

HAVFORSKNINGSINSTITUTTET
INSTITUTE OF MARINE RESEARCH





Hvordan kan vi bestemme mengde og fiskestørrelse i en stim?

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HI, Simrad, CMR

CRISP/ WHOFISH/ DABRAF

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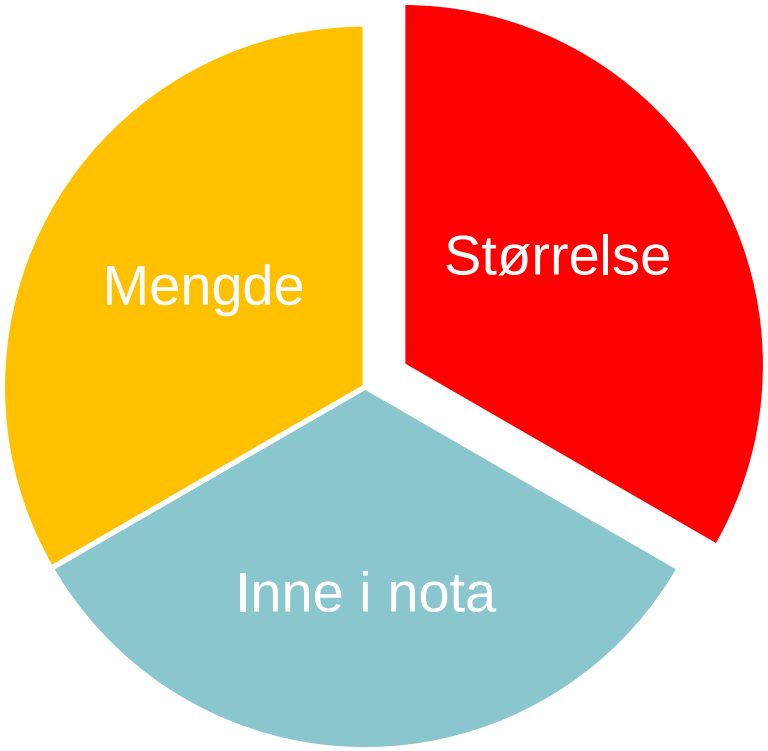
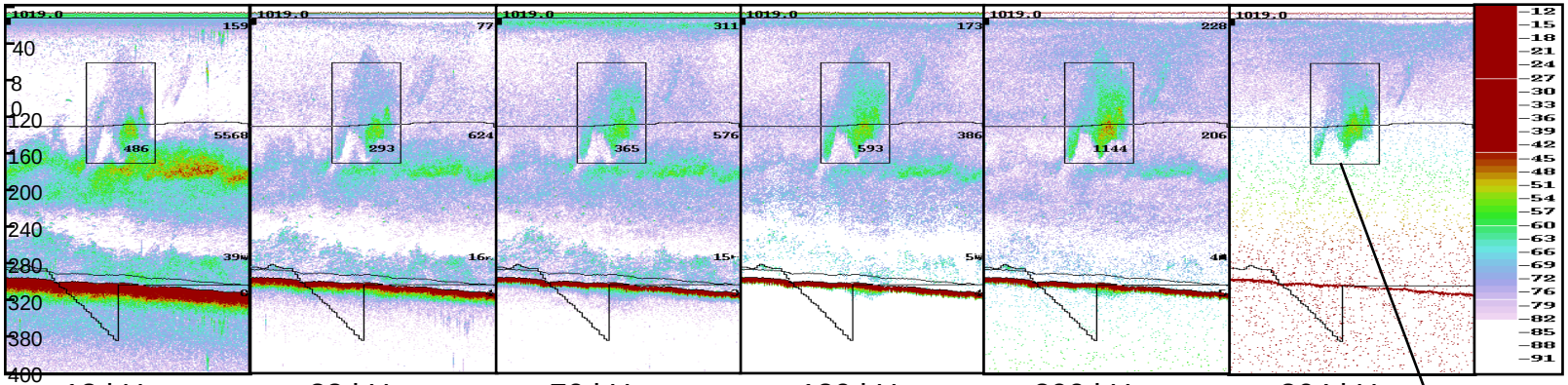
Innhold

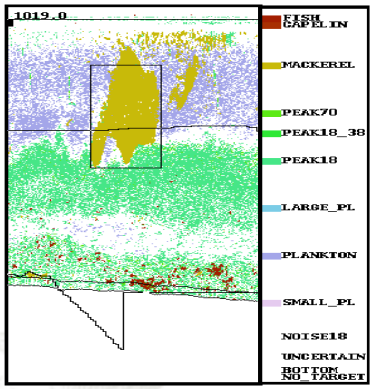
- CRISP –prosjektet, kort
- Prinsipp for akustisk mengde og størrelsesmåling av fisk
- Bredbånds-ekkolodd
- DABGRAF resultater og demo
- Foreløpige konklusjoner

Pre-catch ID, biomass and sizing

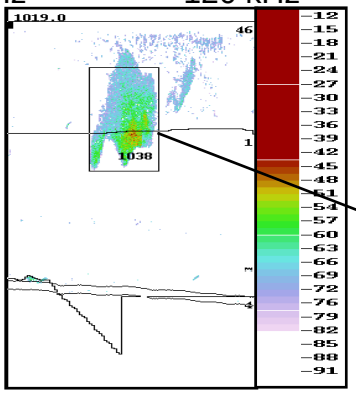


ID, multifrekvens, BB

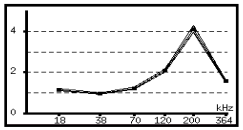




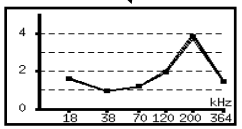
Identified acoustic categories based on a 6-frequency algorithm



Mackerel only at 200 kHz



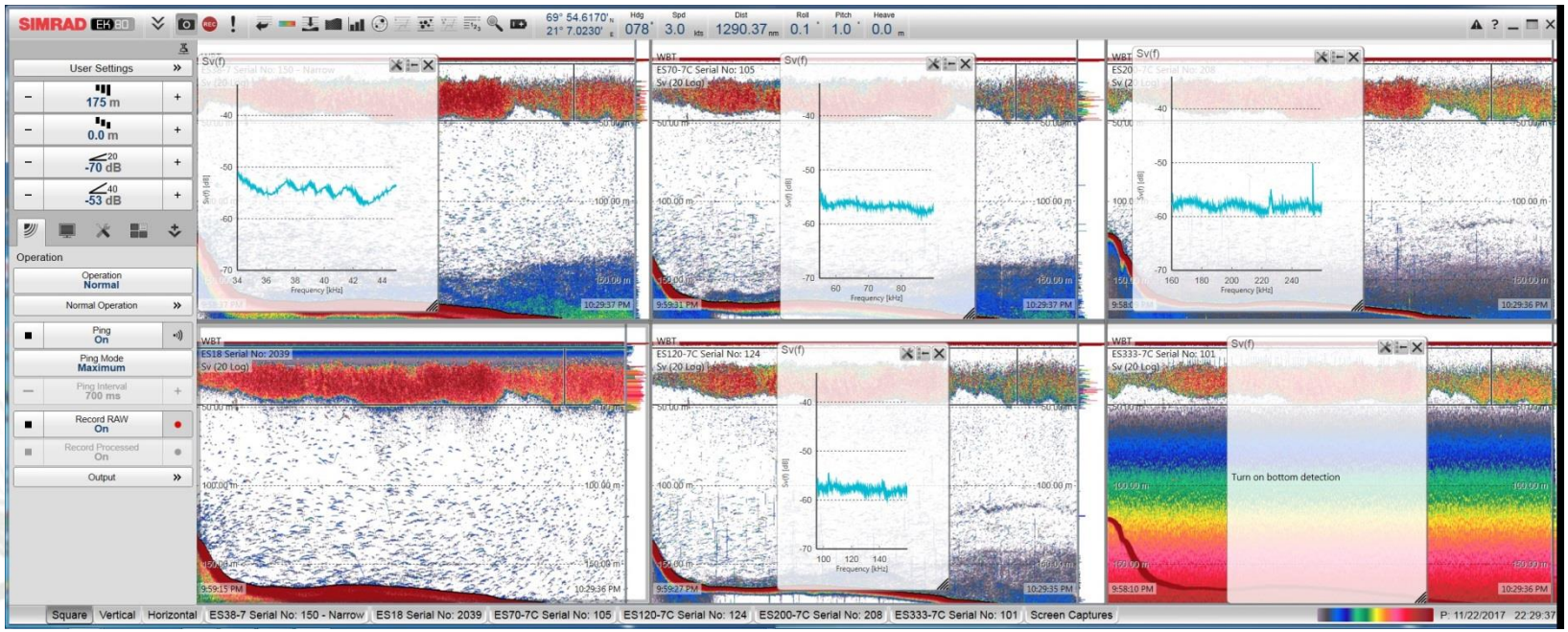
r(f) inside box for mackerel only



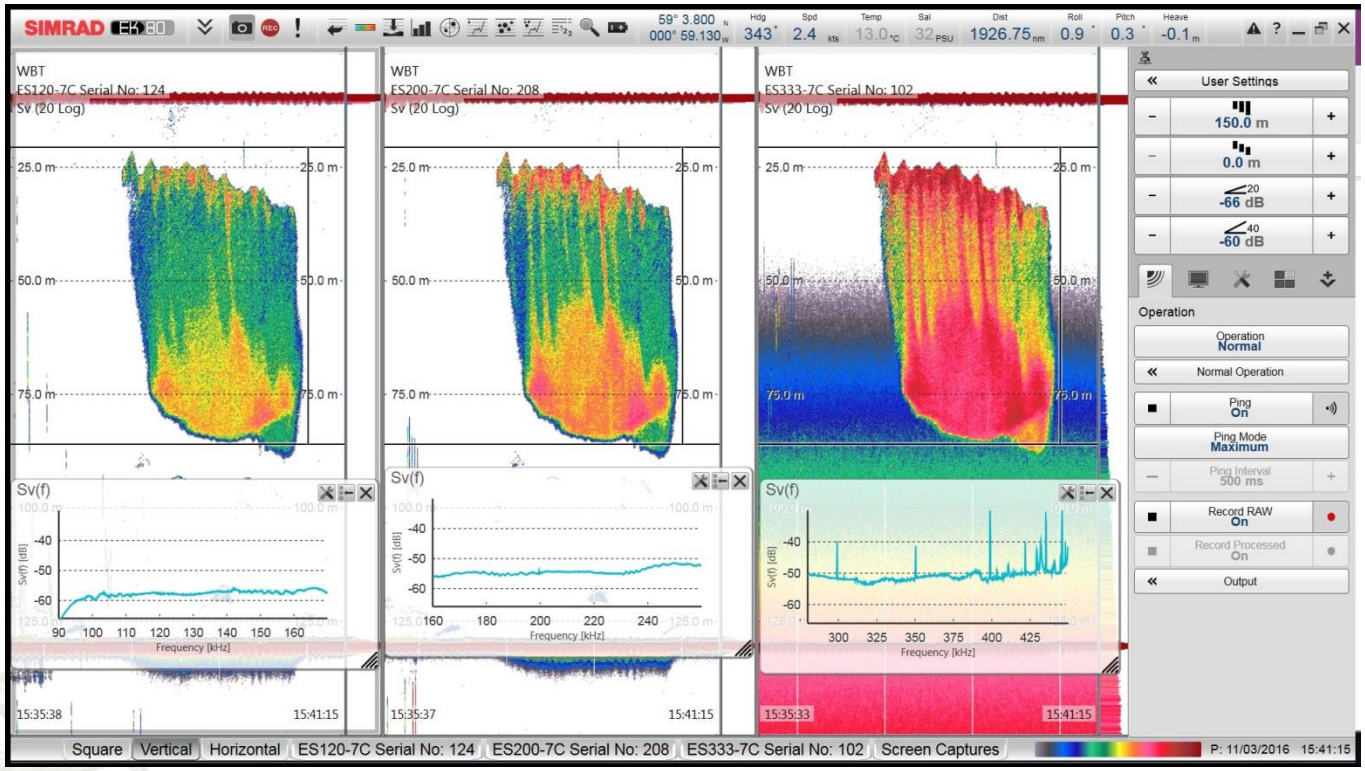
Relative frequency responce, r(f), inside box

2010 - 208 Bredbånds-analyse

Sild, Kvænangen 2017
18 – 450 kHz



Makrellstim 2016



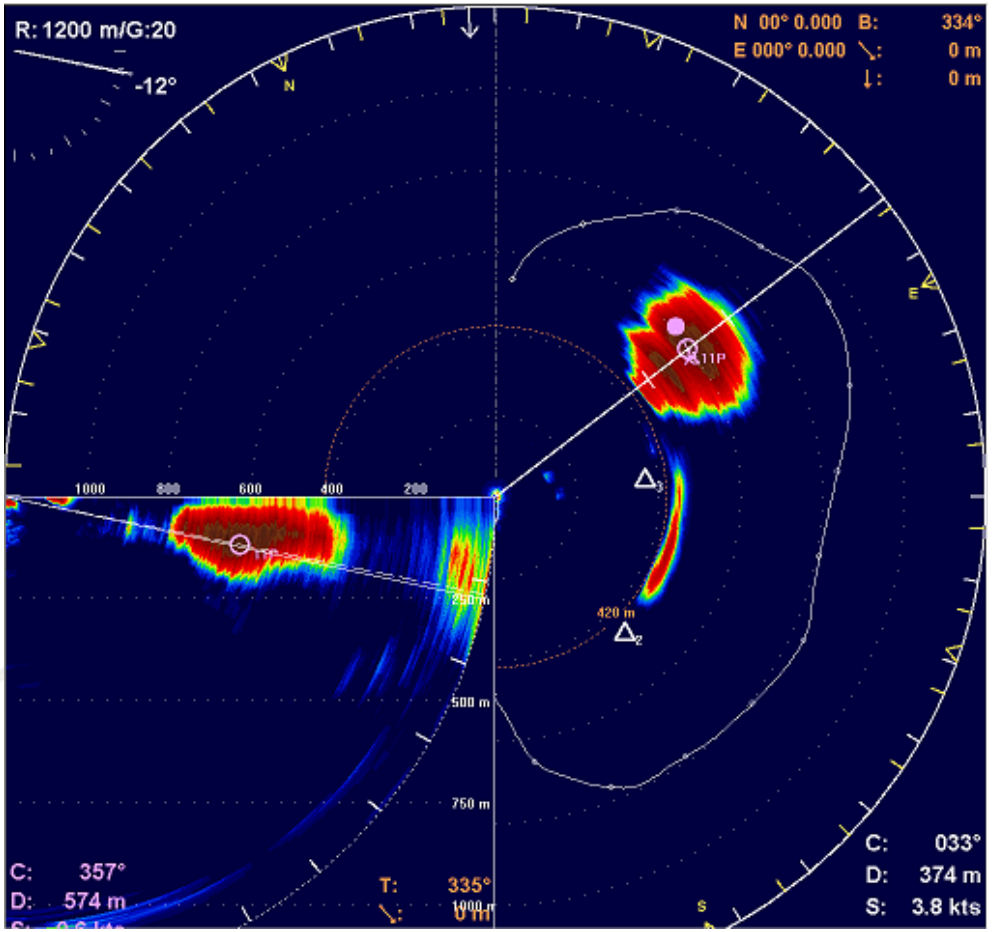
Identifikasjon, viktigste arter

- Her foregår det nå masse FUO,
- Utenom CRISP

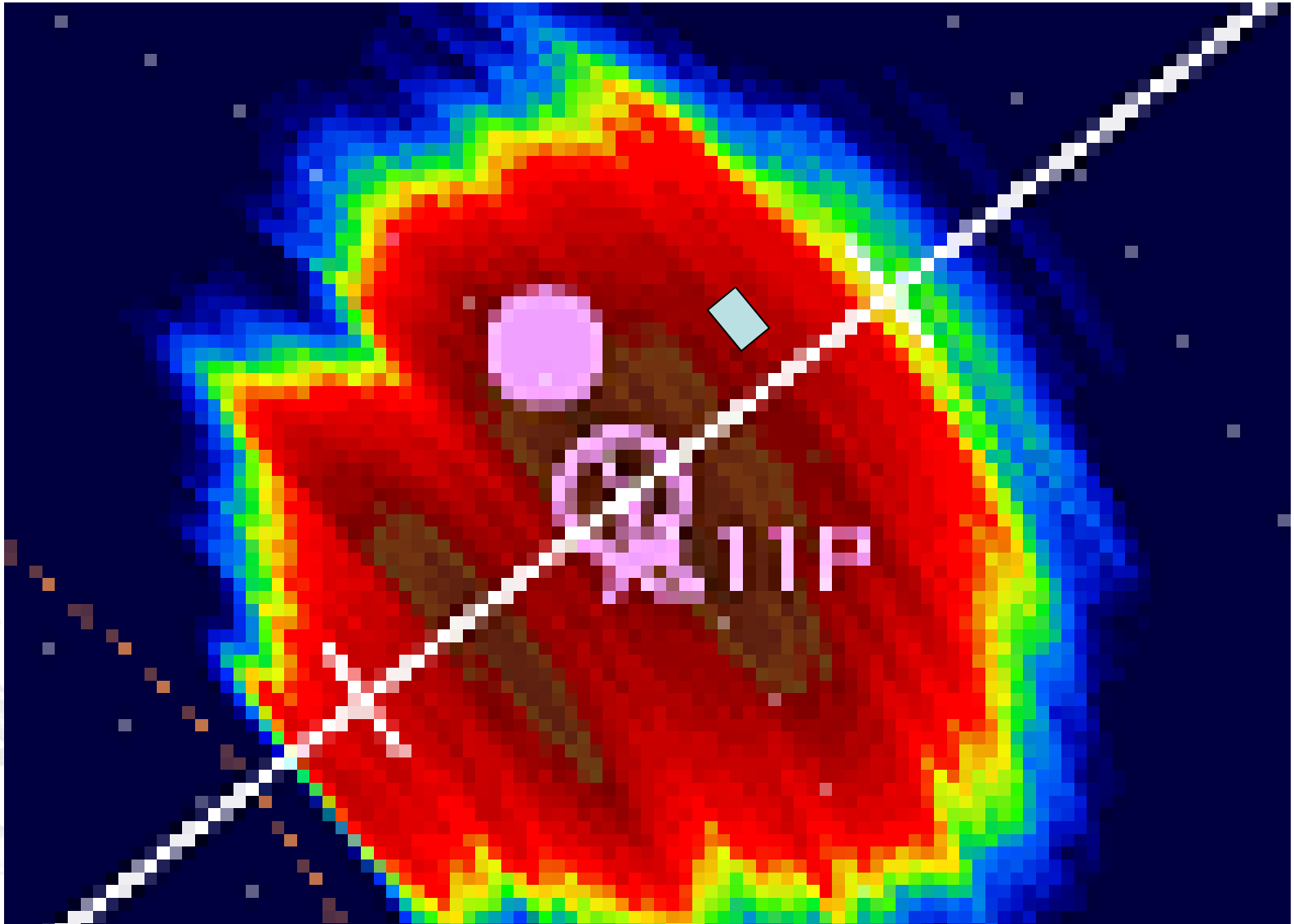
SONAR

- CRISP WP 1, biomasse målt med fiskerisonar

Inspeksjonsfasen før kasting



Pixel SV



Forutsetninger mengde

Enkle ligninger

$$\bar{s}_v = \bar{\sigma}_i \bar{\rho}_v$$

$$10\log_{10}(\bar{\rho}_v) = \overline{SV} - \overline{TS}$$

$$N_t = \bar{\rho}_v V$$

$$W = \bar{w}_i n$$

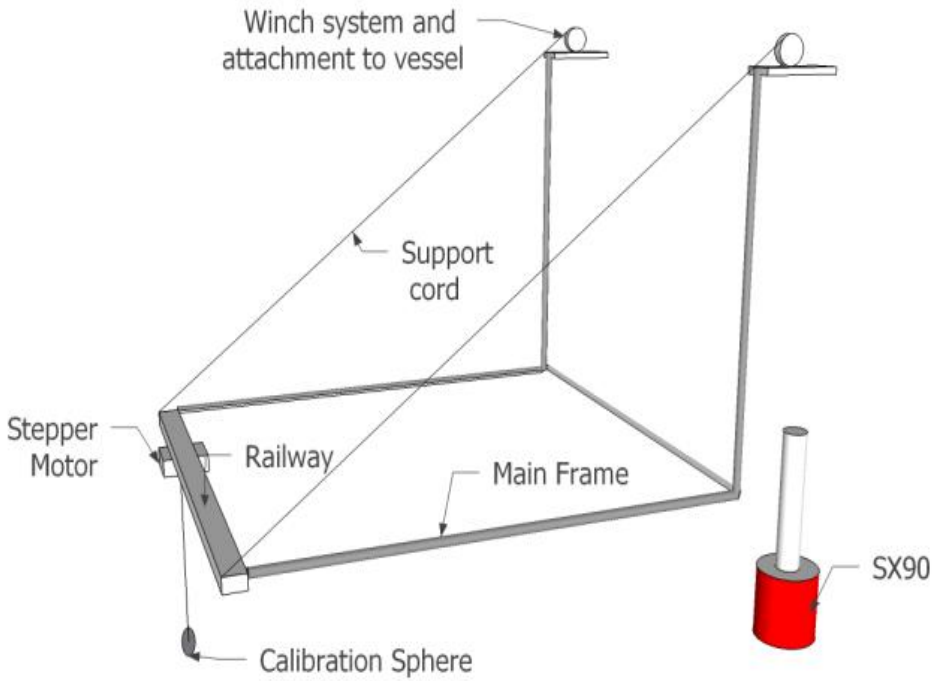
Forklaring

- Ekkostyrke i et del-element = volumtetthet av fisk i pulsvolumet X ekkostyrke til ett enkelt individ
- (alle verdier lineære)
- Samme på logaritmisk form
- Total antall i stim = volumtetthet*volum
- Vekt (av stim) = gjennomsnittsvekt* antall

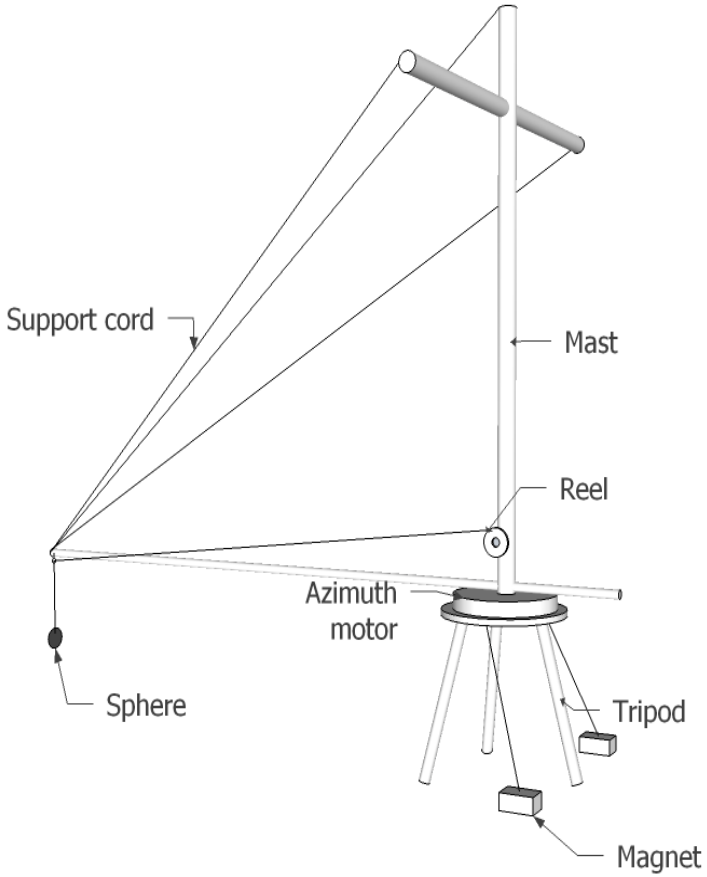
Kalibrering !
WC 64

Kaliberings-rigger sonar

High precision rig



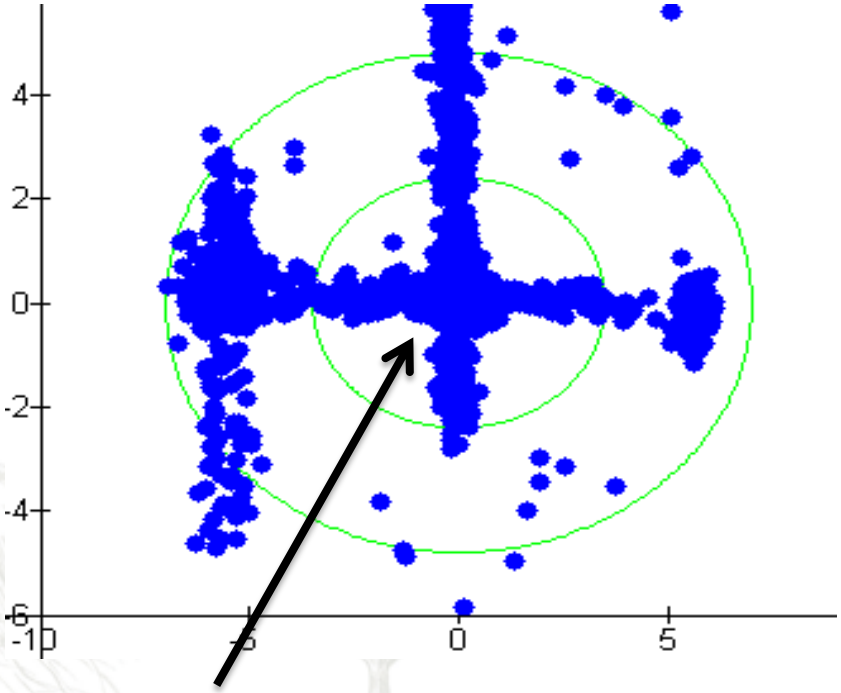
Multi-beam rig



Ny kalibrerings-rigg

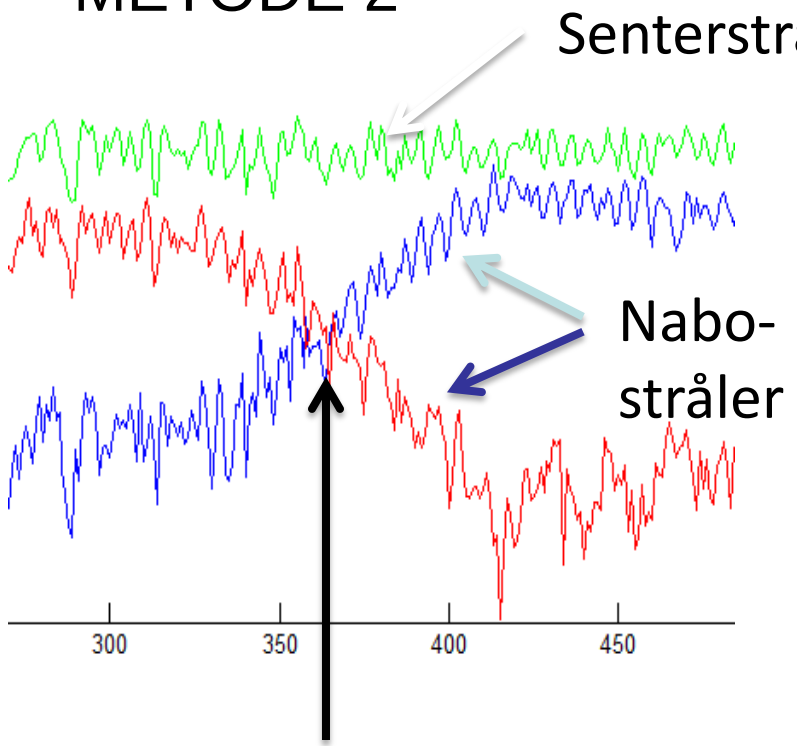
Lokalisering av strålens senter

METODE 1



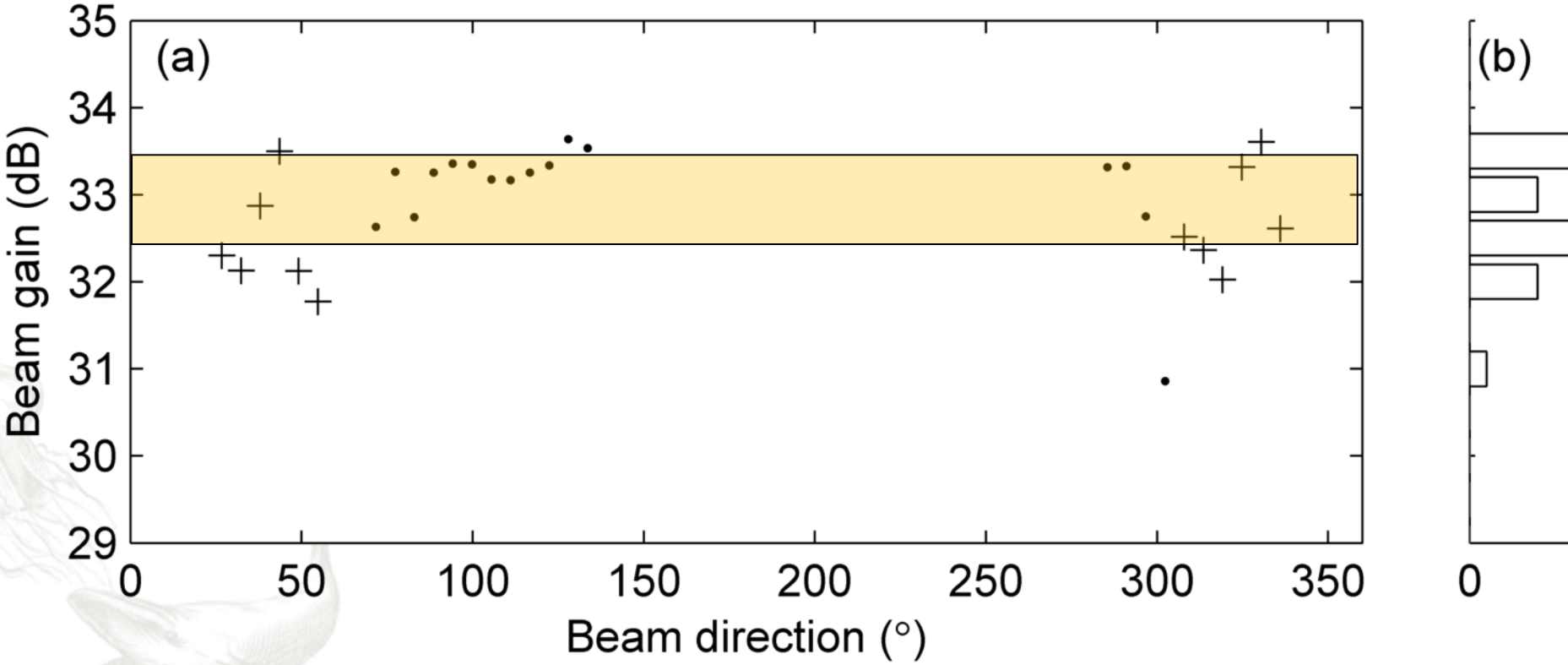
Estimated centre of beam using split beam

METODE 2



Strålesenter

Accuracy, 40 beams (ARTUS)



Kalibreringsmetode ferdig 2015

8 fartøy, SX90, SU90

Sindre Vatnehol PhD

”Kalibrering” imot stimer,

Feltforsøk 2012, 2013 (sild),
2014, 2015, 2016 (makrell), 2017(sild), 2018 2019(lodde)

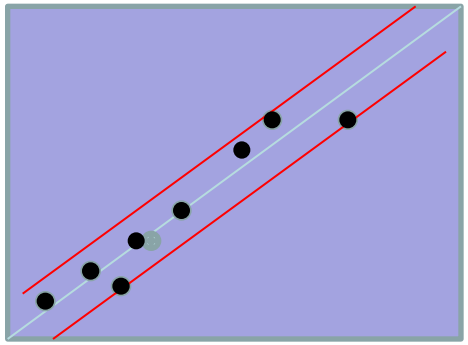
G.O.Sars

MS70
SU90

Ringnotfartøy
SU90
SH90

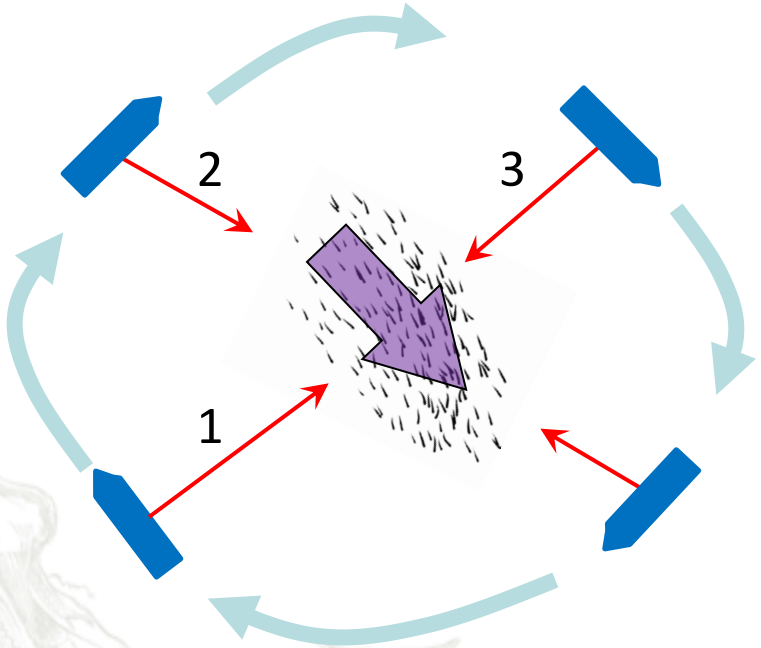
Forskningskvote

Målt mengde

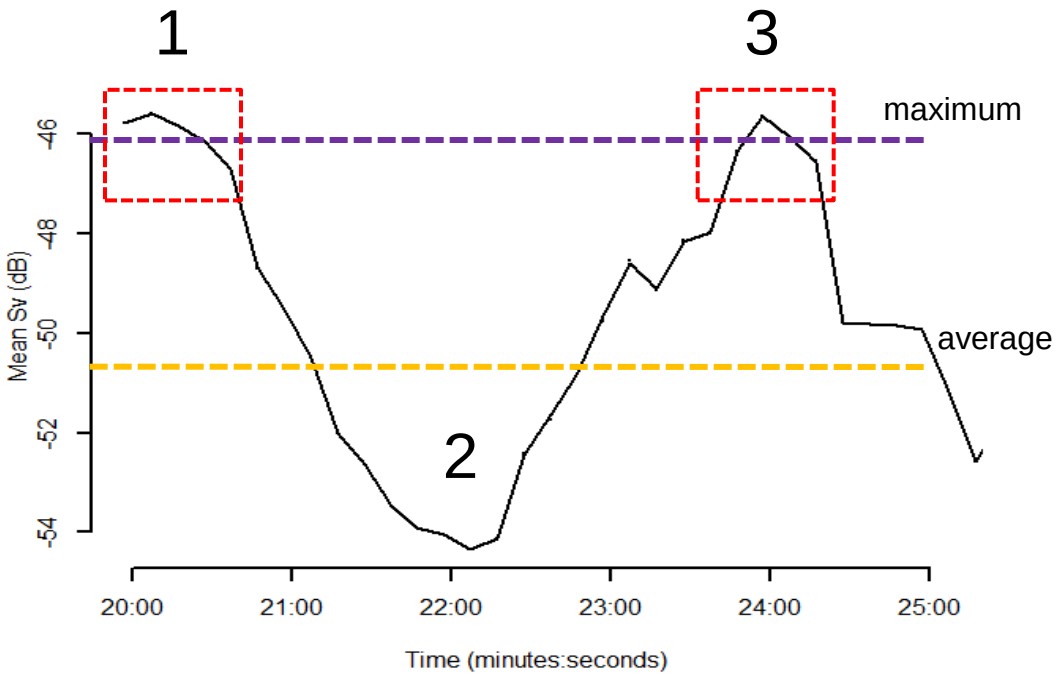


Fangst

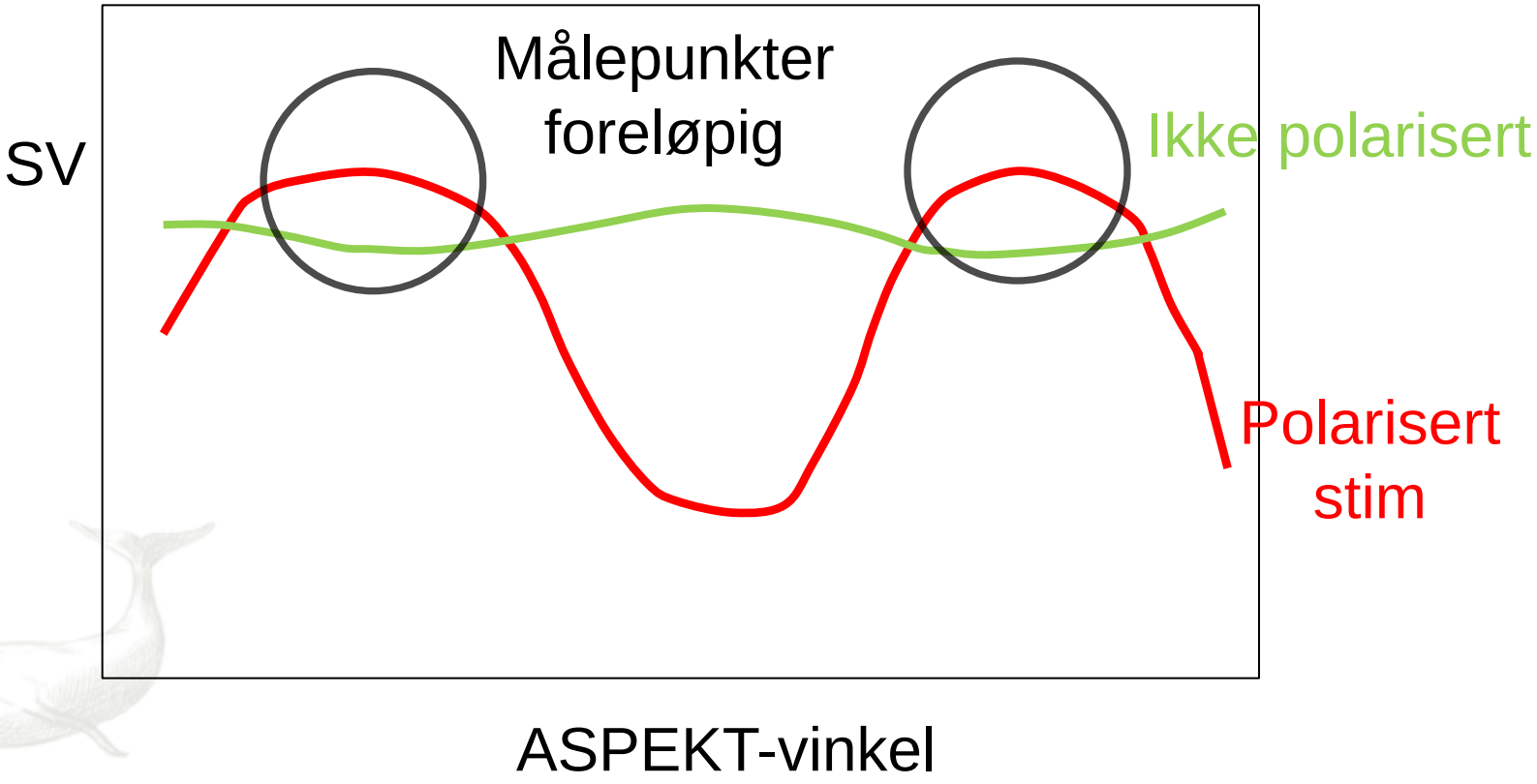
Detaljert inspeksjon av stim, 2 fartøy



Ekkomengde (SV) endres systematisk under inspeksjon pga. direktivitet



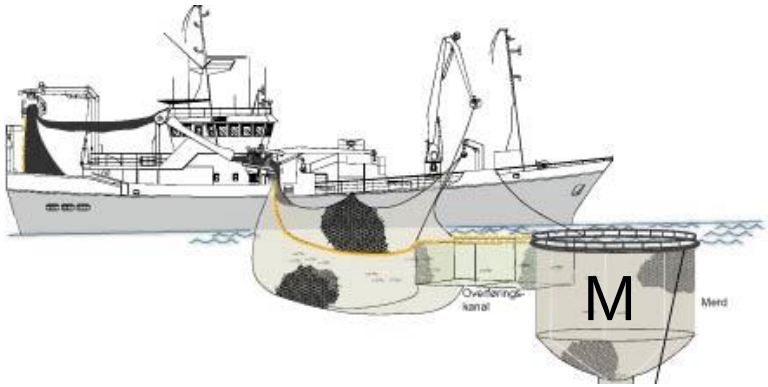
Prinsipp-forenklet



Beregninger

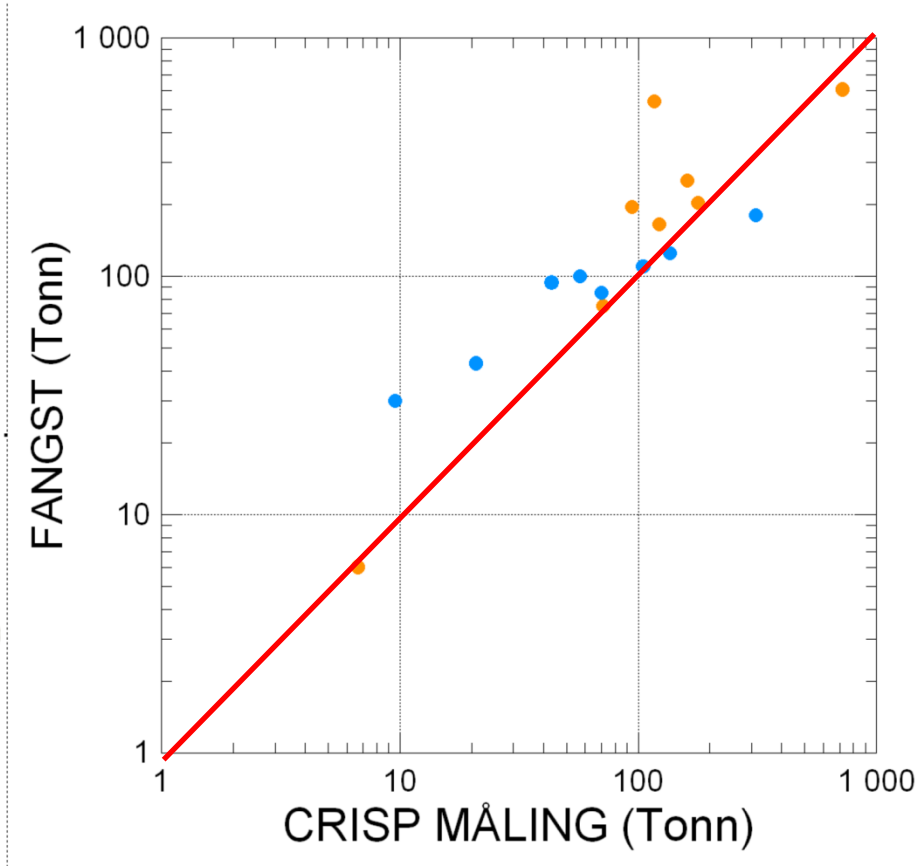
- Stimvolum, korrigert for ståle-smøring
- Middel (topp 90% deteksjoner), SV (ekkostyrke)
- Beregning av usikkerhet
- Midlere ekko fra en 35 cm sild, sett fra siden (viser dette senere)

Eksperiment-merd, monofilament 20-30 tonn



Kontrollerte målinger imot kjent mengde

Valideringer



Sild

Makrell

Plan CRISP 2018-2019

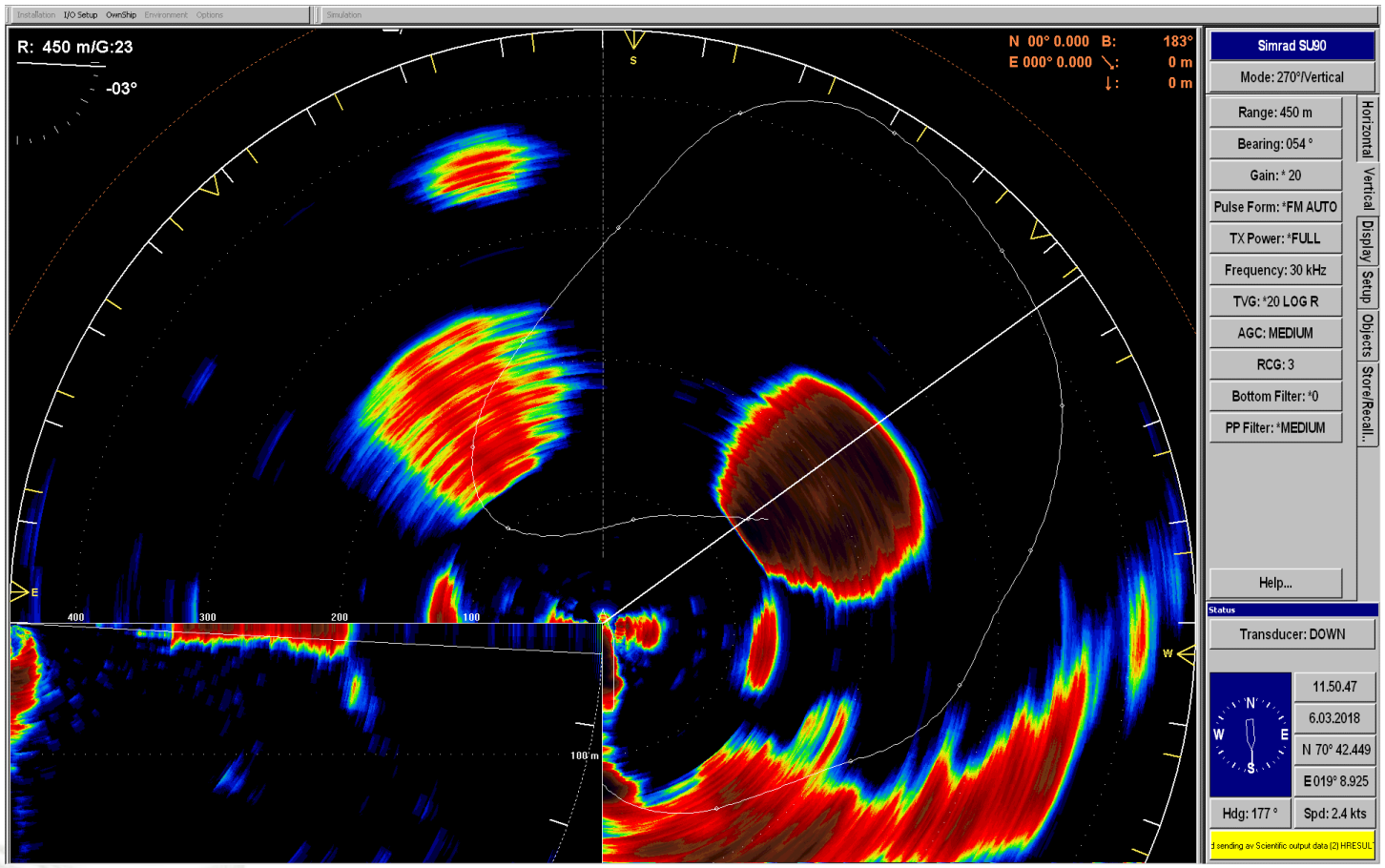
- Ny sonar programvare 2018 og nye sonarer
- Kalibrering-system i sonaren
- Korrigere for ekstinksjon (demping av lyden gjennom tette stimer), særlig for tette loddestimer.
- CRISP- algoritmer bygges inn i sonaren(e)
- Enklere lagring av erfaring
- Avansert læring, bruke alle data fra inspeksjon
- (etter CRISP):Bygge erfaring inn i sonaren

Ekstinksjon, eksempel 2018

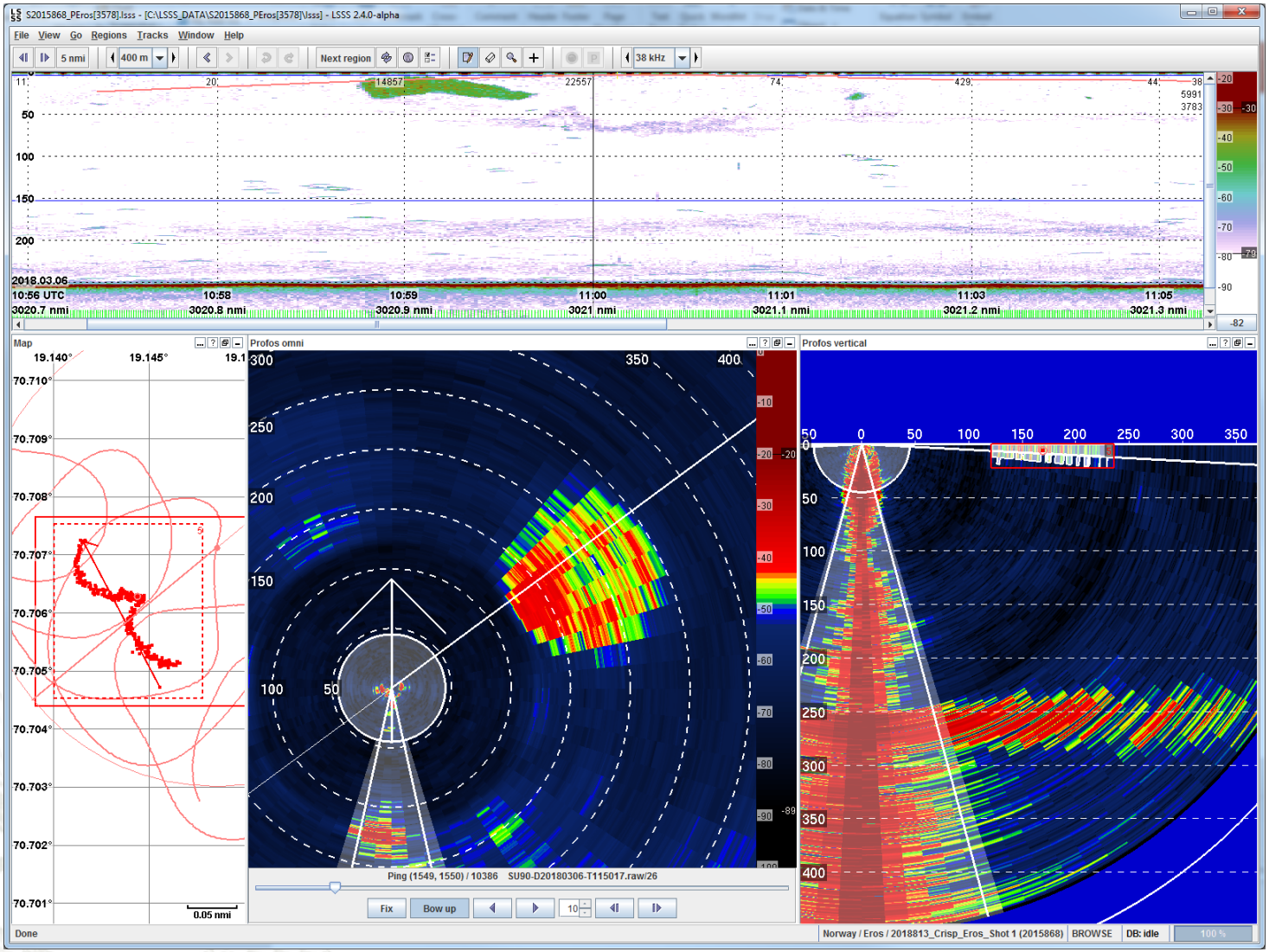
Løst for ekkolodd, 1990-2003

Nødvendig med en del teori-arbeid 2018

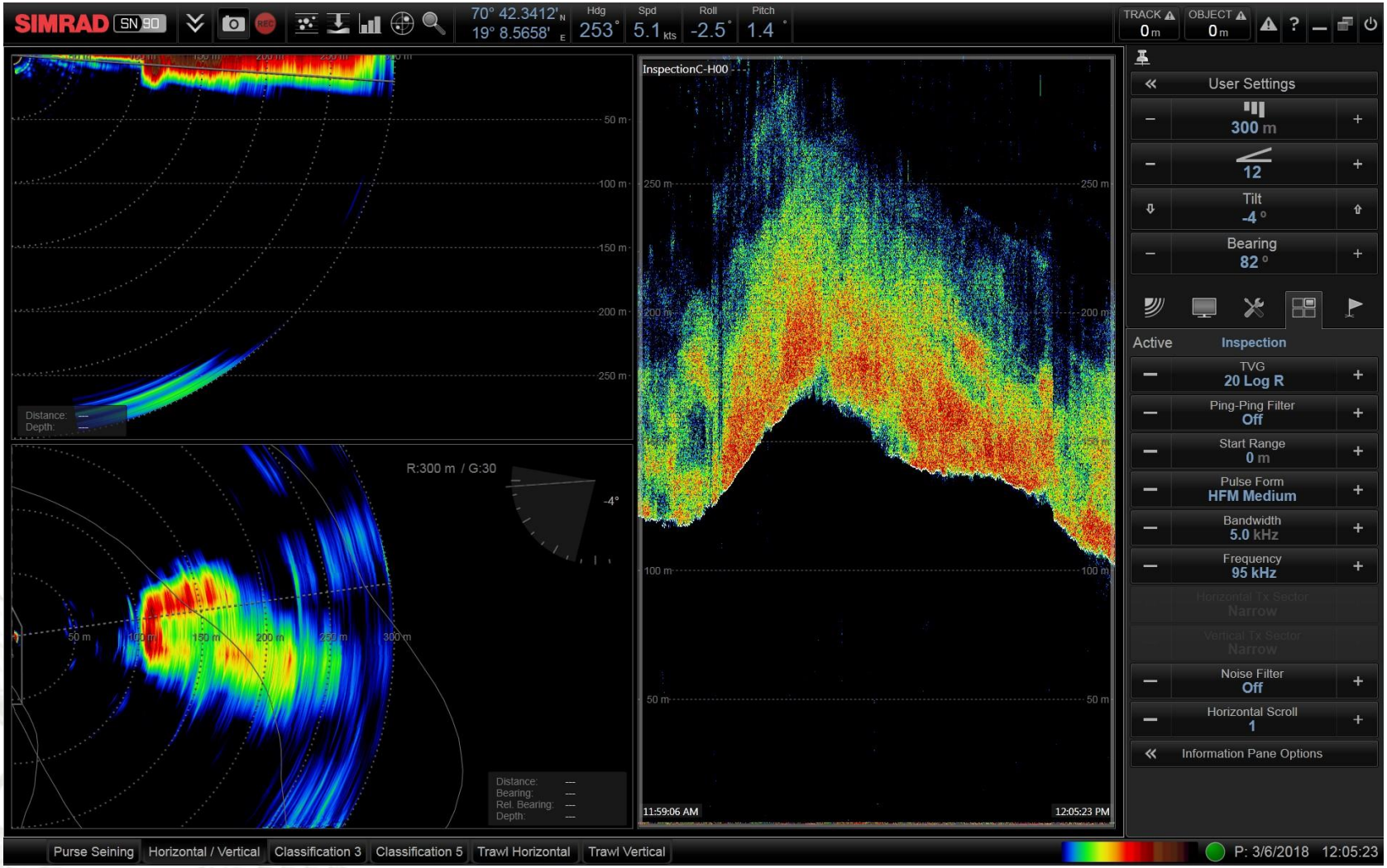
Lodde stim, inspection
Mellom 150 til 200 tonn ??



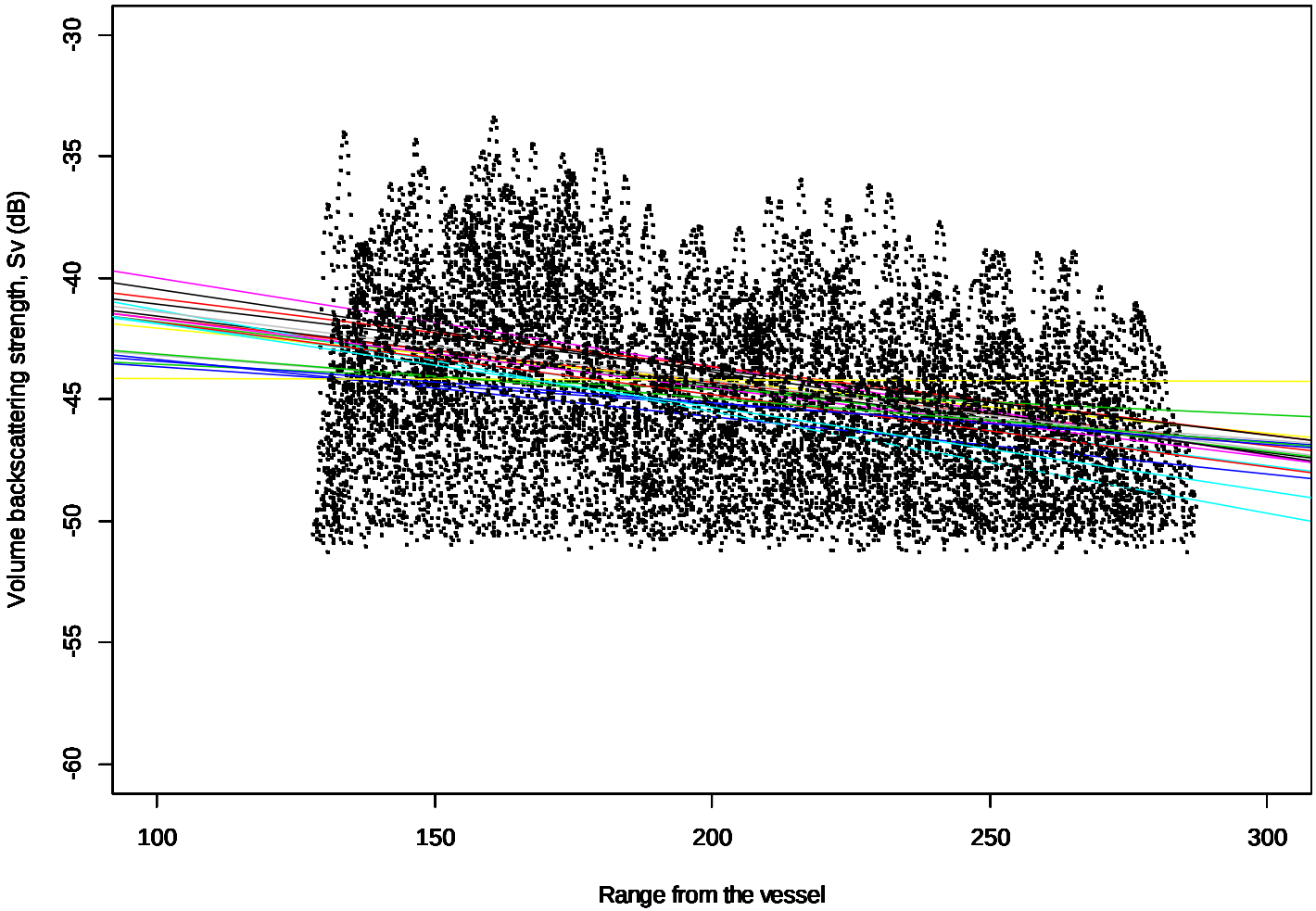
Data-analyse, raw data
Legg merke til demping gjennom stimen



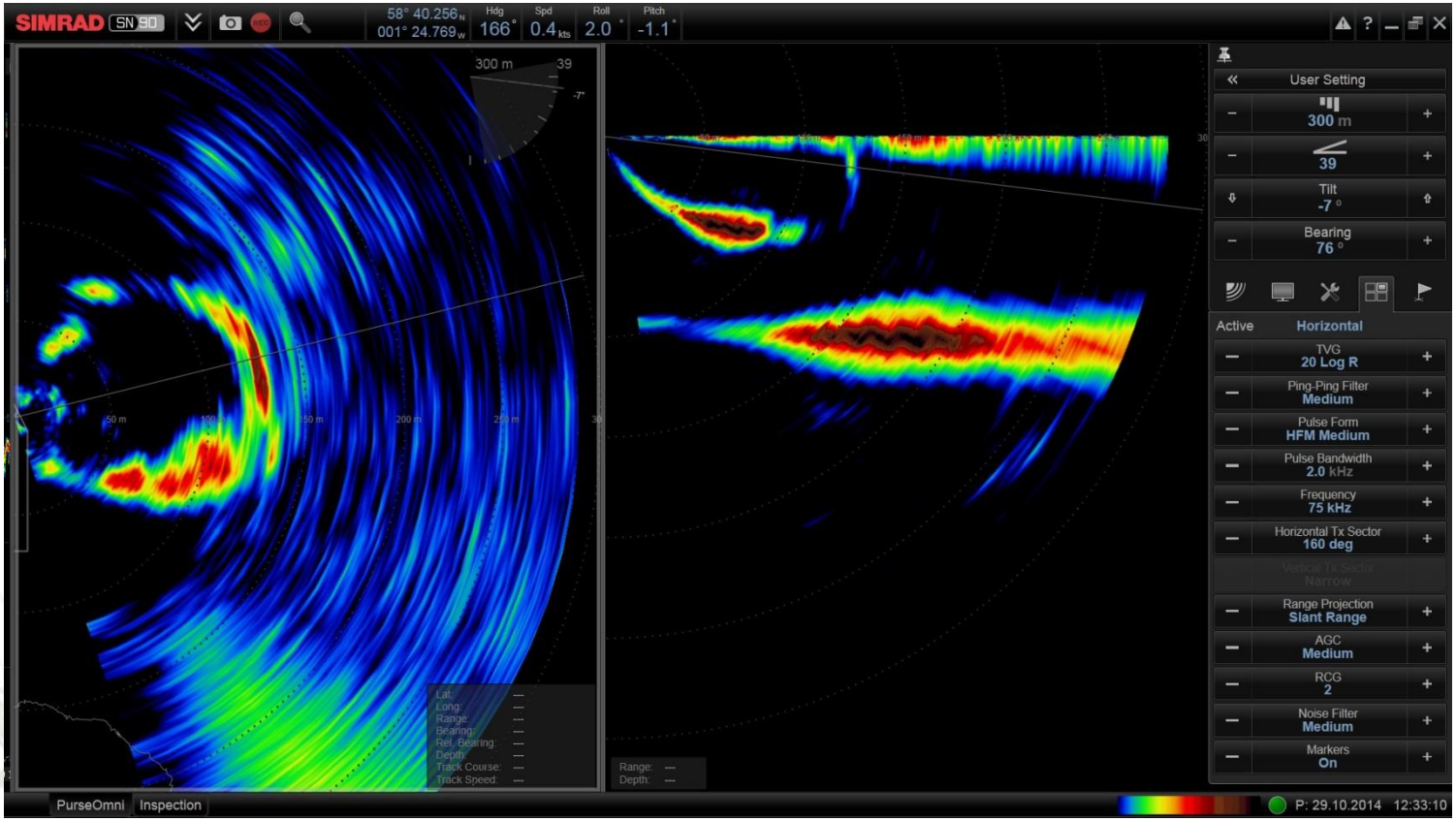
SN90 sonar
Inspection beam



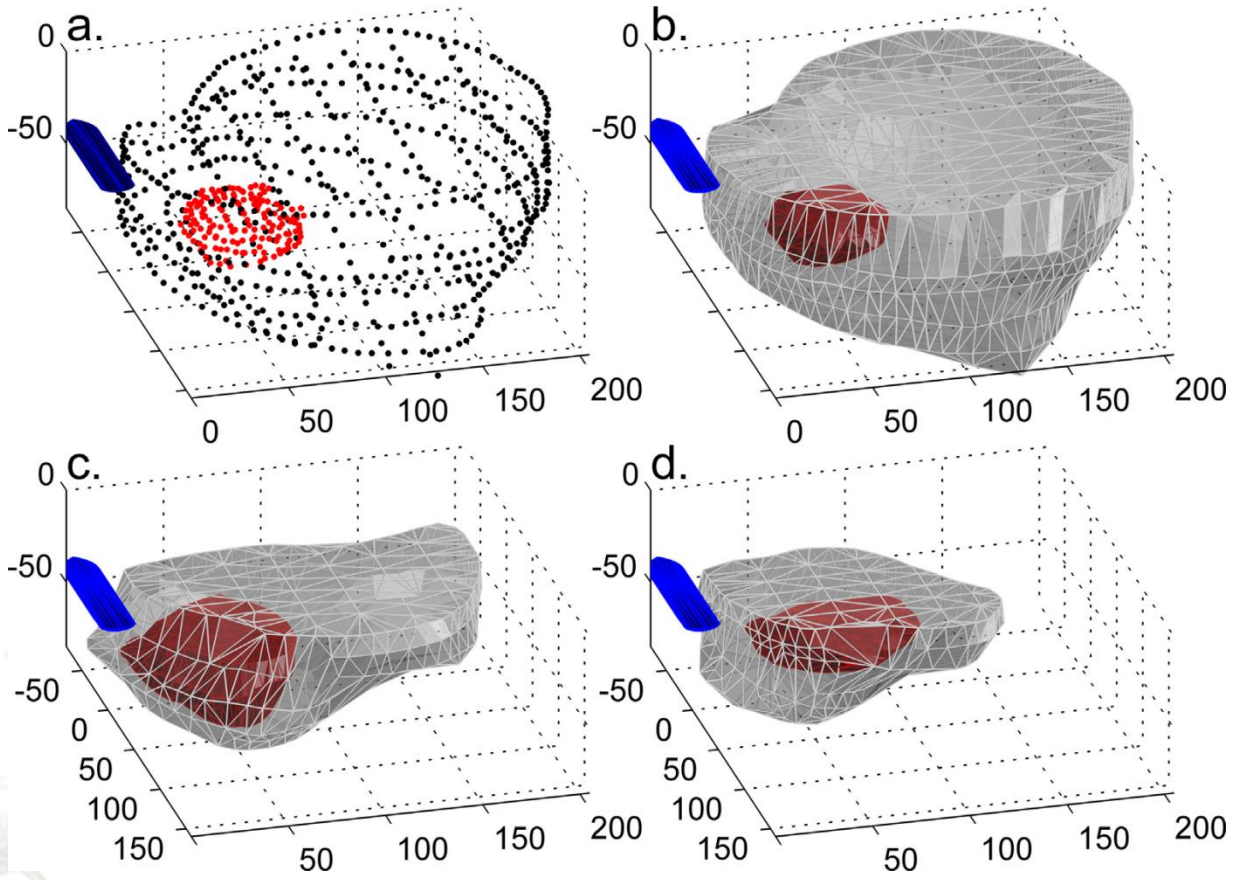
Regressjons-kurver, SV and Range
Beregning av: $\alpha(\text{capelin}), [\text{dB/m}]$



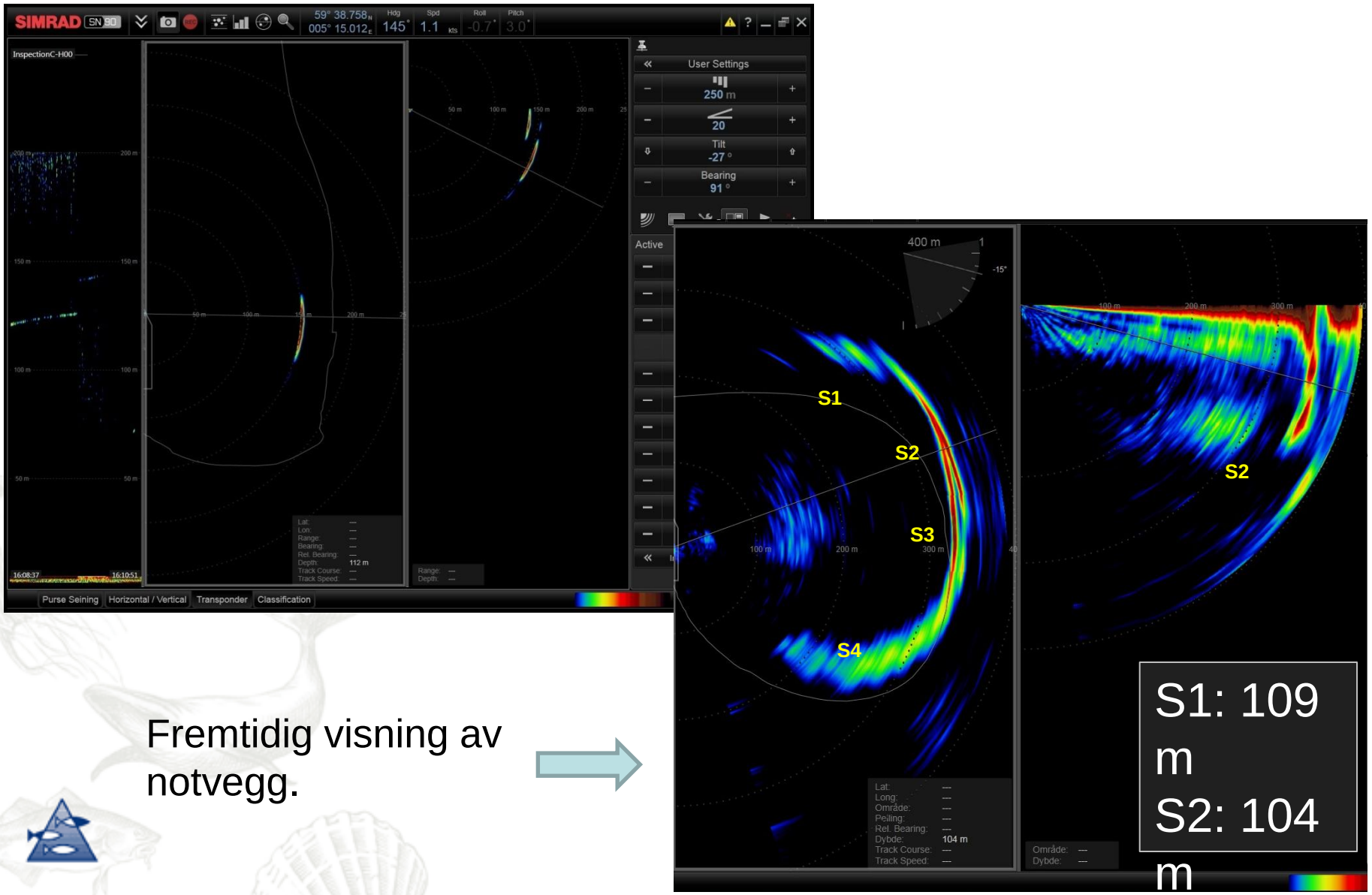
P3: Tilsvarende målinger inne i nota(etter fangst)-SN90



P4: Notvolum /trengingsgrad



P5: Visualisering av not-geometri - Transponderteknologi



Fremtidig visning av notvegg.

NYTT EMNE !

Størrelse ?

CRISP størrelsesmåling

Nytt ekkolodd

Kalibrering

Observasjoner og metodikk

Datafangst, beregnings og grafisk presentasjons-verktøy for størrelsesmåling av fisk med bredbåndsekkolodd

DABGRAF (FHF)

Nytt dataprogram

Samarbeid DABGRAF

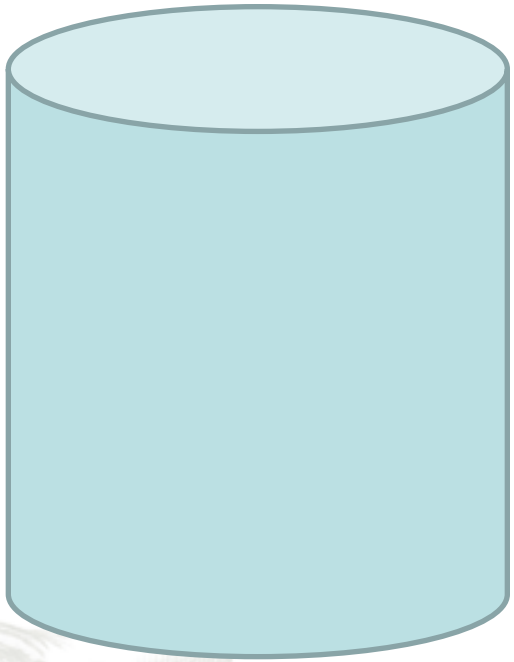
- Kongsberg Maritime (Simrad)
- Utlån og utvikling EK80
- CRISP prosjektet

- HI
- Dataopptak
- Metodikk for størrelses-måling

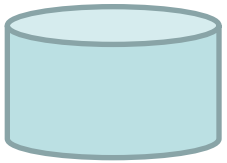
- CMR computing
- Koding av programvare
- Uttesting

Pulsvolum

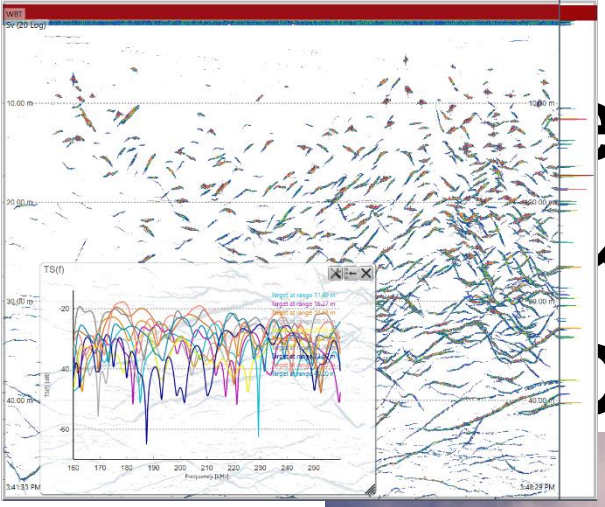
- EK60



BREDBÅNDS EK80

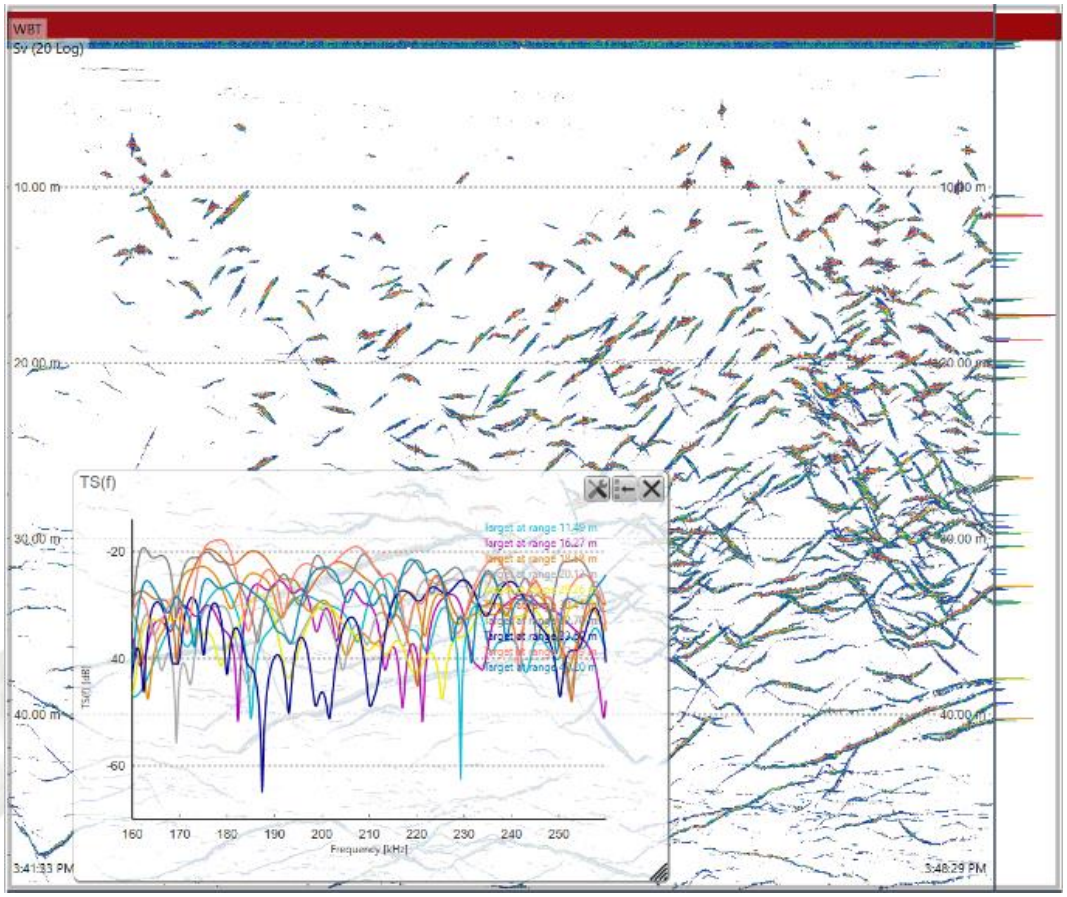


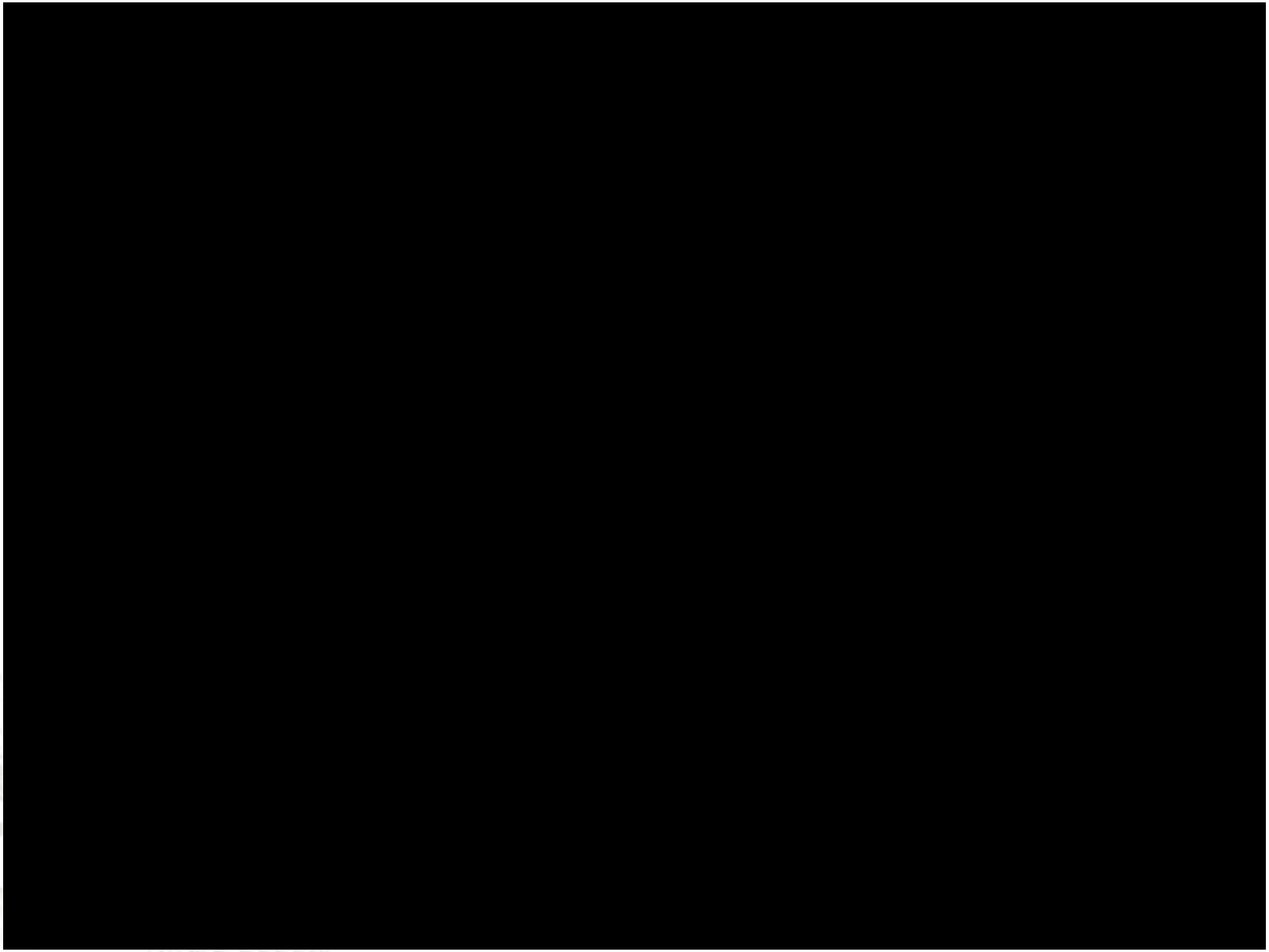
empler fra med nytt kkoloddprinsipp OBÅND) fra TS probe



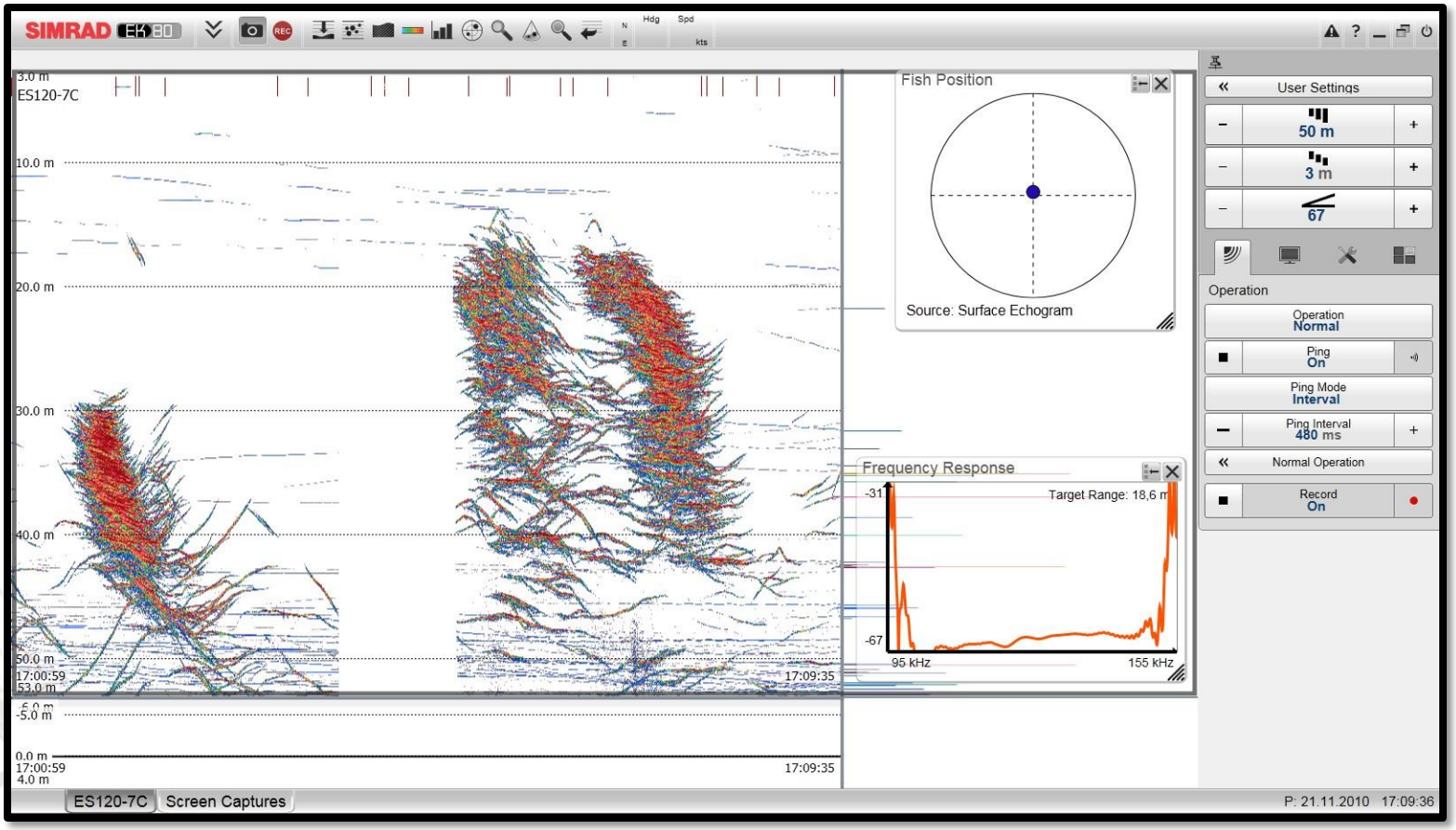
Spektral-analyse av enkeltsild

(måling av midlere TS sideveis)





Eksempler
Sei-stimer 50 – 100 m dyp

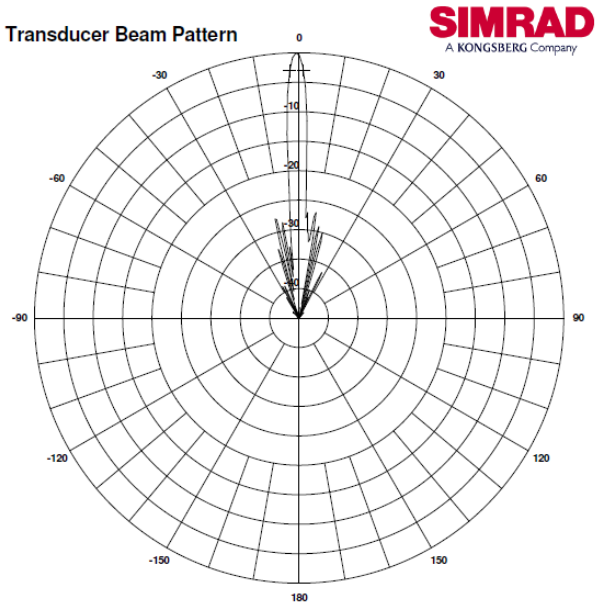


Hovedprinsipp DABGRAF

- Løs opp enkeltspor i tette forekomster: (pulskompresjon + strålebredde)
- Beregn ekkomodell for sild i 3D (f)
- Finn beste tilpassning : Måling / Modell
- Gi ut bare en lengde per enkeltspor
- Oppsummer fordeling i dataprogram

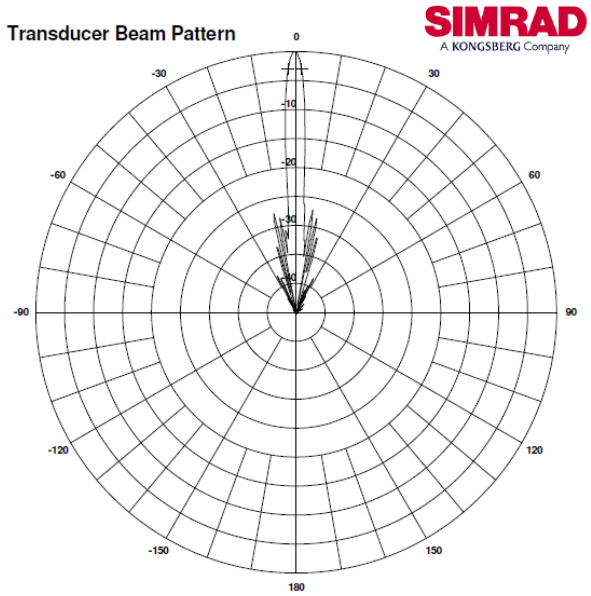
Ny svinger ES200-3C-101

Vertikal



Transducer Type:	ES200-7CD 312-206995	**Plane:**	Longitudinal
Serial no.:	ES200-3C-1	**Hydrophone Type:**	B&K 8103
Frequency:	200,0 kHz	**Hydrophone Serno.:**	2429024
Tested by:	solveigw	**Hydrophone Cal.Date:**	26.03.13
Date/time:	25.10.2013 10:39:55	**Distance to Hydrophone:**	4,81 m
Voltage Generator:	300 mV	**Water Temperature:**	22 °C
Amplifier Gain:	34 dB	**Module:**	1
Beam Width:	3,16°	**Element:**	5
Source Level:	215,74 dB		
DI:	35,44 dB		

Horisontal



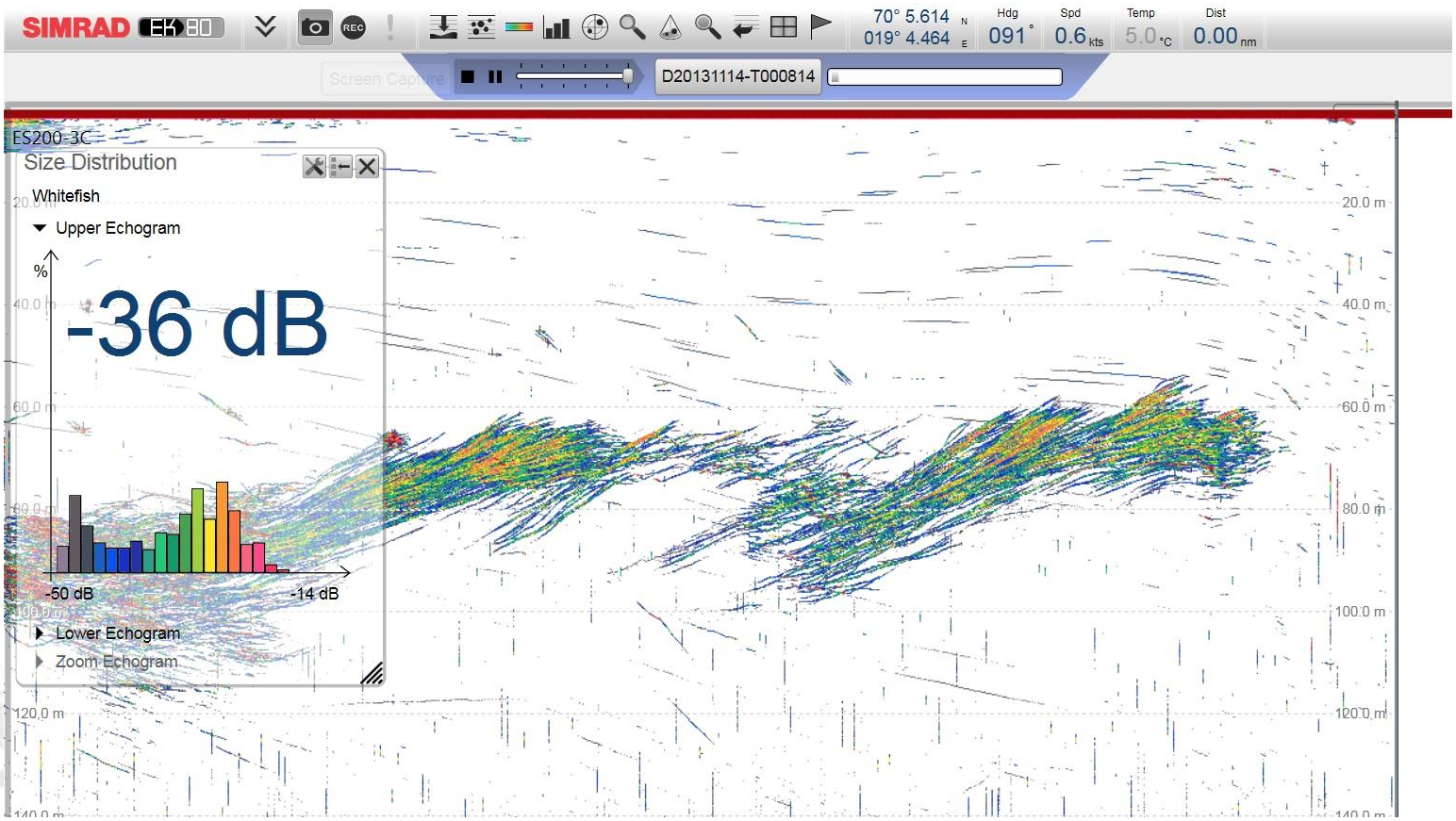
Transducer Type:	ES200-7CD 312-206995	**Plane:**	Transversal
Serial no.:	ES200-3C-1	**Hydrophone Type:**	B&K 8103
Frequency:	200,0 kHz	**Hydrophone Serno.:**	2429024
Tested by:	solveigw	**Hydrophone Cal.Date:**	26.03.13
Date/time:	25.10.2013 10:34:53	**Distance to Hydrophone:**	4,81 m
Voltage Generator:	500 mV	**Water Temperature:**	22 °C
Amplifier Gain:	28 dB	**Module:**	1
Beam Width:	3,17°	**Element:**	5
Source Level:	220,13 dB		
DI:	35,12 dB		

Nov. 2014, 2015, makrell

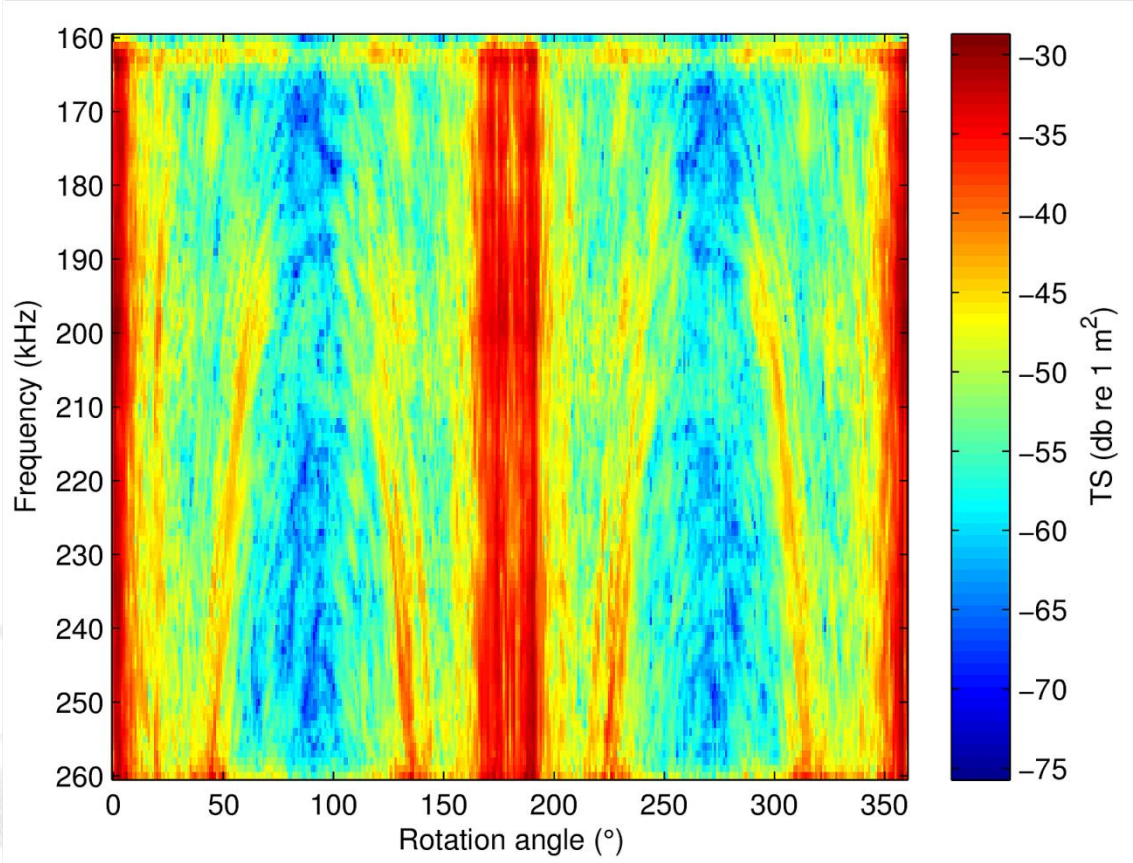
NED

SIDE, -15^{o}

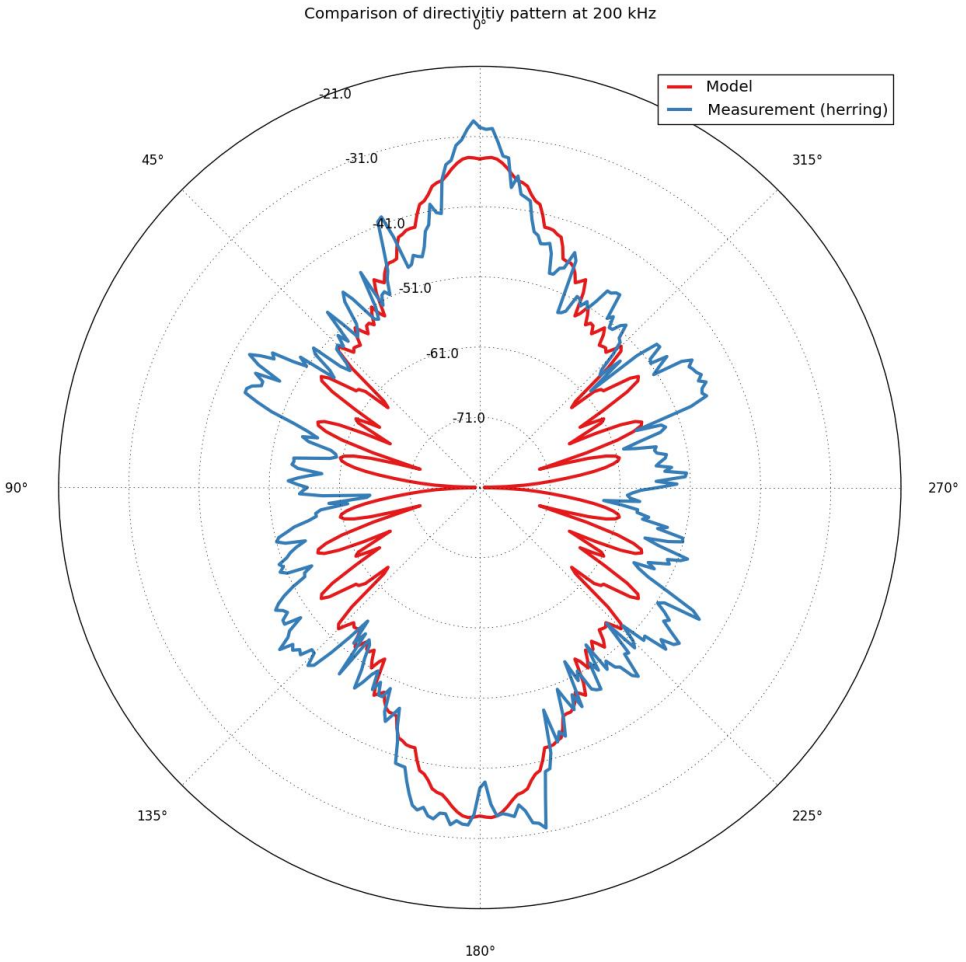
Oppløsning med ny svinger, sild 80-100m



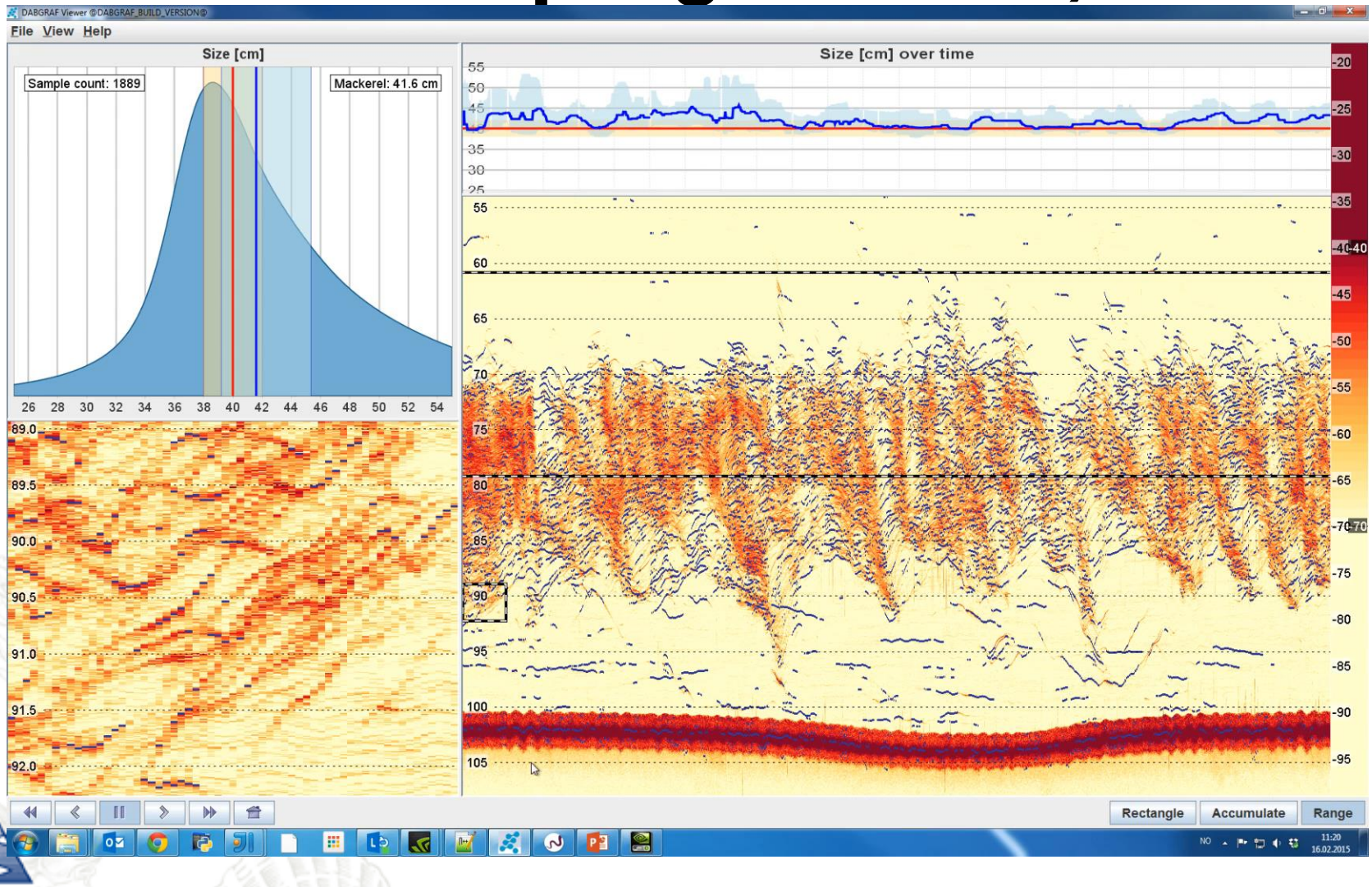
Sild, 33 cm, ekko over 360 grader og frekvens



Modell –måling, 33 cm sild

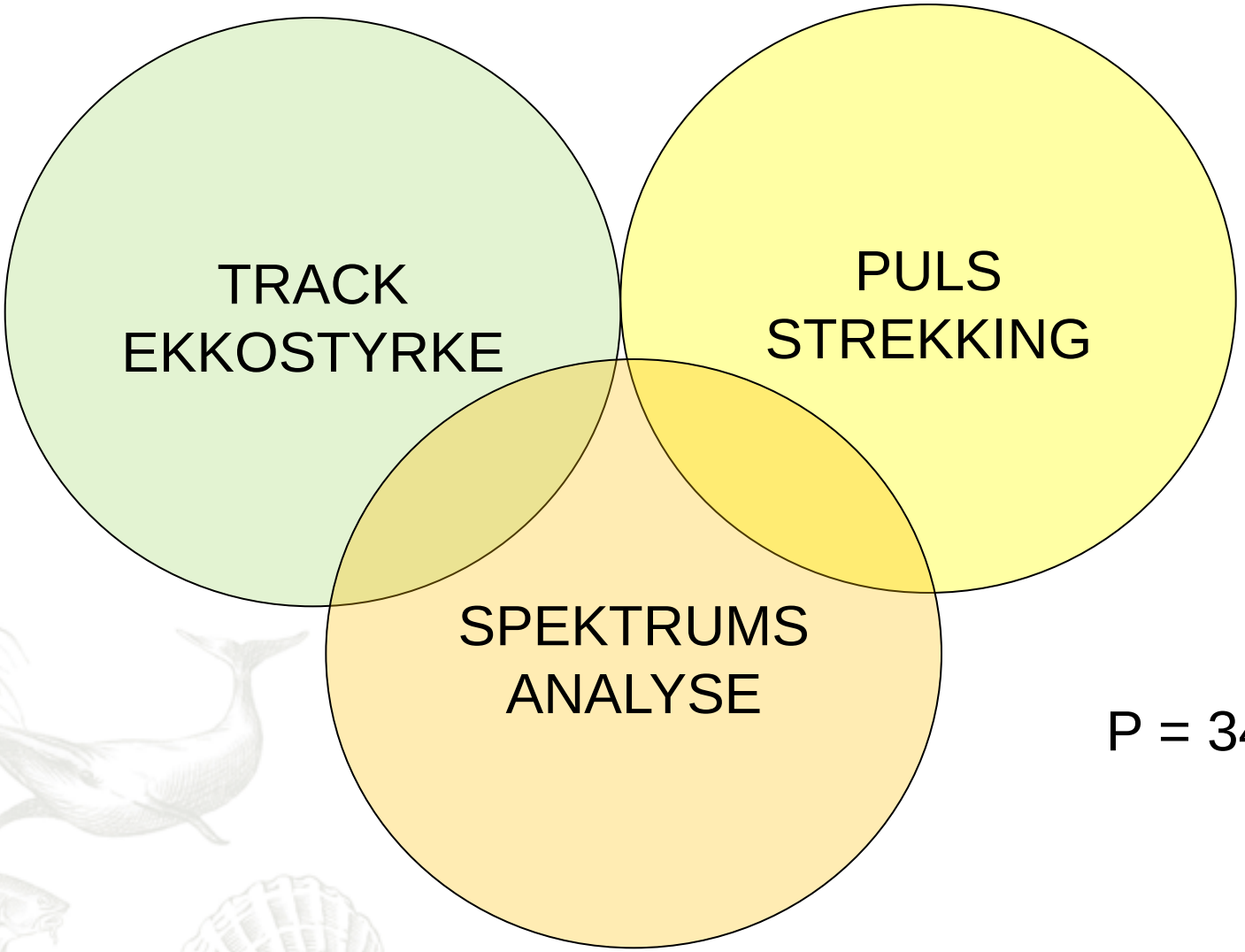


DABGRAF programvare, 2016



Takk !

2014 metoder: DABGRAF



P = 34 cm ??

NY METODE

NYTT NFR prosjekt

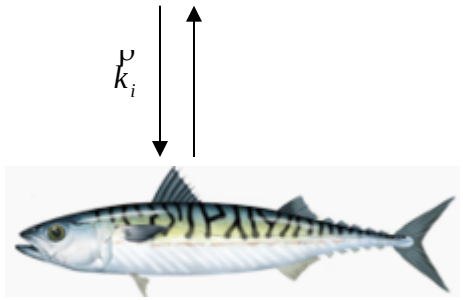
Tre metoder

- Amplitude, TS
- Frekvens-analyse

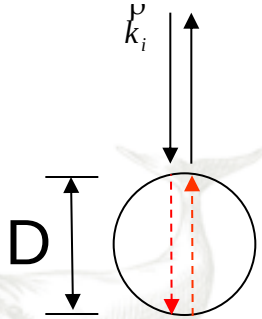
- Tids domenet

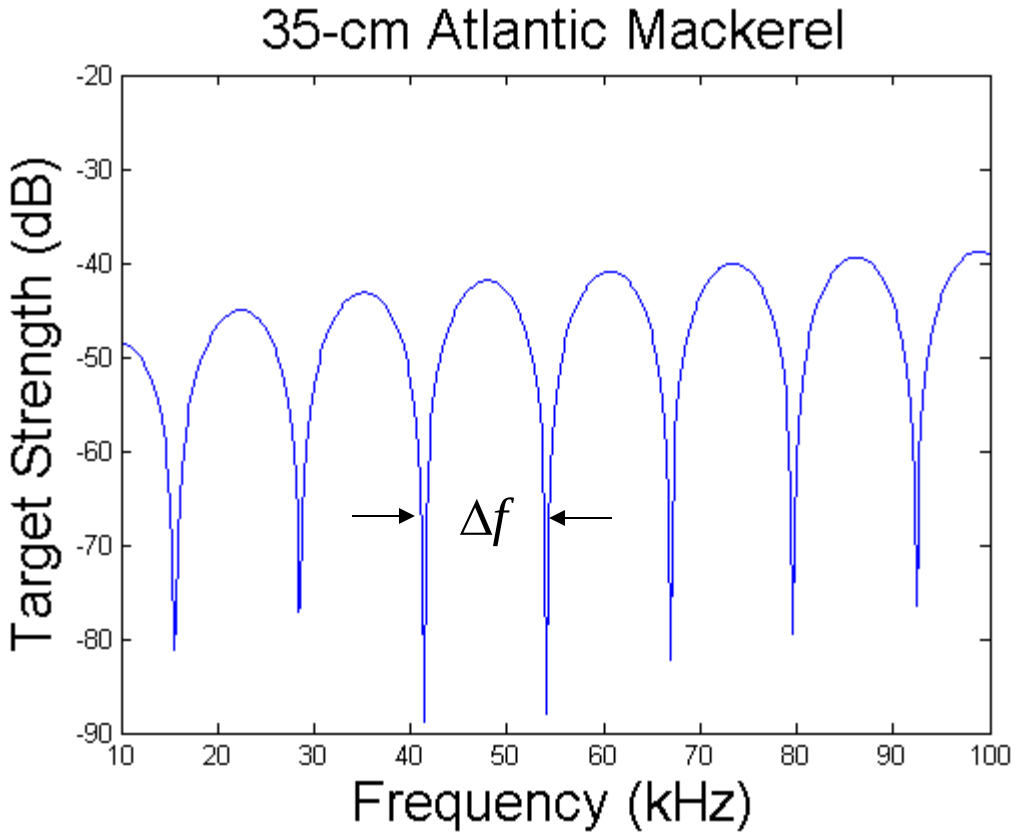
Frekvens domenet

Modell eksempel: Atlantic Mackerel (*Scomber scombrus*)



Cross Section





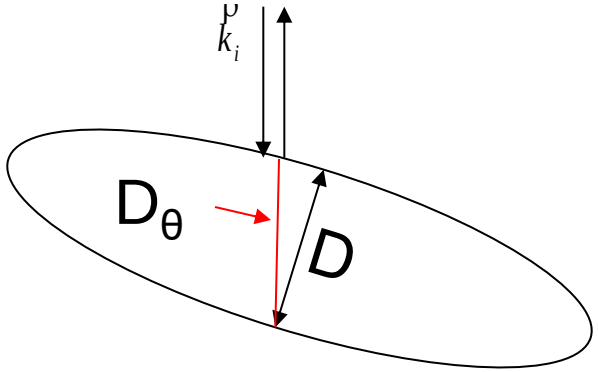
Måling av D fra Δf

$$D = \frac{hc_w}{2\Delta f}$$

h = lydhastighets kontrast (fiskekjøtt/sjø)

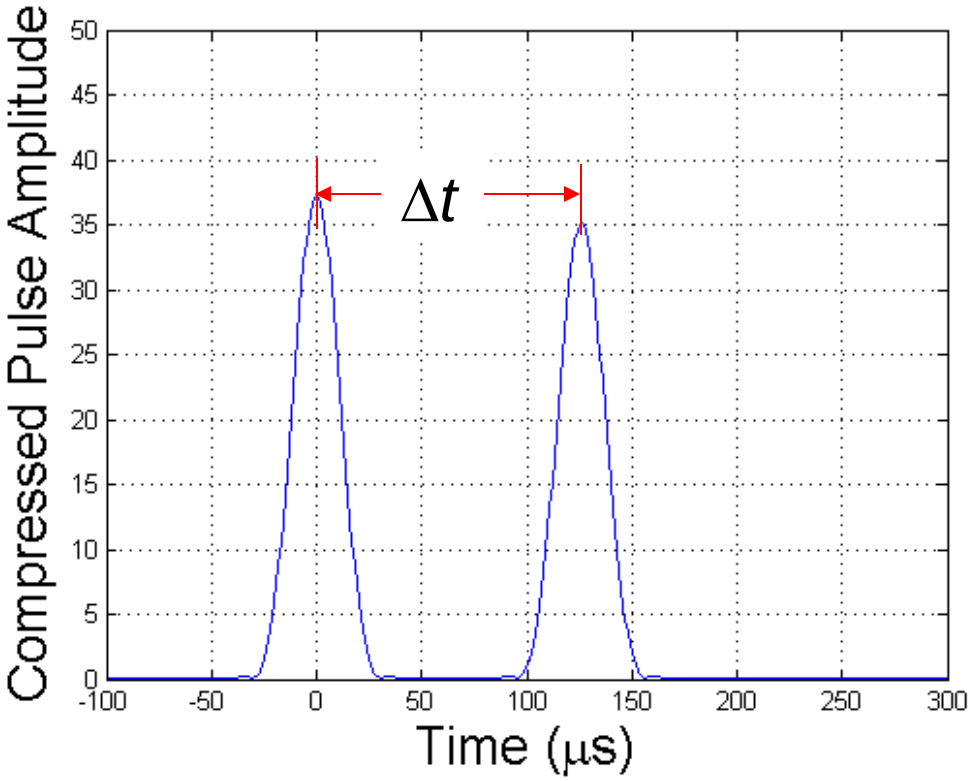
C_w= lydhastighet I sjøvann (målt)

Men, også fiskens orientering:



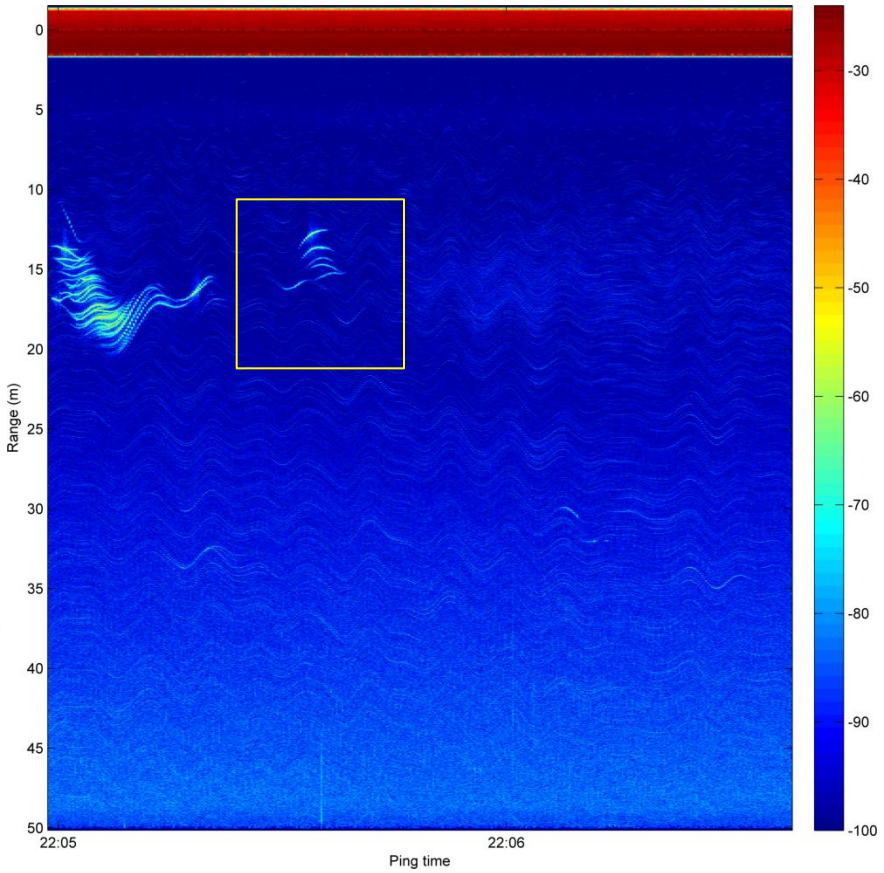
$$D_\theta = \frac{D}{\cos(\theta)}$$

Alternativ: Tidsdomenet
(krever veldig høy signaloppløsning)

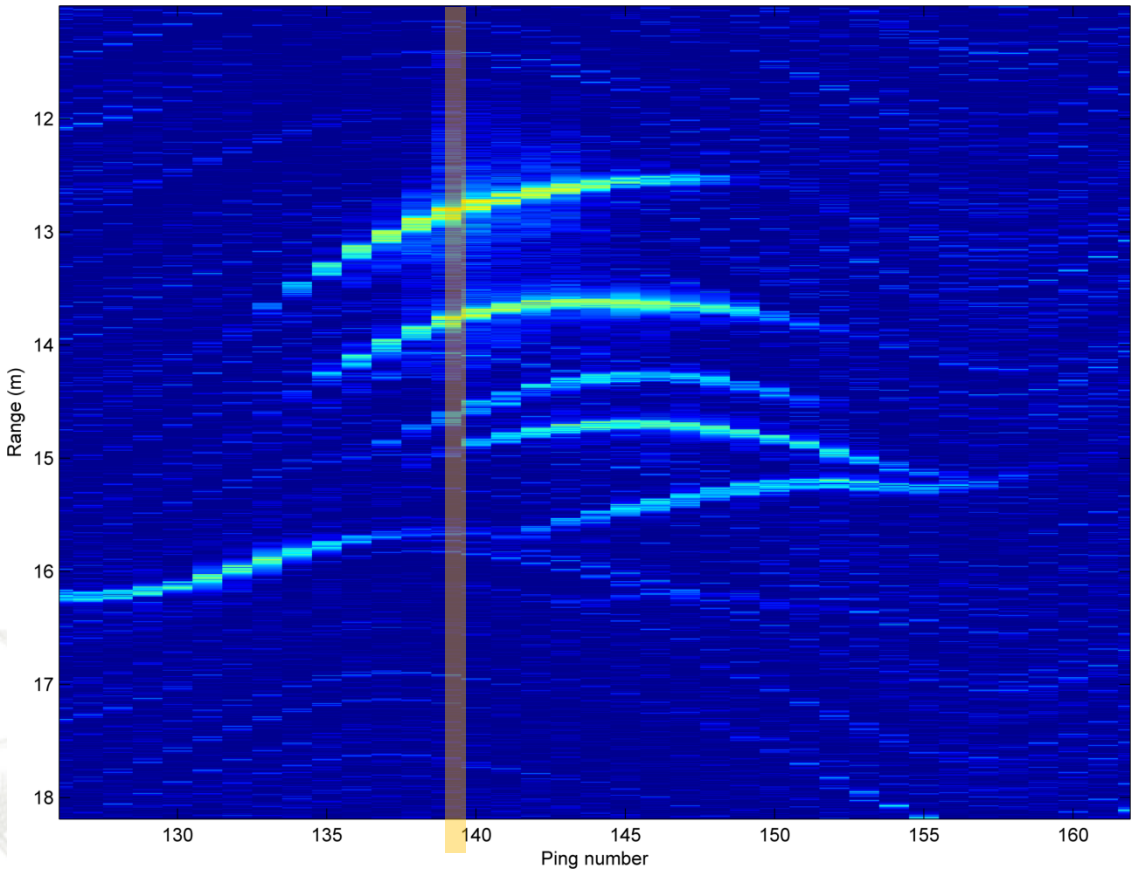


$$D = \frac{hc_w \Delta t}{2}$$

Oppløste track fra probe
(eller DABGRAF svinger)

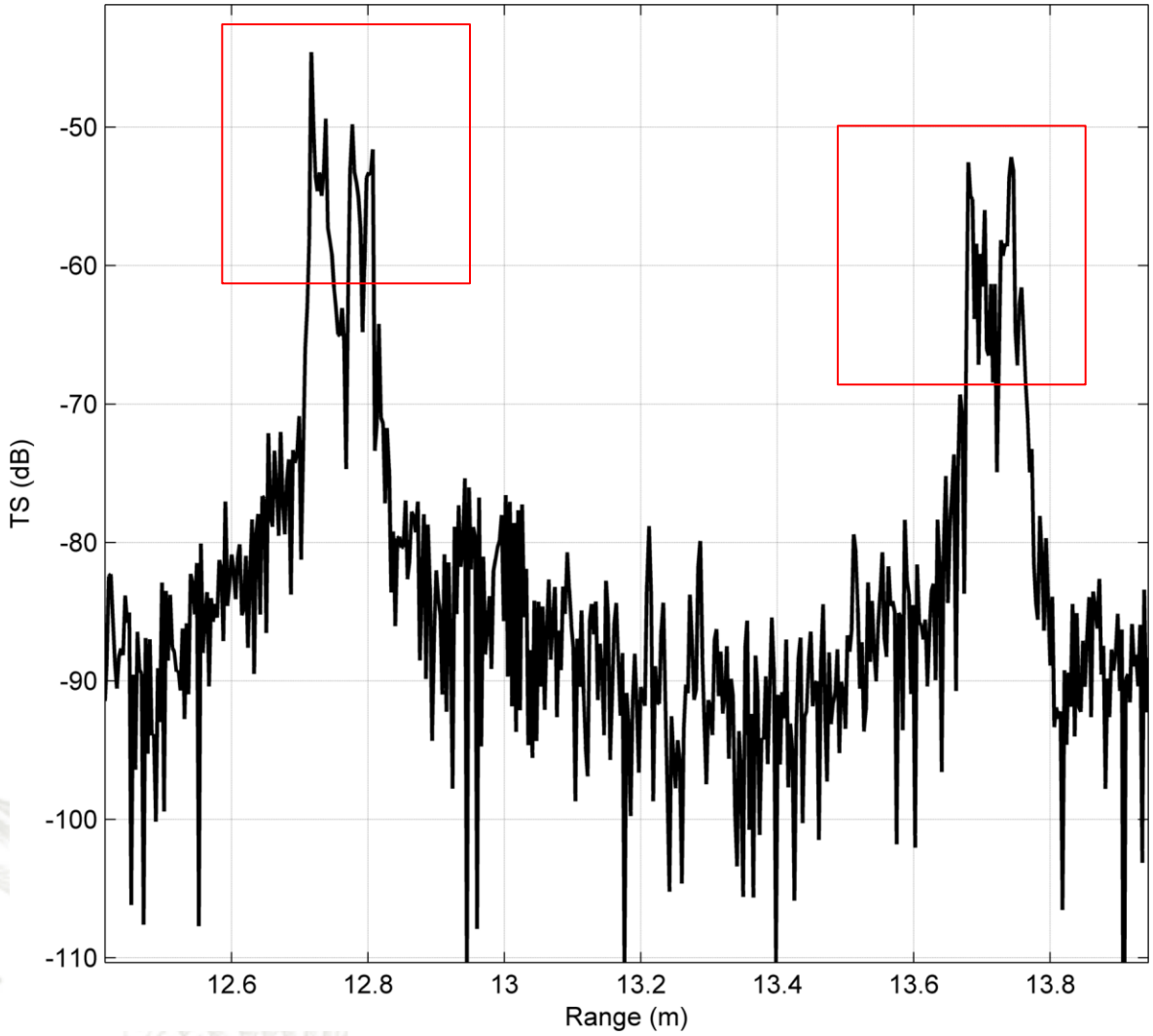


Zoom



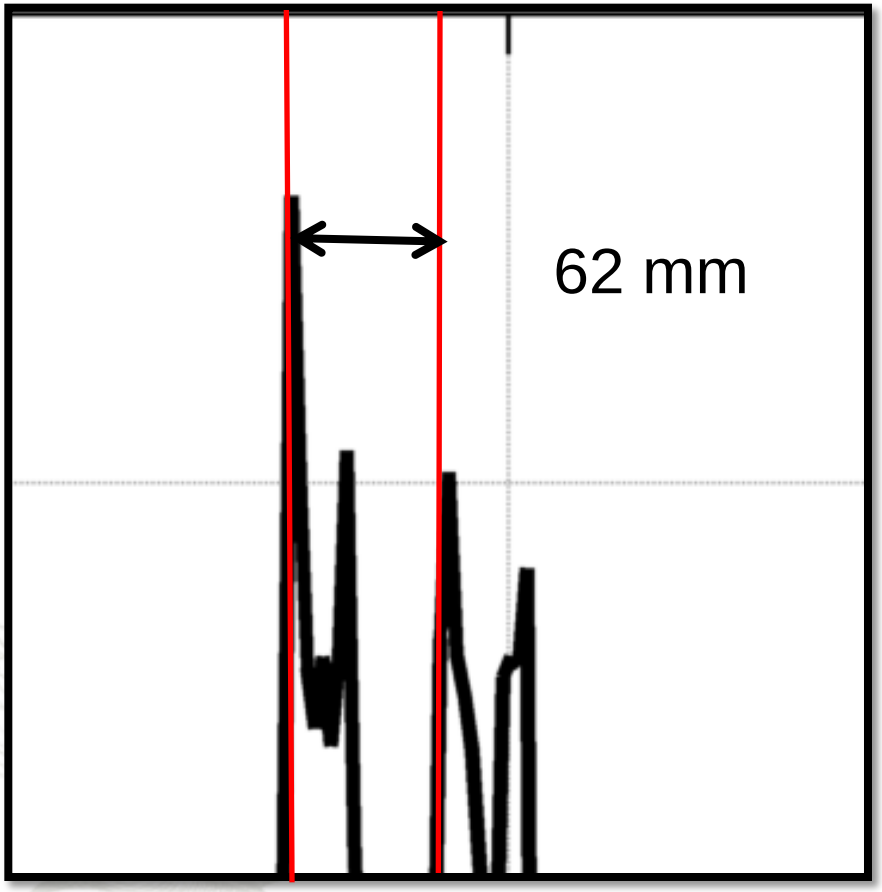
Ping no. 139

Ekkostyrke i tidsdomenet

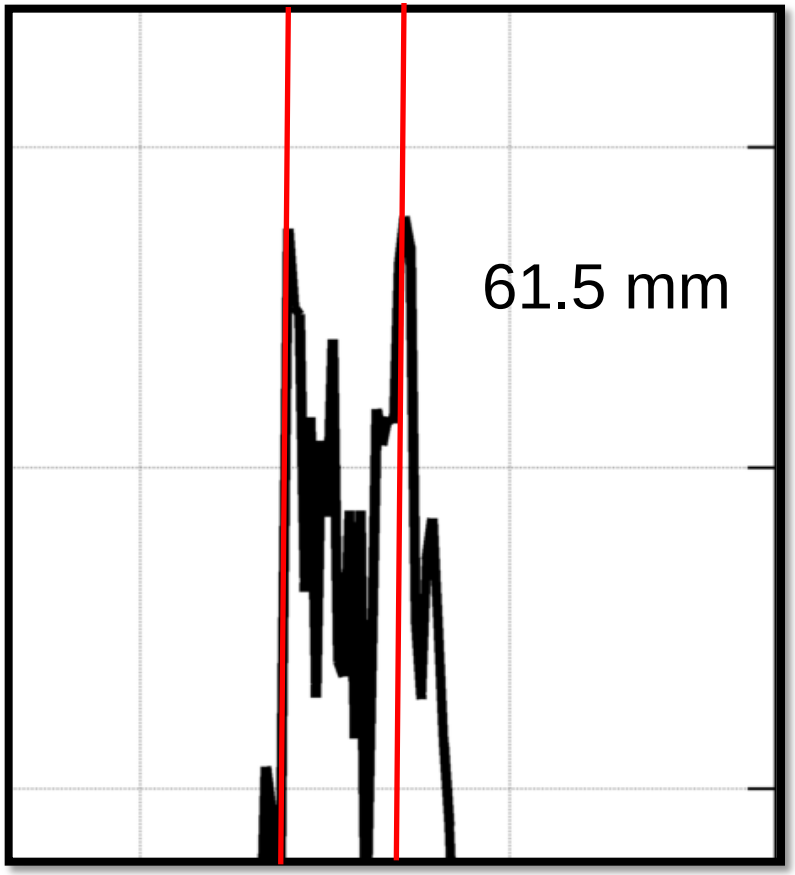


Akustisk diameter

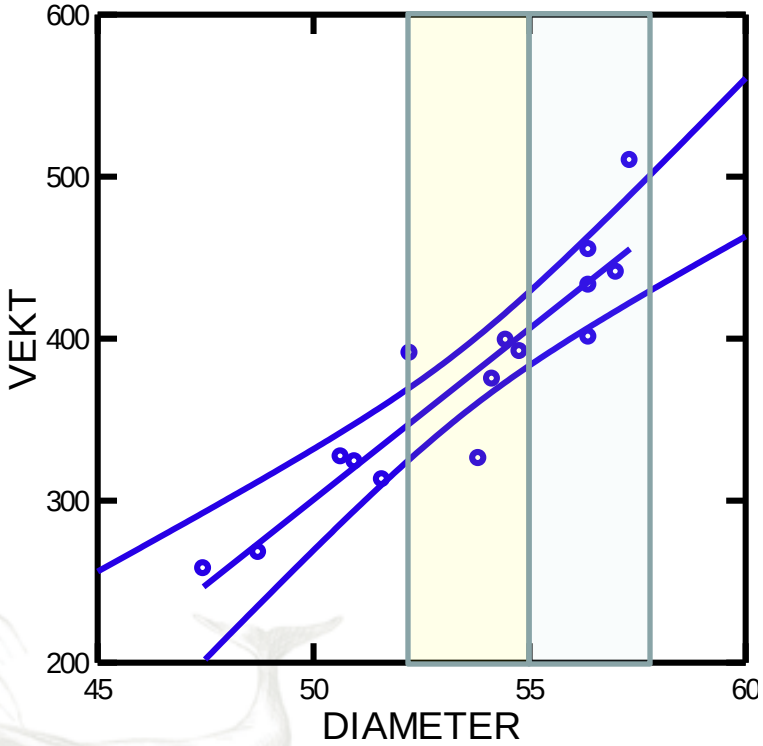
TRACK 1

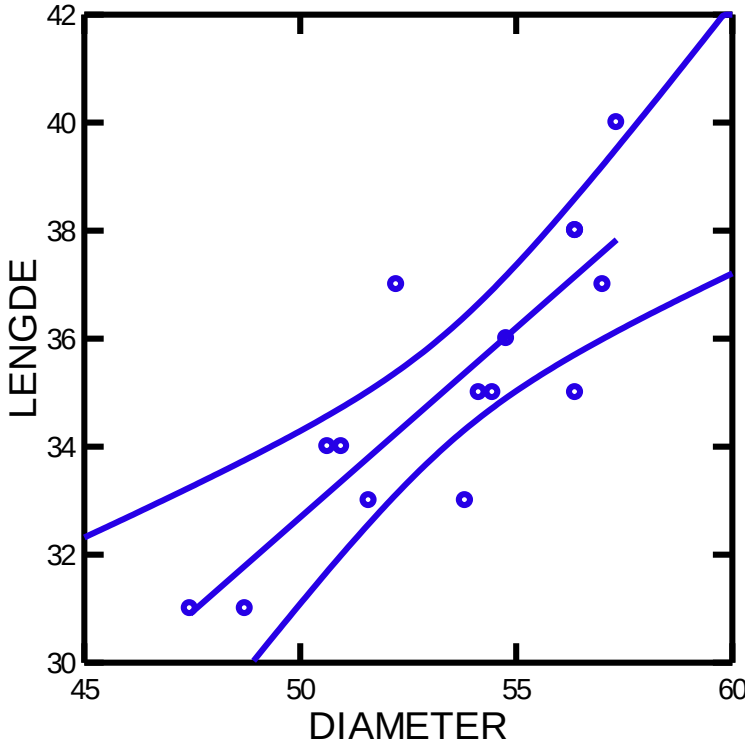


TRACK 2

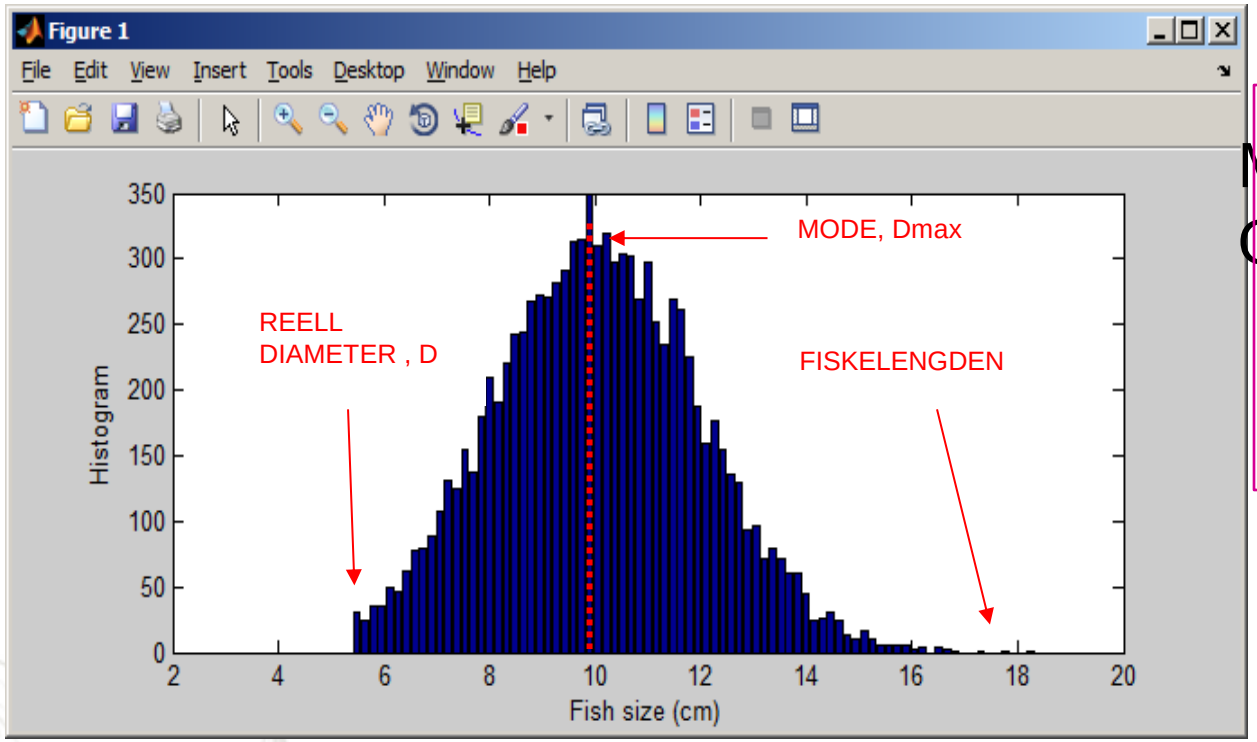


Egentlig ”effektiv” diameter
(målt på siste fangst, KB)





Hypotetisk fordeling av målt diameter,i sjøen



Mean Angle of Orientation

$$\langle\theta\rangle = \cos^{-1}\left(\frac{D}{D\max}\right)$$

Konklusjon

- Størrelsesmåling av sild og makrell med smal stråle og bredbånds ekkolodd er fysisk mulig.
- Forbedring av modellene bør gjøres ved kontrollerte målinger på enkeltfisk med stor lengdespreding i Austevoll
- NYTT NFR PROSJEKT FRA 2016 !
- Forsøk på fiskefartøy kan starte i 2018