Earth observation satellite data processing for GPM/DPR

Report Number: R22ER0200
Subject Category: Space Technology
URL: https://www.jss.jaxa.jp/en/ar/e2022/20872/

Responsible Representative

Takeshi Hirabayashi, Director, Satellite Applications and Operations Center (SAOC)

Contact Information

GPM Mission Operation Officer(GPM-MOS@ml.jaxa.jp)

Members

Masanori Toyoda, Sachiko Kawase, Masaki Yamada, Osamu Motohashi, Toshiyuki Konishi, Hisashi Tanaka, Takashi Maruyama, Yuuichi Asechi, Tomohiko Higashiuwatoko, Takeshi Masaki, Kazuhiro Sakamoto, Shinji Ohwada, Yoshihiko Tonooka, Makoto Imanaka, Yuya Hirose, Takuya Arakawa, Ashizawa Kouta, Minami, Takahiro, Yuuichirou Kitayama, Yamamoto, Tadahiro, Yukie Nakagawa, Mori, Hiroshi Kajiyama Kenichi

Abstract

In recent years, worldwide interest has been increasing about the necessity of grasping the global environmental change. To deal with such problems, various approaches using observation technology from space have been carried out by satellites.

Global Precipitation Measurement (GPM) mission, as follow-on and expansion of Tropical Rainfall Measurement Mission (TRMM) satellite, is an international mission to achieve highly accurate and frequent global rainfall observation. it is carried with multiple satellite, GPM core satellite with Dual-frequency Precipitation Radar (DPR) jointly developed by JAXA and NICT, and with GPM Microwave Imager (GMI) developed by NASA, and another constellation satellites with Microwave Imager. In addition, GSMaP (Global Satellite Mapping of Precipitation), which estimates global precipitation distribution based on data acquired by these GPM core satellites and constellation satellites, is available.

Long-term data accumulation is important to understand global environmental changes, and it is necessary to ensure continuity of data from the TRMM, which operated from 1997 to 2015, the GPM, which is currently in operation.

Ref. URL: http://global.jaxa.jp/projects/sat/gpm/

Reasons and benefits of using JAXA Supercomputer System

Processing of earth observation data includes "operational processing" performed routinely and "re-processing" performed once a year or so for several year data. The purpose of re-processing is to correspond with version-up of computing model and algorithm performed periodically. The amount of observation data grows year by year. Then, we need more and more time to complete reprocessing of all archived observation data. By using

supercomputers, the calculation time is greatly shortened, and it is possible to provide products quickly to users.

In addition, the frequency of re-processing is about once every one to two years, so the necessary period of computer resource for re-processing is limited. If this computer resource is prepared on ourselves, it is inefficient in terms of the computer utilization. The use of JSS3 is advantageous in that it can relatively flexibly secure computer resources when we needed.

In this project, the total re-processing time is reduced by increasing the number of concurrently executing processes using MPI parallel processing called "workflow control".

Achievements of the Year

In FY2022, reprocessing of GPM/DPR L2, L3, latent heat L2, L3, and TRMM/PR L1B, L2, L3, latent heat L2, L3, and GSMaP was performed in response to the major version upgrade (V07) in December 2021. Figures 1 through 3 show a summary of reprocessing results.

Processing Algorithms	Total number of processes	Total elapsed times (hours)	Total	
			File Count	File Size(GB)
KuPR L2	16,856	4,641.37	132,390	85,816.6
KaPR L2	16,777	3,965.38	132,393	75,938.5
DPR L2	20,524	6,403.33	131,829	100,281.6
DPR L3(Daily)	2,828	3,878.33	11,277	651.8
DPR L3(Monthly)	121	226.77	93	165.3
SLH L2	77,921	1,131.12	43,933	744.6
SLH L3(gridded orbital)	77,699	589.68	43,934	343.4
SLH L3(Daily)	7,350	185.37	2,819	393.5
SLH L3(Monthly)	269	28.85	93	103.3

Fig. 1: GPM/DPR Reprocessing Results Summary (Observation Period: 2014/03/08 - 2021/11/30)

Processing Algorithms	Total number of processes	Total elapsed times (hours)	Total	
			File Count	File Size(GB)
PR L1B	106,331	3,515.07	96,827	11,652.8
PR L2	97,211	24,942.97	290,481	199,302.0
PR L3(Daily)	6,221	3,689.62	24,788	692.8
PR L3(Monthly)	207	343.98	206	92.3
SLH L2	96,827	1,315.42	96,827	1,627.1
SLH L3(gridded orbital)	96,827	547.37	96,827	614.4
SLH L3(Daily)	6,197	140.20	6,197	665.7
SLH L3(Monthly)	206	14.68	206	121.4

Fig. 2: TRMM/PR Reprocessing Results Summary (Observation Period: 1997/12/08 - 2015/04/01)

Processing Algorithms Identifiers	Total number of processes	Total elapsed times (hours)	Total	
			File Count	File Size(GB)
MML	25,644	43,649.03	850,015	72,621.6
MMR	104,566	91,943.53	1,261,781	4,937.0
MMG	35,102	99,294.97	1,750,790	1,920.3
MMG2	17,022	55,237.30	—	—
MMN	609	3,284.60	288	1.0
IBW	8,770	1,613.85	247,776	13.7
IFW	11,104	2,052.93	210,384	1,257.1
INT	2,174	3,458.57	—	—
MBW	15,936	13,627.77	210,130	584.8
MFW	14,891	3,624.25	123,456	473.8
MCH	15,477	4,550.27	79,068	312.5
MCD	9,933	690.78	365,472	7,905.8
MCM	312	4.30	254	3.6

Fig. 3: GSMaP Reprocessing Results Summary (Observation Period: 1998/01/01 - 2021/11/30)

- **Publications**

  N/A

- **Usage of JSS**

- **Computational Information**

Process Parallelization Methods	N/A
Thread Parallelization Methods	N/A
Number of Processes	1
Elapsed Time per Case	25.5 Minute(s)

- **JSS3 Resources Used**

Fraction of Usage in Total Resources[*1](%): 0.20

Details

Computational Resources		
System Name	CPU Resources Used (core x hours)	Fraction of Usage[*2](%)
TOKI-SORA	0.00	0.00
TOKI-ST	1,580,909.62	1.58
TOKI-GP	0.00	0.00
TOKI-XM	0.00	0.00
TOKI-LM	1.68	0.00
TOKI-TST	0.00	0.00
TOKI-TGP	0.00	0.00
TOKI-TLM	0.00	0.00

File System Resources		
File System Name	Storage Assigned (GiB)	Fraction of Usage*2 (%)
/home	219.08	0.20
/data and /data2	1,156,471.67	8.92
/ssd	1,408.33	0.20

Archiver Resources		
Archiver Name	Storage Used (TiB)	Fraction of Usage*2 (%)
J-SPACE	77.86	0.35

*1: Fraction of Usage in Total Resources: Weighted average of three resource types (Computing, File System, and Archiver).

*2: Fraction of Usage：Percentage of usage relative to each resource used in one year.

- **ISV Software Licenses Used**

ISV Software Licenses Resources		
	ISV Software Licenses Used (Hours)	Fraction of Usage*2 (%)
ISV Software Licenses (Total)	0.00	0.00

*2: Fraction of Usage：Percentage of usage relative to each resource used in one year.