Automated-Monitoring Design of Acquisition Service Level Agreement (SLA) for Landsat-8 Satellite at Rumpin Remote Sensing Ground Station

Yuvita Dian Safitri[1, 2], Ali Syahputra Nasution[1], Wismu Sunarmodo[1], Hidayat Gunawan[1], Ayom Widipaminto[1]

[1] Pusat Teknologi dan Data Penginderaan Jauh, LAPAN
[2] E-mail : yuvita.dians@lapan.go.id

Abstract. The acquisition of the Landsat-8 satellite at Rumpin Remote Sensing Ground Station is accompanied by acquisition monitoring that can be assessed through the achievement of Service Level Agreements (SLA). SLA calculation is still manual, which causes operators to have difficulty in providing SLA data quickly and accurately. Here we describe an automated monitoring procedure to display the results of percentage calculations of Landsat-8 SLA automatically and in real-time. Using python automation code, the percentage of SLA achievements can be calculated, databases can be updated, and results in the form of tables and graphs from the database can be displayed using the web interface. The python program counts the number of track schedules, successful tracks, scene schedules, and successful scenes that are collected monthly. The python algorithms created for each data item differ from one another depending on the file format being read and the specific data to be recorded for the percentage calculation of Landsat-8 SLA. SLA automated-monitoring application helps operators complete the SLA calculation process more efficiently. Data that had to be checked manually can now be processed automatically.

1. Introduction

Law Number 21 of 2013 concerning Space, mandates LAPAN to collect, store, process and distribute data through the National Remote Sensing Data Bank (BDPJN) as a data network node in the national spatial data network system. Pustekdata has an obligation to service remote sensing satellite data ranging from low, medium and high resolutions to users of government institutions and universities throughout Indonesia. [1]

Landsat-8 is the eighth satellite in the Landsat program. Like other Landsat programs, Landsat-8 has a primary mission to observe the earth's surface. Landsat is a satellite that has been successfully acquired by LAPAN Remote Sensing Ground Station since 2013. Landsat satellite imagery has helped research in agriculture, environmental conditions, land area, and so on. The acquisition of Landsat-8 satellites was accompanied by monitoring the success of acquisitions that could be assessed through Service Level Agreement (SLA) achievements. From the beginning of the year the Landsat acquisition was carried out, complete SLA data was only available in 2017. This was due to the lack of awareness of the acquisition organizers about the periodic and consistent SLA. SLA calculation is still manual, which causes operators to have difficulty in providing SLA data quickly and accurately. The benefit of automated-monitoring include, automation works by making everything automatically controlled using technology to control and do the jobs that we would normally do manually, also the reduction of production cost due to remote monitoring. [2]

SLA automated-monitoring, aims to ensure that the SLA data that has been achieved by the Remote Sensing Ground Station can be accessed in real-time with automatic computation methods, making it easier for operators to obtain SLA percentage values efficiently. The monitoring information system is presented in the form of a web interface to facilitate users in accessing the results of Landsat-8 SLA. Information system is a system within an organization that brings together daily transaction processing needs, helps and supports operational activities, is managerial in nature from an organization and helps facilitate the provision of required reports. [3]

2. Theoritical Basis

Needs that must be met to make SLA automated-monitoring include an automation program to read the required information, a local website platform that becomes a monitoring platform, integration on LAPAN domains. Online monitoring offers an observation of the communication between components during the operation phase. [4]

a. Python

Python is used to create a counter value reading automation program that is needed for the calculation of the Landsat-8 satellite SLA every month. A general-purpose programming language like python provides facility to ease data generation, conversion, and presentation. In addition, it provides document auto generation and test framework. [5]

Python is a high programming language that can execute a number of multipurpose instructions directly (interpretive) with object orientation methods (Object Oriented Programming) and using dynamic semantics to provide a level of readability syntax. As a high programming language, python can be learned easily because it is equipped with automatic memory management (pointers). Python is used in various development fields such as websites and the internet, scientific and numerical research, data science and big data, programming learning media, Graphical User Interface (GUI), software development, and business applications.

Python can be used freely, even for commercial purposes. Many companies are developing python programming languages commercially to provide services. Python syntax can be run and written to build applications on various operating systems. [6] Python provides us with the opportunity to write the code we need, swiftly. The presence of an enhanced byte compiler and support libraries forms the backbone behind the increased speed of applications using Python code. [7]

b. XAMPP

XAMPP which stands for Apache, MySQL, PHP and Perl while the letter "X" is intended as a software that can run on four major OSes such as Windows, Mac OS, Linux and Solaris. This term is often referred to as cross platform (multi OS software).

This software is a combination of several software with the same function that supports web makers who want their own web server on a PC or laptop. [8]

- Htdocs
  Htdocs is a web server storage folder for pages that have been created and will be displayed later. Both on the original web server and XAMPP the Htdocs form is the same but the difference is in its capacity. Because XAMPP uses internal computer storage, the capacity is to adjust the computer.
- PHPMyAdmin
  PHPMyAdmin is a special software for managing MySQL administration. If in the Htdocs store your web display files then in PHPMyAdmin there are all the databases that you use for the purposes of website.PHPMyAdmin is a special software for managing MySQL administration. If the Htdocs store your web display files, in PHPMyAdmin there are all the databases that you use for website purposes.
- Control Panel
  Control Panel controls or controls XAMPP more effectively, starting from setting website settings, databases, and much more. In the world of hosting, the term CPanel is better known.

3. Method

The method used in this system development is the System Development Life Cycle (SLDC) Method. The stages in it include:

a. Study of Existing Condition that serves as a starting point to determine the existing condition of SLA data provision that has been carried out.
b. Identification of system requirements helps developers to prepare a system environment in terms of hardware and software.
c. Design is an important part of the reference for developers in system development process.
d. Implementation is the stage where the system begins to operate, in the process the developer also asks for user feedback about what should be improved in the system created (via questionnaire).
e. Maintenance and improvement are reciprocal given to the user to ensure that the system works well.

SLA automation is done on the acquisition of Landsat-8 satellite data. Data sources taken in this system come from the Remote Sensing Ground Station in Rumpin, Bogor. Every data is downloaded via the landsat.usgs.gov website. The data needed for SLA automation are track schedule, successful track acquisition, scene schedule, and successful scene acquisition. The entire data of the track schedule is read except at night pass. All track schedule data, successful track acquisition, scene schedule data, and the list of Successful Scene Acquisition are stored in four different folder. Currently, Landsat-8 satellite SLA monitoring is done manually by reading data files with the .xml, .txt, and .png extensions. In each data there are some information needed to make SLA reports that can be seen in Figure 1, Figure 2, Figure 3, and Figure 4. The initial development of this system was done on a stand-alone server with PC specifications as :

Operating System	: Windows 10 Pro
Processor	: Intel® Core™ i7-7700 CPU @ 3.60GHz
RAM	: 8 GB
System Type	: 64-bit

```
020686  CONFIRMED CONTACT:  506 RPI 2017-002-01:55:18   2017-002-02:03:59   NM
020686      506 AIG1    2017-002-01:55:18   2017-002-02:03:59   X0
020687  CONFIRMED CONTACT:  506 RPI 2017-002-03:31:32   2017-002-03:42:38   NM
020687      506 AIG1    2017-002-03:31:32   2017-002-03:42:38   X0
020701  CONFIRMED CONTACT:  506 RPI 2017-003-02:36:23   2017-003-02:48:04   NM
020701      506 AIG1    2017-003-02:36:23   2017-003-02:48:04   X0
020715  CONFIRMED CONTACT:  506 RPI 2017-004-01:44:07   2017-004-01:50:52   NM
020715      506 AIG1    2017-004-01:44:07   2017-004-01:50:52   X0
020716  CONFIRMED CONTACT:  506 RPI 2017-004-03:19:04   2017-004-03:30:42   NM
020716      506 AIG1    2017-004-03:19:04   2017-004-03:30:42   X0
TEXTEND:
```

Figure 1. Track schedule Information (.txt)

Figure 2. Successful Track Acquisition Information (.png)

```
<rootFile>
    <ROOT_FILE_ID>220</ROOT_FILE_ID>
    <ROOT_FILE_CMD_TIME>2017-006-01:30:32.511</ROOT_FILE_CMD_TIME>
    <RESOURCE>OLI</RESOURCE>
    <PRI_FLAG>N</PRI_FLAG>
    <PROTECT_FLAG>Y</PROTECT_FLAG>
</rootFile>
<NUM_SCENES>7</NUM_SCENES>
<scene>
    <SCENE_ID>020744_108_065</SCENE_ID>
    <RSRC_NAME>BOTH</RSRC_NAME>
    <IC_NAME>RPI</IC_NAME>
    <PRI_FLAG>N</PRI_FLAG>
    <PROTECT_FLAG>N</PROTECT_FLAG>
    <OFF_NADIR_FLAG>N</OFF_NADIR_FLAG>
    <PATH>108</PATH>
    <ROW>065</ROW>
</scene>
```

Figure 3. Scene Schedule Information (.xml)

```
<INTERVAL>
    <INTERVAL_NUMBER>1</INTERVAL_NUMBER>
    <ORBIT>020948</ORBIT>
    <SENSOR_ID>OLI_TIRS</SENSOR_ID>
    <NUMBER_OF_SCENES>16</NUMBER_OF_SCENES>
    <SCENE>
        <SCENE_NUMBER>1</SCENE_NUMBER>
        <DATE_ACQUIRED>2017:020:01:44:27</DATE_ACQUIRED>
        <WRS_PATH>110</WRS_PATH>
        <WRS_ROW>060</WRS_ROW>
        <FULL_PARTIAL_SCENE>PARTIAL</FULL_PARTIAL_SCENE>
    </SCENE>
    <SCENE>
        <SCENE_NUMBER>2</SCENE_NUMBER>
        <DATE_ACQUIRED>2017:020:01:44:51</DATE_ACQUIRED>
        <WRS_PATH>110</WRS_PATH>
        <WRS_ROW>061</WRS_ROW>
        <FULL_PARTIAL_SCENE>FULL</FULL_PARTIAL_SCENE>
```

Figure 4. Successful Scene Acquisition Information (.xml)

Integration is the final stage of activities carried out if all systems are running well. This integration is a process of laying the system into the LAPAN domain so that it can be accessed anytime and anywhere via public internet connection. This automation system is designed by considering the existential studies that have been carried out. The results of the study show that the Landsat-8 monitoring automation system resulting from the acquisition of Rumpin Ground Station, Bogor needs to be held to facilitate the calculation of Service level Agreement obtained by the ground station.

Figure 5. Basic Concept of System Flow

The concept of SLA automated-monitoring is to display the results of the calculation through the website display. The goal is for users to more easily access SLA values that have been reached each month for one year. Figure 5 shows the basic concept of the system process from automation, updating the database, and finally display SLA value in the form of the website interface. Database is a collection of files that are interrelated and interacting, these relations when indicated by the key of each file that exists. [9] The interface display concept is made as a concise , ease of access is an important point that must be considered in making the interface display. User interface is everything that the user will see and act with. [10] Web interface is important for its appearance because a good and easy to use web interface will make users get a satisfying online experience. [11] The initial design flowchart as shown in Figure 6 shows the course of monitoring automation in entering the results of SLA automation reading data into the SLA Database per year. Starting from running a python automation file, calculating the percentage of SLA, updating the database, and displaying the results in tables and graph from the database using website interface.

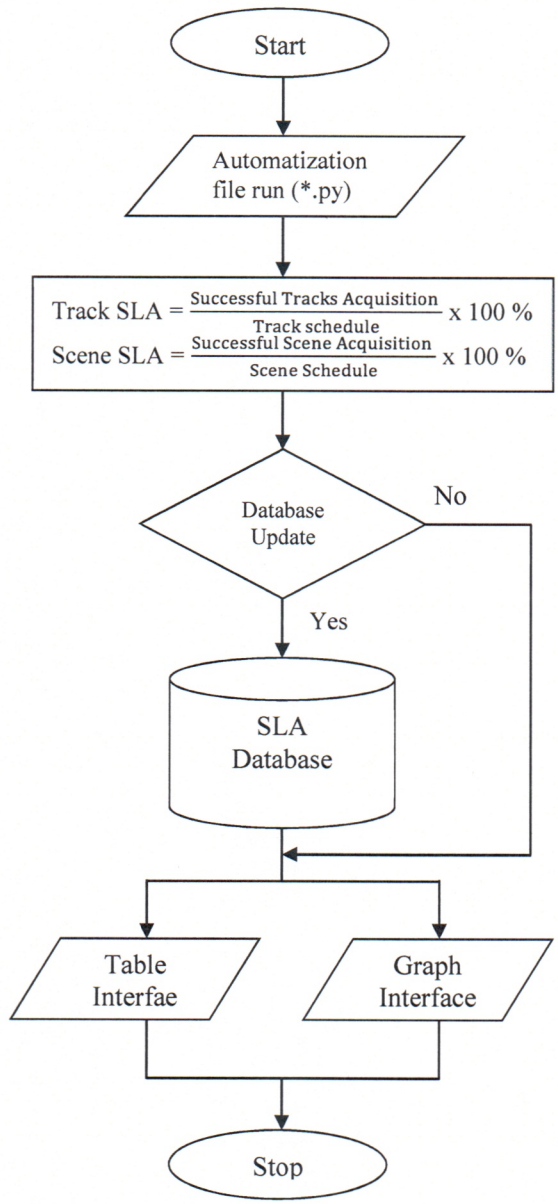


Figure 6. SLA Automated-monitoring Flowchart

4. Implementation

Configuration testing is done in a python program that carries out a data filter to be used as a calculation material for the Landsat-8 SLA percentage. Python shell and automation program as shown in Figure 7, file folders that provide track schedule data, successful track acquisition, scene schedule data, and the list of successful scene acquisition are used for the testing.

The python algorithm program created for each folder differs from each other depending on the file format that is read and the specific data that must be taken for the sake of the SLA percentage calculation. The Landsat-8 SLA monitoring automation system is generally run by programs created using Python programming languages. Data on Landsat-8 satellite acquisition schedule which consists of track schedule data, successful track acquisition, scene schedule data, and the list of successful scene acquisition stored in four different folders.

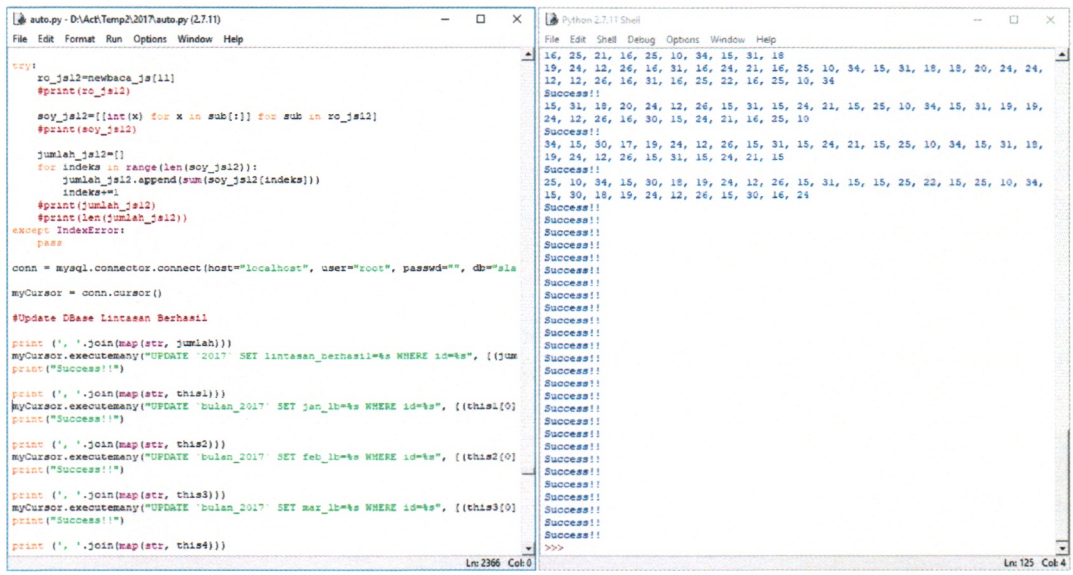


Figure 7. Automation Program

The python program will read each folder containing each of these data. The program opens one by one the files needed to fulfill the Landsat-8 SLA data calculation. After the required parameters are obtained, the counter goes to calculate the amount of data on the track, success, schedule, and scene success. The entire data is then processed to generate the percentage of SLA into a number list form. The number list is then grouped according to the table needs to be entered into the database using the advanced function of the python update database program. The data list entered into the database is then reprocessed using the PHP programming language. The PHP program which is also the basis of the interface display serves to call the data needed to be displayed on the monitoring system. In this case, the data is presented in the form of tables and graphs that display clear numbers from the results of the python calculation program both in the monthly and daily SLA categories. The monthly SLA displays the results of the percentage of SLAs generated each month in one year. Daily SLA is monitoring data that is done to find out new acquisition data per day.

SLA Automation Monitoring Landsat-8 was proven to be able to assist the performance of the employees concerned in providing Landsat-8 SLA acquisition data. This system can support Landsat-8 SLA monitoring, and can accelerate operational work. Data that had to be checked manually can now be processed automatically. Calculations using the program with the support of an informative display that provides data in the form of tables and graphs proved to be more convenient. Questionnaire is made to evolve the ease of access for the users. Users can give their opinions to help the developer improve the website. The results of the questionnaire show that most respondents agree with the use of websites that are able to provide data more efficiently. The most complained about on the website is about the display interfaces that may be less comfortable to use. The possibility is that different devices are used by each respondent to access the website. Then an experiment is done to access different devices and produce a display that does not match expectations, especially in the table view. Periodic repairs are carried out to meet user expectations. Some respondents also suggested several things for website development. Among the things that can be improved is the provision of a back button, improvement of button overlap, improvement of color selection, and instructions to use the website.

Comparison of conditions is carried out on the results of manual and automatic calculations in 2017 considering that the data and the calculation in that year is complete. Comparison between manual and automatic calculations has a difference of 7.8% for Track SLA, and 1.34% for Scene SLA. Complete data can be seen in Table 1 and Table 2.

Table 1. Manual Calculation Result

	Track schedule	Successful Track Acquisition	Scene Schedule	Successful Scene Acquisition	Track SLA	Scene SLA
January	50	45	644	492	90,00%	76,40%
February	43	36	554	363	83,72%	65,52%
Mach	51	50	658	567	98,04%	86,17%
April	49	45	624	502	91,84%	80,45%
May	52	50	653	570	96,15%	87,29%
June	48	41	623	453	85,42%	72,71%
July	50	44	648	386	88,00%	59,57%
August	50	49	634	530	98,00%	83,60%
September	49	44	608	481	89,80%	79,11%
October	51	43	676	434	84,31%	64,20%
November	49	41	617	437	83,67%	70,83%
December	50	44	643	487	88,00%	75,74%
Total	**592**	**532**	**7582**	**5702**	**89,86%**	**75,20%**

Table 2. Automatic Calculation Result

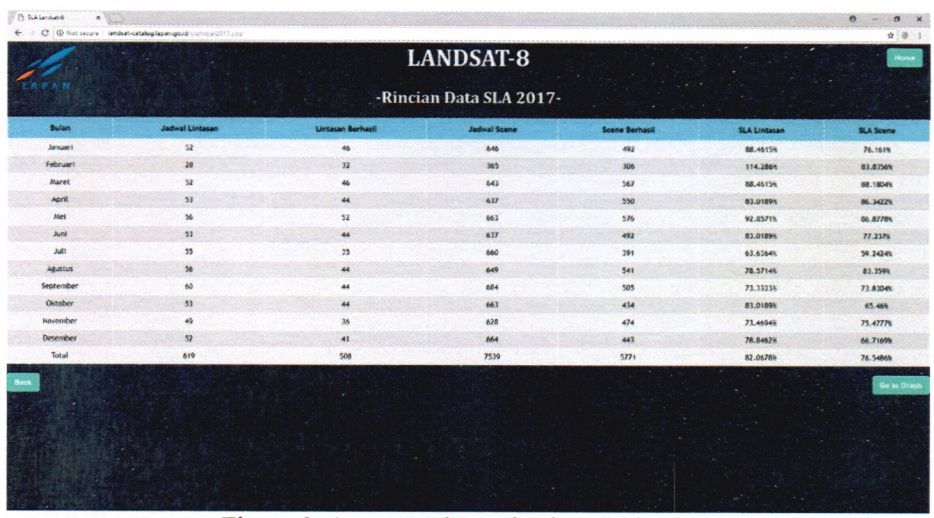
	Track schedule	Successful Track Acquisition	Scene Schedule	Successful Scene Acquisition	Track SLA	Scene SLA
January	52	46	646	492	88,46%	76,16%
February	28	32	365	306	114,29%	83,84%
Mach	52	46	643	567	88,46%	88,18%
April	53	44	637	550	83,02%	86,34%
May	56	52	663	576	92,86%	86,88%
June	53	44	637	492	83,02%	77,24%
July	55	35	660	391	63,64%	59,24%
August	56	44	649	541	78,57%	83,36%
September	60	44	684	505	73,33%	73,83%
October	53	44	663	434	83,02%	65,46%
November	49	36	628	474	73,47%	75,48%
December	52	41	664	443	78,85%	66,72%
Total	**619**	**508**	**7539**	**5771**	**82,07%**	**76,55%**

In Table 2. the results of automation also show that the February SLA value is more than 100%. The factors that influence the difference in results are:

a. Human error during manual calculation
b. Incomplete data provided in the folder to read the program

The comparison results show that this system still requires verification of the data read by the program, the certainty and consistency of the updated data also required for good performance. The final view can be seen in Figure 8, Figure 9, and Figure 10. SLA Automated-Monitoring System of Landsat-8 can be accessed through the address : *http://landsat-catalog.lapan.go.id/sla.*

Figure 8. Automated-Monitoring Home Page



Bulan	Jadwal Lintasan	Lintasan Berhasil	Jadwal Scene	Scene Berhasil	SLA Lintasan	SLA Scene
Januari	52	46	646	492	88.4615%	76.161%
Februari	28	32	365	306	114.286%	83.8356%
Maret	52	46	643	567	88.4615%	88.1804%
April	51	44	637	550	83.0189%	86.3422%
Mei	56	52	663	576	92.8571%	86.8778%
Juni	51	44	637	492	83.0189%	77.237%
Juli	55	35	660	391	63.6364%	59.2424%
Agustus	56	44	649	541	78.5714%	83.359%
September	60	44	684	505	73.3333%	73.8304%
Oktober	53	44	663	434	83.0189%	65.46%
November	49	36	628	474	73.4694%	75.4777%
Desember	52	41	664	443	78.8462%	66.7169%
Total	619	508	7539	5771	82.0678%	76.5486%

Figure 9. Automated-Monitoring Table view

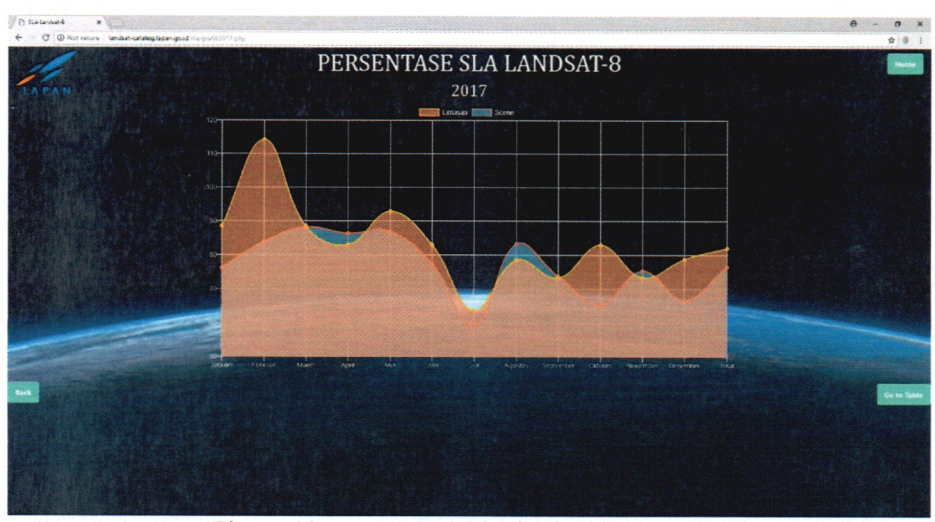


Figure 10. Automated-Monitoring Graph view

5. Conclusion

Automation programs that are made using the Python language are able to work and read the data needs of the SLA calculation properly. Web-based interfaces can also be run smoothly with the concept of invoking database values that are updated through automation programs.

The provision of Landsat-8 satellite SLA data is a form of accountability for the earth station to report the acquisition process that was successfully received by LAPAN. This automation application improves the efficiency of earth station SLA reporting to internal and external parties.

6. Future Works

Ensure data-naming consistency, daily data availability, and data verification to help the system work optimally. Annual maintenance in the database to ensure the readiness of new data. Development of SLA automated-monitoring on other satellites that are acquired by LAPAN

7. References

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