MODERNIZATION OF MARITIME DGPS IN POLAND

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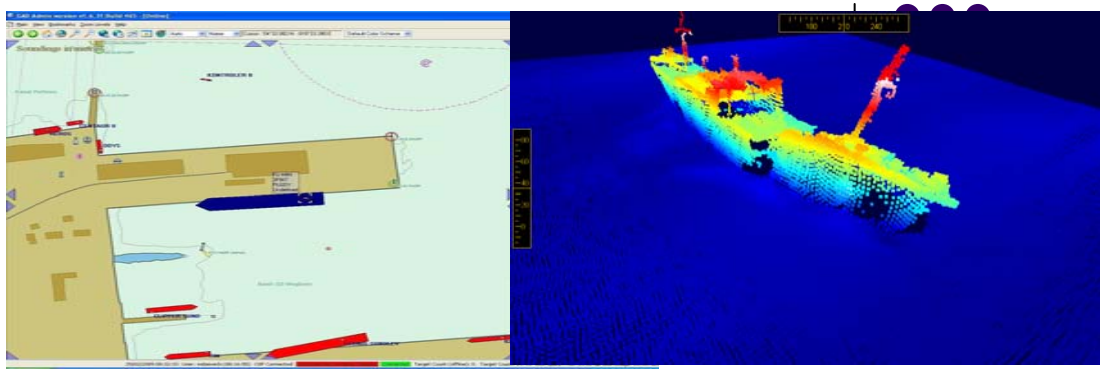
Presentation plan

- Introduction - Why DGPS ?
- IALA approach
- European options

- Modernization of Polish DGPS (base stations & coverage)
- IT infrastructure

- Field tests
- RS RTK installation
- Future expectations and Conclusions

WHY DGPS …?



•Useful. Most of mariners use GNSS as a primary means of navigation.
Available GNSS does not meet the requirements of IMO with respect to integrity, while the use of IALA maritime DGNSS does fulfil these requirements.

• International maritime standards exist for both: onboard receiver and LB DGNSS service.
• Popular. DGPS beacon systems were installed in many countries over the period 1993-2000 and now became obsolete. The R-NAV (presently e-Navigation) Committee concluded that there is a requirement to recapitalise national systems.

• It is potentially a good reason to re-organise the system for the benefit of users and to enhance DGNSS capabilities taking into account technical innovations as well as e-Navigation architecture.

•Validation. At the same time countries are considering submission of their DGNSS services to IMO as components of the World Wide Radio Navigation

IALA approach

- The baseline approach would be to replace existing equipment with similar, dedicated RSIM based on known, commercially available technology. New dedicated hardware Reference Stations and Local Integrity Monitors (RSIM). This solution could limit the potential for future development.
- Modernization of DGNSS should be considered in the context of requirements for e-Navigation.

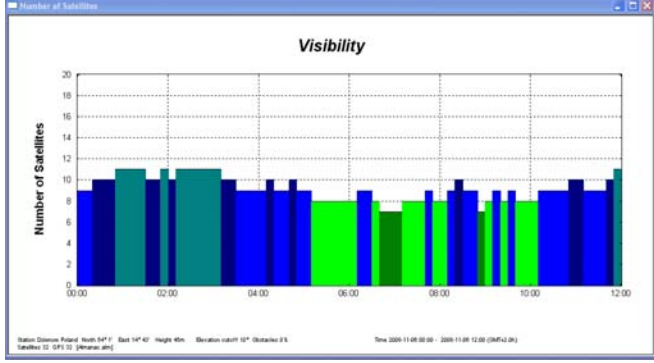
Possibilities include:

- Software Reference Stations and Integrity Monitors (RSIM)
- Virtual Reference Station (VRS)
- SBAS (EGNOS, WAAS) Integration

DGPS RE-CAPITALIZATION - MEETING IN GDYNIA - European trends

- The response of representatives at the meeting indicate that most administrations providing DGNSS services are undertaking re-capitalization or are planning such activities based also on co-operation with National Geodetic Networks.
- **Sweden** is currently studying options for software RSIM solutions and transmissions of VRS data via MF beacon system taking into account also the geodetic network SWEPOS.
- **Germany** is planning to implement DGNSS recapitalization plan by creating RAAS and VRS based on national network operated from national centre of control. The new concept of "moving centre of system accuracy" was presented.
- A new type of MF transmitting antenna (NTA) was presented.

……European trends



- **Germany** also announced a feasibility study to investigate the addition of ranging signals (R-Mode) on MF beacon and AIS carriers.
- **Scotland** referred UK and Ireland studies of DGPS replacement options which concluded that the lowest risk would be hardware replacement, although the flexibility provided by the software option would better meet emerging requirements and should not be ruled out .The GLA have tendered for new RSIM equipment, which may be fulfilled by either hardware or software solution.
- **Russia** is testing broadcast of DGlonass and DGPS corrections via AIS system in Golf of Finland.

Introduction to DGPS-PL

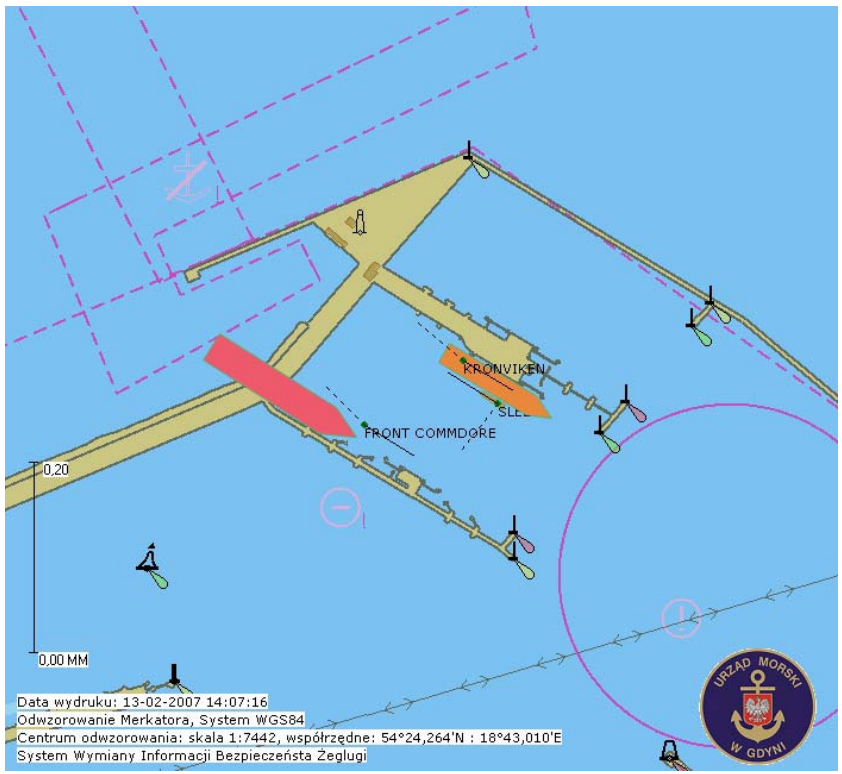
- **Established**
  - since 1995 – 1996
- **Modernized** 2007-2008

Driving factors:

- IALA R-NAV Recommendations
- SOLAS Convention, Ch.V

Legal regulations:

- ITU-R, RTCM regulations
- Declaration on the Safety of Navigation and Emergency Capacity in the Baltic Sea Area" – Copenhagen 2001



Layout of Polish DGPS coverage

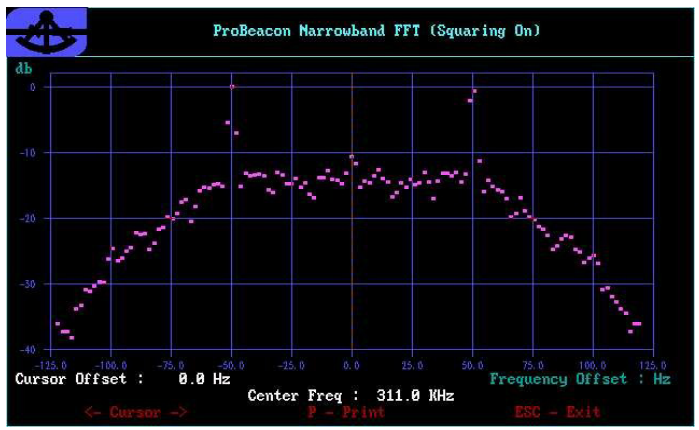
DZIWNOW 283,5 kHZ

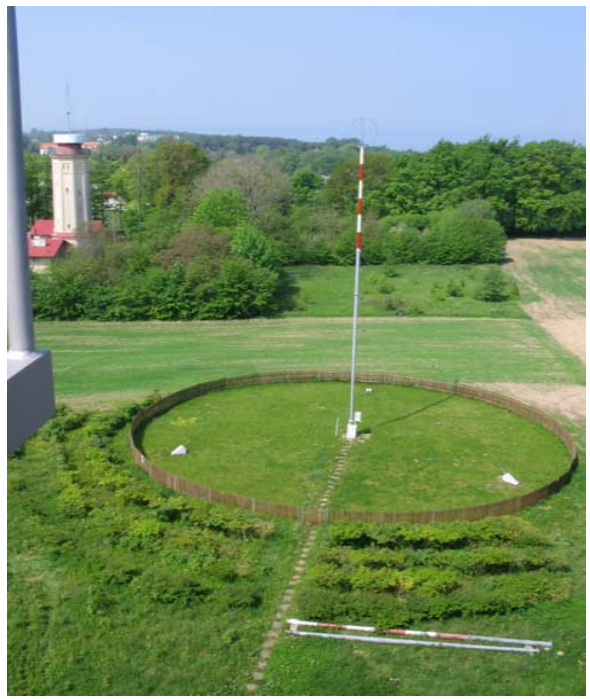
ROZEWIE 301,0 kHz

RTCM transmission from DGPS-PL

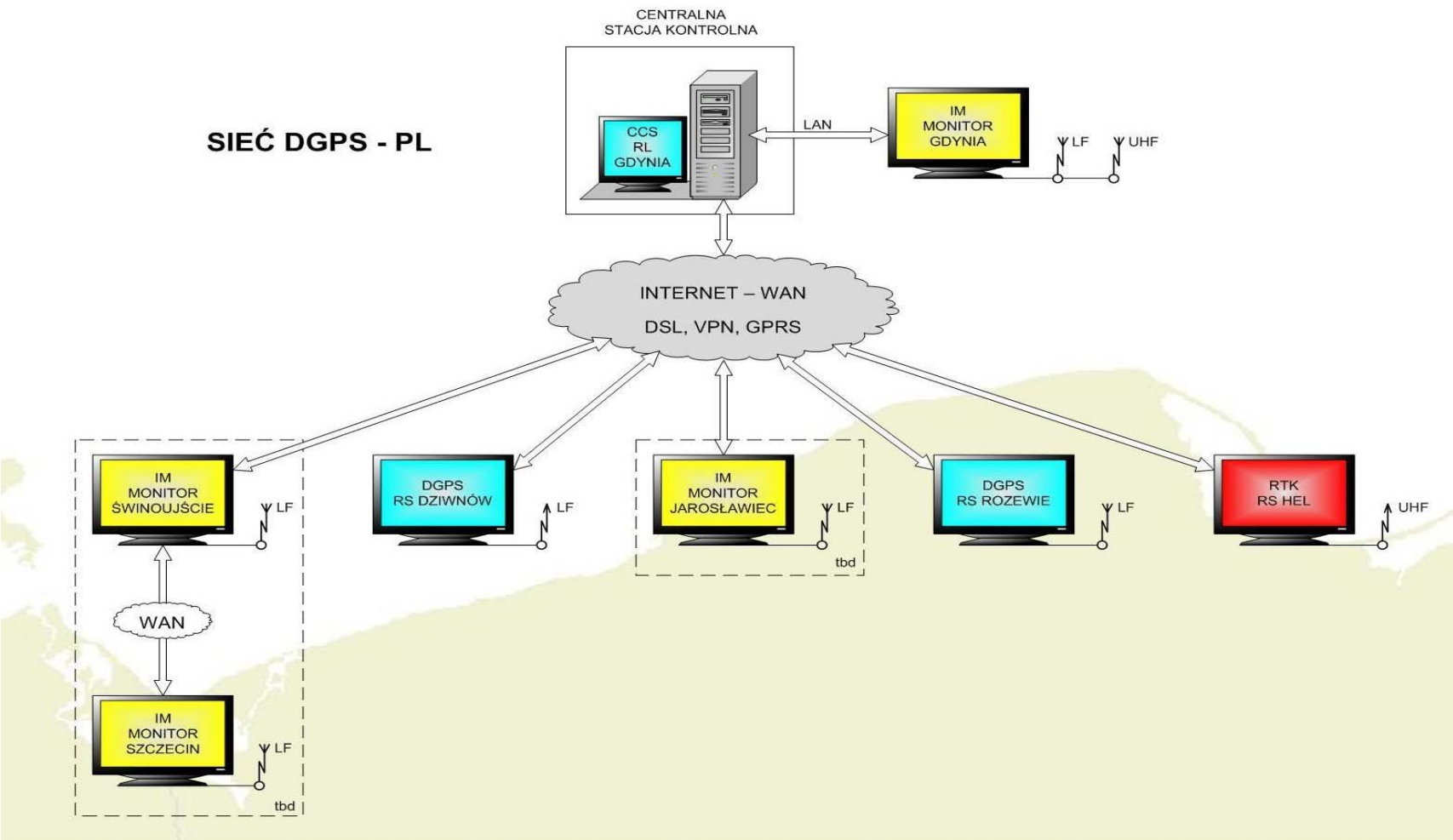
Table I. Polish DGPS stations

Table of DGNSS Stations			Country: POLAND		Date of last amendment: July 2008			
Station name	Identification Nos		Geographic Position Lat/ Lon	Station in operation	Integrity Monitoring	Transmitted message types	Freq (kHz)	Bit Rate (bps)
	Reference Station(s)	Transmitting Station						
Dziwnów	741 742	481	54°01' N 14°44' E	yes	yes	9,3,7,16	283.5	100
Rozewie	743 744	482	54°49' N 18°20' E	yes	yes	9,3,7,16	301.0	100





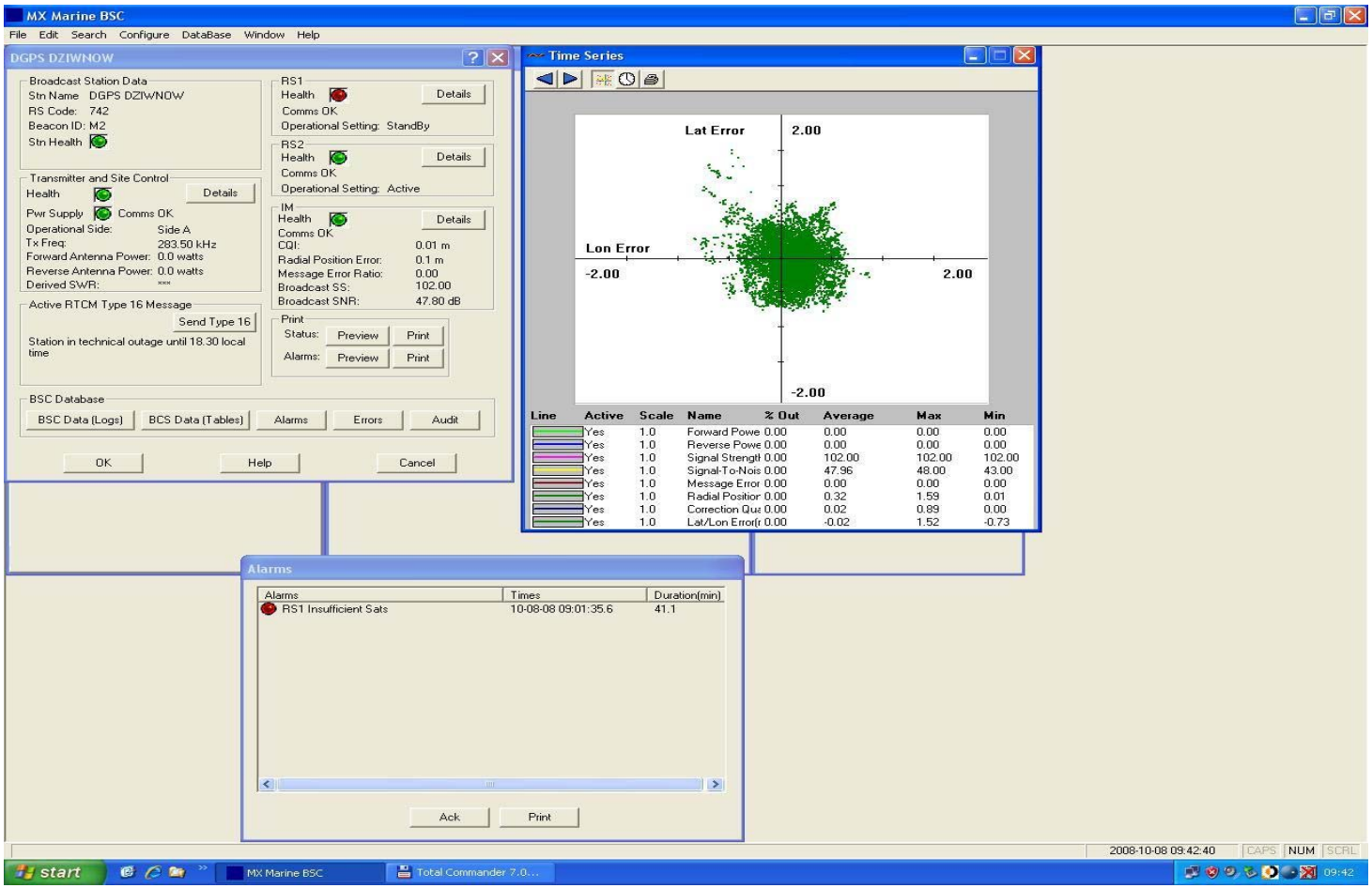
DGPS-PL SYSTEM TOPOLOGY



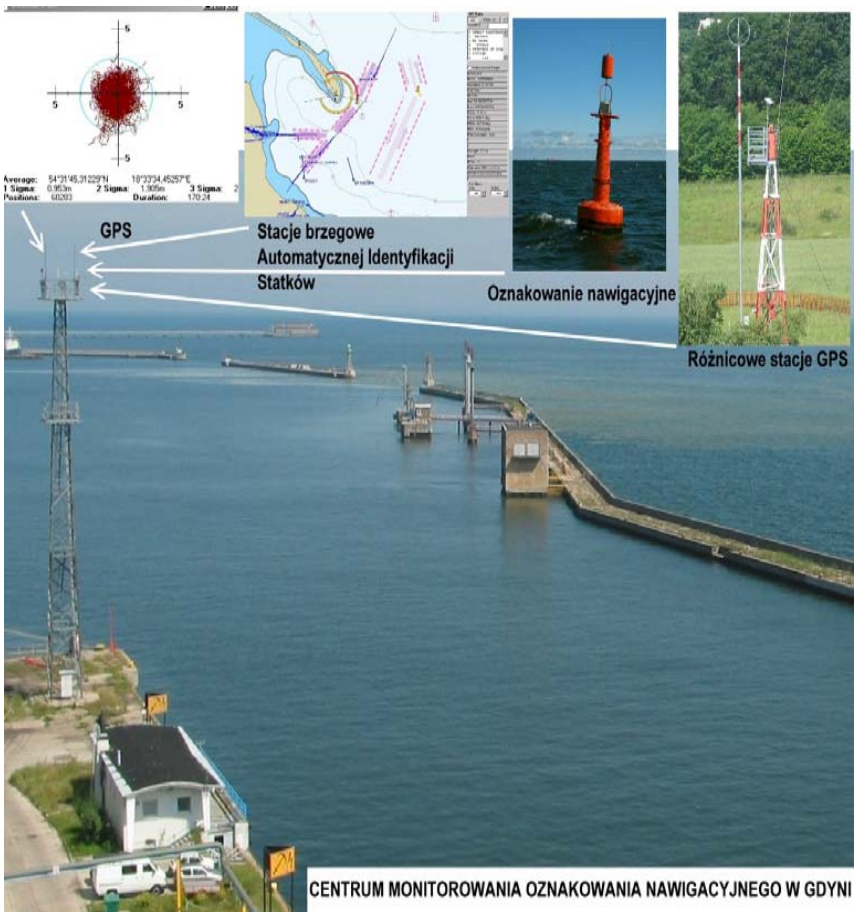
New antenas and RS-IM equipment

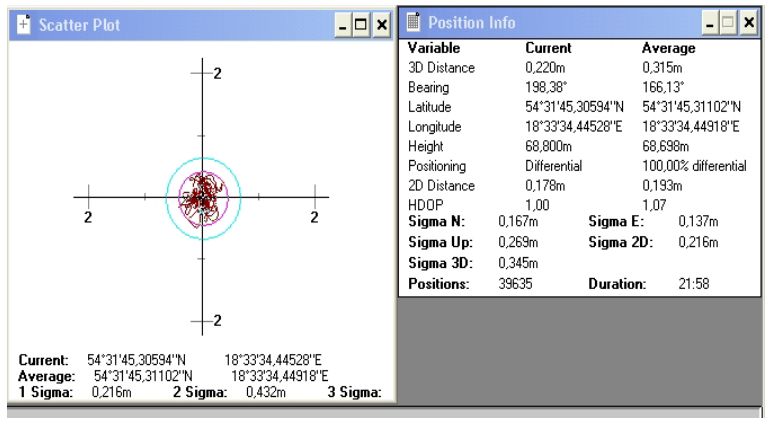
L1, L2 antymultipath GPS antennas 24 channels L1,L2 RS doubled receivers and L1 integrity monitor , rack mounted industrial PC

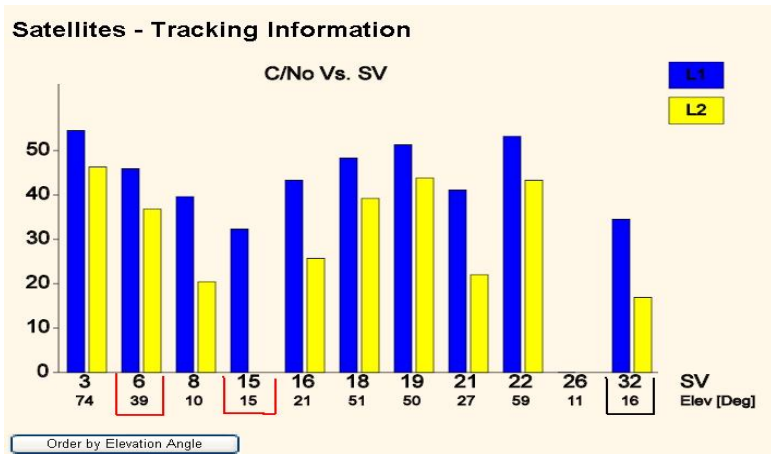
REMOTE CONTROL



Farfield IM monitor in Gdynia Port (24 h)



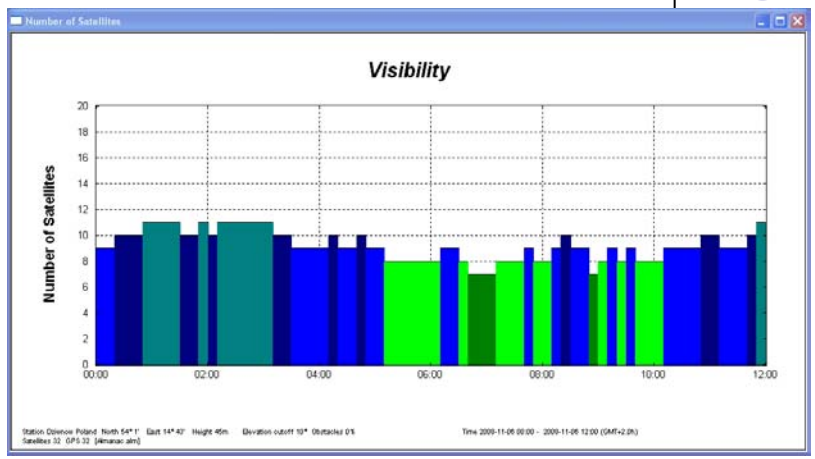


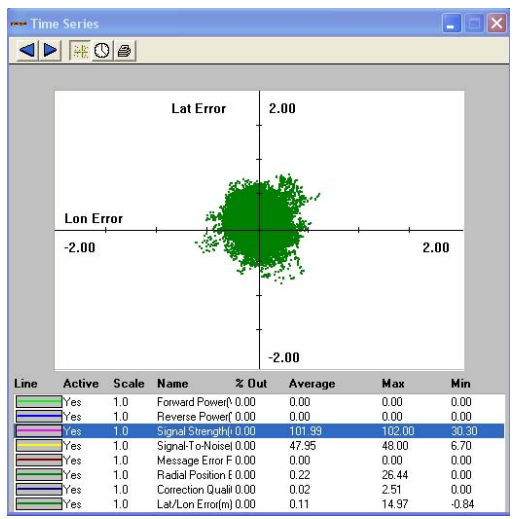


FIELD MEASUREMENTS

- **Station Name: DGPS Dziwnow**
- **Start: → 2008-8-1 10:23**
- **End: 2008-8-5 10:23**

→ Tx Frequency → 283.5 KHz	Average Signal Strength → 102.00 dBuV/m	Signal/Noise Ratio → 47.95 dB
→ Truth Reference:	Last Delta Position Error:	Average Delta Position Error:
→ Lon: N 54 01 19.185	→ dE 0.00 m	→ dE 0.05 m
→ Lat: E 014 43 50.055	→ dN -0.10 m	→ dN -0.07 m
→ Ht 45.4000	→ dH -0.20 m	→ dH -0.13 m
Sample Interval: Longest 5671.00 Seconds Average 9.04 Seconds	# of Samples: → 38234	% Of DGPS: →100.00 %
Position Standard Deviation: 0.25 m (dN), 0.16 m(dE) 0.43 m(dH)		
Horizontal Position Threshold: → 5.00 m	% Time Outside Threshold: → 0.00 %	Amount of Time Outside Threshold: 0.00 (min)
Error Statistics: → → Horizontal → Percentage		
→ → → 0-1m→ → 99.57 → → → 1-2m→ → 0.43 → → → 2-3m→ → 0.00 → → → 3-4m→ → 0.00 → → → 4-5m→ → 0.00 → → → 5-10m→ → 0.00 → → → > 10m→ → 0.00		
Remarks:		

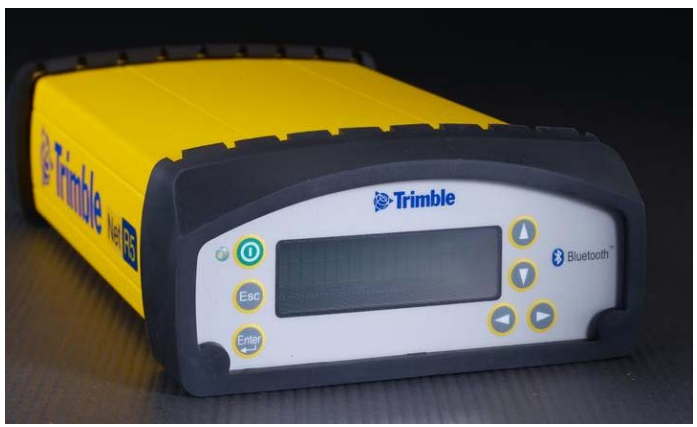




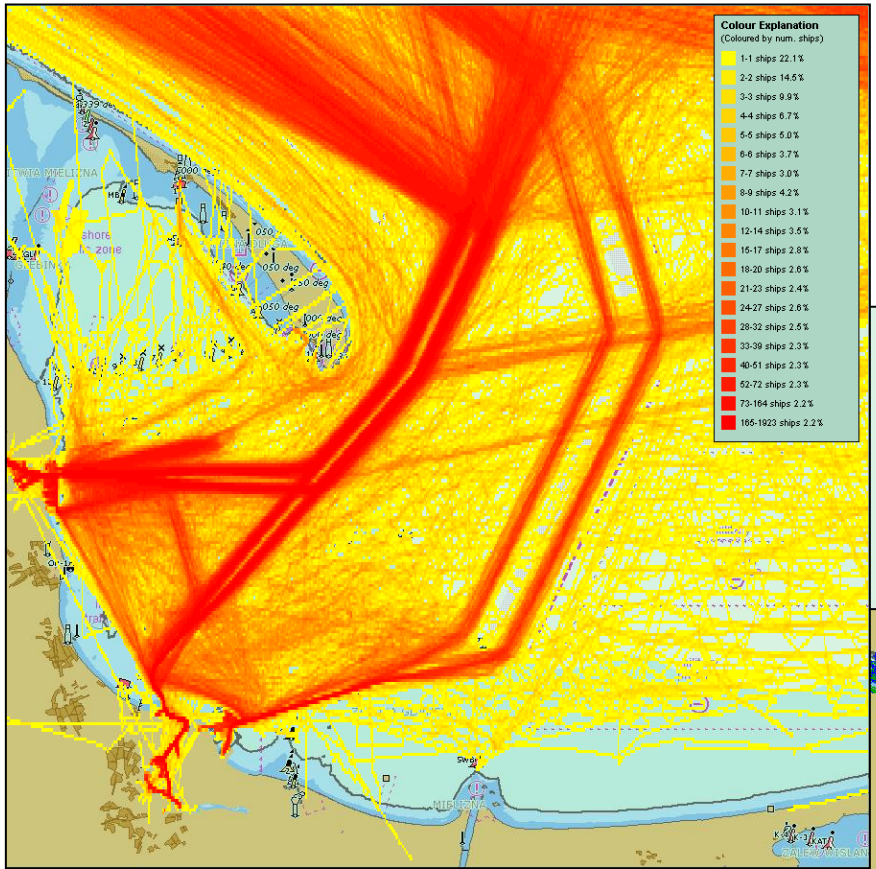
Permanent RTK, RS-Hel

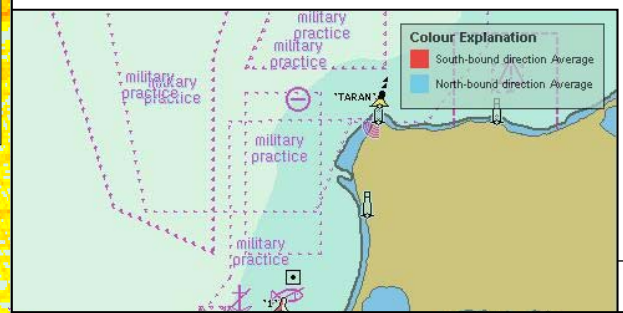
Table II Characteristics of RTK RS-Hel

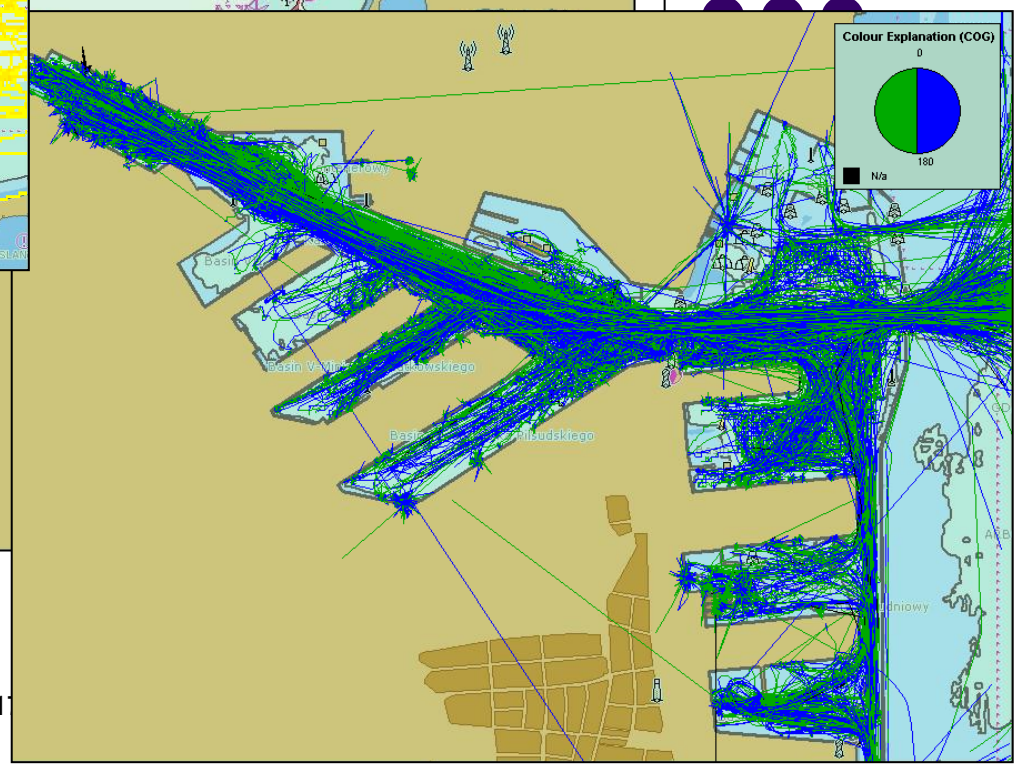
Name RS- Hel	Receiver type	Corrections output	Radio-transceiver	Options
System	R-5	RTCM 18, 19, 20, 21	Satelline 3AS Epic	VRS
Application	GPS, Glonass	Binary code CMR, CMR+	UHF 2-10W Rt range 10-40km	RTK, DGPS
Frequency	L1,L2, L5	1Hz	434.25 MHz	+/- 1MHz
Link Mode	Network (LAN)	serial, NMEA	simplex, Com	



Statistics based on tracking ships…







Conclusions and plans

- Modernized DGPS-PL system is operational in Polish responsibility zone, RTCM corrections are being internationally available,
- DGPS+AIS data became the main source of information for traffic analysis, FSA and evidence purposes
- Additional 2 remote IM stations are planned,
- New transmitting system is under construction
- All of the described systems require permanent (24h/7d/365d) system monitoring,

Thank You for Your attention

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