



EGNOS performance assessment in Gulf of Finland

November 2019



IALA ENG# 12 – WG3

Presenter: Rodrigo González (**ESSP**)

Authors: Rodrigo González and Elisabet Lacarra (**ESSP**),
Manuel López (**GSA**) and Kaisu Heikonen (**Väylä**)



02.09.2020



ESSP-COM-26927



NAVIGATION
MADE IN
EUROPE



EGNOS Dynamic Data Campaign

General Overview

Scope of the activity

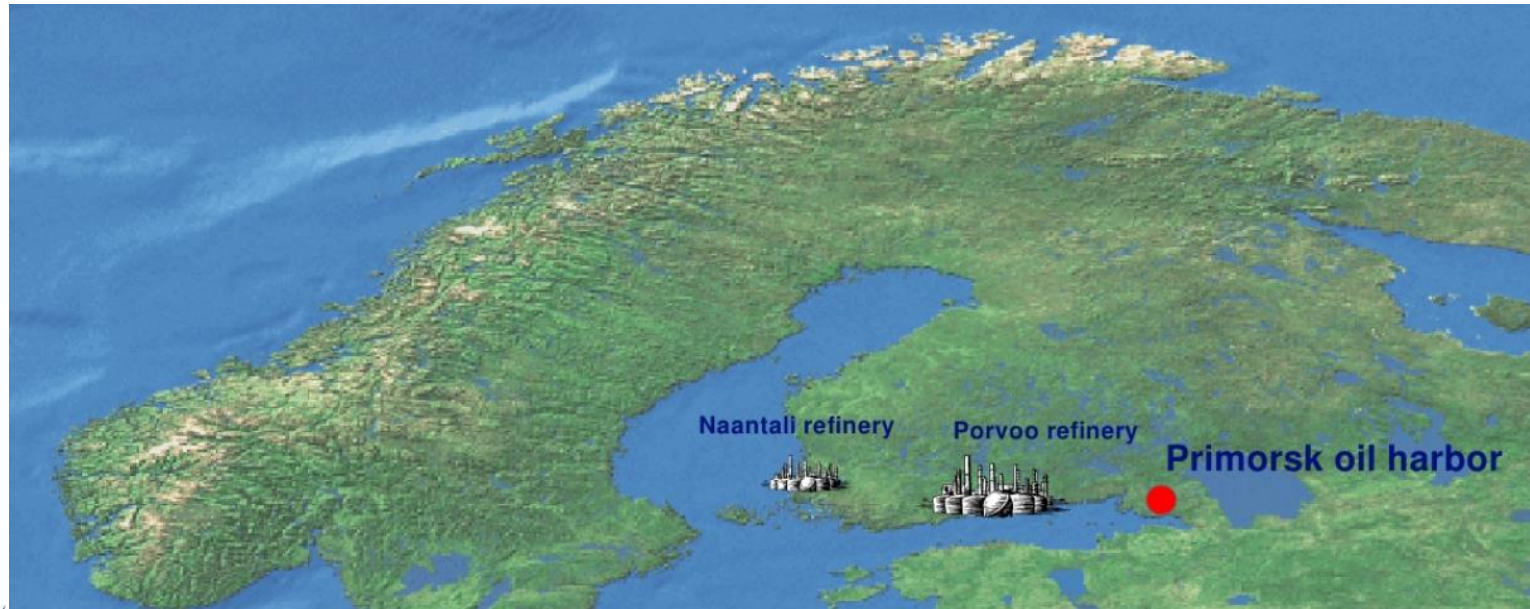
Perform **dynamic GNSS test** in **Finnish coast**:

- To assess EGNOS performance in real maritime scenario.
- **Verification that EGNOS service** is compliant with maritime requirements stated in **IMO Res. A. 1046** over **Finnish coast**.

Description of the data campaign

- Time framework: 01.11.2019 - 14.11.2019 at Porvoo.
- Vessel: Mastera.
- Route: Porvoo (Finland) - Primorsk (Russia) - Naantali (Finland).

Data campaign: tanker stops



Days 305-306

Legend

- DOY 305
- DOY 306
- Naantali
- Porvoo
- Primorsk

1st - 2nd Nov. 2019:
Poorvo - Primorsk

Google Earth

©2020 Google
Image Landsat / Copernicus
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
US Dept of State Geographer

NAVIGATION
MADE IN
EUROPE

Days 307-310



EGN

02.09.2022

Days 311-316

Legend

- DOY 311
- DOY 312
- DOY 313
- DOY 314
- DOY 315
- DOY 316
- Naantali
- Porvoo
- Primorsk

7th – 8th Nov. 2019:

Naantali - Uusimaa

8th – 11th Nov. 2019:

Uusimaa

11th – 12th Nov. 2019:

Uusimaa - Primorsk

Google Earth

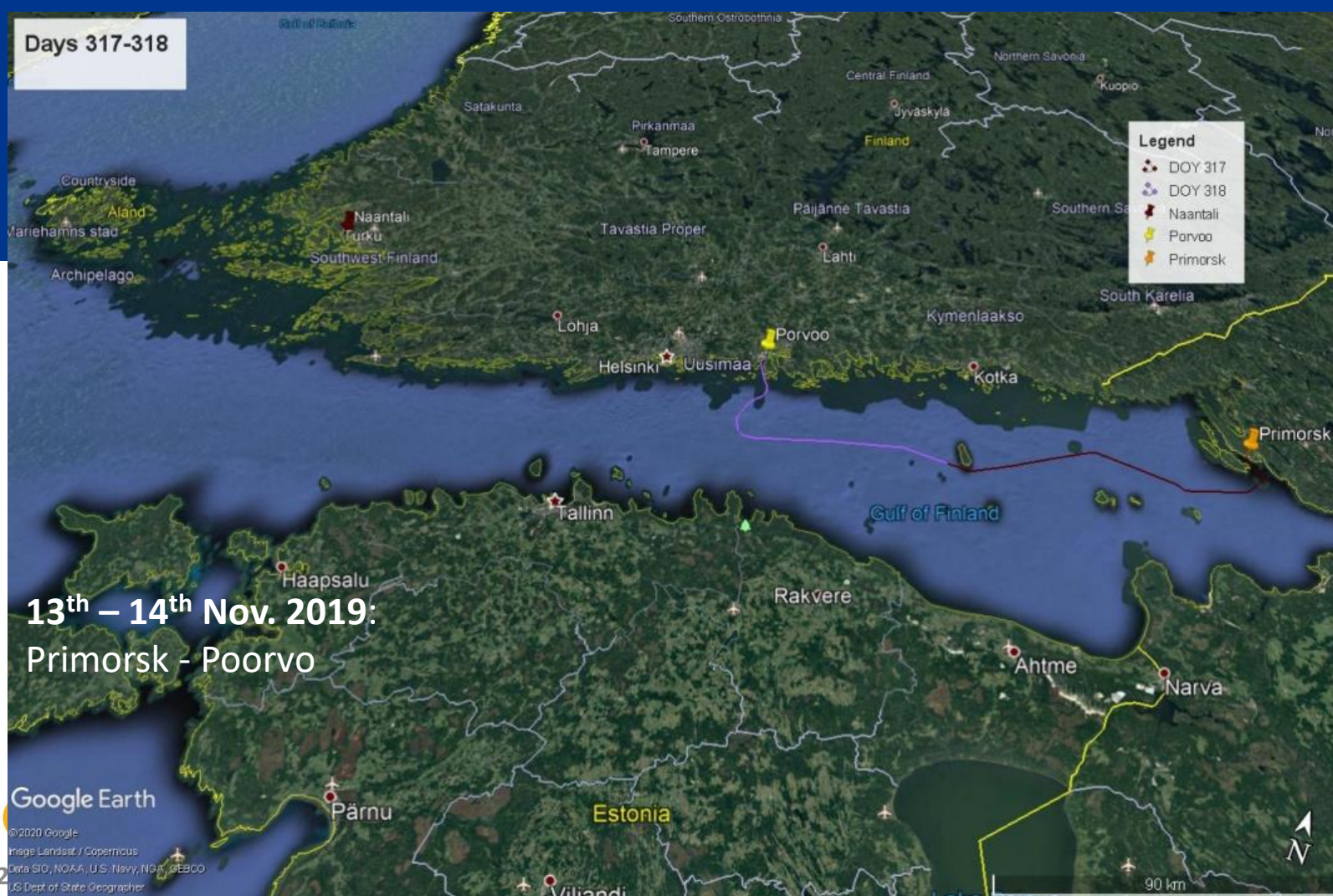
EGN

02.09.202

©2020 Google
Image Landsat / Copernicus
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
US Dept of State Geographer

NAVIGATION
MADE IN
EUROPE

Days 317-318



13th – 14th Nov. 2019:
Primorsk - Poorvo

EGN

Google Earth

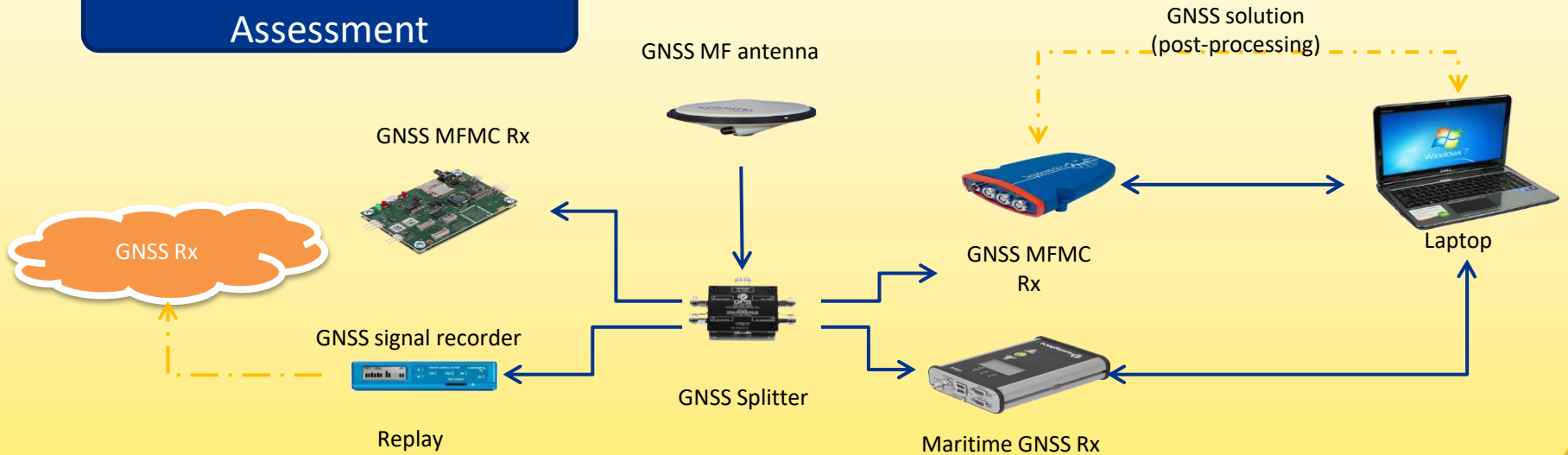
©2020 Google
Image Landsat / Copernicus
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
U.S. Dept of State Geographer

02.09.2022

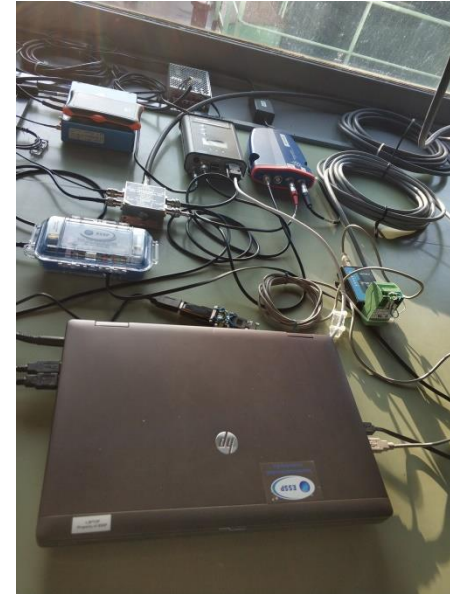
NAVIGATION
MADE IN
EUROPE

Equipment set-up 1/3

GNSS Performance Assessment



Equipment set-up 2/3



Equipment set-up 3/3



Equipment set-up 3/3





EGNOS Dynamic Data Campaign

EGNOS vs GPS Availability and Continuity

IMO 1046 (27) Avail. % Cont. Requirements

Typical Operation	Availability	Continuity ⁽¹⁾
Ocean Waters	99.8%	N/A
Harbour Entrances, Harbour Approaches, and Coastal Waters	99.8%	≥99.97% over a period of 15 minutes

(1) Coverage of the system should be adequate to provide position-fixing throughout this phase of navigation.

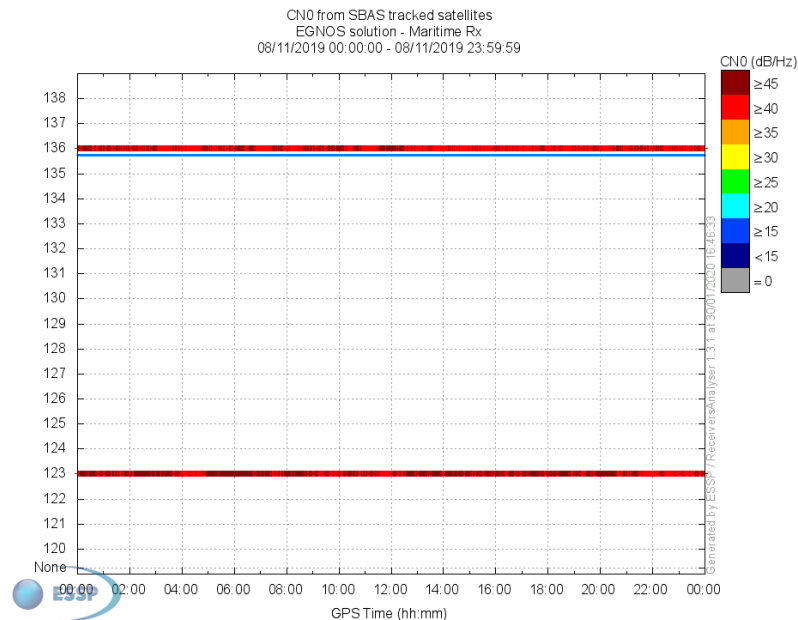
EGNOS Availability and Continuity 1/3

- **EGNOS continuity events**, are *the number of transitions the receiver had from EGNOS to GPS standalone for the position computation.*
- **EGNOS position availability** is considered as *the percentage of time that EGNOS position solution is computed by the receiver.*

EGNOS Availability and Continuity 2/3

- During the GNSS data campaign, there were no lost of EGNOS navigation solution so, **EGNOS availability is 100%.**
- During the GNSS data campaign, there were no single continuity events so, **EGNOS continuity is 100%.**

EGNOS Availability and Continuity 3/3



- EGNOS SIS availability
 - Broadcast at least one EGNOS GEO satellite: **100%**
- At receiver level → % time SBAS PRN is tracked by the receiver:
 - EGNOS PRN136 tracked: 100%
 - EGNOS PRN123 tracked: 100%



EGNOS Dynamic Data Campaign

EGNOS vs GPS accuracy

IMO 1046 (27) Accuracy Requirement

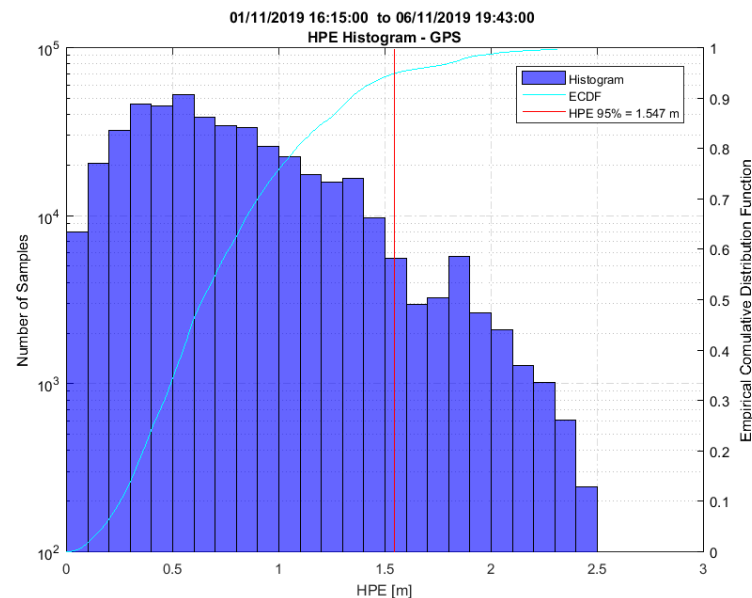
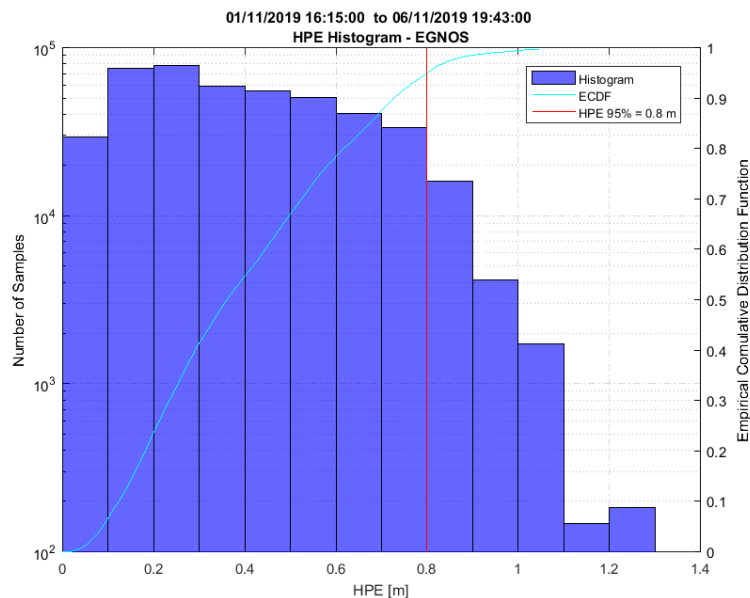
Typical Operation	Horizontal Accuracy (95%)	Update Rate of Displayed Position Data ⁽¹⁾
Ocean Waters	100 m	2 s
Harbour Entrances, Harbour Approaches, and Coastal Waters	10 m	2 s

(1) Applies to computed and displayed position data, but not to the update rate of any correction data which may remain valid for 30 s or more.

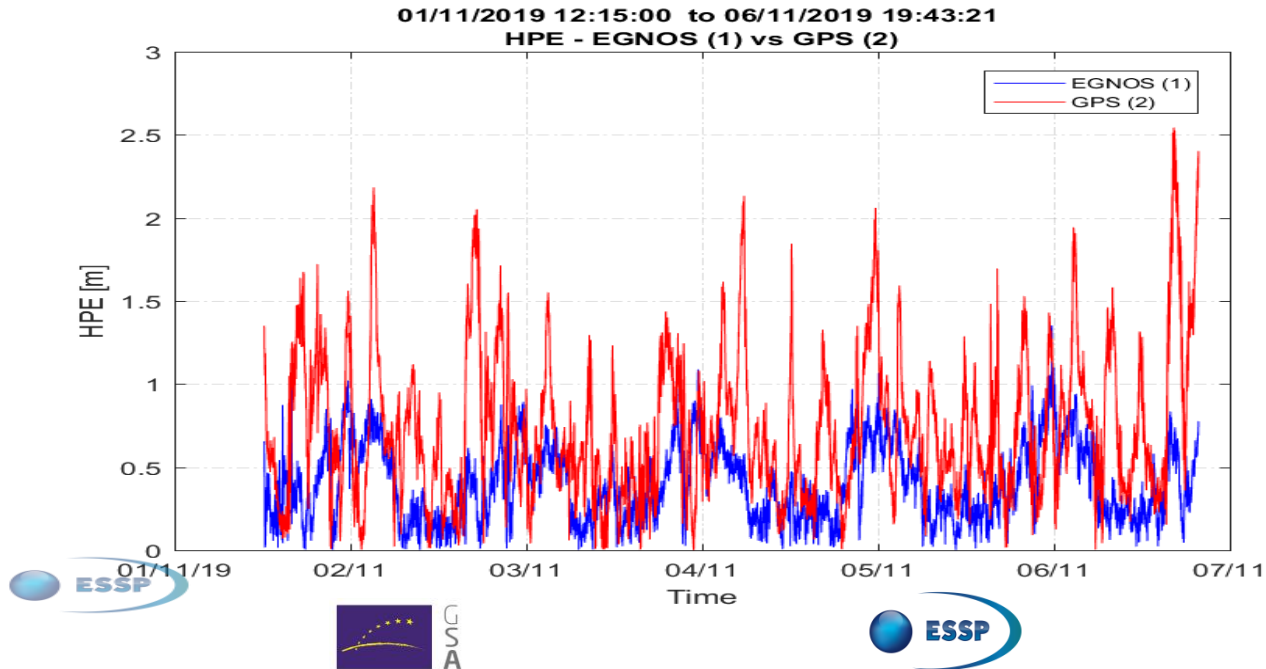
EGNOS and GPS-only HNSE (95%) 1/2

GNSS maritime receiver

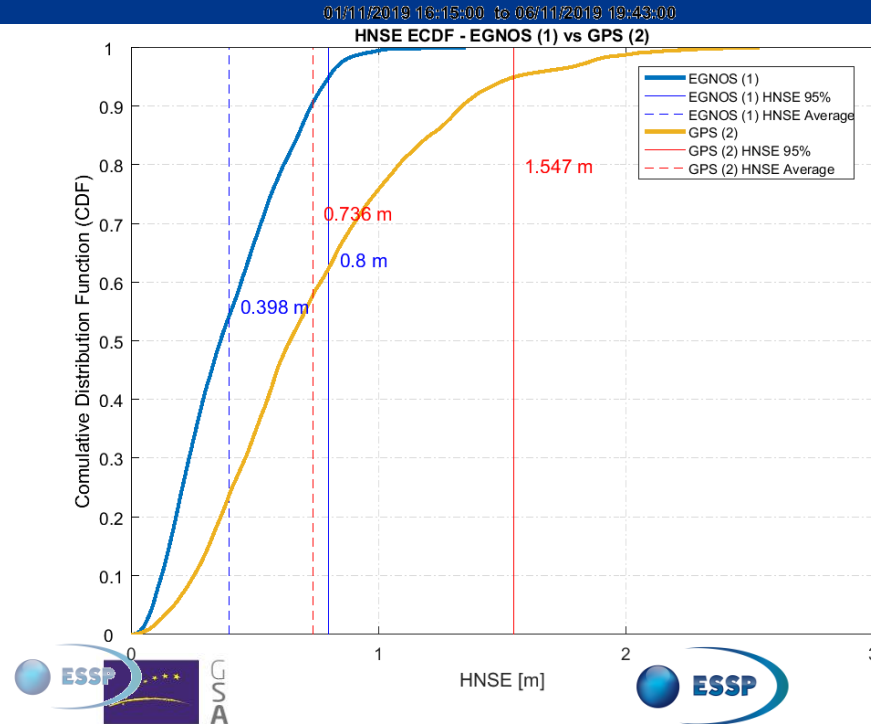
EGNOS and GPS-only HNSE (95%) 1/2



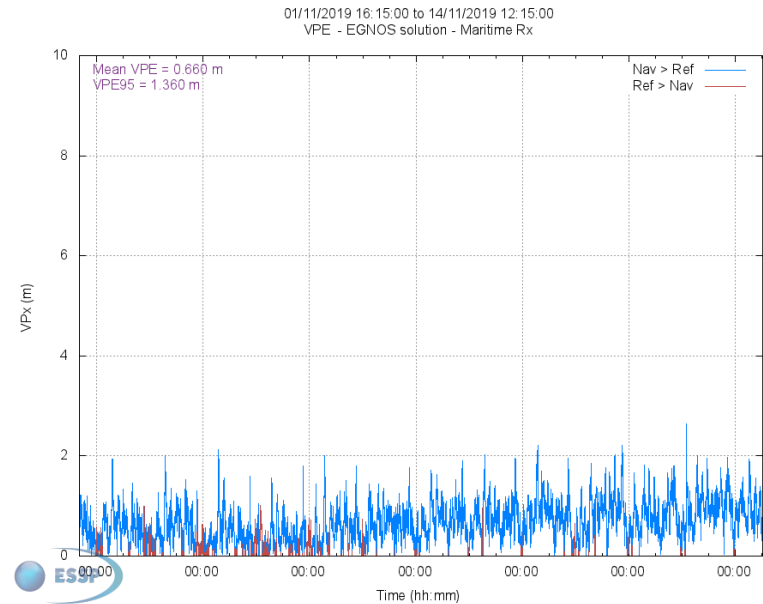
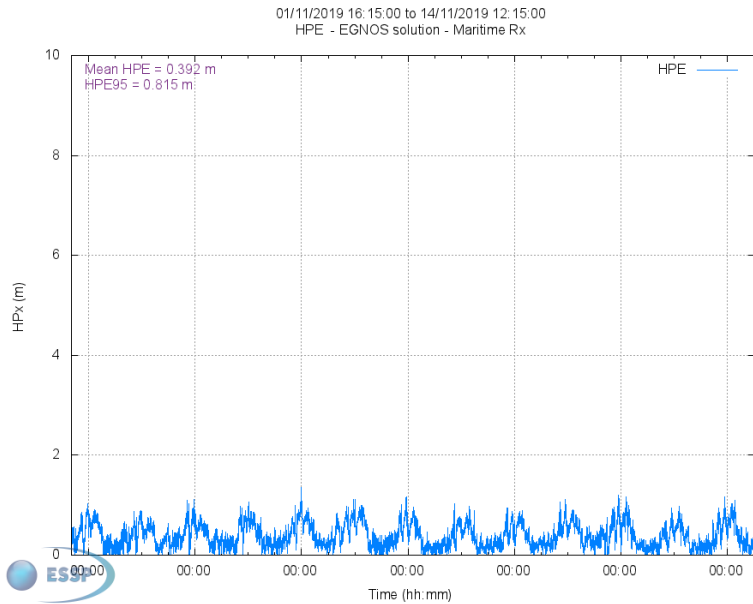
EGNOS and GPS-only HNSE (95%) 2/2



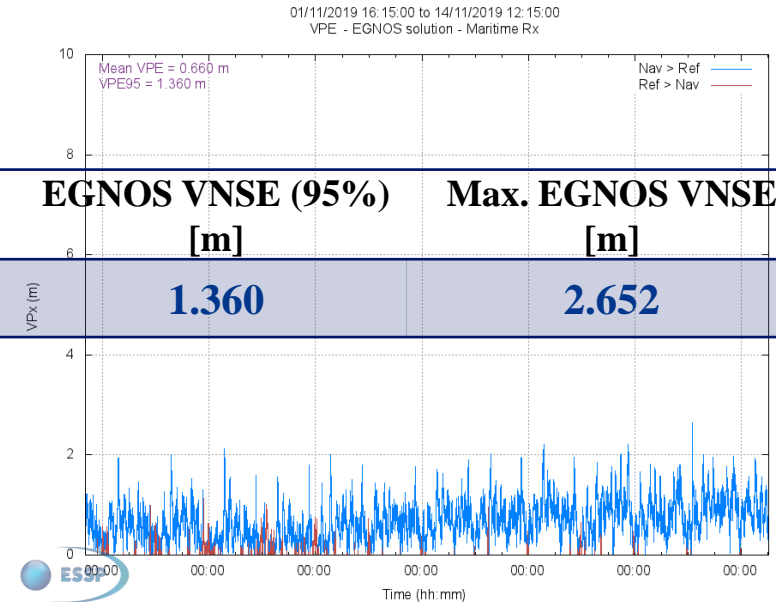
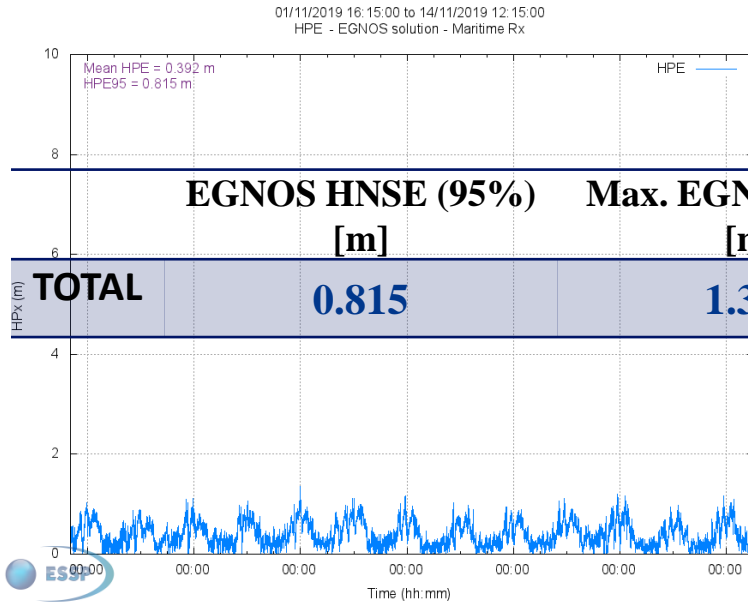
EGNOS and GPS-only HNSE (95%) 2/2



EGNOS Accuracy



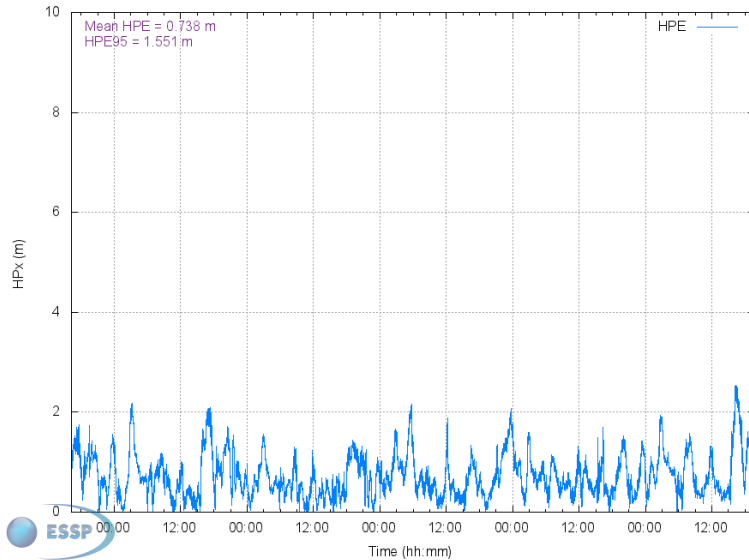
EGNOS Accuracy



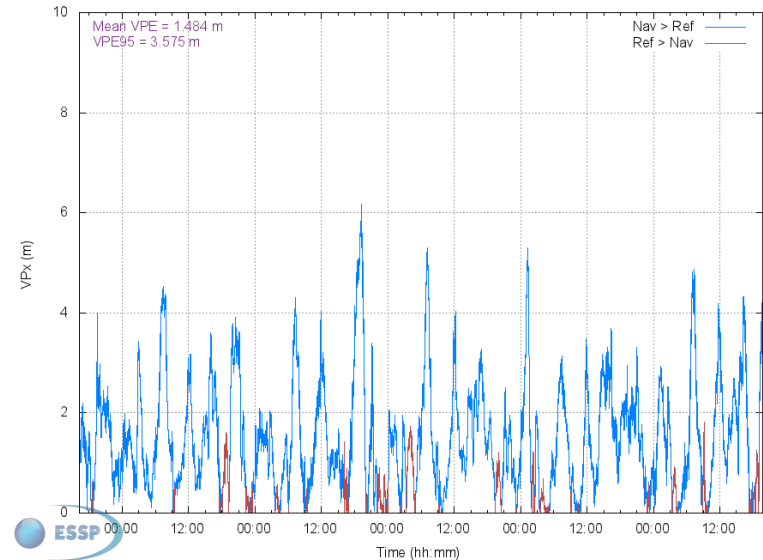
	EGNOS HNSE (95%) [m]	Max. EGNOS HNSE [m]	EGNOS VNSE (95%) [m]	Max. EGNOS VNSE [m]
TOTAL	0.815	1.353	1.360	2.652

GPS Accuracy

01/11/2019 16:15:00 to 06/11/2019 19:43:39
HPE - GPS-RAIM solution - Maritime Rx

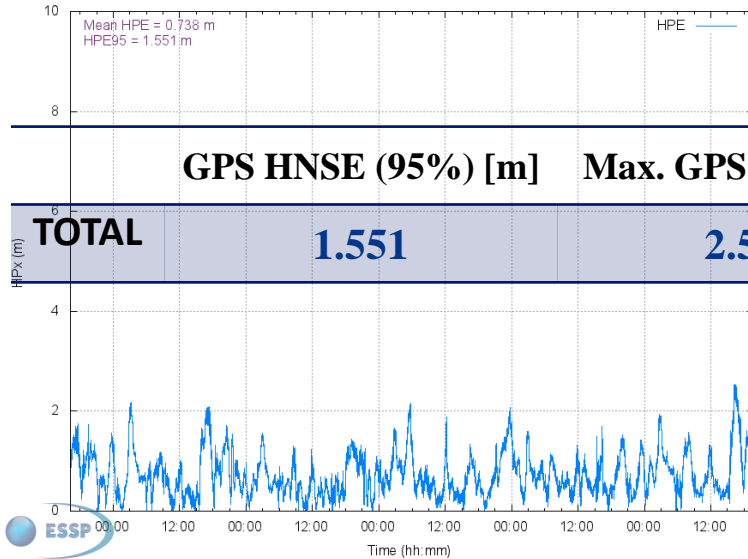


01/11/2019 16:15:00 to 06/11/2019 19:43:39
VPE - GPS-RAIM solution - Maritime Rx



GPS Accuracy

01/11/2019 16:15:00 to 06/11/2019 19:43:39
HPE - GPS-RAIM solution - Maritime Rx



GPS HNSE (95%) [m]

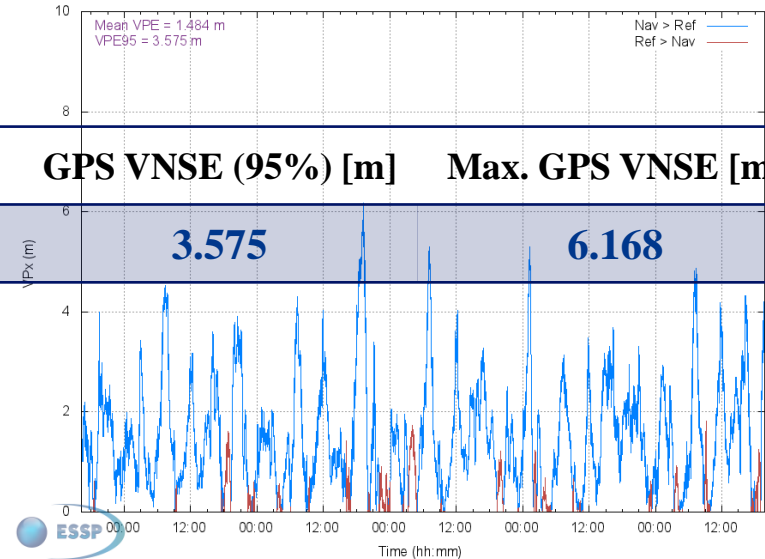
Max. GPS HNSE [m]

TOTAL

1.551

2.544

01/11/2019 16:15:00 to 06/11/2019 19:43:39
VPE - GPS-RAIM solution - Maritime Rx



GPS VNSE (95%) [m]

Max. GPS VNSE [m]

3.575

6.168



EGNOS aged corrections

Time since last corrections update	TOTAL
≤2s	0%
2-3s	1.28%
3-4s	25.75%
4-5s	72.64%
5-10s	0.28%
>10s	0.03%



EGNOS Dynamic Data Campaign

Conclusions

EGNOS performance assessment conclusions

- **Availability:**

EGNOS has fulfilled the 100% of the time **IMO Res. A. 1046** availability requirements.

- **Continuity:**

EGNOS has fulfilled **IMO Res. A. 1046** Continuity requirements.

EGNOS performance assessment conclusions

- **Accuracy:**

- **95th percentile of the Horizontal Position Error is 0.81m.** This value is compliant with **IMO Res. A.1046** requirement.
- **95th percentile of the Vertical Position Error is 1.36m.**

EGNOS performance assessment conclusions

- **Signal Availability.** Compliant with IMO Res. A.1046 (27).
- **Horizontal Accuracy.** Compliant with IMO Res. A.1046 (27).
- **Service Availability.** $\geq 99.8\%$ position-fixing.
- **Service Continuity.** Compliant with IMO Res. A.1046 (27).

EGNOS performance assessment conclusions

- **Signal Availability.** Compliant with IMO Res. A.1046 (27).
- **Horizontal Accuracy.** Compliant with IMO Res. A.1046 (27).
- **Service Availability.** $\geq 99.8\%$ position-fixing.
- **Service Continuity.** Compliant with IMO Res. A.1046 (27).

EGNOS is

IMO Res. A. 1046 Compliant



Acknowledgements

Acknowledgements

GNSS data campaign in Mastera tanker was possible thanks to:

- **Väylä** (*Finnish Transport Infrastructure Agency*): Kaisu Heikonen.
- **MML** (*Finnish Geospatial Research Institute*): Mohammad Zahidul Hasan Bhuiyan.
- **OSM Group AS** (*Norwegian Oil Transport provider*): Markus Jussila and Mikko Varpio.
- **GSA** (*European GNSS Agency*): Manuel López.

Acknowledgements



Members of ESSP, Väylä and NLS during the installation on Nov. 2019



www.essp-sas.eu

rodrigo.gonzalez@essp-sas.eu

<http://egnos-user-support.essp-sas.eu>

egnos-helpdesk@essp-sas.eu

+34 911 236 555 (H24/7)

Corporate Video



Analysis of potential interference during the data campaign

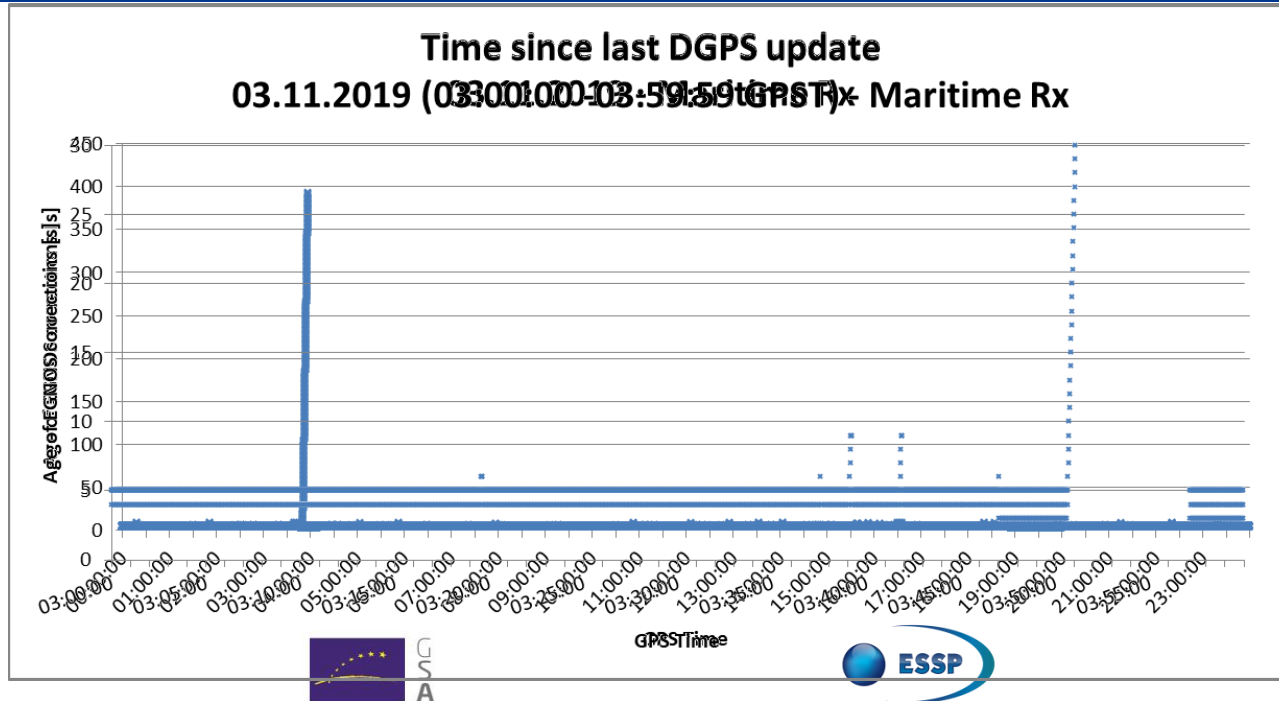
Back-up slides

Analysis of potential interference on 3rd November 2019

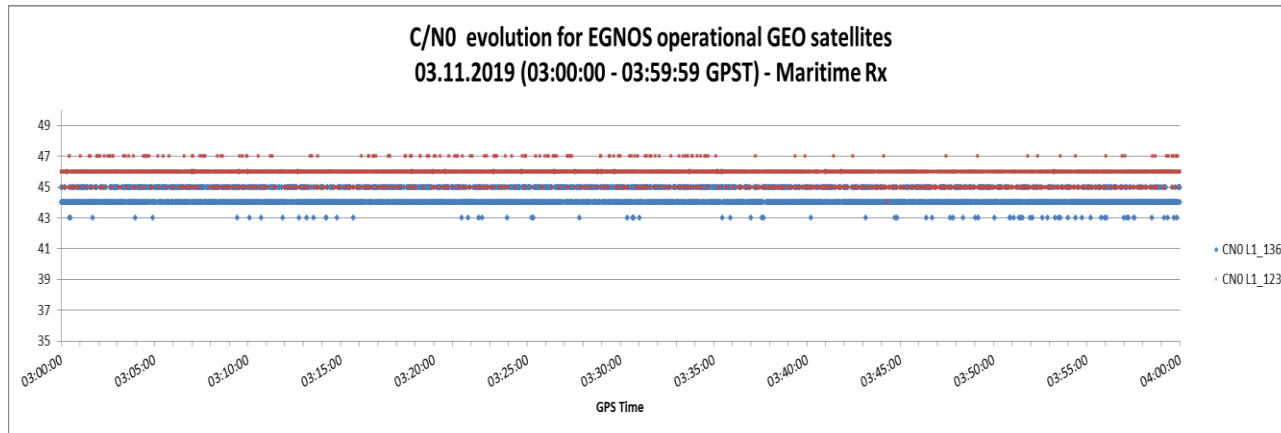


On 3rd November 2019 between 03:50:28 UTC and 03:56:50 UTC, the maritime receiver is not applying updated EGNOS corrections (**update over 10s**).

Analysis of potential interference on 3rd November 2019



Analysis of potential interference on 3rd November 2019



- Both EGNOS operational GEO satellites are tracked without any kind of interruption and enough C/N₀.
- Their signal is also received during this particular period of time.
- Verified with a second receiver installed on-board.

Analysis of potential interference on 3rd November 2019

CONCLUSION

No interference event happened at Primorsk on 3rd November 2019 between 03:50:28 UTC and 03:56:50 UTC.