SGD23-03

衛星レーザ測距観測網の拡充：新たな局はどこに？

Satellite laser ranging network: Where should a new station be placed?

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Toshimichi Otsubo (Hitotsubashi Univ)
Koji Matsuo (GSI)
Keiko Yamamoto (NAO)
Yuichi Aoyama (NIPR)
Thomas Hobiger (Chalmers Univ of Tech)
Toshihiro Kubo-oka & Mamoru Sekido (NICT)

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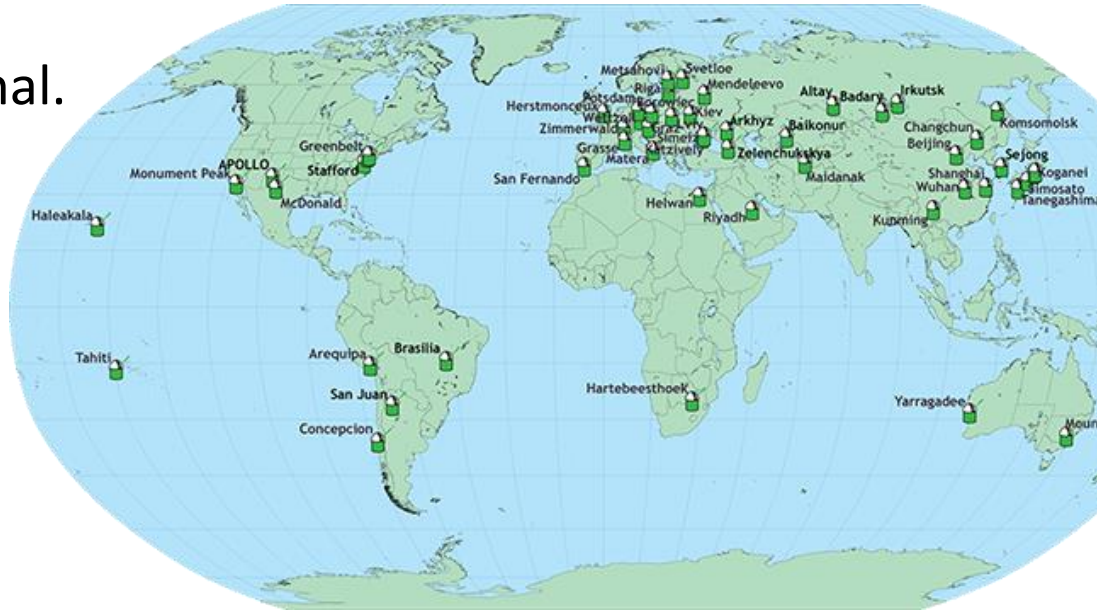
Herstmonceux SGF, East Sussex, UK

Scope of this study: SLR Network good enough?

- Current SLR (Satellite Laser Ranging) Network
  - About 40 stations operational.
  - Filling gaps: S. hemisphere, Russia.
  - Still far from uniform distribution.



- Question: Where should we place a new station?

2-Step Simulation

[1] Generating Simulation Data Set

SLR: not a 100%-of-time observable technique (weather, operator,..)
Visibility as a function of a satellite orbit and a station position.
→Realistic amount/coverage based on the actual observing statistics.

[2] Simulating POD Analysis

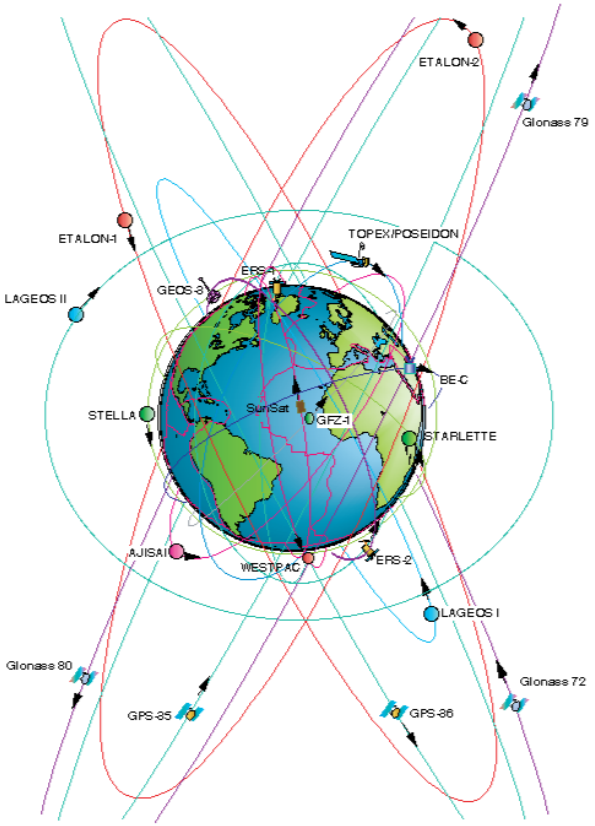
Software: c5++ simulation mode

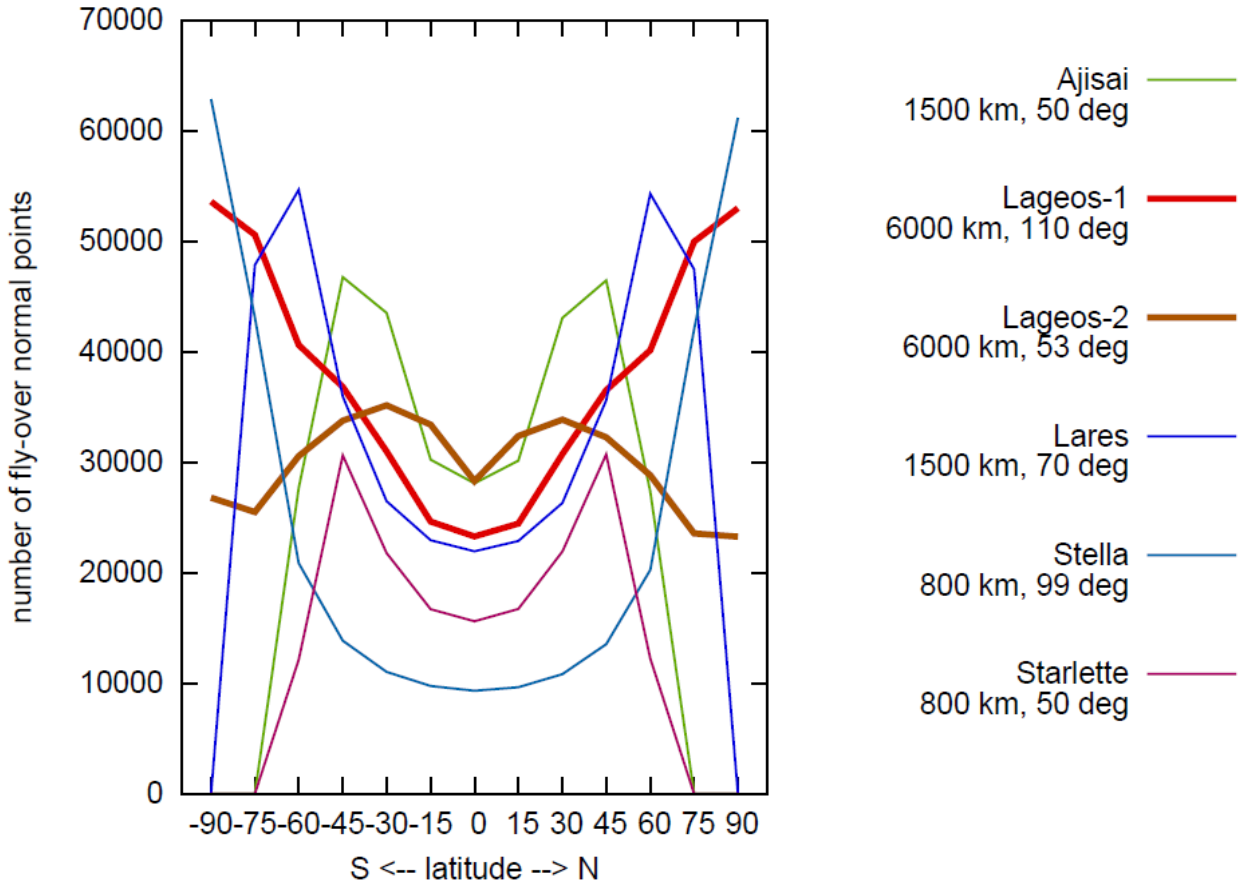
Baseline:

6 satellites (LAGEOS-1, LAGEOS-2, Ajisai, Starlette, Stella & LARES)
Existing ground station network

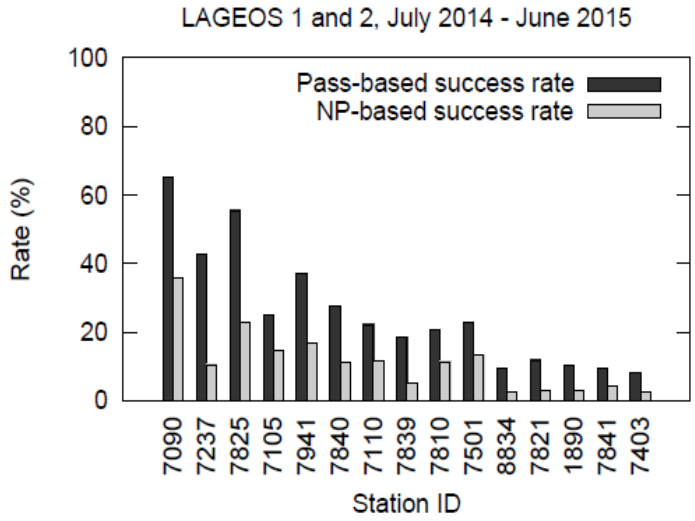
Virtual:

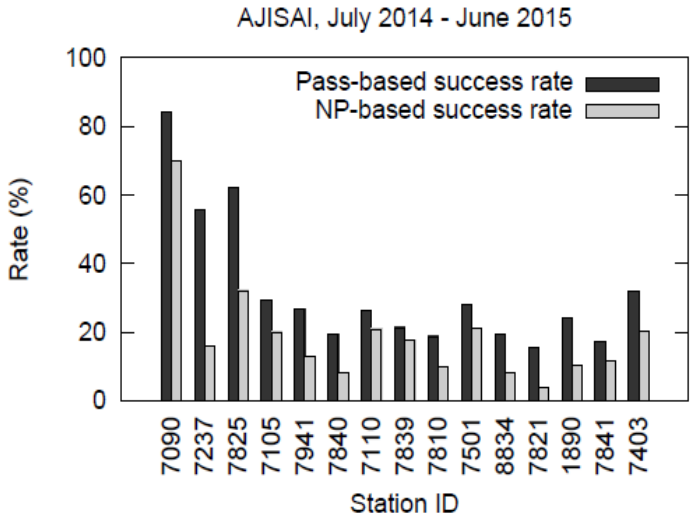
Baseline +
One virtual station placed somewhere on the earth

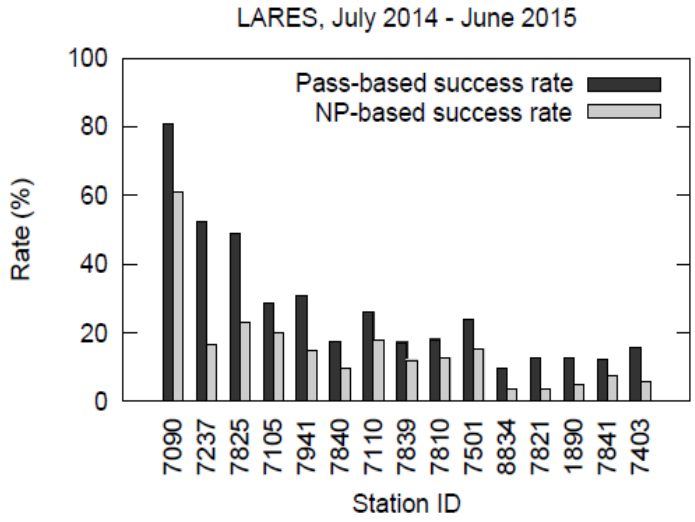


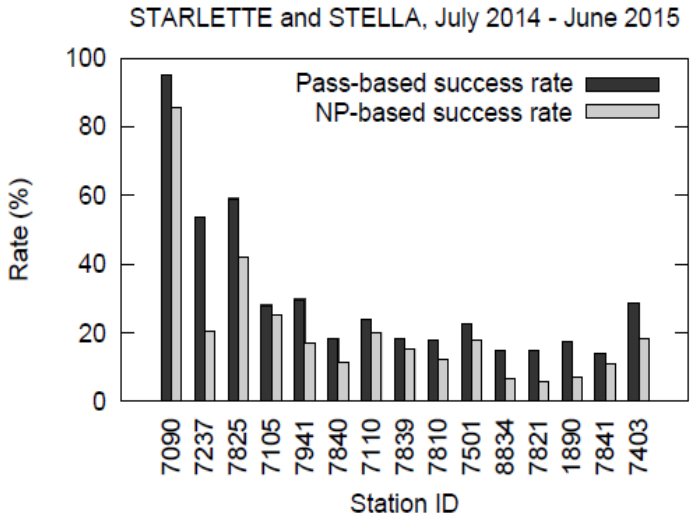


The number of fly-over normal points with respect to the latitude (in degrees) of a ground station, for six geodetic satellites during a one-year period from July 2014 to June 2015. The distance (km) and the angle (degrees) in the legend are the altitude and the inclination of satellite orbits.









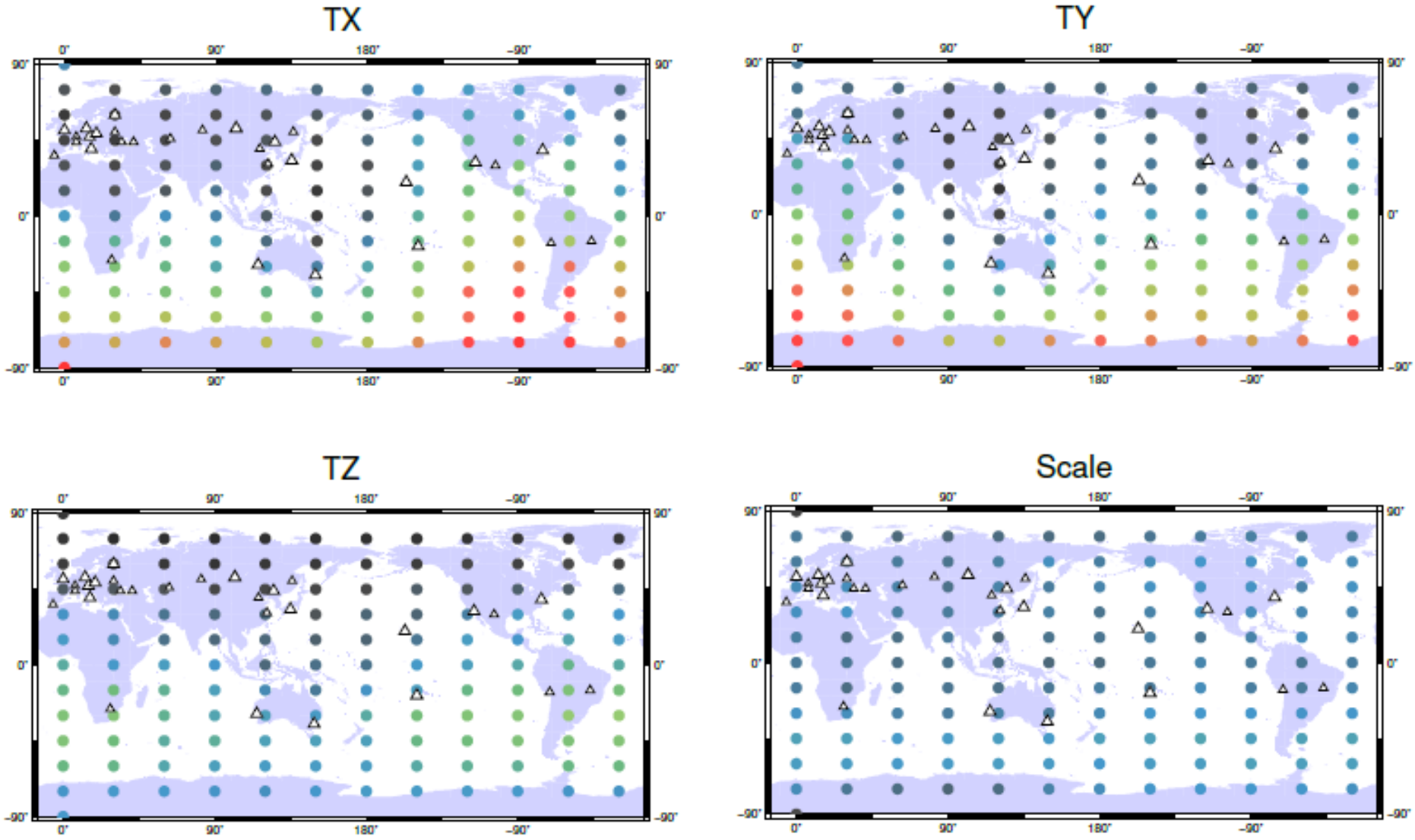
Pass rate 25%
NP rate 15%
を設定
（5-10 位相当）

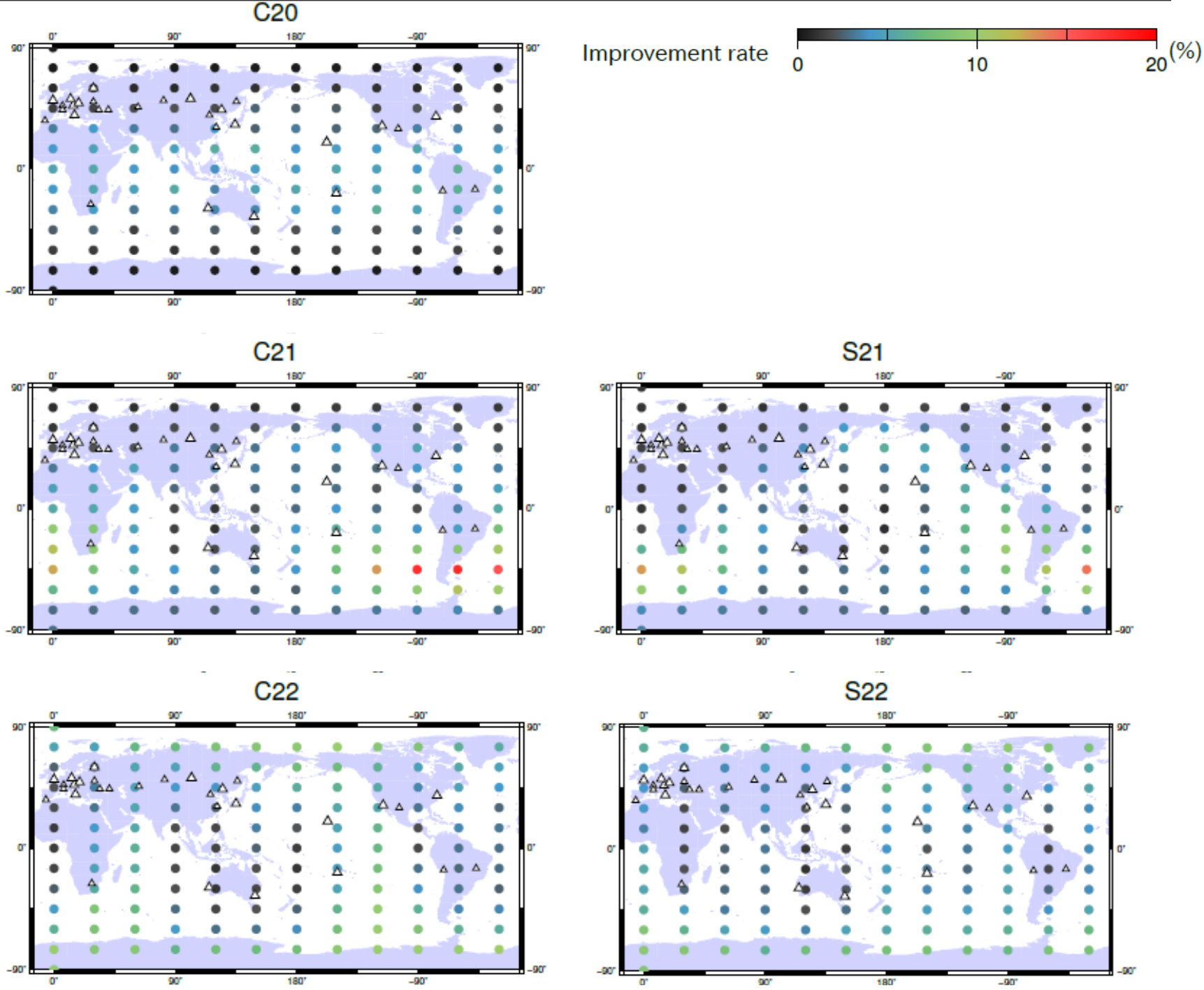
Pass-based success rates and normal-point-based success rates for four types of satellites during a one-year period from July 2014 to June 2015. Fifteen highly productive stations are shown where the four-digit station IDs are the NASA CDDIS Codes.

[2] Simulation Analysis

- Parameters to be investigated
  - Geocenter (TRF translation)
  - TRF Scale
  - Low-degree Earth gravity terms (up to degree/order 4)
  - (EOP)
  - (Orbit)

- POD analysis simulation using software c5++
  - Span: Mar-Apr 2015
  - 134 virtual points: latitude 15-deg interval, longitude 30-deg interval
  - Estimated formal error = Sqrt(Diagonal element of covariance matrix)
  - Compare the formal errors between baseline and virtual
  - 5-6% increase of total number of observation → 2-3% improvement expected according to the Sqrt(N) rule.


TX
TY
TZ
Scale
0°
90°
180°
-90°
90°
0°
-90°
Improvement rate
0
10
20
(%)

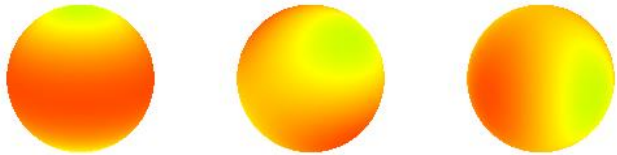

C20
Improvement rate
0
10
20
(%)
C21
S21
C22
S22

Results

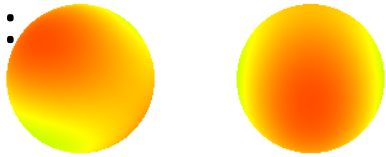
- Improvement rate: mostly better than 2-3% (predicted by the Sqrt(N) rule)
  - Building a new station should be encouraged anywhere.
- High latitude stations in S hemisphere effective in general.

- High-latitude station effective
  - TX, TY, C22, S22 (Sectoral terms)
- Middle-latitude station effective
  - C21, S21 (Tesseral terms)
- Low-latitude station effective
  - TZ, C20 (Zonal terms)

C_{20} -- C_{22}:



S_{21} -- S_{22}:



- Similar results for gravity degree-3 & 4 terms
- No significant improvement
  - Scale, Polar motion XY

Future Studies

- To relate this outcome with physical phenomena & future projects.

  Proposals welcome.

- To add “orbit” to the optimizing parameter.

  For uniform orbit quality all over the world.

- To combine with VLBI, GNSS, DORIS etc.

  Analysis software development. GGOS.

- GGOS WG 会合

  本日 12:30- アパホテル＆リゾート東京ベイ幕張　A05会議室