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Protecting Our World, Conquering New Frontiers

Study on modernizing the General Standard of Operation Specifications for Public Surveys (12009)

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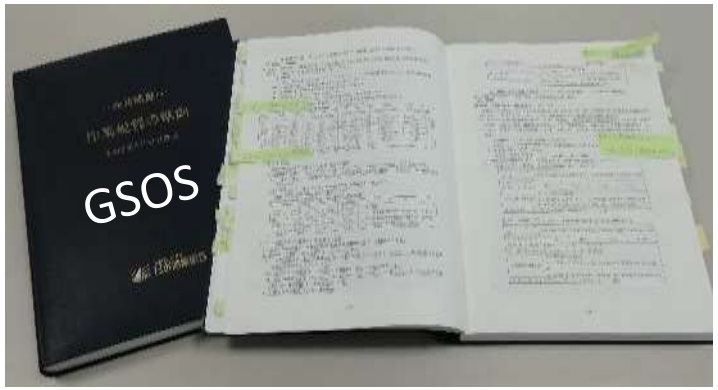
Theme of our study

- Why should we modernize the standard of specifications and processes that are accepted widely and work well today?
- What should we change in the standard?
- And further in future,
- How can we make the modernized standard widely accepted despite the fact that no (or few) customers request it?

1. Introduction

- The General Standard of Operation Specifications for Public Surveys (GSOS) is provided by GSI (Geospatial Information Authority of Japan) served as a model for public organizations to conduct surveying and mapping and it works well



public organizations
municipalities

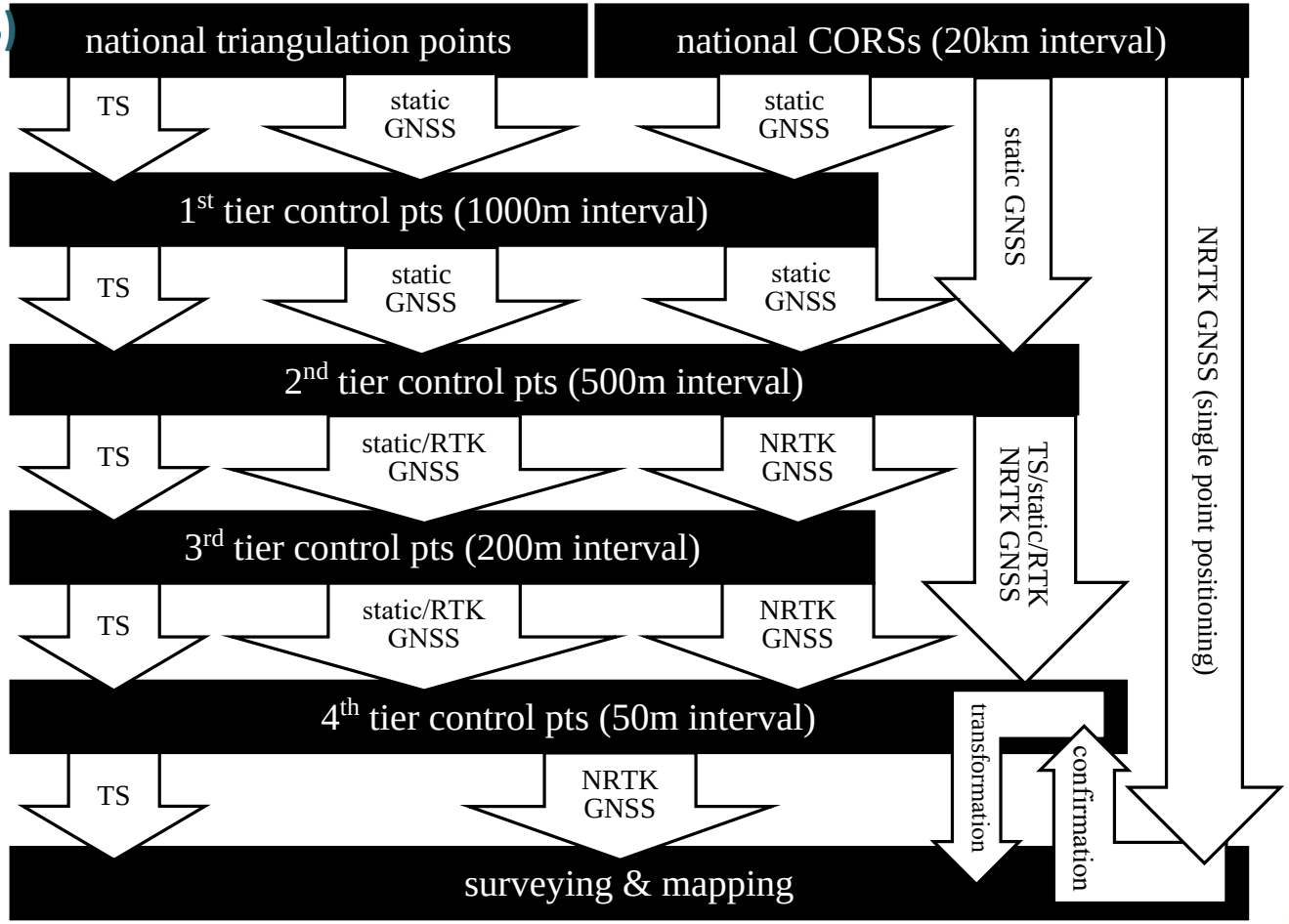
surveying & mapping
by private companies

2. (Previous) GSOS (revised on 3/31/2023)

- No substantial change in QC since 1977

2.1 Control Surveys

- Hierarchical structure of control points
- national reference frame realized by both triangulation points & CORSs
- method: theodolite/EDM or TS and GNSS



2.2 Photogrammetric surveys

- Standardized classification of map scale
  - based on printed maps
- Quality criteria
  - based on film cameras & printed maps
- Method: combined use of GCP and GNSS/IMU

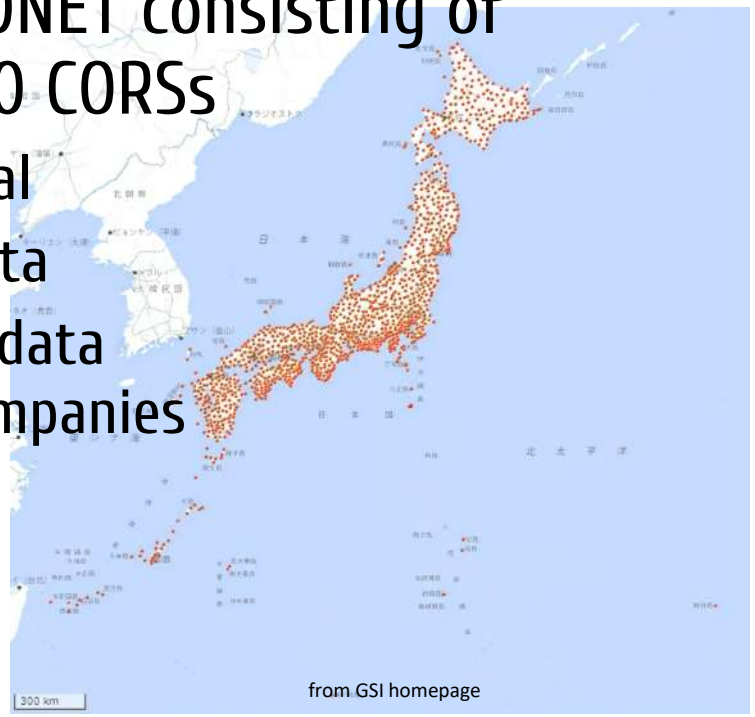
eliminated from GSOS this year

Map Information Level	Positional Accuracy (Horizontal)	Photographic Scale (Film Camera)	Ground Sample Distance (Digital Camera)
1000	0.70m	1:6000 – 1:8000	360*B/H – 480*B/H mm
2500	1.75m	1:12000 – 1:25000	600*B/H – 750*B/H mm
5000	3.50m	1:20000 1:25000	1200*B/H – 1500*B/H mm

3. Prevailing technologies and challenges for modernization

3.1 Prevailing technologies in use in Japan

- nationwide GEONET consisting of more than 1,300 CORSs
  - ~20km interval
  - free RINEX data
  - Network RTK data service by companies



from GSI homepage

- digital technology for cameras, photogrammetry, and mapping

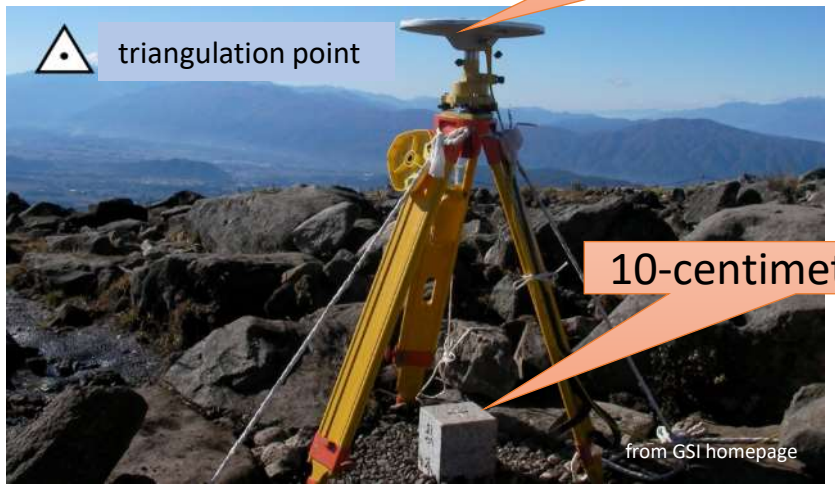

from Leica Geosystems brochure


from Vexcel Imaging brochure

3.2 Challenges to modernizing Control Surveys

- QC based on less accurate triangulation points

centimeter-level accuracy



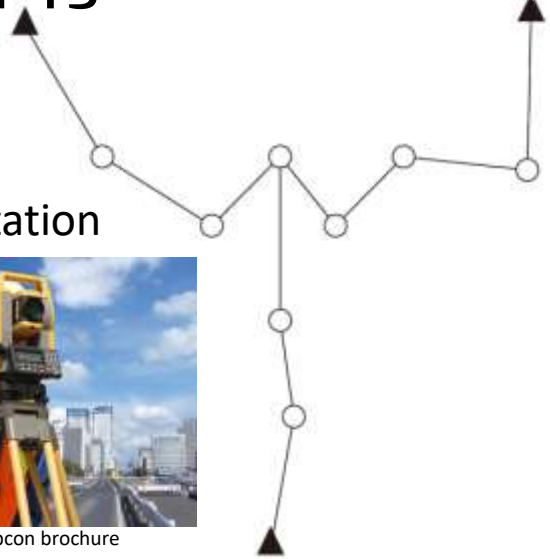
10-centimeter accuracy

CORS

centimeter-level accuracy
monitoring change in time

- progress of TS

10-centimeter accuracy



total station

from Topcon brochure

millimeter accuracy
efficient, convenient in traversing

3.3 Challenges to modernizing Photogrammetric Surveys

- Map quality criteria are obsolete

Map Information Level	Positional Accuracy
1000	0.70m
2500	1.75m
5000	3.50m

ASPRS Positional Accuracy Standards for Digital Geospatial Data

TABLE B.6 HORIZONTAL ACCURACY/QUALITY EXAMPLES FOR HIGH ACCURACY DIGITAL PLANIMETRIC DATA

ASPRS 2014				Equivalent to map scale in	
Horizontal Accuracy Class $RMSE_x$ and $RMSE_y$ (cm)	$RMSE_r$ (cm)	Horizontal Accuracy at the 95% Confidence Level (cm)	Approximate GSD of Source Imagery (cm)	ASPRS 1990 Class 1	ASPRS 1990 Class 2
60.0	84.9	146.9	30.0 to 60.0	1:2400	1:1200
75.0	106.1	183.6	37.5 to 75.0	1:3000	1:1500
100.0	141.4	244.8	50.0 to 100.0	1:4000	1:2000

- Quality Criteria of GSDs are less comprehensible, less specific

Map Information Level	Ground Sample Distance (Digital Camera)
1000	360*B/H – 480*B/H mm
2500	600*B/H – 750*B/H mm
5000	1200*B/H – 1500*B/H mm

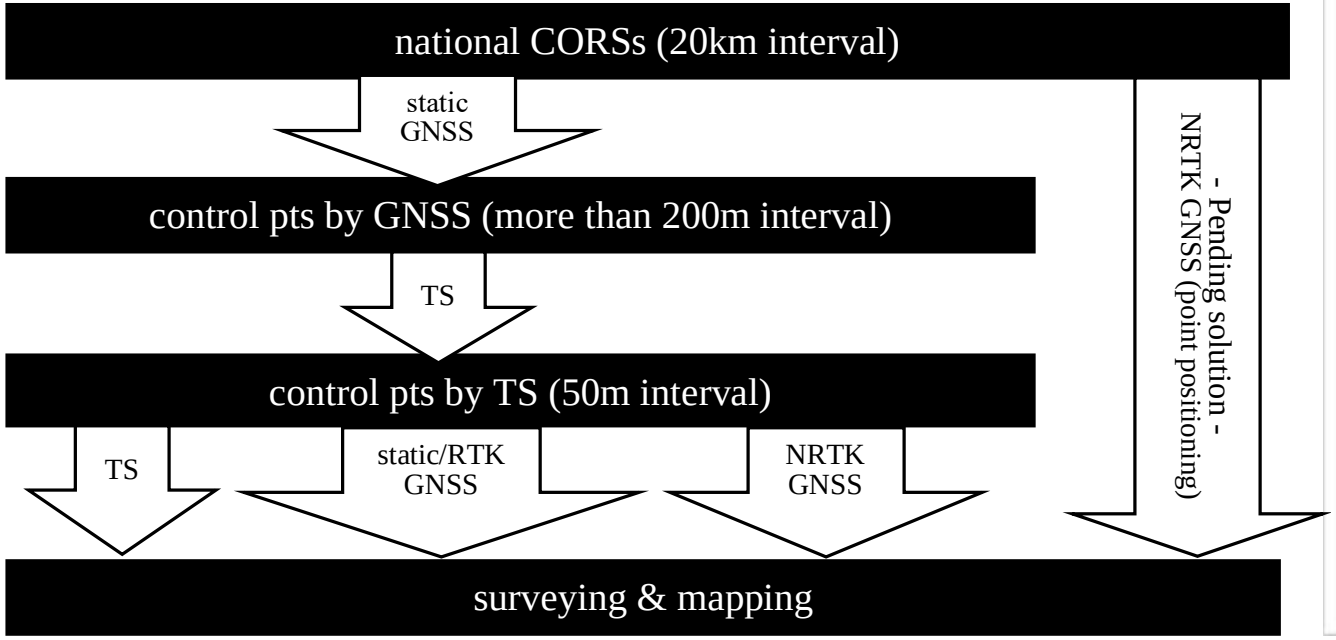
~~Photographic Scale (Film)~~

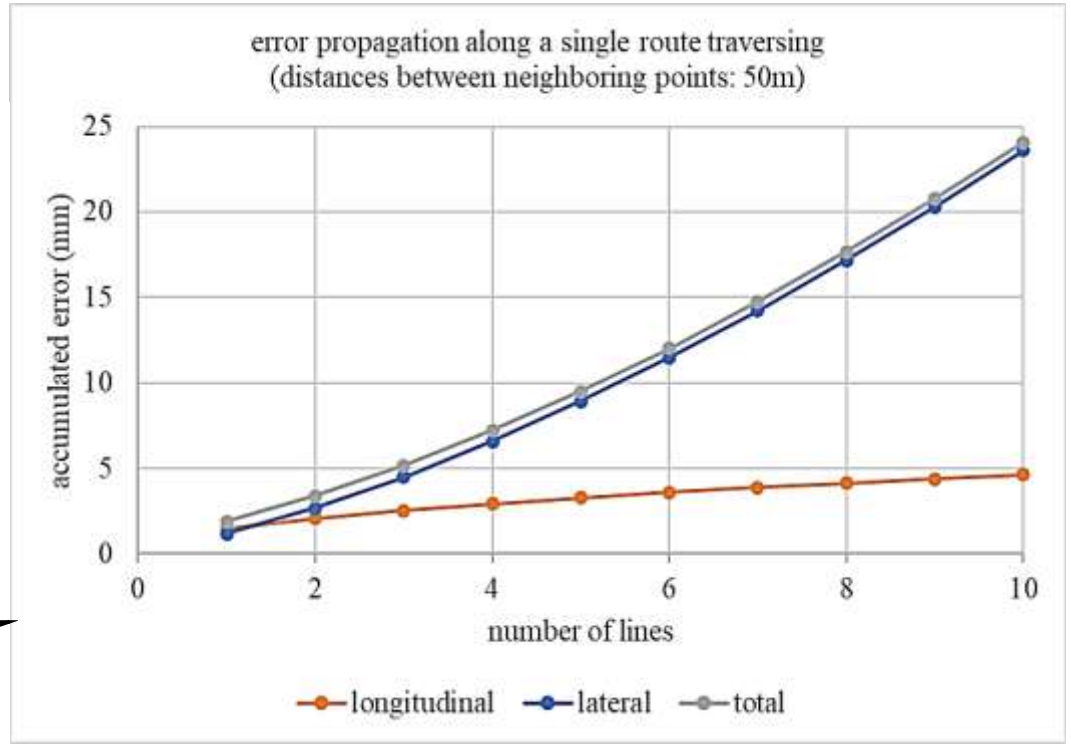
B/H depends on cameras & lenses

4. Proposed approaches to overcome the challenges

4.1 Control surveys

- Two tier control points





4.2 Photogrammetric surveys: under consideration and discussion

Conclusion, but not yet conclusion

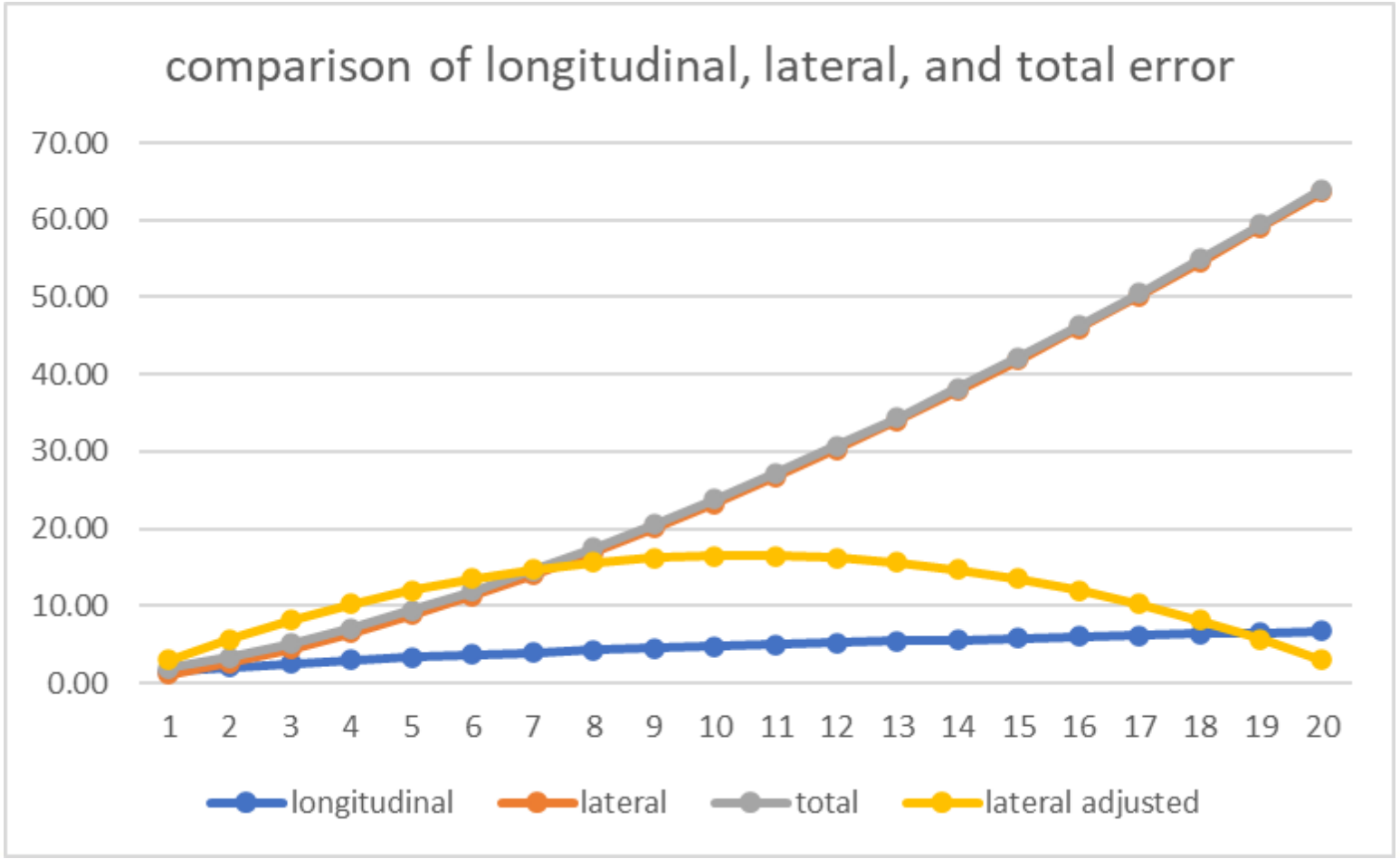
- GSOS has been continually updated by GSI to include new geospatial concepts and technologies.
- No substantial change in QC in GSOS since 1977.
- Most of public organizations still use GSOS without any inconvenience.
- Public surveys are conducted by modern equipment and technologies.
- The accuracy of surveying and mapping can be greatly improved.
- Private sector set up a study group to modernize GSOS for the future needs for accuracy.

➢How can we promote it despite no request for accuracy from customers?

end of presentation slides

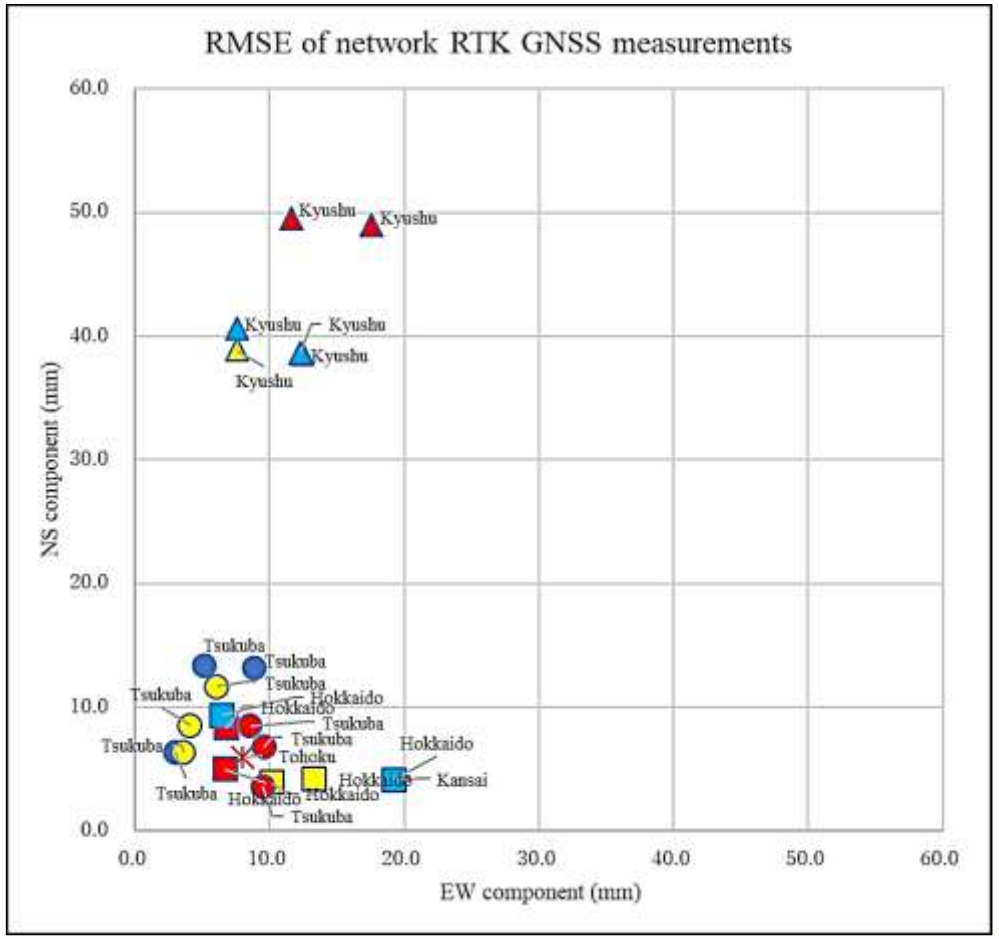
(spare slide) control surveys by TSS

- comparison of longitudinal, lateral, and total error



(spare slide) reliability of network RTK GNSS

- RMSR of network RTK GNSS measurements



(spare slide) 4.2 Photogrammetric surveys

- Based on real data inspected:
- the evaluated accuracy of map information level 2500 was proved to be more accurate (~0.8m) than the nominal accuracy (1.75m).
- GSD of 20cm is prominent to produce map information level 2500.

ASPRS Positional Accuracy Standards for Digital Geospatial Data

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60.0	84.9	146.9	30.0 to 60.0	1:2400	1:1200

GSD 20cm could be excessive?

- Need more examinations on more data to specify appropriate QC