economie
FOD Economie, K.M.O., Middenstand en Energie

Results of the RV Simon Stevin EM2040 Sea Acceptance Test and comparison with EM3002D data from the HS Ter Streep and RV Belgica.

Cattrijsse Andre, Degrendele Koen, De Mol Lies, Naudts Lieven, Roche Marc, T'Jampens Michiel, Vanparys Kris, Versteeg Wim and Verstraeten Johan

VLIZ

AFDELING KUST

VLAAMSE HYDROGRAFIE

MUMM

A mix of the following topics:

- A new research vessel, the Simon Stevin
- A new project to map the entire Belgian Continental Shelf
- And troubles with the EM2040 on board the Simon Stevin

May 2012: the new RV Simon Stevin

- Length: 36 m
- Beam: 9.4 m
- Draught: 3.5 m
- Maximum speed: 12 kn

- Area of operations: Southern Bight of the North Sea & eastern part of the English Channel

- Physical oceanography
- Fisheries research
- Marine geology
- Microbiology
- Chemical oceanography
- Geochemistry
- Maritime archaeology
- Marine pollution

- Year of construction: 2012
- Shipbuilder: Damen Shipyards Group

- Flag: Belgium
- Port of registry: Ostend

May 2012: the new RV Simon Stevin

Acoustic equipment

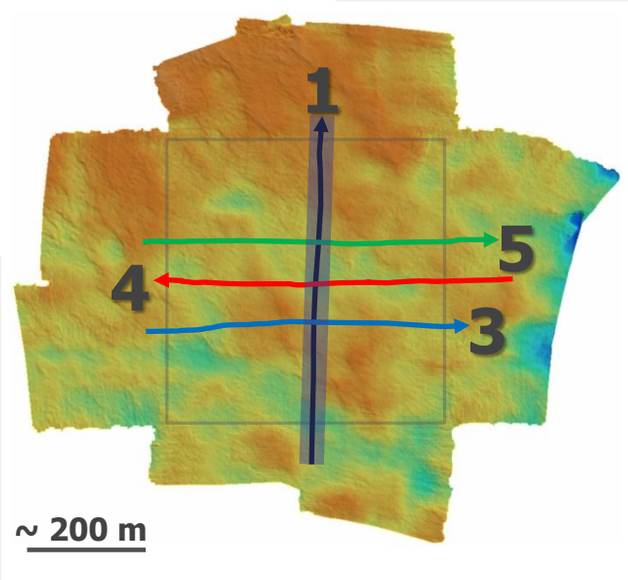
- EM2040 Single Head
- Draught sensor : ATM
- SV profiler : Valeport
- Mini SV sensor : Valeport
- Octans IV from IXSEA
- RTK GPS MGB Tech (~~LRK-RTK~~)
- ADCP : RDI instruments, 600kHz
- Odom CV300 : 200 & 33kHz
- Singlebeam (navigation) : 50kHz (JRC, jfe-380/200)
- Speedlog : 2 MHz (JRC, jln-205)

Research Facilities
Vlaams Instituut voor de Zee vzw
Flanders Marine Institute
VLIZ – InnovOcean site

July 2012: SAT of the Simon Stevin EM2040

SURVEY 23/07/2012 @ 300 kHz

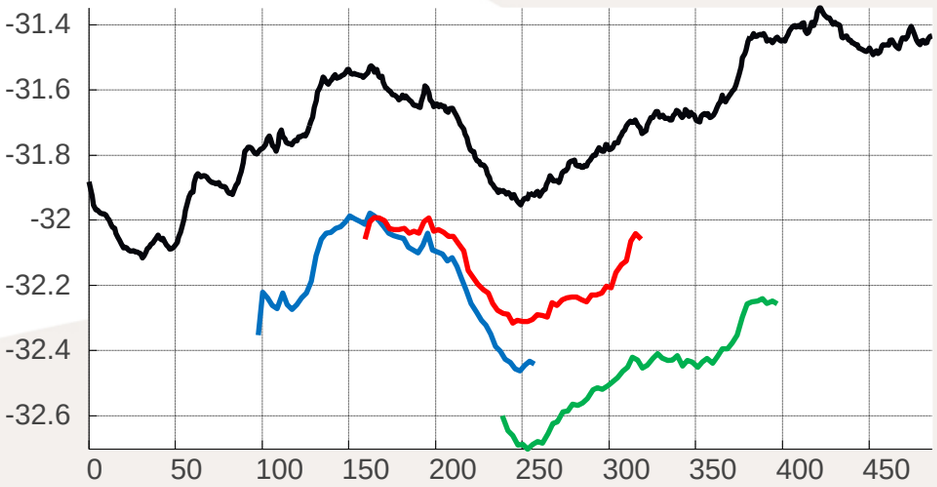
SAT area 1: flat gravel area



Belgica EM3002D
SAT area 1 reference model
Min depth = -27.6 m
Max depth = -29.3 m

CROSS SECTION (x and y in m)
Along nadir of line 1, across lines 3, 4 and 5

Without tide reduction



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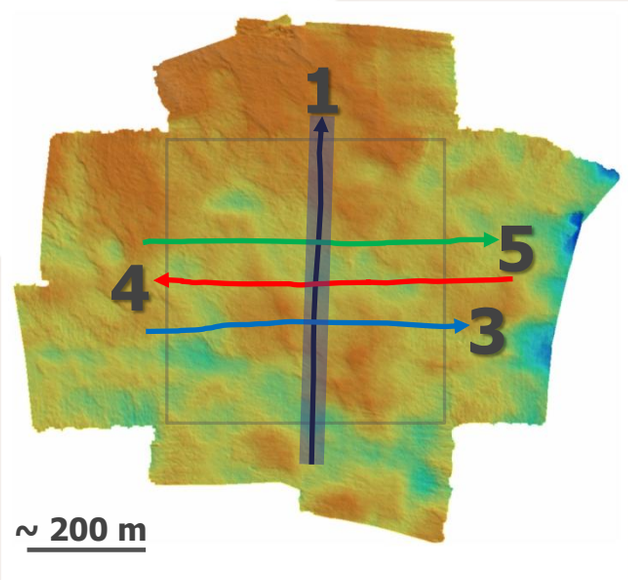

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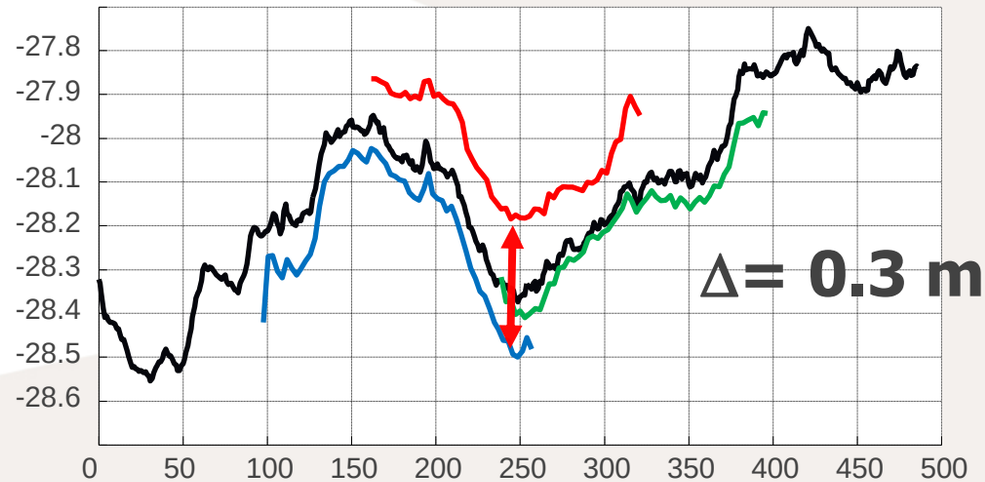

Complete inability to model a coherent surface from this data!

July 2012: SAT of the Simon Stevin EM2040

SURVEY 23/07/2012 @ 300 kHz

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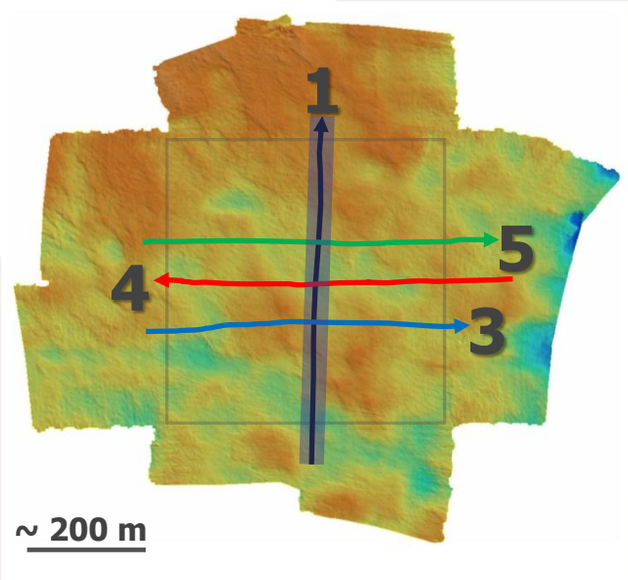

Belgica EM3002D
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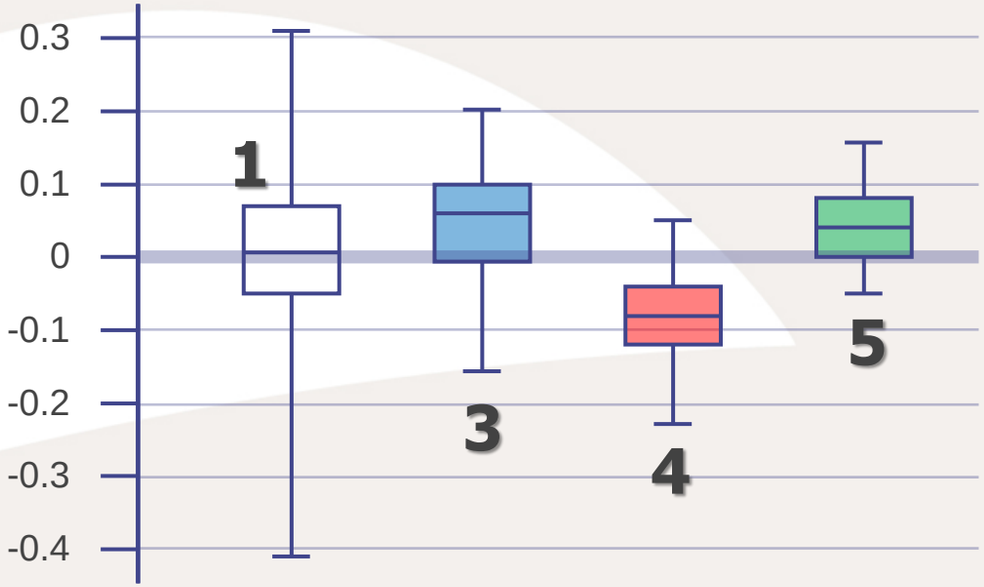
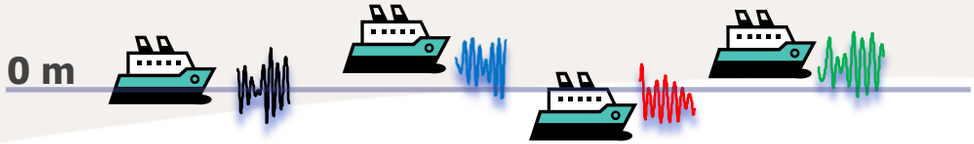
Real-time HEAVE (in m) statistics:

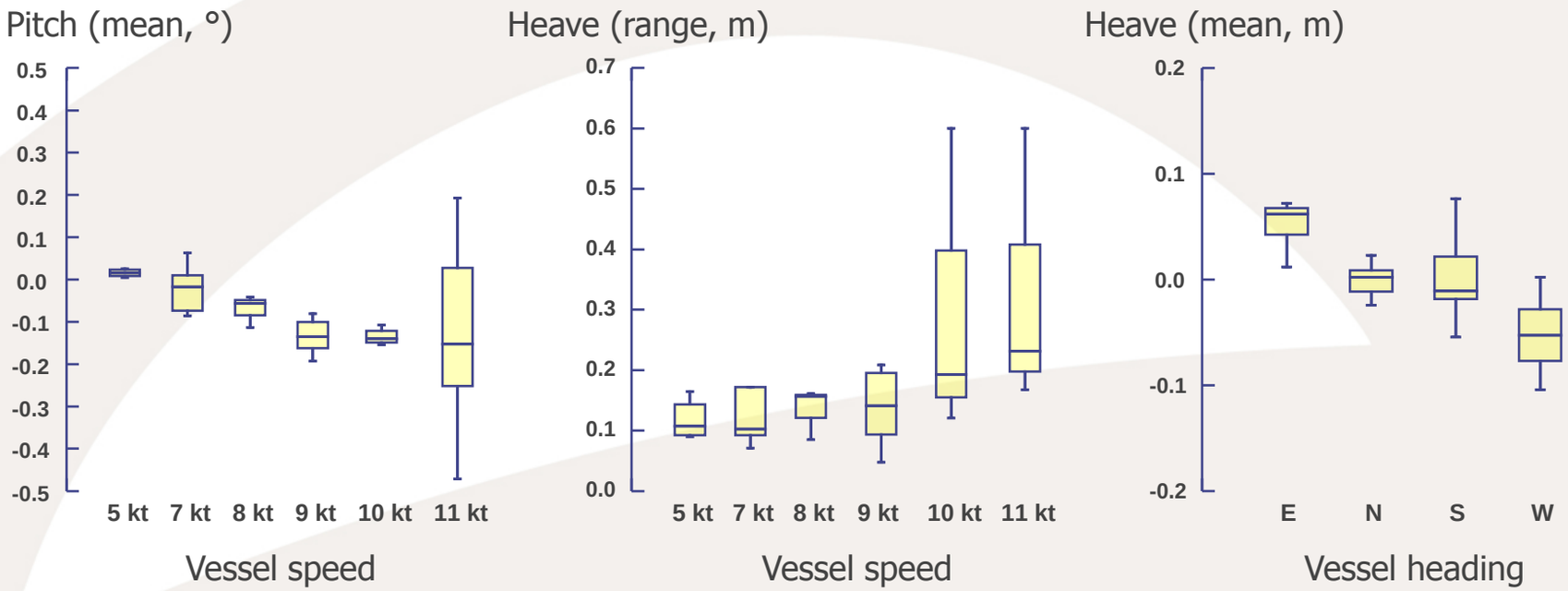




+ ? heading and vessel speed dependent

August 2012: dynamic draught and heave tests

Influence of heading and vessel speed?



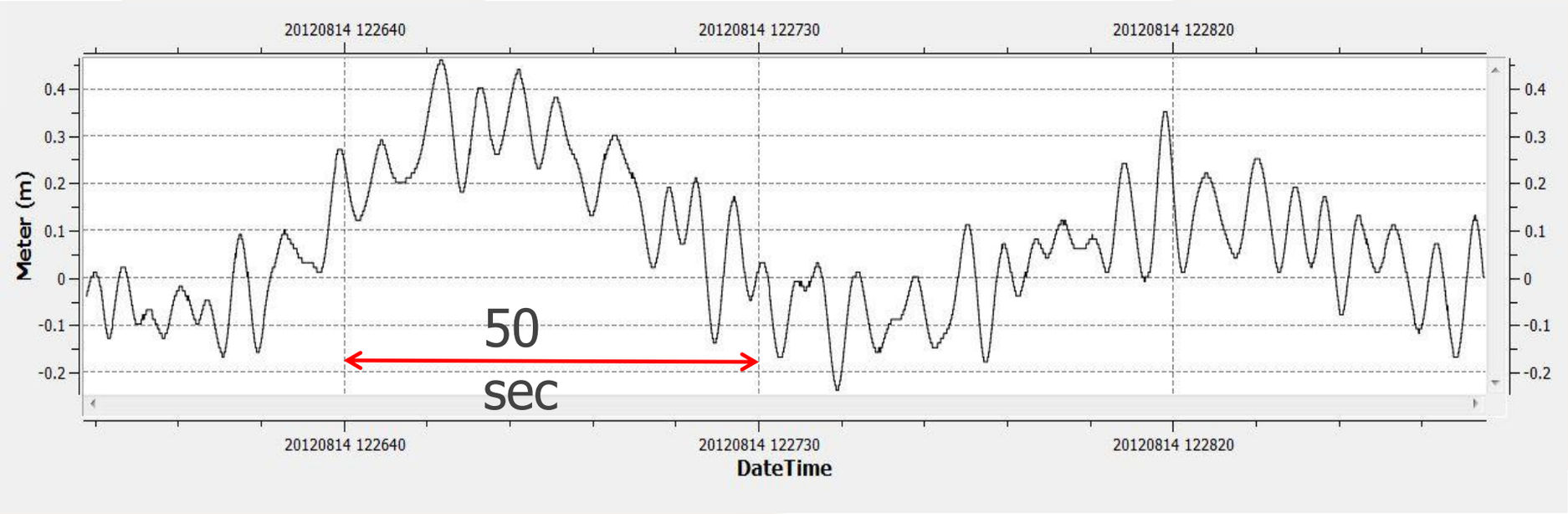
→ Impact of speed and heading on pitch and heave

→ Can dynamic draught explain the large differences in bathymetry?

August 2012: dynamic draught and heave tests

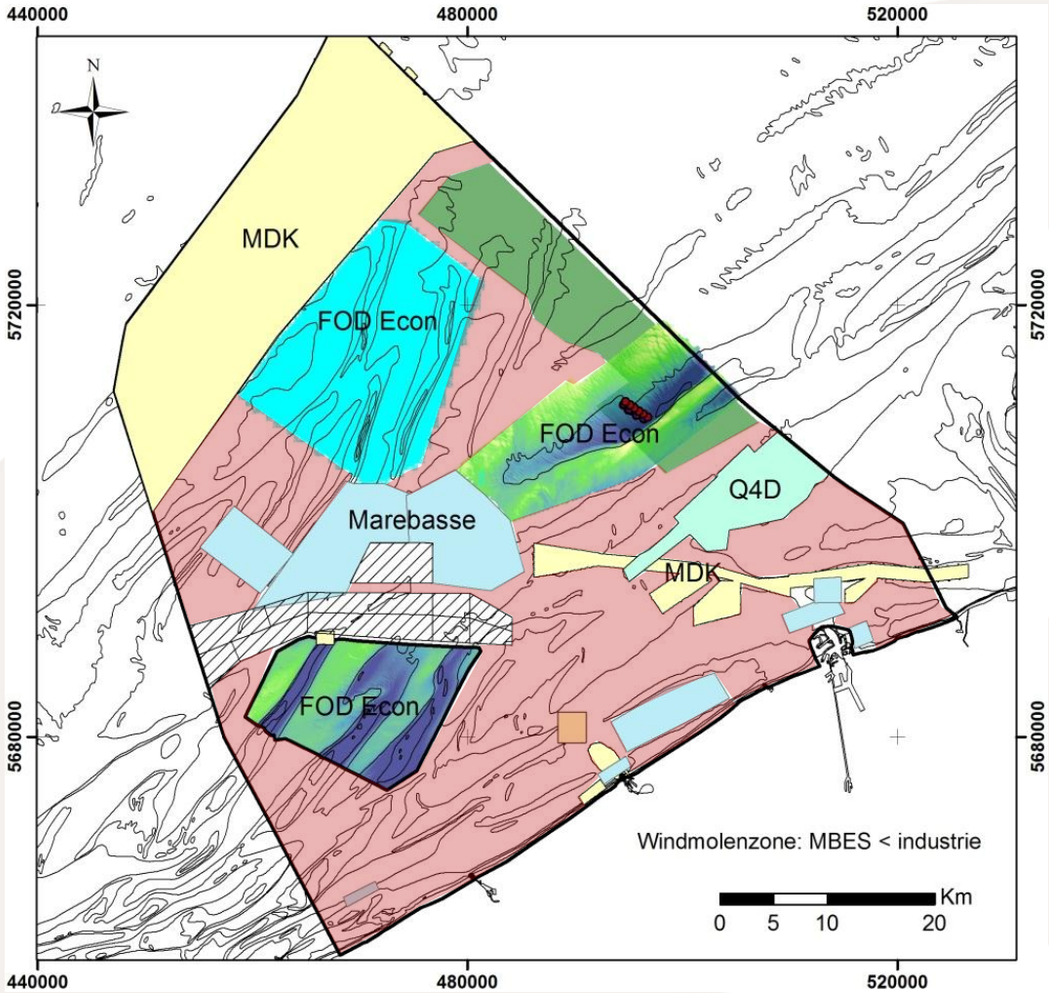
Heave signal:

slowly undulating during a single track (with constant speed and heading)



→ Problem with the motion sensor?

September 2012: Comparison of 3 multibeam systems



From Vera Van Lancker, MUMM

Part of the project to chart the entire surface of the BCS with high resolution.

Two federal agencies:

- MUMM
- FPS Economy
  RV Belgica EM3002D

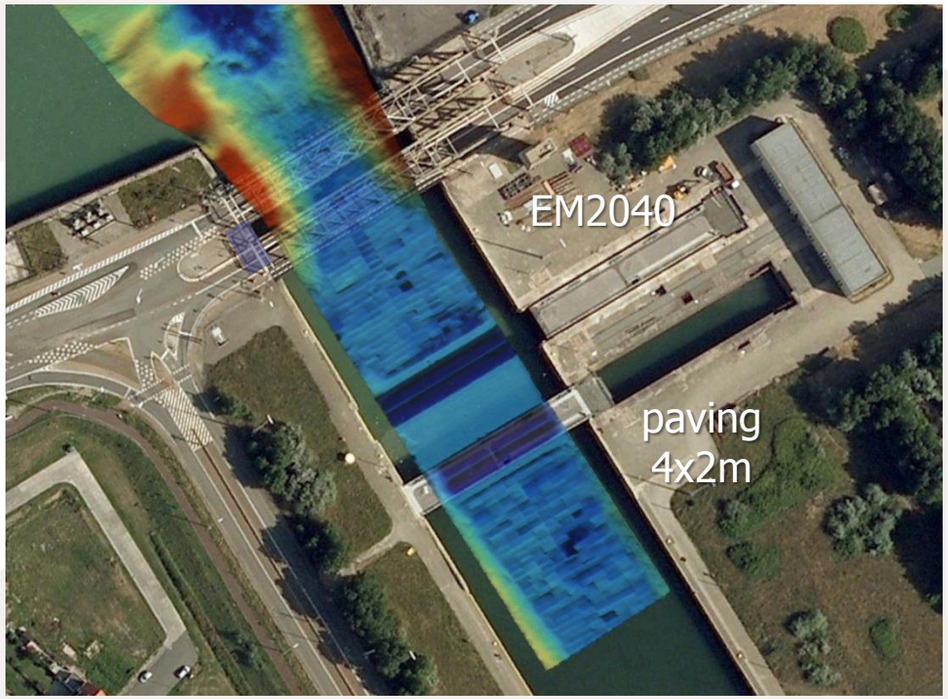
Two regional agencies

- MDK - Afdeling Kust
  Ter Streep EM3002D
- Flanders Marine Institute – VLIZ
  Simon Stevin EM2040

→ Quality assessment and regular comparison between systems

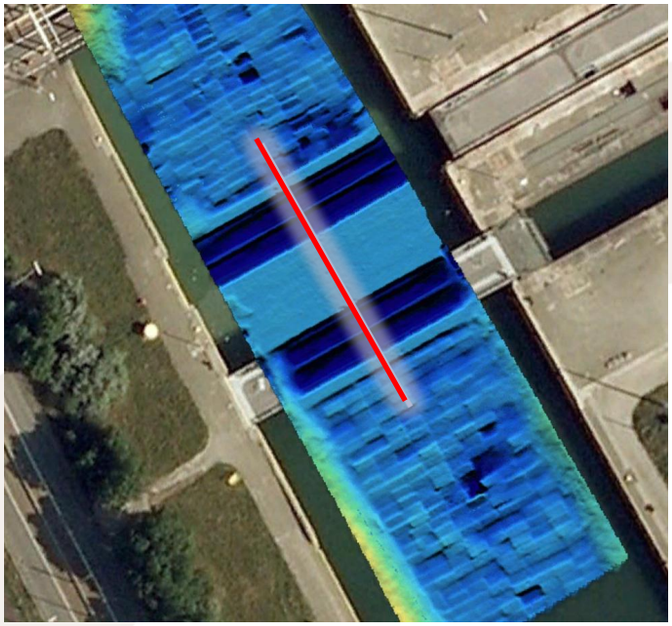
September 2012: Comparison of 3 multibeam systems

Zeebrugge harbor

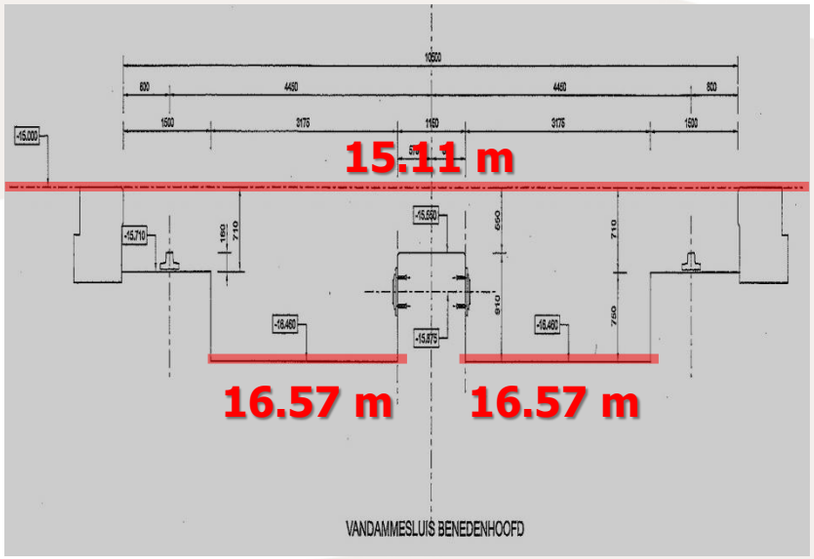


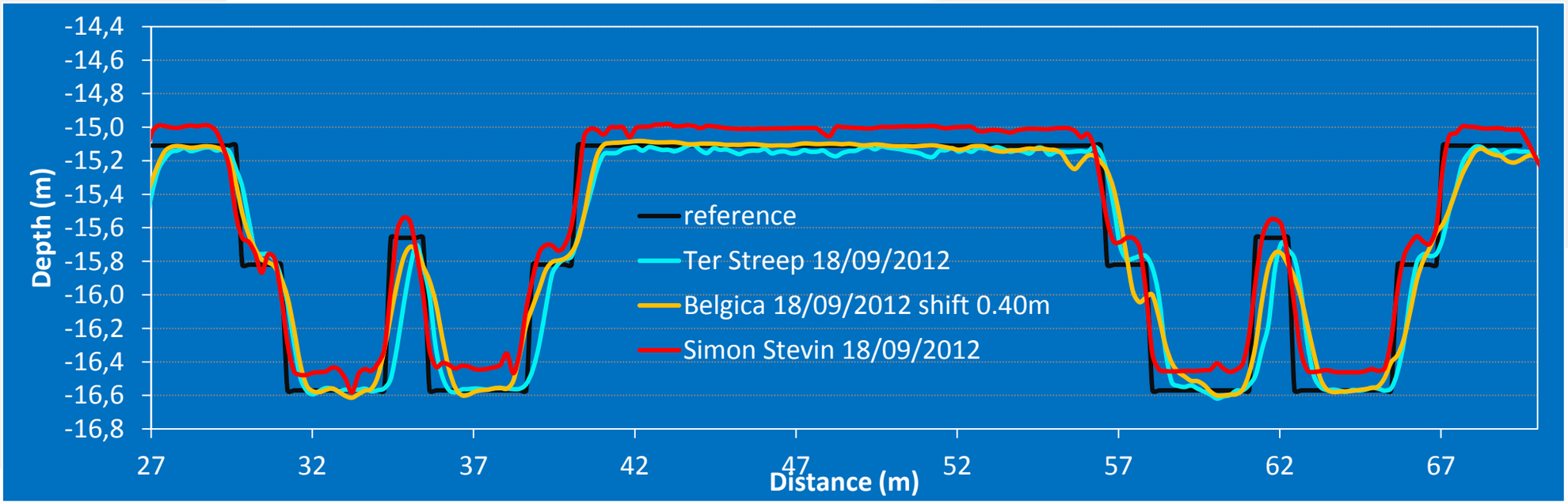
18/09/2012: measurements in a lock (Vandammesluis)

September 2012: Comparison of 3 multibeam systems



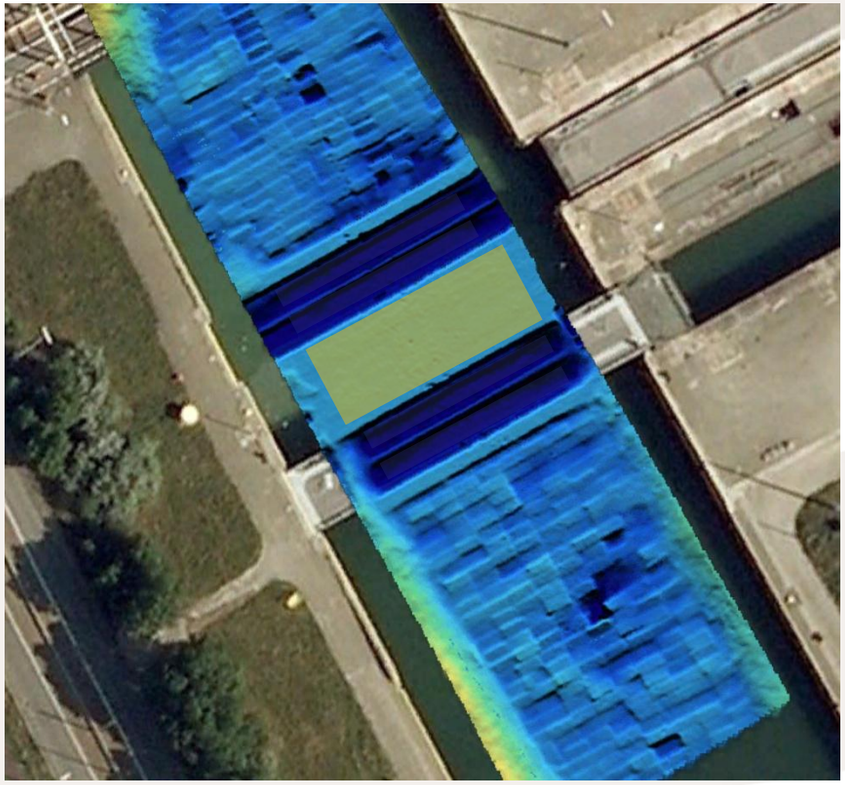
Along track profile

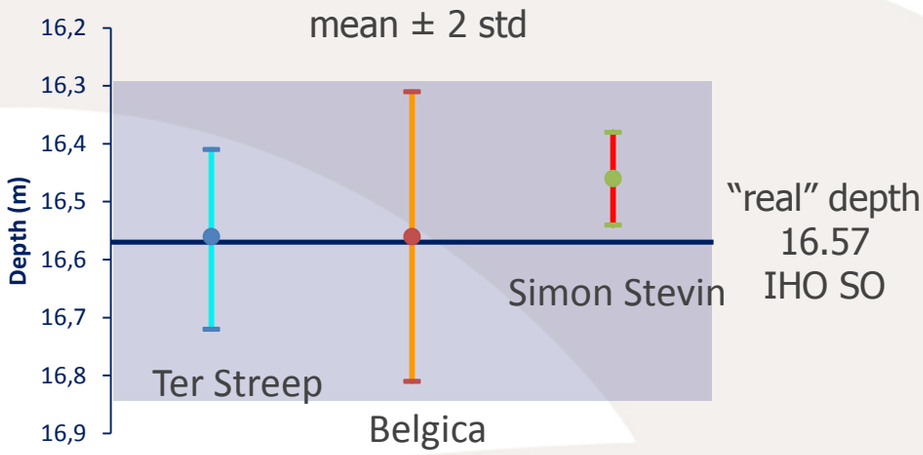


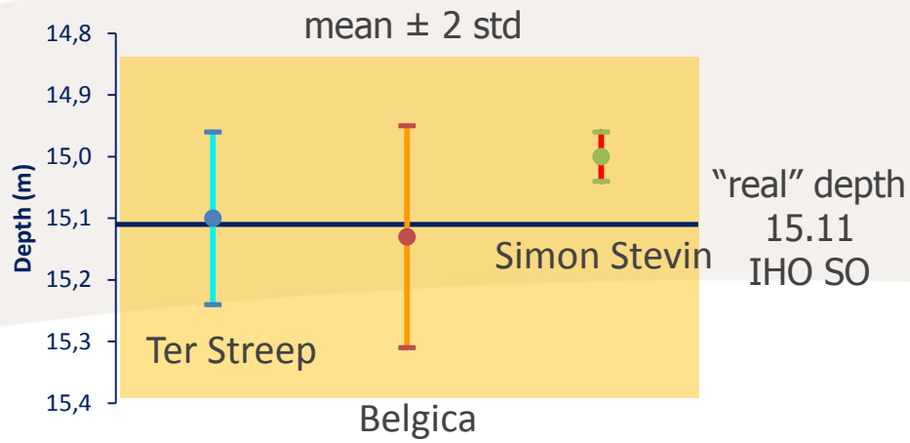


September 2012: Comparison of 3 multibeam systems

Bathymetry results







→ Only the central part of the swath is compared

September 2012: EM2040

full swath

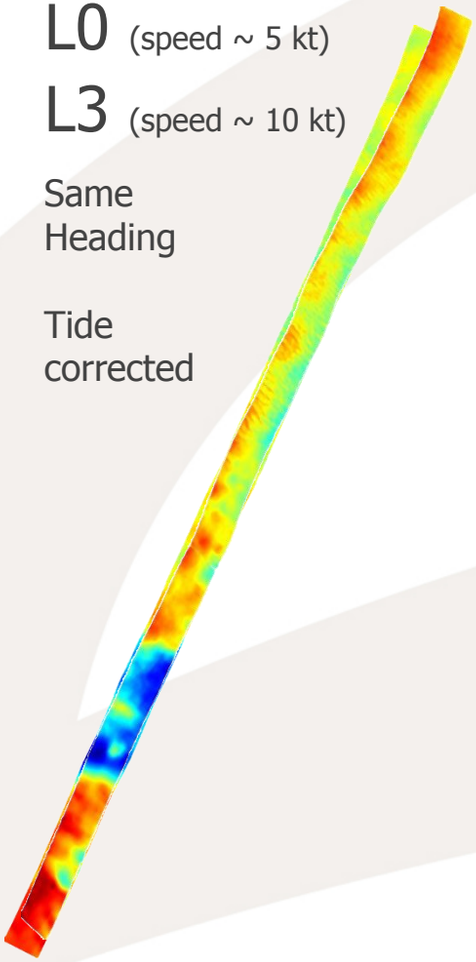
EM2040 measurements:
SURVEY 18/09/2012 @ 300 kHz

L0 (speed ~ 5 kt)

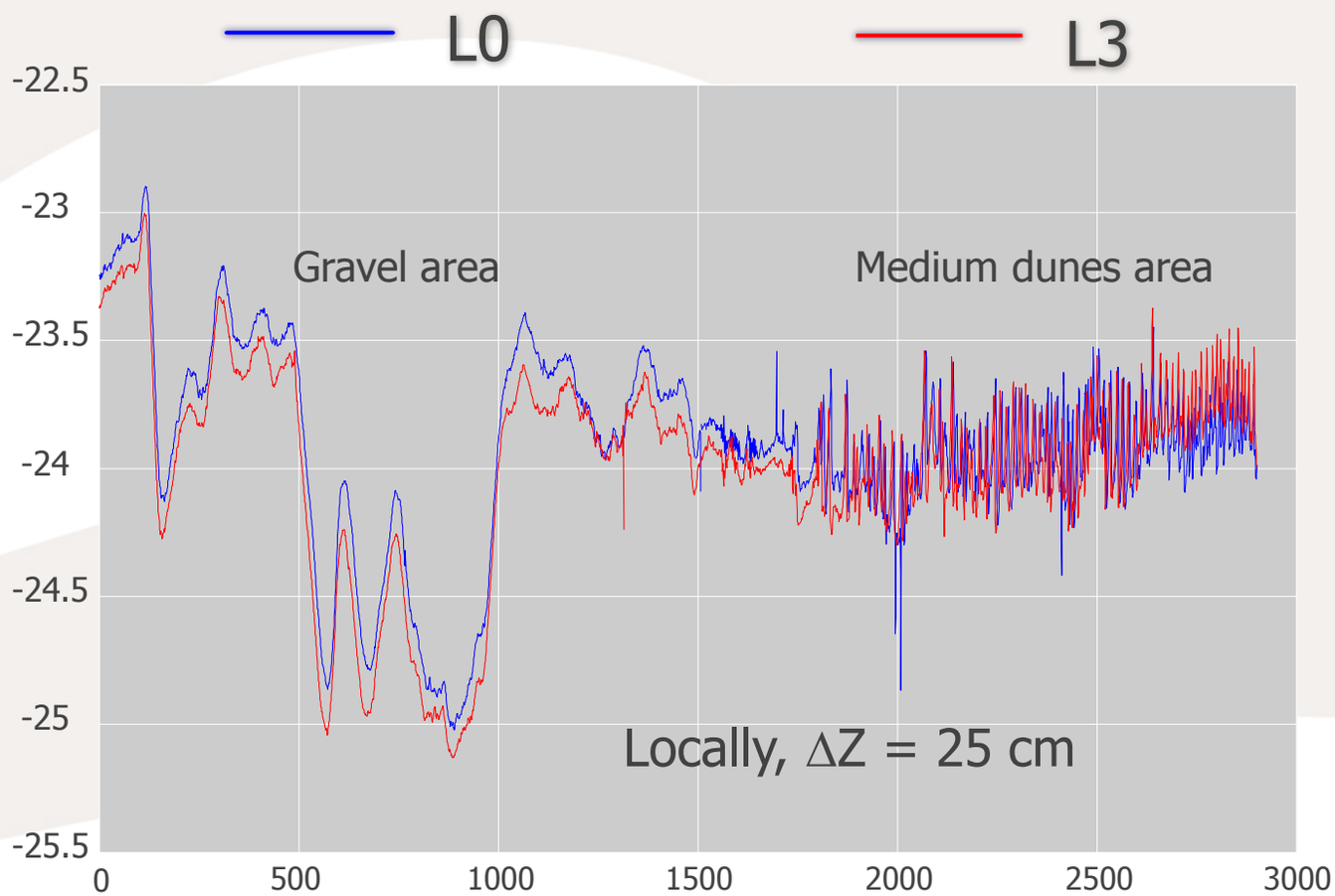
L3 (speed ~ 10 kt)

Same Heading

Tide corrected



CROSS SECTION (x and y in m)



September 2012: EM2040

Real-time heave low frequency fluctuations:

SURVEY 18/09/2012 @ 300 kHz

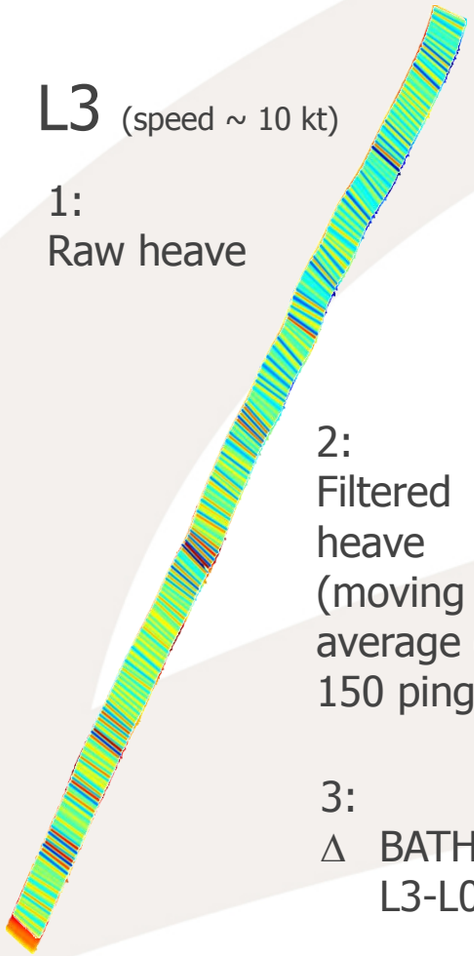
ANALYSIS OF THE L3 REAL-TIME HEAVE:

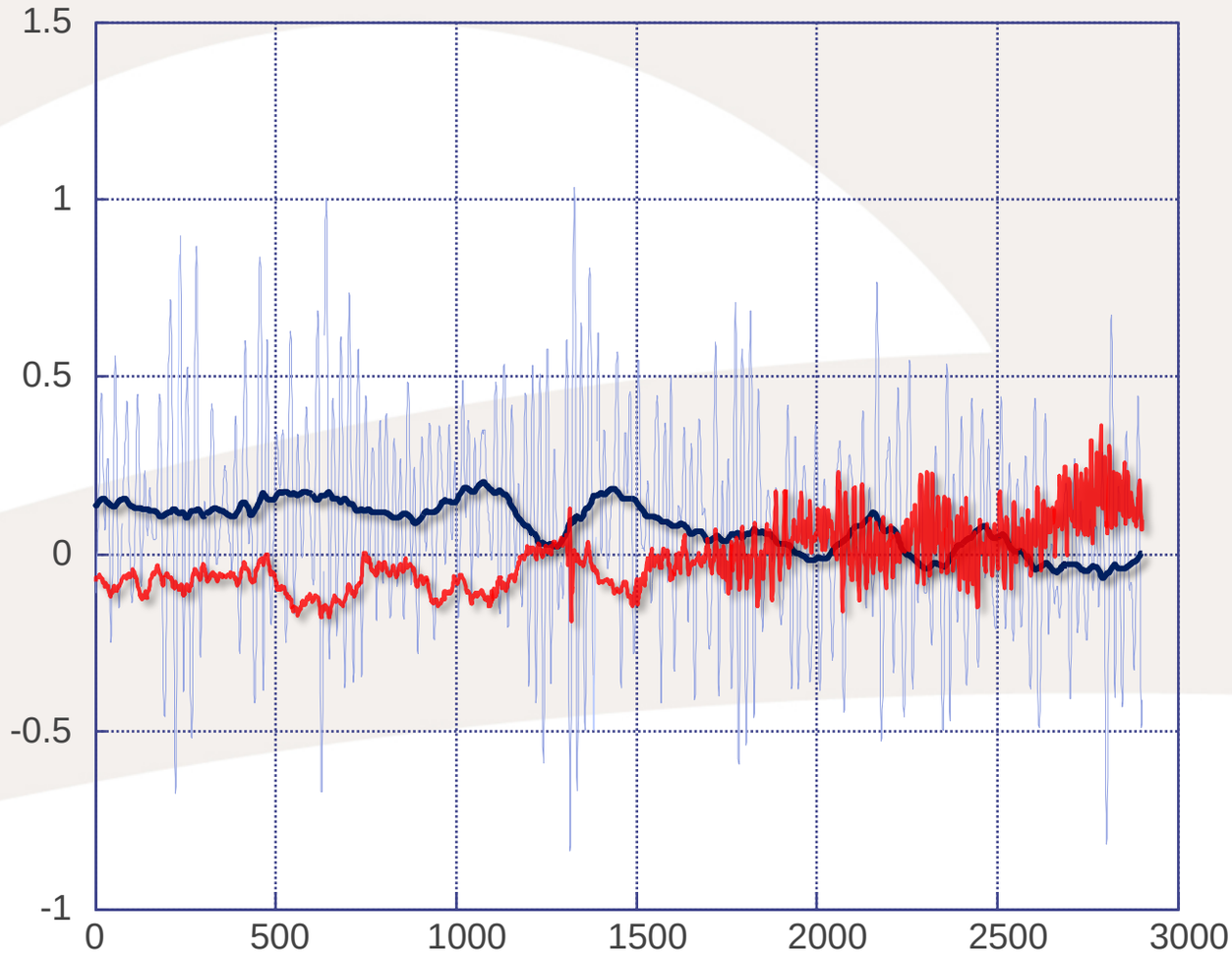
L3 (speed ~ 10 kt)

1:
Raw heave

2:
Filtered heave (moving average on 150 pings)

3:
Δ BATHY L3-L0

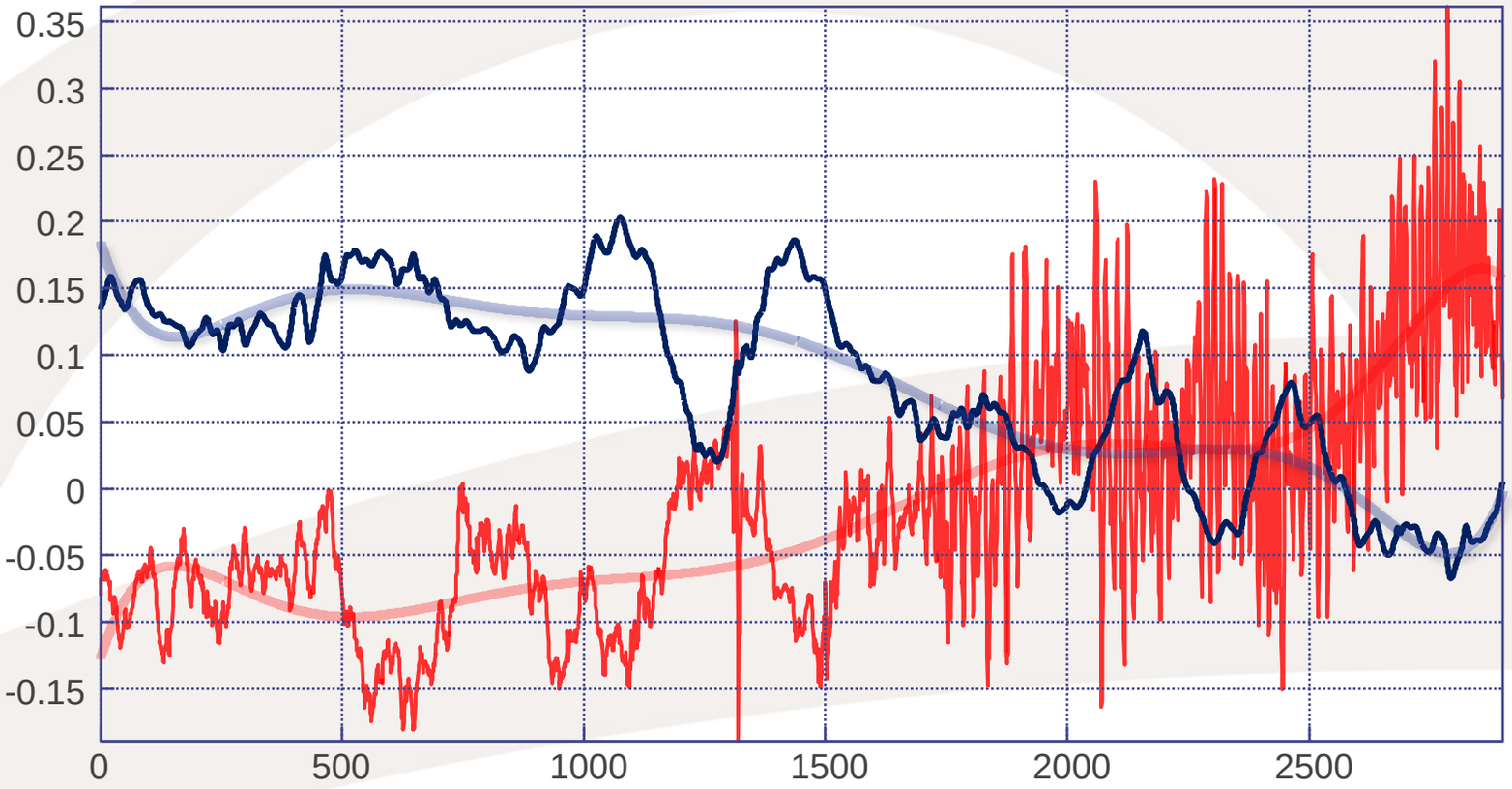




September 2012: EM2040

Correlation with low frequency fluctuations of real-time heave:

Filtered heave (moving average on 150 pings, m) and Δ BATHY L3-L0 (m)

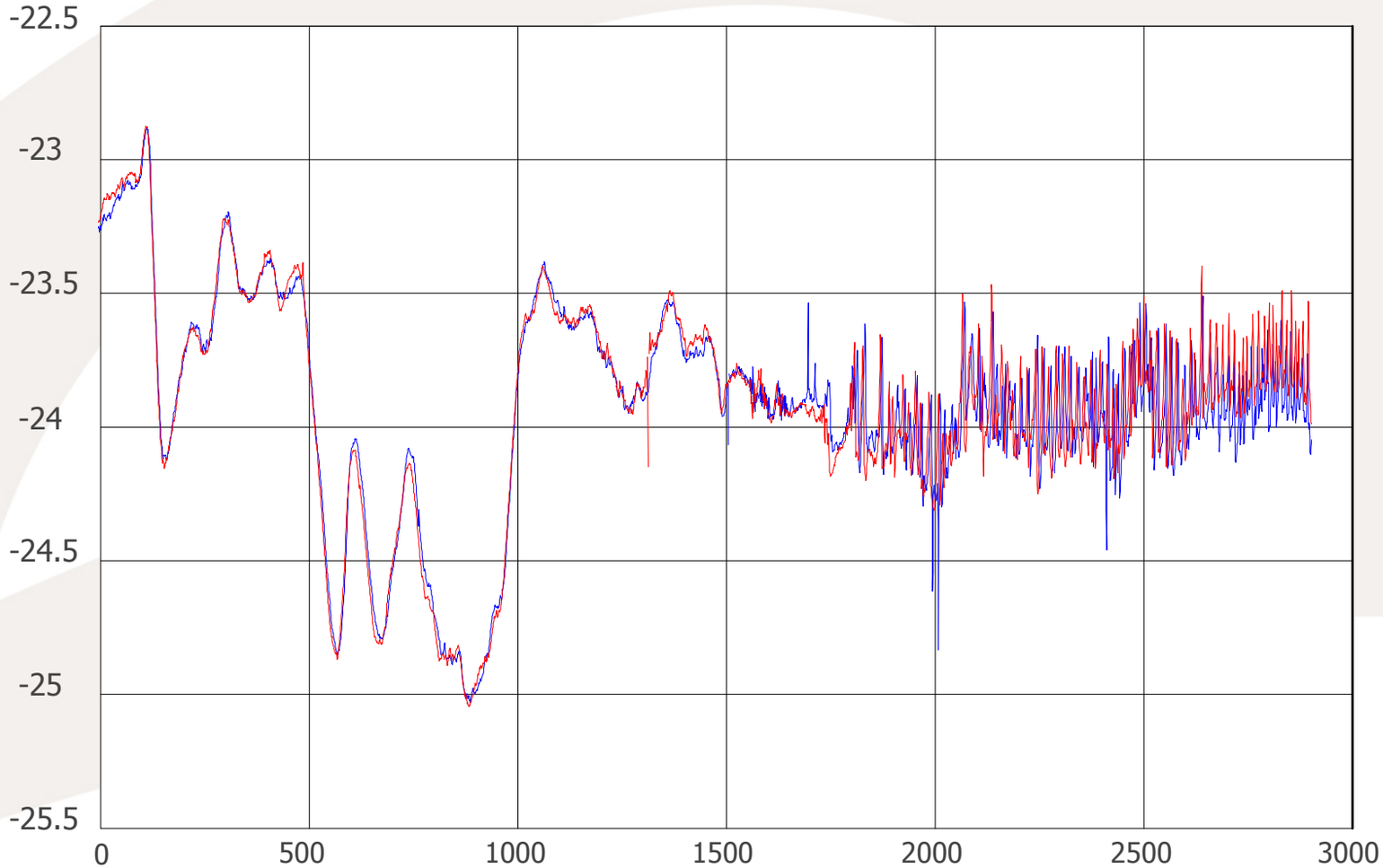


→ Line by line correction of the bathymetry with the low frequency real-time heave signal…

September 2012: EM2040

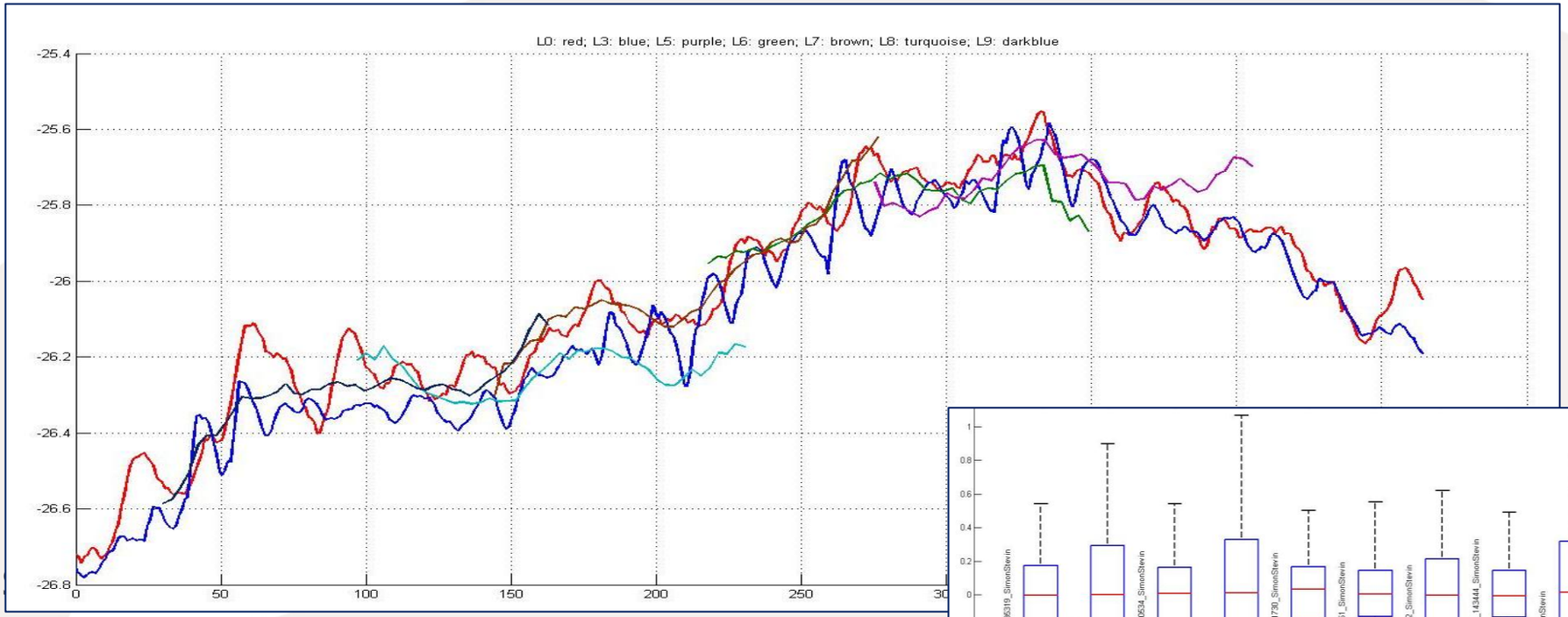
Line by line correction of the bathymetry with the low frequency real-time heave signal after tide correction:

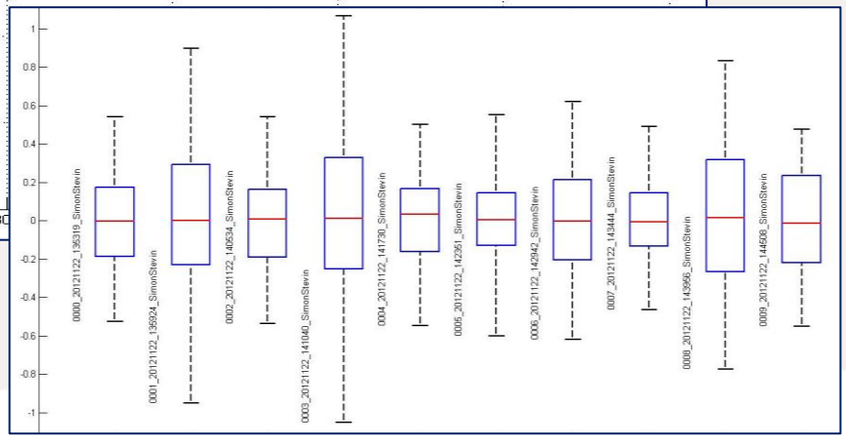
SURVEY 18/09/2012 @ 300 kHz line 0 (5 kt) and line 3 (10 kt)



November 2012: SAT part 2

Visit and installation of different software for the OCTANS IV:





- No apparent bias (all median ~ 0 m)
- All distributions symmetrical

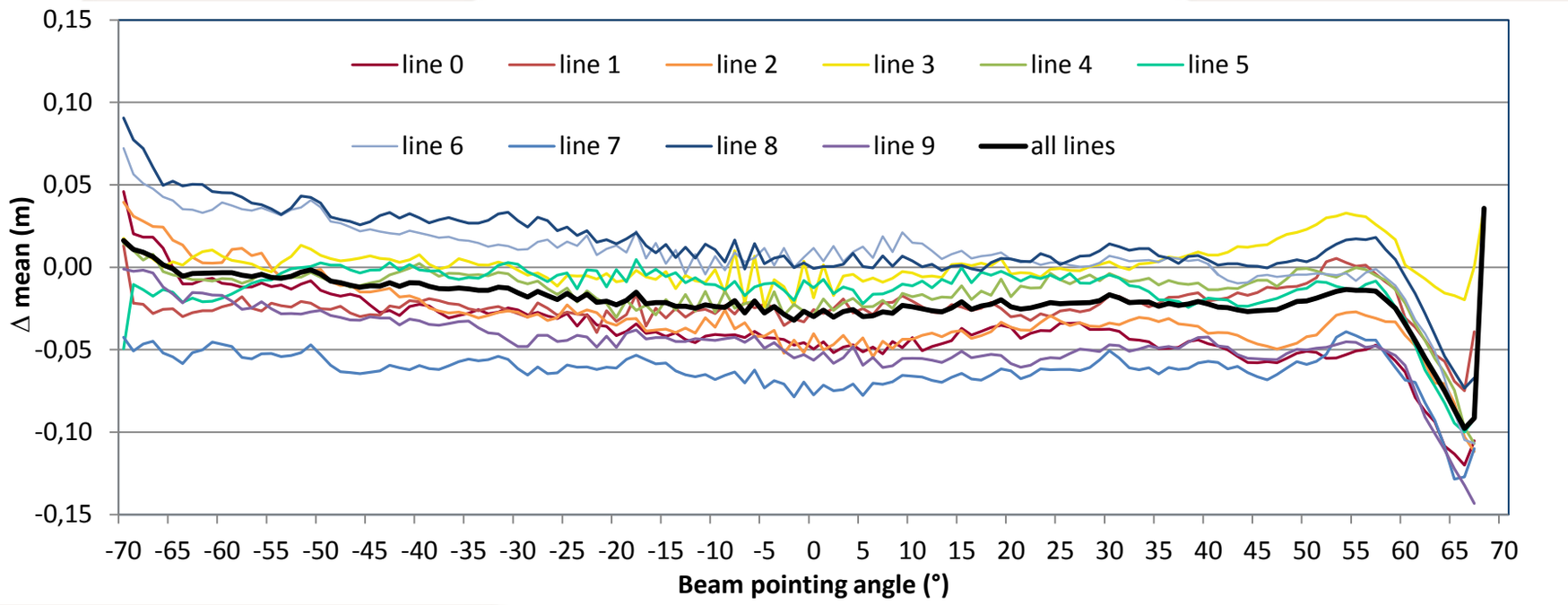
→ Heave low frequency artifact problem looks solved

→ But still inconsistent bathymetry

November 2012: SAT part 2

Asymmetry across track:

Construction of bias curves of the measurements (points) for each line with reference model:



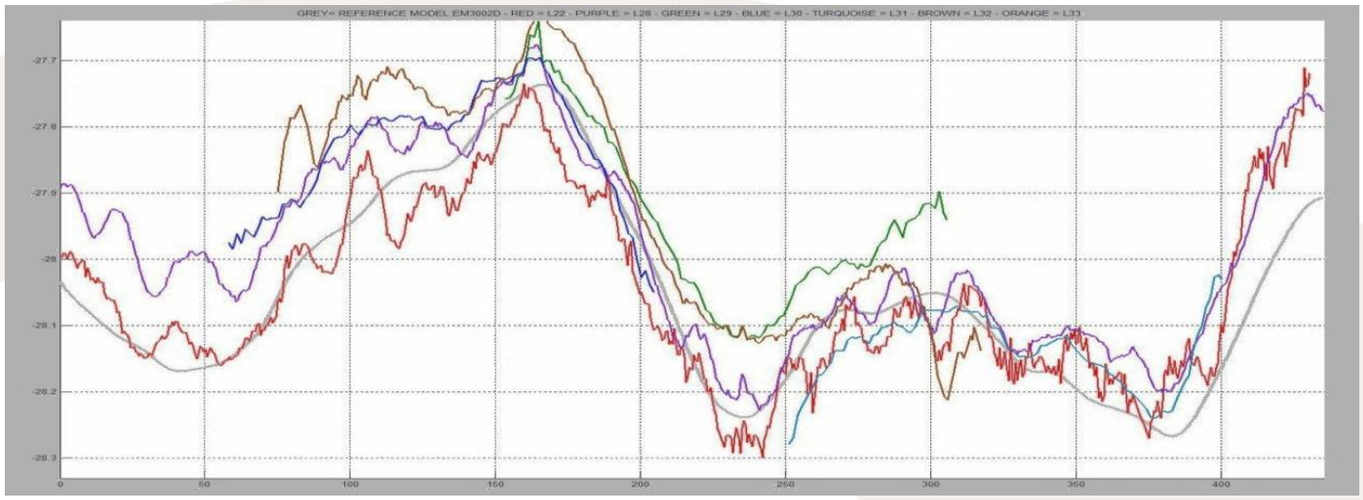
→ Confirmation of the difference in depth between the lines (range ≈ 0.08m)

→ Asymmetry of the bias curves – sharp drop of the values outside 55° and -65°

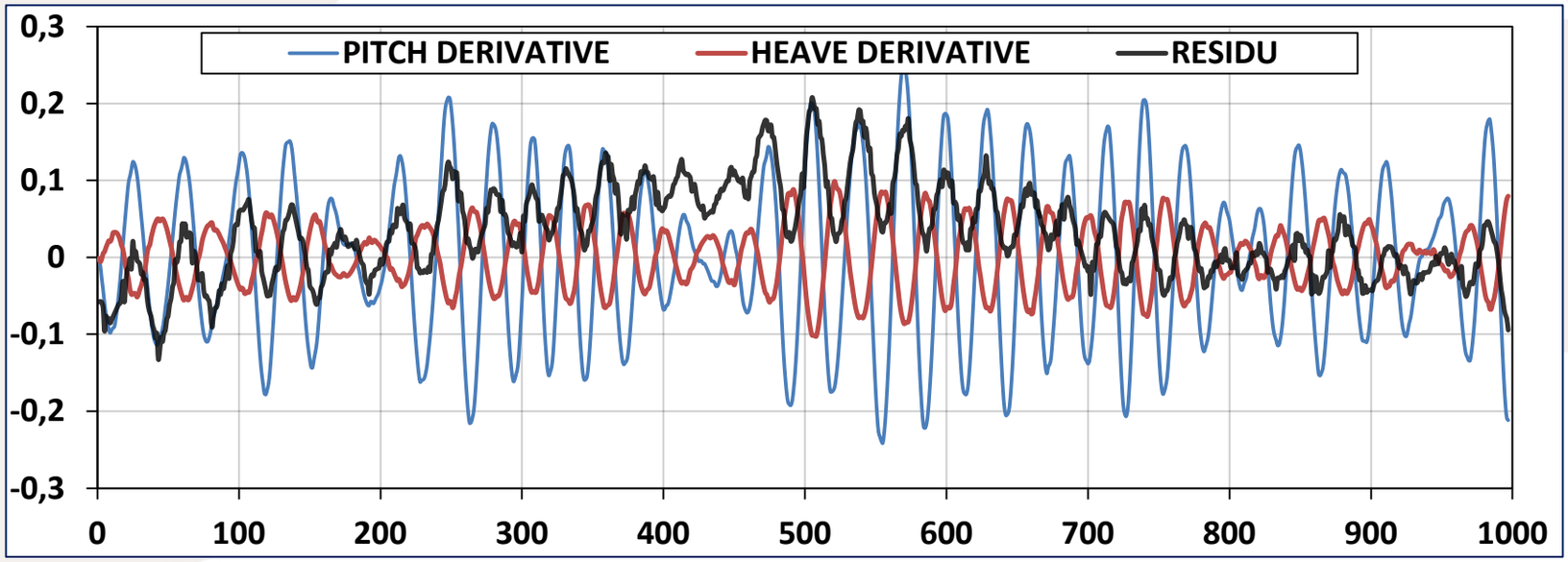
December 2012: SAT part 2

Bathymetry differences between lines:

SURVEY 19/12/2012 @ 300 kHz



Cross section of all lines along diagonal:



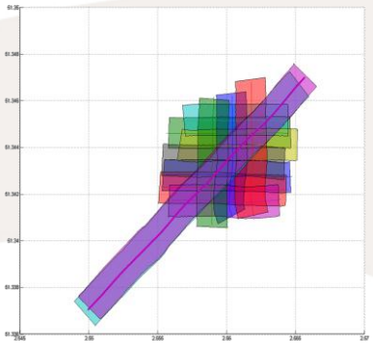
Perfect cross correlation observed for all lines

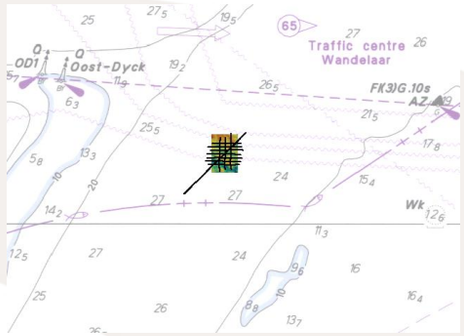
→ Suggests a major X lever arm problem?

December 2012: SAT part 2

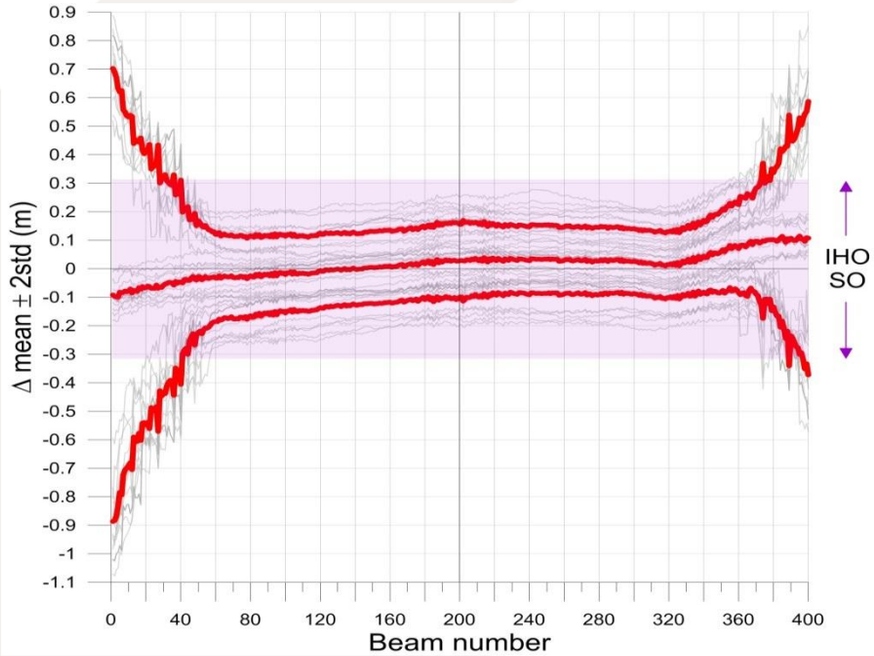
Asymmetry across track:

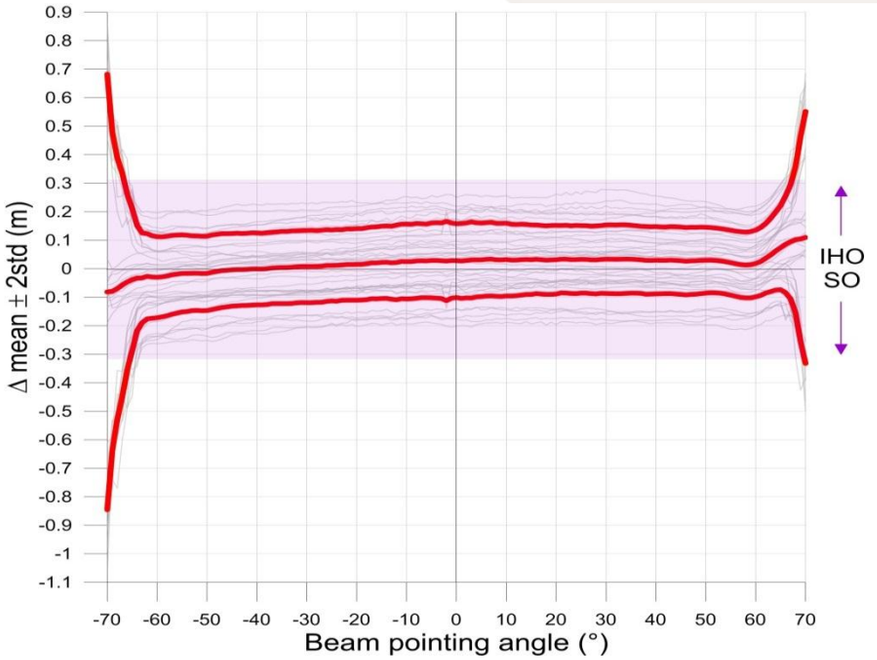
SURVEY 19/12/2012 @ 300 kHz





Evaluation of the standard deviation:



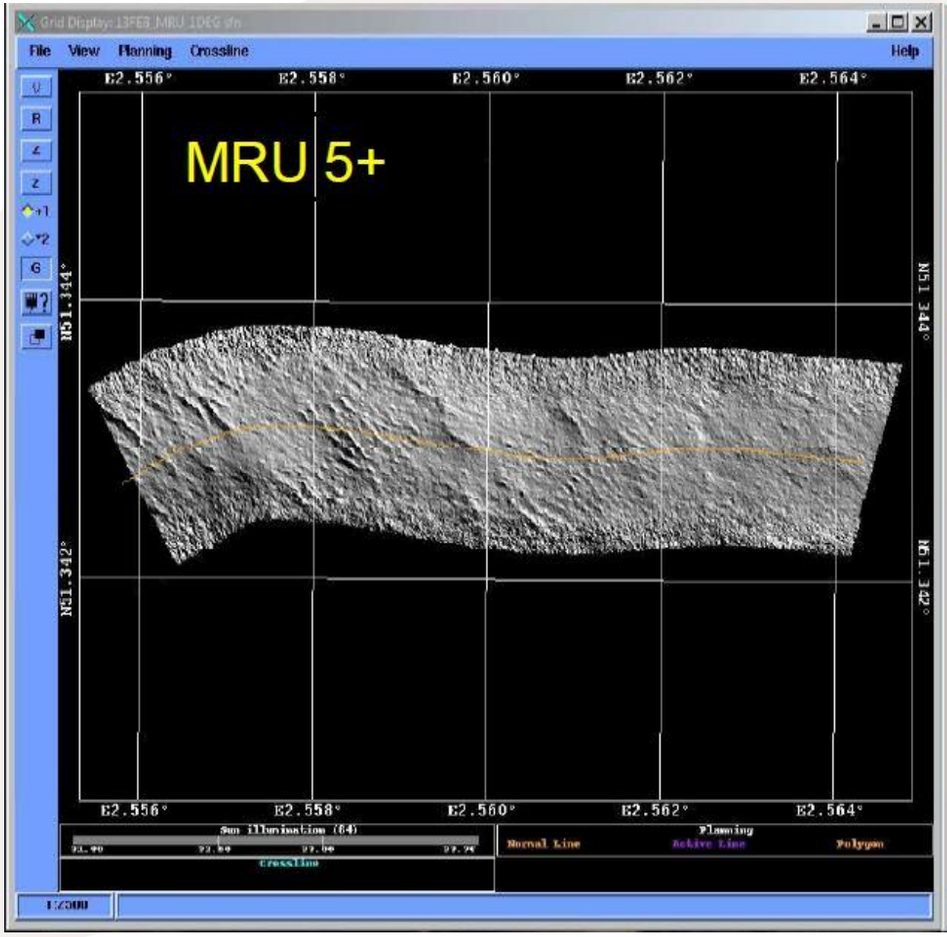


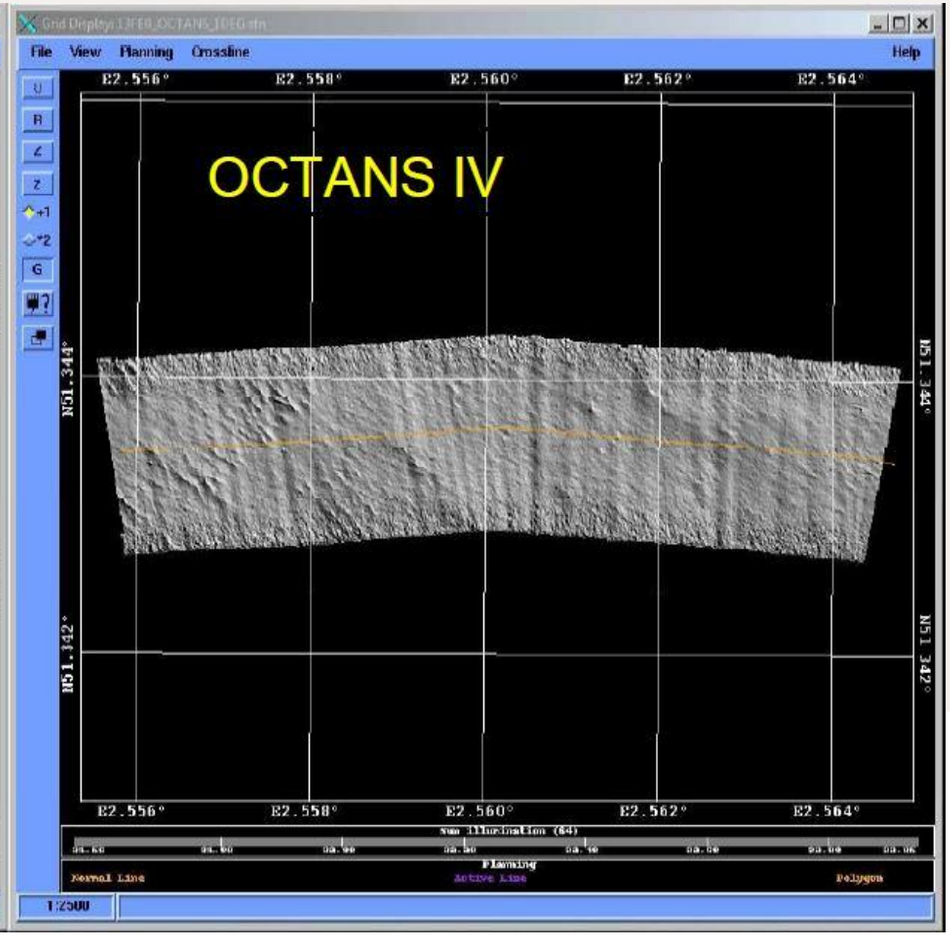
→ Asymmetry across track of the lines + dropping of outer beams

→ From beams 0-40 and 360-400 the performance is very bad

February 2013: final test by Kongsberg

Comparison between OCTANS IV and MRU 5





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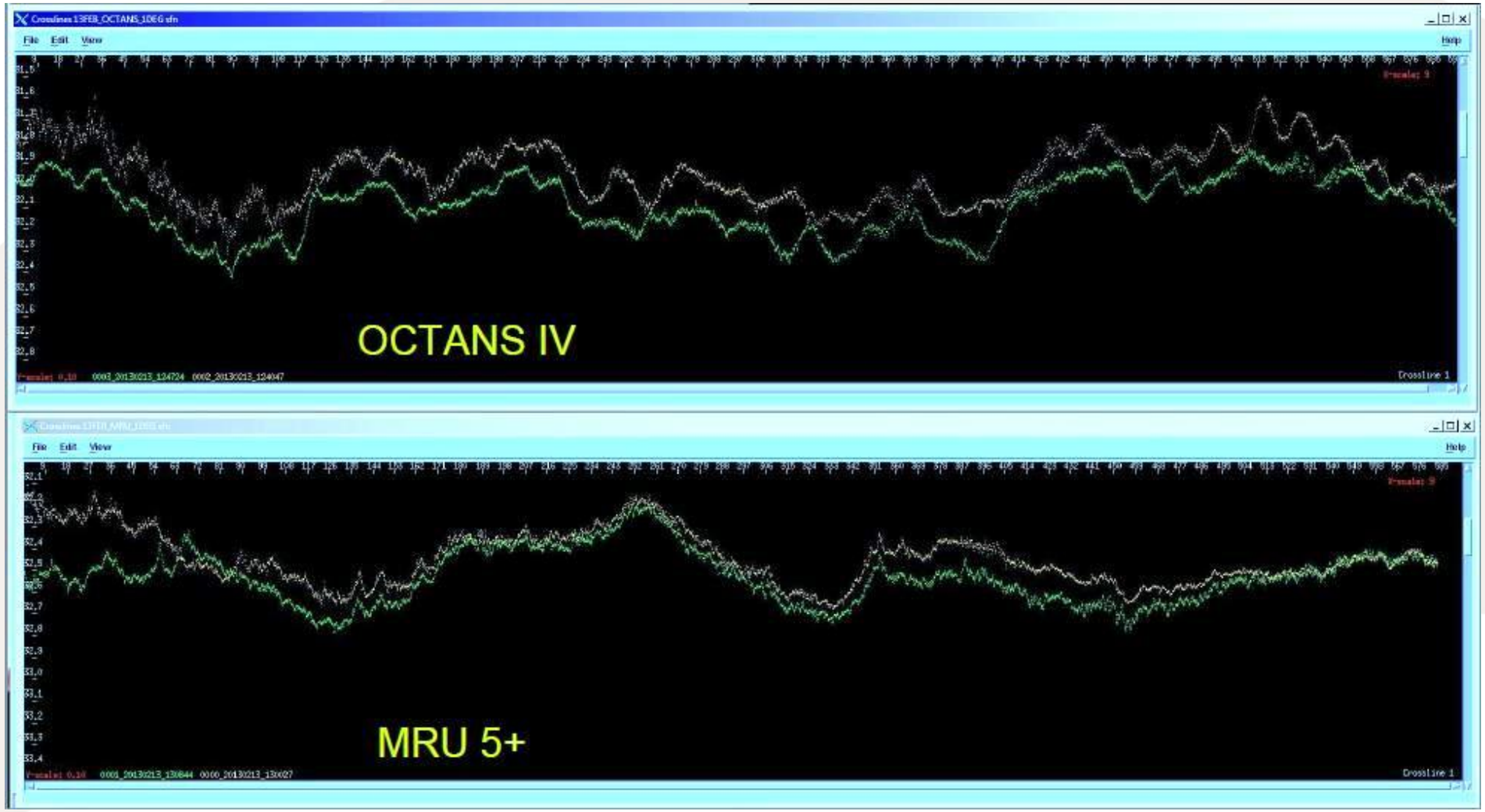

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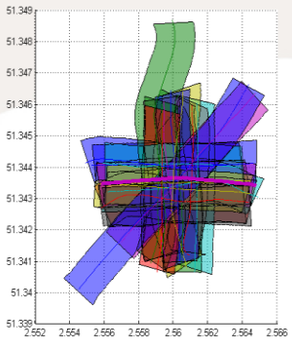
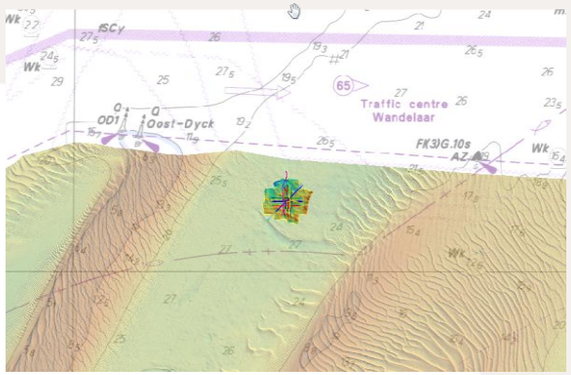
Comparison between OCTANS IV and MRU 5

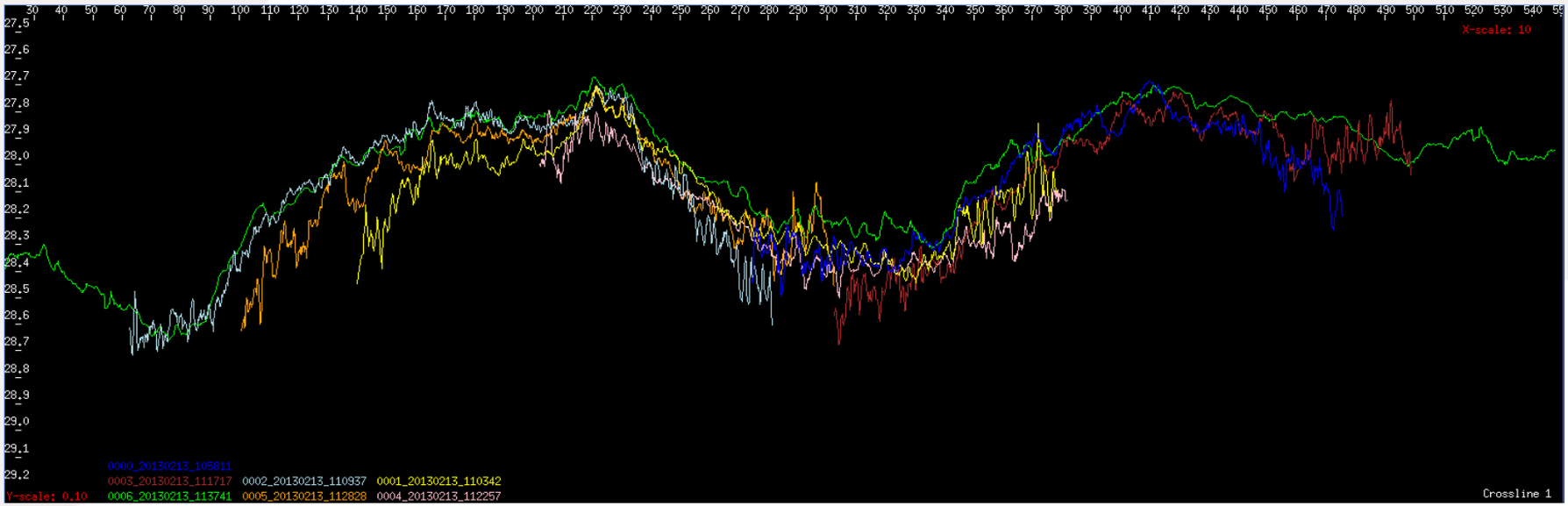
SURVEY 13/02/2013 @ 300 kHz

Cross section of all lines along diagonal:





OCTANS



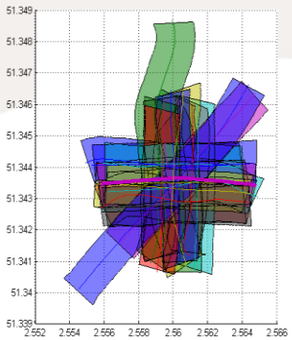
→ Asymmetry across track of the lines – depth difference between lines

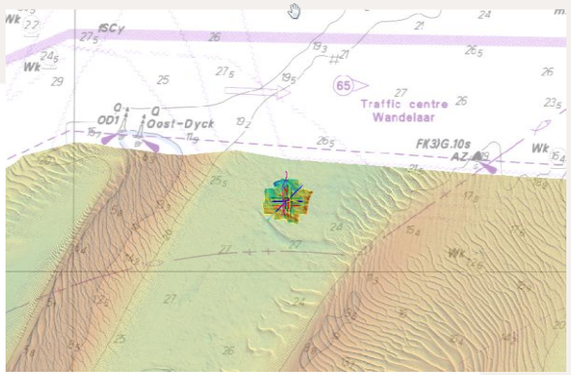
February 2013: final test by Kongsberg

Comparison between OCTANS IV and MRU 5

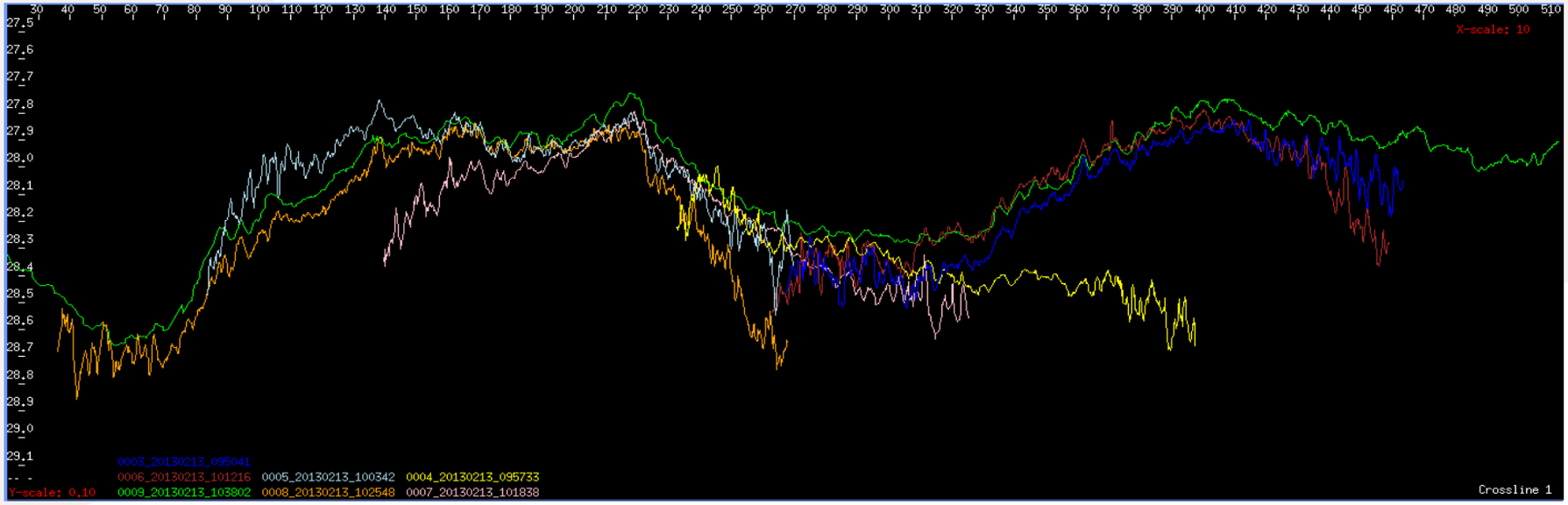
SURVEY 13/02/2013 @ 300 kHz

Cross section of all lines along diagonal:





MRU

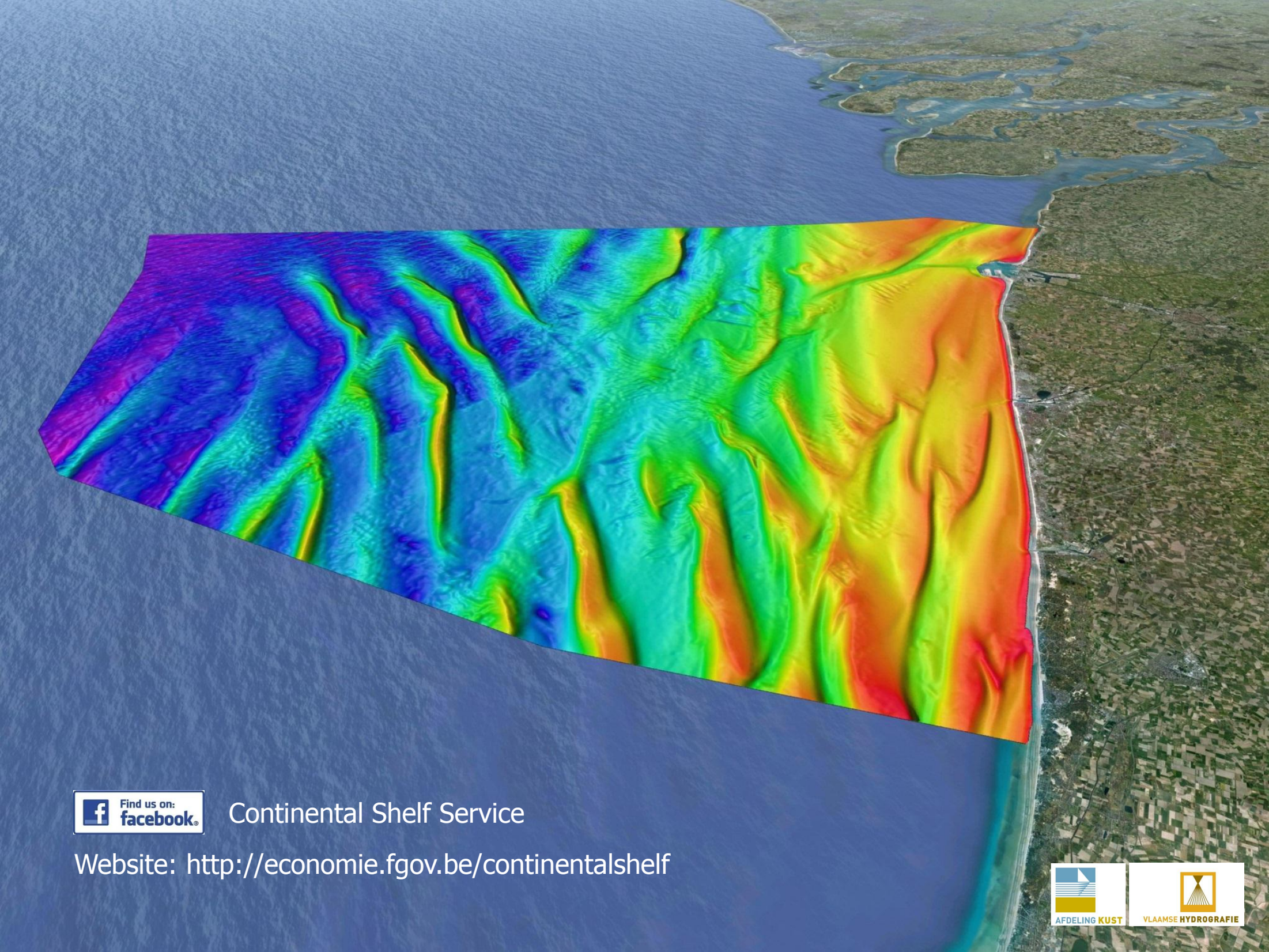


→ Asymmetry across track of the lines – depth difference between lines

Conclusions: A happy ending?

- EM2040:
  - IHO SO S44 compliant for -65° to 65°
  - Inconsistency of the bathymetry from one line to another
  - Asymmetry across track of the lines + Quality of outer beams
  - → Need for explanation!

- Comparison HV Ter Streep, RV Belgica and RV Simon Stevin:
  - Simon Stevin's EM2040 is provisionally out-of-competition
  - average solution of EM3002D systems within 2cm of reference
  - EM3002D's are both fully IHO SO compliant



Continental Shelf Service

Website: http://economie.fgov.be/continentalshelf