



**Australian Government**  
**Geoscience Australia**



# Yarragadee SLR station (MOBLAS-5) scheduling and optimal tracking strategies



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# Scheduling Issues

- Many more satellites to track – with a great increase in demand from GNSS targets - and only one SLR aperture.
- Trackers naturally want to obtain the most data – this traditionally means the most normal points.
- This is often not compatible with demands of “good” GNSS SLR coverage.
- Many of the harder GNSS and especially RNSS satellites can take a longer time to acquire and hence add pressure to operators trying to maximize their data yield.
- Weather of course determines which targets are most suitable for each time period.
- The more targets, the more challenging – good and bad.

# Scheduling at Yarragadee

- We use ILRS / NERC priority lists as a guideline.
- Use horizon to horizon coverage as the goal but pass centred around PCA as the “rule”. We use interleaving to achieve this.
- Select GNSS targets where 3x3x3 NPs can be achieved when there is a choice.
- Interleave lageos and LEOs with GNSS if needed to achieve desired GNSS coverage. ( Lageos / GNSS interleaving can be done without any loss of NPs ).
- Both receive chain (amp and non-amp) modes can be easily accommodated in the same tracking scenario due to pre-processing routines ( unlike standard MOBILAS / NASA systems).
- Continually encourage operators to “lose” a few HEO NPs in the quest for better GNSS coverage.
- We rarely schedule the “quiet” Glonass (<Glonass122).

# Scheduling at Yarragadee

- “Gold medals” awarded in several categories each month for operators.
- Categories (on a per shift average basis) include :

Most NPs

Most Campaign Satellite NPs

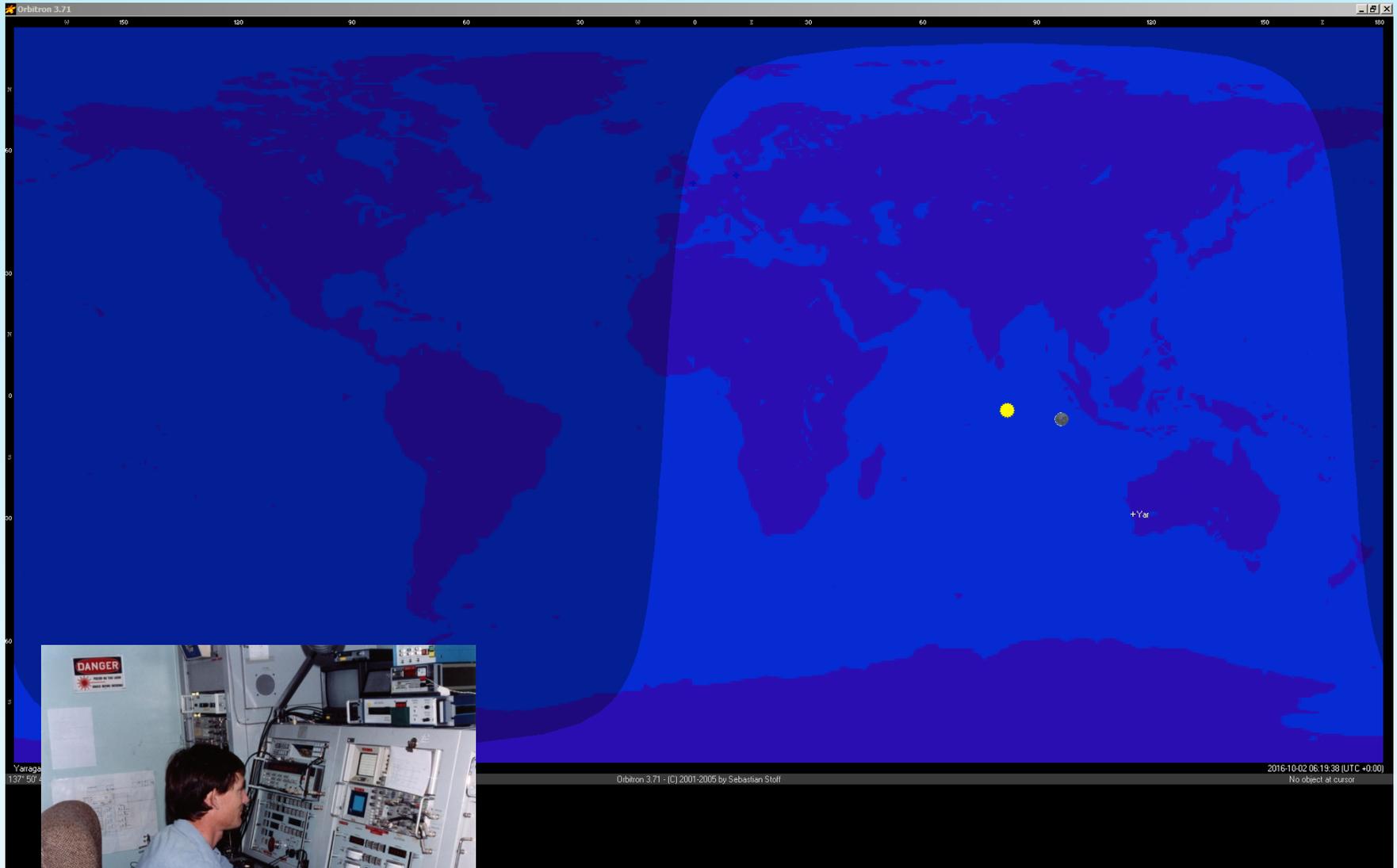
Most Daylight HEO NPs

Most IRNSS NPs

These are easy to automatically tally and award but subject to some amount of gaming.

- It is not easy to calculate and reward individuals for “good horizon to horizon coverage”.

# GNSS Satellites to track in 1992





# Scheduling Tools at Yarragadee

The screenshot displays the SLR Operations Screen 1 interface, which is divided into three main sections:

- Top Section (SatScope - Panoramic Horizon View):** This section shows a panoramic view of the sky with various satellites tracked. The Sun is 35.0 degrees above the horizon, and the Moon is 15.2 degrees above the horizon. The interface includes a compass with directions NORTH, EAST, SOUTH, WEST, and NORTH. Satellites shown include G103, Gal104(7104), Gal103(7103), HD(3304), HD(3305), CG1(2002), G2S-1(1581), G129-PL, ET1(0829), G134-PL, G127L, HIC(3303), CIS2(2010), CIS(2005), HA(3301), G136, Gal102(7102), G120, CBB(2012), CIS1(2006), G117, G121, G116, Gal101(7101), CMS2(2008), CMS2HB(3302), G119, RadioAstro(8559), and CB(2003).
- Bottom Left Section (Weather Radar):** This section displays a radar map of Western Australia. The map shows various locations such as Alkana, Dartmoor, Binnu, Oglivie, Northampton, Yuna, Horrocks, Habava, Mullewa, Eradu, Geraldton, Perseus Ap, Tardun, Dongara, Mingenew, Three Springs, Carnamah, and Eneabba. The radar shows a 128 km range. The text "Copyright: Image by Bureau of Meteorology. For related Warnings, see www.bom.gov.au" is visible. The date and time are "Gerlton 22/09/16 00:30UTC 000.5e1 128km -1".
- Bottom Right Section (Satellite Imagery):** This section shows a satellite image of the Earth, specifically the Western Australian coast. The image is titled "Play" and shows a "Thu 07:50 WST". The image is controlled by a "JMA Himawari-8" satellite. The interface includes playback controls (play, stop, fast forward, fast reverse) and settings for Duration (1 hour), Speed (normal), and Dwell (3x). There are also checkboxes for Terrain, Rainfall, Rivers, Roads, Borders, Locations, and Lightning. The text "weatherzone" and "JMA Himawari-8" are visible.

SLR Operations Screen 1

# Scheduling Tools at Yarragadee

The screenshot displays the Orbitron 3.71 software interface. The main window shows a satellite map of Australia with numerous satellite icons labeled with names like G126L, G107, G106, etc. A search bar at the top left contains '172.20.110.92'. Below the map, there are several control panels and data tables.

**Search and Filter Panel:**

- Mode: Real time (selected), Simulation
- Time: Local (selected), UTC
- Location: Yarragadee
- Time: 2016-09-22 00:55:53
- Periods: 1

**Table 1: Search Results**

Online/3A	ESA	7631	0	677	01:33	264	Yarragadee
ariette	SGF	7621	0	535	21:59	263	Yarragadee
ella	SGF	7631	0	18.1k	01:29	264	Potsdam
sat2C	KAI	7601	0	16	11:36	261	Yarragadee
warmA	ESA	7621	10	65	22:24	263	Yarragadee
warmB	ESA	7621	0	3	14:20	263	Yarragadee
warm	ESA	7631	5	30.1k	20:58	263	Potsdam
warmC	ESA	7621	20	26	22:26	263	Yarragadee
anDemX	qfz	7622	10	150	21:13	263	Yarragadee
ndemx	GFZ	7631	0	367	05:05	263	MLRO-Matera
rraSarX	qfz	7622	10	30	22:58	263	Yarragadee

**Table 2: Eurostatus**

Eurostatus	2016-09-22	00:55:46	SLRDEBRIS1	CUR	0	JNP9999	0.000
Graz	2016-09-22	00:54:56		OUT			
Hersimonceux	2016-09-22	00:55:43		OUT			
Ketzjely	2016-09-22	00:55:43	Lares	CUR			
McDonald	2016-09-22	00:52:00	glonass106	CUR	14	COD7651	0.000
Metshovi	2016-09-22	00:55:42		OUT			
San_Pernando	2016-09-22	00:55:34	Calibrate	CUR	388		
Simeiz-1973	2016-09-22	00:55:53	Lares	CUR	9	SGF7651	0.000
Wetzell	2016-09-22	00:55:48	Lares	CUR	0	SGF7651	0.000
Yarragadee	2016-09-22	00:55:51	Cryosat2	LST	5	ESA7651	0.000
Zimmerwald	2016-09-22	00:55:46	SLRDEBRIS1	CUR	0	JNP9999	0.000

**Table 3: Cryosat(8006)**

Lon	122° 32' 45" E
Lat	6° 03' 06" S
Alt (km)	727.914
Azm	17.3°
Elev	2.5°
RA	10h 48m 48s
Decl	53° 58' 54"
Range (km)	2 877 050
RA (km/s)	6.260
Vel (km/s)	7.488
Direction	Ascending
Eclipse	No
MA (phase)	197.6° (140)
TIA	197.5°
Oribit #	34 226
Mag (illum)	? (133)
Constellation	UMa

**Table 4: Moon**

Azm	300.57°
Elev	15.3°
RA	04h 39m 36s
Decl	17° 30' 20"
Lon	55° 28' 09" E
Lat	16° 57' 42" N
Range (km)	368 783
illum	67%
Phase	Last quarter
Constellation	Tau

**Table 5: Sun**

Azm	66.8°
Elev	35.0°
RA	11h 57m 57s
Decl	0° 12' 01"
Lon	164° 12' 39" E
Lat	0° 12' 48" N
Range (km)	150 152 707
Constellation	Vir

## SLR Operations Screen 2

# Scheduling Questions

- Is the GNSS coverage adequate for purpose? Would it be better to have a prime subset of Galileo targets the same as Glonass?
- Is it better to concentrate on one or two RNSS targets per day at each station and get better pass coverage or get a few NPs for each visible satellite per day?
- Is the single segment GNSS pass at all useful?
- Are there some LEOs that don't require every station to track every day? Of course every one wants the NP gold medal!
- How do we give credit for best coverage for each satellite?
- Should we occasionally track the “quiet” (<G122) glonass?
- Of course a second (LEO/MEO capable), SLR system at YGO would relieve some scheduling pressure!
- Khz and fast interleaving – would it provide useful data or just more operator stress?

# Moving Forward

- Encourage operators to obtain as good a pass coverage as possible.
- Encourage feedback from data users – Are we getting enough coverage to be useful? Conversely is there such a thing as too much data – are some of our efforts wasted? We want to know – information can be used to instruct / encourage operators.
- More discussions to follow in the clinic sessions.