13-0203

Subdaily quality check of laser ranging data at Hitotsubashi University

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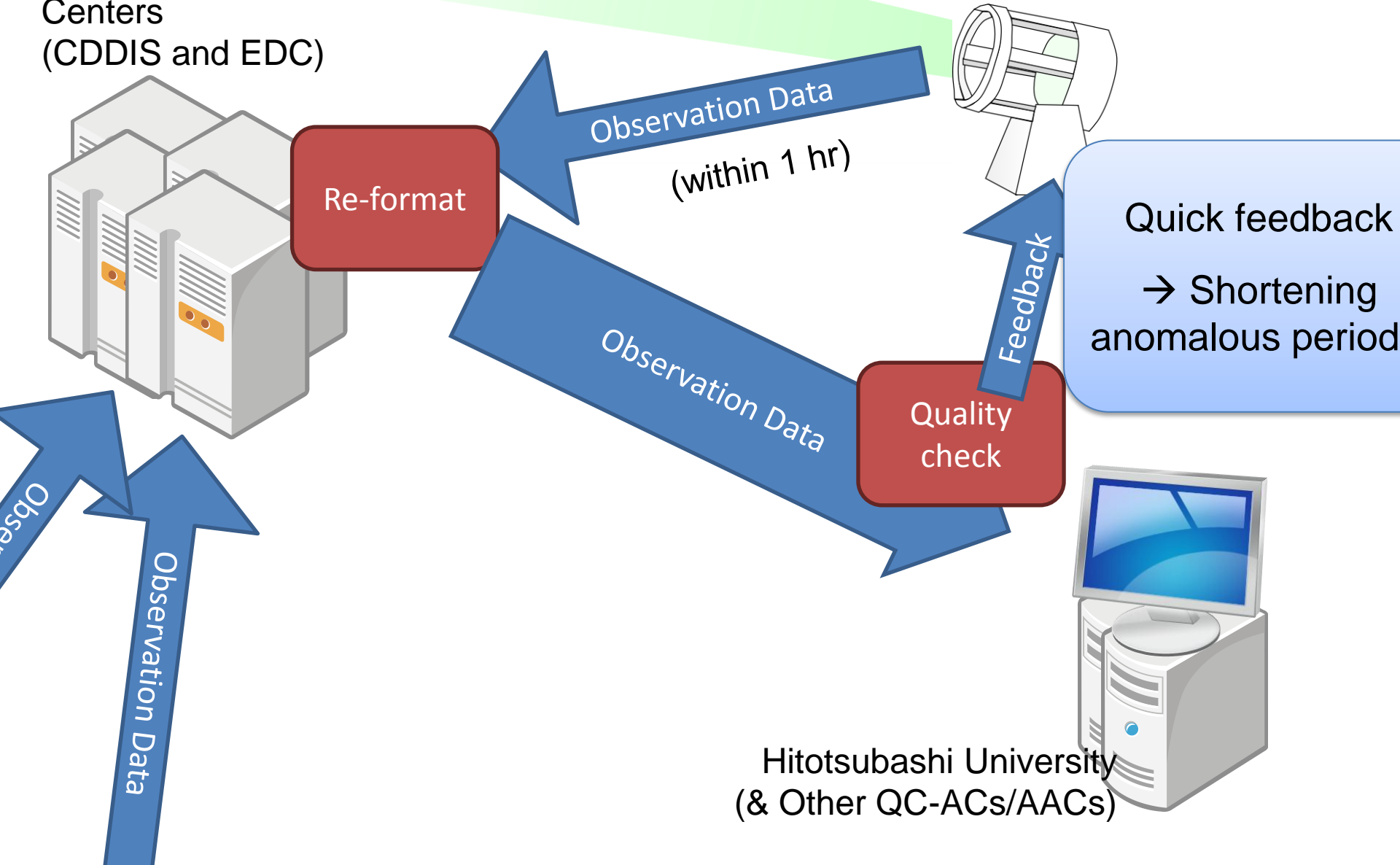Hitotsubashi University, Japan
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HITOTSUBASHI UNIVERSITY

Data Flow

Operational Centers/Data
Centers
(CDDIS and EDC)

Laser Ranging Station

Observation Data
(within 1 hr)

Re-format

Observation Data

Quality
check

Feedback

Quick feedback

→ Shortening
anomalous period

Observation Data

Observation Data

Hitotsubashi University
(& Other QC-ACs/AACs)

true orbit
observation

```
# 7838 = SIMOSATO
# sat site date       time dur rb mm err tb us err prec bad total
AJI1 7838 2013/10/09 15:40 11 11 ( 6 )  -5.1 ( 1.6 ) 3 0 / 24
LAG2 7838 2013/10/09 16:03 40 19 ( 7 ) -17.1 ( 5.9 ) 5 0 / 22
:
:
```

http://geo.science.hit-u.ac.jp/slr/bias/

Multi-Satellite Bias Analysis Report v2
for Worldwide Satellite Laser Ranging Stations
being updated every 6 hours!

Geoscience Hitotsubashi

Latest Analysis Report: >> from **00h UTC, 25 Oct 2013** to **00h UTC, 08 Nov 2013** (updated 02:15 UTC, 8 Nov 2013)

Stations with high productivity

sat	orbit fit WRMS in mm	# pass/# NP	1st site(ID) # pass/# NP	2nd site(ID) # pass/# NP	3rd site(ID) # pass/# NP
Lageos-1	10	393 / 3417	Matera (7941) 35/339	Changchun (7237) 35/196	Zimmerwald (7810) 33/385
Lageos-2	11	331 / 2849	Changchun (7237) 28/156	Arkhyz (1886) 26/127	Matera (7941) 20/249
Etalon-1	11	56 / 272	Changchun (7237) 8/26	Zimmerwald (7810) 7/26	Matera (7941) 5/38
Etalon-2	11	33 / 223	Zimmerwald (7810) 7/72	Changchun (7237) 5/15	Yarragadee (7090) 4/14
Ajisai	24	526 / 5976	Changchun (7237) 56/428	Mt Stromlo (7825) 54/688	Yarragadee (7090) 46/621
Lares	12	307 / 3194	Changchun (7237) 44/275	Zimmerwald (7810) 31/440	Yarragadee (7090) 24/346
Starlette	12	402 / 3521	Changchun (7237) 50/324	Mt Stromlo (7825) 40/334	Beijing (7249) 33/275
Stella	28	198 / 1559	Mt Stromlo (7825) 24/183	Changchun (7237) 22/98	Zimmerwald (7810) 16/145

and more satellites (GNSS and LEO) are included in the reports!!

Archive: (each covers 14 days from the date)   2012   v1: Year 2011 2010 2009 2008 2007 2006 2005

Oct 2013	Sep 2013	Aug 2013	Jul 2013	Jun 2013	May 2013	Apr 2013	Mar 2013	Feb 2013	Jan 2013
25 (00)	30 (00 06 12 18)	31 (00 06 12 18)	31 (00 06 12 18)	30 (00 06 12 18)	31 (00 06 12 18)	30 (00 06 12 18)	31 (00 06 12 18)	28 (00 06 12 18)	31 (00 06 12
24 (00 06 12 18)	29 (00 06 12 18)	30 (00 06 12 18)	30 (00 06 12 18)	29 (00 06 12 18)	30 (00 06 12 18)	29 (00 06 12 18)	30 (00 06 12 18)	27 (00 06 12 18)	30 (00 06 12
23 (00 06 12 18)	28 (00 06 12 18)	29 (00 06 12 18)	29 (00 06 12 18)	28 (00 06 12 18)	29 (00 06 12 18)	28 (00 06 12 18)	29 (00 06 12 18)	26 (00 06 12 18)	29 (00 06 12
22 (00 06 12 18)	27 (00 06 12 18)	28 (00 06 12 18)	28 (00 06 12 18)	27 (00 06 12 18)	28 (00 06 12 18)	27 (00 06 12 18)	28 (00 06 12 18)	25 (00 06 12 18)	28 (00 06 12
21 (00 06 12 18)	26 (00 06 12 18)	27 (00 06 12 18)	27 (00 06 12 18)	26 (00 06 12 18)	27 (00 06 12 18)	26 (00 06 12 18)	27 (00 06 12 18)	24 (00 06 12 18)	27 (00 06 12
20 (00 06 12 18)	25 (00 06 12 18)	26 (00 06 12 18)	26 (00 06 12 18)	25 (00 06 12 18)	26 (00 06 12 18)	25 (00 06 12 18)	26 (00 06 12 18)	23 (00 06 12 18)	26 (00 06 12

More frequent and fresher!

1999- Weekly

2005- Daily

2012- Subdaily (every 6 hrs)

New report uploaded at 2.30, 8.30, 14.30, 20.30 UTC.

Possible to include up to 2.5-hr-old observations.

➜ **Observers can check today's quality before going home!**

New software and new procedure

Newly developed "c5++" (collaboration with NICT etc)
  - IERS Conventions (2010) compatible
  - Other latest models such as gravity field.

Quarantine data included in the analysis (marked as "Q")

More satellites added to the analysis
   - Some LEOs and GNSSes
   (Sometimes excluded when the obs amount is not sufficient or when the orbit fit is poor.)

➔ **More precise and robust diagnosis.**

Fast!

New computer and parallel processing

New PC: w/ AMD 8-core FX-8150

7 processes in parallel (one process per satellite

Language: C++ ("c5++") ← Java ("concerto v4")

➔ **Faster, approx 17 to 25 min/report**

   (was 3 to 4 hrs/report).

Current status = Manual check

Routine work.

Impossible to check 4 reports/day everyday.

Hitotsubashi Univ

SLR Station

E-mail

Cc: RapidServiceMail@dgfi.badw.de

Hello ABC station,
It seems your laser observations …
(Glad if you give me a reply!)

Examples of anomalous passes

```
⋮
⋮
# sat    date      time dur rb mm    err     tb us    err prec bad total
AJI1 2013/09/04 00:52  4    -81 ( 134)   -7.0 ( 48.9 ) 7  1 /  8
LARS 2013/09/05 02:50  7     30 ( 44 )    7.3 ( 12.2 ) 7  0 / 15
AJI1 2013/09/05 04:00  7  -2542 ( 68 )    7.6 ( 19.3 ) 10 0 / 16
LAG2 2013/09/05 04:11 19  -1295 ( 97 )  -31.4 ( 57.2 ) 10 0 / 11
LARS 2013/09/05 04:41  7  -2499 ( 34 )   16.1 ( 11.8 ) 8  0 / 14
STEL 2013/09/05 04:51  8  -2498 ( 12 )   14.5 ( 3.1 ) 5  0 / 18
LAG1 2013/09/05 05:23 22  -1225 ( 10 )    2.6 ( 8.3 ) 2  0 / 13
AJI1 2013/09/05 05:59  8     -1 ( 19 )    8.1 ( 11.3 ) 8  0 / 18
STEL 2013/09/05 06:33  5    -63 ( 16 )    3.5 ( 5.3 ) 5  0 / 12
AJI1 2013/09/05 08:02 12    -54 ( 12 )    2.1 ( 3.4 ) 4  0 / 15
LAG1 2013/09/05 08:52 29    -51 ( 17 )    0.8 ( 9.3 ) 5  0 / 11
⋮
⋮
```

➔ Detect these passes automatically and statistically

Statistical and automatic procedure

- Read past 10 sets (20 weeks) for each station
- Assess both the formal error in "( )"
  and the stdev of the past data

Filters :

| Out of 3 × formal error ? | Out of 3 × stdev ? | 3 or more anomalous passes ? | Multiple satellites ? |

In-House Testing

Current status

- **Successfully extracted about 80% of anomalous passes reported by DGFI, UMBC & HIT-U via RapidServiceMail.**

- **Detected at least 3 obvious problems not reported in RapidServiceMail.**

- **[To Do] Implement this procedure into the routine task.**

34 incidents in 54 Rapid Service Mail messages
2011.06-2013.10

Hit (**28**)

Miss(7)
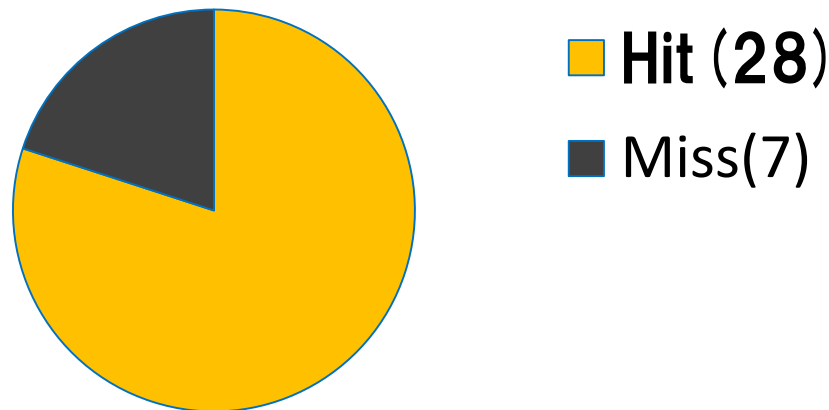
"v2" Quality control service

4 times per day

Software "c5++"

Full manual check → Stations & RapidServiceMail

Ongoing & Near Future

Automatic detection → Quick manual check

→ Stations & RapidServiceMail

Station-Analyst Interaction

Face-to-face communication is important! Speak to us.

Use of "fresh" coordinates for some stations.