



EDAS

as alternative source for a DGPS service
for maritime users

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Alberding GmbH

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Outline



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Motivation

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EGNOS-VRS

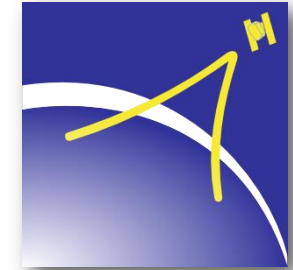
EDAS based VRS performance tests

Conclusions

Alberding GmbH



- German GNSS software and hardware development company
- Based in Wildau (near Berlin)
- 20 years of experience in high-accuracy GNSS positioning
- Specialised in GNSS data communication, management, processing and monitoring
- Independent from GNSS receiver manufacturers





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- Existing maritime and inland waterway DGPS services face obsolescence and require modernisation
 - Aging Beacon DGPS hardware and software
 - Augmentation information for future GNSS signals
- VRS concept – a solution in line with the IMO e-Navigation strategy
 - Virtual Reference Station (VRS) solution – corrections and integrity information generated at a central site
 - Separating the GNSS correction generation from the data transmission technology (radio beacons, AIS, GSM, etc.)





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Beacon.net modules



- **GNSS raw data input**
 - IALA beacon stations
 - AIS DGPS base stations
 - Other GNSS reference stations
 - Supports GPS and GLONASS
- **VRS server**
 - Network DGNSS processing
 - Generation of virtual corrections
 - No GNSS receiver needed at transmission sites
- **Integrity monitoring**
 - Pre-broadcast monitoring (position and SV domains)
 - Far field monitoring (position and signal quality)
- **Data transmission**
 - IALA radio beacons, AIS, Ntrip (GPRS, WLAN)
 - RTCM 2.x, 3.x, AIS Type #17, etc.





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EGNOS-VRS

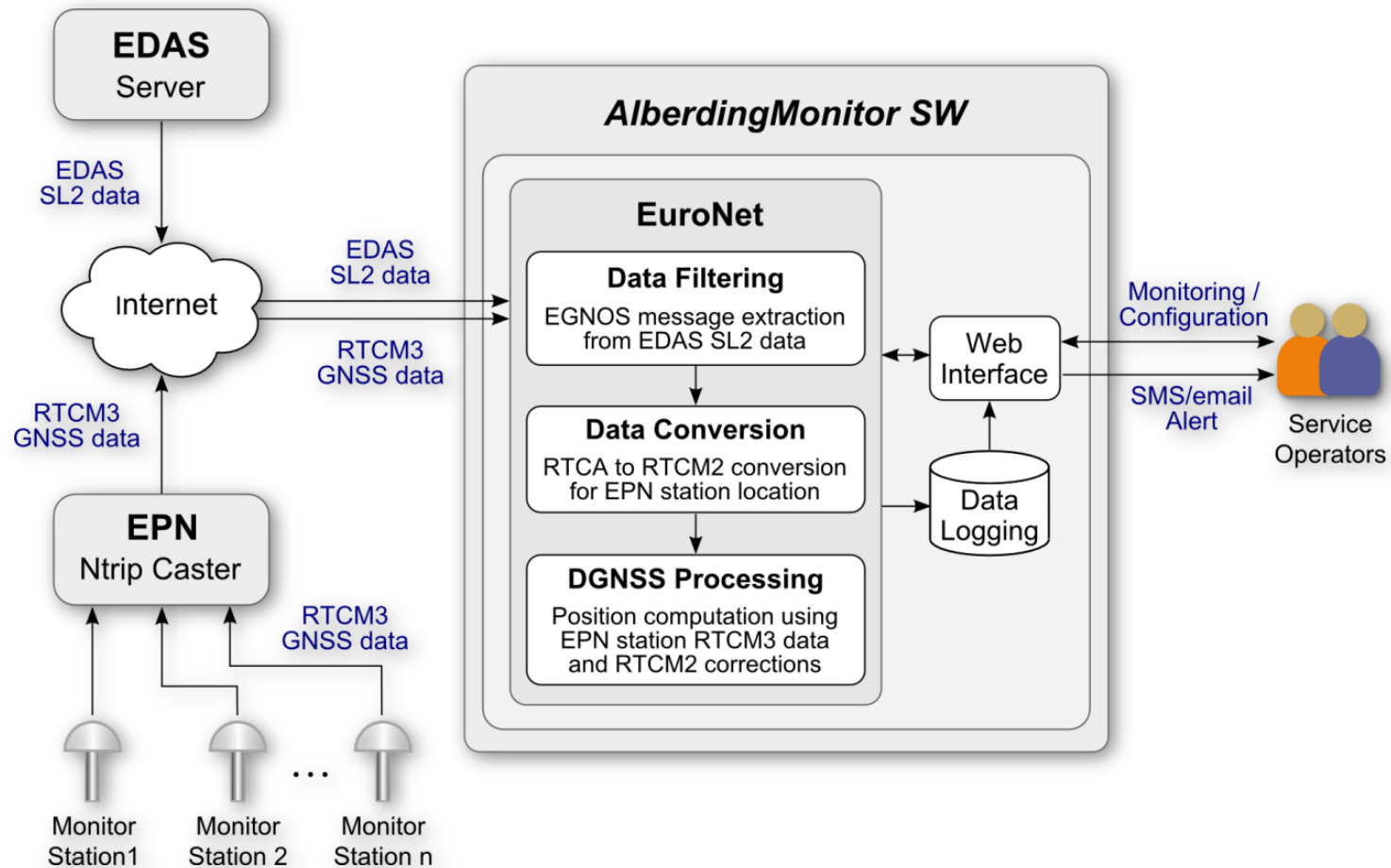


Data conversion module

- EGNOS RTCA data conversion to RTCM corrections for user definable positions: **“EGNOS-VRS”**
- Input data sources:
 - EGNOS enabled GNSS receiver
 - EDAS (SL2, SISNeT)
- Rebroadcast via
 - IALA radio beacons, AIS, Ntrip
- EGNOS/EDAS is free of charge
- Can be used as a backup solution to conventional DGPS or even as a primary system



EGNOS-VRS based DGNSS





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Motivation

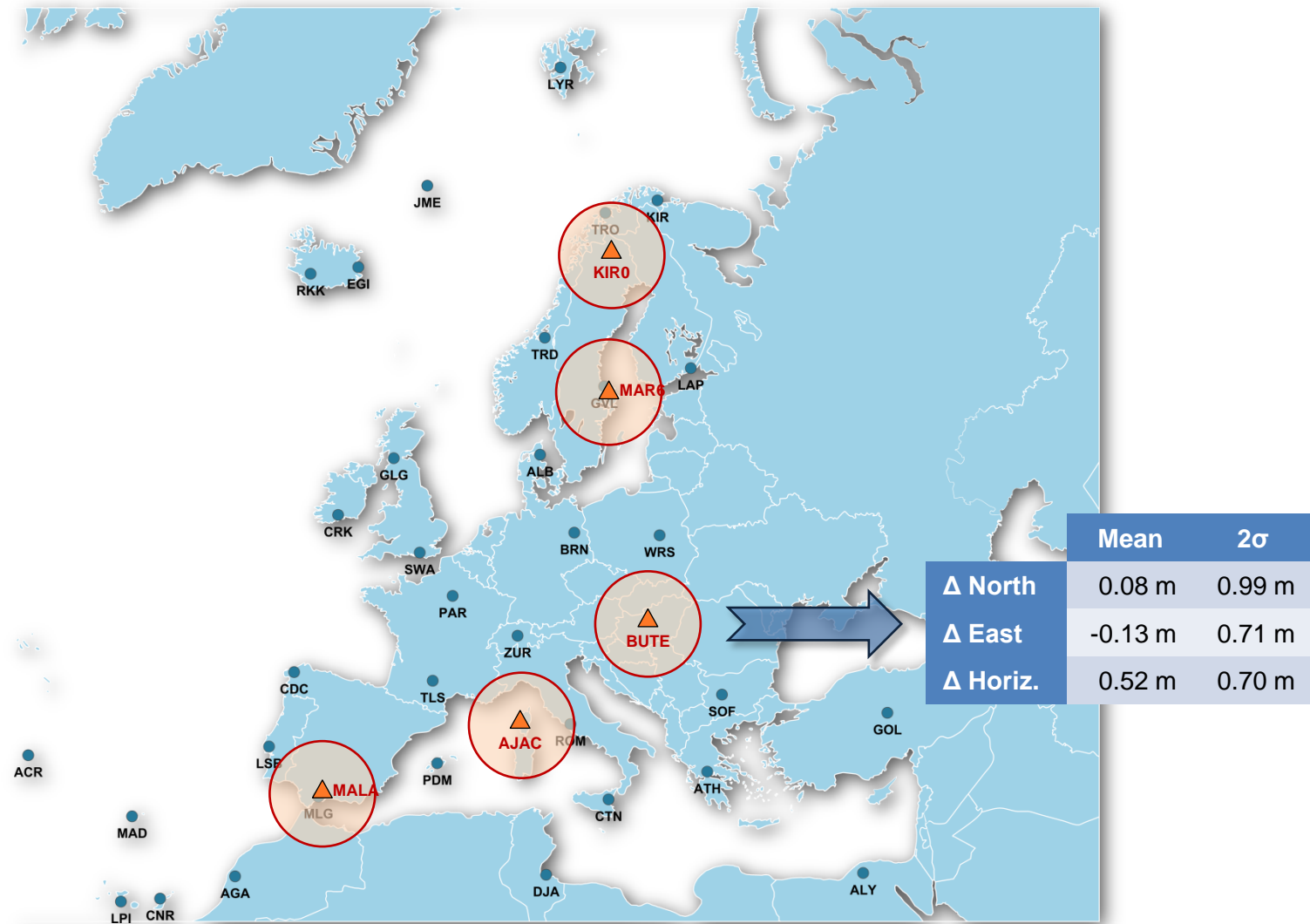
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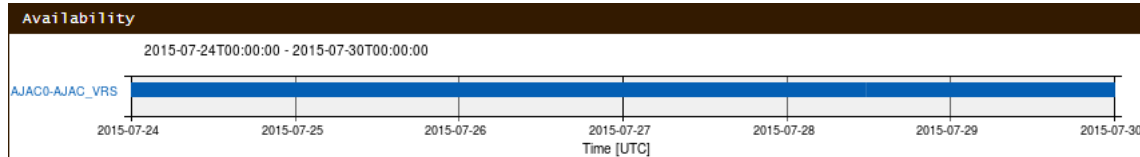
EGNOS RIMS and EPN stations



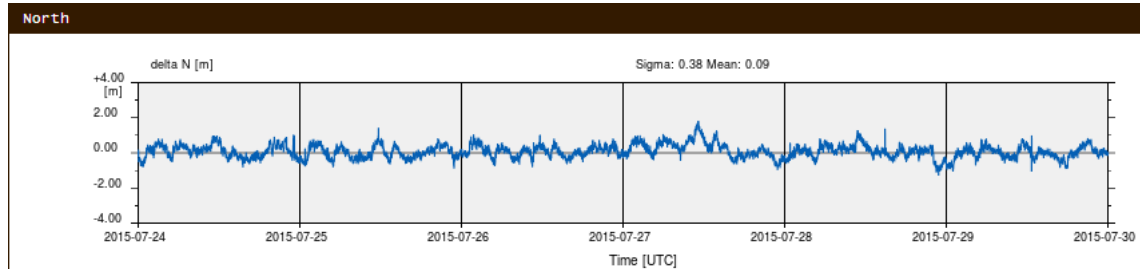
EDAS based VRS performance at AJAC



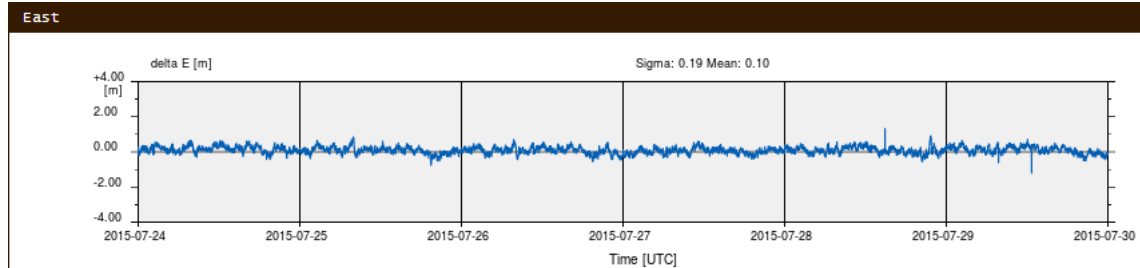
Availability



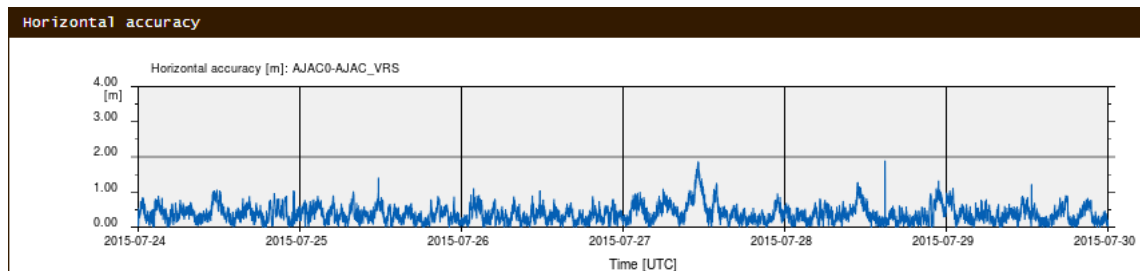
Delta North



Delta East



Delta Horiz.



Monitoring at Ajaccio, FR

Lat: 41.9° Lon: 8.8°

Mean: 0.09 m
2σ: 0.76 m

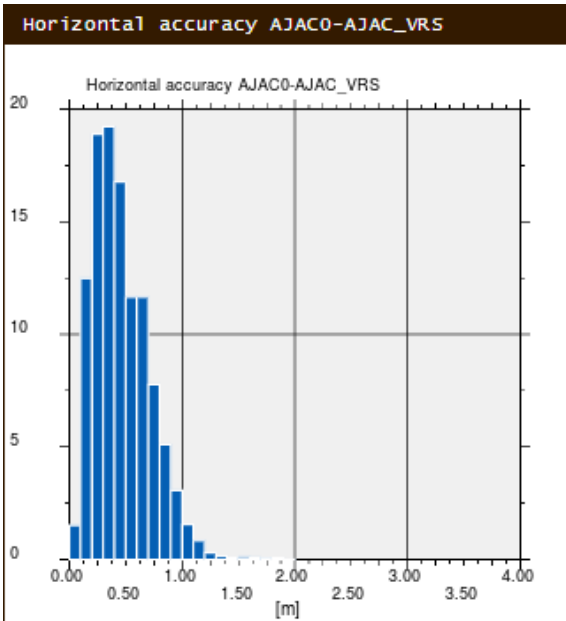
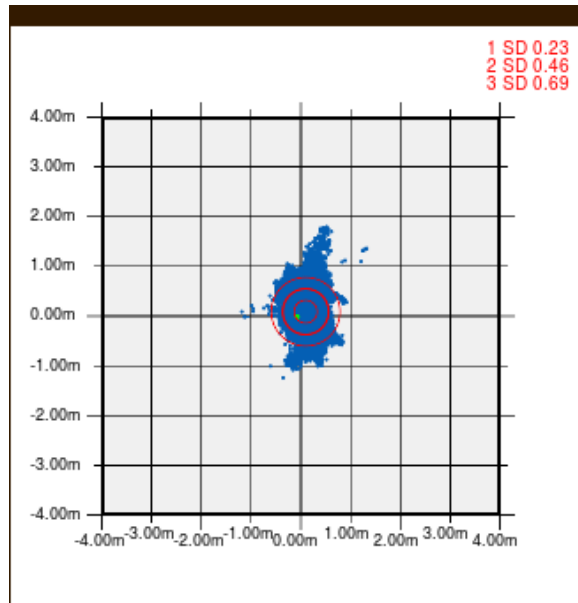
Mean: 0.10 m
2σ: 0.38 m

Mean: 0.38 m
2σ: 0.46 m

EDAS based VRS performance at AJAC



Horizontal scatter

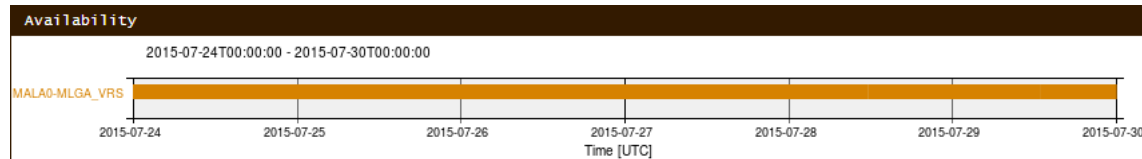


Horizontal accuracy

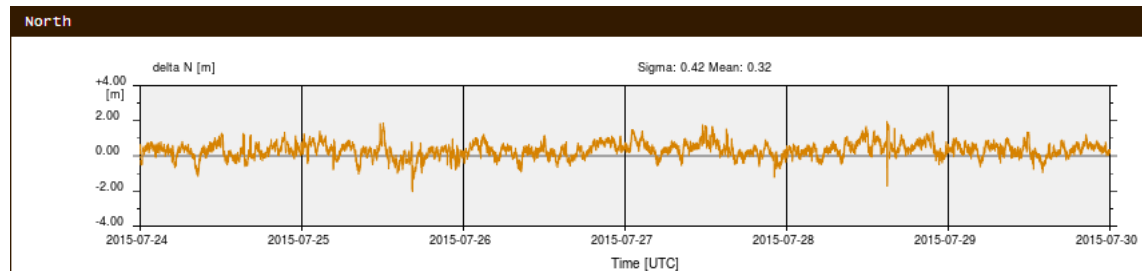
EDAS based VRS performance at MALA



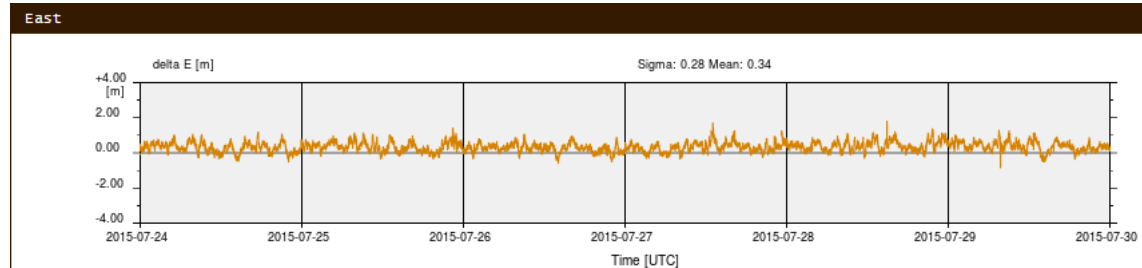
Availability



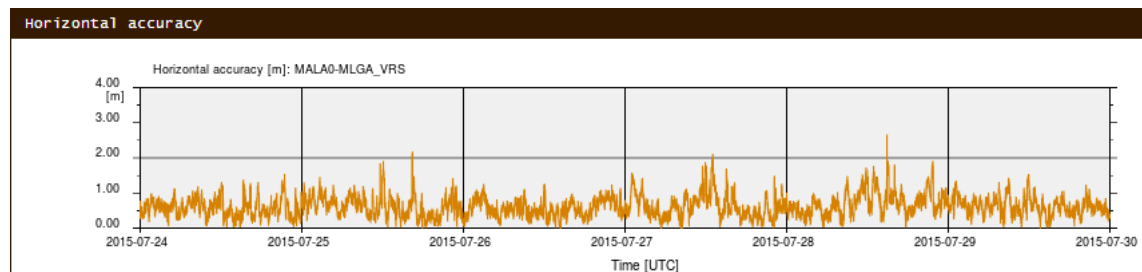
Delta North



Delta East



Delta Horiz.



Monitoring at
Malaga, ES

Lat: 36.7° Lon: -4.4°

Mean: 0.32 m
2σ: 0.84 m

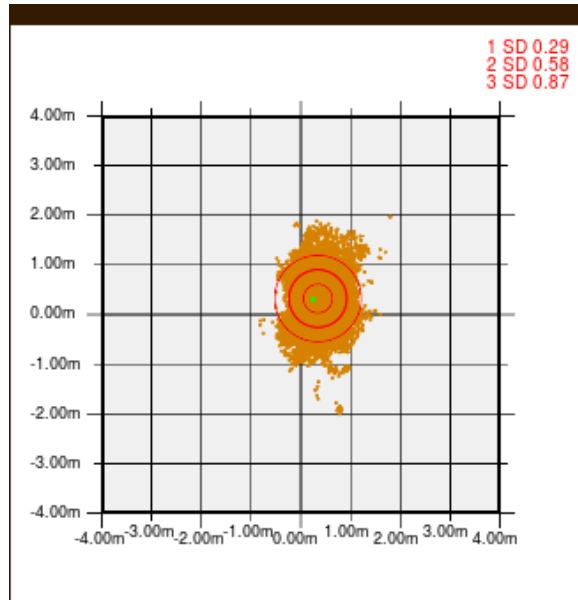
Mean: 0.34 m
2σ: 0.56 m

Mean: 0.62 m
2σ: 0.58 m

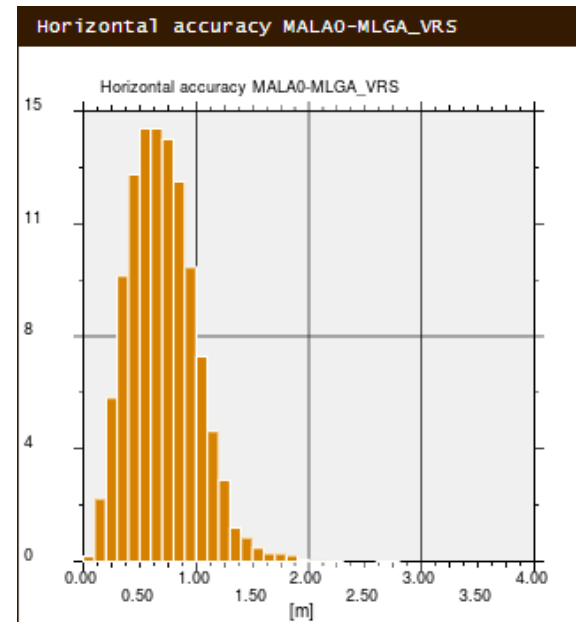
EDAS based VRS performance at MALA



Horizontal scatter



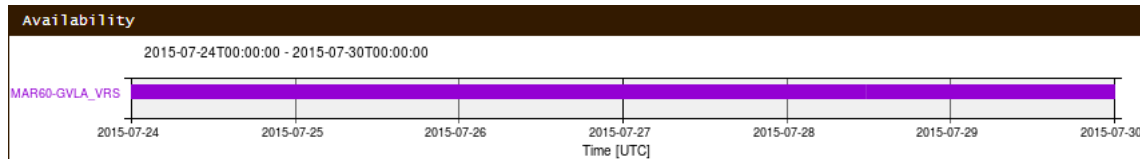
Horizontal accuracy



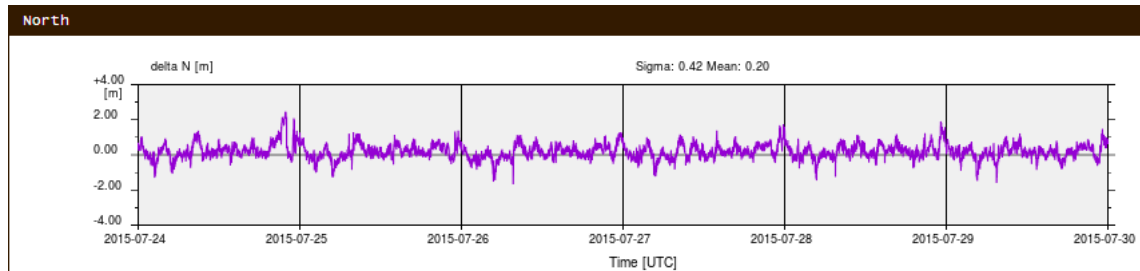
EDAS based VRS performance at MAR6



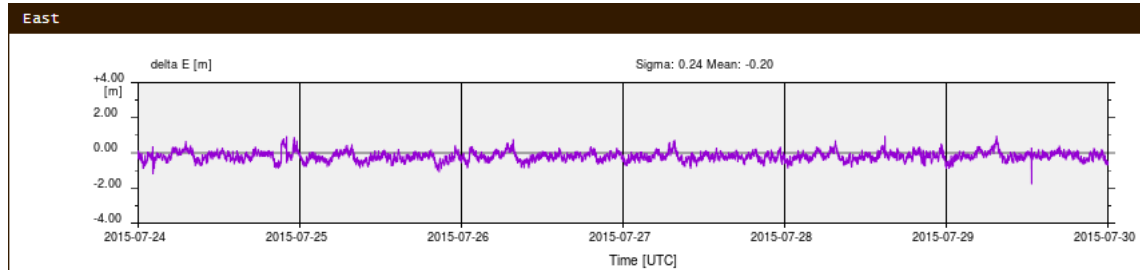
Availability



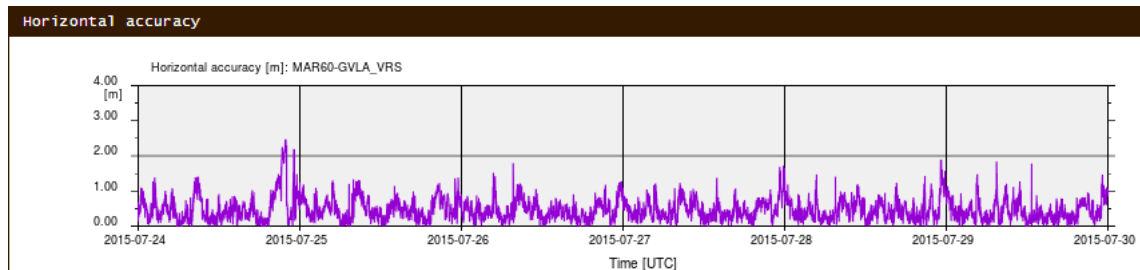
Delta North



Delta East



Delta Horiz.



Monitoring at
Maartsbo, SE
Lat: 60.6° Lon: 17.3°

Mean: 0.20 m
2σ: 0.84 m

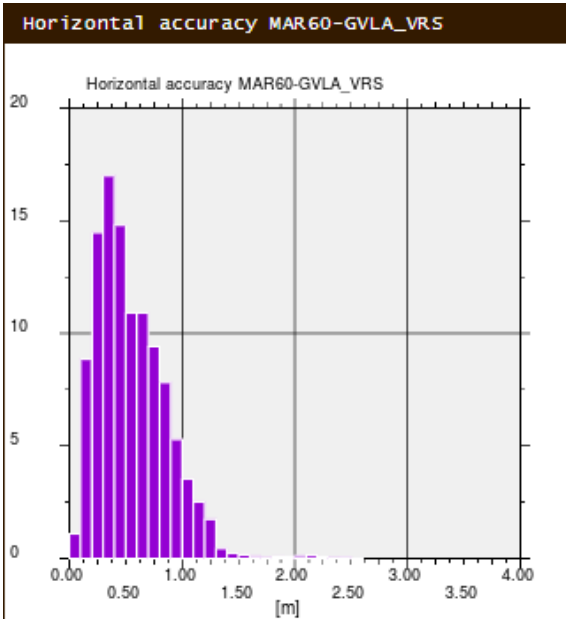
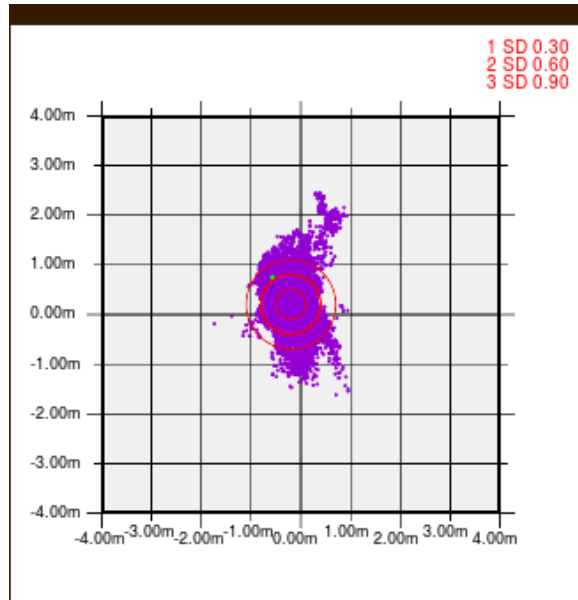
Mean: -0.20 m
2σ: 0.48 m

Mean: 0.47 m
2σ: 0.60 m

EDAS based VRS performance at MAR6



Horizontal scatter

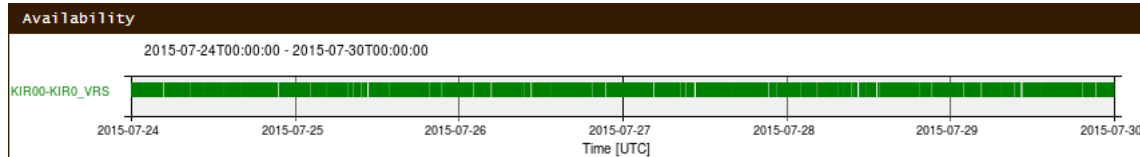


Horizontal accuracy

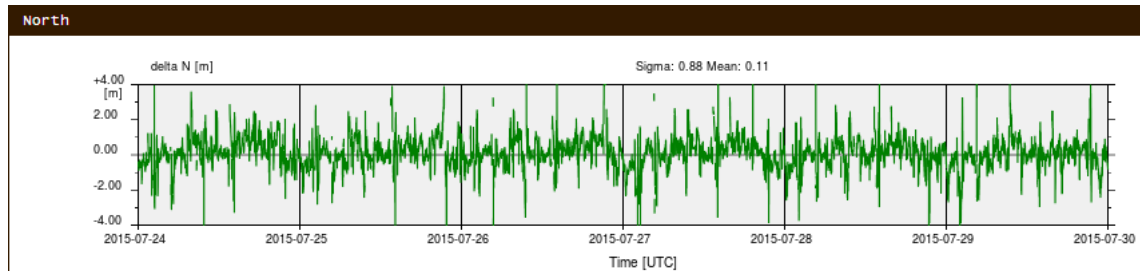
EDAS based VRS performance at KIRO



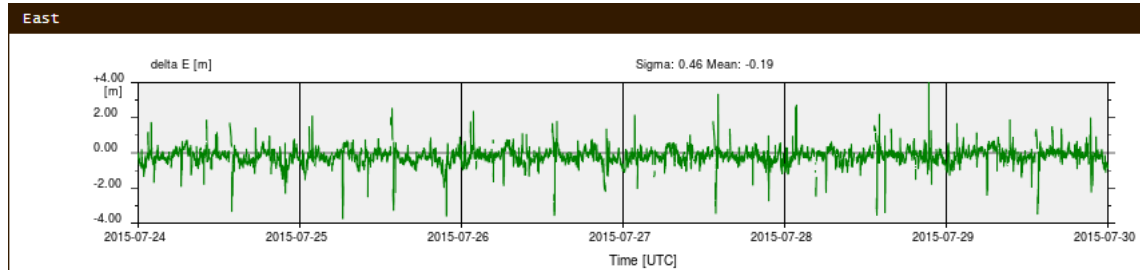
Availability



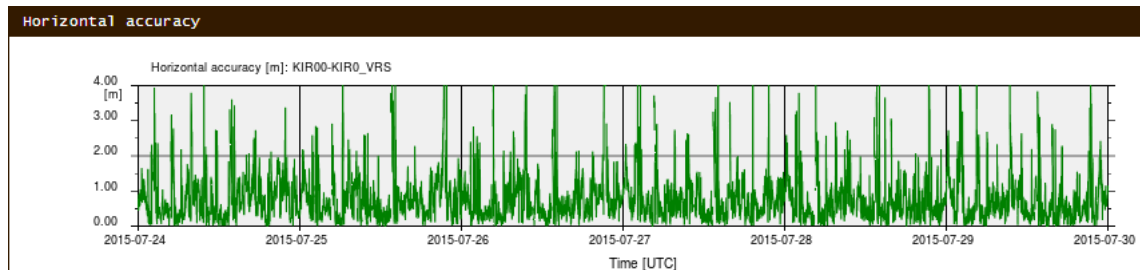
Delta North



Delta East



Delta Horiz.



Monitoring at Kiruna, SE

Lat: 67.9° Lon: 21.1°

Mean: 0.11 m
2σ: 1.76 m

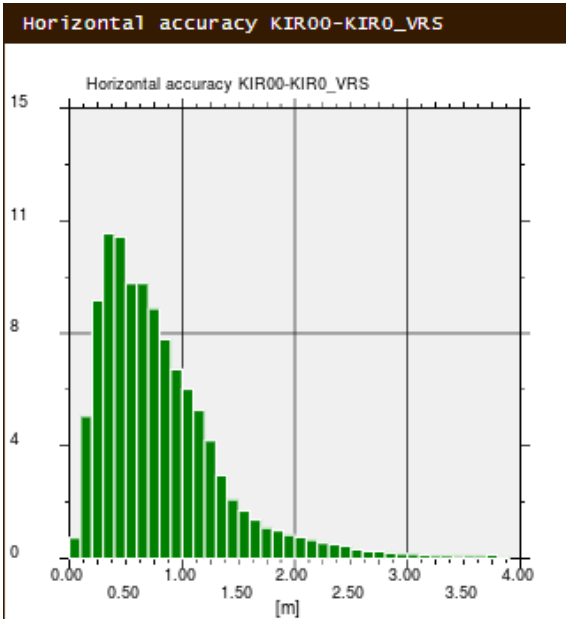
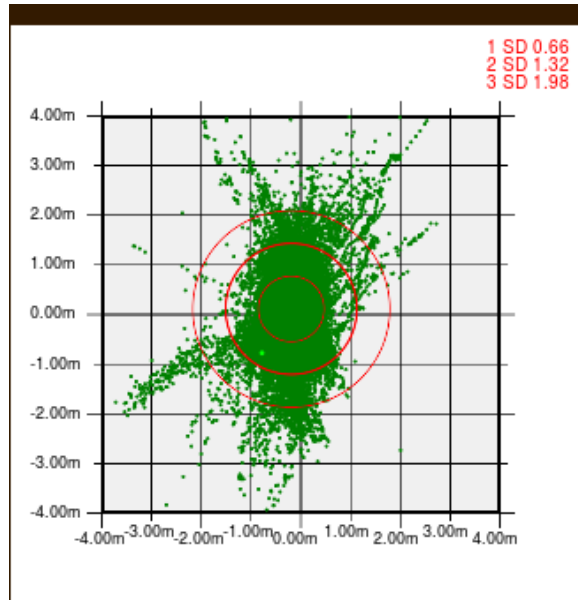
Mean: -0.19 m
2σ: 0.92 m

Mean: 0.78 m
2σ: 1.32 m

EDAS based VRS performance at KIRO



Horizontal scatter

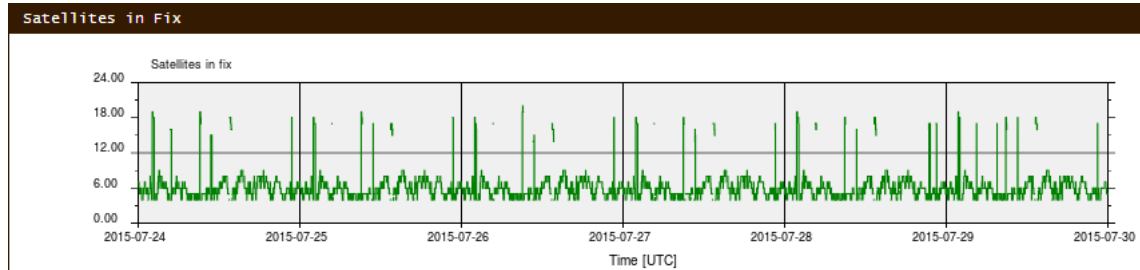


Horizontal accuracy

EDAS based VRS performance at KIRO



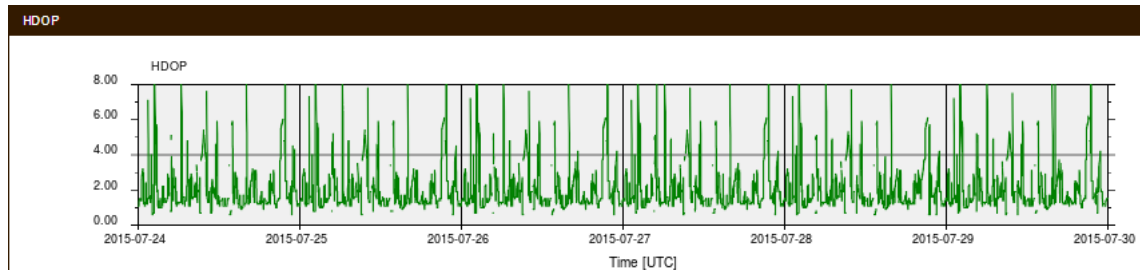
Number of SVs



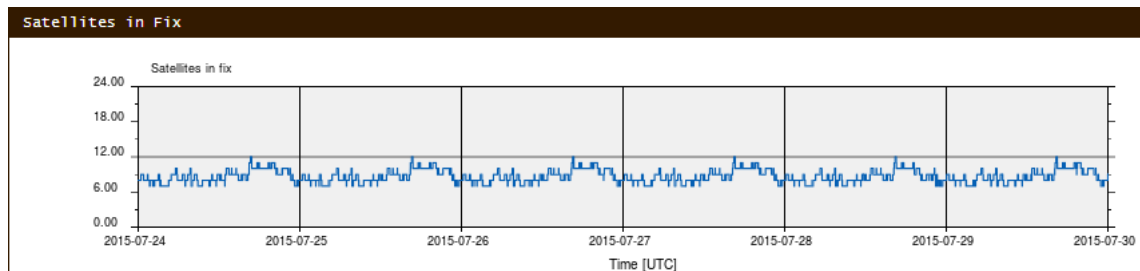
Monitoring at Kiruna, SE

Lat: 67.9° Lon: 21.1°

HDOP



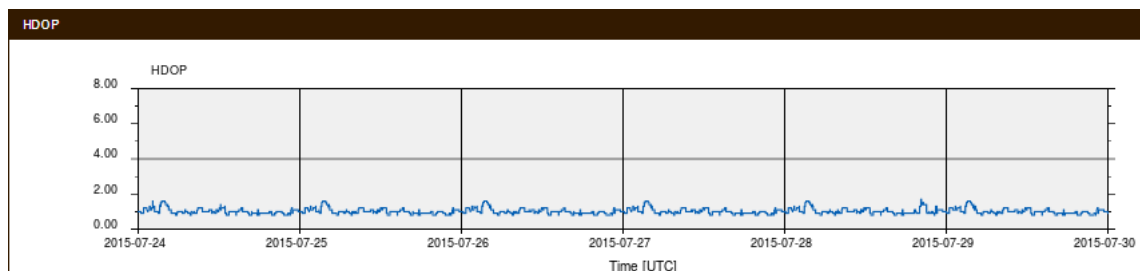
Number of SVs



Monitoring at Ajaccio, FR

Lat: 41.9° Lon: 8.8°

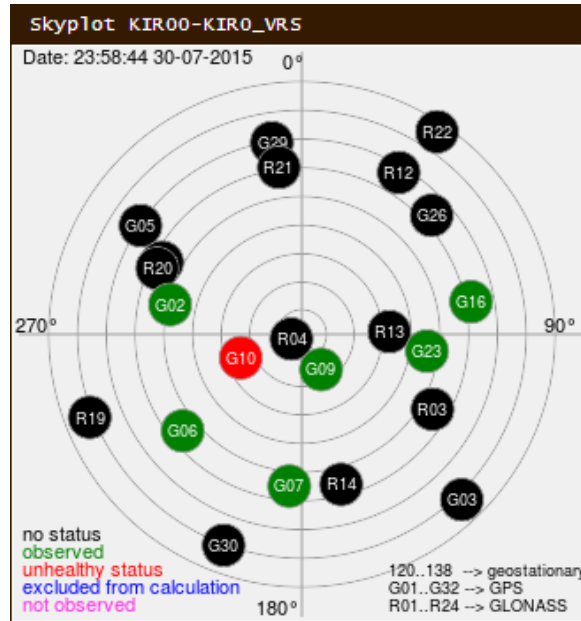
HDOP



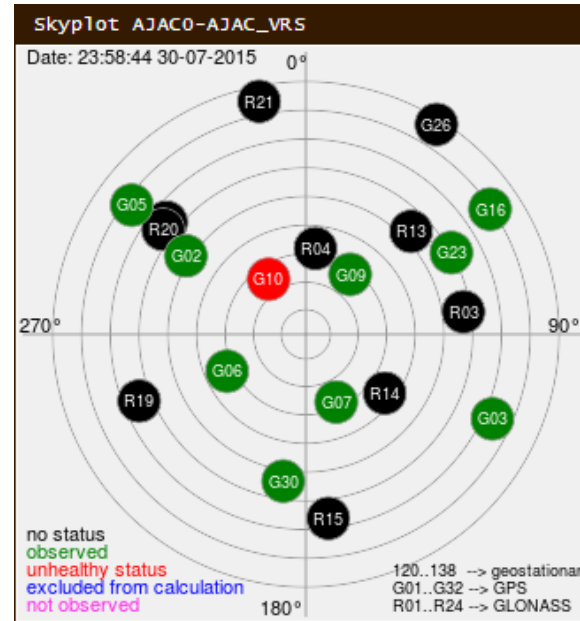
EDAS based VRS performance at KIRO



Skyplot

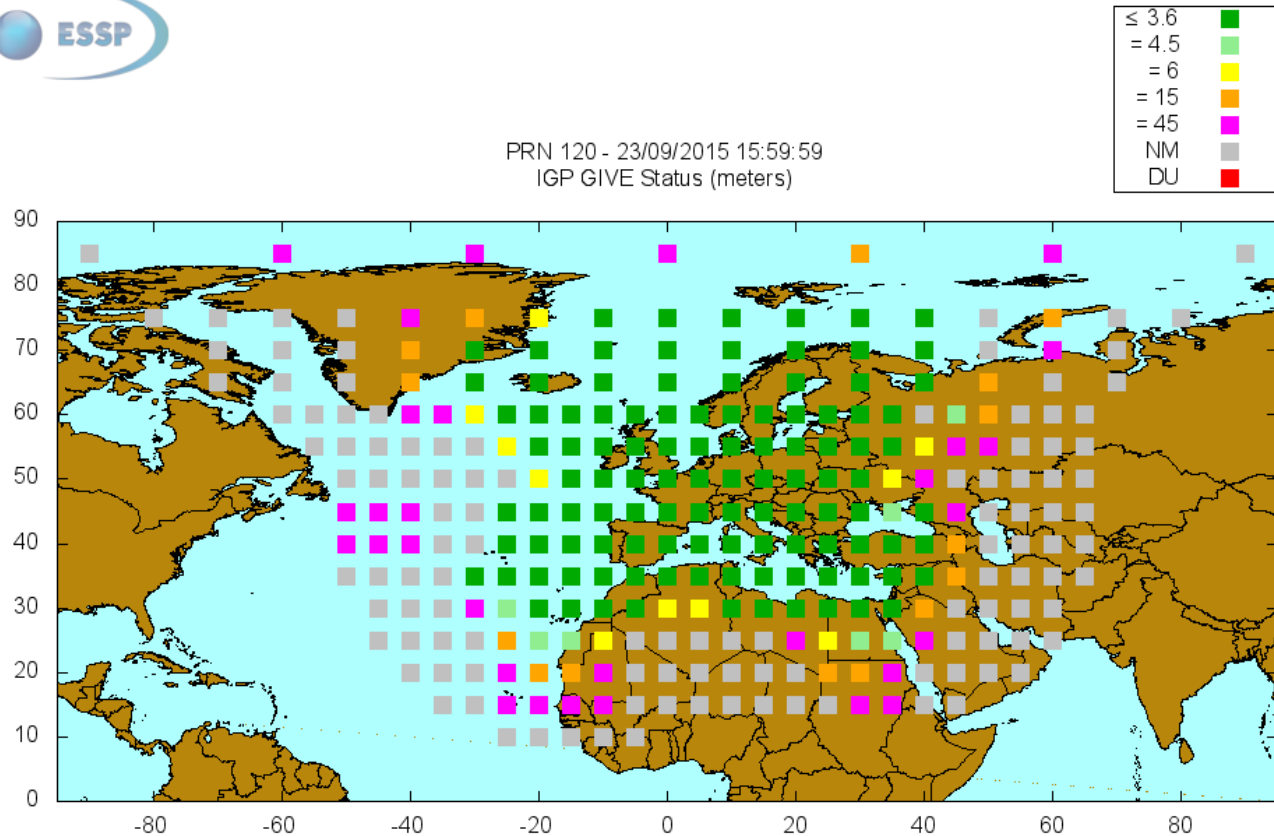


Monitoring at Kiruna, SE
Lat: 67.9° Lon: 21.1°

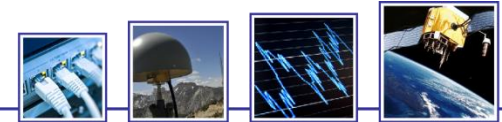


Monitoring at Ajaccio, FR
Lat: 41.9° Lon: 8.8°

Missing ionospheric information



Solution: use of Klobuchar ionosphere model at EGNOS-VRS correction generation for the Arctic



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Conclusions

Conclusions



- EGNOS-VRS corrections can be **remotely generated** for any location within the EGNOS coverage area. Hence, a physical reference station at or close to the transmission site would not be required for the delivery of DGPS corrections for maritime navigation.
- EGNOS-VRS provides **homogeneous accuracy** over the entire coverage area.
- On short baselines EGNOS-VRS **accuracy** could be **suitable even for port navigation** with the most stringent accuracy requirements (1 m).
- EGNOS-VRS is more **robust** than conventional DGPS since it does not depend on a single GNSS reference station.
- EDAS provides **higher redundancy/robustness** for the EGNOS message retrieval than a single receiver (as long as one EGNOS station is getting the SBAS message it will be output by EDAS).
- **High service availability** can be achieved by redundant RTCA data sources (i.e. EGNOS-enabled GNSS receiver, EDAS) and backup hardware components. The availability requirement of 99.8% for the maritime operations can be met.
- Where there is no nearby EGNOS RIMS station, **EGNOS-VRS is a very promising solution.**



Thank you for your attention!



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