

May 21, 2004

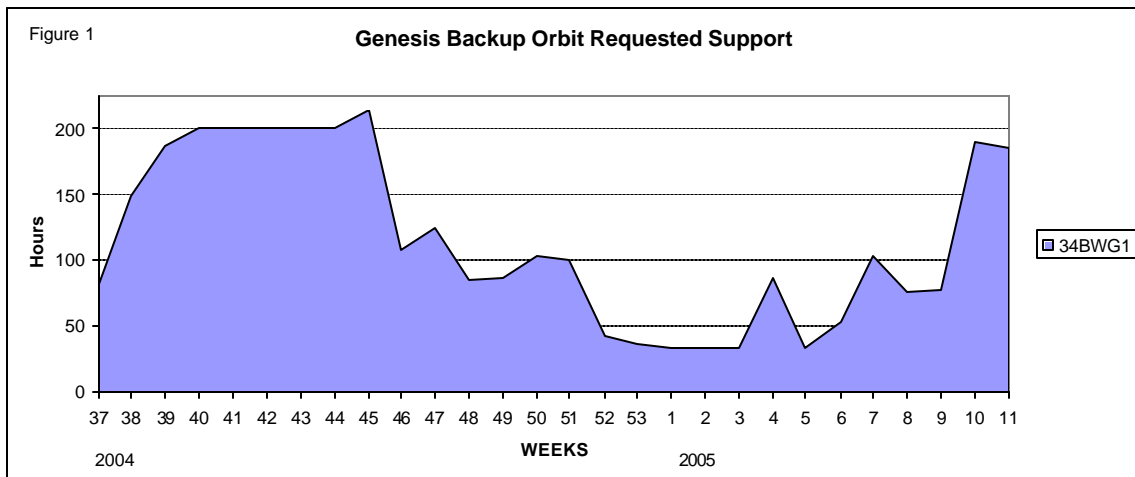
TO: E. Burke

FROM: E. C. Hampton

SUBJECT: Genesis Six-Month Backup Orbit Loading Study

**INTRODUCTION**

This study is in response to a request from the Genesis Project to forecast the amount of DSN support they would receive if it is necessary to implement the Genesis Backup Orbit Plan that will allow the project a second chance to successfully complete Earth return in March 2005. References for this study include the Genesis Backup Orbit User Loading Profile, ULP, provided by project, DSN updated mission set and database from the February 2004 Resource Allocation Review Board (RARB). The analysis for this study was accomplished using the FASTER (Forecasting and Scheduling Tool for Earth-based Resources) forecasting system, TIGRAS (TMOD Integrated Ground Resource Allocation System) scheduling tool, and the RAPSO Mid-Range Planning Schedule. Antenna time conflicts and not equipment conflicts were considered in this study.



This study will look at the weeks 37 in 2004 through week 11 in 2005. The RAPSO Mid-Range Planning Schedule for weeks 37 through 49 of 2004 has been negotiated for the Genesis Disposal Orbit support. The difference between the support scheduled for the Disposal and Backup Orbit Plan is evaluated here. This report will also provide projections for the Backup Orbit phase beginning in week 50 of 2004 through week 11 of 2005, the end of the planned Backup Orbit phase. The six-month backup orbit requires that the 34M beam waveguide 1 subnet be used to support Genesis with the majority of the support requested over DSS-34. Genesis is requesting from approximately 36 hours to 214 hours of support per week in weeks 37 through 53 of 2004 and from 32 hours to 189 hours per week in weeks 01 – 11 of 2005. *See Figure 1.* The Genesis six-month backup orbit view period for the 34BWG1 subnet overlap with ACE, DSS maintenance, Chandra (CHDR), Deep Impact Flyby (DIF), IMAGE (IMAG), the Mars missions (MEX, MGS, and M01O), MESSENGER (MSGR), SOHO, Voyager 1 (VGR 1), Voyager 2 (VGR 2) at DSS-34 only and WIND.

However if on September 9, 2004, the capsule is still on board the spacecraft, this will cause a major re-working of the Mid-Range Planning Schedule to meet the routine requirements and the major events as shown in Table 1 for the Backup Orbit.

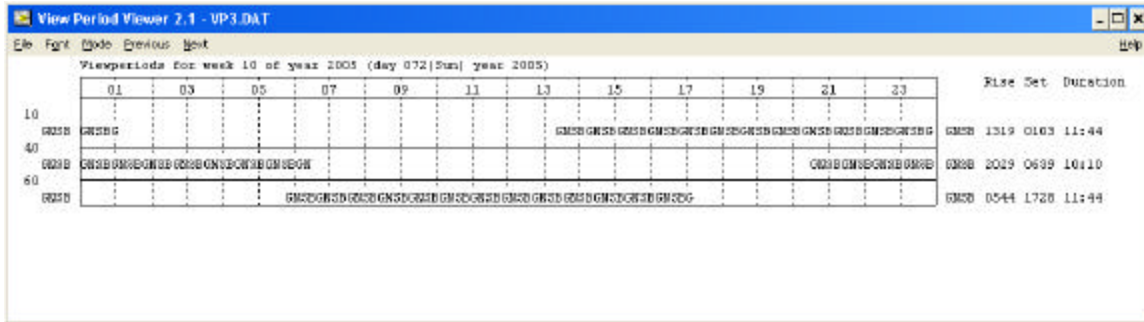
**Table 1. Genesis Major Events for Backup Orbit Support**

<b>YEAR</b>	<b>START DOY</b>	<b>END DOY</b>	<b>MAJOR EVENT</b>
<b>2004</b>	<b>252</b>	<b>252</b>	<b>Divert to Backup Orbit</b>
<b>2004</b>	<b>284</b>	<b>285</b>	<b>TCM (13 m/s) Apogee 1</b>
<b>2004</b>	<b>315</b>	<b>316</b>	<b>TCM (102m/s) Perigee 2</b>
<b>2004</b>	<b>324</b>	<b>325</b>	<b>TCM, Apogee 2</b>
<b>2004</b>	<b>333</b>	<b>334</b>	<b>TCM, Perigee 3</b>
<b>2004</b>	<b>343</b>	<b>344</b>	<b>TCM, Apogee 3</b>
<b>2004</b>	<b>350</b>	<b>351</b>	<b>Lunar Closest Approach</b>
<b>2004</b>	<b>353</b>	<b>354</b>	<b>TCM, Perigee 4</b>
<b>2005</b>	<b>027</b>	<b>028</b>	<b>TCM, Apogee 4</b>
<b>2005</b>	<b>046</b>	<b>047</b>	<b>TCM E-30d</b>
<b>2005</b>	<b>066</b>	<b>067</b>	<b>TCM E-10d</b>
<b>2005</b>	<b>074</b>	<b>074</b>	<b>TCM E-2.2d</b>
<b>2005</b>	<b>075</b>	<b>075</b>	<b>TCM E-1.2d</b>
<b>2005</b>	<b>076</b>	<b>076</b>	<b>EDL</b>

The adding of additional support to the negotiated Mid-Range Planning Schedule to fulfill the requirements for the Backup Orbit in weeks 37 through 49 will create severe unsupportable time for the projects using the 34BWG1 subnet especially in weeks 46 through 49 where Genesis has requested and negotiated 1 to 3 short passes per week. Since the majority of Genesis's Backup Orbit support is requested at DSS-34, the concern is that DSS-34 is already scheduled and there are few available gaps (gaps of 2 hours or more) in the Genesis view period. Also, the scheduled downtime of DSS-45 for Life Extension repairs and installations leaves no room for substitution for those missions scheduled at DSS-34 that could be moved to DSS-45. Because coverage for the Disposal

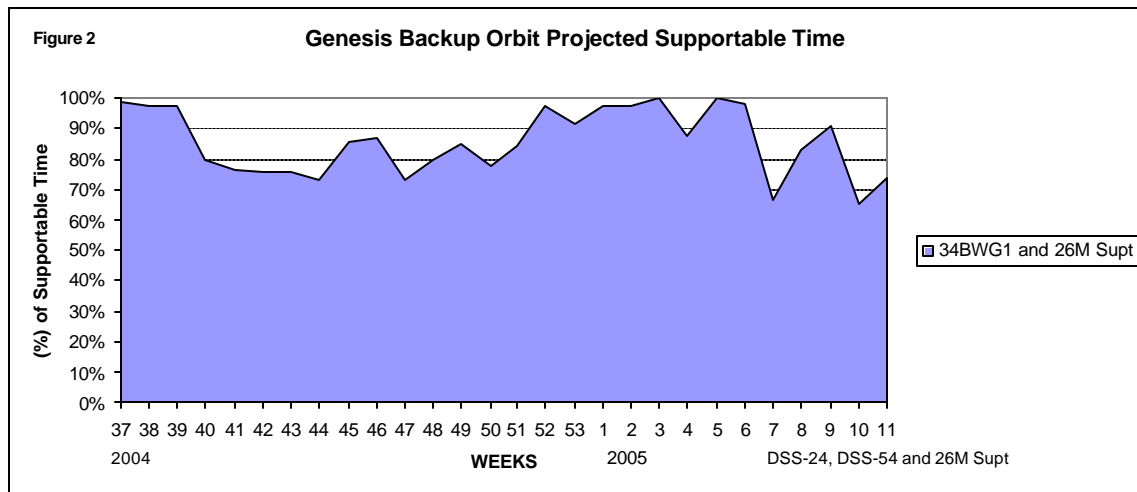


Chart 2. 2005 Genesis Backup Orbit View Period



### Assumptions

- DSN Setup time is 1-hour
- Support is requested on the 34BWG1 and 26M subnets only
- DSS-45 is down for Life Extension beginning in week 33 of 2004
- DSS-34 is down for X/X-Ka band installation from weeks 09 through 14 of 2005
- DSS-43 and DSS-46 cannot be used to replace DSS-34 in weeks 09 – 11
- DSS-24 Genesis supports were changed from 6-hour supports to full view, reflecting rise to set supports to supplement for DSS-34 being unavailable due to scheduled downtime.
- The Sun view period is used to represent ACE, SOHO and WIND on the View period Overlap charts, figures.



### Assessment

The Genesis backup orbit support planned for weeks 37 through 49 of 2004 is dependent upon re-negotiation of the RAPSO Mid-Range Planning schedule and the delay of the DSS-45 scheduled downtime in weeks 33 - 49. For weeks 50 through 53 of 2004 the projected supportable time Genesis can expect to receive is from 78 to 98 percent of their

requested support. *See Figure 2.* The projected Supportable time in weeks 50 - 51 and in week 53 can be attributed to the off-loading of DSS-14 supports to the 34BWG1 antennas to accommodate scheduled downtime which ends in week 50, Deep Impact Flyby launch, Cassini critical activities (Probe checkout, TCM, critical uplink sequence and probe release) MEX Occultation, and SDU maneuver and TCM. *See Table 2. DSN Major Events for 2004 – 2005.* The DSS-45 downtime impacts Genesis because of the additional load placed on DSS-34.

Genesis backup orbit supports on the 34BWG1 subnet is in contention with CHDR, DSS Maintenance, Image, Mars missions requesting the 34BWG1 subnet, MSGR, SOHO, ULYS, Wind, and VGR 2 at DSS-34 only. The projected contention for Genesis backup orbit is due to Genesis' view period overlap with CHDR, DIF, DSS Maintenance, MSGR, Mars missions, and the Sun view period (Polar, SOHO and WIND), ROSE, SDU, ULYS, VGR1 and VGR 2. *See Figures 3 – 3C, Genesis View Period Overlap with DSS Maintenance and Genesis View Period Overlap at SPC-40 and view period supporting data in Figures 5A-8B9.*

The Genesis backup orbit support in 2005 is requesting from 33 hours to 189 hours per week and of those requested hours, it is projected that Genesis can expect to receive approximately from 87 percent to 100 percent of their requested support in weeks 01 through 6 on the 34BWG 1 and 26M subnets and from 66 percent to 91 percent using DSS-24, DSS-54, and the 26M subnets in weeks 7 through 11. The projected supportable time for 2005 is shown in figure 2.

The 20 percent or more projected unsupported time in weeks 7, 8, 10, and 11 is due to the scheduled downtime for DSS-34 beginning in week 7, reducing the S-band missions to two northern hemisphere antennas, to be shared with Mars Express Science and Occultation, Rosetta Earth swing ending in week 11, SOHO keyhole event and maneuver, Wilkinson Map maneuver support in week 11 and view period overlap with DSS maintenance, CHDR, DIF, Mars missions, MSGR, ULYS, and VGR 2. *See Figures 3 – 3A-3C DSS Maintenance and SPC-40 View Period Overlap.*

The projected 66 percent of supportable time occurs in week 10, where Genesis has a planned TCM and DSS-34 and DSS-65 are scheduled for downtime. In week 10, DSS-24 is used for the TCM due to DSS-34 scheduled downtime for X/X-Ka Band installation. The planned downtime for DSS-34 places an additional load onto DSS-24 and DSS-54 for S-Band missions (CHDR, SOHO keyhole supports, ULYS and WIND) as they can be supported only on the 34BWG1 therefore all of their supports are moved to DSS-24 and DSS-54 only.

### **Conclusion**

Because the RAPSO Mid-Range plan has been negotiated for weeks 37 through week 49, Genesis backup orbit in those weeks will have to be re-negotiated if the Backup orbit is implemented on September 9. The projected support for weeks 50 through 53 of 2004 and early 2005 show that Genesis Backup Orbit can be supported; however the following missions will be impacted due to their S-Band up and down limitations, Chandra, SOHO

Key hole event and maneuver, ULYS and WIND. Genesis will need to negotiate with the above missions and DSS-maintenance to achieve 100 per cent of their requested support. Also, please note that the RAP Team will have negotiated the Mid-Range Planning Schedule through week 11 of 2005 by August of 2004, therefore the projected supportable time for Genesis Backup Orbit in weeks 50 of 2004 through 11 of 2005 may change based upon re-negotiations.

As always, the results of this study are subject to change. Network loading changes as mission requirements are updated and periods of antenna downtime are identified and or changed. RAPSO will continue to work with Genesis and other users of the DSN to maximize the time available for each individual user.

cc:

R. Bartoo

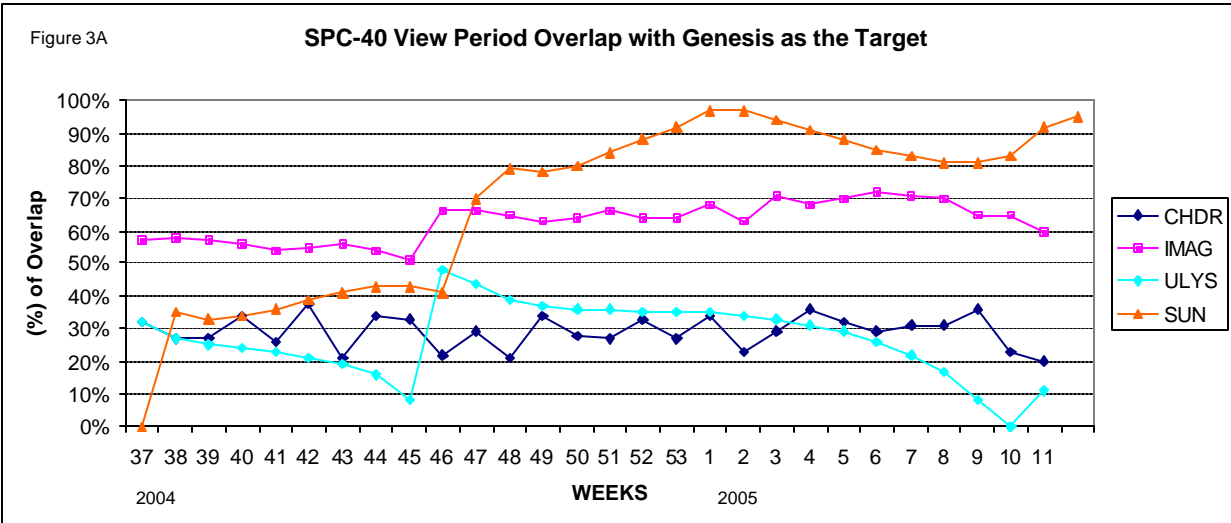
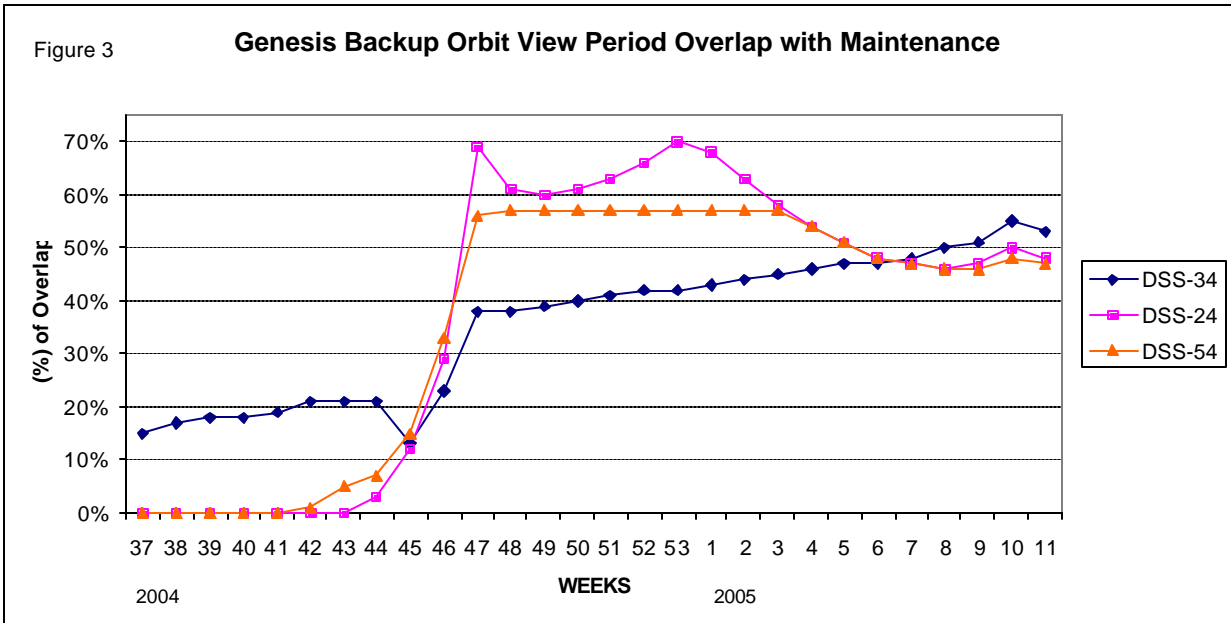
S. Guduru

E. Hampton

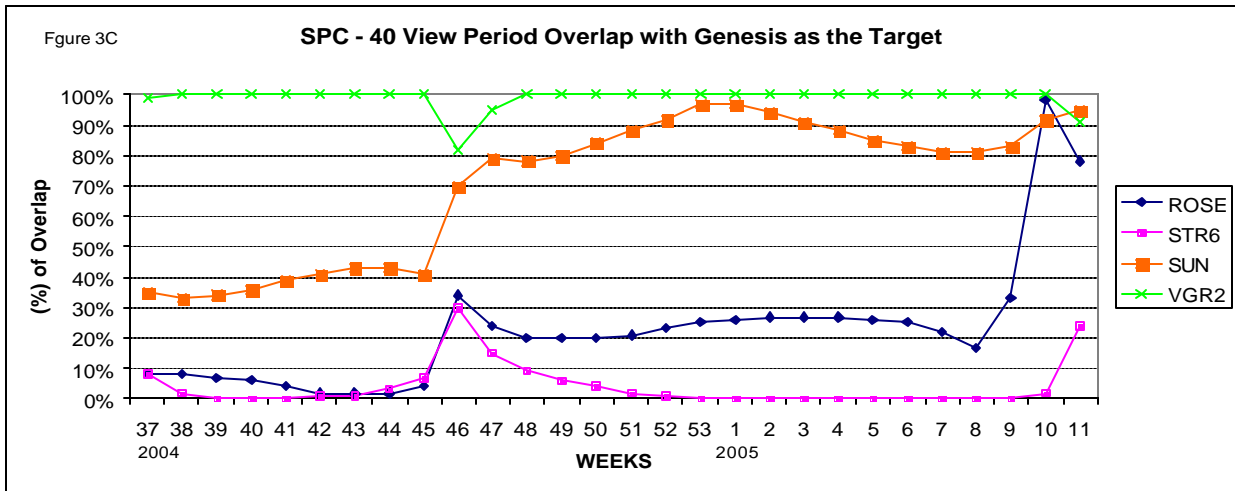
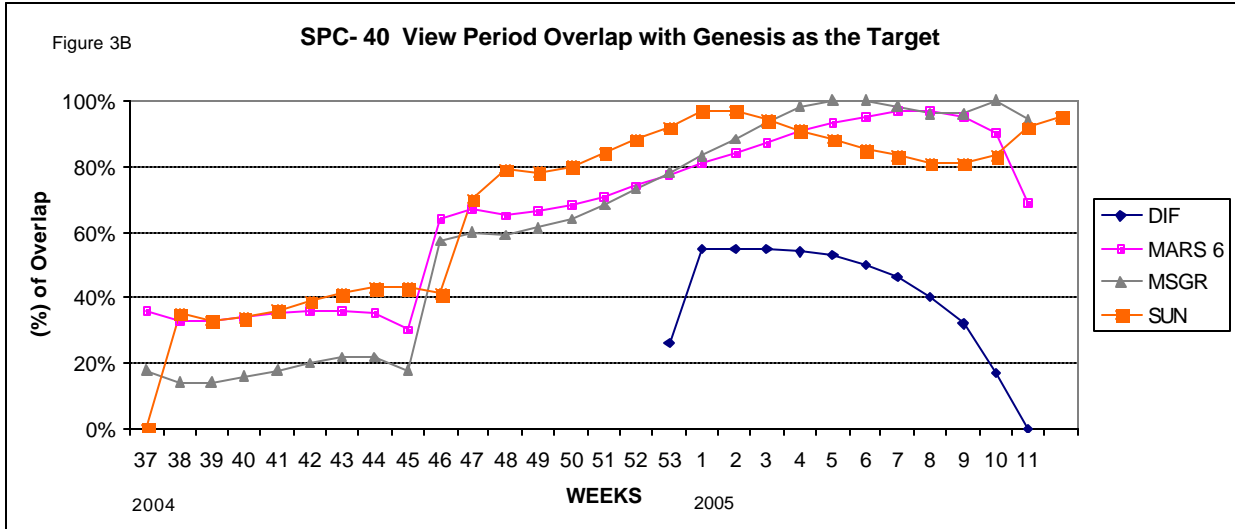
N. Lacey

D. Morris

Support Data continues



Support Data continues



# Support Data continues

Figure 5-A1

**2004 BACKUP ORBIT VIEW PERIOD OVERLAP AT SPC - 40 WITH GNSB AS TARGET**

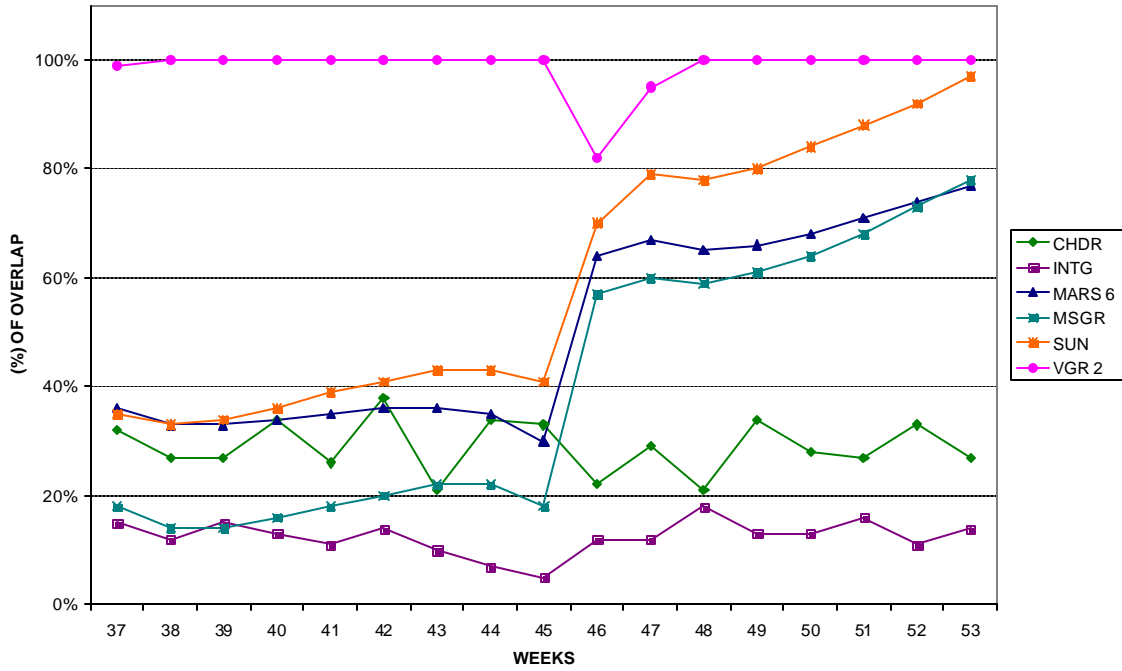
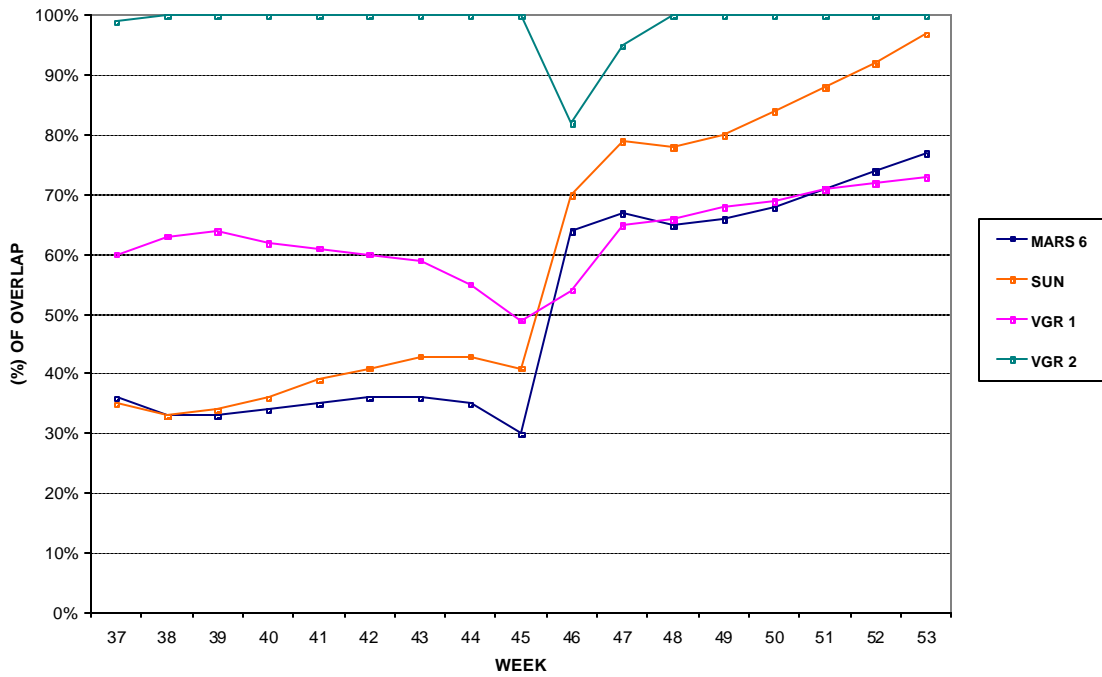


Figure 5-A2

**2004 BACKUP ORBIT VIEW PERIOD OVERLAP AT SPC - 40 WITH GNS AS TARGET**



## Support Data continues

Figure 5-A3

**2004 BACKUP ORBIT VIEW PERIOD OVERLAP AT SPC - 10 WITH GNSB AS TARGET**

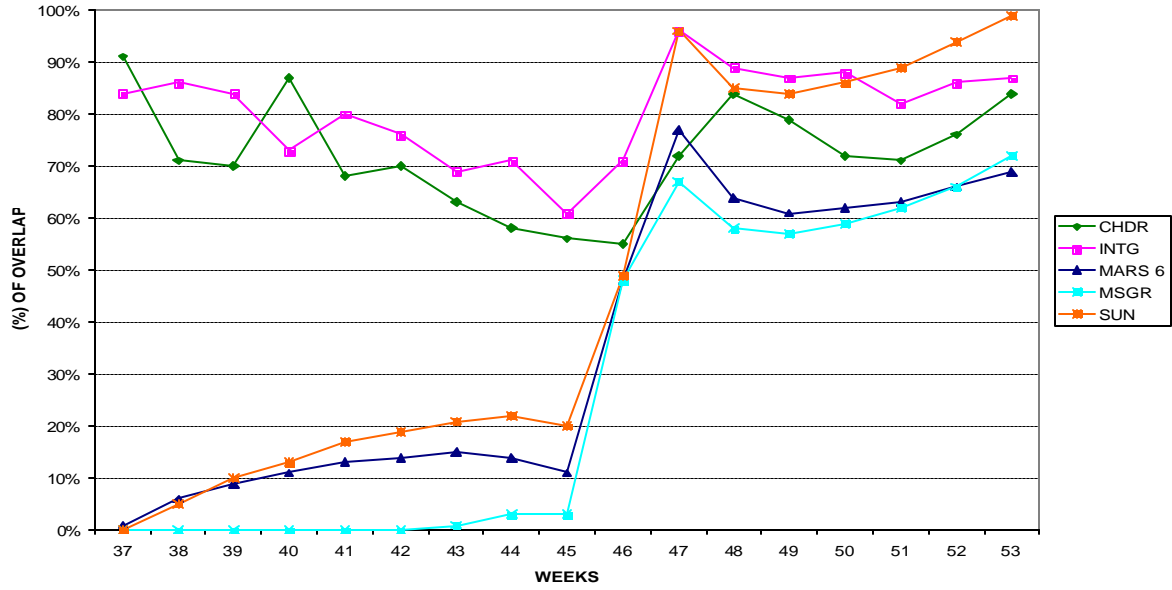
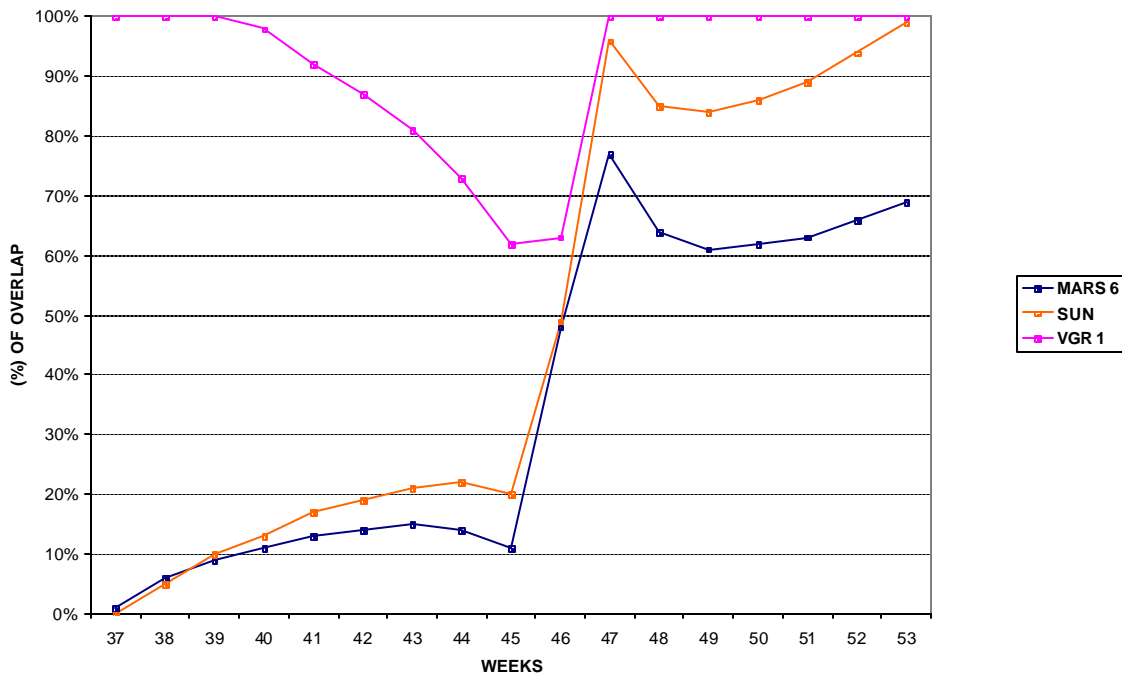


Figure 5-A4

**2004 BACKUP ORBIT VIEW PERIODS AT SPC - 10 WITH GNSB AS TARGET**



# Support Data continues

Figure 5-A5

2004 BACKUP ORBIT VIEW PERIOD OVERLAP AT SPC - 60 WITH GNSB AS TARGET

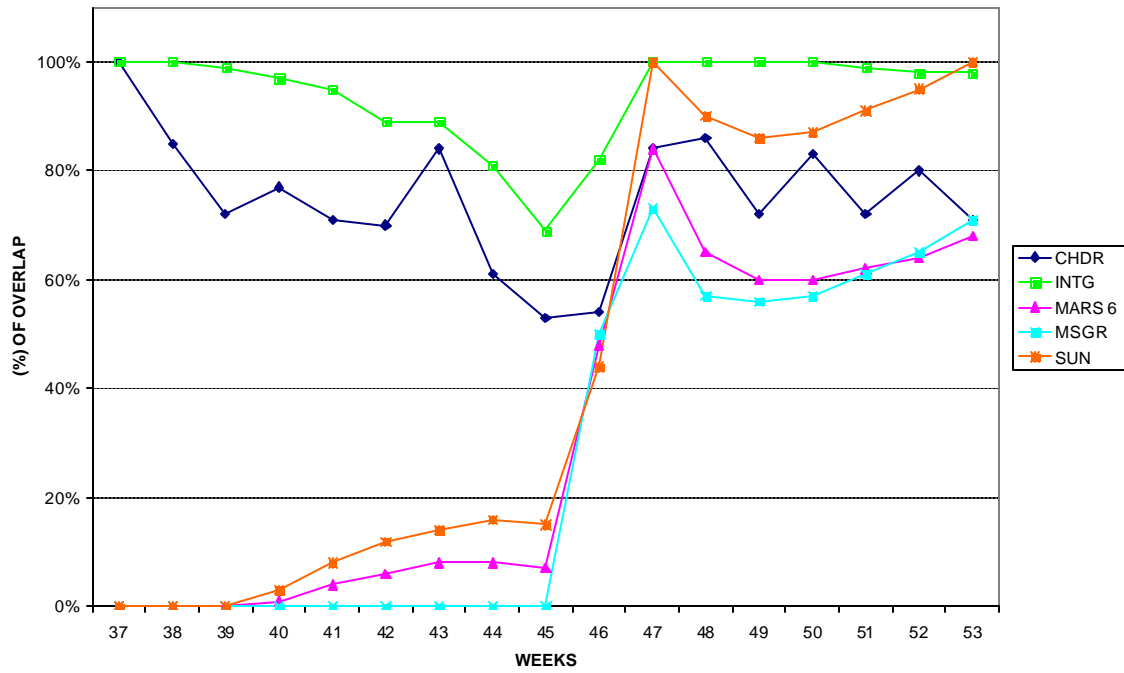
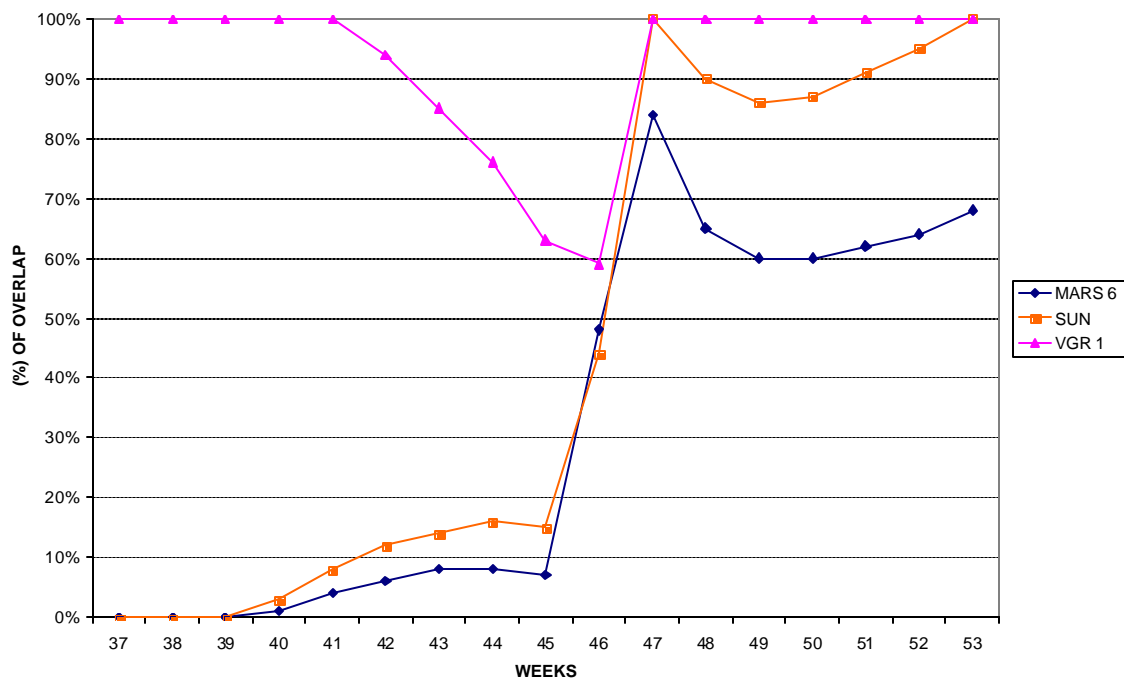


Figure 5-A6

2004 BACKUP ORBIT VIEW PERIOD OVERLAP AT SPC - 60 WITH GNS AS TARGET



## Support Data continues

Figure 5-B1

**2005 BACKUP ORBIT VIEW PERIOD OVERLAP AT SPC - 40 WITH GNSB AS TARGET**

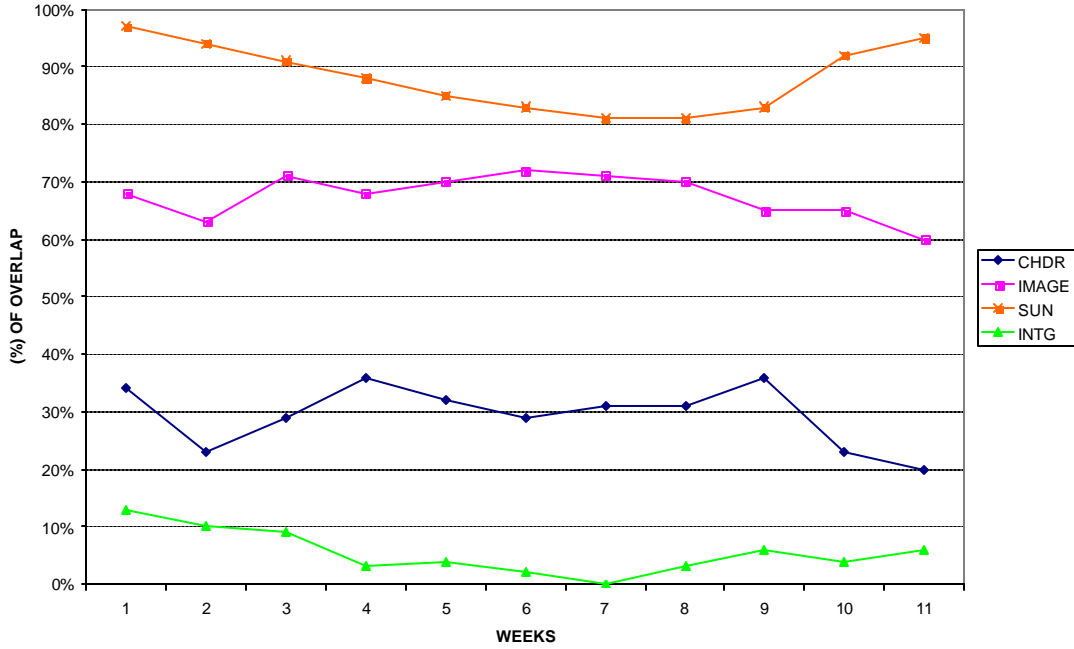
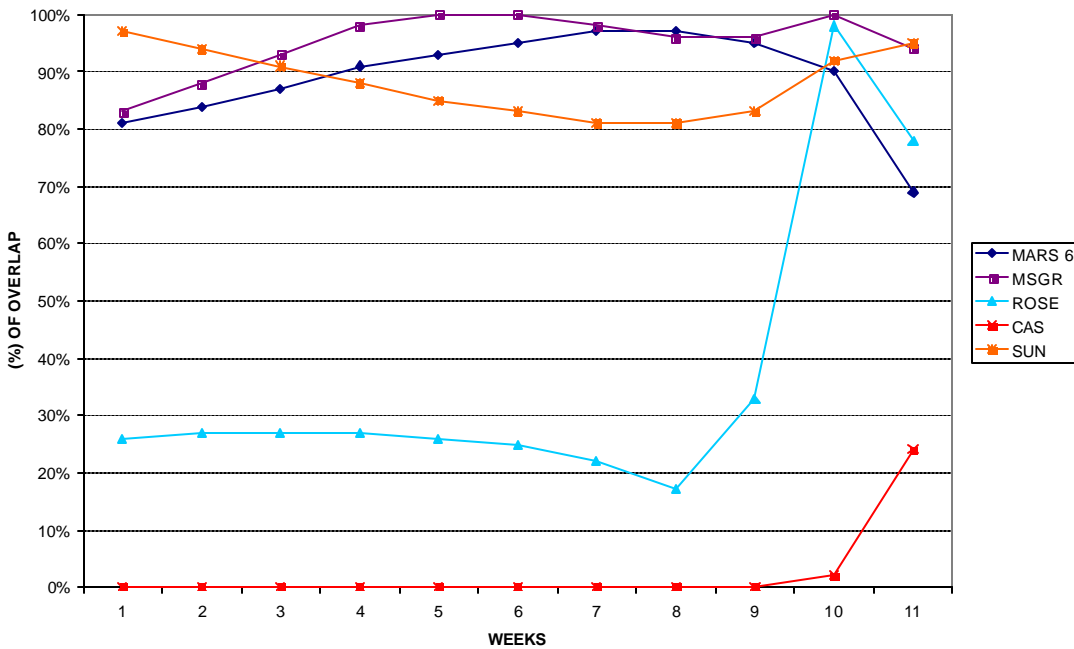


Figure 5-B2

**2005 BACKUP ORBIT VIEW PERIOD OVERLAP AT SPC - 40 WITH GNSB AS TARGET**



Support Data continues

Figure 5-B3

2005 BACKUP ORBIT VIEW PERIOD OVERLAP AT SPC - 40 WITH GNSB AS TARGET

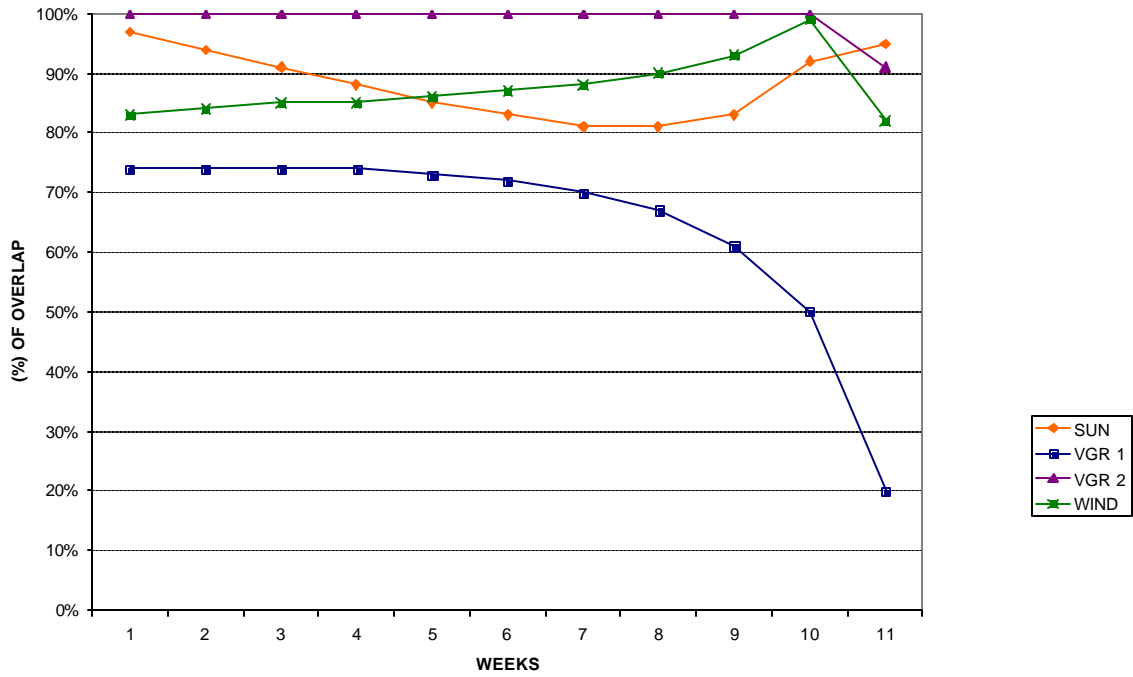
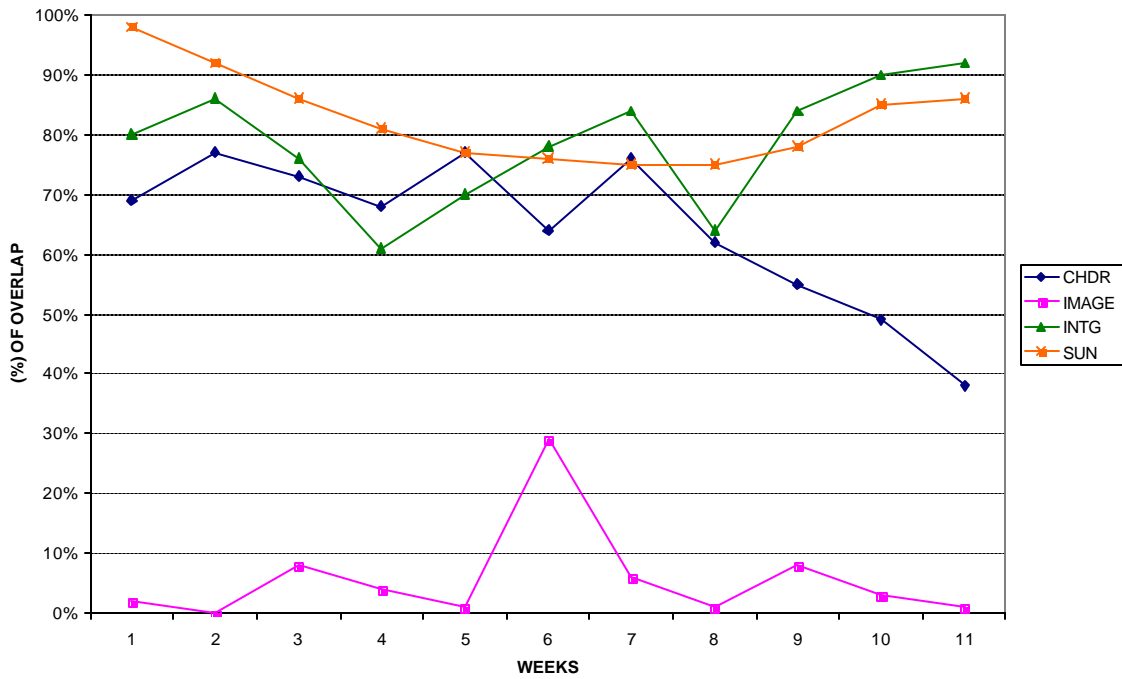


Figure 5-B4

2005 BACKUP ORBIT VIEW PERIOD OVERLAP AT SPC - 10 WITH GNSB AS TARGET



# Support Data continues

Figure 5-B5

2005 SPC - 10 VIEW PERIOD OVERLAP WITH GNSB AS THE TARGET

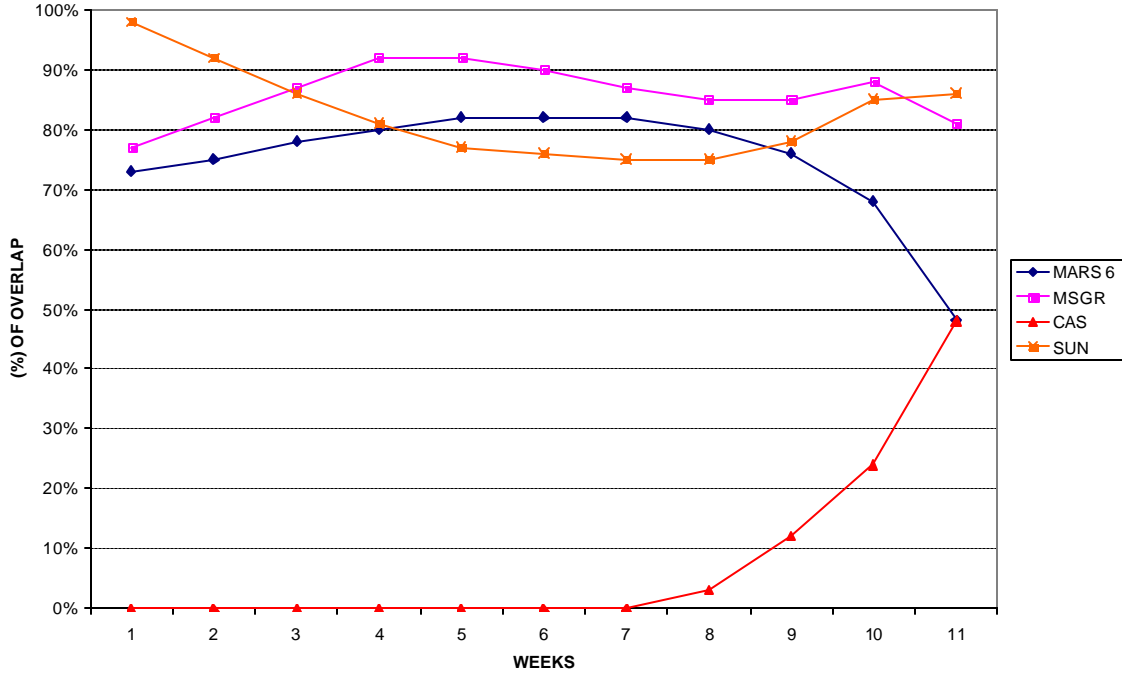
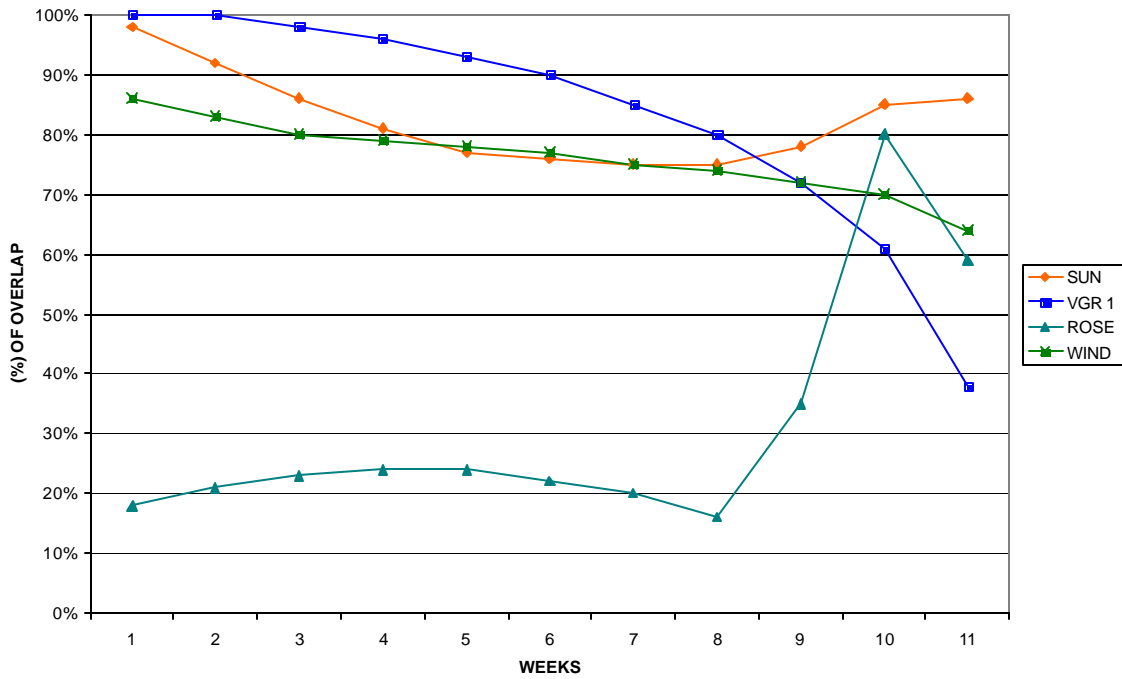


Figure 5-B6

2005 SPC - 10 VIEW PERIOD OVERLAP WITH GNSB AS THE TARGET



Support Data continues

Figure 5-B7

2005 SPC - 60 VIEW PERIOD OVERLAP WITH GNSB AS THE TARGET

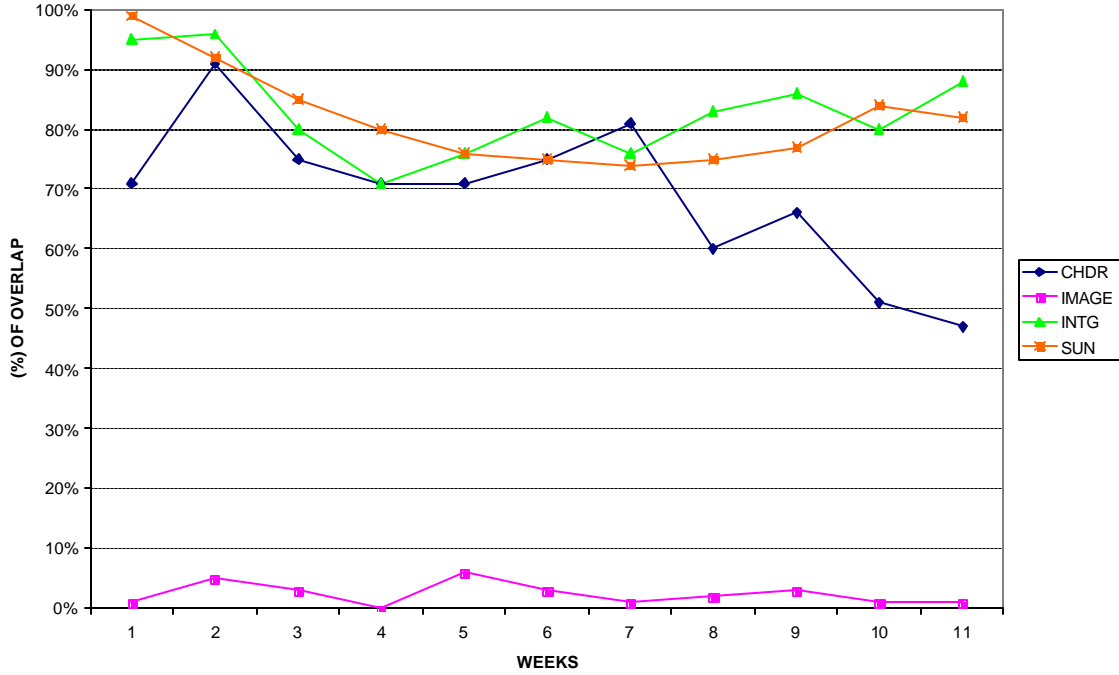
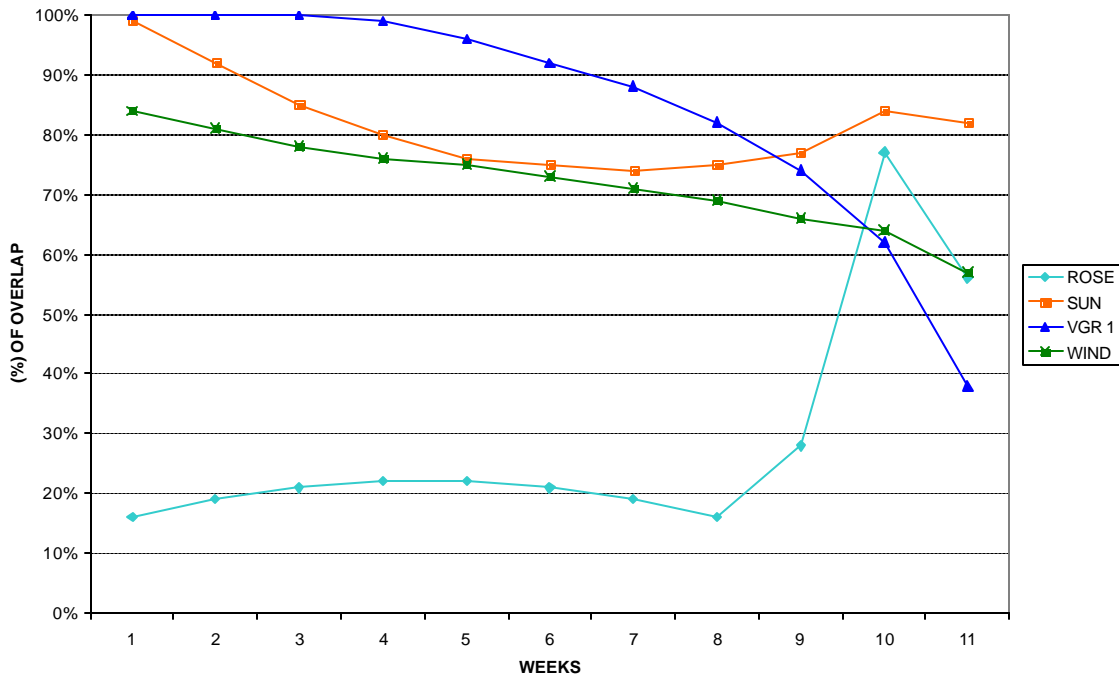


Figure5-B9

2005 BACKUP ORBIT VIEW PERIOD OVERLAP AT SPC - 60 WITH GNSB AS TARGET



Support Data continues

**Table 2. Major Events for September 2004 through March 2005**

**Major Events for 2004**

Cassini Saturn Tour
Cassini Probe Checkout in week 48
Cassini Probe target TCM, Probe Checkout, and Probe Release and critical U/L Sequence in week 50
Deep Impact Flyby Launch and initial Acquisition and launch phase support in week 53
GOES-N Launch NET December 1
Mars Express Solar Corona in weeks 34 – 47
Mars Express Occultation in weeks 52 - 53
Stardust Maneuver and TCM support in week 40 – 44
Voyager 1 DTR Playback, ASCAL and MAGROL Maneuvers in week 48
Voyager 2 DTR Playback, ASCAL and MAGROL Maneuvers in week 38
Wilkinson MAP Maneuver in week 46
Wind TCM support in week 43

**Major Events for 2005**

Cassini Probe Entry in weeks 01 – 02
Cassini Saturn Tour
Deep Impact Flyby LEOP
Deep Impact in flight demo and TCM in week 08
Deep Impact Flyby TCM in weeks 09 – 12
Deep Impact Flyby Comet Encounter rehearsal in week 12
Deep Impact Flyby TCM in weeks 16 - 17
Hayabusa TCM-2 in weeks 02 – 04
Hayabusa Asteroid Rendezvous in week 13 - 17
Mars Express Orbital Science and Occultation
Rosetta Earth Swing-by in weeks 07 – 11 (Earth Swing-by on DOY 061)
SOHO Key-hole support in weeks 09- 13 and Maneuver in week 12
Voyager 1 MAGROL Maneuver in week 05
Voyager 1 DTR Playback in week 17
Voyager 2 DTR Playback, ASCAL and MAGROL Maneuvers in weeks 10 - 11
Wilkinson MAP Maneuver in week 11
Wind TCM in week 02 and in week 15