Parker Maritime AS

Practical water level correction for near shore surveys in Norway.
Using GNSS
and the official tide gauge network

ENGINEERING YOUR SUCCESS.

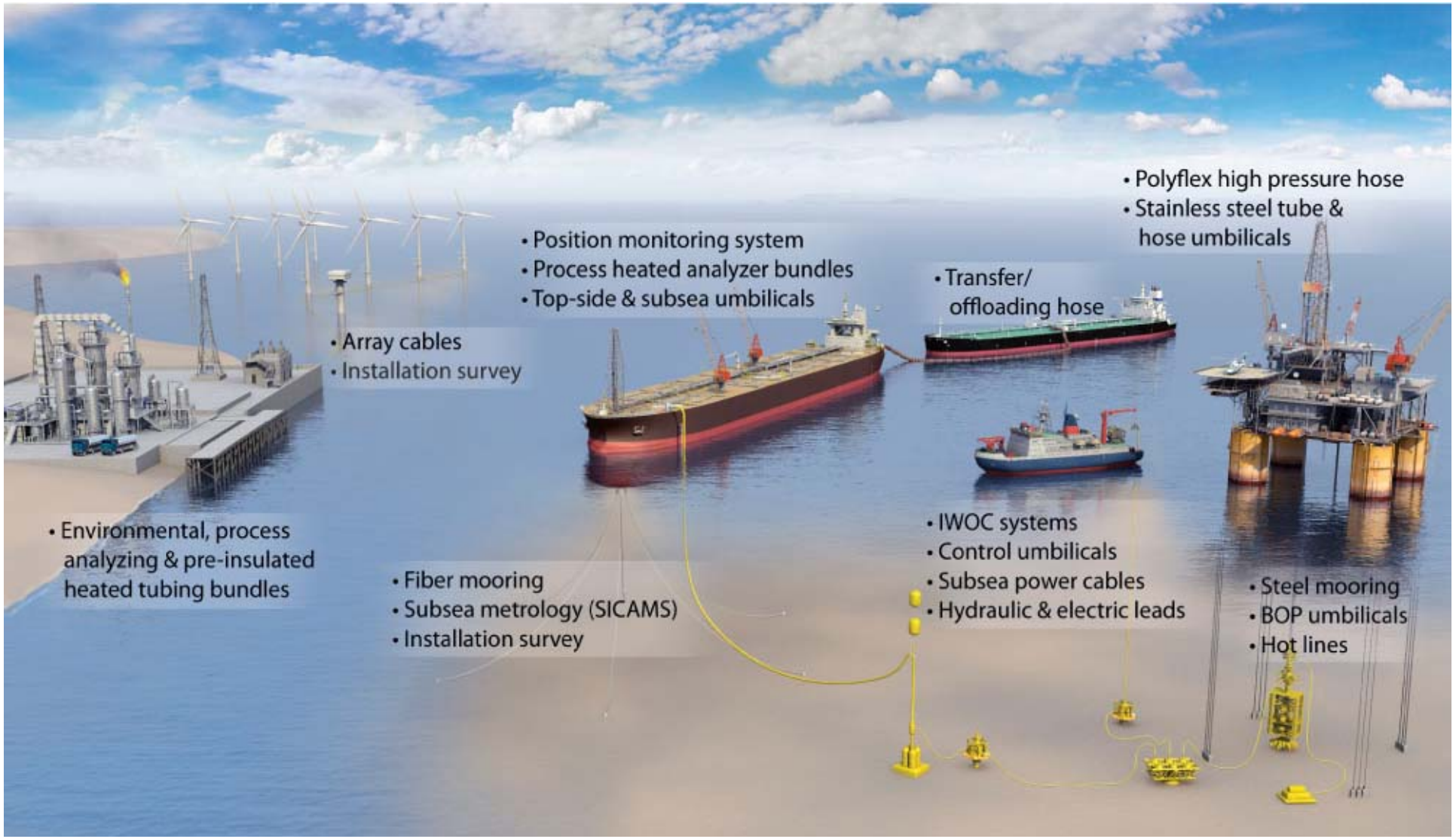
February 2014

Content

- Company information
- Near-shore seabed survey operations
- The official tide gauge network operated by “Kartverket”
- Recording ellipsoidal height from RTK positioning
- Tools for analysis GNSS RTH v.s. observed water level
- Comparing surveys from same area
- Conclusion

Manufacturing & Administrative Locations

The World of EPD



Parker Maritime AS – Stavanger

Brief history of PMT

1954 — **Bloms Oppmåling**
(Private Company)

1972 — **Bloms Oppmåling**
(Office in Stavanger)

1988 — **Blom ASA**
(Listed in Oslo Stock Exchange)

2004 — **Blom Maritime AS**
(New Name)

2007 — **Scan Maritime AS**
(Scan Subsea demerged from Blom ASA)

2007 — **Parker Maritime AS**
(Acquired by Parker)

Parker

PMT Strengths

- 40+ years offshore experience
- 40+ highly specialized engineers
- Strong legacy with key players in the offshore market
- Worldwide service and solution provider
- State of art equipment, tools and software

Pictures: A surveyor or many, total station

Services Provided

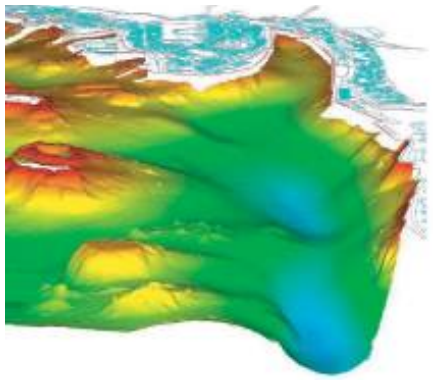
Dimensional Control

Vessel control
Gyro Calibration & GNSS health check

Position Monitoring System

Subsea Metrology

Windmill installation survey support



Charting and marine services

Nearshore seabed survey operations

Getting ready for operation, loading on truck at our office

Nearshore seabed survey operations

Launch in Krisitiansand for depth verifiction for cruise ship quay

Nearshore seabed survey operations

Cruise ship safely moored in Krisitiansand

Nearshore seabed survey operations

Launch in Ståvann along E 134 at 980 m above sea

Nearshore seabed survey operations

Challenges to reach the water when working in fresh water

Nearshore seabed survey operations

Narrow and difficult access, fresh water near Bergen, Rv 557

Nearshore seabed survey operations

Ready for launch in Bjørndalsvatnet , near Bergen, Rv 557

Nearshore seabed survey operations

We got it safely in and out of the fresh water

Nearshore seabed survey operations

Transport to Honningsvåg for work at Veidnes

Water level observations by Kartverket

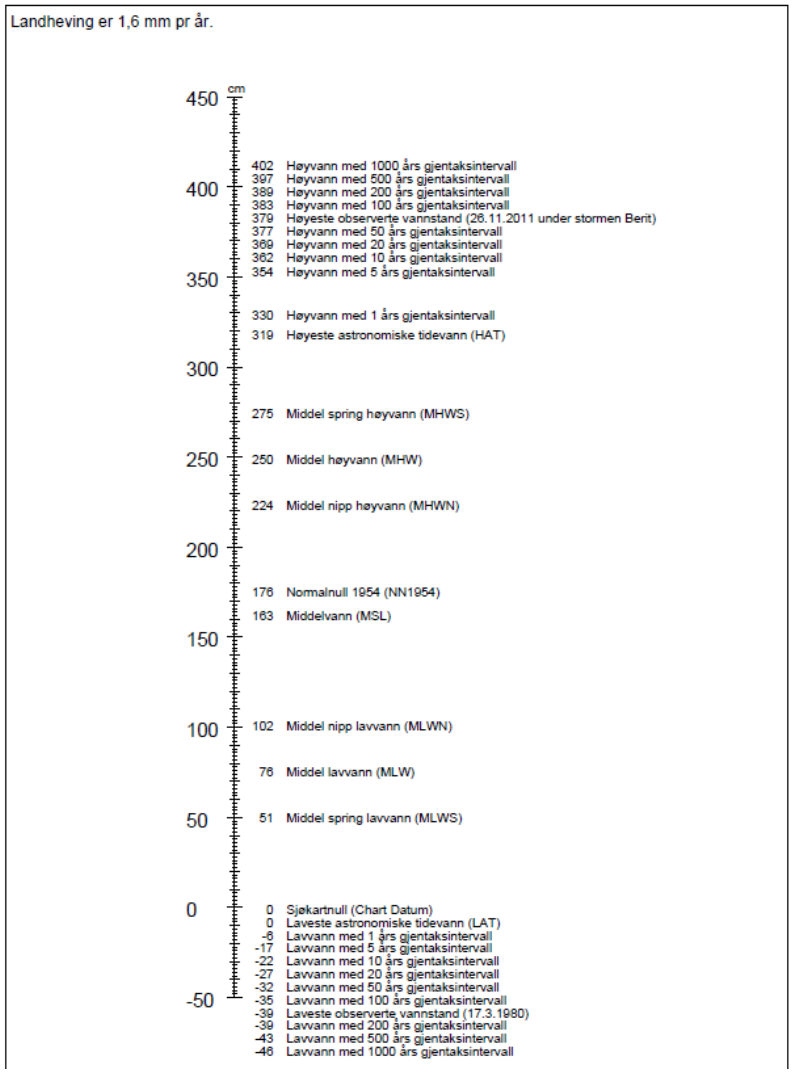
- Operates 24 permanent water level stations from Oslo to Kirkenes
- Measurements available on-line from http://sehavniva.no/ 10 – 20 minutes after observation
- Provide official water level and land rise information
- Observed water level modeled to any geographic location in Norway
- Water level can be downloaded at 10 min interval as text files

Source: http://sehavniva.no/

Official water level definition at Sarnes

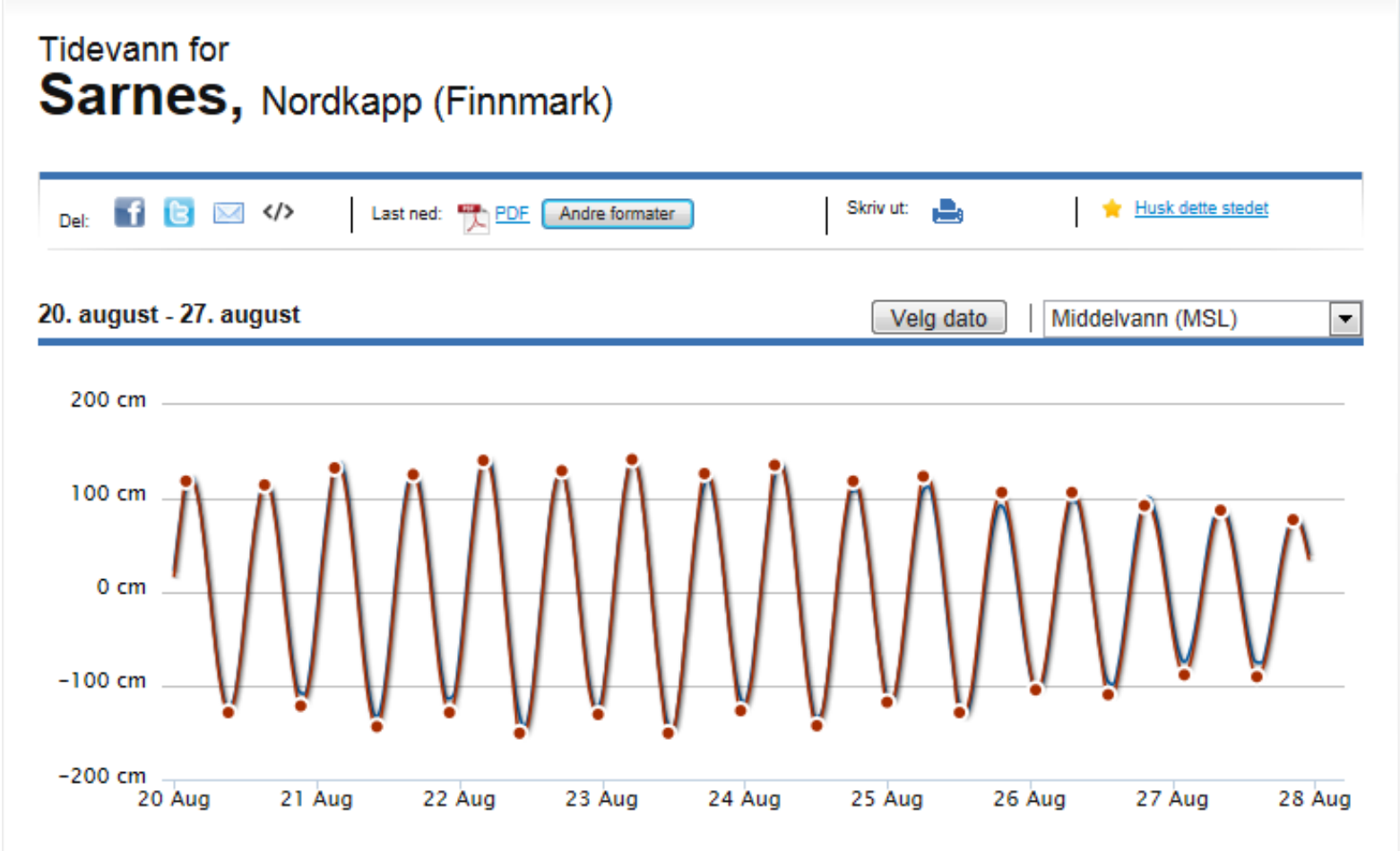
Kartverket

Nivåskisse for Sarnes



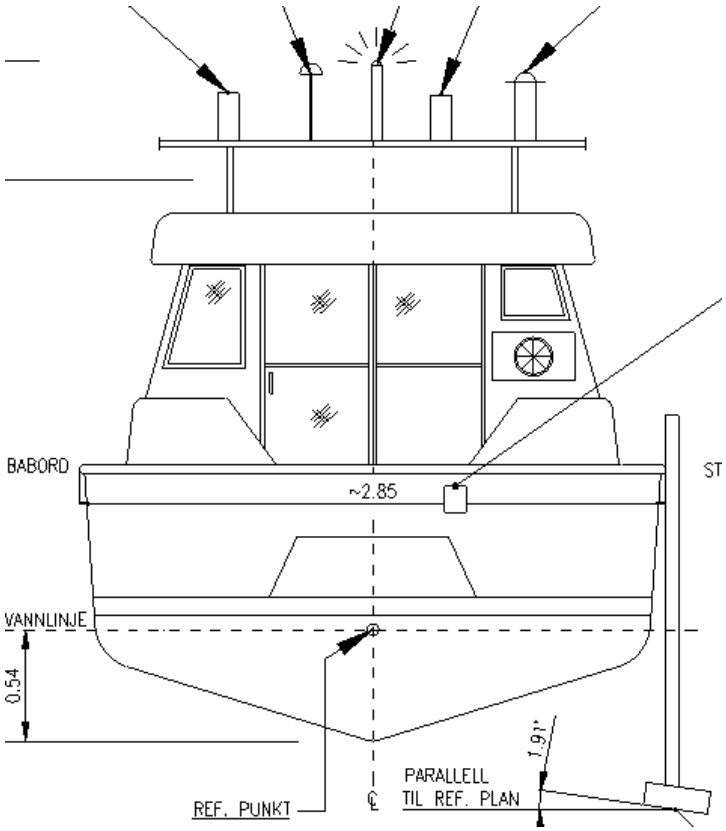
- Provides information about official vertical reference levels in Norway
- Chart Zero
  (LAT) north of Bergen
- MSL - Mean Sea Level
  (based on long term observations)
- NN1954 (NN2000?)
  Vertical reference in Norwegian land maps
- Land rise in mm / year

Observed and predicted water level



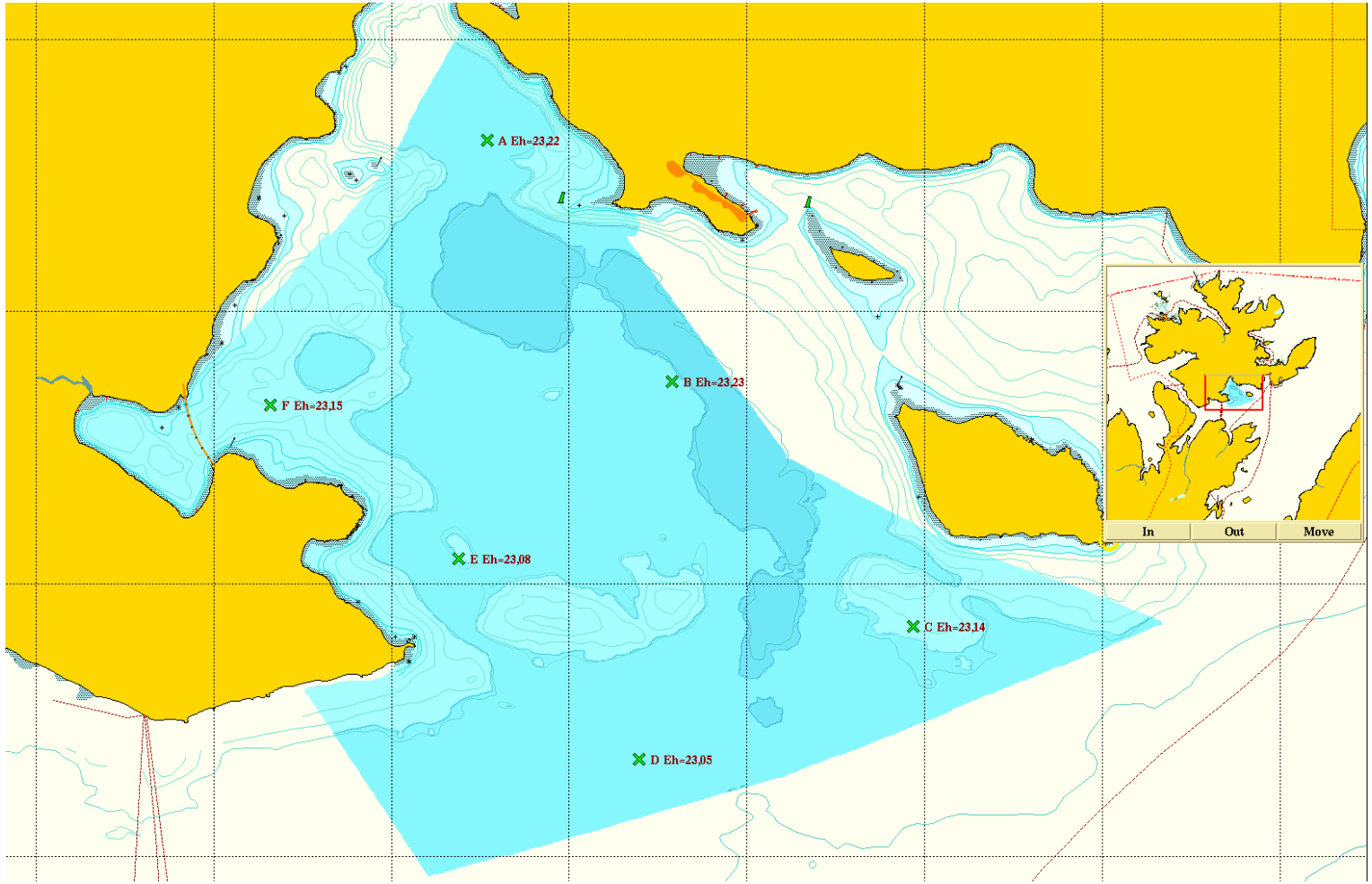
Water level observations at Sarnes close to Veidnes in Finnmark

Recording ellipsoidal height from RTK



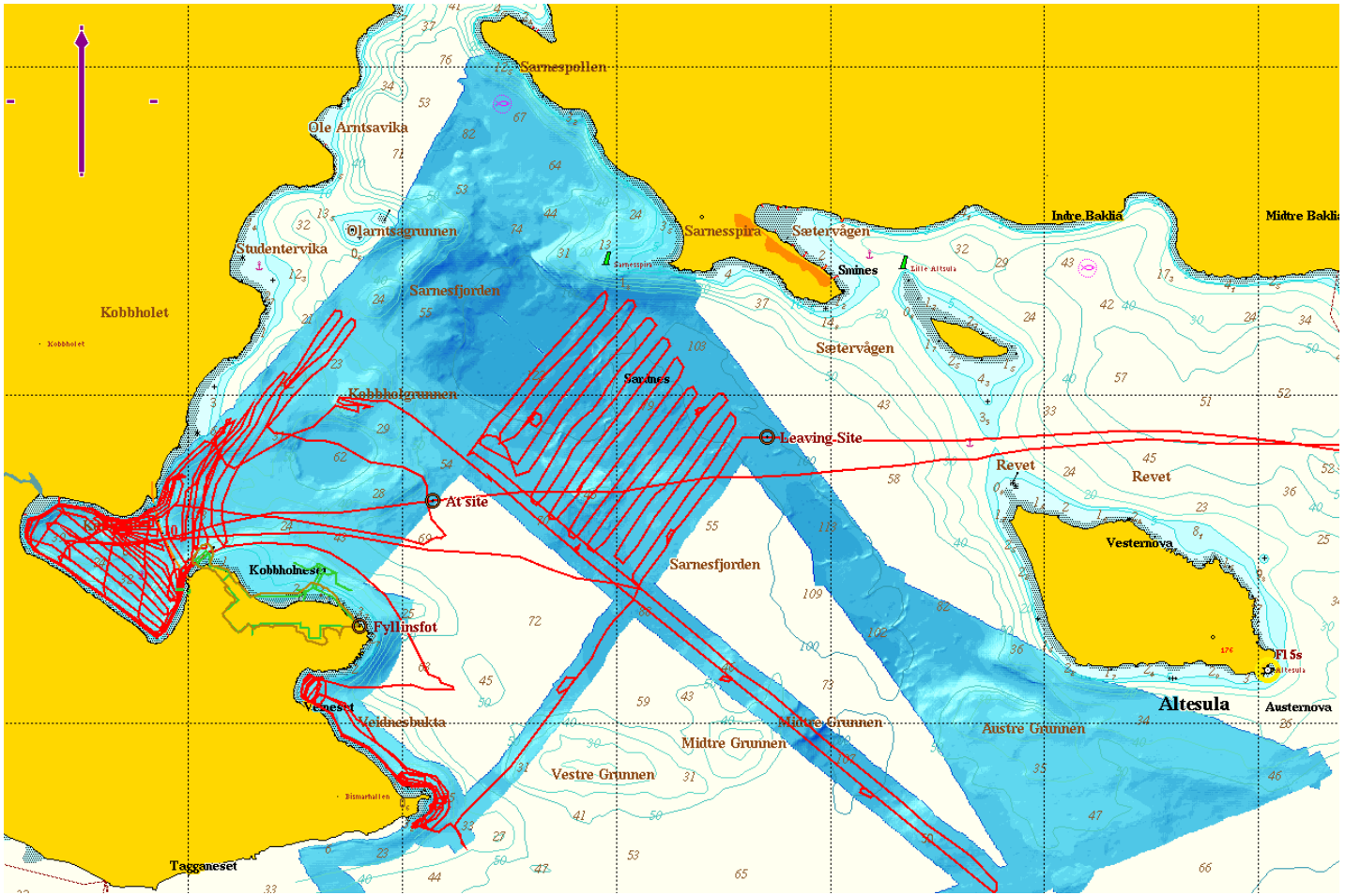
- Positioning by Seapath 330 RTK with GPS and GLONASS
- Corrections from CPOS to EUREF 89 transferred using ICE net or GPRS, 3G
- Lever arm correction by Seapath to an MP at the water line.
  Also MP at antenna for PPP processing if required
- Both positioning streams logged in SIS at 2 Hz into KM raw.all files
- Extracted and combined from all logged lines in Neptune pre-processing

Establishing Geoid - ellipsoid separation



Calculating geoid – ellipsoid separation for random locations in the suvey area using href2008a in Wsktrans.

Typical survey coverage for a day



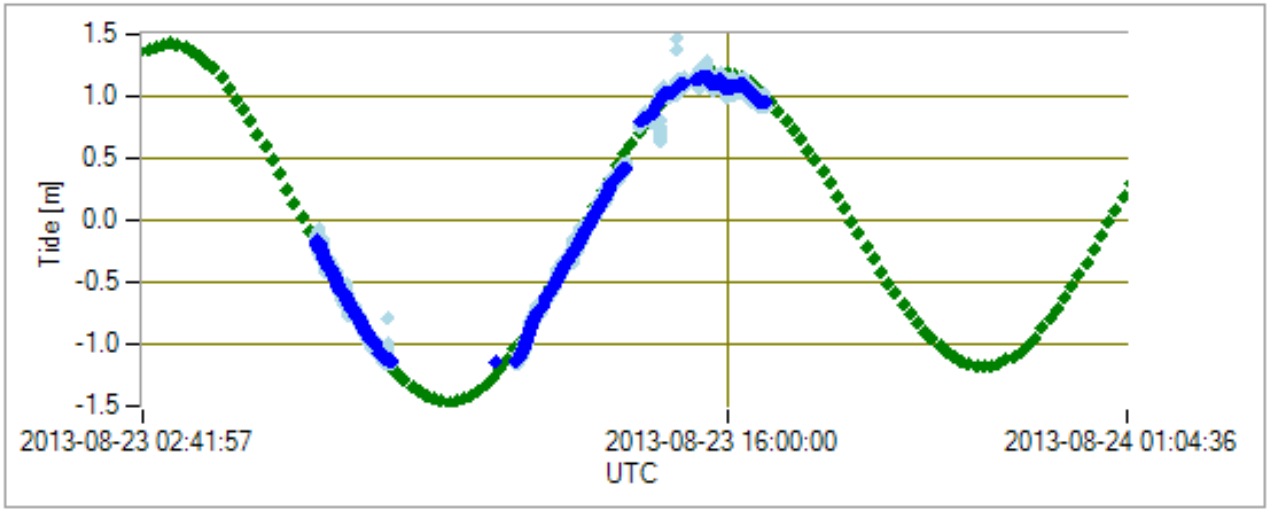
Vessel tracks for survey lines performed on the 23rd of August 2013.
Number of lines 177, sailed distance 89.4 km, net survey distance 71.5 km

GNSS RTH v.s. observed water level

Parker Maritime

Water level data
RTH Bintang vs MSL Sarnes

Start UTC	Stop UTC
2013.08.22 22:00	2013.08.24 21:50



Tide:	Timeshift to get UTC [s]: -7200
	Z correction [m]: 0.00
	Range factor:1.00
	Time correction [s]: 0
RTH:	Z correction [m]: 0.00, Geoidal height [m]: 23.17

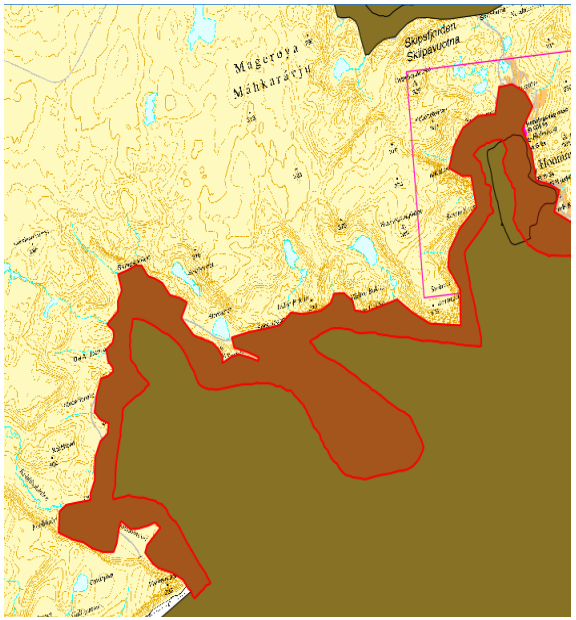
Comparing filtered RTH with observed WL from Kartverket

Procedure

- Logg ellipsoidal height at water line
- Establish separation
- Download observed WL modeled to location from Kartverket
- Timeshift to UTC
- Compare to filtered RTH
- Write water level correction files for post processing

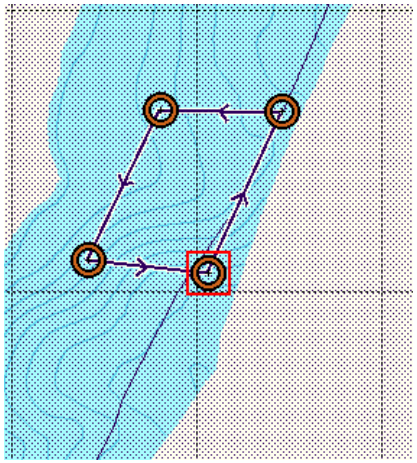
Parker

Comparing against Kartverk surveys

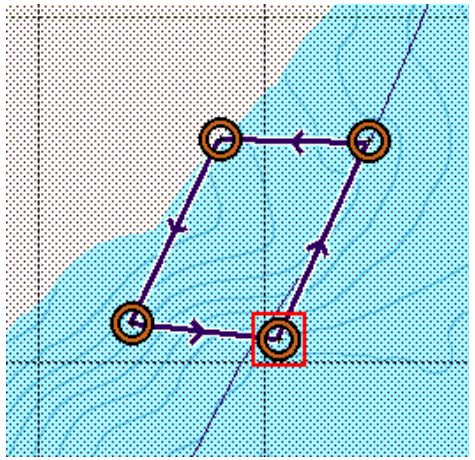


Same area in two different surveys

Hydrograf-3006



PMT Aug 2013



Volume calculation	
Wet area	33255 m2 ~= 0.03 km2
Water volume	618568 m3
Mean depth	18.60 meters
Terrain volume	Not calculated
Depth range	0 to 9999 meters
Calculated at	12/12-2013 19:52:52

Volume calculation	
Wet area	33252 m2 ~= 0.03 km2
Water volume	619537 m3
Mean depth	18.63 meters
Terrain volume	Not calculated
Depth range	0 to 9999 meters
Calculated at	12/12-2013 19:52:19

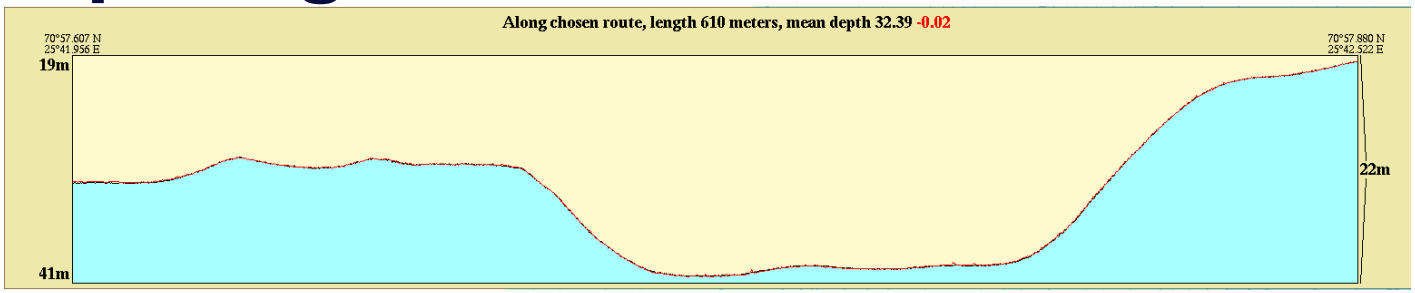
Purchased soundings from Hybas:

- hydrograf-3006, EM 3000, 2006
- XI-235EM, EM 100, 1995

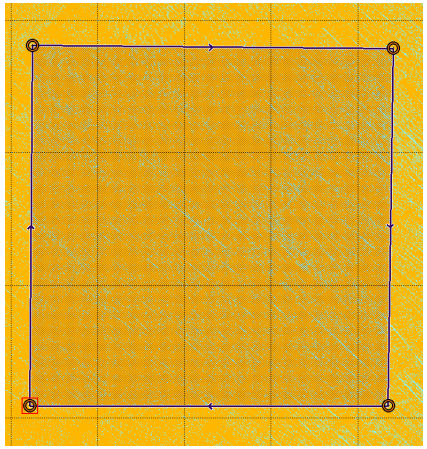
Adjusted to NN54

Mean depth Hydrograf 18.60 m
Mean depth Parker survey 18.63
Difference 3 cm

Comparing cont..

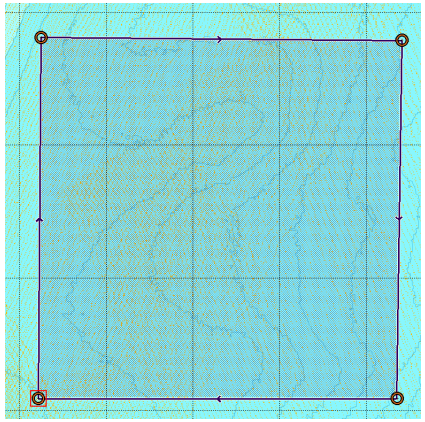


Same profile through different models hydrograf-3006 and PMT aug 2013



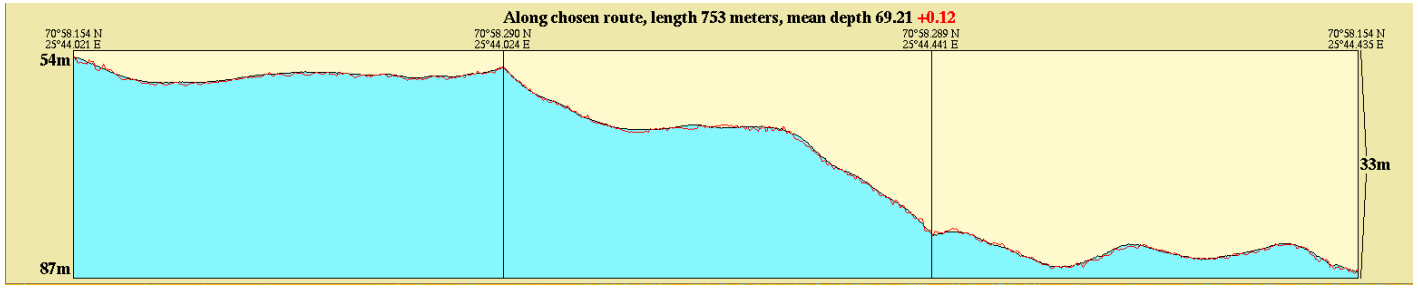
Volume calculation	
Wet area	62978 m2 ~= 0.06 km2
Water volume	4229808 m3
Mean depth	67.16 meters
Terrain volume	Not calculated
Depth range	0 to 9999 meters
Calculated at	12/12-2013 19:57:12

PMT aug 2013
Point density about 10 times more.



Volume calculation	
Wet area	62963 m2 ~= 0.06 km2
Water volume	4237612 m3
Mean depth	67.30 meters
Terrain volume	Not calculated
Depth range	0 to 9999 meters
Calculated at	12/12-2013 19:57:39

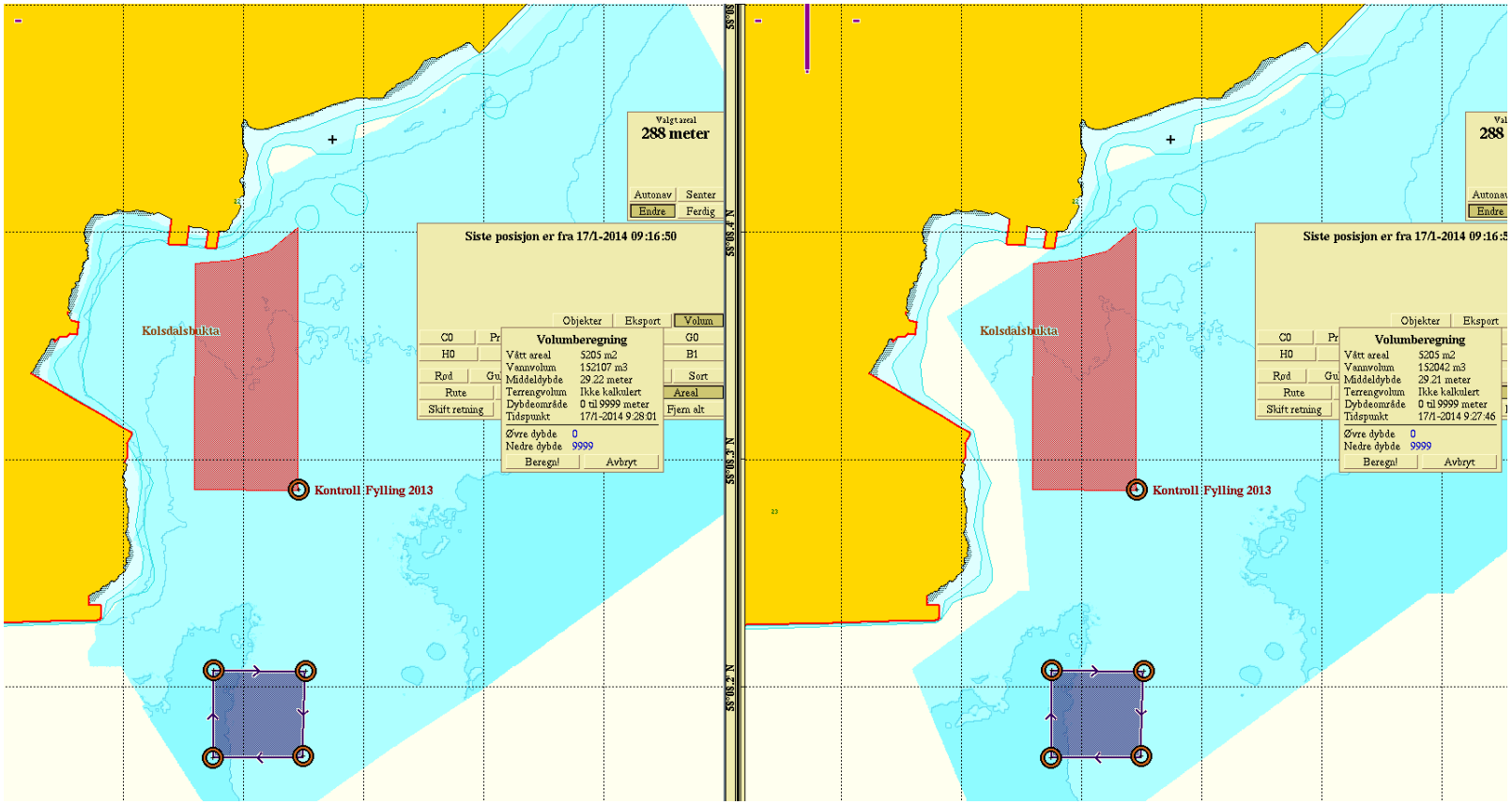
IX-235EM
Average difference 12 – 14 cm



Comparing PMT aug 2013 and IX-235EM-1995

Comparing cont..

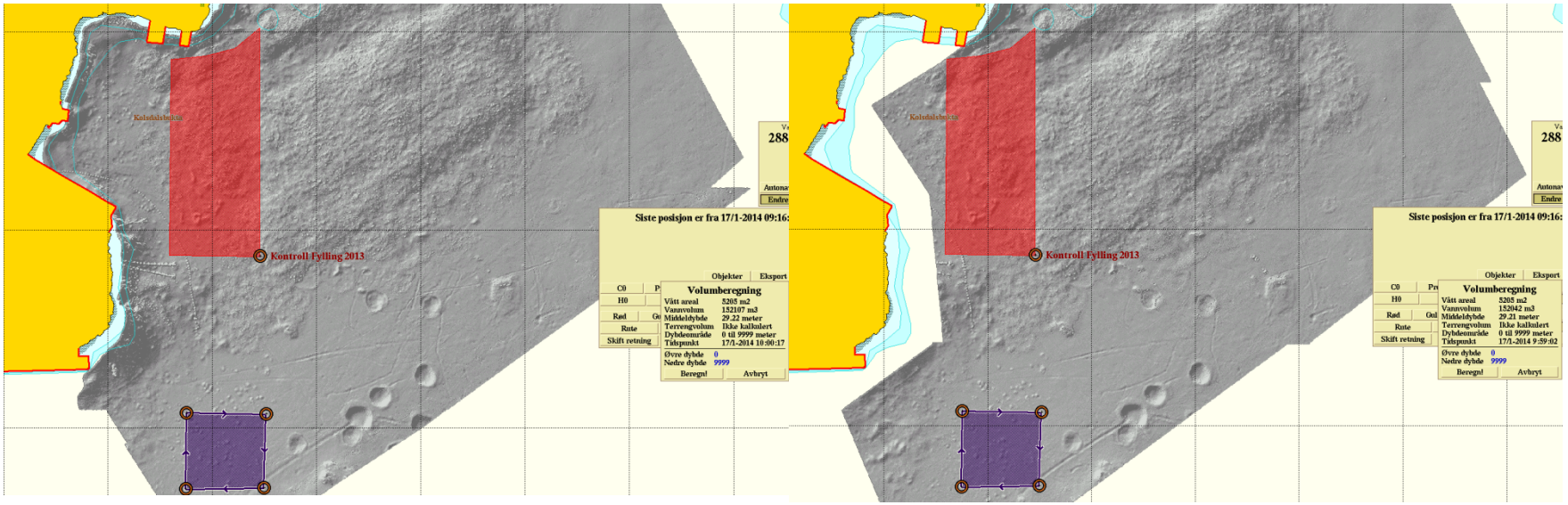
Side by side same area Kristiansand jan 2012 (left) and july 2013 (right)



Average difference 1 cm in unmodified area

Comparing cont..

Side by side same area Kristiansand jan 2012 (left) and july 2013 (right)



Rock dumped area for new container quay in Kristiansand

Very soft seabed.

Rock dump subsided about 50 cm between jan 2012 and july 2013.

Conclusions

- Obtaining water level observations compared to GNSS observation works near-shore Norway
- We have observed some differences between GNSS and water-level model when working at long distance from permanent recorders. Example 20 – 50 cm in Sognefjorden
- Consistent water level corrections make it possible to perform repeated surveys with high accuracy
- We always use the official water levels when performing hydrographical surveys for delivery to “Kartverket”


Thank You
Questions?