AIUB SPACE SAFETY EXPERT CENTER MULTI-SENSOR DATA ACQUISITION CAMPAIGN – OVERVIEW, RESULTS AND LESSONS LEARNED

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ABSTRACT

Aiming to test the available observing infrastructure, the Expert Centre for Space Safety (ExpCen) coordinated the observation campaign to a predefined set of target objects using different measurement techniques. The coordination of the campaign included interfacing with the involved stations, sensor planning and tasking, data exchange, with emphasis on formats and standardized procedures, besides a critical analysis on the performance for both ends: the involved observing stations and the ExpCen. The multi-sensor observing network consists of six passive optical and one radar sensor. The array of passive optical sensors included telescopes with apertures ranging from 0.2 to 1m tasked to do tracking, photometry and survey observations. The radar system consists of a S-band (3GHz) fully-steerable 25m single dish antenna, focused on tracking targets flying in Low Earth Orbit (LEO). In this work, we present the obtained results after the coordination of the campaign. One of the highlights of the campaign was the simultaneous data acquisition between radar and passive optical. We report our findings including challenges and lessons learned applicable to future campaigns.

1 INTRODUCTION

The presented multi-sensor data acquisition campaign was carried out in the framework of the ESA P3-SST-XIX activity "Space Surveillance and Tracking (SST) Sensor Data Acquisition for Endurance Tests and Validation – Phase 2". The activity was a part of the third phase of the European Space Agency (ESA) Space Situational Awareness (SSA) programme. The focus of the campaign was on collection of additional SST data from passive optical and radar sensors. In such manner the capabilities of managing a heterogeneous sensor pool were tested by: overall planning of the activity; negotiating the participation and availability of the observing facilities; planning of the individual observing nights; data quality control; and managing the overall data flow between the participating sensors and the end customer – ESA. This activity was developed and carried out in close collaboration between the Astronomical Institute of University of Bern (AIUB), Switzerland and GMV Innovating Solutions, Poland. GMV was responsible for the radar data acquisition and analysis, while AIUB focused on the passive optical sensors segment and the overall management of the activity. The collaboration network for the observing campaign covered more than twenty different individuals, across seven organizations and eight different European countries. It is an excellent example for a successful and mutually beneficial international collaboration under the auspices of the European Space Agency. In this contribution we are presenting the overall activity, examples of the data acquired, obtained results and lessons learned. It is organized as follows: after the brief introduction in the current section, the sensor pool utilized throughout the activity is presented in Section 2, followed by information about the observing sub-campaigns carried out and targeted objects in Section 3. Section 4 contains information about the overall planning of the activity, and also examples of the nightly/daily planning for the sensors. In Section 5 we are providing

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examples of the data acquired, along with summary of the overall data volume and sensor performance. Section 6 highlights some of the encountered difficulties and lessons learned. It is followed by summary and conclusions in Section 7.

2 PARTICIPATING SENSORS

Six passive optical sensors participated in the course of the activity, along with one radar sensor. Their geographical locations are illustrated on Fig.1.

Figure 1. Locations of the contributing sensors.

2.1 Passive optical sensors

The passive optical sensors that participated in the activity are listed below in an order of decreasing aperture, along with a brief description. A collage of images of the individual telescopes is shown on Fig.2, along with representation of the mirror sizes on Fig.3.

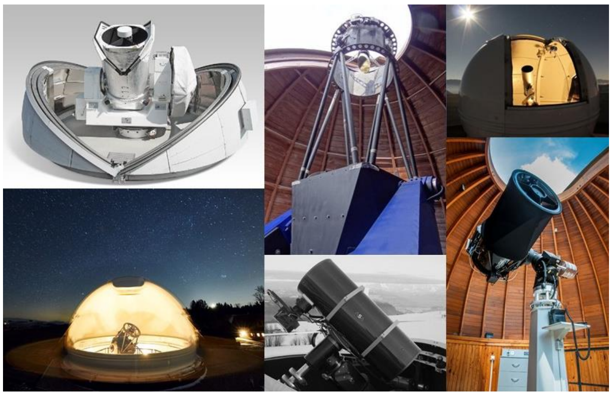

Figure 2. Images of the contributing sensors. From top left corner in clockwise direction: 1m ZIMLAT; 0.7m AGO70; 0.22m Castelgrande-ORI22; 0.43m SHOT; 0.2m ZimSMART; 0.8m ZimMAIN.

2.1.1 ZIMLAT

The ZIMmerwald Laser and Astrometry Telescope (ZIMLAT) is a 1m Ritchey-Chrétien-Coude telescope, operated since 1997. It is located at the Swiss Optical Ground Station and Geodynamics Observatory Zimmerwald (MPC code 026), operated by Astronomical Institute University of Bern (AIUB) and Swisstopo. The observing system utilizes an Alt-Azimuthal mount with direct drives, capable of tracking objects in the full range of orbital regimes from Low Earth Orbits (LEO) to Geostationary Objects (GEO). It is mainly geared towards space debris observations: Satellite Laser Ranging (SLR), Light Curves (LC) and astrometric observations. The telescope is operated on a 24/7 basis, as the system allows for daytime SLR. ZIMLAT is the most powerful optical passive sensor utilized in the course of the activity. The FoV is equal to 0.7 x 0.7 degrees.

2.1.2 ZimMAIN

The Zimmerwald Multiple Applications INstrument (ZimMAIN) is a 0.8m Ritchey-Chretien telescope with two Nasmyth foci on an Alt-Azimuthal mount. It is also located at the Swiss Optical Ground Station and Geodynamics Observatory Zimmerwald. The sensor is capable of tracking objects at high altitude orbits. It has a FoV of 0.3 x 0.3 degrees and could be utilized for survey and tracking observation of sub-catalogue size objects at high altitude orbits as well. It is dedicated to space debris characterization observations including astrometric, photometric, and spectroscopic observations, with a focus of follow-up of faint objects.

2.1.3 AGO70

The AGO70 telescope is a 0.7-m Newtonian telescope with parabolic primary on an equatorial fork mount. The telescope is operated by the Faculty of Mathematics, Physics and Informatics of the Comenius University, Bratislava. It is located at the Astronomical and Geophysical Observatory in Modra, Slovakia (MPC code 118). The sensor is dedicated to the space debris observations with focus on high altitude orbits, especially objects on geosynchronous orbit (GEO), eccentric (GTO and Molniya) and GNSS orbits. It was installed in 2016 and developed within the framework of ESA Plan for European Cooperating States (PECS) [1]. AGO70 FoV is equal to 0.475 degrees square.

2.1.4 SHOT

The Sand Hill Optical Telescope (SHOT) sensor consists of a 0.43m corrected Dall-Kirkham telescope on an Equatorial German mount. It is located at the North-Bohemian Observatory and Planetarium in Teplice, Czech Republic (MPC code K62) [2]. The sensor is capable of tracking and observing objects from LEO to GEO orbital regimes with 1.1 x 1.1 degrees FoV.

2.1.5 Castelgrande ORI-22

This is a 0.22m Newton-Hamiltonian telescope, mounted on an Equatorial German mount. The sensor is located at the Gastelgrande in Italy (MPC code L28) and is operated by the Group of Astrodynamics for the Use of Space Systems (GAUSS). This sensor provides a rather wide 4 x 4 degrees FoV.

2.1.6 ZimSMART

The Zimmerwald SMall Aperture Robotic Telescope (ZimSMART) is yet another sensor situated at the Swiss Optical Ground Station and Geodynamics Observatory (MPC code 026). The telescope is a 0.2m aperture Newtonian astrograph on a German Equatorial mount. The FoV of the system is 3.6 x 3.6 degrees. The large field allows to conduct surveys in the GEO and MEO regimes with the aim of building up and maintaining a catalogue of objects. The telescope is operated in a fully automated mode on a routine basis for about 180 nights per year.

2.2 Radar sensors

The radar sensor participating in the activity is described below and presented on Fig.4. Furthermore, Fig.3 illustrates the antenna size with respect of the passive optical sensors mirrors.

2.2.1 CASTR

The Chilbolton Advanced Satellite Tracking Radar (CASTR) is owned and operated by the United Kingdom Science and Technology Facilities Council (STFC). Chilbolton Observatory is located near Winchester in Hampshire, Southern England. The Chilbolton radar, a high-power S-band radar (3 GHz) equipped with a fully-steerable 25 m diameter parabolic antenna, has been used mainly for atmospheric and ionospheric research. Since 2010, the radar is in use for SST observations as well. It is capable to track LEO objects down to 10 cm size at 600 km altitude. Being an all-weather sensor it can operate day-or-night, and provide precise ranging and radar cross-section (RCS) measurements capability. CASTR augments the contribution from optical passive sensors.

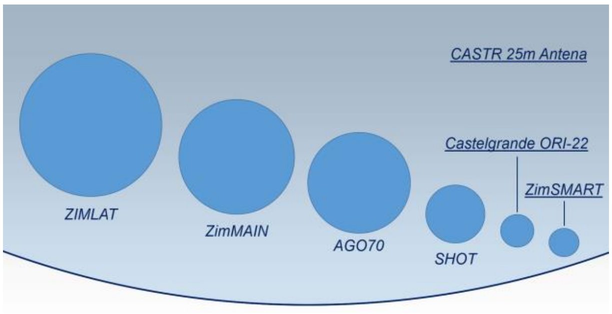

Figure 3. Sizes of the sensors apertures in perspective. The CASTR antenna is completely out of scale and is represented on the image by the light blue area.

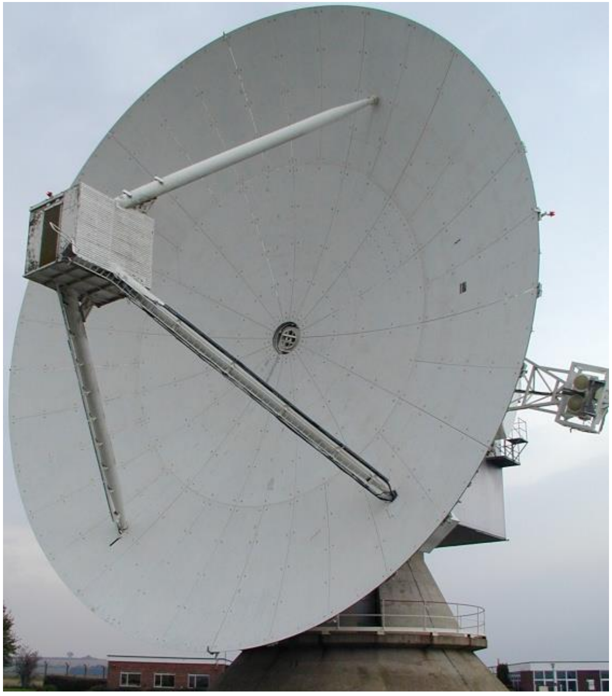

Figure 4. The Advanced Satellite Tracking Radar 25m parabolic antenna at the Chilbolton observatory.

3 TARGET LIST AND OBSERVING SUB-CAMPAIGNS

3.1 Target list

The list of objects targeted for observations throughout the campaign has been presented in Table. 1. It contains 68 entries and was compiled accounting for the priorities set by ESA, and is optimized to cover the entire range of orbital regimes from LEO to HEO, and with a suitable parameter space of orbit inclinations.

Table 1. Target list for the data acquisition campaign

COSPAR	**Apogee [km]**	**Perigee [km]**	**Incl. [deg]**	**CS [m^2]**
Priority I – VESPA upper part				
13021D	800	663	98.83	3.9
Priority II – selected objects from IADC				
80039B	993	962	82.94	4.3
87074G	1473	1410	82.57	6.1
94023B	847	840	71.00	10.3
94077B	842	841	70.98	8.5
99008D	837	636	96.45	9.9

13033B	647	614	97.94	1.1
15040B	1205	1064	100.33	6.6
COSPAR	**Apogee [km]**	**Perigee [km]**	**Incl. [deg]**	**CS [m^2]**
16066G	1026	504	98.65	0.1
16068B	797	748	98.47	8.0
Priority III – selected ESA targets				
91050A	789	743	98.60	10.3
95021A	499	493	98.54	9.5
02009A	766	764	98.14	18.6
08032A	1317	1305	66.04	12.8
Priority V - ESA targets-of-opportunity				
77029A	38414	2740	27.43	4.3
77108A	35810	35706	10.32	2.2
78044A	36133	36079	12.51	1.0
78071A	36052	36024	10.74	2.0
81057A	36356	36096	13.81	4.6
81057C	20358	269	10.22	2.0
81122A	37811	36830	14.57	1.7
81122B	26274	247	10.66	2.7
83058A	36238	36129	14.49	3.2
84081A	36241	36169	14.85	5.0
84114B	37559	36541	15.95	3.2
85056B	23327	450	8.32	1.1
88051A	36772	36718	15.85	4.1
88063B	36447	36329	15.58	5.0
89020B	36774	36621	15.9	4.5
89053A	35521	35441	14.38	6.3
89062B	35743	534	6.86	9.2
89020E	36271	35215	13.49	1.0
81057F	36375	35707	12.31	1.0
91015B	36323	36288	15.26	8.9
91015E	36466	35165	14.08	0.9
95062A	70000	611	0.12	4.2
97066A	26393	579	7.68	19.0
97066B	26506	573	7.72	31.7
97066C	26565	591	7.62	0.5

98059A	35503	1004	7.18	28.9
01029A	36115	36013	13.61	20.0
COSPAR	**Apogee [km]**	**Perigee [km]**	**Incl. [deg]**	**CS [m^2]**
05005C	32591	274	7.20	0.5
05005D	33144	230	7.34	27.6
05043E	699	677	98.04	0.4
05051A	23371	23325	58.04	6.7
08020A	23832	23816	57.99	4.9
12055A	23237	23208	54.98	8.6
12055B	23233	23211	54.98	13.8
Priority VII – GSTP19 study (*Tumbling motion assessment for space debris*)				
85007A	35801	35766	12.44	
87053A	846	827	98.70	
87060A	802	774	65.01	
90100C	21738	278	7.11	
93031A	36238	36160	10.40	
94050C	19134	19126	65.63	
94056A	38781	8460	15.34	
96019A	20743	20698	54.35	
96046A	795	792	98.91	
98044B	35767	589	18.92	
98045B	846	833	71.01	
99031A	2049	2046	51.99	
00008C	1605	1601	52.00	
03056A	19234	19028	63.36	
12009B	35184	3283	18.71	
12025F	621	615	98.22	
12025G	625	618	98.22	
13023B	21413	20570	56.53	
15013B	20966	20797	53.60	
19090D	17690	257	55.00	

Note that there are no targets of priorities IV and VI. These were envisioned to be objects physically similar to ESA priority I and III targets (for priority IV) and elongated rocket bodies in LEO/MEO/GTO (for priority

VI). The goal was to provide a number of objects, sufficient to allow efficient observations planning for a particular sensor. Nevertheless, our initial planning sessions revealed that the original list provides enough opportunities to fully fill and efficiently utilize the observing time available. The only objects added through the course of the data acquisition campaign were the 20 targets of Priority VII, related to the tumbling motion assessment for space debris study. Target priorities were meticulously followed during the planning of the individual nights (accounting for the visibility) and communicated to the sensor operators.

In order to acquire the necessary calibration data for the optical passive sensors, a list of 40 satellites with high precision orbits from the GNSS constellations were included in the preparation of the nightly plans. The radar data was calibrated by using dedicated calibration objects and dedicated routines.

3.2 Observing sub-campaigns

3.2.1 Sub-campaign I – passive optical observations of catalogue size objects

This campaign consists of two major parts. The first part was dedicated to observations in tracking mode, to follow-up objects from the target list for monitoring, orbit maintenance and improvement. Second part was focused on survey observations of the GEO belt. For both parts GNSS satellites were included as calibration objects in the nightly plans. Information about the participating sensors and the data volume initially planned is provided in Tab. 2.

3.2.2 Sub-campaign II – passive optical observations of sub-catalogue size objects and breakup fragments

Main objective is characterization of space objects population with sizes smaller than the nominal detection size of SST segment. This objective was pursued by dedicated survey observations with the ZimMAIN sensor. Target fields selection and campaign planning were prepared by AIUB. GNSS satellites were included as calibration objects in the nightly plans. Information about the data volume planned is also provided in Tab. 2.

3.2.3 Sub-campaign III – radar observations

This campaign contained 30 observing scenarios, each consisting of two 1-hour slots. Those observations had to be scheduled during working hours in nominal working days. The operating mode of the CASTR facility (mostly day time during working hours) introduced certain complexity in the attempts for coordinated observations acquisition. During each one hour observing slot up to 4 objects were allowed to be requested. The data provided will support the tumbling motion studies of LEO targets. Observations of the same object within the same pass were coordinated, although the possibilities of those were really limited due to the conditions outlined above.

3.2.4 Sub-campaign V – tumbling motion observations

Main objectives were light curves observations allowing characterisation of the tumbling motion of selected high-priority removal targets (see the corresponding section in Tab.1). Information about the participating sensors and the data volume initially planned is provided in Tab. 2.

We note that originally one more sub-campaign was considered - SLR observations. Due to constraints related to sensors availability it was removed from planning and the available funds and resources were re-directed to light curves observations for tumbling motion assessments.

Table 2. Planned data volumes for the campaign

Sensor	**Data volume planned**
Sub-campaign I (Passive Optical Measurements of Catalogue Size Objects)	
ZimSMART	21 nights (Survey)
SHOT Templice	14 nights (Tracking)
AGO70	20 nights (Tracking)
Sub-campaign II (Passive Optical Measurements of Sub-catalogue Size Objects and Breakup Fragments)	
ZimMAIN	45 nights (Survey)
Sub-campaign III (Radar Measurements)	
CASTR	60 hours of data
Sub-campaign V (Tumbling Motion Measurements)	
ZIMLAT OPT	130 CCD and CMOS light curves
ORI-22	80 CCD light curves

4 CAMPAIGN PLANNING

There were two notable aspects of the campaign planning. First was the long term strategic planning that included accounting for the overall goals, sensor availability, changing priorities and state of the campaign. Second was the routine planning of the daily/nightly operations. The tasks related to both were carried out in close cooperation between AIUB and GMV, again accounting for the overall priorities set by

ESA. As noted before GMV was focusing on the radar operations and AIUB carried out the overall planning and the routine preparation of the observing plans for the passive optical sensors. The role of the sensor operators should be noted here as well. They were important participants in the entire process, constantly providing necessary information and feedback related to the strategic and nightly planning. They also had the liberty to adjust the nightly plans according to the observing conditions (within the priorities set) in order to improve the quality of the data and the efficiency of the observations.

4.1.1 Long term strategic planning

Overall we had to plan for a total of more than 100 nights of data to be observed and delivered. Furthermore, taking into account the CASTR observing scenarios definitions, planning had to be prepared for 30 days of radar operation. The planning for light curve observations usually combined the requirements of several ongoing programs, but also required effort dedicated on a daily basis. Planning examples are presented in the following sub-section. It should be noted that the initial observing campaign plan was extremely optimistic. This version was assuming all observations to be done in parallel or closely one after another, without accounting for the availability of the sensors, incremental weather conditions, technical issues and personnel work load. The availability of the sensors turned out to be a major limitation as all of them have multiple observing programs going on. Advance planning was indispensable, especially if coordinated observations were attempted. Furthermore, we had to exchange sensors on the go to avoid significant delays related to their availability or readiness for observations. Weather conditions limitations varied a lot from sensor to sensor, but also accounted for about 30 percent increase of the planning campaign duration. An extended period of downtime was experienced due to a major technical failure with the CASTR radar. The personnel work load turned out to be a major factor for the smaller sensors. It is worth noting that the overall length of the activity was planned to be 18 months in the optimistic planning case outlined above. Even taking into account all the limitations just outlined, we were able to complete the observations between June 2021 and December 2022.

4.1.2 Nightly planning

The nightly planning was done with a set of dedicated software tools developed at the Expert Centre and/or AIUB. There are three significant cases related to the passive optical observations part of the current campaign: planning of tracking observations, planning for light curves and surveys planning.

In the case of tracking observations (Sub-campaign I: SHOT and AGO70) the process started by receiving a message from the sensor operator about the sensor availability (mostly due to the expected weather conditions). Then the ephemerides for the visible tasking and calibrating objects for the location of the sensor were provided at a dedicated folder on the ExpCen sftp server. The sensor was then informed by e-mail about the availability of the planning data and the related priorities for the night. An example of the visibility visualizations for the night of 20211208 (last night of observations during the campaign) for the AGO70 sensor are presented on Fig. 5. The sensor operator then had the responsibility to carry out the local planning according to the object priorities, visibility and weather in order to maximize the observations efficiency. Identical planning data was sent to the SHOT sensor as well.

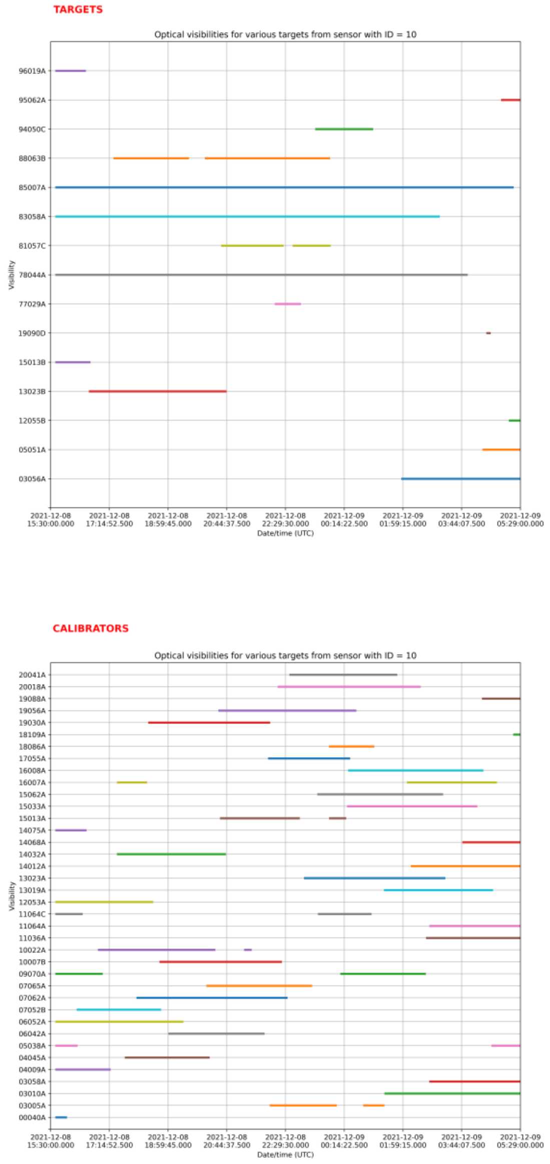

Figure 5. Example of the visibility visualizations for the night of 20211208 for the AGO70 sensor. At the top is the

planning for the tasking targets. Bottom panel represents the visibility of the calibration GNSS objects.

In the case of survey observations (Sub-campaigns I and II: ZimSMART and ZimMAIN) the survey fields centres were automatically calculated on a nightly basis and then distributed to the telescopes. The field centres were optimized to maximize the efficiency of the observations, taking into account overall visibility and the position of the shadow.

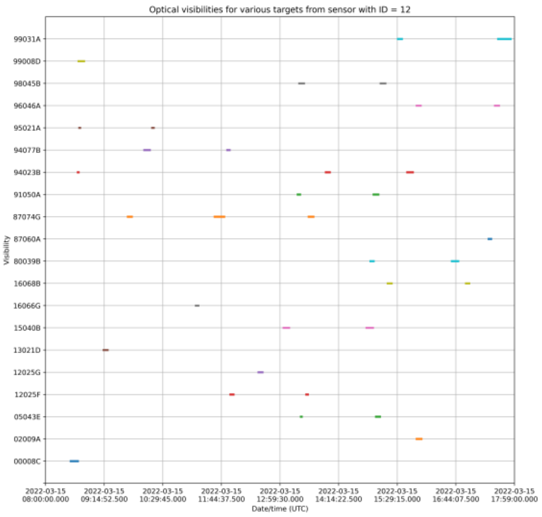

Figure 6. Example of the visibility visualizations for the day of 20220315 for the CASTR sensor. It is representing the planning carried out with the ExpCen software.

The radar observations (Sub-campaign III) were planned by GMV, using a dedicated software. Here we present a planning visualization example, prepared with the ExpCen planning tools for the day of 20220315. (refer to Fig. 6). This particular planning was carried out as part of the effort to schedule coordinated observations of objects of particular interest. Unfortunately, the possibilities for such observations were really limited by the working hours of the radar facility. It is worth pointing that it may be beneficial to plan a dedicated campaign (over two or more winter seasons) when there is a good overlap between the availability of the radar and the possibility of passive optical observations. If such campaign is planned, it will be very important to ensure the participation of a multiple passive optical sensors at different locations to minimize the possible increment weather effects.

The approach for the light curves observations planning was similar to those of tracking observation. But in this case there was no need to carry out calibration observations of GNSS objects. An example of the visibility visualizations for the night of 20220413 for Castelgrande is shown on Fig.7. Similar example for ZIMLAT using the dedicated Zimmerwald photometry planning tool is shown on Fig. 8.

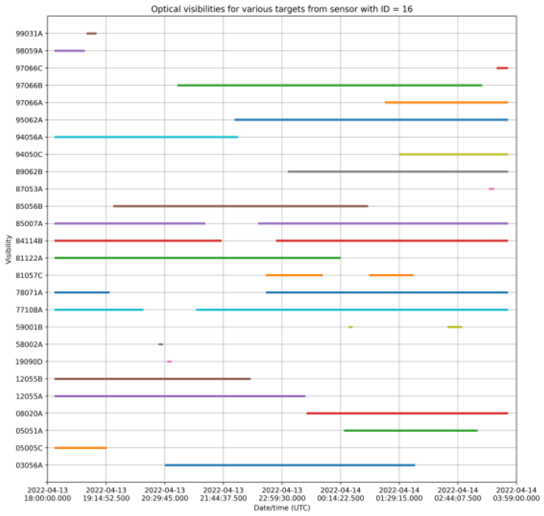

Figure 7. Example of the visibility visualizations for the day of 20220413 for the Castelgrande-ORI22 sensor.

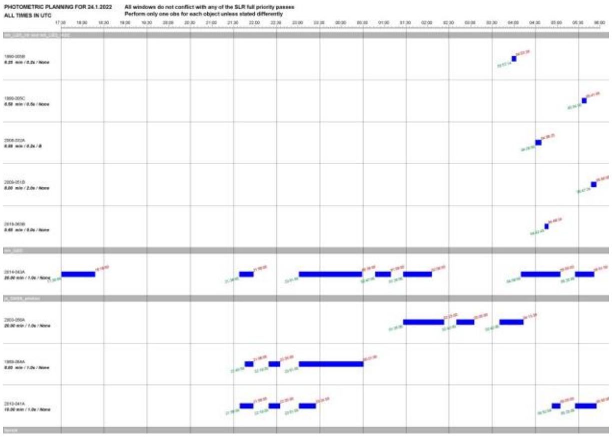

Figure 8. Example of the visibility visualizations for the day of 20220124 for the ZIMLAT sensor.

5 DATA ACQUIRED

Table 3. Billing Units definitions for the different observation types

Observation type	Billing Unit	Fractions
FUP (including calibrations)	¼ night (2h)	Not possible
Survey	½ night (4h)	Possible
Light curves (OPT)	¼ night (2h)	Possible
Radar	1 hour	Not possible

Table 4. Duration of the observing campaigns per sensor

Sensor	Campaign start	Campaign end
AGO70	18 Aug. 2021	07 Dec. 2021
SHOT	08 Oct. 2021	09 Nov. 2021
ZIMLAT	12 Apr. 2021	28 Mar. 2022
ZimMAIN	08 Nov. 2021	05 Dec. 2022
ZimSMART	20 Jun. 2022	19 Dec. 2022
Castelgrande	11 Aug. 2021	14 Apr. 2022
CASTR	19 Jul. 2021	15 Mar. 2022

A summary of the data acquired is presented at Tab. 3-6. These tables contain information about the duration of the individual observing campaign, number of planned nights, number of successful nights, percentage of time lost by sensor, the Billing Units BUs metrics for the individual sensors and the amount of data that was delivered.

Table 5. Information about observing campaigns per sensor

Sensor	Planned	Observed	Success
AGO70	47 nights	38 nights	81%
SHOT	22 nights	20 nights	91%
ZIMLAT		47 nights	
ZimMAIN	69 nights	56 nights	81%
ZimSMART	34 nights	26 nights	77%
Castelgrande	83 nights	58 nights	42%
CASTR	30 days	30 days	

Table 6. Data delivered per sensor

Sensor	BUs	Notes
AGO70	81	20 nights of observations
SHOT	59	15 nights of observations
ZIMLAT	32	129 light curves
ZimMAIN	90	45 nights of data
ZimSMART	42	21 nights of data
Castelgrande	20	80 light tcurves
CASTR	60	242 observations

In Tab. 5 the success rate on a nightly basis is not calculated for ZIMLAT and CASTR. Since CASTR is an all-weather sensor, data was acquired for all the observing scenarios requested. (In this case we are not taking into account the time lost due to the sensor technical downtime.) In the ZIMLAT case, observations were scheduled for several projects in parallel. Not surprisingly, CASTR had efficiency of about 100 percent. SHOT reached the highest efficiency among the optical passive sensors. If we transfer the different data metrics into nights, 134 nights of data were delivered. For definition purposes one night lasts from astronomical twilight to next twilight. The length of the night varies significantly through the year and for the different sensor locations. For the time accounting purposes, we consider it equal to eight hours.

Example light curves from Castelgrande-ORI22 and ZIMLAT are presented on the following Fig. 8 and 9 below.

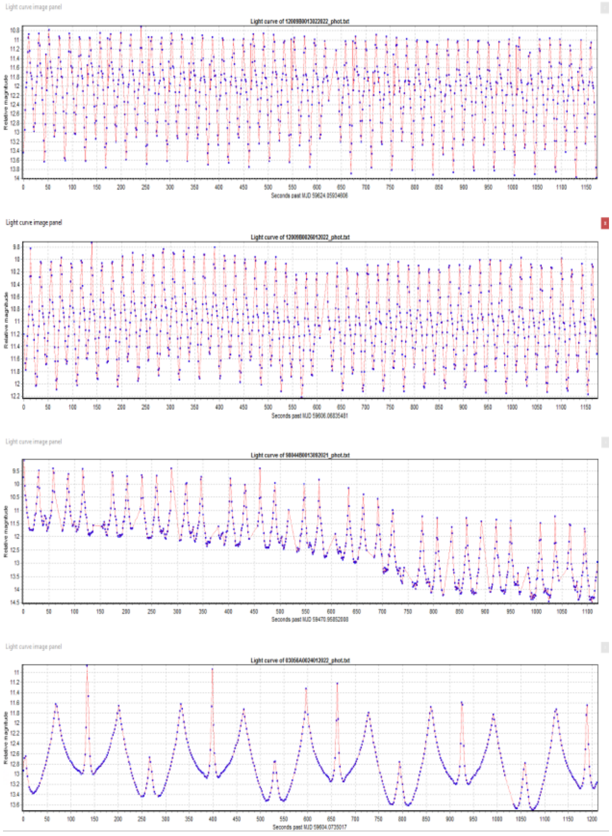

Figure 8. Example light curves from the ZIMLAT sensor. From top to bottom: 12009B (Atlas 5 Cen. R/B) observed on Feb. 13 2022; 12009B on Jan. 26 2022; 98044B (CZ-3B R/B) on Sep. 13 202; 03056A (COSMOS 2404) on Jan. 24 2022

6 LESSONS LEARNED

More attention need to be paid on the planning (initial activity planning and short term adjustments needed). It is always better to include the most pessimistic variant envisioned at least as a reference. In reality unforeseen circumstances are encountered on a regular basis. A prime example related to this particular campaign was the Covid-19 situation, which significantly hampered and delayed the completion of the observations. Planning of such an extensive observing campaign should always include accounting for the weather factor. Based on our estimates an overhead of 30 percent is a fairly realistic value to be considered.

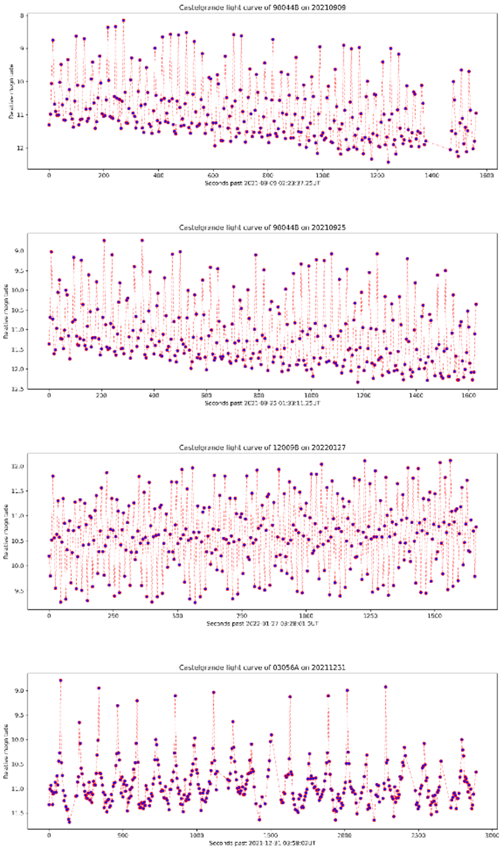

Figure 9. Example light curves from the Castelgrande-ORI22 sensor. From top to bottom: 98044B (CZ-3B R/B) acquired on Sep. 09 2021; 98044B on Sep. 25 2021; 12009B (ATLAS 5 CENT. R/B) on Jan. 01 2022; and light curve of 03056A (COSMOS 2404) observed on Dec. 31 2021

Changes of personnel are having an overall negative influence on the progress of the activity. We had such on three occasions and although they were rather well mitigated due to mutual efforts of all participants, at least certain glitches in communication have to be pointed out. Knowledge transfer is crucial in the case of imminent personnel replacement.

Flexibility is needed to properly account for the changing conditions and overall environment of the activity. Close cooperation and transparency is crucial for the successful collaboration and positive outcome. Lessons learned from the current activity are an important result on their own and should be utilized in the future planning.

7 SUMMARY AND CONCLUSIONS

Results from the AIUB Expert Centre multi-sensor, multi-wavelength data acquisition campaign have been presented. The campaign was carried out within the ESA P3-SST-XIX activity and included cooperated effort from seven different sensors and seven organizations across eight European countries. The activity was planned for 18 months and unfortunately experienced delays, but is worth noting that the data acquisition was planned, coordinated and carried out between June 2021 and December 2022. Hence, in terms of time, the overall planning framework of the campaign was met. In the process a total of 134 nights of observing data were delivered across the pool of optical passive sensors, plus a 60 hours of radar observations. On their own accord, the experience acquired and the lessons learned in the course of the campaign are a significant contribution to similar observing activities in the future.

The AIUB Expert Centre staff extends sincere gratitude to all our collaborators in the course of the campaign and the ESA staff involved for their hard work, flexibility, dedication and willingness to look for solutions when hardships encountered. The campaign would not have been successfully completed without those highly motivated specialists. It is not possible to fully express how much the opportunity to work and grow together is appreciated.

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