

Onland and seafloor geodetic observations in Japan and the role of Shimosato Hydrographic Observatory

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THE UNIVERSITY OF TOKYO

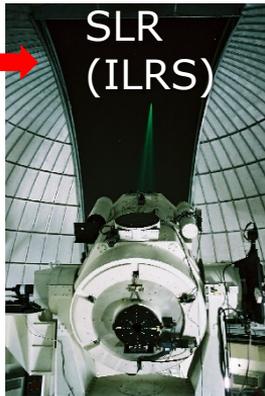


ILRS Virtual World Tour 2020
2020/11/04 @Online

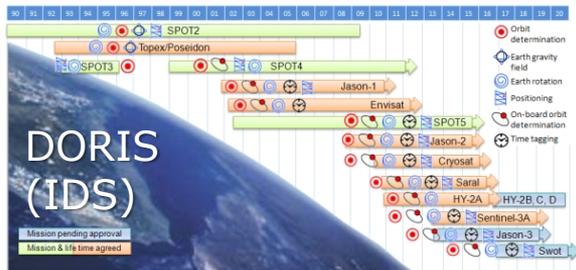
GGOS

President: Basara Miyahara, GSI

Seafloor geodesy



VLBI (IVS)



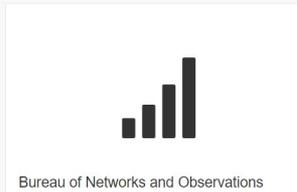
DORIS (IDS)

Gravity & ...



Global Geodetic Observing System

About - Bureaus - Focus Areas - GGOS Affiliates - Data & Products - GGOS Meetings



Bureau of Networks and Observations



Bureau of Products and Standards

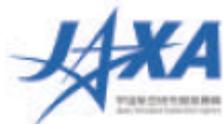
Tweets by @IAG_GGOS

GGOS
@IAG_GGOS
In Memoriam - Günter Stangl, former Director of GGOS Coordinating Office, passed away, unexpected, much too early and in the first years of his retirement. We will miss him. ggos.org/en/memoriam-gu...

Japan SLRs



Shimosato



Tanegashima & ..



HITOTSUBASHI
UNIVERSITY



Several domestic institutions are currently collaborating to start new research.



GGOS affiliate “GGOS Japan”
made this pamphlet.

日本の GGOS 観測局

- | | |
|---|-------------|
| SLR (Satellite Laser Ranging) | ／衛星レーザー測距 |
| VLBI (Very Long Baseline Interferometry) | ／超長基線電波干渉法 |
| GNSS (Global Navigation Satellite System) | ／全球測位衛星システム |
| DORIS (Doppler Orbitography and Radiopositioning Integrated by Satellite) | ／DORIS 電波灯台 |



GGOS Japan core member (2020)

- Chair: Toshimichi Otsubo (Hitotsubashi Univ.) since 2015
Also the Chair of ILRS GB (2019-2020)
- Secretary: Basara Miyahara (GSI) since 2015
Also the GGOS President (2019-2023)
- Representatives from GGOS geodetic techniques
 - VLBI: Yu Takagi (GSI) ← Hiroshi Munekane (GSI)
 - SLR: Shun-ichi Watanabe (JCG)
 - GNSS: Hiroshi Takiguchi (JAXA) ← Takayuki Miyazaki (GSI)
 - DORIS: Yuichi Aoyama (NIPR)
 - Gravity: Koji Matsuo (GSI) ← Yoichi Fukuda (Kyoto Univ.)
- Working Group Chairs
 - Outreach: Shinobu Kurihara (GSI)
 - Data DOI: Yusuke Yokota (Univ. of Tokyo)

Workshops by GGOS Japan (& Local survey tour in Ishioka)



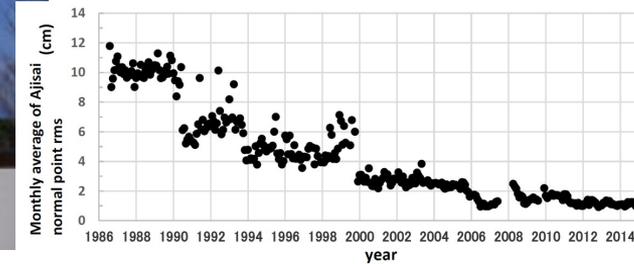
2-day meeting of GGOS Japan,
Kyoto Univ, 23-24 January 2020



Ishioka local survey using a point of Mt Tsukuba, with visitors from other institutes, 3 Sept 2020
(It is very important to visit and be visited)



Shimosato Hydrographic Observatory



Monthly average of Ajsai normal point rms

Owned & operated by: **Japan Coast Guard**



Operational since 1982. Longest operating point in Asia.

Primary missions:

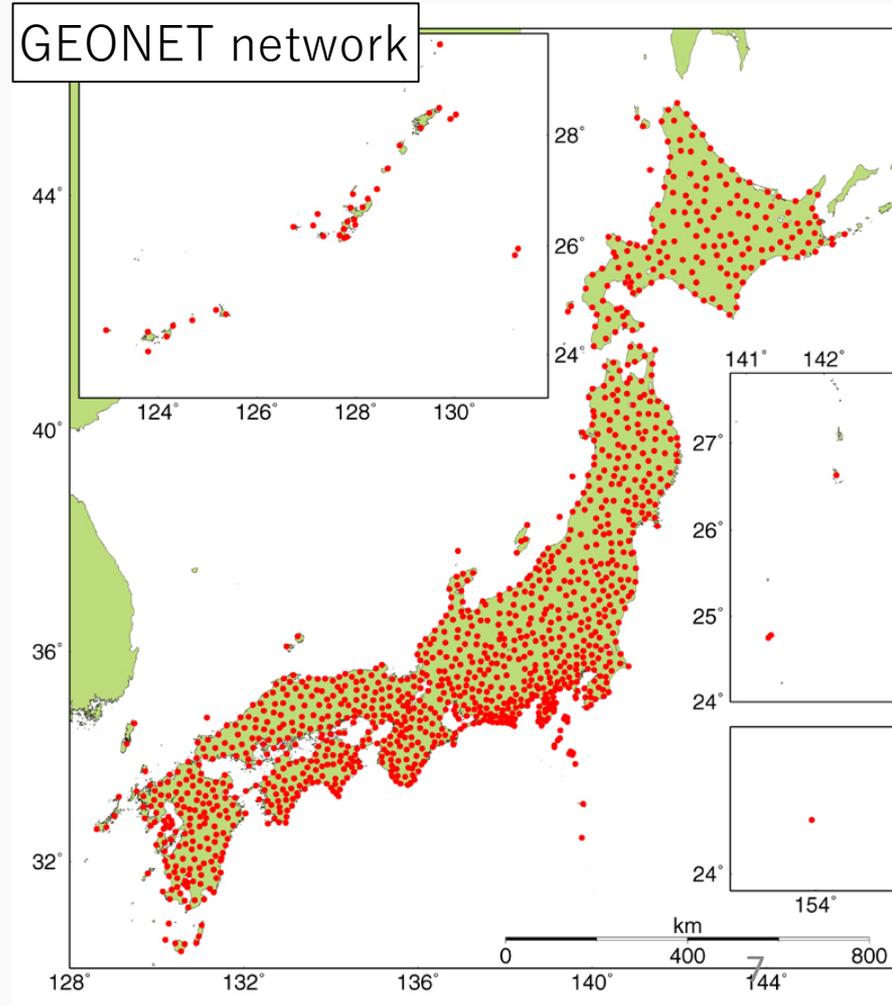
Nautical chart, Reference frames, Island positioning...

Future project:

kHz laser to be installed by the end of 2018.

GEONET: GNSS network by GSI

2000s Present GNSS network GEONET was constructed.

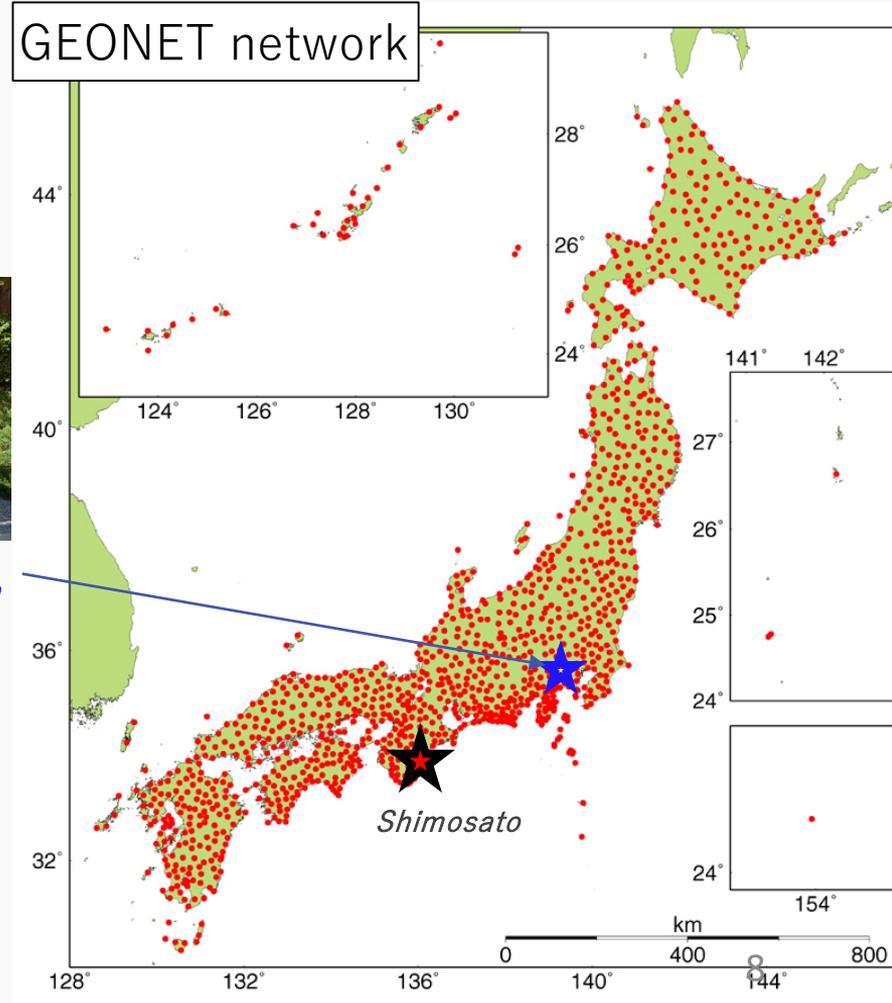


GEONET: GNSS network by GSI

2000s Present GNSS network GEONET was constructed.



*Fuji-Yoshida
18th ILRS Workshop*



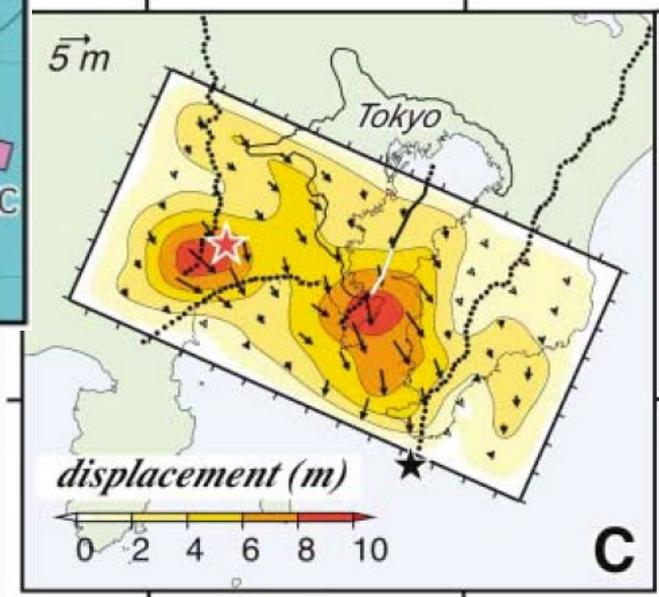
Modern history of earthquake disaster in Japan

1923 Great Kanto Earthquake (M~8)

More than 100,000 dead / missing
(Worst in Japan)



Sato et al., Science, 2005



Modern history of earthquake disaster in Japan

1923 Great Kanto Earthquake (M~8)

More than 100,000 dead / missing
(Worst in Japan)

1933 Showa-Sanriku Earthquake (M~8.4)

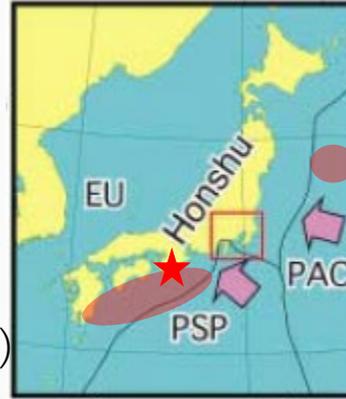
1944&46 Tonankai & Nankai Earthquakes (M~8)



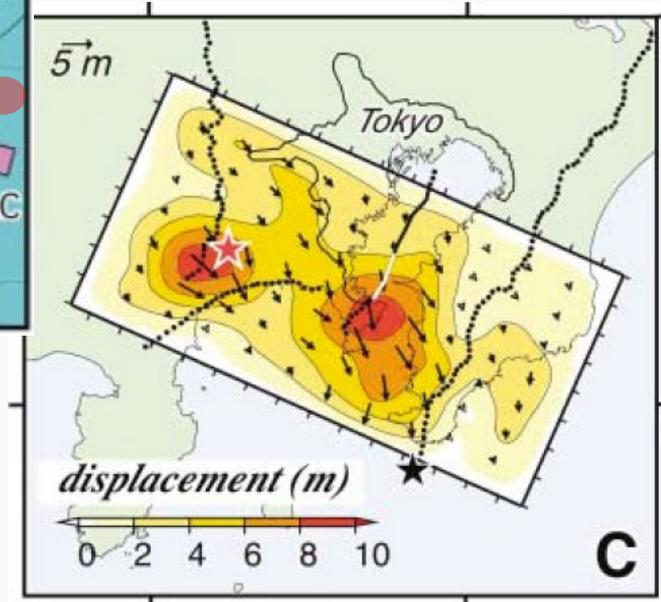
More than 1,000 dead / missing

1995 Kobe Earthquake (M~7.2)

More than 6,000 dead / missing



Sato et al., Science, 2005



Modern history of earthquake disaster in Japan

1995 Kobe Earthquake (M~7.2)

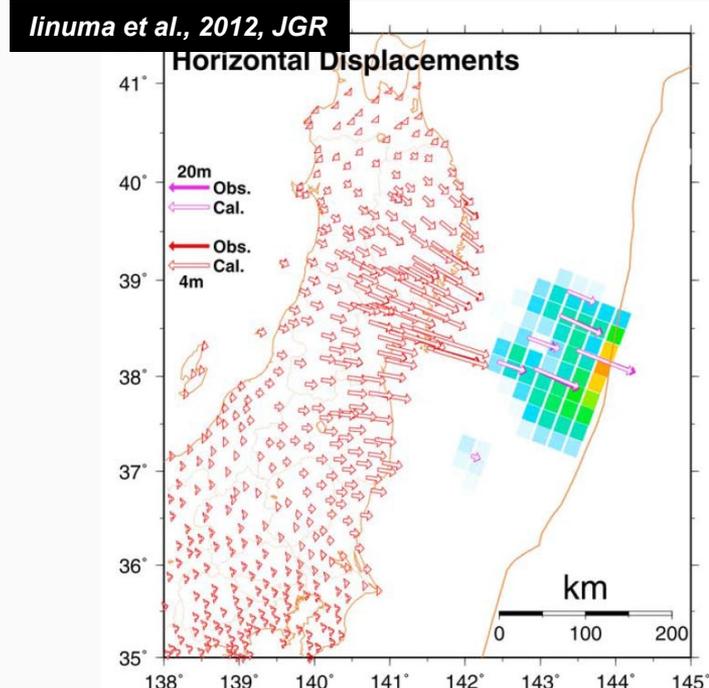
More than 6,000 dead / missing



2011 Tohoku Earthquake (M~9.0)

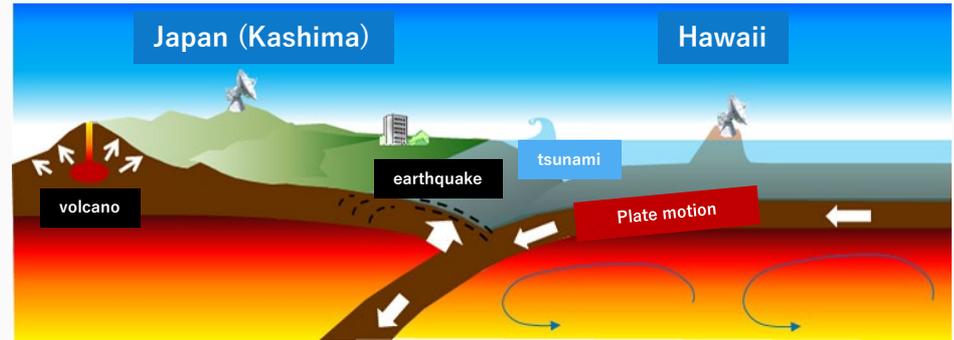
More than 22,000 dead / missing

Slip distribution of Tohoku earthquake



Geodetic monitoring & earthquake

1985 Monitoring of plate motion by VLBI



In this case, there was a newspaper article saying that expectations for “earthquake prediction” (In Japan, geodetic observations have been expected to contribute to earthquake science)

1995~ after Kobe Earthquake (M~7.2)

Science and Technology Agency (~2001)

It must be possible to detect the crustal movement field before, immediately after, & after event. The current high-density observation network “GEONET” is established.

The world's leading geodetic observation network was still for seismic observation in Japan.

However, as a result, it brought about the development of global geodesy, gravity, ionosphere, and meteorology in Japan.

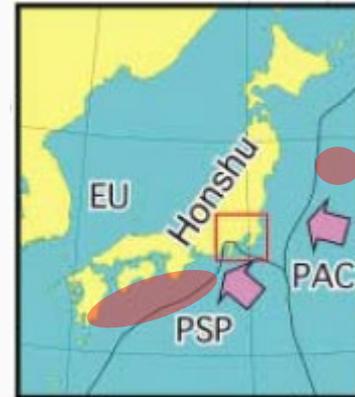
Geodetic monitoring & earthquake

The world's leading geodetic observation network was still for seismic observation in Japan.

However, as a result, it brought about the development of global geodesy, gravity, ionosphere, and meteorology in Japan.

However, even in 2000, there was almost no geodetic measurement method for the sea area.

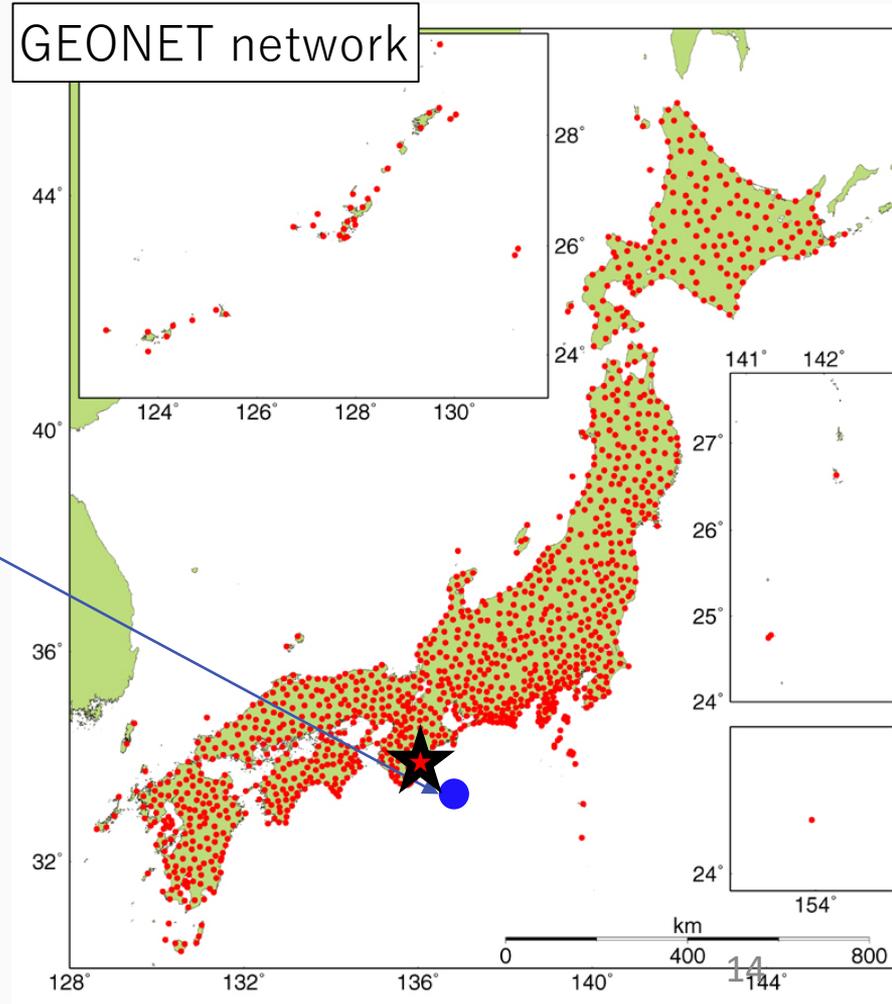
→ This was not good for Japan Islands.



GEONET: GNSS network by GSI

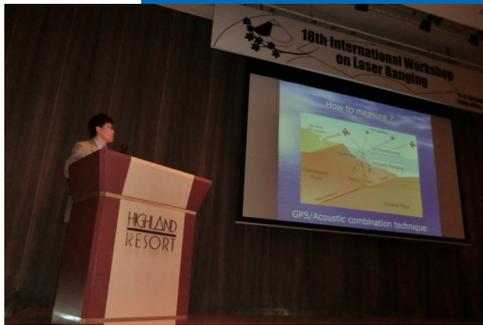
2000s Present GNSS network GEONET was constructed.

2000 First “seafloor GNSS” station was set. (GNSS-A(Acoustic) station)



GNSS-Acoustic combination technique

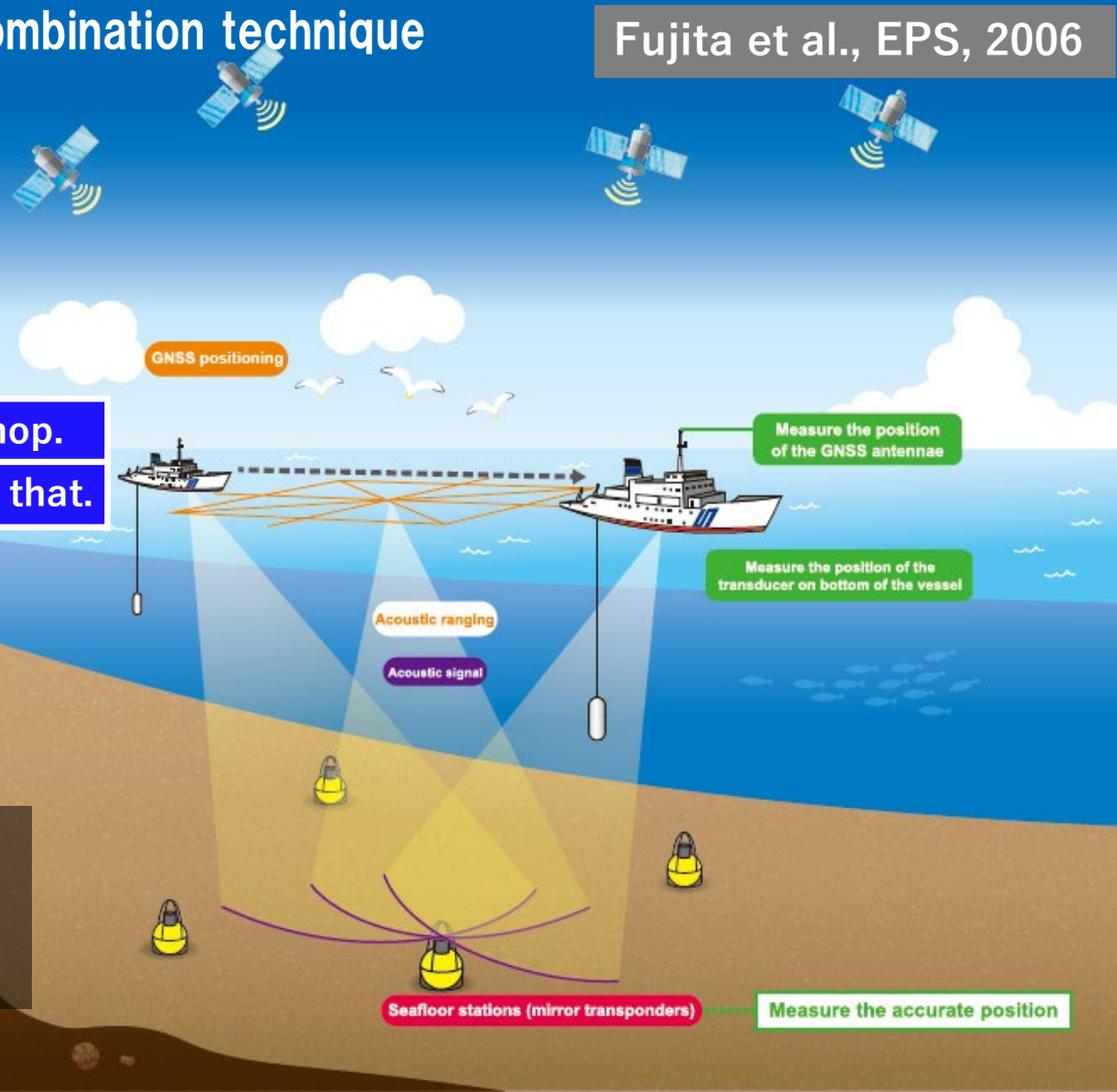
Fujita et al., EPS, 2006



Fujita-san talked in 18th Workshop.
I will introduce a progress after that.

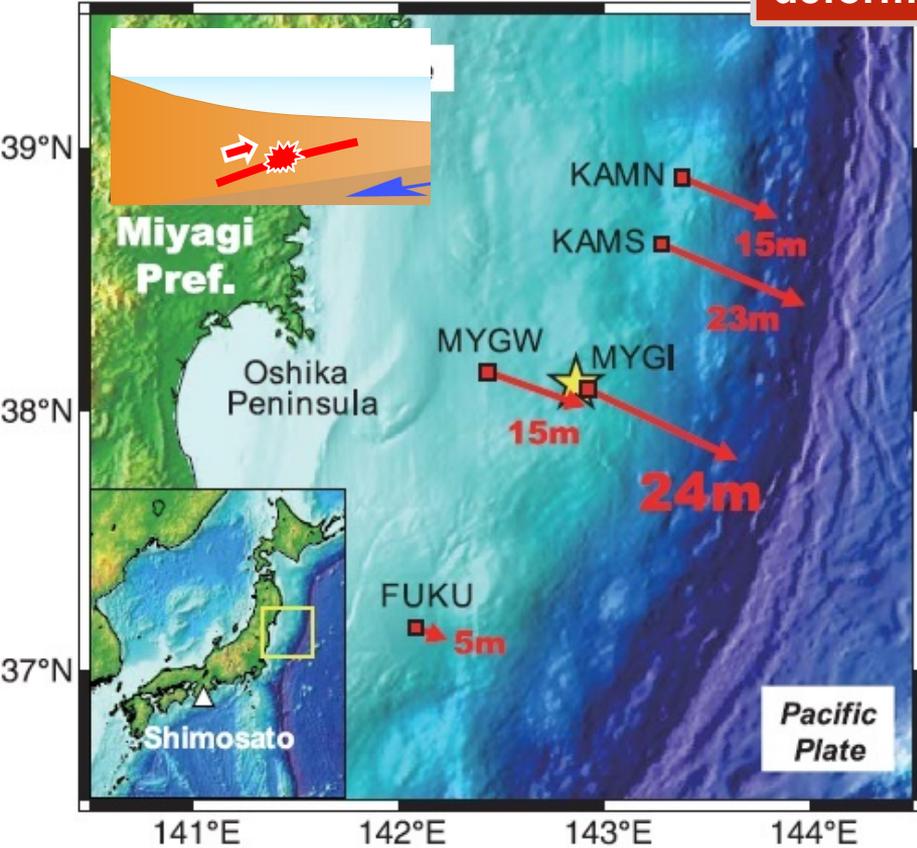


Present frequency & precision :
2 → 4 times/year
2-4 → 1-3 cm
(we can discuss <1 cm/year)

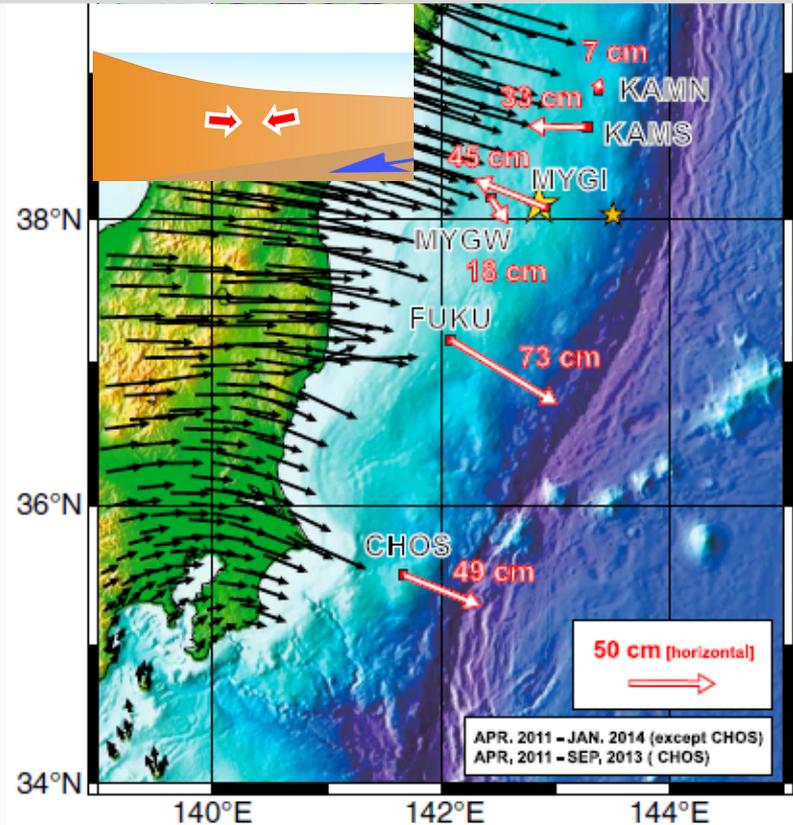


2011 Tohoku earthquake

Crustal deformation due to M9 earthquake & following deformation fields were detected by seafloor geodesy



Sato et al., 2011, Science



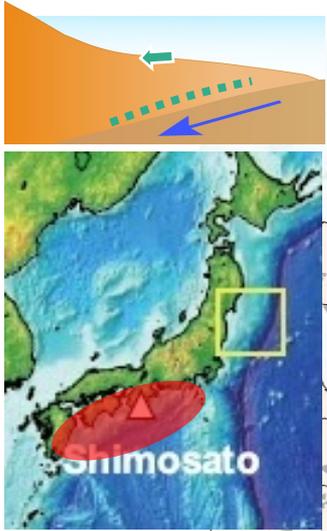
Watanabe et al., 2014, GRL



Nankai Trough interplate deformation

Yokota et al., 2016, Nature

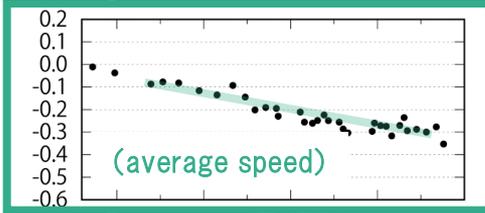
Interseismic crustal deformation field of interplate boundary were detected by 9-years seafloor monitoring.



Nankai Trough coupling condition

Yokota et al., 2016, Nature

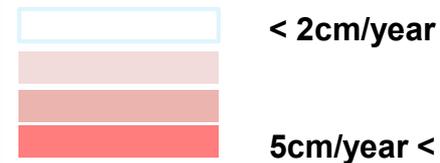
Interplate coupling regions were assumed by seafloor data.



Assumed maximum earthquake region

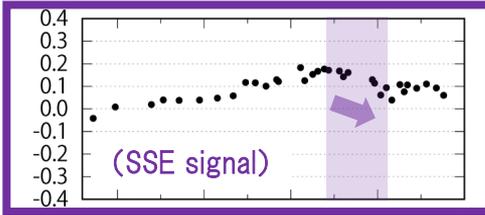
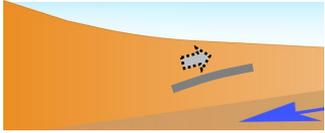
1940s historical earthquake region

Coupling condition



No station region

Shallow slow slip event signals

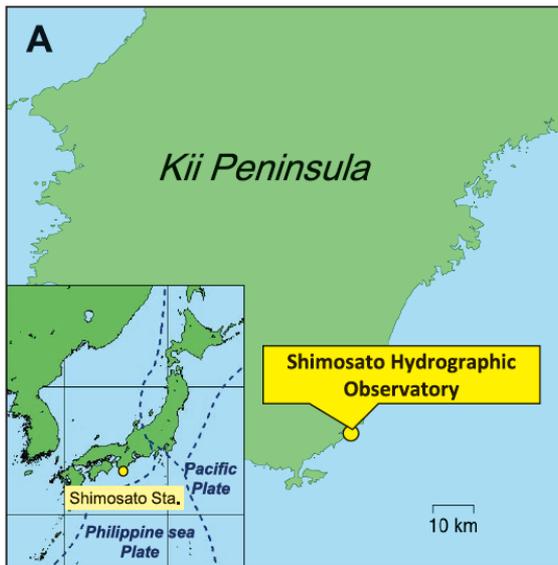


Interplate boundary sometimes released coupling in the opposite direction. Accuracy of seafloor geodesy was upgraded in this decade.



Japan Coast Guard group & we will continue to monitor it in the future. It may also contribute to global geodesy.

Shimosato observatory



Continuous observation for about 40 years
Only geodetic SLR station in Japan
also improving the value of data from other GGOS stations in Japan



In detail, talk by him...



Thank you