



EMERGENCY WARNING SERVICES

via GNSS signals



 **Cabinet Office**
National Space Policy Secretariat



Frédéric Domps, European Commission
Yasuhiko Kawazu, National Space Policy Secretariat



Emergency Warning Service Background



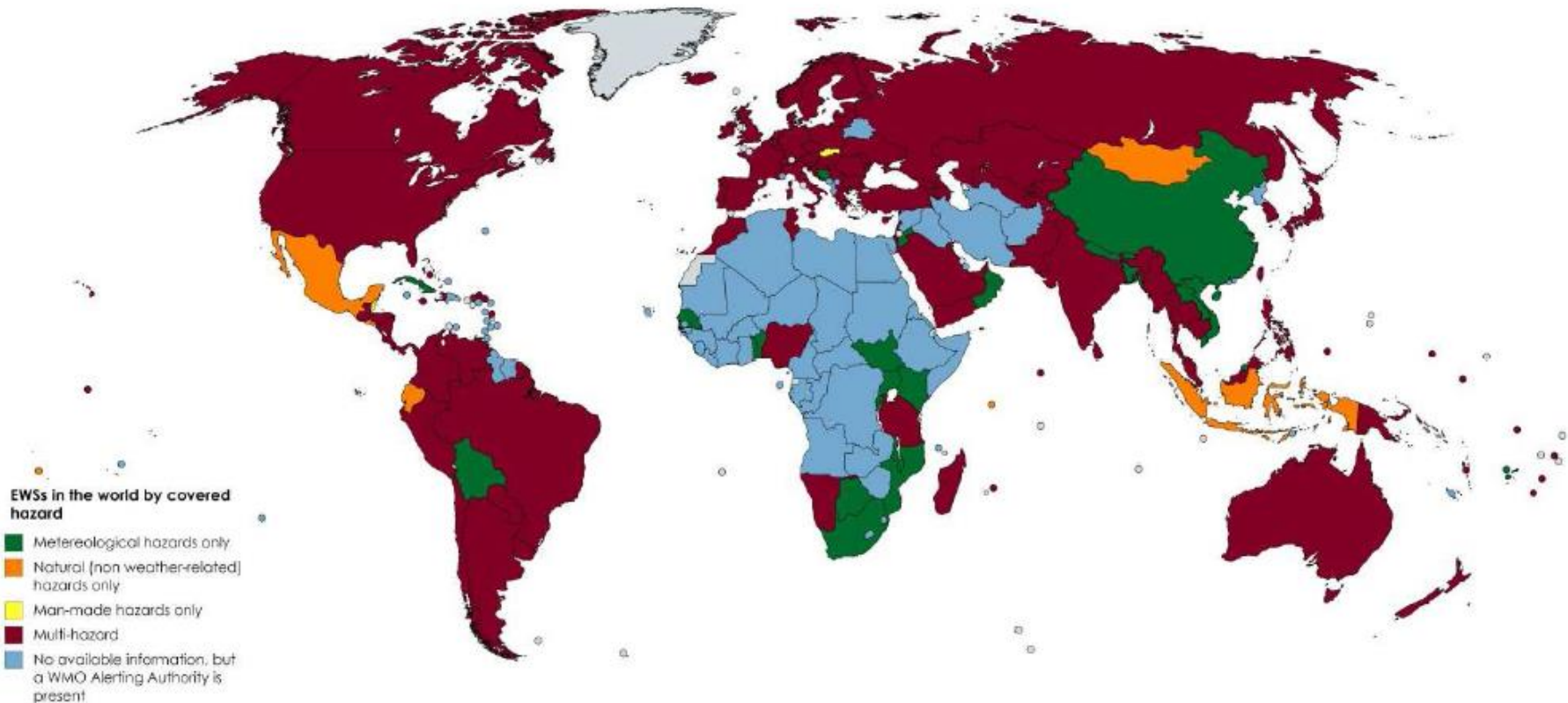
- ★ *Global trend to develop Disaster Risk Reduction technologies*
 - ★ *Sendai Framework for Disaster Risk Reduction 2015-2030 endorsed by the UN General assembly*
 - ★ Asian Ministerial Conferences on Disaster Risk Reduction (AMCDRR)
 - ★ European Forum for Disaster Risk Reduction (EFDRR)
 - ★ National initiatives
- ★ *Need to develop Disaster Risk Reduction technologies*
 - ★ *Japan Cabinet Office, National Space Policy Secretariat*
 - ★ ***QZSS Satellite Report for Disaster and Crisis Management DC Report service***
 - ★ *European Commission:*
 - ★ ***Studying a new potential Galileo based EWS service***



Emergency Warning Service: Stakeholder consultation



- ★ EU Member States were contacted (civil protection).
- ★ Non EU countries
- ★ Face to face meetings, online questionnaires, teleconferences



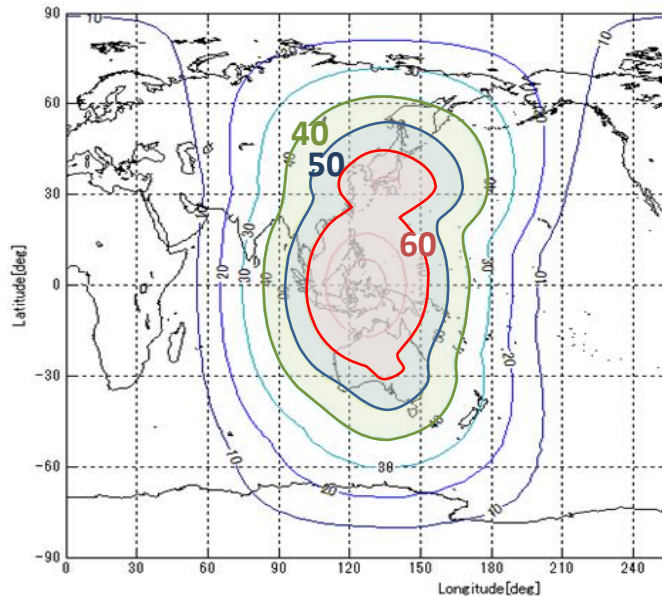


- ★ A GNSS-based Emergency Warning System is a **significant improvement** for EWS-lacking countries and countries already owing an EWS:
 - ★ Resilience to ground destruction and reliability
 - ★ Global: Standardisation
 - ★ Multi-hazard (tornadoes, earthquakes, nuclear disaster or industrial disaster, terrorist attacks)
 - ★ Independent of any terrestrial infrastructure/communication channel
 - ★ Additional channel on top of existing EWS and Possible combination with other alerting means (sirens...) or telecommunication channels

=>>MAJOR BENEFITS !!



- ★ Taking the opportunity of the coverage area provided by navigation satellites:
 - ★ Global coverage for the Galileo constellation
 - ★ Asian zone for the QZSS constellation



■ Coverage Area of QZSS

The figure shows areas where at least one QZS is visible, with lines representing the elevation angles.

- ★ **QZSS and Galileo common objective: aiming at deploying Emergency Warning Services through the navigation signals**

Emergency Warning Service



★ QZSS DC-Report service

DC Report is the service which Disaster Prevention Information (Earthquake, Tsunami, etc.) and crisis management are delivered. Supply sources of information are JMA (Japan Meteorological Agency) and the other organizations.

The trial service of DC Report has been started from 27th September !



Tsunami



Volcano



Earthquake



River flooding



災害・危機管理通報サービス「災危通報」

Emergency Warning Service

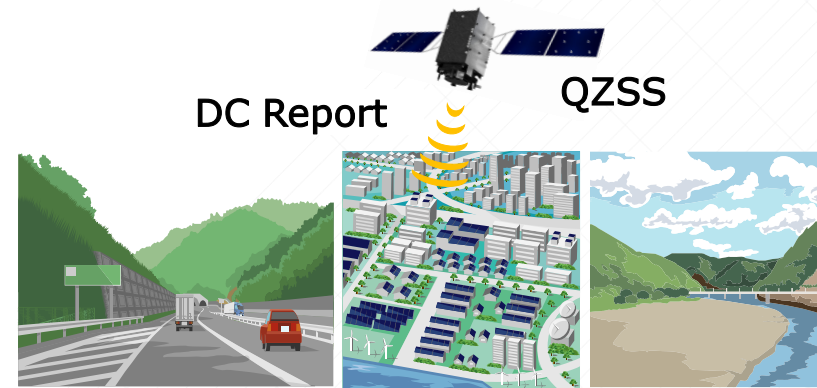


★ Use case of DC-Report service

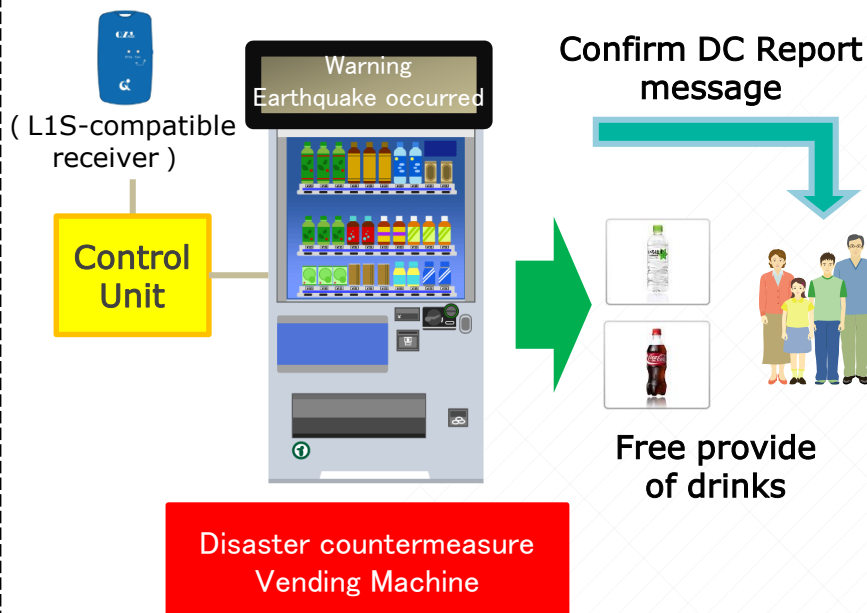
Digital Signage Applications

< Example of display message >

- Earthquake Early Warning
Pay alert for strong earthquake.
- Earthquake in Pacific coast
Maximum seismic intensity is 5 upper.



Vending Machine



Car Navigation System





★ Use case of DC-Report service

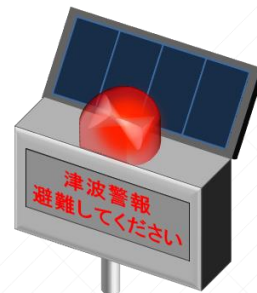
Tsunami Warnings

■ Signs with voice guidance (broadcast disaster information)

- Provide disaster information and guide to evacuation area by voice guidance and electronic board.
- Install on area map or electric poles or any other necessary places.



Image



Image

Display evacuation information or guide by speaker.

■ Providing disaster information in cooperation with QZSS.

Local Time: 2015/12/06 14:10

QZSS

L1S-compatible receiver inside

Display disaster information or guide by speaker.

Image

Detailed description: This complex block contains a diagram and two images. The diagram at the top shows a QZSS satellite in orbit, emitting yellow signal waves towards a ground-based receiver. The receiver is shown in a separate inset image labeled "L1S-compatible receiver inside". Below the diagram is a photograph of a tsunami warning sign with a speaker, which is also shown in a separate inset image labeled "Display disaster information or guide by speaker".



- ★ Limited use of Navigation data broadcast capacity
 - DC-Report and SLAS (Sub-meter Level Augmentation Service) signal broadcast pattern is fixed.
 - When DC-Report has not any information, NULL Message is broadcasted at DC-Report broadcast timing.
 - **SLAS message and DC-Report message are no influence each other.**
 - SLAS positioning service and DC-Report service are consist of independence, and these services can be used simultaneously.

Signal	Service Name	Center freq.	Modulation	Bit Rate
L1S	Sub-meter Level Augmentation Service (SLAS)	1575.42MHz	BPSK	250bps
	DC Report Service			

- ★ Consistent with:

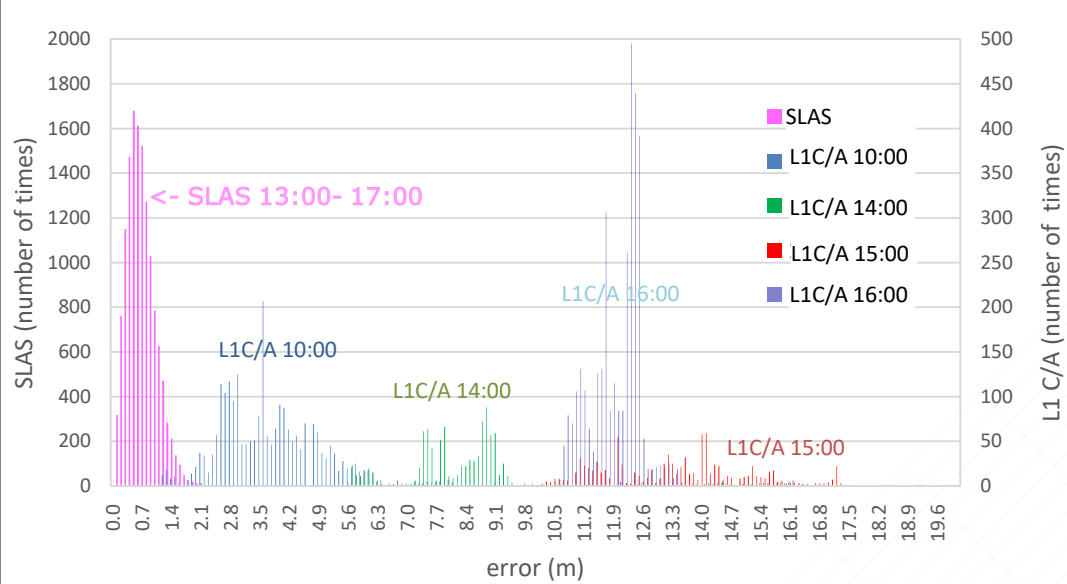
"ITU EWS type messages can be covered under Radio Regulation Article 4.4, which allows non-allocated transmissions (such as basic messaging) provided they do not impact the allocated radio services (navigation)."

SLAS evaluation result

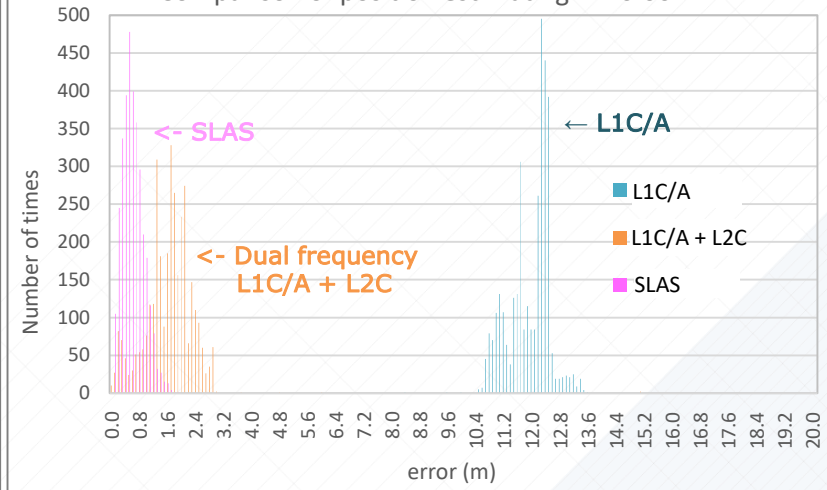
Influence of the ionosphere in Okinawa



Comparison of L1C/A and SLAS

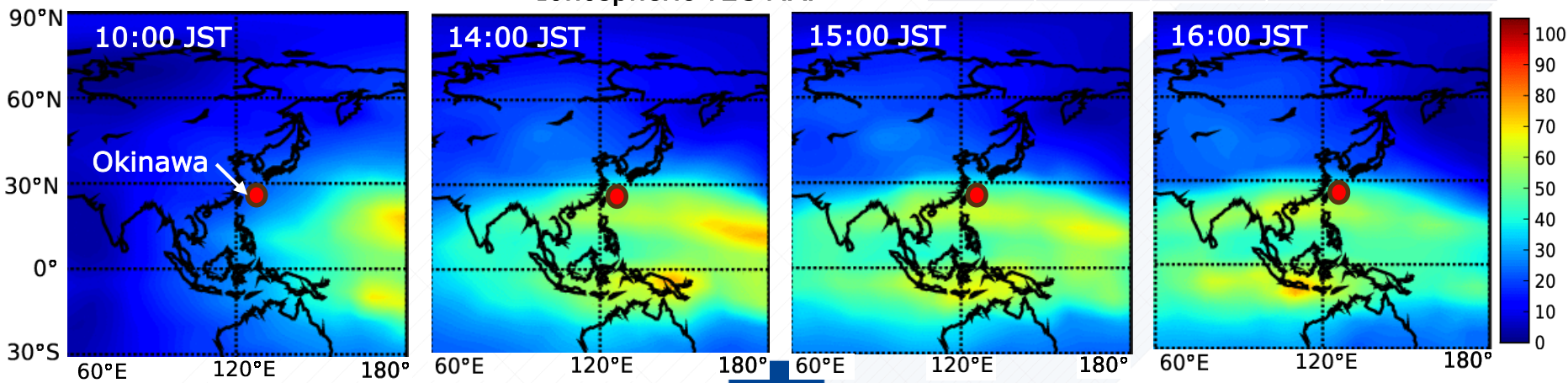


Comparison of position estimating in 16:00



	Avg.	1 σ	2 σ	95%	unit [m]
L1 C/A	11.97	12.56	13.15	12.7	10
L1+L2	1.64	2.48	3.32	2.6	
SLAS	0.54	0.96	1.37	1.1	

Ionospheric TEC MAP





- ★ Currently studying the possibility of EWS through the following Galileo signals
 - *Some data broadcast capacity currently available on*
 - *E1B: One word, 128 bits available*
 - *E5B: More bandwidth available*
 - *Next generation of Galileo satellites (G2G)*
- ★ *Ideally, targeting mobile phone (E1B, E5 is coming!)*

GALILEO-ENABLED PIONEERS

Bq Aquaris X5
July 2016



Sony Xperia XZ
March 2017



Huawei P10
March 2017



Samsung S8
April 2017



Apple iPhone 8,
8s and X
Sept 2017



EWS: To make it work globally: A common effort



- ★ EWS providers
 - ★ Technical level
 - ★ Converge on EWS data formats and standards
 - ★ Development of an operational EWS network and/or operational interfaces (Civil protection / GNSS Operations)

- ★ Receiver industry needs to be involved



- ★ Policy level:
 - ★ GNSS program managers (Cabinet Office NSPS, European Commission, ...)
 - ★ Japan/EU open to working multilaterally to develop [a common approach/a common message /commonalities / synergies with other systems]



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12th Meeting of the International Committee on Global Navigation Satellite Systems

13

THANK YOU

Yasuhiko Kawazu, National Space Policy Secretariat, yasuhiko.kawazu.c7i@cao.go.jp
Frédéric Domps, European Commission, Frederic.DOMPS@ec.europa.eu

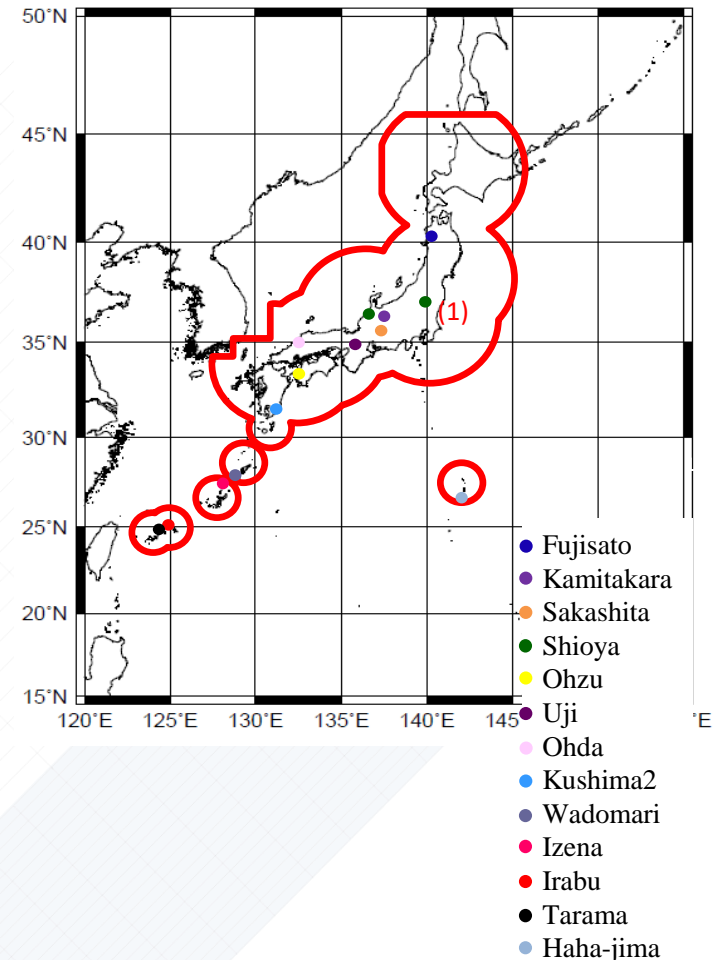
Emergency Warning Services (back-up slide)



★ SLAS Positioning Accuracy

- SLAS is kept high accuracy even including DC-Report (or NULL) message broadcast.

monitoring station	evaluation point	Baseline length [km]	Positioning Accuracy [m] (95%)	
			Horizontal	Vertical
Sapporo	Fujisato	343	0.83	1.24
Sendai	Kamitakara	420	0.68	1.48
Hitachi-ohta	Sakashita	280	0.85	1.17
Komatsu	Shioya	314	0.90	1.21
Kobe	Ohzu	296	0.73	1.19
Hiroshima	Uji	310	0.85	1.04
Fukuoka	Ohda	278	0.74	1.14
Tanegashima	Kushima2	90	0.75	1.40
Amami	Wadomari	70	0.84	1.68
Itoman	Izena	95	0.78	1.36
Miyako-jima	Irabu	65	0.72	1.52
Ishigaki-jima	Tarama	60	0.75	1.38
Chichi-jima	Haha-jima	50	0.87	1.46



SLAS evaluation result

Influence of the ionosphere in Okinawa



- Influence of ionosphere in Okinawa
 - Okinawa is located low magnetic latitude, so this area is big influence from ionospheric disturbance.
- Comparison of L1 C/A and SLAS
 - L1 C/A positioning had been degrade at afternoon caused by ionosphere, but SLAS could be provided stable positioning service at any time.
 - SLAS can be provided positioning accuracy around 1m.
- Comparison of position estimating at 16:00
 - This graph and table shows comparison between L1 C/A only positioning, Dual frequency (L1C/L2C) positioning and SLAS positioning at 16:00.