SatTrackCam Report no. 1

The First 15 months

(August 2005 - October 2006)

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1.1 Introduction: brief history & station details

Amateur photographic satellite tracking station *SatTrackCam Leiden* started operations on August 1st 2005, receiving Cospar station code 4352, later changing into 4353 after a move to a new location in February of 2006. It is operated by the author of this report. *SatTrackCam*'s main focus is on position determinations of classified satellites.

1.1.1 Brief history

In July of 2005, the author of this report was presented with a small pocket digital photographic camera by Casper ter Kuile. From a longer more "recreational" interest in satellites (as a by-product of his meteor observations), the idea to try to use it for serious satellite position determinations was born when during trials with simple fixed tripod astrophotography it accidentally captured a bright satellite.

Familiar with astrometry of astronomic images due to his work on meteors and asteroids and possessing the relevant software, it was realized by the author that such images could provide satellite positions. After a series of trials, mainly focussing on the difficult task of calibrating the exact shutter times and shutter time delays of the camera (done by comparing time residues to those of other observers and the resulting TLE's), the first serious attempts to obtain useful data were done in August 2005 at station 4352, the first data reported being on an August 1 pass of *Lacrosse 5* (05-016A, NCat # 28646). Calibration was still in progress at that time, so in these early observations time errors are still present.

The move to a new home, station 4353 in February 2006 greatly facilitated the observational program, as a wider part of the sky came in reach of the camera.

15 months later, the camera setup imho has proven that a quite simple digital pocket camera can deliver good quality positional measurements on bright satellites. The accuracy of obtained results is discussed in chapter 2.1 of this report.

1.1.2 Station details

The older location (August 2005 - February 2006, location *Diefsteeg,* Cospar 4352) was on the 2nd floor in a narrow alley in almost the exact city center of Leiden:

```
52.15894 N        4.48883 E (WGS84)       +5 m ASL                   (Cospar 4352)
Dutch RD coordinates:  93527/463802 meter                             GPS determined
```

Observations were conducted from a south-facing living-room window, giving acces to the southern sky from the zenith to an elevation of ~25°.

SatTrackCam is currently (February 2006 onwards) located in an 1807 AD almshouse in the inner historic city of Leiden, at coordinates:

```
52.15412 N        4.49081 E (WGS84)       +0 m ASL                   (Cospar 4353)
Dutch RD coordinates:  93655/463263 meter                             GPS determined
```

This is some 500 meter due east of the historic Leiden Observatory, and within the medieval city moat perimeter of the town.

Observations are done from the central courtyard of the almshouse, which provides a safe secluded environment at night. From the courtyard there is acces to the sky in all directions, the minimum elevation that can be reached depending on the direction:

```
North:          ~ 40°
East:           ~ 50°
South:          ~ 30°
West:           ~ 25°
```

The long axis of the courtyard is oriented almost exactly east - west.

The main focus of observations is on the north. This is primarily due to the laziness of this observer: for these observations, the observer only has to open the north-facing French windows of his apartment and put up the tripod in front, and he can operate the camera from the comfort of his room with the lap-top nearby. Only when a pass of an object does not reach into the northern part of the sky, the observer moves out onto the courtyard.

The equipment used by *SatTrackCam* and data reduction details are outlined in chapter 1.2.

1.2 Method, equipment & software

1.2.1 Camera

The camera is a *Canon Digital Ixus 400* (named *Digital Elph* in the USA) with 4 megapixel resolution. In manual mode, it is capable of making exposures up to 15 seconds in duration at ISO 400.

It has a fixed 7.4 - 22.2 mm focal length zoom lens, equivalent to a 36-108mm lens on an analogue 35mm camera, with a focal ratio of F2.8 - 4.9. The camera has a 4 megapixel CCD sensor. When set at its highest resolution, the resulting digital images measure 2275 x 1704 pixels. These can be downloaded to a PC as uncompressed full colour JPEG's: such an image file is approximately 2 to 2.5 Mb in size.

For satellite tracking purposes, the camera is used in wide field mode (7.4 mm/F2.8) at ISO 400 with a "10 second" exposure (in reality, this turned out to be 10.7 seconds upon calibration). The resulting image covers 51.4° x 40.0° of sky. The camera lens is fixed on infinity focus by means of the appropriate camera setting.

When exposure times of 1.3 seconds or more are used, e.g. when making images for tracking, the camera automatically makes an additional dark frame image after each shot, which it uses for image noise reduction.

1.2.2 Camera operation, limitations and time calibration

In the urban environment of Leiden, a 10 - 15 second exposure with the camera captures stars up to magnitude +7 to +8, depending on the sky conditions. The limiting magnitude for satellite trails is at about magnitude +3.0 to +3.5 (in the urban, light polluted environment of Leiden) and heavily dependant on the sky conditions, notably the brightness of the sky background as contrast is a main factor in trail visibility.

With faint, low contrast trails, camera CCD noise becomes a main ambiguity factor in determining where trails start and end on the image.

The camera is operated from a tripod. In manual "starlight" mode, necessary for long exposure times, it alas cannot be triggered directly from the PC. It has to be triggered the old fashioned way by pushing the trigger button on the camera. In order to reduce effects of tripod and camera vibration due to the trigger push, the 10 second self-timer feature on the camera is used.

The timing of the shutter release push is guided by the observer watching the display of an Oregon Scientific RM318P Radio Controlled DCF77 clock receiving time signals from Frankfurt DCF77. It automatically recalibrates itself to the radio time signal each full hour. If the observer does not forget to do so in time, the clock is manually prompted to recalibrate on the time signal just before the start of an observing run, just for certainty.

Calibrating the time delays introduced by the camera itself was cumbersome. In September of 2005, it was discovered that it actually is dependant on the exact camera settings. When a particular satisfying configuration of settings had been chosen in Sept 2005, the author therefore stuck to this configuration.

In the used configuration the camera opens 10 seconds (self-timer) + 1.1 seconds after shutter release, hence 11.1 seconds after pushing the shutter release button. The actual exposure time in "10 second" setting in reality turned out to be 10.7 seconds after calibration.

1.2.3 Astrometry & data processing procedure

Obtained images are downloaded from the camera to the laptop after an observing run. Data processing takes place the same evening if possible, otherwise the next day.

Archiving - Each image is given a unique ID consisting of the date of observation and a serial number, with an "s" prefix. For example, the 2nd image taken on the evening of October 21 2006 would get the number *s211006_2*. The filename used to store the image on the laptop hard-disc is equal to this image code.

Image processing - In order to be able to load the image in the astrometric software for measurement, it has to be converted into an 8-bit black-and-white bitmap first. This is done using Paint Shop Pro 8. Especially with faint trails, the brightness and contrast of the image are boosted as well at this point. Moreover the date, exact times of start and end of the exposure, the target's common name and it's NCAT number as wel as the Cospar code of the observing site are added to the EXIF data of the image file for catalogue purpose.

Astrometry - The *.bmp* image file is then loaded into ASTRECORD v3.2 software. ASTRECORD 3.2 is professional grade astrometric software developed by Marc de Lignie of the Dutch Meteor Society (DMS) for measuring digitized small camera meteor images (De Lignie 1997). It runs under MS-Windows. Measured X/Y positions of (in this case) start and end points of the satellite trail on the image are compared to the X/Y positions of measured reference stars in the image. The software fits and corrects the positions for camera lens distortions by means of the TURNER algorithm. It gives feedback on the internal consistency of the measurements on the reference stars (the average fit error in arcseconds). The derived RA and declination of the measured satellite trail begin- and endpoints are stored in a *.log* file and given in decimal degrees, listed to an accuracy of three decimals, in the following format:

Meteor	year	mo	day	H	M	S	mag	w	dw	RAB	DEB	RAE	DEE	sig	sur
"25017b "	2006	7	16	22	27	31	0.0	0.00	0.00	335.196	85.506	~~345.730~~	~~80.145~~	0.006	100
"25017e "	2006	7	16	22	27	42	0.0	0.00	0.00	~~335.242~~	~~85.506~~	345.776	80.145	0.006	100

Unlike meteors, two separate log entries need to be saved for satellite trails, one for the begin- and one for the endpoint of the trail, as there is a clear time separation for these, and ASTRORECORD automatically adjusts the RA of the point for sky rotation based on the difference beween the values for image start time, and the time of the point in question. For the first log entry line this is zero (start of the trail) and only the RAB and DEB values are valid, for the second it is 12 seconds (end of the trail) and only the RAE and DEE values are valid.

Note that each image ideally provides 2 positions (start and end of the trail), 10.7 seconds apart in time.

ASTRORECORD needs a minimum of some 20-25 measured reference stars spreading 360 degrees around the trail to arrive at a good astrometric fit. I usually however measure ~100 stars on a typical satellite trail image. After some practise, the reduction of one image now takes me some 15-20 minutes.

The average fit on the used reference stars with the described SatTrackCam setup has an accuracy of about 20" - 30". This is not the same as the true accuracy of the obtained satellite trail points however, as these are also influenced by timing accuracy (see chapter 2.1 for an analysis of the accuracy of the latter).

Data processing - Finally, data from the ASTRORECORD *.log* file are hand-keyed into George D. Lewis' OBSENTRY program to convert them to IOD format. Fits to the last available McCants elsets for the object are assessed using Scott Campbell's SATFIT software. IOD formatted data are reported to SeeSat and interested analysts by e-mail and posted on the author's website.

2.0 Targets & observation statistics

During its 15 months of operation *SatTrackCam Leiden* successfully targeted the following objects:

Class common name	origin	NCAT#	Cospar ID	Pos	Remarks
Keyholes:					
USA 116	USA	23728	1995-066A	2	Keyhole (KH-12) class optical reconnaissance sat
USA 129	USA	24680	1996-072A	28	Keyhole (KH-12) class optical reconnaissance sat
USA 161	USA	26934	2001-044A	4	Keyhole (KH-12) class optical reconnaissance sat
USA 186	USA	28888	2005-042A	12	Keyhole (KH-12) class optical reconnaissance sat
Lacrosses:					
Lacrosse 2	USA	21147	1991-017A	21	Lacrosse (Onyx) class radar reconnaissance sat
Lacrosse 3	USA	25017	1997-064A	38	Lacrosse (Onyx) class radar reconnaissance sat
Lacrosse 4	USA	26473	2000-047A	35	Lacrosse (Onyx) class radar reconnaissance sat
Lacrosse 5	USA	28646	2005-016A	37	Lacrosse (Onyx) class radar reconnaissance sat
Japanese IGS:					
IGS 1B	Japan	27699	2003-009B	42	IGS class radar reconnaissance sat
Other classified:					
Lacrosse 5 Rk	USA	28647	2005-016B	23	Rocket stage from Lacrosse 5 launch
Non-classified:					
Kosmos 1602	Russia	15331	1984-105A	2	Stray, used for accuracy test
Kosmos 1833 Rk	Russia	17590	1987-027B	2	Stray, used for accuracy test
Kosmos 2082 Rk	Russia	20625	1990-064B	2	Stray, used for accuracy test
ISS	INT	25544	1998-067A	3	test images for accuracy calibration
Progress-M58	Russia	29503	2006-045A	1	image used for accuracy calibration

Table: Objects targeted by SatTrackCam Leiden, August 2005 - October 2006. The columnn „Pos‟ lists the number of positions obtained and reported on each listed object.

On these objects, a total of 252 positions (excluding rejected ones) were obtained and reported in the time span under discussion. A total of 242 of these were on classified objects not listed on SSC's Space-Track public web catalogue. The Lacrosses and IGS 1B account for the majority of observations, as these are bright easily targeted objects. The Keyholes usually only cross the minimum brightness treshold of the camera when they flare and hence are more difficult to catch as these flares are not predictable.

The observations spread over the 15 months in question as shown in the diagram on the next page. July 2006 was especially prolific, because of the unusually good weather that month.

A number of unclassified objects were either picked up unintentionally as strays on images with classified objects, or (in the case of ISS and Progress-M58) deliberately targeted. These objects have been useful in assessing the accuracy of the obtained positions, because they could be compared to accurate SSC Space-Track TLE's. The results of this accuracy assessment are presented in chapter 2.1.

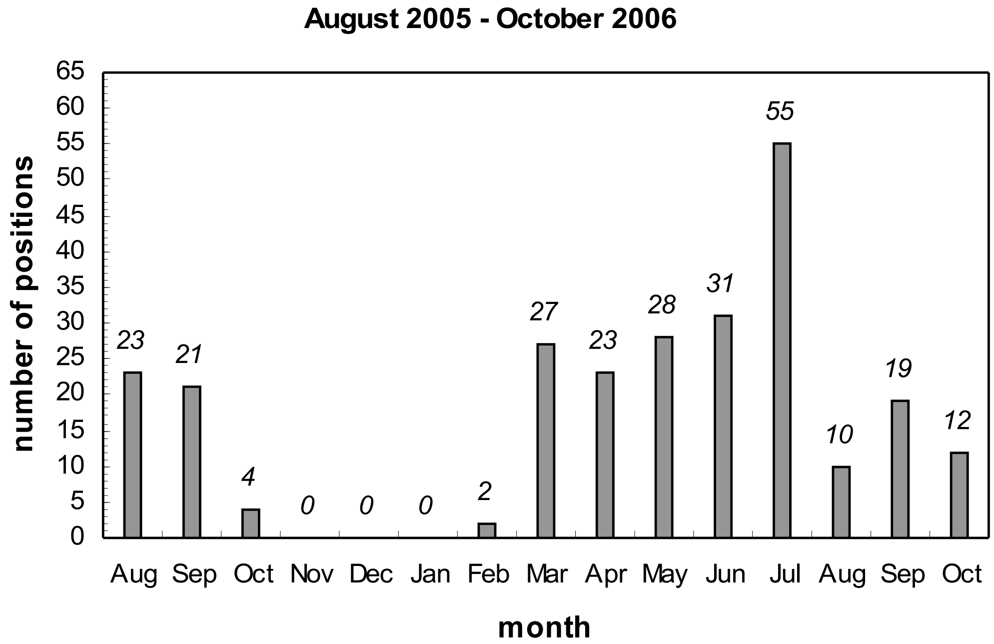

Diagram: distribution of reported observations over the 15 month time period August 2005 - October 2006

Target selection is on brightness and elevation. Objects known to be able to cross the imaging treshold of SatTrackCam are extracted from a timely McCants' *classfd.tle* using Willy Koorts' *extract* utility. The resulting file of TLE's is then loaded into Stephen Fels' *SatHunt* software, and skytrack predictions are generated for those objects which rise high enough in the sky to be targeted that evening.

2.1 Accuracy tests using data on unclassified satellites

This chapter has been removed from the public version due to SSC Space-Track User Agreement restrictions that prohibit dissemination of data used in this analysis

3.0 Flare observations & the behaviour of Lacrosse 5

Starting early 2006, an additional point of observational focus became the flaring behaviour of the *Lacrosse* satellites, and the peculiar brightness behaviour of *Lacrosse 5* (2005-016A, NCAT #28646).

3.0.1 Lacrosses and KH-12 Keyholes

Flares of Lacrosse satellites were observed and photographed by accident in 2005 and early 2006. Early 2006, Phillip Masding from the UK contacted the author with a request for timings on such flares, as he was working on software for modelling and predicting these Lacrosse flares. His early results based on his and my flare timings suggested that the flares might be the result of a reflective (SAR?) panel oriented under an angle of 25-30° with the X/Y plane of the main body. This while Lacrosse satellites are believed to be equipped with a large wire mesh parabolic antenna, not a flat SAR panel.

After a couple of predicted Lacrosse flares were confirmed visually by Phillip, the author managed to photograph a flare of *Lacrosse 3* (97-064A) at exactly the predicted time on 14 July 2006, 00:22:27 UTC.

Flare hunting became an enjoyable and unexpectedly prolific passtime for *SatTrackCam*, not only with regard to *Lacrosse* satellites but also with regard to KH-12 *Keyhole* satellites. In particular, the flare behaviour of *USA 186* (05-042A) showed interesting, with it both showing series of very short flares (glints rather) of less than a second duration, and slower flares of 10+ seconds. Examples of both types were photographed by SatTrackCam, including a beautiful shot of a slow magnitude -2 flare through Ursa minor at 50 degrees elevation in the north on 21 September 2006. KH-12 Keyhole *USA 129* (96-072A) showed to be another Keyhole prolific in bright long slow flares.

So far, these flare observations are by-products of the position program, there is no real dedicated focus on it except for the predicted Lacrosse flares for which Phillip Masding gives the author an heads-up.

3.0.2 Lacrosse 5 peculiar behaviour

Early 2006, *Lacrosse 5* (05-016A) caught SatTrackCam's attention by its peculiar brightness behaviour (reported earlier by other observers too). Usually brighter than the other Lacrosses, it would suddenly, in the cause of a few seconds only, dim and „disappear“ (well away from the point of shadow entry), i.e. become too faint to be seen by the naked eye and the camera. Initial, e.g. at March 22, 2006, this caused some confusion with the author, as he failed to see the normally very bright satellite while minutes before and after other observers did see and report it. The author then managed to observe several of these sudden fading events „live“ as it happened, and on 26 July 2006 managed to photograph the satellite in the event of doing it's „disappearance trick“.

As Ted Molczan and Allan Thomson have stated on SeeSat, the suggestion is that a dark "something", perhaps an antennae panel, blocks view of the main body during such events. At any rate, this behaviour is peculiar to Lacrosse 5 and not shown by Lacrosse 2, 3 & 4. In fact, Lacrosse 5 deviates in a number of things:

- it is brighter (visually and photographically) than the other Lacrosses;
- instead of red-orange it is yellow in colour;
- the other Lacrosse-birds don't do the "disappearance-trick";
- it is the first Lacrosse not to employ a frozen orbit.

4.0 Summary and conclusions

In the past 15 months of operations, the concept of photographic position determinations of bright satellites using a small pocket digital camera and ASTRORECORD astrometric software imho has proven feasible.

The *SatTrackCam* experiment has shown that even from a strongly urban, light-polluted environment, this simple equipment can be quite productive, with 252 positions determined and reported in a 15 month timespan.

On average, the observations appear to satisfy the demand that *delta T* remains < 0.1 seconds and the *cross-track error* < 0.03 degrees. The results of SatTrackCam can therefore be judged to be accurate enough for analytical use.

SatTrackCam can successfully target objects which can become brighter than magnitude +3.5. Basically, these are (as far as classified objects are concerned) the *Lacrosses*, the *KH-12 Keyholes* and the Japanese *IGS*, as well as some rocket stages from classified launches (e.g. *Lacrosse 5 Rk*). If anyone has suggestions for additional bright objects that might be worthwhile to target besides those mentioned in the table on page 6, please let me know.

SatTrackCam will certainly continue to operate. Besides the regular program on classified objects, plans are to continue the occasional coverage of unclassified objects for accuracy tests too.

A change of equipment is not imminent at Cospar 4353, as current finances do not allow that. For the distant future however, an upgrade in camera and perhaps the addition of a low-light-level video system are things being considered.

Acknowledgements

The author wishes to thank *Casper ter Kuile* for donating the Canon Digital Ixus 400 camera which is the backbone of SatTrackCam, and *Marc de Lignie* for his help with ASTRORECORD. I also want to thank *Ted Molczan* for his helpful comments regarding the data accuracy in August 2005, and *Scott Campbell* for providing very useful analytical software and feedback on various related points. The Lacrosse flare predictions by *Phillip Masding* are highly appreciated. Last but not least, I thank my fellow satellite trackers for various contacts, especially *Greg Roberts*, *Bram Dorreman* and *Pierre Neirinck*.

References

DE LIGNIE, M., 1997: Astro Record 3.0. *Radiant (J. Dutch Meteor Society)* 19:2, p.28-30.

Resources - SatTrackCam

SatTrackCam website:	http://home.wanadoo.nl/marco.langbroek/satcam.html
SatTrackCam station log:	http://sattrackcam.blogspot.com
SatTrackCam obtained data:	http://home.wanadoo.nl/marco.langbroek/OBSENTRY.txt

Resources - software used

ASTRORECORD 3.2:	http://www.xs4all.nl/~biko/dmsweb/astrorec32/
Scott Campbell's software:	http://www.coastalbend.edu/acdem/math/sats/index.htm
Stephen Fels' SatHunt:	http://fathom.org/Stephen/sathunt.html
Willy Koorts' Extract:	http://www.saao.ac.za/~wpk/#software

Resources - TLE's

McCants' classified TLE's:	http://www.io.com/~mmccants/tles/index.html
SSC Space-Track:	http://www.space-track.org/

Resources - other

SeeSat list archives:	http://www.satobs.org/seesat/seesatindex.html#Arch
Lacrosse flares (Masding):	http://www.zen32156.zen.co.uk/lacrosse.htm

Appendix 1: Accuracy calibration results on unclassified satellites (table, 2 pages)

This Appendix has been removed from the public version due to SSC Space-Track User Agreement restrictions that prohibit dissemination of data used in this analysis

Appendix 2: Observational data August 2005 - October 2006 (table, 5 pages)

Table of 252 positions in IOD format reported by *SatTrackCam* over the timespan August 2005 - October 2006. August 2005 positions might still suffer from time calibration issues. For the URL to an electronic version of the table, see section *resources* on page 13. An explanation of the IOD data format can be found at: http://www.satobs.org/position/IODformat.html

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Location Cospar 4352, 52 09' 32.2" N, 4 29' 19.8" E (WGS84), +5 m ASL

28646 05 016A   4352 G 20050801215010800 17 75 1703581+088770 56 S+020 10
28646 05 016A   4352 G 20050801215021500 17 75 1719334+069010 56 S+020 10
28646 05 016A   4352 G 20050802205610800 17 75 1813542+195580 56 S+010 10
28646 05 016A   4352 G 20050802205621500 17 75 1830446+167600 56 S+010 10
27699 03 009B   4352 G 20050802215010800 17 75 1720391-020810 56 S+010 10
27699 03 009B   4352 G 20050802215021500 17 75 1710221+015940 56 S+010 10

27699 03 009B   4352 P 20050816210430800 17 75 2224283+277430 56 S+020 10
27699 03 009B   4352 P 20050816210441500 17 75 2237005+340500 56 S+020 10
27698 03 009A   4352 P 20050816214045800 17 75 1824173+159670 56  +030 10
27698 03 009A   4352 P 20050816214056500 17 75 1810132+218800 56  +030 10
21147 91 017A   4352 F 20050817215135800 17 75 2323550+314870 56 S+025 10
21147 91 017A   4352 F 20050817215146500 17 75 2322578+269620 56 S+025 10
27698 03 009A   4352 F 20050817211730800 17 75 2106410+280590 56  +030 10

21147 91 017A   4352 F 20050822203800800 17 75 2236173+360020 56 S+020 10
21147 91 017A   4352 F 20050822203811500 17 75 2234533+313100 56 S+020 10
27699 03 009B   4352 P 20050823212818500 17 75 1959250+393170 56 E+020 10
21147 91 017A   4352 P 20050823210311500 17 75 1928437+247370 56 S+025 10

26473 00 047A   4352 F 20050830203600800 17 75 2152377+151320 56 S+020 10
26473 00 047A   4352 F 20050830203611500 17 75 2208036+179970 56 S+020 10
26473 00 047A   4352 F 20050830203700800 17 75 2328281+295610 56 S+020 10
26473 00 047A   4352 F 20050830203711500 17 75 2346312+314600 56 S+020 10
24680 96 072A   4352 F 20050831202145800 17 75 2147274+330930 56
24680 96 072A   4352 F 20050831202156500 17 75 2150185+372270 56

26473 00 047A   4352 P 20050903194110800 17 75 2101235+151380 56 I+025 10
26473 00 047A   4352 P 20050903194121500 17 75 2115468+179810 56 I+015 10
25544 98 067A   4352 F 20050904195525800 17 75 1900355+263390 56 S-030 10
25544 98 067A   4352 F 20050904195536500 17 75 1952060+282850 56 S-030 10
25544 98 067A   4352 F 20050904195635800 17 75 2321209+227230 56 E+000 10
26473 00 047A   4352 F 20050905030815800 17 75 0712098+419970 56 S+030 10
26473 00 047A   4352 F 20050905030826500 17 75 0705348+379030 56 S+030 10
26473 00 047A   4352 B 20050905191350800 17 75 2041324+163340 56 X+000 10

24680 96 072A   4352 F 20050908203600800 17 75 2115492+287860 56 I+020 10
24680 96 072A   4352 F 20050908203611500 17 75 2114396+326270 56 I-010 10
24680 96 072A   4352 F 20050908203640800 17 75 2110235+440080 56 I+030 10

24680 96 072A   4352 F 20050912204310800 17 75 2059581+340540 56 S+030 10
24680 96 072A   4352 F 20050912204321500 17 75 2056286+379700 56 S+030 10

25017 97 064A   4352 B 20050918191341100 17 75 2037324+122630 56 S+025 10
25017 97 064A   4352 B 20050918191351800 17 75 2056576+145740 56 S+025 10
24680 96 072A   4352 B 20050918200411100 17 75 2340480+305580 56 S+030 10
24680 96 072A   4352 B 20050918200421800 17 75 2345511+336440 56 S+030 10
24680 96 072A   4352 P 20050919202951100 17 75 2223264+324020 56 S+030 10
24680 96 072A   4352 P 20050919203001800 17 75 2224010+362460 56 S+030 10
24680 96 072A   4352 P 20050920205531100 17 75 2043166+292330 56 S+030 10
24680 96 072A   4352 P 20050920205541800 17 75 2036576+329410 56 S+030 10

25017 97 064A   4352 P 20051007182501100 17 75 2208384+389300 56

26473 00 047A   4352 F 20051010185521100 17 75 2348394+400920 56 S+020 10
26473 00 047A   4352 F 20051010185531800 17 75 2348254+351780 56 S+020 10
26473 00 047A   4352 F 20051010185606100 17 75 2348331+214600 56 E+025 10
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New location Cospar 4353, 52 09' 14.8" N, 4 29' 26.9" E (WGS84), +0 m ASL

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28647 05 016B   4353 G 20060224193911100 17 75 2317245+783330 56 R+020 10
28647 05 016B   4353 G 20060224193921800 17 75 2202250+831800 56 R+025 10
28646 05 016A   4353 G 20060304202636100 17 75 0451134+230060 56  +010 10
28646 05 016A   4353 G 20060304202646800 17 75 0501142+262700 56  +005 10

28647 05 016B   4353 G 20060306191716100 17 75 0543367+600380 56 I+020 10
28647 05 016B   4353 G 20060306191726800 17 75 0636178+571490 56 I+020 10

28646 05 016A   4353 G 20060311191401100 17 75 0238487+666620 56 I+015 10
28646 05 016A   4353 G 20060311191411800 17 75 0255367+715550 56 I+015 10
28646 05 016A   4353 G 20060311191441100 17 75 0604590+836850 56 I+010 10
28646 05 016A   4353 G 20060311191451800 17 75 0922497+837890 56 I+010 10
21147 91 017A   4353 P 20060312193606100 17 75 1001144+643000 56 S+025 10
21147 91 017A   4353 P 20060312193616800 17 75 1004545+579520 56 S+025 10
28646 05 016A   4353 P 20060312200146100 17 75 0117082+570660 56 S+020 10
28646 05 016A   4353 P 20060312200156800 17 75 0114017+608570 56 S+020 10
28646 05 016A   4353 B 20060313190731100 17 75 0110535+651120 56 S+020 10
28646 05 016A   4353 B 20060313190741800 17 75 0109420+698020 56 S+020 10
28646 05 016A   4353 B 20060313205011100 17 75 0158518+596920 56 S+015 10
28646 05 016A   4353 B 20060313205021800 17 75 0201545+632920 56 S+015 10
28646 05 016A   4353 B 20060313205056100 17 75 0222348+766450 56 S+015 10
28646 05 016A   4353 B 20060313205106800 17 75 0242497+812300 56 S+015 10

28646 05 016A   4353 G 20060320193631100 17 75 0220427+541020 56 S+020 10
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28646 05 016A   4353 G 20060320193736100 17 75 0549569+669370 56 S+020 10
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Appendix 3: Excerpt from United Nations resolution 2222 (XXI).

Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies

Article XI

In order to promote international co-operation in the peaceful exploration and use of outer space, States Parties to the Treaty conducting activities in outer space, including the moon and other celestial bodies, agree to inform the Secretary-General of the United Nations as well as the public and the international scientific community, to the greatest extent feasible and practicable, of the nature, conduct, locations and results of such activities. On receiving the said information, the Secretary-General of the United Nations should be prepared to disseminate it immediately and effectively.

http://www.unoosa.org/oosa/SpaceLaw/gares/html/gares_21_2222.html