View ("OV") is an innovative map-based satellite tracking program. It features realistic 256-color maps and an unlimited numbers of satellites, observers, and views.

Orbcomm View is available in two forms: 16- and 32-bit. The 16-bit version of OV runs under Microsoft® Windows 3.1 and later (including Windows '95) whereas OV32 requires Microsoft® Windows '95 or Windows NT.

Features:

- Visually stunning maps, projections, styles, and sizes
- Unlimited numbers of satellites, observers, and views simultaneously
- Tracks all artificial satellites, Moon, Sun, planets, and celestial noise sources
- Fast, accurate, and clear satellite positions
- Floating/docking toolbar for easy access to common functions
- Context-sensitive online help
- Multi-level configuration setup screens
- Text listings to screen, printer, or disk file
- Priority tracking of groups of satellites
- Two-satellite mutual visibility, including 1- and 2-observer 2-satellite mutual windows
- Satellite eclipse predictions
- 2,000-city database included

In this manual, references to "OV" apply to both varieties of the program (16- and 32-bit); "OV32" refers to specific features found only in the 32-bit version.

System requirements:

- 33 MHz 80386 (or better) processor, Pentium® preferred for OV32
- Math coprocessor required
- **Orbcomm View 16** (16-bit): Microsoft® Windows 3.1x (or Windows '95)
- **Orbcomm View 32:** Microsoft® Windows '95 or Windows NT
- Video: 256 colors or more; 800x600, 16-bit color preferred
- At least 10 MB hard disk drive storage

Installing Orbcomm View

From diskette:

- Insert the Orbcomm View **Disk #1** into the floppy disk drive of your computer.
- If you are using Windows 3.1x, click on *File* (top left in Program Manager)
- If you are using Windows 95, click on the *Start* button (lower left corner of the Windows desktop).
- Click on *Run*.
- In the file name box, type **A:Setup.EXE**.
- Follow the directions in the Orbcomm View Setup.

From the Orbcomm Network:

- Click on *Network Neighborhood*
- Click on *OCC*, then *Volume 2*
- Click on *OV*
- Double-click *OV_16.EXE* or *OV_32.EXE*
- This begins installation process on your computer

Orbcomm View's Views

Orbcomm View displays satellite tracking information in "Views." A View consists of a map, columnar text data, or both together. One or more Views may be visible simultaneously. Each View is completely independent of the others; different Views may contain different satellites, observers, and time/date. A View may include a map, text data, or both at once. OV may have as many Views active as you desire.

In normal use, two or three Views is usually sufficient, but there is no inherent limit to the number of Views that may be open simultaneously. Each View can track an unlimited number of satellites and observers. Satellite positions are displayed on maps and numerical data are displayed in columnar format as shown below.

Views are created by double-clicking anywhere on the OV "desktop," by choosing **Views/Create new View** from the main menu, or by clicking on the  *New View* button on the toolbar.



Orbcomm View's Views may contain text, map, or both. This View shows a Rectangular-style map.

Text

The text portion of Views displays each satellite's current position as well as a summary of the next pass.

The layout of the text display is dependent on the number of observers currently active in the View. The text displays the greatest amount of information if one observer is specified. Two observers' data are summarized in a format similar to that of one observer but with fewer lines of data for each observer. If more than two observers are included in the View's list then each satellite's current position is listed for each observer.

Maps

Orbcomm View contains four major map types with many user-modifiable attributes in each map:

- Rectangular (modified Miller projection)
- View from Space (Orthographic projection)
- Radar (upper hemisphere projection)
- Sky Noise (rectilinear RA/Dec projection)

The **Rectangular** map (above) covers most of the Earth; only the poles are omitted. It is convenient for showing the positions of several satellites and their footprints at once. The rectangular map can be set to display any longitude at the center. Individual continents can be "zoomed in" for greater detail. On the standard 800*600 display, the single-continent rectangular map displays a resolution of about 12 km per pixel. Land and water are accurately shaded to illustrate elevation and depth, respectively.

9/21/97 16:01:07 UTC

Change the continent at the center of the map by mouse-clicking on a new continent.

Satellite's "footprint," the area of the Earth visible to the satellite at this moment.

| 1 Sat | F1 |
|------------|----------|
| Azimuth | 116.8° |
| Elevation | -1.2° |
| Range | 3,115.2 |
| Height | 748.9 |
| AOS time | 16:01:18 |
| LOS time | 16:04:38 |
| Until | 00:01:10 |
| Duration | 00:03:20 |
| AOS Az. | 108° |
| Max El. | 1° |
| LOS Az. | 79° |
| Orbit Num. | 13034 |
| Keps age | 76d,03hr |

Real-time text data concerning the satellite. You can show as many columns of data as there are satellites in the View (see Individual View Configuration/Text columns).

*The **View from Space** presents the Earth in a 3-dimensional perspective. You may configure the map to show ground tracks, orbits, and satellite footprints.*

The **View from Space** map shows a realistic perspective of the Earth from a position out in space. The land surface is rendered to show topography and the oceans are shaded to indicate water depth. The position is centered over one of the continents. You may change the center continent in one of two ways:

- Left-mouse click directly on the continent that you want to turn to;
- In the **Map Configuration** screen (accessed from the  *Configure Maps* button on the ToolBar or the View's pop-up, activated by clicking the right mouse button).

In addition, you can easily change the apparent distance from which the Earth is viewed by clicking the left mouse button out in space, away from the Earth's image.

Clicking on the View from Space map near a satellite will display a pop-up information window about that satellite.

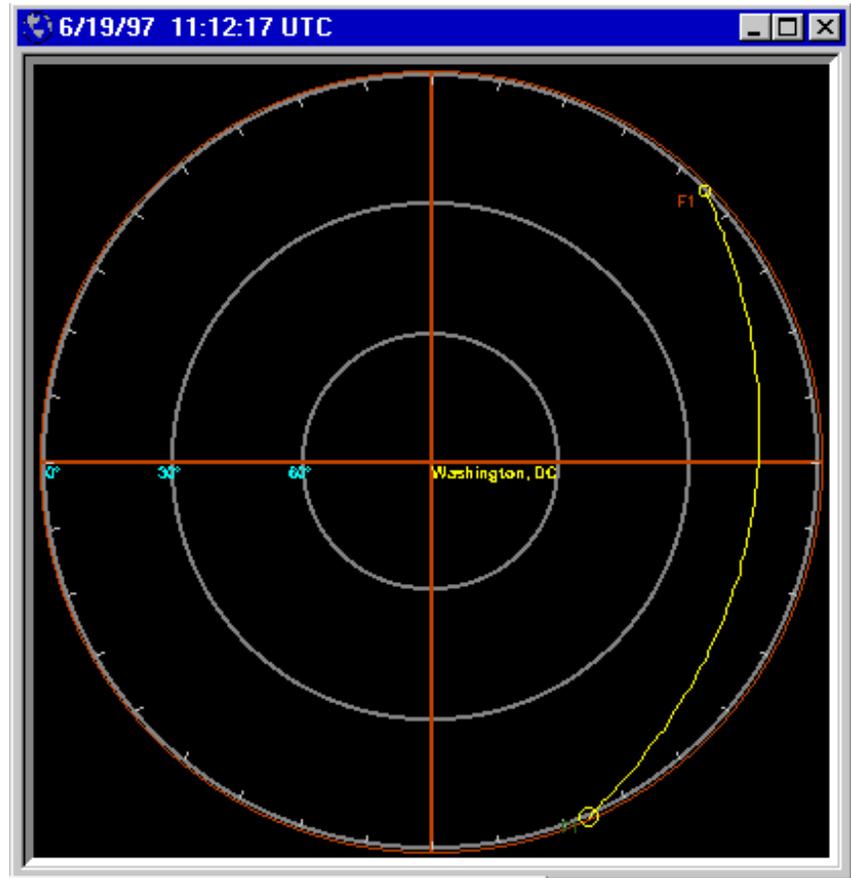
| F1 | |
|------------|--------------|
| Orbit Num: | 13036 |
| Azimuth : | 31.5° |
| Elevation: | -21.6° |
| SSP Lat : | 63.8°N |
| SSP Lon : | 14.9°E |
| Range : | 6,340.3 km |
| Height : | 757.4 km |
| Next AOS : | 02:20:42 UTC |
| Next LOS : | 02:32:42 UTC |
| Until : | 06:38:44 |
| Duration : | 00:12:00 |
| Mode : | GlobalGram |

Pop-up information about a satellite is available by clicking on its name in any map.

The **Radar Map**, a Northern Lights Software innovation, displays a view of the sky with the observer at the center, similar to a radar station. North is at the top of the map, east to the right, etc., like a compass. The outer perimeter of the Radar Map represents the observer's horizon and the center of the Radar Map is directly overhead. As a satellite becomes visible, it appears on the map's perimeter and passes inside the circle. The higher the satellite gets in the sky, the closer to the center of the map it appears.

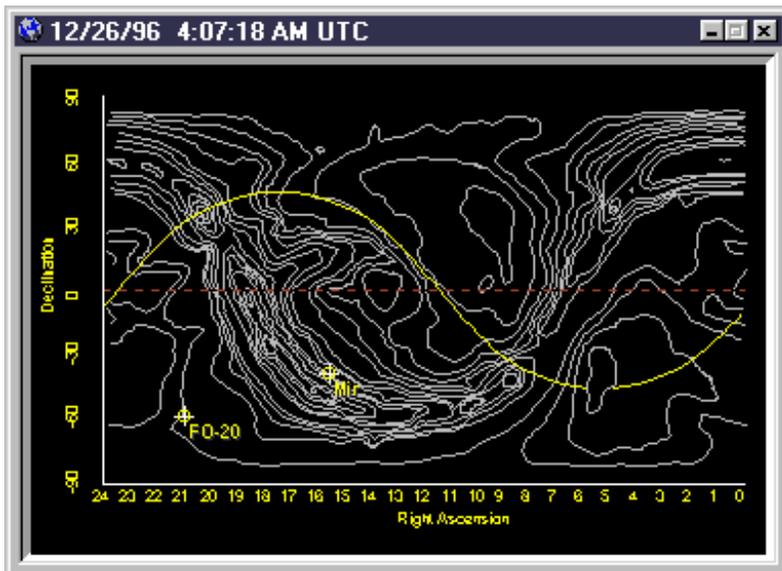
Like all maps, the Radar Map is configured in the Map Configuration screen. Upcoming passes can be displayed as arcs across the map. The rise-point of a pass is shown as a larger circle and the set-point is a smaller circle; this permits visualization of the direction that the pass will travel across the sky.

The **Sky Temperature Map** portrays the sky's "equivalent noise temperature." Thermal noise, generated by billions of stars in the universe, is more concentrated in some parts of the sky than others. Contour lines on the Sky Temperature map are similar to contour lines on a topographic map; they show areas of higher or lower amounts of sky noise.



OV's Radar map shows a full view of the Observer's sky. Overhead is in the center of the Radar map.

This information is useful in situations where desired signals from space are extremely weak. If the source of the signals (for example, a failing artificial satellite) is "in front of" noisy areas, then the signals are much more difficult to detect.



The axes of the Sky Temperature map are familiar to astronomers but perhaps not to satellite users. The vertical axis is Declination, which is the angle between the item of interest and the celestial equator (the imaginary extension of the Earth's equator into space). The horizontal axis is in Right Ascension. This represents the angle (measured in hours = 15°) between the item of interest and 0° longitude at Greenwich, England.

Orbcomm View includes Sky Temperature maps derived from IEEE measurements at three frequencies: 50, 137, and 400 MHz.

Setup/General

The **General** setup screen provides access to settings that concern all of the OV program. These settings will affect the overall OV screen display as well as performance. All selections are retained from session to session.

Tracking Algorithm: Select between G3RUH's Plan-13 and SGP4/SDP4 tracking algorithms. The G3RUH algorithm by James Miller at Cambridge University is a simplified version of SGP4 which is very fast and sufficiently accurate for most applications. SGP4/SDP4 uses the two-part (near-Earth and deep-space) model presented in SpaceTrack Report #3 and re-coded by Lt. Col. T.S. Kelso, Ph.D. of the U.S. Air Force. SGP4/SDP4 employs general perturbation theory to provide highly accurate prediction of orbital positions. SGP4/SDP4 is more time-consuming and should be used if high accuracy is needed. SGP4/SDP4 is also useful if Keplerian elements are old because it more accurately accounts for long-term effects of small gravitational and drag forces. SGP4/SDP4 is the default algorithm for OV.

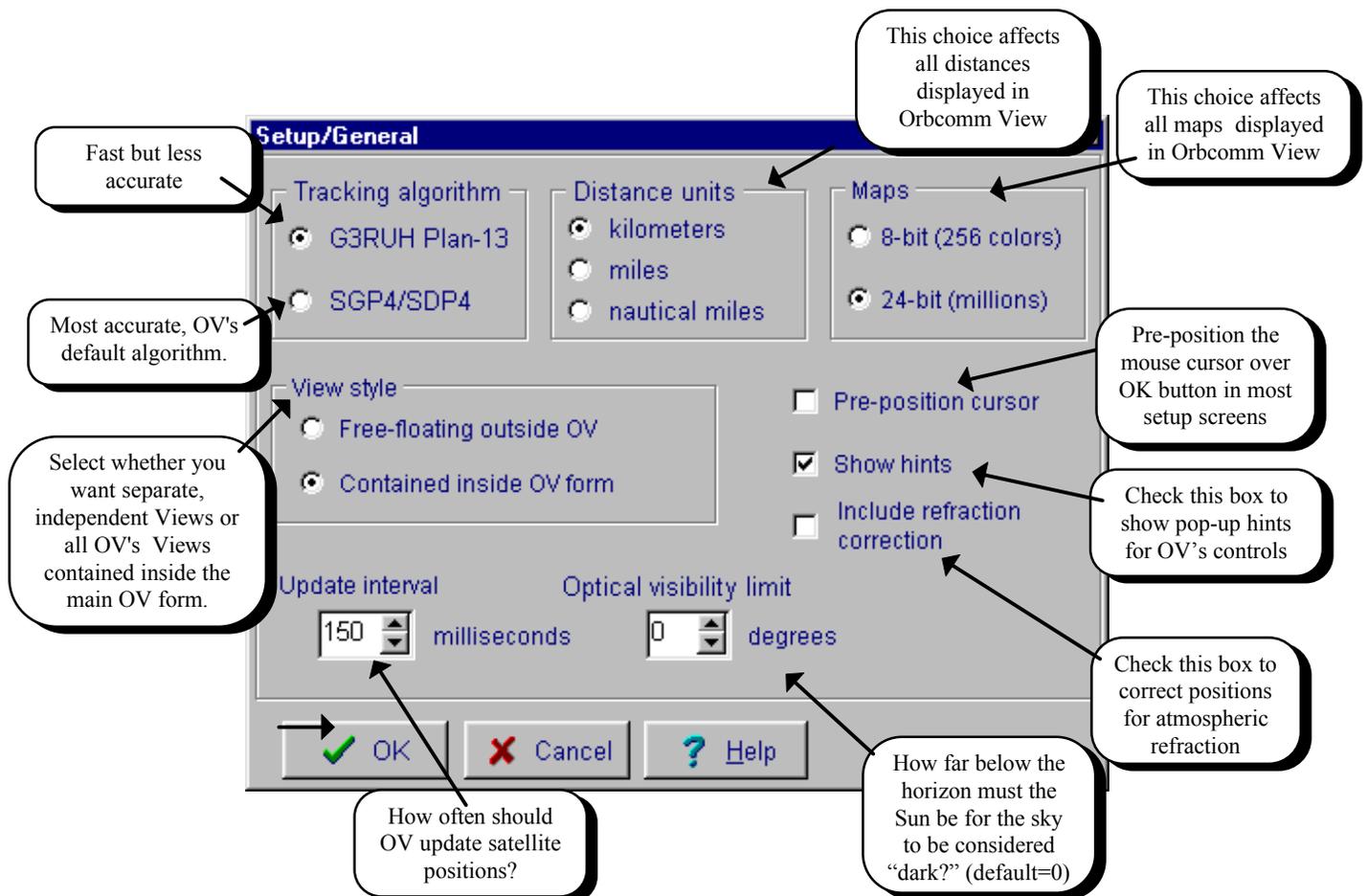
Distance units: select between English, metric, or nautical units. These units will be used throughout Orbcomm View. Default is metric.

Maps: 8-bit maps have 256 colors and most laptop users should select this option. 24-bit maps have millions of colors and appear best on high-quality monitors.

View style: (see p. 6) *Free-floating Views* may be placed anywhere on the Windows desktop. A thin Main Menu bar for OV will remain, providing access to control functions. This option permits fast switching of focus between OV and other programs but it may result in a cluttered screen.

“*Contained within main OV form*” means that all Views are confined to the OV screen, which may be minimized if desired. This option generally results in the most pleasing screen display if OV is the only program being run. This is the default for OV.

Show hints in setups controls whether small pop-up hints appear when the mouse rests on a button or other control for more than two seconds. These hints are



Use **Setup/General** for items that apply throughout Orbcomm View.

useful when you are first learning to use OV but you may want to turn them off after you are familiar with the program. "On" is the OV default.

Include refraction correction instructs OV whether to correct satellite elevation angles for the effects of atmospheric refraction. This effect is always small, becoming entirely insignificant above about 5° elevation. There is a slight speed penalty for including refraction correction.

Update interval controls how often OV updates its on-screen display. A small value results in faster updates but may consume more computer CPU time than desired. A value of 150, which results in 4-6 updates/second on a Pentium-120 MHz, is a reasonable compromise between speed and CPU loading, and is the OV default. Use a larger number if other programs appear to run sluggishly.

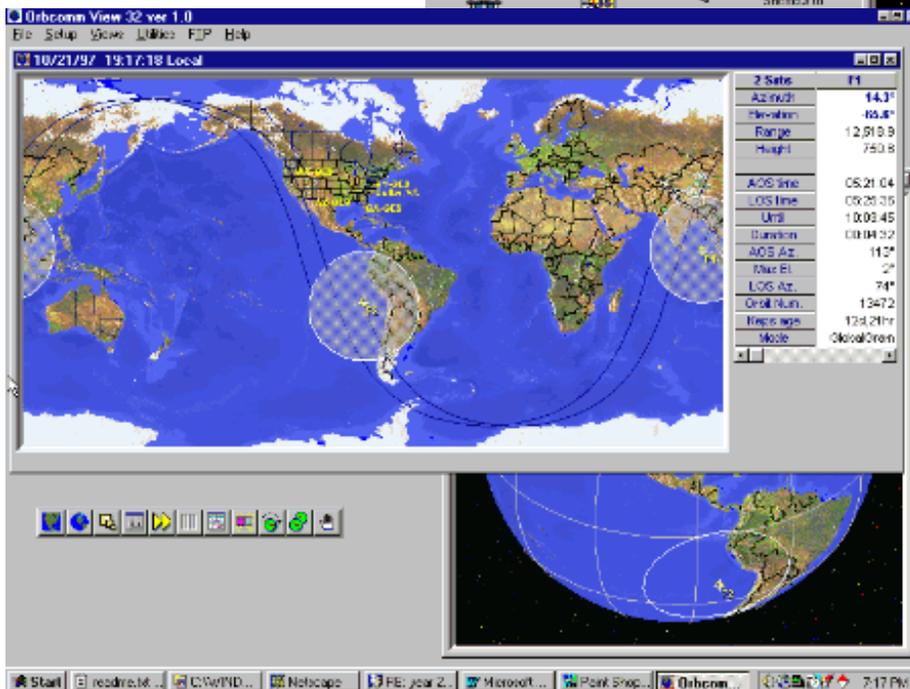
Views/View Style

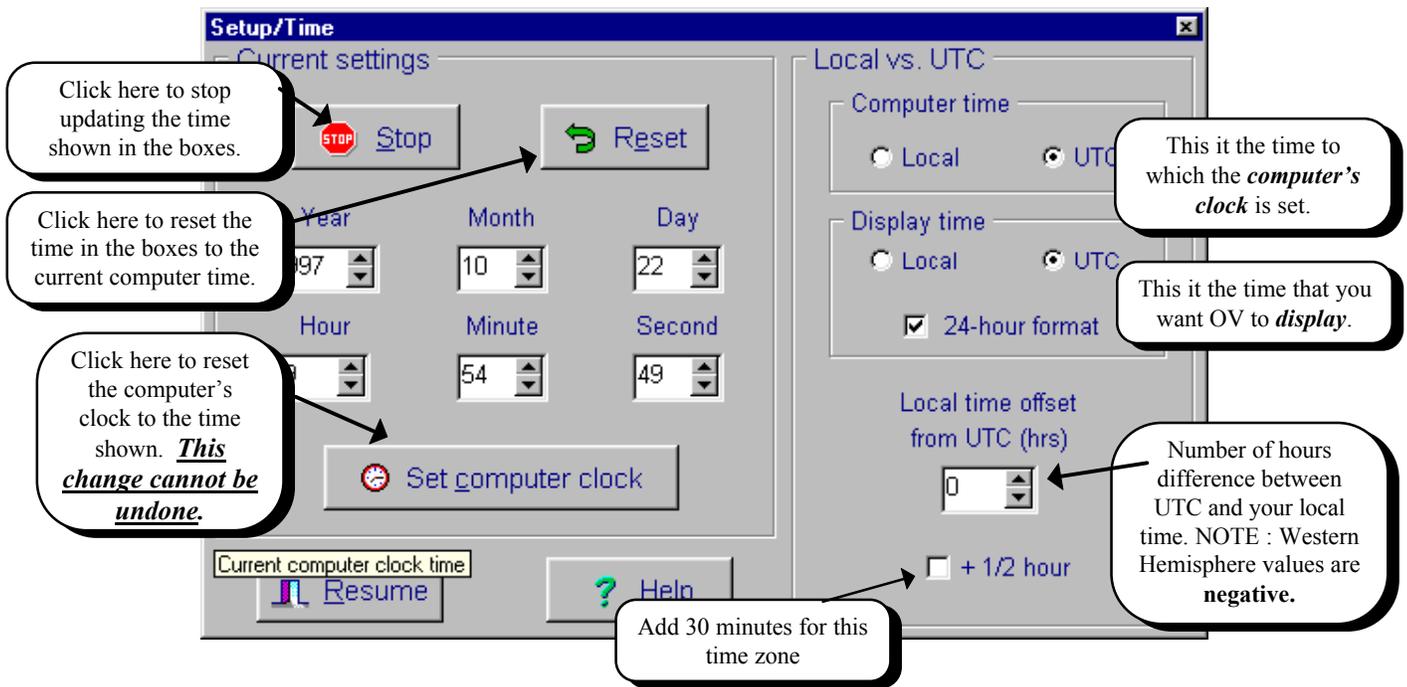
Orbcomm View can operate in one of two modes:

Free-Floating Views (right): all Views are free to be located anywhere on the windows desktop. They may overlap other Windows applications and other application can "show through" between OV's Views. With free-floating Views, the OV Main menu is unobtrusive (but it can also be hidden under other programs' windows).



Contained Views (left): All OV Views are contained inside the main OV screen. If a View is moved beyond the edge of the main OV screen, it is trimmed. Space between Views is solid desktop color. With contained Views, the Main Menu is always at the top and easy to find.





*Correct timekeeping is essential for accurate satellite predictions.
Make sure that Orbcomm View is correctly configured for your system.*

Setup/Time

This selection provides access to your computer's date/time clock. Every computer has an internal clock that keeps track of the date and time. This clock is the basis for all of OV's satellite predictions so it must be set accurately. It is wise to check the clock at least on a regular basis to make sure that it remains accurate; some computer clocks drift many seconds per day.

The **Current Settings** display shows the current date and time as reported by the computer to the Windows operating system. To change the displayed values, first click on the Stop button to prevent continued updates. Then enter new values in the appropriate boxes. If you want to reset the computer's clock to the new values, press the Set Computer Clock button. To reset the Current Settings display to the computer clock (after making changes but before setting the computer clock), click on the Reset button.

Setup/Satellites

The Setup/Satellites display consists of two "pages," Keplerian Elements and Groups. These will be described separately although they share a common Main Database.

Keplerian Elements are numbers that describe the position and velocity of a satellite at a single instant in time. "Keps," as they are sometimes called, are

The **Local vs. UTC** box tells OV how to interpret the time and date that it retrieves from Windows. Check the appropriate boxes to tell OV whether your computer clock is set to local time or UTC, and whether you wish OV's display to be in local time or UTC.

If "Local" is selected for either the computer clock or OV's display, a "**Local time offset from UTC**" value must be entered in the lower box. This value represents the number of hours difference between your local time and UTC. If your local time is behind UTC, then the offset is negative.

NOTE: The offset value is **negative** for Western Hemisphere stations. For example, U.S. Eastern Standard Time requires an offset of -5.

generated by ground-based radar ranging stations operated by governments and the military. Keplerian elements are used in satellite-tracking calculations to predict the position of a satellite at some time in the future. OV combines Keplerian Elements and the current time/date from the computer to determine the satellite's current position. OV then uses the observer's location to compute the satellite's azimuth,

Setup/Satellites

Keplerian elements

Satellite name: F1

Catalog number: 23545

Epoch time: 97282.09916627

Element set: 282

Inclination: 69.97100000

RA Asc. Node: 138.58210000

Eccentricity: 0.00152120

Arg. of perigee: 238.27470000

Mean anomaly: 121.69030000

Mean motion: 14.45613813

Decay rate: 0.00000568

Epoch orbit #: 13286

183 available satellites. Last update on: 10/10/97

| | | | |
|--------|----|------------|------------|
| A1 | C2 | G2 | Glonass 56 |
| A2 | C3 | Glonass 34 | Glonass 57 |
| A3 | C4 | Glonass 36 | Glonass 58 |
| A4 | C5 | Glonass 39 | Glonass 59 |
| A5 | C6 | Glonass 40 | Glonass 60 |
| A6 | C7 | Glonass 41 | Glonass 61 |
| A7 | C8 | Glonass 44 | Glonass 62 |
| A8 | D1 | Glonass 45 | Glonass 63 |
| AMSC-1 | | | Glonass 64 |
| B1 | | | Glonass 65 |
| B2 | | | Glonass 66 |
| B3 | | | Glonass 67 |
| B4 | D6 | Glonass 50 | Glonass 68 |
| B5 | D7 | Glonass 51 | Glonass 69 |
| B6 | D8 | Glonass 52 | Glonass 70 |
| B7 | F1 | Glonass 53 | Glonass 71 |
| B8 | F2 | Glonass 54 | Glonass 72 |
| C1 | G1 | Glonass 55 | Glonass 73 |

Click on a satellite name to select it. Then you may view or edit its Keplerian elements manually.

Derived shows information derived from the currently-selected satellite's Keplerian elements.

Click Update to update Keplerian elements from a computer disk file.

Find locates a satellite in the database.

Clean updates Keplerian elements and removes all non-matching satellites from the main database.

Setup/Satellites is the place to update Keplerian Elements

elevation, and other values from that spot on the Earth's surface.

Keplerian elements may be acquired from a number of sources. Current Keplerian elements are provided at many sources including Orbcomm's web site <http://www.orbcomm.com>.

How often do you need to acquire Keplerian elements? The answer depends on your requirements and your ground-station characteristics. For almost all applications, updating Keplerian elements once a month is entirely sufficient. Users of the Orbcomm Low Earth Orbiting (LEO) satellites who need very accurate positions might need to update every two weeks whereas higher-altitude satellites' elements are usable for several months.

The *Setup/Satellites/Keplerian Elements* page in OV provides the means to update Keplerian elements smoothly and easily. The large list on the right of the screen contains all of the satellites in OV's database. There is no practical limit to the size of this database but a large number of satellites requires longer time to load and process.

The *Keplerian Elements* page contains edit boxes on the left side of the Setup/Satellites page. These boxes provide the option of manually changing individual Keplerian Elements. Select the satellite whose elements are to be edited by clicking on the satellite's name in the main database list. Be cautious when manually editing these values because some values may cause the satellite to "crash" or its calculations to make OV unstable.

✓ **Tip:** Each satellite's Catalog Number is unique and is used to identify the satellite internally within OV. If the Catalog Number is changed, the satellite will be treated as a new satellite and added to the OV database.

The  **Derived** button displays a pop-up box containing values calculated from the selected satellite's Keplerian Elements. **Period** is the time required for one complete orbit. **Apogee height** is the maximum altitude that the satellites achieves and **perigee height** is the minimum altitude.

The  **Add** button provides instructions about adding a satellite. It doesn't actually do anything.

To update the satellite database, click on the  **Update** button. A pop-up dialog box will prompt you for the name of the computer file containing new elements. This file must be in the "NASA 2-line" format. Header text, which often accompanies files downloaded from the Internet, is ignored. OV reads the new file and updates the Keplerian elements for all satellites in its database that match entries in the new file. For example, if OV contains entries for fictitious satellite A, B, and C but the new file only contains elements for A and B, then C's elements will remain unchanged. On the other hand, if the new file contains elements for additional satellites, then they are automatically added to OV's database. In the preceding example, if the new Keplerian element data file contained entries for A, B, and D, then OV's database would add D automatically. This may be useful if you have access to a variety of elements in small files but it may lead

to an accumulation of unneeded satellites after some time.

Use the  **Clean** button to make OV's database exactly match the contents of a particular Keplerian element file. In this operation, all non-matching satellites are removed from OV's database. After a Clean operation, OV's database will contain only those satellites in the new file and no others.

Note: The Sun, Moon, planets, and celestial noise sources do not require Keplerian elements. They are included in the "Naturals" group and cannot be edited or removed from OV's database.

If you wish to add one or two new satellites from a NASA 2-line format file, you may use the  **New** button. It will prompt you for the file name, read the file, and add the satellites to OV's database.

The  **Delete** button removes selected satellites from the database. If the database is later Updated from a file that contains the removed satellites, they will be added back to the database.

The  **Find** button helps to locate a satellite in the database. Enter its name and the database list will move to it, displaying its Keplerian elements in the edit region to the left of the list.

The  **Who's Up?** scans through the satellites in the main database and highlights all satellites that are currently above the observer's horizon.

Setup/Groups

OV's *Groups* are user-defined associations of satellites. They are provided as a convenience for accessing similar satellites together. For example, each plane of Orbcomm satellites might be placed in a Group. You may have as many Groups as desired and each group may contain an unlimited number of satellites. For the sake of practicality, however, we recommend that groups contain fewer than 25 or 30 satellites.

The Groups page of Setup/Satellites creates and edits Groups. Groups are collections of satellites that are defined by the user.

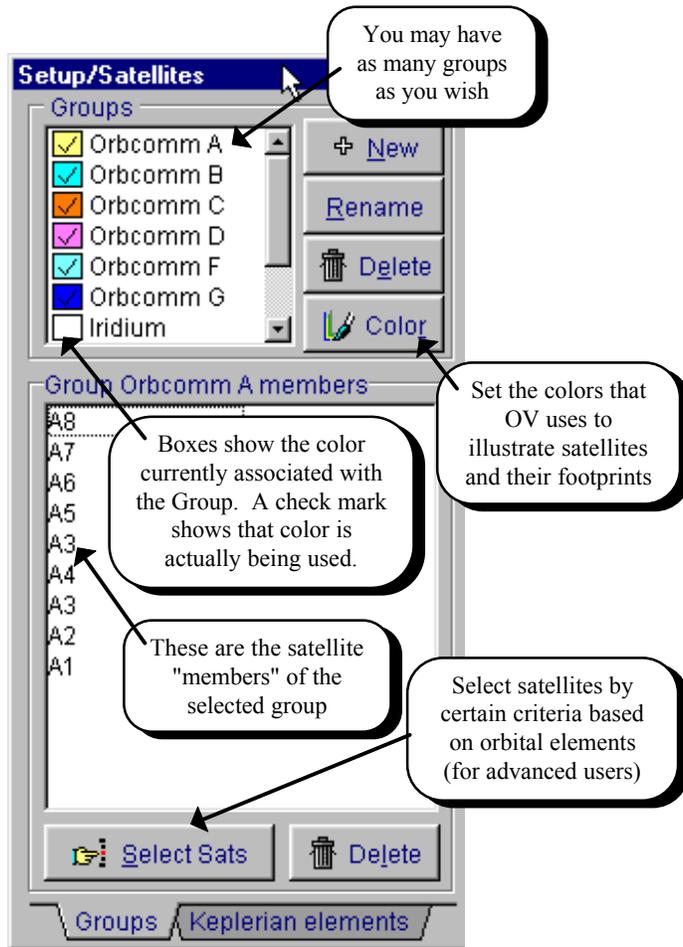
Groups are collections of satellites that have something in common. You create and edit your groups in Setup/Groups

They have no direct connection with any View but are merely a convenient way to “grab” similar satellites at one time. Clicking on a name in the Groups box will display the members of the Group in the box below.

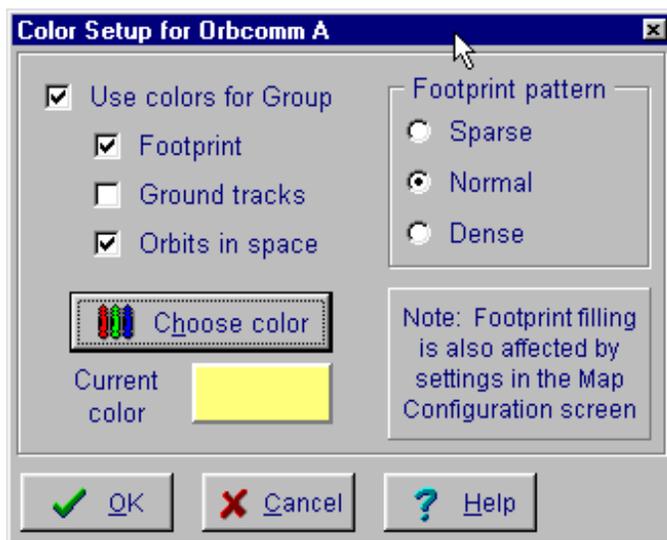
Groups are created with the **Add** button. The group is named and at first it contains no satellites. Select the satellites of interest with the mouse and drag them to the Group members box. Entries in the Group members box may be deleted or rearranged with the mouse as well.

To delete satellites from a Group, select the satellite name with the mouse and then click the **Delete** button. You may rearrange the members of a Group by dragging their names with the mouse.

Colors opens a dialog box where you may set the colors associated with groups. If a particular satellite is included in more than one Group, the satellite's color will be set by the Group most recently edited.



OV includes existing and planned Orbcomm constellation, weather satellites, and other groups



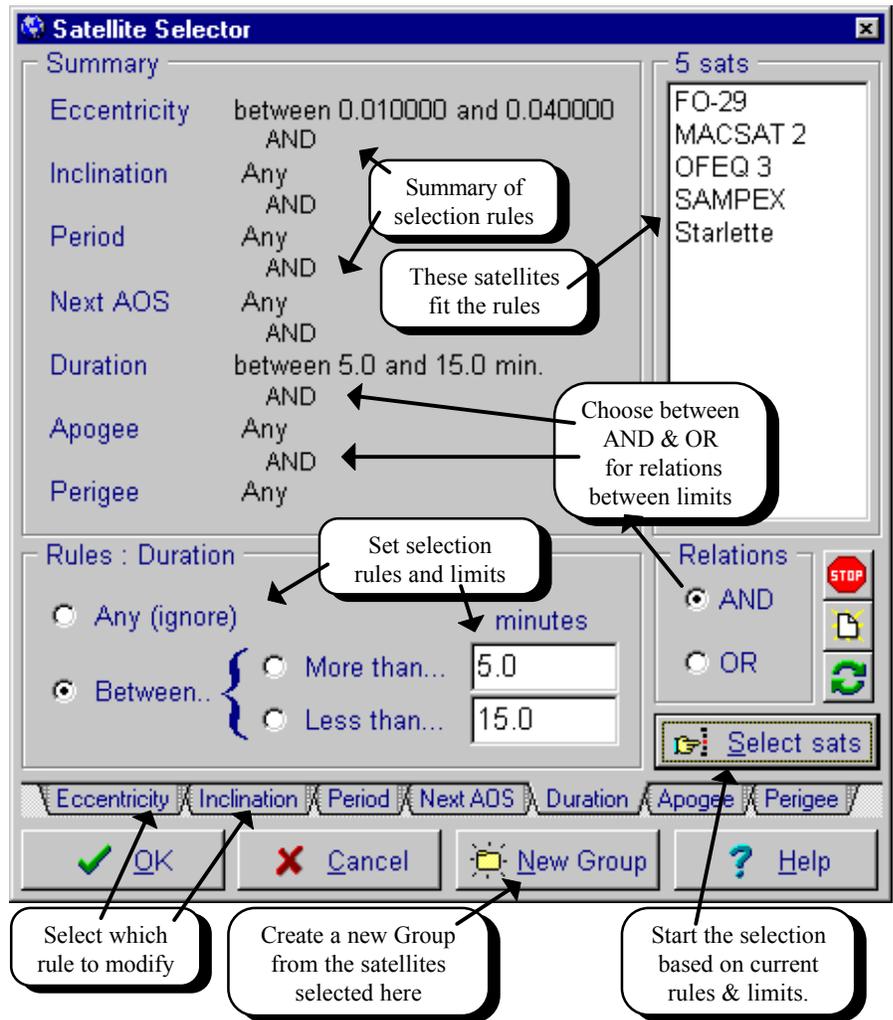


opens the **Satellite Selector** shown above. This feature permits advanced users to sort through OV's entire satellites database and extract satellites meeting certain criteria. For example, a particular application may require selection of all satellites with, say, certain eccentricity or mean motion. Use the tabs across the bottom of the page to choose which rule to modify (Eccentricity, Inclination, Period...). For each rule, select whether you want **Any** value to be all right or if the value must fall **Between, More than, or Less than** the limits that you set in the edit boxes.

To effectively ignore the value of any quantity, select *ANY* as the rule. For example, choosing *ANY inclination* means that *ANY* is ignored in selection when inclination is evaluated.

Finally, in the **Relations** box, select whether you want all the rules to be met simultaneously (**AND**) or whether meeting any rule (**OR**) will be satisfactory. For example, saying "Eccentricity Greater than 0.01 *AND* Inclination Greater than 50°" means that a satellite must meet both criteria, whereas **OR** means that if it meets either the Eccentricity *OR* the Inclination criterion, the pass will be selected.

✓ **Tip** : If **OR** is used as the Relations operator, then setting *any* rule to **ANY** will mean that all satellites in the list will qualify for selection.



OV's Satellite Selector is used to build groups based on their orbital characteristics.

It may require some experimentation to learn to use the Satellite Selection facility. After you have become familiar with it, you may want to use it to select satellites for a Group.

Pressing the **New Group** button will cause the selected satellites to become a new group, as if you had dragged each satellite from the master database list manually.

Setup/Observers

The Setup/Observers screen presents OV's database of observer locations. OV's observer database is maintained in two parts: the *Main Database* which contains thousands of cities and a short *Observers list* of observers that are user-selected. The short list is shown on the left of the Setup/Observers screen.

The shorter Observers List is used in configuring Views instead of presenting the entire Master Database. For example, in the Individual View Configuration screen, only the contents of the Observers List (and NOT the Main DataBase) are presented. Therefore it is necessary to set up the Observers List to contain all locations that you might want to use in Views.

Customize the Observers List to suit your needs. Observers may be taken from the Main Database or you may manually enter latitude/longitude data in the edit space in the lower left of the screen. Add or delete Observers to/from the Observers list by drag-and-drop. Search for locations in the Main database by using the **Find First** and **Find Next** speed buttons (with the flashlight icons).

To enter new locations that are not already contained in the Master Database, mouse-click on individual lines in the editing region (lower left) and enter the appropriate values. When the entry is complete, press the **Add to Observer List** button to place the new location in the Observers Box or **Add to GES List** to enter it in the GES list. Entries in the Main Database cannot be edited.

The screenshot shows the 'Setup/Observers' window. It is divided into several sections:

- Observers list:** A scrollable list of selected locations such as Anchorage, AK; AZ-GES (St. Johns, AZ); Beijing, China; etc.
- Main Database:** A large list of cities from which to select, including Warsaw, Poland; Wausau, WI; West Memphis, AR; etc.
- Edit Location:** A form for entering location details:

| | |
|----------------|-----------|
| Location | Temporary |
| Latitude deg. | 45 |
| Latitude min. | 0 |
| Latitude sec. | 0.00 |
| North or South | North |
| Longitude deg. | 75 |
| Longitude min. | 0 |
| Longitude sec. | 0.00 |
| East or West | West |
- Buttons:** 'Delete', 'Sort', 'Add to Observers List', and 'Add to GES List'.
- Right Panel:** A preview of the selected location: 'Washington (USNO)', 'Latitude : 38.92° North', 'Longitude : 77.07° West'. It includes 'OK', 'Cancel', and 'Help' buttons.

Callouts provide the following instructions:

- "Build your personalized 'short list' of Observers by dragging locations from the Main Database of 2,000 cities to the Observers List"
- "Edit the latitude & longitude of locations by dragging them to the Edit Location box. After making changes, click on **Add to Observers List** to save."
- "To add an unlisted Observer, enter data in the Edit Location box, then click on **Add to Observers List** to save the new location"
- "The Orbcomm GES list is a list of GES locations, separate from the main location database."

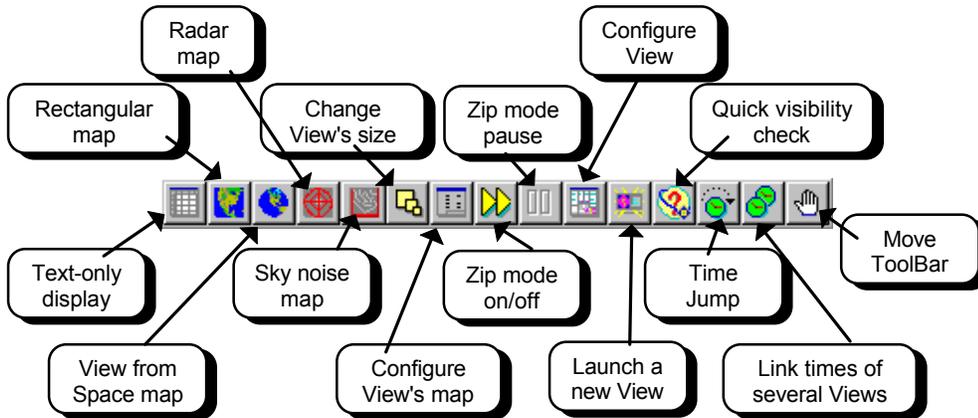
Use Setup/Observers to build your personalized "short list" of observer locations. Each View's observers are set in the Individual View Configuration Screen by selecting from the "short list."

OV's ToolBar

The ToolBar provides fast access to the most commonly-used functions in Orbcomm View. Clicking on ToolBar buttons avoids several steps of menus. The ToolBar floats freely on the screen, but *its functions are tied to whichever OV View has focus*. Determine which View has focus by noting the color of its title bar. Change focus by simply clicking on the View.

Views will follow the Master. Changing the Master View's time will automatically change the time on the other Views. Clicking the Time Link button again releases the Views.

To change which View is the Master, turn Link Time off. Then click on the View that you want to become the Master, giving it focus. Then activate the Link Time facility again by clicking on the button.



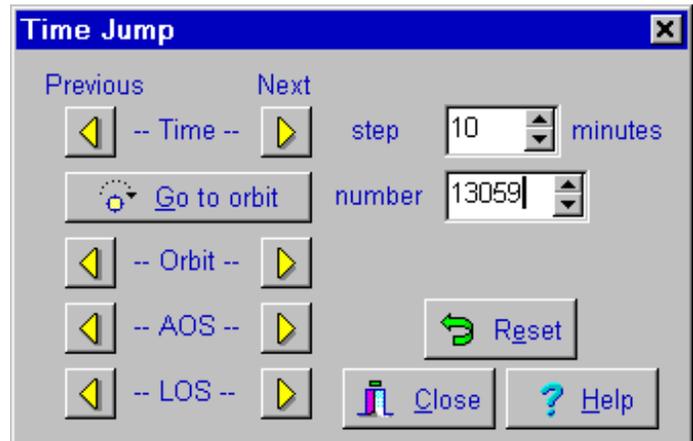
OV's floating ToolBar provides access to the most frequently-used functions.

The function of each button is shown on the picture above. The ToolBar may be dragged anywhere on the screen by using the hand-shaped button. Configure the ToolBar to suit your tastes in Setup/ToolBar or by right-clicking the mouse on the ToolBar itself.

✓ **Tip:** If you drag the ToolBar against the side of the screen, it re-shapes itself into a vertical orientation; dragging it against the top or bottom of the screen arranges the buttons horizontally.

 **Time Jump** is a means to quickly adjust the internal time of an OV View. Time may be advanced forward or backward by a particular number of minutes. In addition, time may be changed to the same mean anomaly position in any orbit number, or simply to the next or previous orbit from the present one. Finally, time can be changed to the next or previous AOS or LOS of the satellite

 **Link Time** links the time of two or more Views. To activate Link Time, click on the Link Time button. The View with focus (a darker title bar at the top) will become the Master time, and all other



Orbcomm View's Time Jump facility permits rapid excursions to future or past times, orbits, etc. Changes in Orbit or AOS/LOS refer to the first satellite in the View's satellite list.

Go to Orbit, Previous or Next Orbit, AOS, or LOS refer to the first satellite in the View's satellite list.

Views/Configure Current View

One of Orbcomm View's main strengths is its ability to independently configure each View. A View is a single "window" which may include a map, tabular text tracking data, or both. Every View is entirely independent from the others, no matter how many Views are open simultaneously. Views may have different satellites, observers, maps, and even timekeeping.

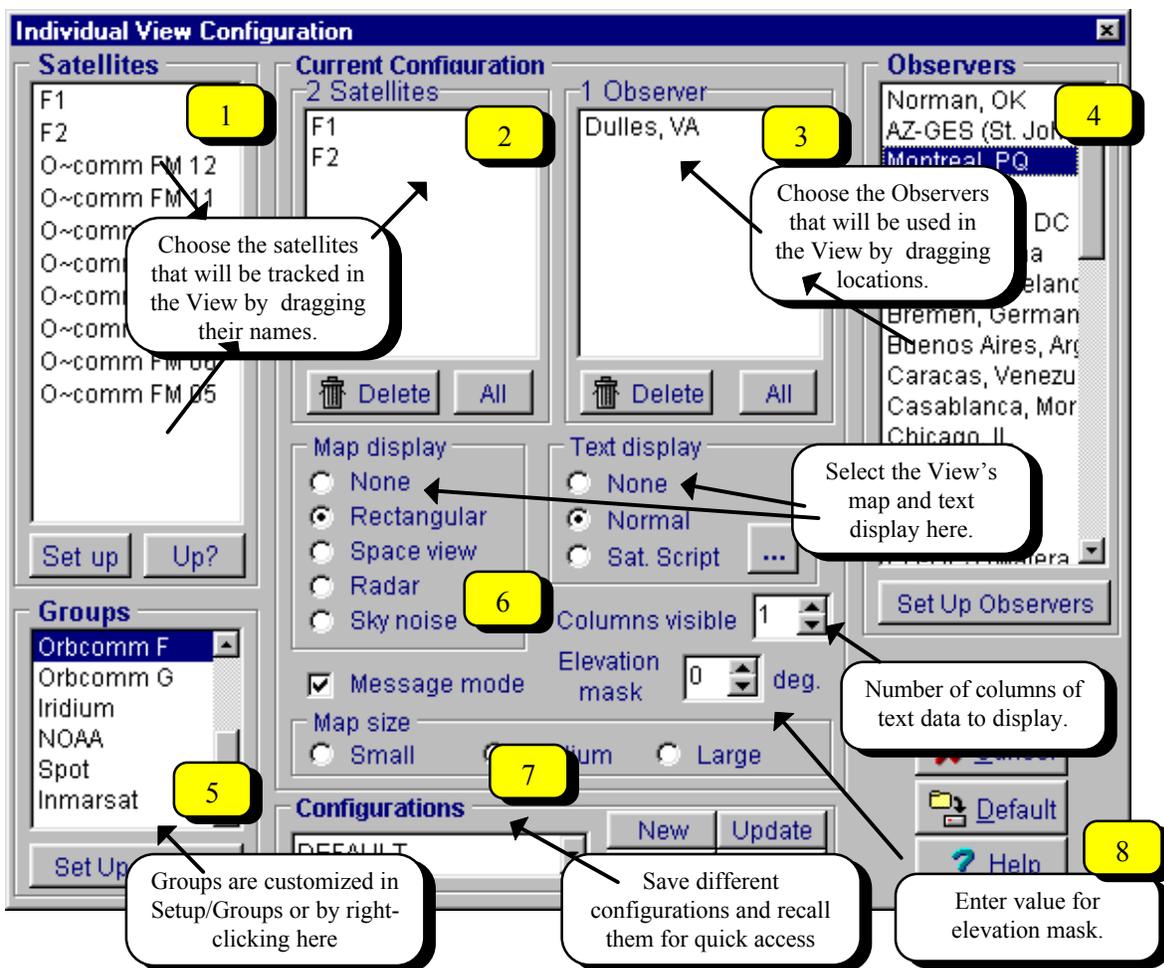
✓ **Tip:** Enter the *Individual View Configuration* screen by:

- Right-clicking the mouse on the View that you wish to configure, causing the pop-up menu to appear;
- or selecting **Views/Configure Current View** from the Main Menu;
- or pressing the  *Configure View* button on the ToolBar.

The **Individual View Configuration** screen is shown below. It is divided into three main regions: **Satellite** selection on the left, **Observer** selection on the right, and the View's **current configuration** in the middle.

You may select satellites from the Satellites list **1**. Drag satellite names from this list to the *Current Configuration, Satellites* list box **2**.

Satellites may be added, removed, or rearranged within the Current Configuration Satellites list; their order in the list determines their order of appearance in the tabular text display in the View. The first satellite in the list will be the left-most satellites in the tabular text display. Entire Groups may be moved at once by dragging the Group name from the Groups list **5**.



The **Individual View Configuration** screen is the main focus for making each View appear the way you want it to. This screen is the place to select the satellites and observers that the View will track, as well as the basic maps and text that will be displayed.

The *Current Configuration, Observers* list  displays the observer(s) for which satellite position information will be calculated. A “short list” of observers is provided for quick access . You may select observers from this list and drag them to the Current Configuration region.

What controls which satellites appear in the Satellite List? The satellites included in the selected Group  are displayed in the Satellites list.

Clicking on different groups changes the list of satellites displayed. Two groups have special status: the “Complete” group includes every satellite in OV’s database and the “Naturals” group includes the Sun, Moon, planets, celestial noise sources, and cold sky regions. The remaining groups may be modified by the user in the Setup/Groups selection from the Main Menu or by right-clicking here on the Groups Box.

The general appearance of the View is controlled by the **Map Display** and **Text Display** boxes .

Select what type of map you wish (or no map for an all-text display) on the left and what sort of text display on the right. Each View *must* contain a map, text, or both.

How does one configure maps? Maps may be configured by right-clicking within the Maps box  or by pressing the  *Configure Maps* button on the ToolBar. This will display a multi-page screen that permits control of many aspects of appearance for all of OV’s maps. This screen is described in detail below (p. 38).

The number of columns of text (1-12 columns) is controlled by the Columns Visible entry; large maps may not fit on the screen with several columns of text. If more satellites are being tracked than can fit in the number of columns that have been entered, a scroll bar is presented in the view to slide the display horizontally.

Satellite Script orders satellites displayed in the text display according to their AOS times. Pressing the  *Configure Script* button opens a screen for generating, displaying, and editing the satellite script. Its functions are described on page 23, under Satellite Pass Times.

Advanced users may wish to store and recall certain **configurations**. You may record View configurations by using the Configurations drop-down box . After establishing an acceptable configuration, press the  button. You will be queried for a name for the configuration that will later be presented in the drop-down box. Other buttons permit you to *update* an existing configuration, *delete* a configuration, or *rename* it. All stored configurations are available for use in other Views. The various combinations of satellites making up the Orbcomm constellation are pre-configured.

 Some installations require use of an elevation mask. This raises the user's effective horizon by a specified number of degrees. For example, setting the mask to 4° means that all footprints and AOS/LOS calculations are adjusted upwards by 4°. A satellite is not considered "above the horizon" until it has attained an elevation of 4°. Separate elevation masks are maintained for each View as well as each Utility. To remove an elevation mask, set its value to 0.

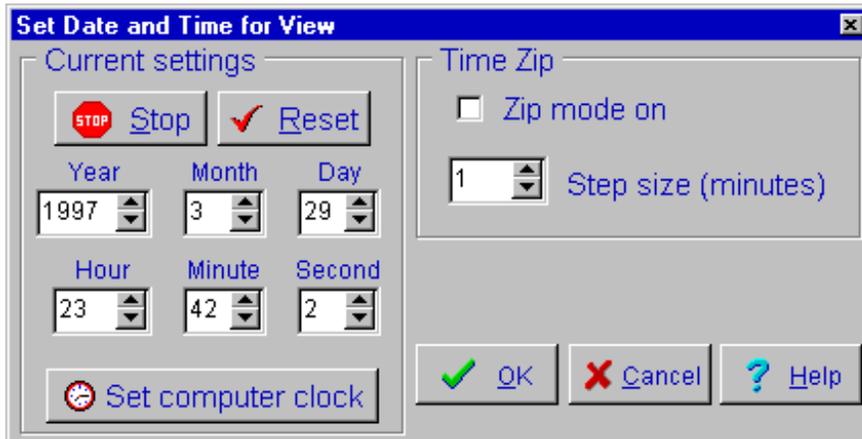
Configuring Views

The appearance of Orbcomm View is determined by the Views that you have launched. Views are configured separately from one another. Changes made to one View do not affect others.

Initial configuration of Views may be challenging at first, but it quickly becomes easy once you are familiar with the View pop-up menu. To bring up the View pop-up menu and configure a View, position the mouse over the View and press the right mouse button.

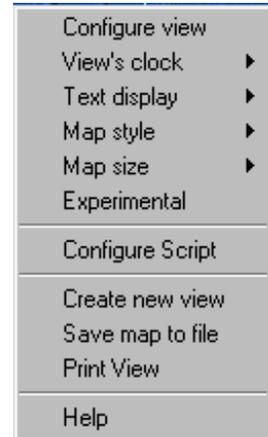
For detailed configuration, such as choosing satellites and observers, select **Configure View** from the pop-up. Alternatively, you may press the  *Configure View* button on the ToolBar. This will display the *Individual View Configuration* screen. Page 19 explains the Individual View Configuration screen.

View's Clock (*below*) sets the time and date for the View. This time can be the same as for the overall Orbcomm View program or it can be entirely different. By default, View time is the same as OV's time. To set the View's time to a different value, click the **Stop** button and enter the desired values in the spin boxes. To set the View's time to OV's time, click **Reset**.



*Note: The **Set Date and Time for View** screen (shown here) is not the place to set OV's time or, typically, the computer clock. To set OV's overall time, use *Setup/Time* from the Main Menu.*

Zip mode is a fast-forward time stepping that is useful for viewing satellite movement in the future. Set the time step for Zip mode in the appropriate box. To zip backwards in time, set the time step to a negative number.



Open this pop-up menu by right-clicking anywhere on a View

Text Display determines whether the View's text is displayed (one column of text data for each satellite, placed to the right of the map), Script tracking (automatically changing as each satellite in the Script becomes visible), or no text at all.

Map Style set the kind of map that will be displayed in the View's map section. The map may be Rectangular, View from Space, Radar, Sky Temperature, or no map.

Map Size: Orbcomm View accommodates several screen resolutions. Views may be sized to fit the screen that you have. *Small* is appropriate for 640x480 pixel screens, *medium* for the default 800x600, and *large* for 1024x768.

Experimental mode is a tool for examining the orbits. Using the Experimental Mode, orbits can be adjusted in real time and the effect on an orbit can be seen immediately.. For example, what would the orbit of the Russian “Mir” space station look like if its inclination was 10° higher and its eccentricity was 0.1 instead?

Experimental Mode is entered via the View pop-up menu described on the previous page. *The satellite used in this mode is the first satellite on the View’s satellite list.* Buttons at the bottom of the Experimental Mode screen allow you to retrieve different satellites or to save the results of changes made in this screen.

The **Derived** button enables examination of several values such as apogee and perigee altitude, period, etc. A more visual approach is to configure the parent View to display the View from Space with an orbit displayed. Then, as changes are made in Keplerian elements, the orbit’s shape changes immediately.

The key to a satellite’s identity is its *catalog number*. Changes made to the satellite’s catalog number will permanently change its identity and prevent OV from updating its Keplerian elements from an external file.

Entries in the *Element set* and *epoch orbit #* fields have no effect on a satellite's orbit calculations.

The screenshot shows a dialog box titled "Experimental elements" with a close button (X) in the top right corner. The dialog contains several input fields, each with a label and a value, and a set of control buttons at the bottom.

| Field Label | Value |
|-----------------|----------------|
| Satellite name | Feng Yun1-2 |
| Catalog number | 20788 |
| Epoch time | 97079.18868160 |
| Element set | 284 |
| Inclination | 98.8200 |
| RA Asc. Node | 81.2144 |
| Eccentricity | 0.0015085 |
| Arg. of perigee | 85.3638 |
| Mean anomaly | 274.9477 |
| Mean motion | 14.01410822 |
| Decay rate | 0.00000109 |
| Epoch orbit # | 33475 |

At the bottom of the dialog, there are five buttons: "Save" (with a floppy disk icon), "Derived" (with a checkmark icon), "Restore" (with a floppy disk icon), "Close" (with a window icon), and "Help" (with a question mark icon).

Experimental Mode permits "what-if" analysis of individual satellite orbits

Map Configuration

Orbcomm View includes over 100 maps of various projections, sizes, and areas of coverage. Furthermore, you have almost complete control of the information displayed in the maps so that they always display the data that you need without clutter.

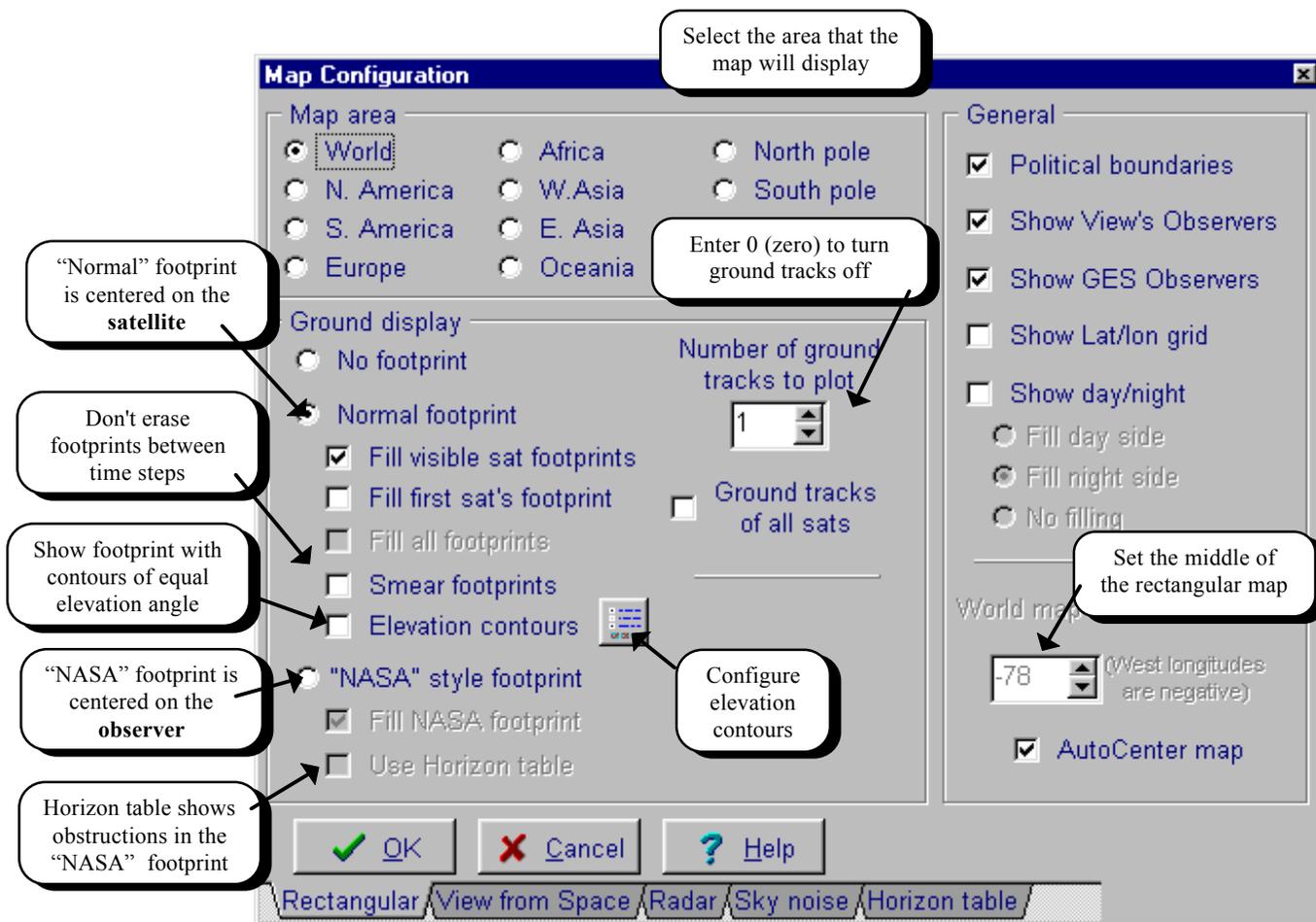
Map Configuration is available in five pages in the same "notebook;" click on the bottom tabs to change pages. The Rectangular and View from Space maps share several options and their setup screens appear similar.

Rectangular Map Configuration

The Rectangular map is familiar to most people. It shows the entire Earth "unrolled" so that it is visible at a glance. OV's Rectangular map is based on a modified Miller projection that shows the major continents with relatively little distortion; the north and south poles cannot be shown adequately on any rectangular map.

The *Map area* box permits selection of the map that will be displayed. *World* means that the map will display the entire world whereas the various continent names allow zoom-in views of each continent. The individual continent maps provide resolution of approximately 10 km/pixel at maximum size.

Ground display controls dynamic features added to the base map. The "normal" *footprint* of a satellite represents the area of visibility of a satellite; that is, the area of the Earth that is visible from the satellite at any particular moment. The normal footprint is drawn around the satellite's sub-satellite point (the point on the Earth directly underneath the satellite). "NASA" style footprint, on the other hand, is drawn around the observer. This is the format used by NASA when showing the Shuttle in orbit. Each ground station has a "fence" drawn around it that represents its horizon for the Shuttle. As the spacecraft crosses the "fence," it simultaneously rises above the horizon for the observer. The radius



Orbcomm View's *Map Configuration* notebook contains separate pages for each type of map. This is the page for the *Rectangular map*

of the NASA-style footprint changes with the height of a satellite above the ground.

Filling footprints refers to the light shading that OV can add to the footprint to make it more easily visible. OV provides the option of displaying filled footprints for only the first satellite on the View's satellite list, for all satellites in the list, or none of them.

Elevation contours may optionally be drawn within a footprint. Elevation contours are concentric lines that show elevation angles of the satellite above the horizon. Pressing the  *elevation contours* button displays a set-up screen for selecting parameters for the contours to be drawn.

Ground tracks are lines that trace the movement of the satellite over the Earth's surface. Ground tracks are useful ways to visualize future positions of the satellite. OV permits you to display ground tracks for only the first satellite in the View's satellite list, for all satellites, or none [enter 0 (zero) in the spin box]. In addition, the spin box allows setting the number of orbits' worth of ground track to be drawn.

OV permits setting the *central longitude* of the Rectangular world map by entering the value in the spin box. Alternatively, OV can automatically center the map over the first observer in the View's Observers list by checking *Auto-Center map*.

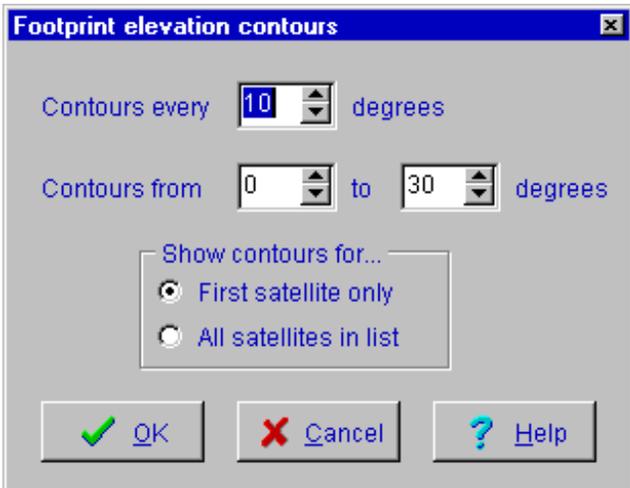
✓ **Tip:** You may access the Map Configuration "notebook" by several routes:

- Right-mouse click on a View and select Map Style, then Configure Maps;
- Click on the  *Configure Maps* button on the ToolBar
- Open the Individual View Configuration screen and right-click on the Maps box (remember that right-clicking on things lets you configure them)

View From Space Map Configuration

The View from Space map presents the Earth as seen from outer space in a three-dimensional perspective. It is based on the Orthographic map projection.

Options for the *View from Space* are displayed in

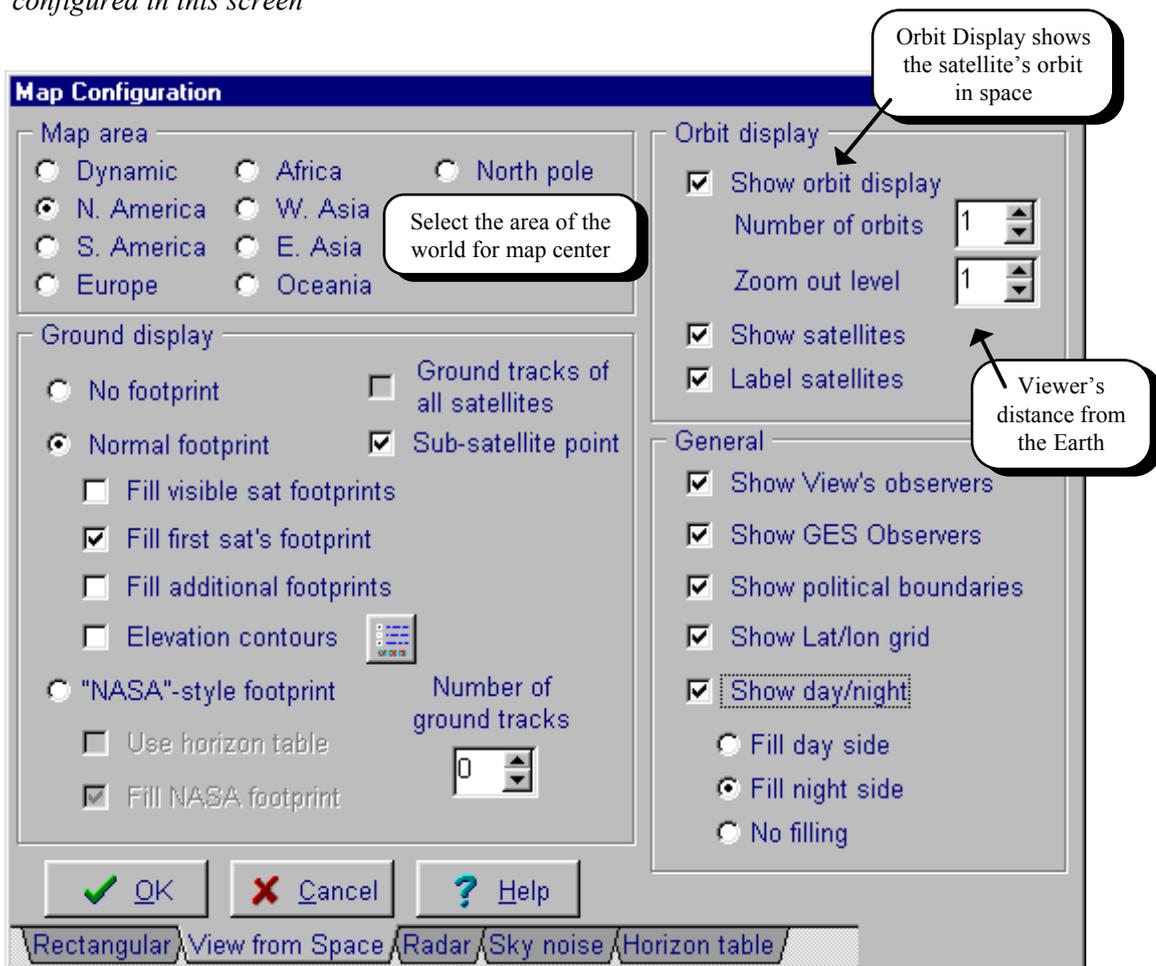


Footprint elevation contours are easily configured in this screen

✓ **Tip:** You can change the View from Space map's center continent by left-clicking on desired continent.

the **Map Configuration** screen (next page). The map may be centered over any of the major continents by selecting them in the **Map Area** box. The Dynamic selection causes OV to change the center of the map automatically, in accordance with the movement of the first satellite in the View's satellite list. As the satellite moves around the Earth, the viewer's perspective changes automatically.

The **Ground Display** box controls information on the surface of the map. *Normal footprint* is a circular area drawn on the map and centered on the satellite's sub-satellite point. This footprint moves with the satellite and represents the area of the Earth that the satellite can "see." High-altitude satellites have large footprints whereas low altitude satellites have small ones.



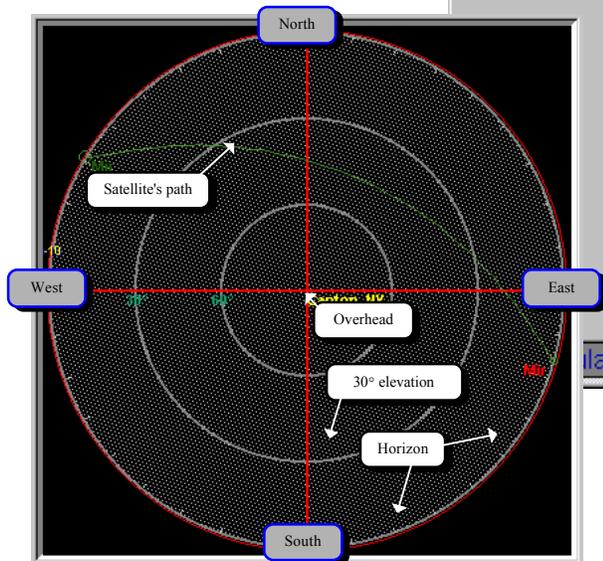
Orbcomm View's View from Space map configuration page.

NASA footprint is centered on the first observer and represents the horizon for the first satellite on the list. In other words, when the sub-satellite point (the spot on the Earth immediately underneath the satellite in space) of first satellite on the list crosses the NASA footprint perimeter, the satellite has just risen above the observer's horizon. This is the display used by NASA for each of its tracking stations. If the observer's horizon is obstructed in some directions and the Horizon table (see below) has been filled out, it will be useful to check the *Use horizon table* box so that the NASA footprint portrays the actual horizon of the observer.

Fill first sat's footprint and Fill additional footprints control whether the footprints are lightly colored to make them more easily visible. Number of Ground Tracks tells OV how many orbits to plot as lines on the Earth's surface. The lines represent the paths of the sub-satellite point; a ground track helps to show where a satellite will be traveling in the future. Set this value to 0 (zero) to turn ground tracks off entirely.

Radar Map Configuration

OV's Radar map is an innovative means to display satellite positions relative to an observer. The Radar Map is centered on the first observer in the View's observer list. North is at the top of the map and concentric circles indicate elevation above the horizon. The outer edge of the map is the observer's



Show sub-satellite point controls whether the map shows the spot on the Earth where the satellite is directly overhead. Usually, this is OFF if the Orbit Display is ON because it is confusing to see both the satellite in space and its sub-satellite point.

The **Orbit Display** box contains setting that control plots of satellite orbits in space (as opposed to on-the-ground). You can set the **number of orbits** of each satellite to show by entering a number in the spin box. In order to show the orbits of some satellites, it is necessary to “step back” from the earth to get a useful perspective. The **Zoom level** spin box controls the viewer's apparent distance from the Earth. Large zoom levels make the Earth appear smaller and permit plotting of high-altitude satellite orbits. Finally, you may select whether to **show** the satellite's position in its orbit as well as whether to **label** it.

Map Configuration

Number of passes to plot: 1

Show passes of all satellites

Use horizon table

Show location label

Enable Sat-ID

Number of satellite passes to plot on the Radar Map. Enter 0 (zero) for no pass display.

Check here to show passes of all satellites rather than only the first satellite in the list

Use the Horizon Table to outline areas of horizon obstruction from Observer's location.

If enabled, clicking on the Radar map will pop-up a satellite status screen

OK Cancel Help

View from Space Radar Sky noise Horizon table

horizon. The center of the Radar map is overhead.

The **Radar map page** of the map configuration screen permits control of several map parameters.

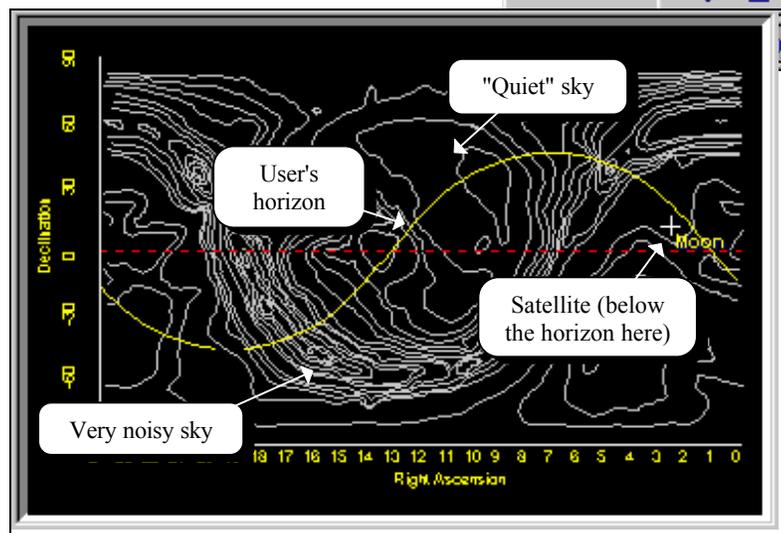
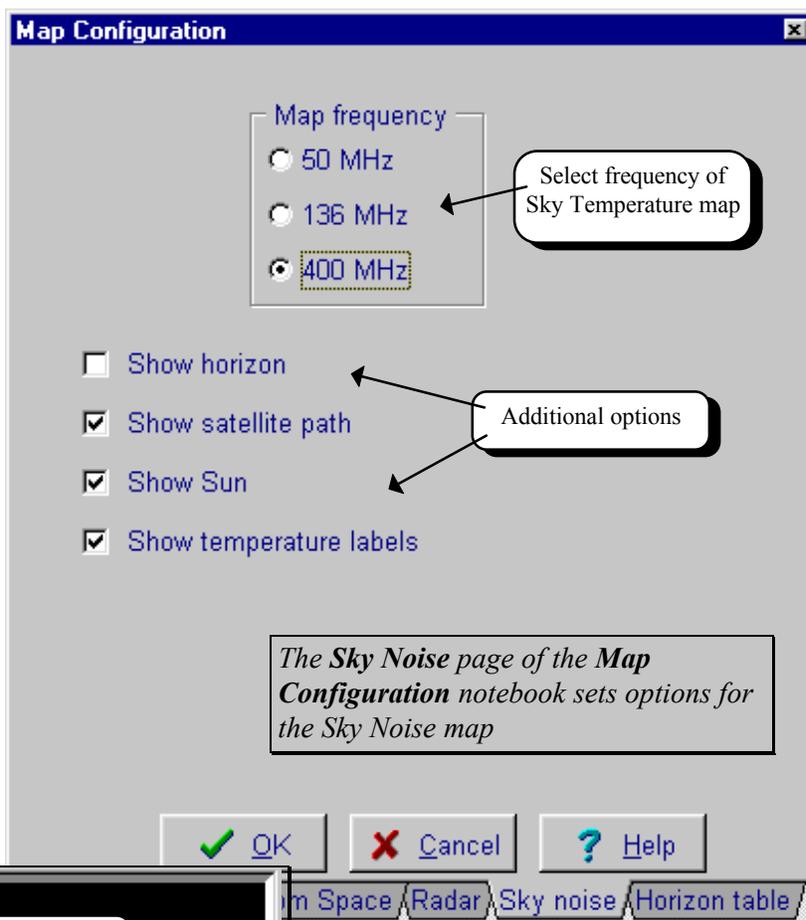
The **number of passes to plot** affects how many paths to display across the Radar map. It is often useful to plot the next pass or two to visualize where in your sky the satellite will be, how high it will ultimately rise, etc. Set this spin box to 0 (zero) to turn off pass plotting. By selecting **Show passes of all satellites** you can control whether OV only plots

passes of the first satellite on the View's satellite list or all of the satellites in the list. If the observer's horizon is obstructed in some directions and the Horizon table (see below) has been filled out, you should check the **Use horizon table** box so that the radar map perimeter portrays the actual horizon of the observer.

Sky Noise Map Configuration

The sky is not entirely quiet at VHF and UHF frequencies. Some regions generate noise that can mask weak radio signals. The Sky Noise map is useful for determining when the satellite will be located in front of noisy areas of sky.

The Sky Noise maps are drawn in a format that may not be familiar to some users. The vertical axis is Declination, which is measured above (north) and below (south) of the equatorial plane. The equatorial plane is a projection of the Earth's equator out into space. The horizontal axis of the Sky Temperature map is presented in Right Ascension. R.A. is measured in hours (1 hour = 15°) with 0 hours being along a north-south line at Greenwich, England. Lines on the Sky Temperature map are "contours" generally similar to contours on a topographic map. Each contour connects points of equal noise



Orbcomm View's *Sky Noise map* shows a contour map of equivalent noise temperature.

temperature.

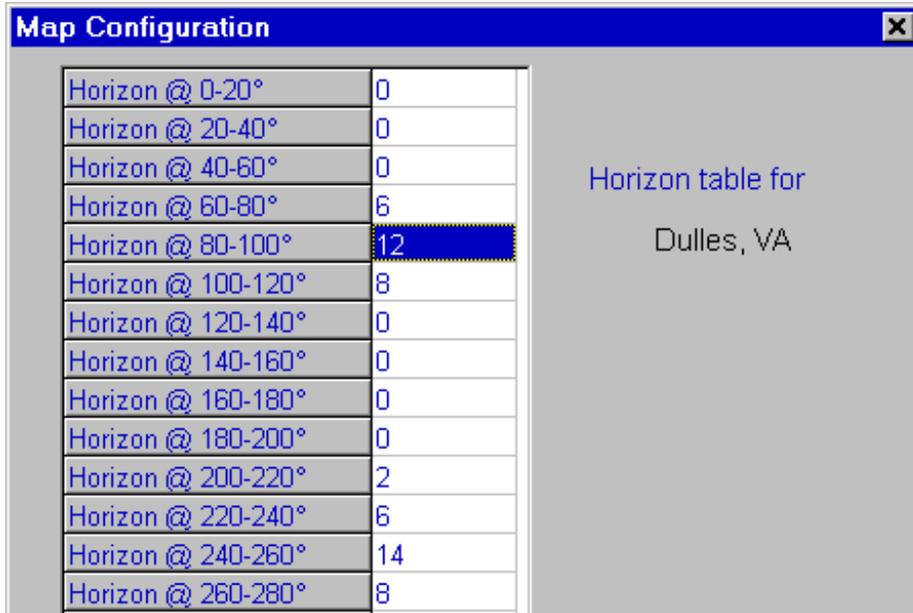
Map Frequency sets which map is drawn on the screen. Maps have been prepared by the IEEE for 50 MHz, 136 MHz, and 400 MHz.

Show Horizon plots a curve on the map that represents the current horizon at the observer's location. **Show satellite path** displays a curve showing the path of the satellite against the sky. **Show Sun** plots the sun's position on the map and **Show temperature labels** displays numbers representing equivalent noise temperature of the map's contours.

Horizon Table Configuration

Horizon Table is a means of modeling the observer’s horizon to account for obstructions such as mountains, buildings, or trees. The full-circle

horizon is divided into 20° slices in the Horizon table configuration page. For each slice, enter the actual horizon elevation as seen from the satellite tracking antenna’s point of view. For example, if mountains obstruct the horizon from 80°-180°, then their general profile can be entered in the 80°-180° slices (see example). Where the horizon is flat, enter 0°. It is also possible to enter negative values if necessary.



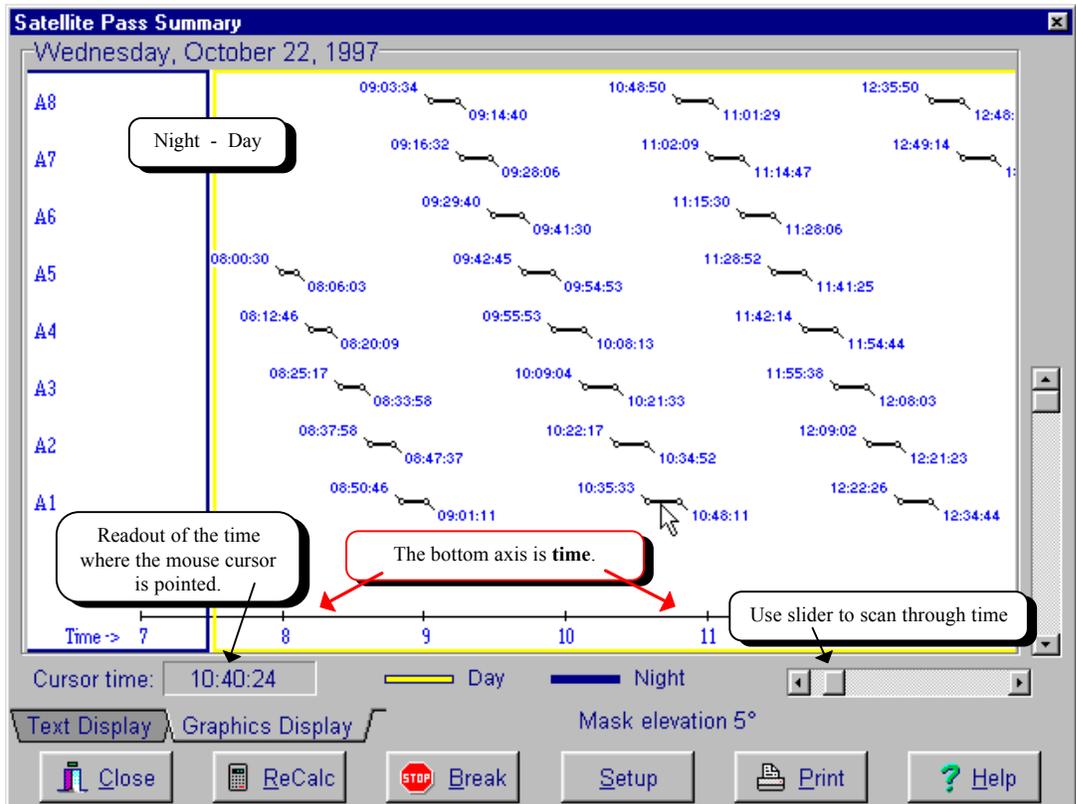
Horizon table modeling is used in display of NASA-style footprints and in the outer perimeter of the Radar map. The horizon table is not included in AOS/LOS calculations, which are based on a horizon mask set in each View.

The Horizon table models obstructions to the observer’s horizon

**Utilities/
Satellite Pass Times**

Orbcomm View includes a powerful tool for managing automated tracking of multiple satellites. The Satellite Pass Times utility calculates a time-sorted list of passes for all the satellites in a View.

The Satellite Pass Times utility consists of two



Orbcomm View’ graphics display of Satellite Pass Times presents a clear summary of multiple passes of several satellites.

pages: **Text** and **Graphics**. The graphics page displays satellite passes vs. Time. Passes are represented as horizontal lines arranged vertically by satellite.

The Text display lists *every* pass of *every* satellite in the View's list in chronological order. Each pass listing includes the AOS and LOS times (adjusted for elevation mask, if any) as well as the duration of the pass. The time interval between sequential passes is indicated.

| Satellite | Date | AOS Time | LOS Time | Duration | Interval Between | AOS Az | Max El | LOS Az | Orbit num. |
|-----------|----------|----------|----------|----------|------------------|--------|--------|--------|------------|
| A5 | 10/22/97 | 08:00:30 | 08:06:03 | 00:05:33 | 23:39:53 | 157° | 7° | 104° | 733 |
| A4 | 10/22/97 | 08:12:46 | 08:20:09 | 00:07:22 | 00:06:42 | 168° | 10° | 96° | 733 |
| A3 | 10/22/97 | 08:25:17 | 08:33:58 | 00:08:40 | 00:05:08 | 178° | 13° | 90° | 733 |
| A2 | 10/22/97 | 08:37:58 | 08:47:37 | 00:09:39 | 00:04:00 | 186° | 16° | 85° | 733 |
| A1 | 10/22/97 | 08:50:46 | 09:01:11 | 00:10:25 | 00:03:08 | 193° | 20° | 81° | 733 |
| A8 | 10/22/97 | 09:03:34 | 09:14:40 | 00:11:06 | 00:02:23 | 200° | 25° | 77° | 734 |
| A7 | 10/22/97 | 09:16:32 | 09:28:06 | 00:11:34 | 00:01:51 | 207° | 30° | 75° | 734 |
| A6 | 10/22/97 | 09:29:40 | 09:41:30 | 00:11:50 | 00:01:33 | 213° | 36° | 72° | 734 |
| A5 | 10/22/97 | 09:42:45 | 09:54:53 | 00:12:07 | 00:01:14 | 219° | 43° | 70° | 734 |
| A4 | 10/22/97 | 09:55:53 | 10:08:13 | 00:12:20 | 00:01:00 | 224° | 52° | 69° | 734 |
| A3 | 10/22/97 | 10:04:17 | 10:21:33 | 00:12:29 | 00:00:50 | 230° | 62° | 67° | 734 |
| A2 | 10/22/97 | 10:17:17 | 10:34:52 | 00:12:34 | 00:00:44 | 235° | 73° | 66° | 734 |
| A1 | 10/22/97 | 10:35:33 | 10:48:11 | 00:12:37 | 00:00:40 | 240° | 84° | 65° | 734 |
| A8 | 10/22/97 | 10:48:50 | 11:01:29 | 00:12:38 | 00:00:39 | 245° | 85° | 65° | 735 |
| A7 | 10/22/97 | 11:02:09 | 11:14:47 | 00:12:38 | 00:00:40 | 250° | 75° | 64° | 735 |
| A6 | 10/22/97 | 11:15:30 | 11:28:06 | 00:12:35 | 00:00:42 | 255° | 66° | 64° | 735 |
| A5 | 10/22/97 | 11:28:52 | 11:41:25 | 00:12:32 | 00:00:45 | 259° | 60° | 65° | 735 |
| A4 | 10/22/97 | 11:42:14 | | | 00:00:49 | 264° | 54° | 65° | 735 |
| A3 | 10/22/97 | 11:55:38 | | | 00:00:54 | 268° | 50° | 66° | 735 |

Text page of the *Satellite Pass Times* notebook shows all passes of all satellites in the list.

Utilities/Detailed Pass Information

Orbcomm View includes comprehensive capabilities for producing tabular listings of satellite positions. Listings may be directed to the screen, to a printer, or to a disk file.

Listings of detailed pass information are available in four main formats:

- **One Observer** presents information about one satellite as seen from one observer's location. Position data are calculated at step intervals as set in the Setup screen (see below).
- **AOS/LOS** lists only AOS/LOS times for one satellite and *one* observer; this is convenient for assessing many upcoming passes of the satellite on one screen.

- **Two Observers** lists one satellite's position from the points of view of *two* observers simultaneously. This is similar to the One Observer page in that data are presented at a specified time interval (chosen in **Setup**).
- **Two Obs. Mutual Window** is a summary of the mutual windows of the satellite with two observers; these are the times when the satellite is above the horizon at *both* locations simultaneously.

To select a format for listing, click on the notebook tabs across the bottom of the Listing screen. Select a satellite and observer by using the Setup button. Remember to click the ReCalc button to recalculate pass information after making changes in the Setup.

Utilities/Two-Satellite Mutual Visibility

The Two-Satellite Mutual Visibility utility calculates times when two satellites will be in line-of-sight of each other.

In addition to simple satellite-to-satellite visibility, OV also calculates the times when one of the satellites will *also* be visible to an Orbcomm Gateway Earth Station (GES).

2-Satellite Mutual Visibility
 A1 + C3 EU-GES (Fucino, Italy)
 Satellite Visibility 2 Satellites + Observer Access

| Date | Start | End | Duration | Start | End | Duration | Satellite |
|---------|----------|----------|----------|----------|----------|----------|-----------|
| 9/22/97 | 14:59:46 | 15:24:59 | 00:25:13 | 15:06:23 | 15:21:14 | 00:14:51 | A1 |
| 9/22/97 | 16:32:20 | 17:05:15 | 00:32:54 | 16:51:51 | 17:05:15 | 00:13:23 | A1 |
| 9/22/97 | 18:12:36 | 18:45:31 | 00:32:55 | 18:00:25 | 18:09:03 | 00:08:37 | A1 |
| 9/22/97 | 19:52:48 | 20:25:45 | 00:32:55 | 19:46:00 | 19:49:16 | 00:03:16 | A1 |
| 9/23/97 | 09:14:50 | 09:47:46 | 00:32:56 | 09:42:07 | 09:50:44 | 00:08:36 | C3 |
| 9/23/97 | 10:55:06 | 11:28:01 | 00:32:55 | 10:18:37 | 10:28:01 | 00:09:24 | C3 |
| 9/23/97 | 12:35:22 | 13:08:17 | 00:32:55 | 11:58:54 | 12:13:47 | 00:14:52 | C3 |
| 9/23/97 | 14:15:34 | 14:48:32 | 00:32:58 | 13:52:13 | 14:06:47 | 00:14:34 | A1 |
| 9/23/97 | 15:55:50 | 16:28:48 | 00:32:58 | 16:14:36 | 16:28:48 | 00:14:12 | A1 |
| 9/23/97 | 17:36:05 | 18:09:03 | 00:32:58 | 18:00:25 | 18:09:03 | 00:08:37 | A1 |
| 9/23/97 | 19:16:21 | 19:49:16 | 00:32:55 | 19:46:00 | 19:49:16 | 00:03:16 | A1 |
| 9/24/97 | 08:38:20 | 09:11:18 | 00:32:58 | 08:38:20 | 08:42:27 | 00:04:07 | C3 |
| 9/24/97 | 10:18:37 | 10:51:35 | 00:32:58 | 10:18:37 | 10:28:01 | 00:09:24 | C3 |
| 9/24/97 | 11:58:51 | 12:31:49 | 00:32:58 | 11:58:54 | 12:13:47 | 00:14:52 | C3 |
| 9/24/97 | 13:39:05 | 14:12:04 | 00:32:58 | 13:52:13 | 14:06:47 | 00:14:34 | A1 |
| 9/24/97 | 16:59:37 | 17:32:32 | 00:32:55 | 17:23:10 | 17:32:32 | 00:09:22 | A1 |
| 9/24/97 | 18:39:53 | 19:12:49 | 00:32:55 | 19:08:46 | 19:12:49 | 00:04:02 | A1 |
| 9/25/97 | 08:01:53 | 08:34:52 | 00:32:58 | 08:01:53 | 08:05:09 | 00:03:16 | C3 |
| 9/25/97 | 09:42:07 | 10:15:03 | 00:32:56 | 09:42:07 | 09:50:44 | 00:08:36 | C3 |

Callouts:
 - "Time when both satellites can see each other" points to the 'Duration' column.
 - "Satellite with best visibility during the pass" points to the 'Satellite' column.
 - "Time when both satellites can see each other AND one satellite can see the observer" points to the 'Start' and 'End' columns of the second set of data.

Timeline Diagram:

- Two Sat. mutual vis.:** 58:51 to 12:31:49
- A1 (Satellite 1):** 12:09:37 to 12:20:24
- C3 (Satellite 2):** 11:58:54 to 12:13:47
- Time when all conditions are met:** 12:09:37
- Time when the 1st satellite (A1) is line-of-sight with the Observer:** 12:20:24
- Time when the 2nd satellite (C3) is line-of-sight with the Observer:** 12:13:47

The **1 Observer** page of the Mutual Visibility utility notebook displays data for two satellites and one observer, whereas the 2 Observers page includes a second ground station.

The first step in generating data of 2-satellite mutual visibility is to enter the **Setup** screen and select the satellites and observer(s) of interest. When this is finished, click on the ReCalc button to perform the calculations.

The first column of the display shows the date, followed by three columns that show when the two satellites can see each other. The following three columns show the times when the satellites can see

each other **and** at least one of them is visible from the observer's location.

The Graphics display shows a diagram of the situation for any pass. First, select a pass by clicking on it. Then press the Graphics button. Three horizontal lines are presented, representing times of visibility of the two satellites. The lower two lines show when the satellites are visible to the observer; the top line shows when the satellites are mutually visible (i.e. visible to each other). The vertical dotted line shows the time period of overlap, when the satellites re visible to each other and one of them is visible to the observer.

Utilities/Eclipses

Orbcomm View' Eclipse Utility permits prediction of time periods during which a satellite will pass into the Earth's shadow. Almost all Earth-orbiting satellites are solar-powered; eclipse periods drain their batteries. If a satellite remains in eclipse for too long, its ability to function may be seriously impaired. In some cases, onboard battery failure has left a satellite totally dependent on exposure to direct sunlight. The satellite cannot function while it is in eclipse.

The Eclipse utility contains two pages: one that displays Eclipse periods on an orbit-by-orbit basis and another that summarizes entire days at a time.

The **Every Orbit** page shows the starting and ending times of each period of eclipse for the selected satellite. As with the other utilities, you may select the satellite by using the Setup button.

Start, **End**, and **Duration** are self-explanatory. **Interval between** represents the time between successive eclipse periods.

Daily Summary combines all eclipses in each 24-hour period and presents a summary. **Duration** is the total number of minutes of eclipse for the day. **Percent** is the portion of the day that the satellite spends in the Earth's shadow. **Longest** is the length of the longest Eclipse of the day. **Sun angle** is the angle between the orbital plane of the satellite and the Sun.

| Date | Start | End | Duration | Interval Between | Sun Angle | Illum. |
|---------|----------|----------|----------|------------------|-----------|--------|
| 9/22/97 | 00:43:54 | 01:19:06 | 00:35:11 | ----- | -21.9° | 0.0% |
| 9/22/97 | 02:28:34 | 02:58:46 | 00:30:11 | 01:04:27 | -22.0° | 0.0% |
| 9/22/97 | 04:03:11 | 04:38:25 | 00:35:13 | 01:04:25 | -22.2° | 0.0% |
| 9/22/97 | 05:42:51 | 06:18:03 | 00:35:13 | 01:04:25 | -22.4° | 0.0% |
| 9/22/97 | 07:22:30 | 07:57:42 | 00:35:12 | 01:04:25 | -22.5° | 0.0% |
| 9/22/97 | 09:02:10 | 09:37:22 | 00:35:12 | 01:04:25 | -22.7° | 0.0% |
| 9/22/97 | 10:41:50 | 11:17:02 | 00:35:12 | 01:04:25 | -22.8° | 0.0% |
| 9/22/97 | 12:21:30 | 12:56:42 | 00:35:12 | 01:04:25 | -22.9° | 0.0% |
| 9/22/97 | 14:01:08 | 14:36:20 | 00:35:11 | 01:04:26 | -23.1° | 0.0% |
| 9/22/97 | 15:40:47 | 16:15:59 | 00:35:11 | 01:04:26 | -23.2° | 0.0% |
| 9/22/97 | 17:20:26 | 17:55:38 | 00:35:11 | 01:04:26 | -23.4° | 0.0% |
| 9/22/97 | 19:00:05 | 19:35:17 | 00:35:11 | 01:04:26 | -23.5° | 0.0% |
| 9/22/97 | 20:39:45 | 21:14:55 | 00:35:09 | 01:04:27 | -23.7° | 0.0% |
| 9/22/97 | 22:19:24 | 22:54:34 | 00:35:09 | 01:04:28 | -23.8° | 0.0% |
| 9/22/97 | 23:59:03 | 00:34:13 | 00:35:09 | 01:04:28 | -23.9° | 0.0% |

The **Every Orbit** page of the **Eclipse Utility** summarizes periods of time when the satellite is in the Earth's shadow. This is useful for predicting daily electrical performance.

| Date | Duration | Percent | Longest | Sun Angle | Illumination |
|---------|----------|---------|----------|-----------|--------------|
| 9/22/97 | 08:13:44 | 34.3% | 00:35:13 | -23.9° | 0.0% |
| 9/23/97 | 08:11:53 | 34.2% | 00:35:09 | -23.9° | 0.0% |
| 9/24/97 | 08:10:24 | 34.1% | 00:35:05 | -23.9° | 0.0% |
| 9/25/97 | 08:09:02 | 36.3% | 00:34:56 | -23.9° | 0.0% |
| 9/26/97 | 08:07:40 | 32.2% | 00:33:20 | -33.7° | 0.0% |
| 9/27/97 | 08:06:18 | 32.0% | 00:32:52 | -34.7° | 0.0% |
| 10/2/97 | 07:26:24 | 31.0% | 00:32:11 | -35.4° | 0.0% |
| 10/3/97 | 07:15:23 | 30.2% | 00:31:29 | -36.0° | 0.0% |
| 10/4/97 | 07:32:10 | 31.4% | 00:30:37 | -36.1° | 0.0% |
| 10/5/97 | 06:46:13 | 28.2% | 00:29:31 | -35.7° | 0.0% |
| | | | | -35.1° | 0.0% |

*Eclipse **Daily summary** combines eclipse data for each 24-hour period, facilitating a longer-term perspective, useful for predicting spacecraft power budgets.*

Utilities/Quick Visibility Check

The Quick Visibility Check provides an overview of all the satellites in the main OV database. When it appears, satellite names are listed in either black or blue text color. Blue names represent satellites that are currently above the observer's horizon. Visibility is recalculated every five seconds.

Azimuth/elevation data for one satellite are displayed in the lower right corner. You may select a different satellite by mouse-clicking on it.

| | | | | | |
|--------|------------|------------|------------|-------------|-------------|
| A1 | C3 | Glonass 36 | Glonass 59 | Glonass 78 | GPS BIIA-18 |
| A2 | C4 | Glonass 39 | Glonass 60 | Glonass 79 | GPS BIIA-19 |
| A3 | C5 | Glonass 40 | Glonass 61 | GPS BII-01 | GPS BIIA-20 |
| A4 | C6 | Glonass 41 | Glonass 62 | GPS BII-02 | GPS BIIA-21 |
| | | Glonass 44 | Glonass 63 | GPS BII-03 | GPS BIIA-22 |
| | | Glonass 45 | Glonass 64 | GPS BII-04 | GPS BIIA-23 |
| | | Glonass 46 | Glonass 65 | GPS BII-05 | GPS BIIA-24 |
| A8 | D2 | Glonass 47 | Glonass 66 | GPS BII-06 | GPS BIIA-25 |
| AMSC-1 | D3 | Glonass 48 | Glonass 67 | GPS BII-07 | GPS BIIA-26 |
| B1 | D4 | Glonass 49 | Glonass 68 | GPS BII-08 | GPS BIIA-27 |
| B2 | D5 | Glonass 50 | Glonass 69 | GPS BII-09 | Inmarsat2F2 |
| B3 | D6 | Glonass 51 | Glonass 70 | GPS BIIA-10 | Inmarsat2F3 |
| B4 | D7 | Glonass 52 | Glonass 71 | GPS BIIA-11 | Inmarsat2F4 |
| B5 | D8 | Glonass 53 | Glonass 72 | GPS BIIA-12 | Inmarsat3F1 |
| B6 | F1 | Glonass 54 | Glonass 73 | GPS BIIA-13 | Inmarsat3F2 |
| B7 | F2 | Glonass 55 | Glonass 74 | GPS BIIA-14 | Inmarsat3F3 |
| B8 | G1 | Glonass 56 | Glonass 75 | GPS BIIA-15 | M1 |
| C1 | G2 | Glonass 57 | Glonass 76 | GPS BIIA-16 | M2 |
| C2 | Glonass 34 | Glonass 58 | Glonass 77 | | M3 |

Utilities/Quick Visibility Check provides a summary of all satellites that are visible above the user's horizon.

Frequently Asked Questions

Q: How do I update Keplerian Elements?

Step 1: Acquire a computer file of new Keplerian elements. There are many sources of these files including the Orbcomm web site

<http://www.orbcomm.com>

as well as links through NLSA's web site

<http://www.nlsa.com>

Step 2: In OV's Main Menu, go to Setup, then Satellites.

Step 3: In the Setup/Satellites screen, click on the



Update button.

Step 4: In the pop-up box that appears, tell OV the name of the file that you downloaded in step 1.

Step 5: Click OK and OV reads the file and updates all Keplerian elements in a few seconds.

Q: How do I tell the program about my location?

Step 1: Go to the Main Menu, Setup, then Observers.

Step 2: In Setup/Observers, see if your location is listed in the Main Database (the one on the right side of the page). If it is there, then drag it to the short list on the left. If it is *not* in the Main Database, do the following:

- Fill in the blanks in Edit Location in the lower left corner of Setup/Observers. Enter your town's name, its latitude, and its longitude.
- When all entries are completed, press the  button to add this new location to the short list.

Getting Help

Orbcomm View includes context-sensitive Help on almost every Setup or configuration page. In addition, small pop-up hints appear near buttons if they have been enabled in Setup/General.

Orbcomm's Customer Service group supports OV users. Send e-mail to

customer.service@orbcomm.com

Northern Lights Software Associates welcomes your e-mail comments, suggestions, and criticisms at nlsa@nlsa.com or nlsa@northnet.org.

If necessary, you may telephone NLSA at (315) 379-0161. Please have your **serial number** available. NLSA's FAX number is the same as the voice number.

NLSA's Web page is <http://www.nlsa.com>

Step 3: Exit the Setup/Observers screen by pressing OK.

Step 4: Click on the View that you wish to configure with your location.

Step 5: Right-click the mouse within the View to reveal the pop-up menu. Select *Configure View*.

Step 6: In the **Individual View Configuration** screen, find your town in the short Observers list on the far right side of the screen. Drag the name toward the middle and drop it in the Observers box under **Current Configuration**.

- ✓ **Tip:** If you want all new Views to have your location automatically used when the View is created, click the  Default button before leaving Individual View Configuration.

Step 7: Click OK and you're finished.

Step 8 (optional): If other Views have already been launched, repeat steps 4-6 as necessary.