Performances of XBT systems in Mediterranean (2003-2010)

Not a fall rate analysis, a small contribution to the knowledge, maybe

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II[nd] XBT Fall Rate Meeting
Hamburg, 25-27 August 2010

If the theory says…

Good Instruments +

Good working procedures +

Good QC

➔ Good Data…

The question is: How reliable is a XBT system?

Probe Type	XBT	XSV	XCTD	XCTD-1	AXSV**	AXCTD**
Sampling Rate	10Hz	10Hz	4Hz	25Hz	10Hz	4Hz
Vertical Resolution	60cm *(18cm for T-11 FSXBT)*	60cm	100cm	17cm	60cm	100cm
System Accuracy	±0.2°C	±0.25 m/sec	±0.035°C* ±0.035mS/cm ±0.05 PSU	±0.02°C	±0.25 m/sec	±0.035°C ±0.035mS/cm ±0.05 PSU
Temperature Resolution	0.01°C	—	0.01°C	0.01°C	—	0.01°C
Temperature Range	-2 to 35°C	—	-2.2 to 30°C	-2 to 35°C	—	-2.2 to 30°C
Sound Velocity Resolution	—	0.04 m/sec	0.05 m/sec	—	0.04 m/sec	0.04 m/sec
Sound Velocity Range	—	1405-1560 m/sec	1405-1560 m/sec	—	1560 m/sec	1405-1560 m/sec
Conductivity Resolution	—	—	-0.01 mS/cm	0.017 mS/cm	—	0.01 mS/cm
Conductivity Range	—	—	-20-75 mS/cm	0-70 mS/cm	—	20-75 mS/cm

System Depth Accuracy: 4.6 meters or 2% of depth, whichever is greater.

- Probe motion ➔ parabolic equation (FRE) with (immediately) terminal speed ➔ in average, good approximation, but not always
- (Estimated) Depth ➔ being not directly measured, estimated error ➔ in general reasonable agreement, but not always
- Electronic response (thermal, delay)➔ not included in the FRE ➔ few analyses and tests, unknown
- Different recording system/probe types➔ needed daily calibration with test probes ➔ slightly different recorded values, few analyses and tests, unknown
- Launching position + launching procedures + ship motion ➔ not included in FRE ➔ few analyses and tests, unknown
- XBT shape/dimensions ➔ industrially constant ⇔ not constant ?➔ variations in the motion, few tests, unknown
- Influence of seawater characteristics on the probe dynamics ➔ theoretically estimated ➔ few tests, not included in FRE
- Metadata➔ as needed as data ➔ often absent or incomplete.
- ... conclusion

Working hypothesis

Usually, we **assume** that the presently deployed probes do have the same physical dimensions (they should be the same) as the earlier manufactured XBTs. LM Sippican states this with two exceptions:

- change of the wire coating process (after 1996)
- the addition of a net on the spool within the afterbody.

Since the late 70's, TSK is the other official manufacturer, and based on the statement of the manufacturers, the probes should be indistinguishable.

The other well known changes occurred during the XBT age (for instance, the transition from a chart recorder to a digital device, after about 1985) should have had a zero-impact on the probe motion, but recorded values could be (slightly) different.

How realistic is this? Namely…

Sippican(Old)=Sippican(New)=

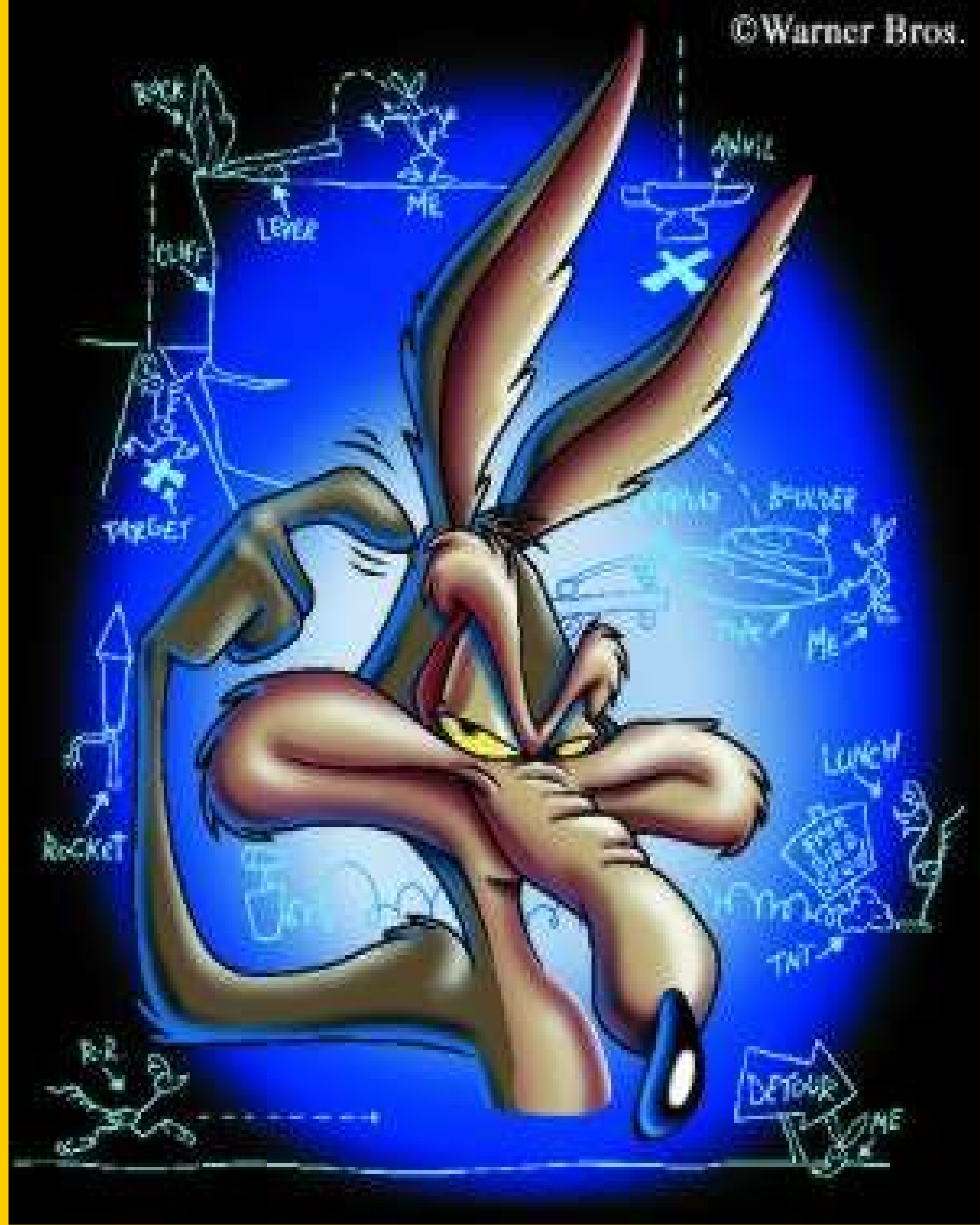
=TSK(Old)=TSK(New)?

Hic Rhodus, hic saltus

The range of the uncertainties of XBT measurements is hard to be quantified.

There are several (partially known) parameters inducing a (larger than unexpected) spread in the results.

But, the harder the play, the more interesting the challenge.



Acknowledgments (alphabetically…)

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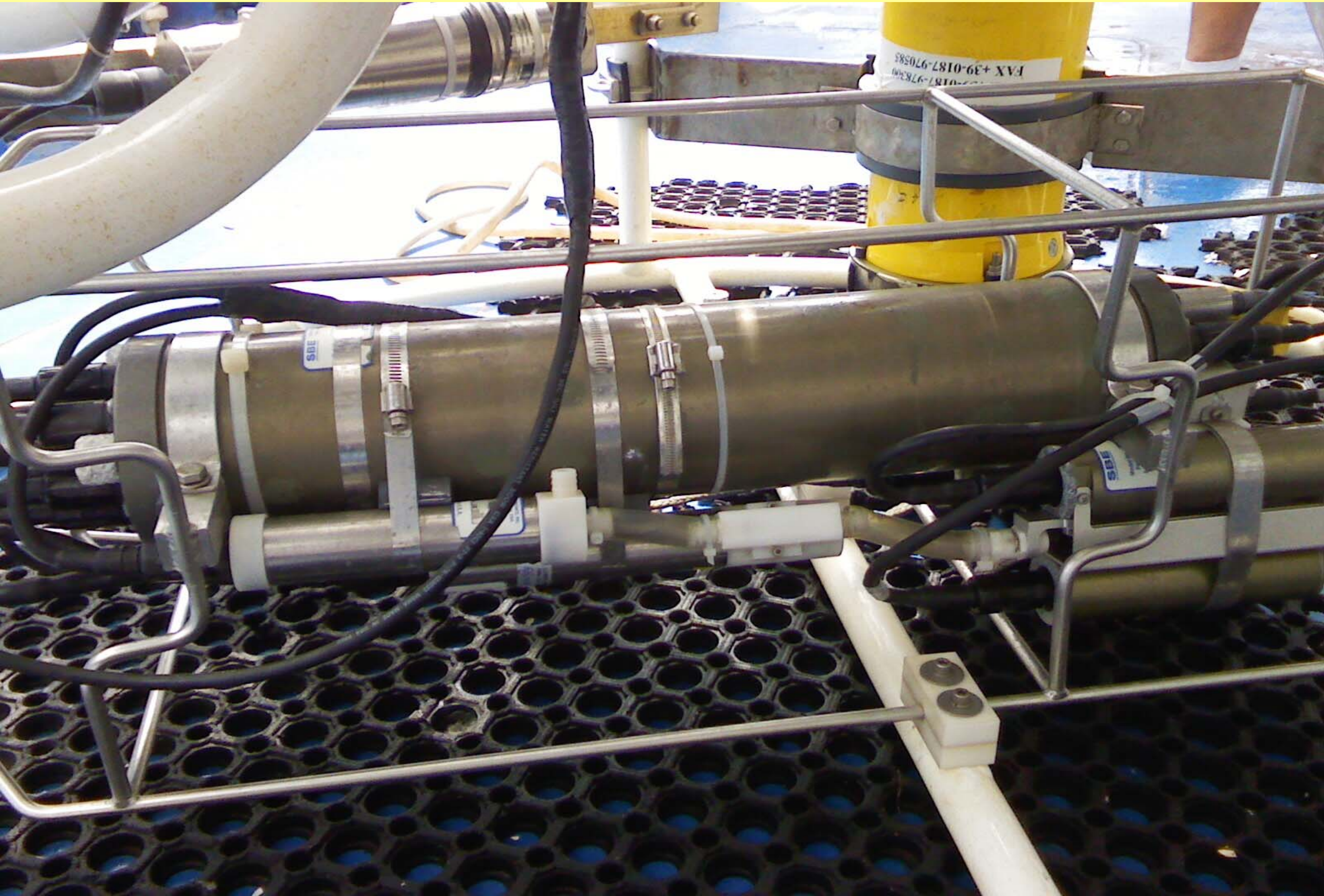
A.Peirano (ENEA, Lerici, Italy) for the XBT video

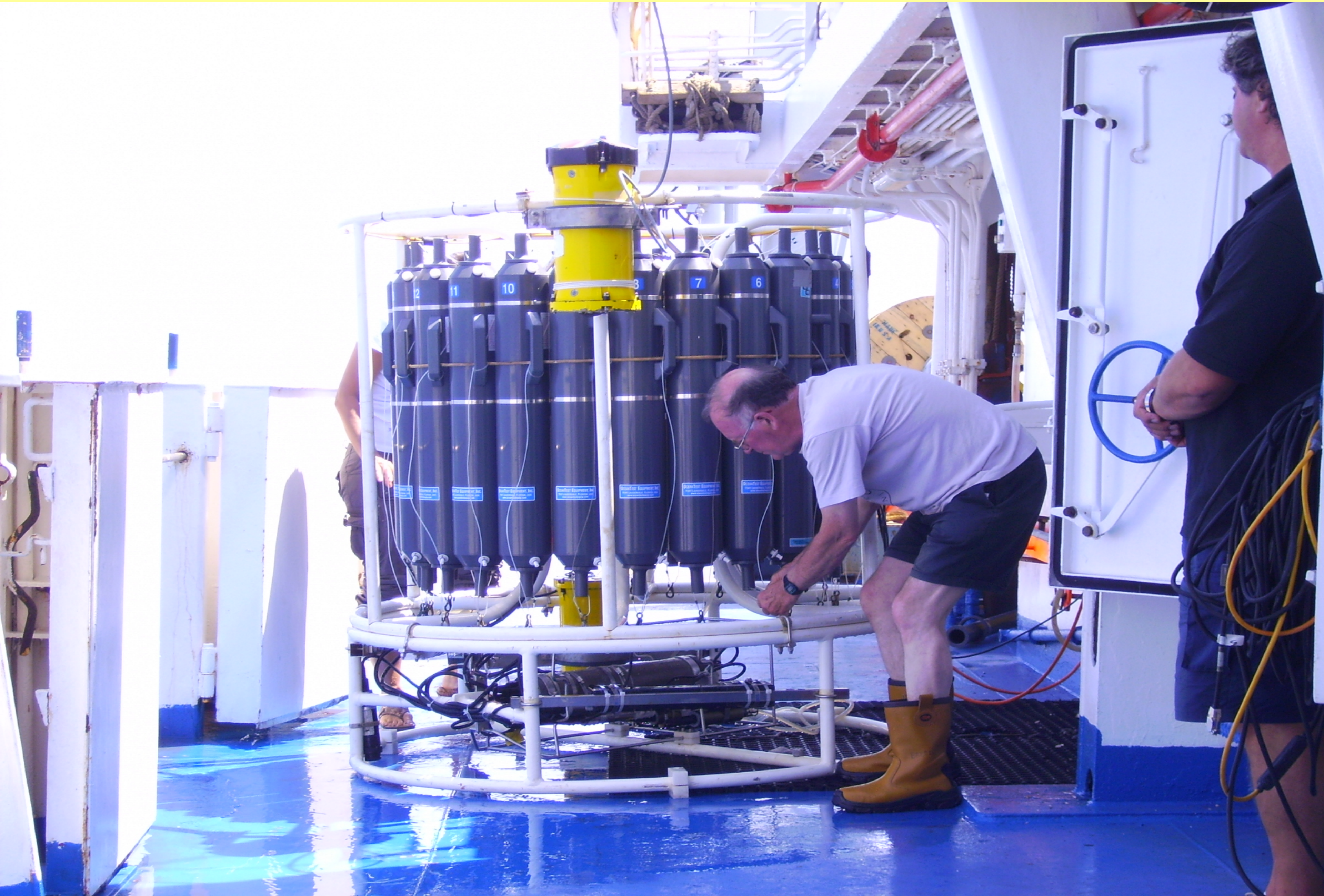
What we did? (but statistics is poor)

- **Since 2003, comparison between CTD casts and co-located and contemporaneous (LM Sippican) XBT probes deployed from a motionless ship (RV URANIA),**
- **CTD profiles: SEABIRD 911 *Plus*, calibrated (before and after each cruise) at NURC Laboratory (La Spezia, I). CTD data processed with standard SEABIRD software.**
- **< 20070101: LM Sippican MK-12, launcher LM3A, junction box, cable, hard-top**
- **> 20070101: LM Sippican MK21-USB, laptop**
- **20100801: QUOLL/TSK/LM SIPPICAN + XBT&XCTD**
- **ALL T values are "*in-situ*" Temperatures.**

What we did? (but statistics is poor)

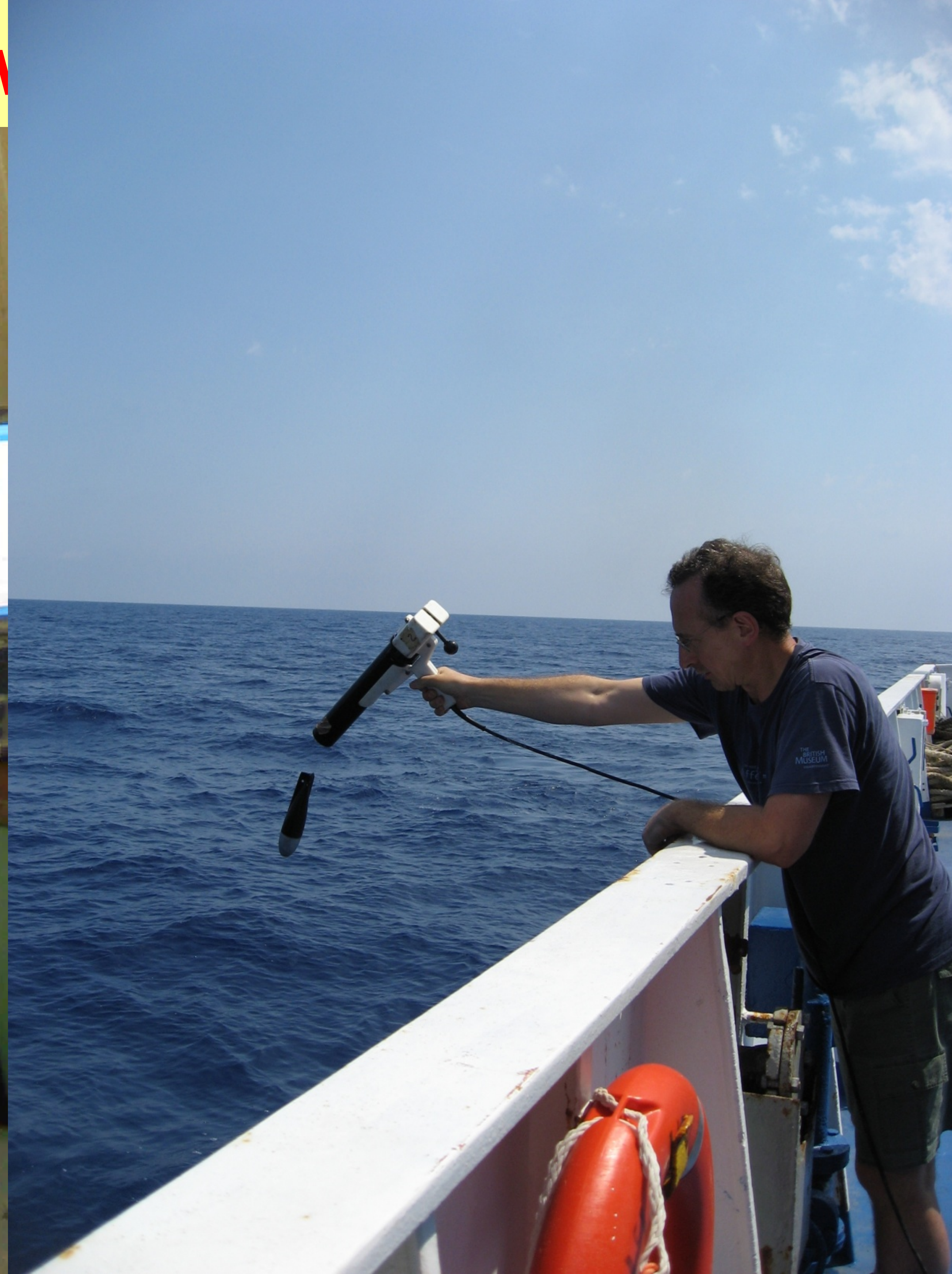


What we did? (but statistics is poor)



What we did? (but statistics is poor)

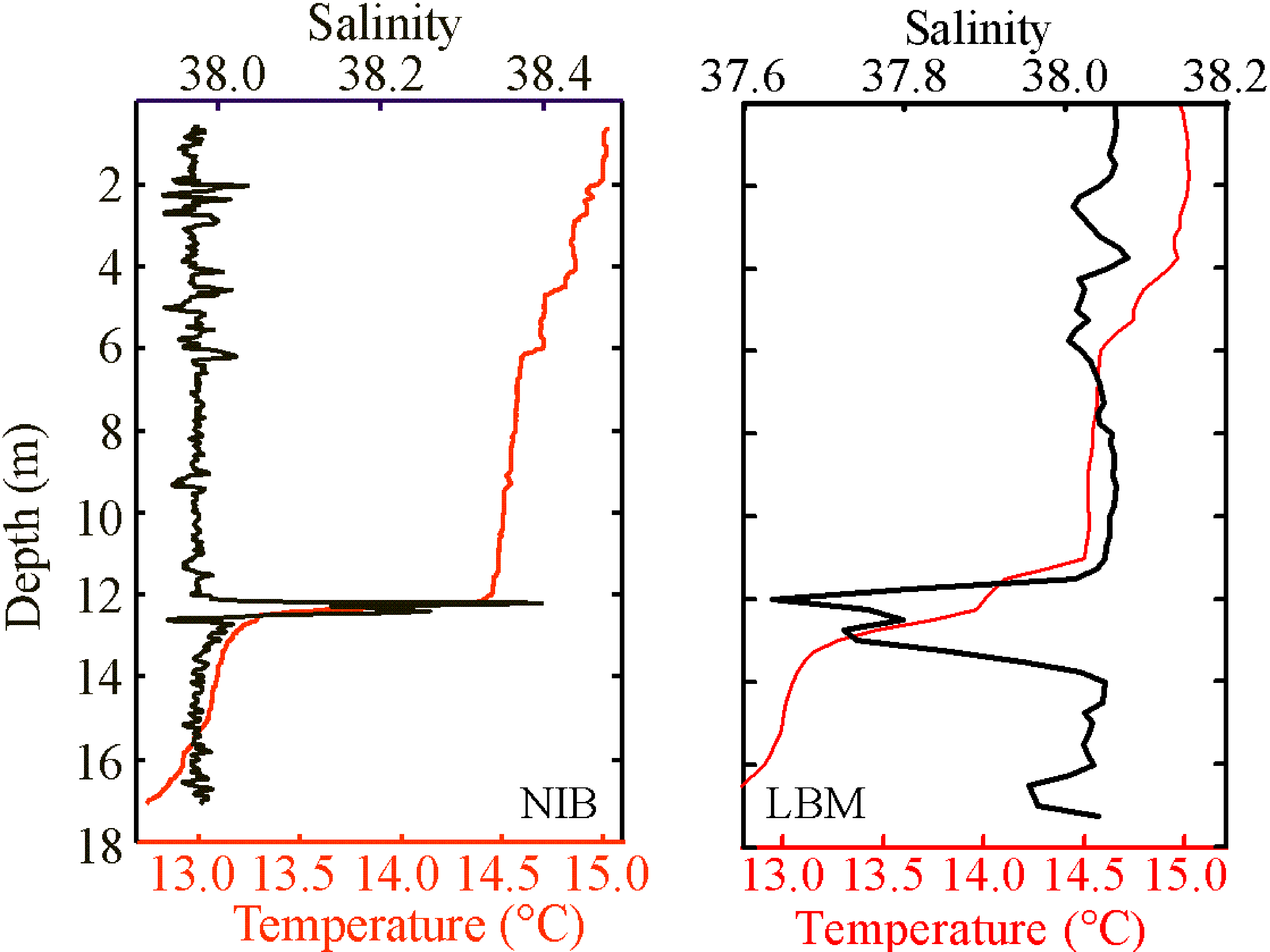
What w … poor)



How good can be a CTD profile?

Nansen Bott.	(0.01 °C; 1.5-6% FS)	(1897)
STD	(0.1 °C; 0.2 PPT)	(1957?)
CTD	(0.001 °C; 0.015% FS)	(1967)
MBT	(0.2 °C; > 1% Z)	(1940)
XBT	(0.2 °C; 2% Z)	(1966)

CTD is usually adopted as reference instrument
ARGOs and GLIDERs use the same sensors as CTD



Salinity
38.0
38.2
38.4
Depth (m)
2
4
6
8
10
12
14
16
18
13.0
13.5
14.0
14.5
15.0
Temperature (°C)
NIB
Salinity
37.6
37.8
38.0
38.2
13.0
13.5
14.0
14.5
15.0
Temperature (°C)
LBM

Depth	E.R. (O.S.316)	LBM (O.S.316)	NIB *	CIM (SBE23)	IZOR(SBE23)
5 m	14. 750 ± 0.140 37.935 ± 0.004	14.86 ± 0.12 38.04 ± 0.02	14.806 ± 0.037 37.966 ± 0.008	14.71 ± 0.03 37.98 ± 0.01	14.865 ± 0.080 37.981 ± 0.004
10 m	14.521 ± 0.017 37.942 ± 0.001	14.52 ± 0.05 38.05 ± 0.01	14.495 ± 0.017 37.977 ± 0.001	14.52 ± 0.05 37.98 ± 0.01	14.602 ± 0.006 37.984 ± 0.002
15 m	12.998 ±0.020 37.932 ± 0.002	13.04 ± 0.07 38.05 ± 0.01	13.001 ± 0.014 37.960 ± 0.004	12.98 ± 0.01 37.97 ± 0.01	13.006 ± 0.010 37.977 ± 0.001

Low. Speed 0.2 - 0.3 m/s

CTD inter-comparison, May 2003 – Adriatic Sea

Depth	E.R.	LBM	NIB	CIM	IZOR
5 m	14.647 ± 0.112 37.934 ± 0.003	14.84 ± 0.05 38.02 ± 0.01	14.733 ± 0.014 37.987 ± 0.017	14.95 ± 0.3 37.98 ± 0.1	14.977 ± 0.032 37.978 ± 0.001
10 m	14.519 ± 0.006 37.936 ± 0.011	14.58 ± 0.01 38.06 ± 0.01	14.519 ± 0.006 37.980 ± 0.002	14.55 ± 0.02 37.98 ± 0.01	14.569 ± 0.025 37.984 ± 0.001
15 m	13. 024 ± 0.015 37.935 ± 0.005	13.06 ± 0.02 38.03 ± 0.01	13.056 ± 0.004 37.970 ± 0.003	13.01 ± 0.03 37.98 ± 0.01	13.032 ± 0.002 37.984 ± 0.002

Low. Speed 0.4 - 0.5 m/s

Depth	E.R.	LBM	NIB	CIM	IZOR
5 m	14.703 ± 0.098 37.886 ± 0.043	14.82 ± 0.15 38.05 ± 0.01	14.718 ± 0.017 37.968 ± 0.003	14.92 ± 0.07 37.98 ± 0.01	14.935 ± 0.065 37.978 ± 0.001
10 m	14.514 ± 0.027 37.935 ± 0.009	14.52 ± 0.07 38.05 ± 0.01	14.519 ± 0.013 37.974 ± 0.006	14.57 ± 0.01 37.98 ± 0.01	14.593 ± 0.007 37.986 ± 0.002
15 m	13.003 ± 0.010 37.915 ± 0.009	13.00 ± 0.01 38.05 ± 0.01	13.018 ± 0.018 37.971 ± 0.002	13.00 ± 0.03 38.00 ± 0.01	13.024 ± 0.010 37.995 ± 0.002

Low. Speed 1.0 m/s

EUROFLEETS research cruise

RV Urania (within the EU project **EUROFLEETS** http://www.eurofleets.eu/np4/home.html) has carry out an inter-comparison among sensors of oceanographic instruments (July 31, 2010 - August 16, 2010).
The ship has traveled across the Western Mediterranean Sea from Sicily toward Strait of Gibraltar and beyond.

EUROFLEETS research cruise

-) SEABIRD 911 plus CTD with:

- -) 2 sensors for Temp/Cond/Oxy/F
- -) 1 sensor as Transmissometer

-) IDRONAUT automatic recording CTD with:

- -) 2 sensors for Temp/Cond
- -) 1 sensor for Oxygen

-) CHELSEA Fluorometer (1 sensor)

-) AANDERAA Oxygen fast (2 sensors)

-) L-ADCP 2 sensors + 2 hull-mounted ADCP (at 75 and 300 kHz)

-) LM Sippican MK21-USB with LM Sippican DB+T5 probes

-) TSK MK150n, with T7+XCTD-1 + XCTD-2 probes

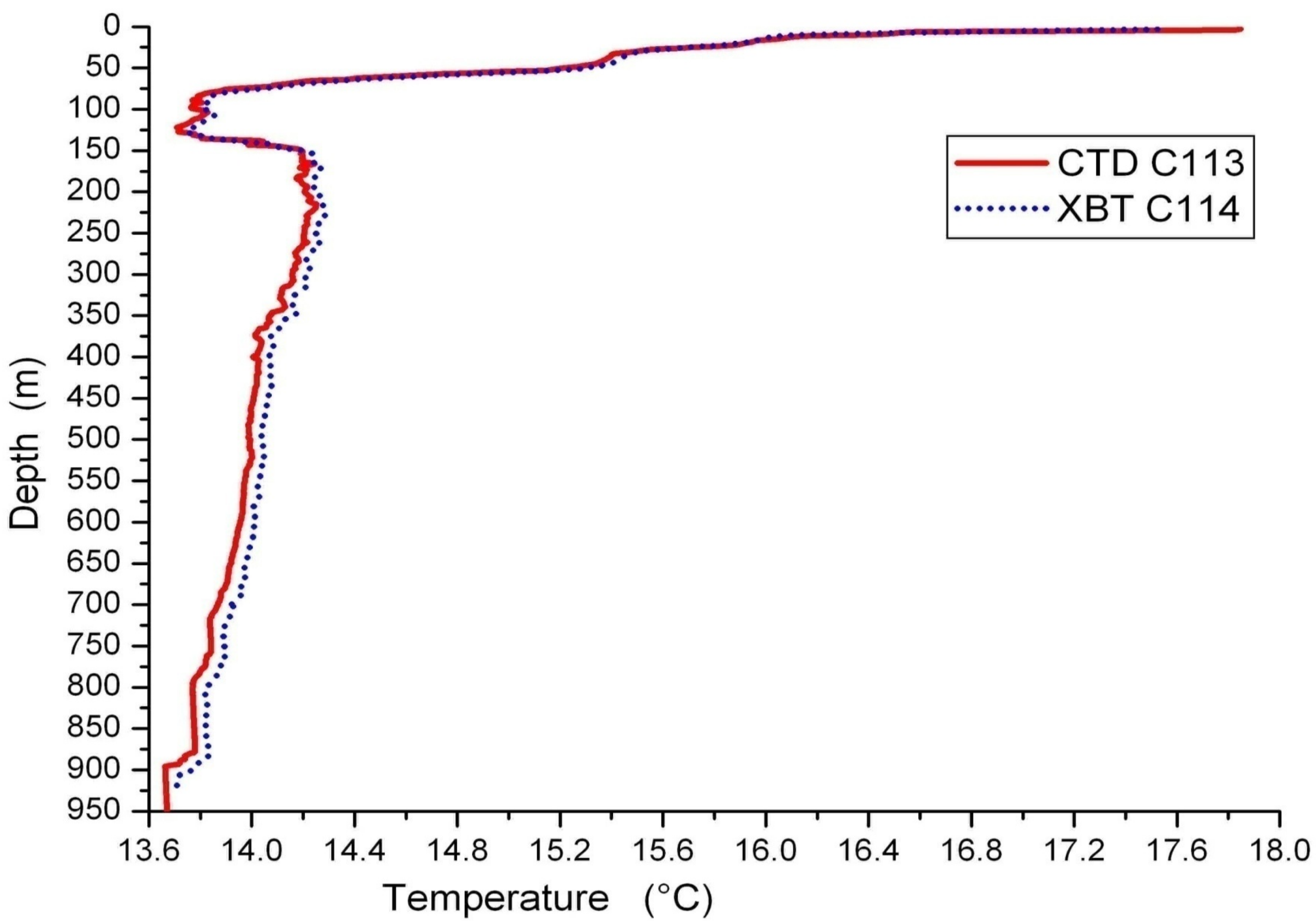
-) TURO QUOLL recorder for expendable probes

On board instrumentation also includes: Salinometer, Winkler, HPLC,…

Where?

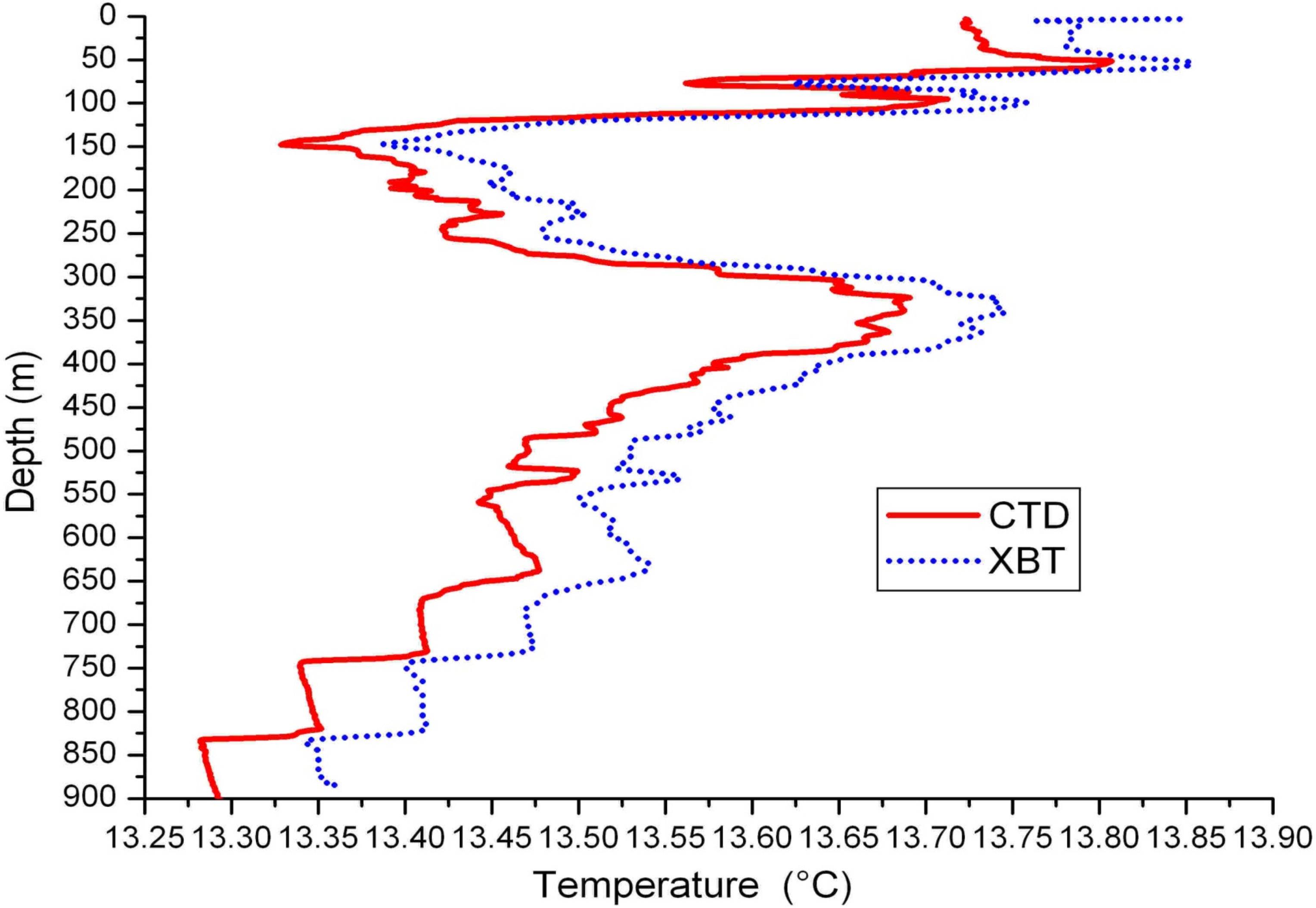
Vienna
Austria
Switz.
France
Slovenia
Hungary
Chişinău
Croatia
Romania
Italy
San Marino
Bosn. & Herzg.
Bucharest
Black
Andorra
Yug.
Bulgaria
Sofia
Madrid
Corsica (France)
Rome
Tirana
Maced.
Ankara
Spain
Sardinia
Albania
Turkey
Greece
Athens
Algiers
Tunis
Sicily
Syria
Rabat
Malta
Crete
Nicosia
Cyprus
Lebanon
Beirut
Damascus
Mediterranean Sea
Israel
Tunisia
Tripoli
Jerusalem
Algeria
Cairo
Libya

Where?



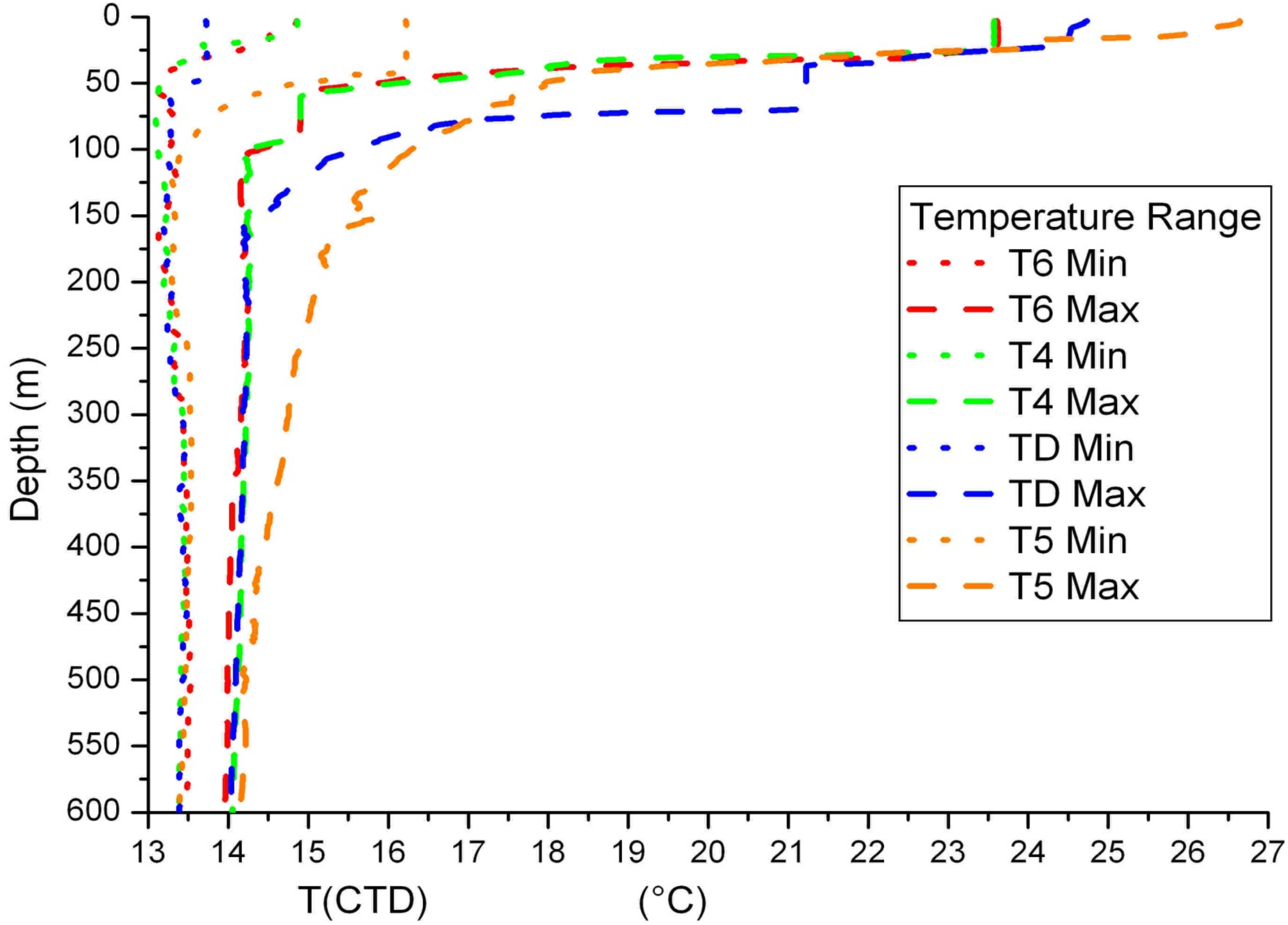
Depth (m)
Temperature (°C)
CTD C113
XBT C114
0
50
100
150
200
250
300
350
400
450
500
550
600
650
700
750
800
850
900
950
13.6
14.0
14.4
14.8
15.2
15.6
16.0
16.4
16.8
17.2
17.6
18.0

Where?



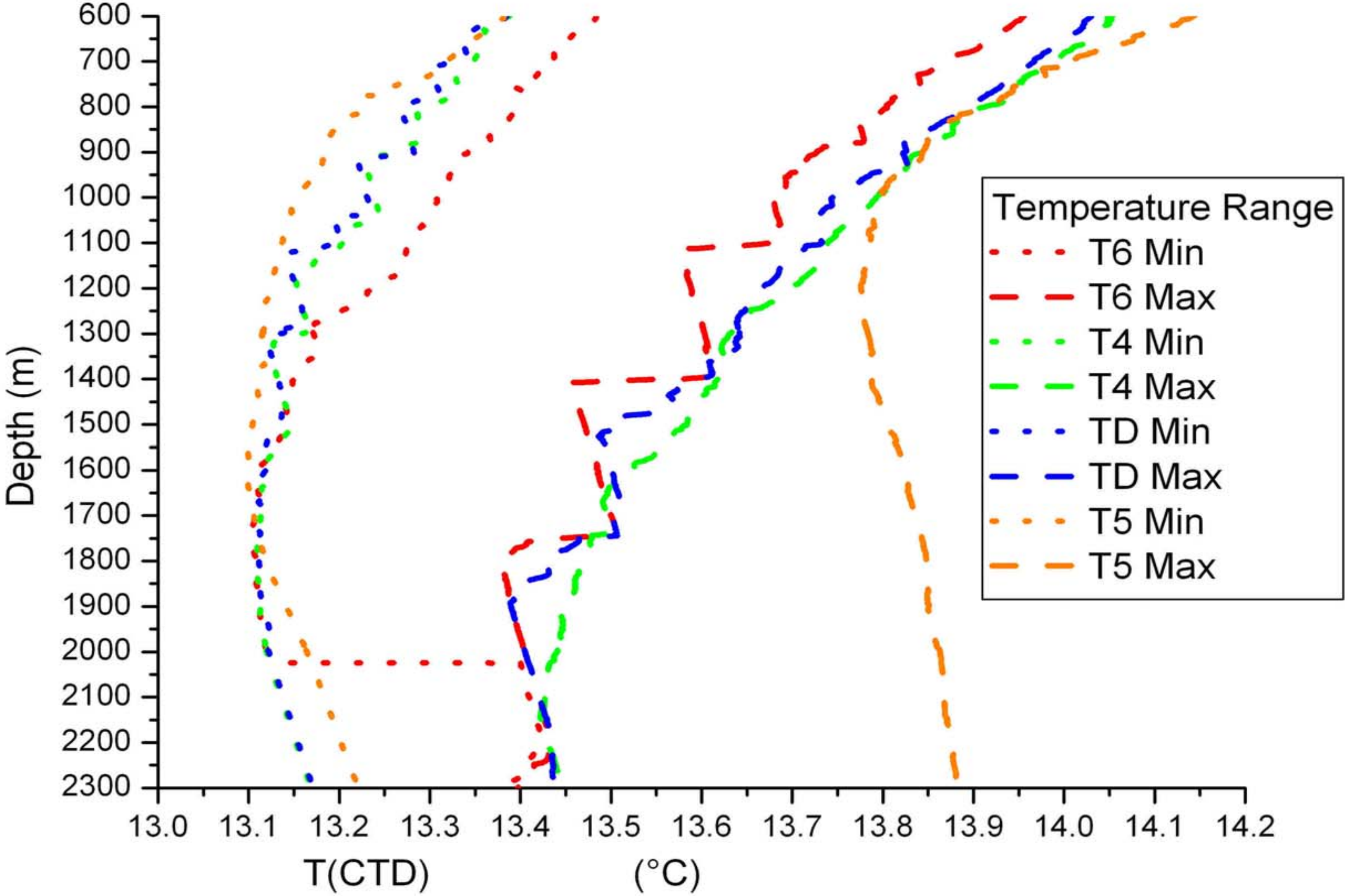
Depth (m)
0
50
100
150
200
250
300
350
400
450
500
550
600
650
700
750
800
850
900
13.25 13.30 13.35 13.40 13.45 13.50 13.55 13.60 13.65 13.70 13.75 13.80 13.85 13.90
Temperature (°C)
CTD
XBT

Where?



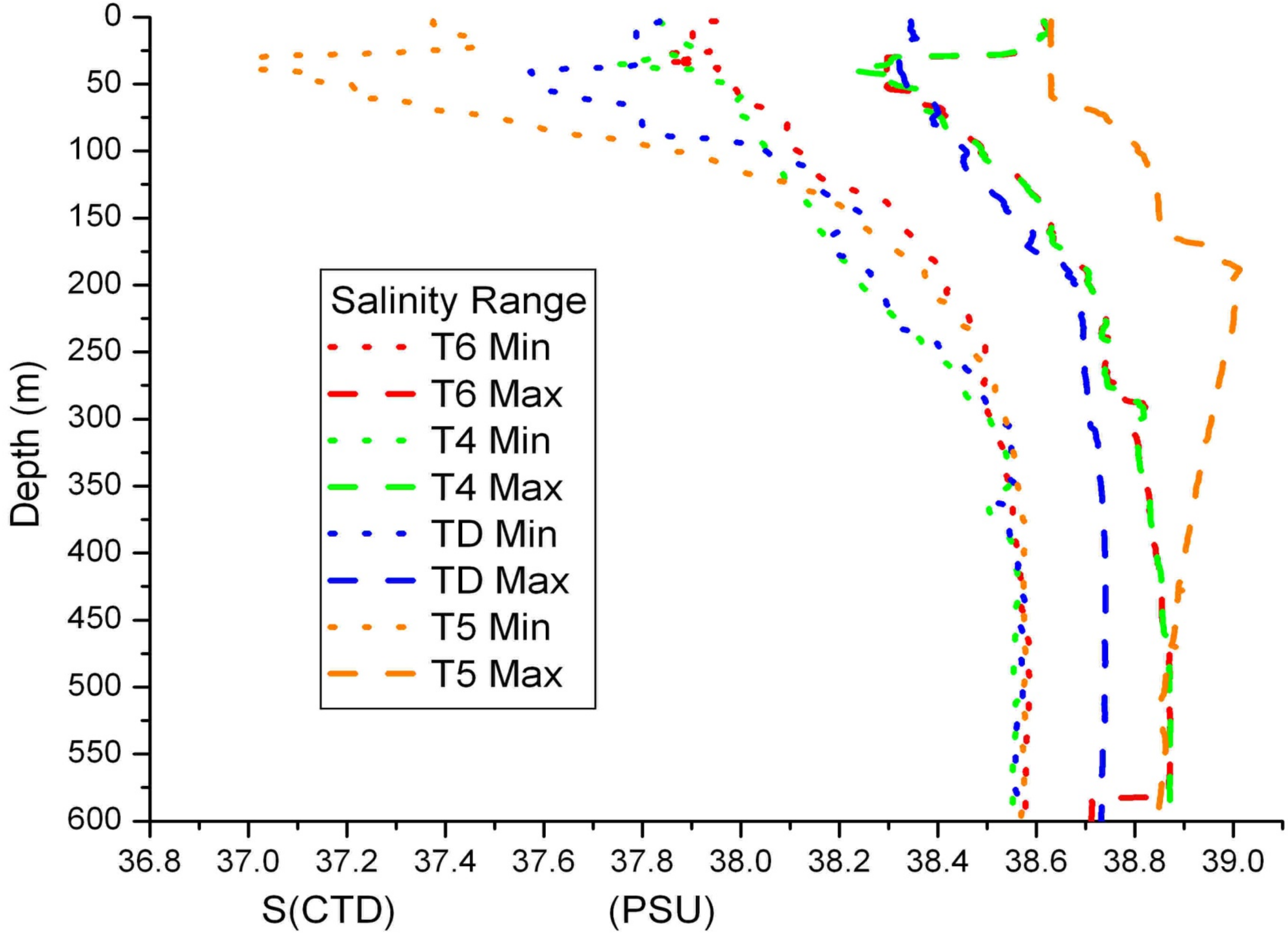
Depth (m)
0
50
100
150
200
250
300
350
400
450
500
550
600
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
T(CTD)
(°C)
Temperature Range
T6 Min
T6 Max
T4 Min
T4 Max
TD Min
TD Max
T5 Min
T5 Max

Where?



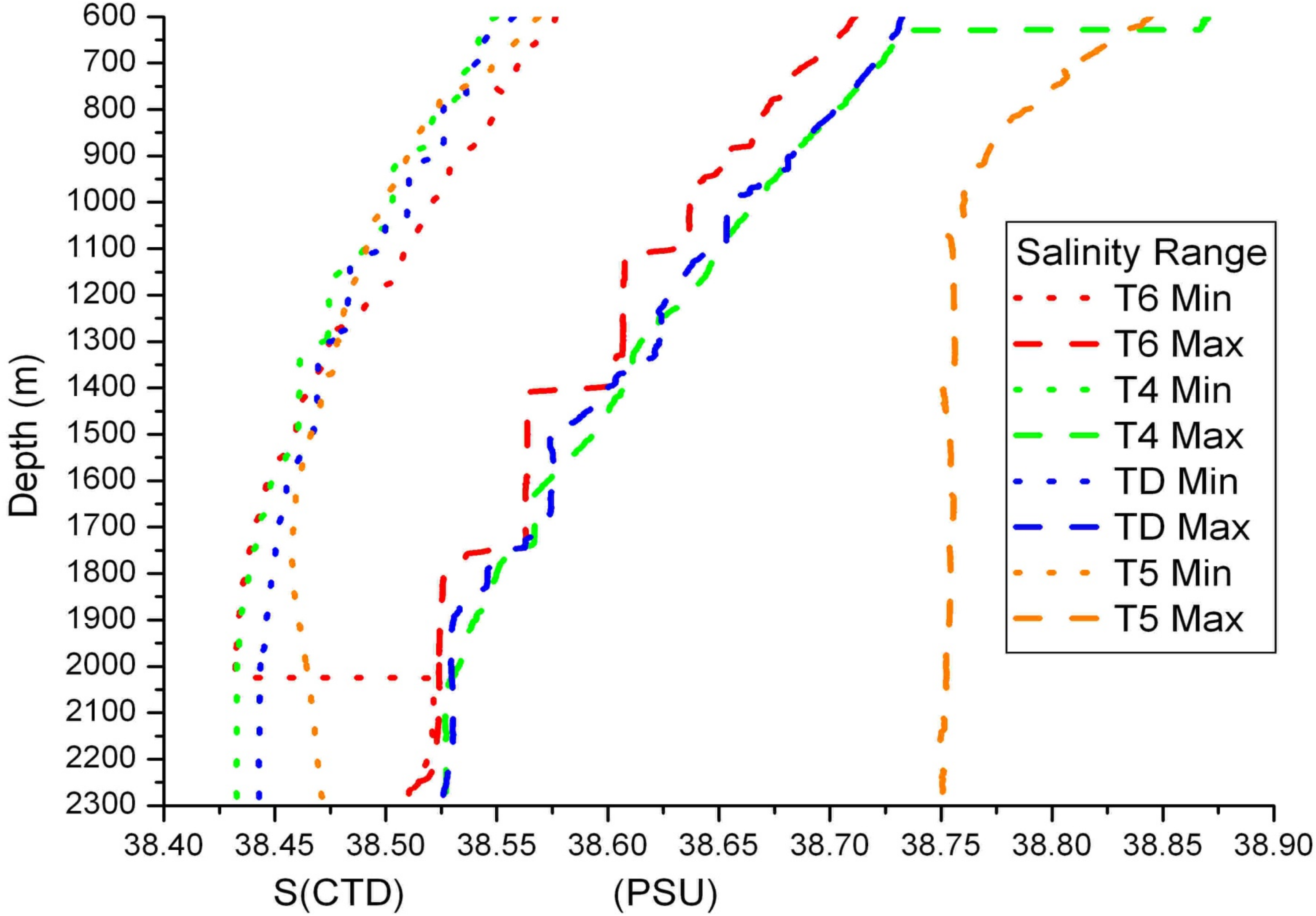
Temperature Range
T6 Min
T6 Max
T4 Min
T4 Max
TD Min
TD Max
T5 Min
T5 Max
Depth (m)
600
700
800
900
1000
1100
1200
1300
1400
1500
1600
1700
1800
1900
2000
2100
2200
2300
13.0
13.1
13.2
13.3
13.4
13.5
13.6
13.7
13.8
13.9
14.0
14.1
14.2
T(CTD)
(°C)

Where?



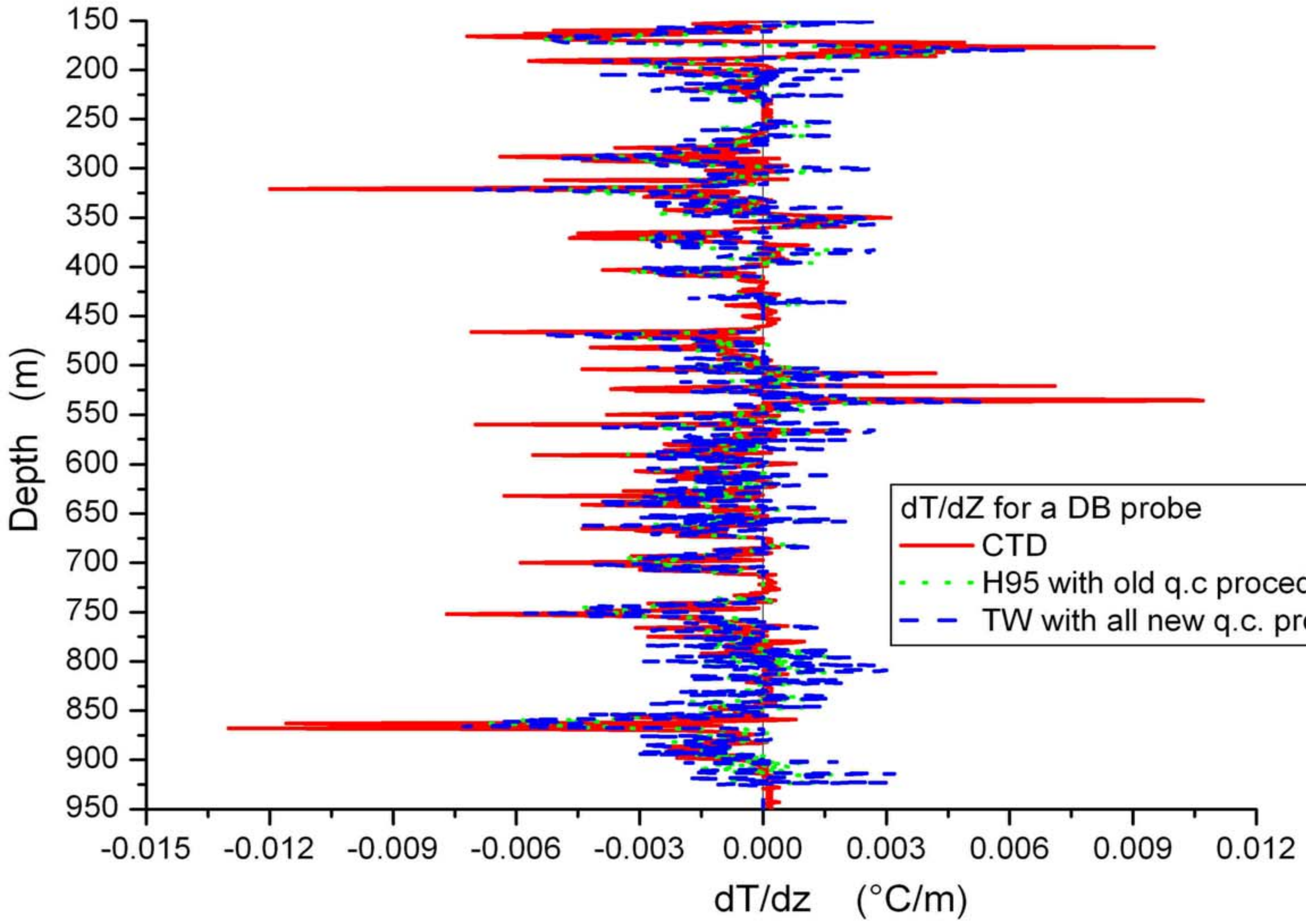
Salinity Range
T6 Min
T6 Max
T4 Min
T4 Max
TD Min
TD Max
T5 Min
T5 Max
Depth (m)
0
50
100
150
200
250
300
350
400
450
500
550
600
36.8
37.0
37.2
37.4
37.6
37.8
38.0
38.2
38.4
38.6
38.8
39.0
S(CTD)
(PSU)

Where?



Salinity Range
T6 Min
T6 Max
T4 Min
T4 Max
TD Min
TD Max
T5 Min
T5 Max
Depth (m)
600
700
800
900
1000
1100
1200
1300
1400
1500
1600
1700
1800
1900
2000
2100
2200
2300
38.40
38.45
38.50
38.55
38.60
38.65
38.70
38.75
38.80
38.85
38.90
S(CTD)
(PSU)

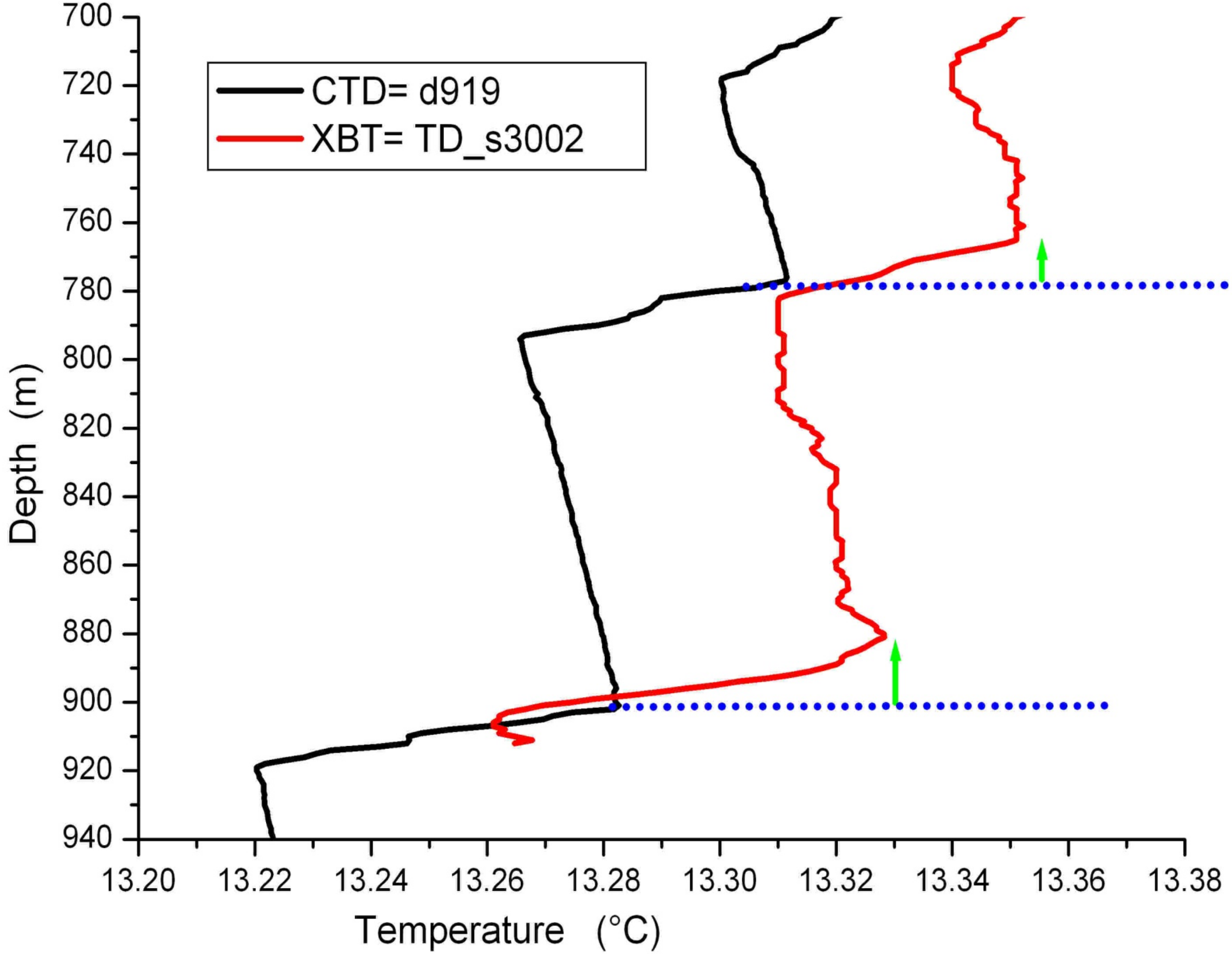
In Mediterranean, H95 method could have problems

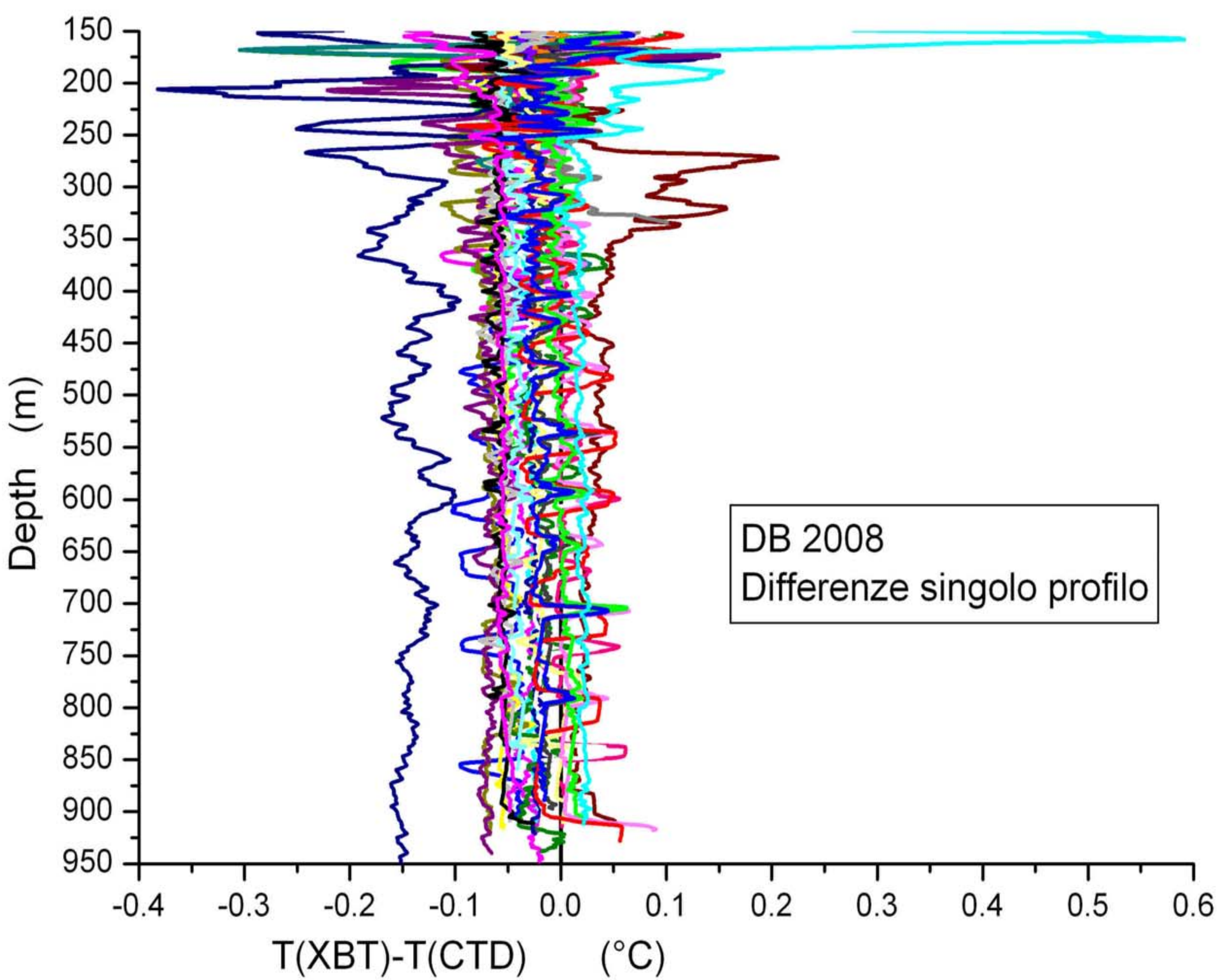


Full wire acquisition

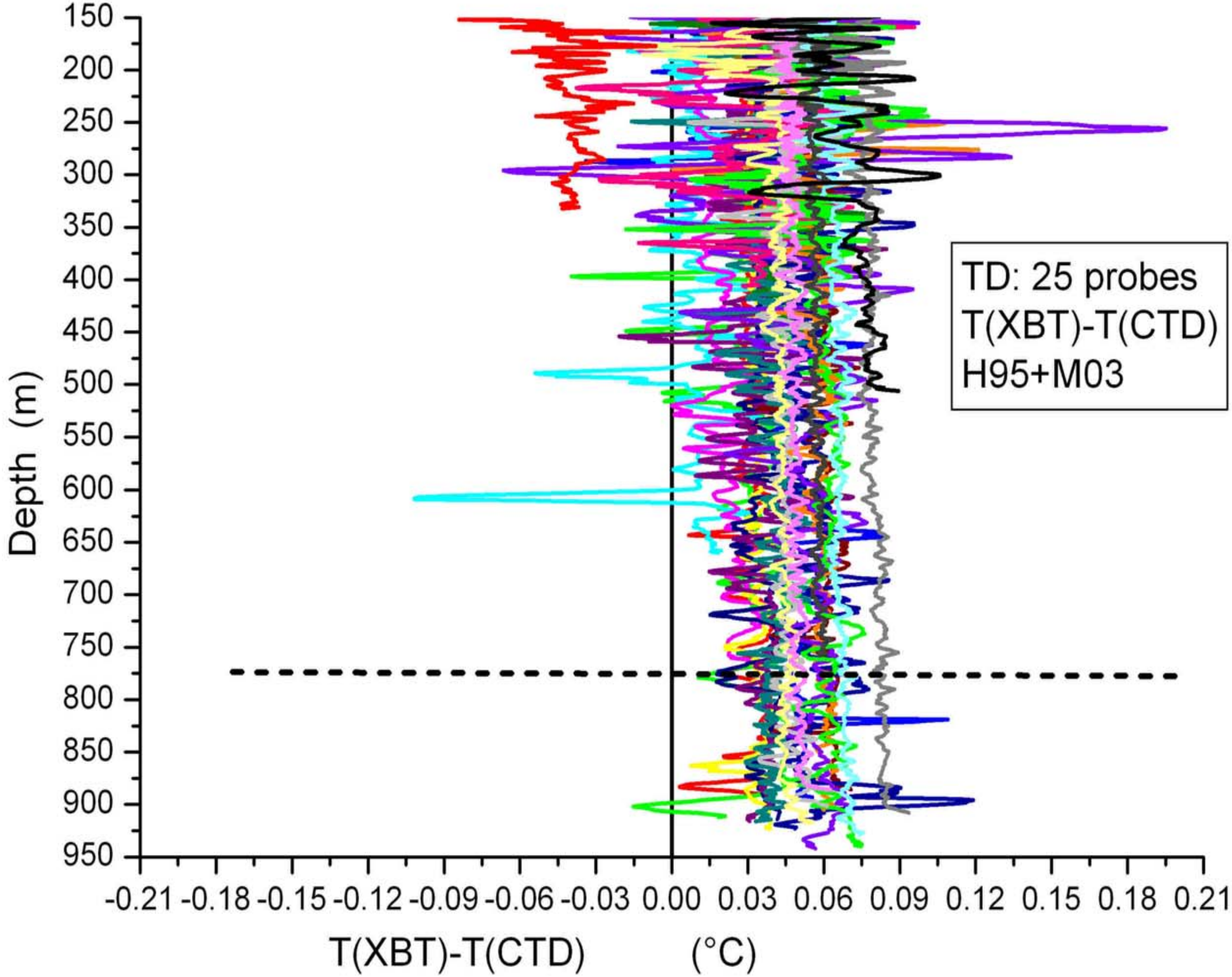
- **Acquisition with free terminal depth for different XBT types.**
- **No evident differences in the last part of the acquisition.**
- **Statistically speaking, results are good up to the wire break.**
- **Depending on the probe batch, and within the same batch, a certain variability**

XBT Type	Max Speed (kn)	Real Speed (kn)	Depth (m)	AT (s)	<AT> (s)	Range (s)	Average Depth (m)	Range (m)	No. XBT
T4	30	0	460	70.5	87.3 ± 2.0	83.0-90.7	567 ± 12	540-588	22
T4	30	21-27	460	70.5	80.6 ± 1.1	76.8-84.9	525 ± 7	500-552	230
T6	15	≤ 10	460	70.5	85.2 ± 4.1	77.7-90.5	554 ± 26	506-587	11
T5 (1830) =					**354.9 ± 11.3 s (320.9-368.0 s)**		**2194 ± 63 m (2004-2266 m)**		**27**
T7	15	≤ 15	760	118.3	142.5 ± 2.2	138.6-150.9	908 ± 14	884-958	68
T7	15	17	760	118.3	136.3 ± 1.4	133.2-138.2	870 ± 9	851-881	15
DB	20	0	760	118.3	143.9 ± 2.4	139.3-148.5	916 ± 14	888-944	18
DB	20	≤ 20	760	118.3	140.9 ± 1.8	126.3-149.6	898 ± 11	809-951	1312
DB	20	21	760	118.3	137.6 ± 1.9	136.3-140.5	878 ± 12	870-896	4
DB	20	22	760	118.3	134.2 ± 2.2	130.9-140.3	857 ± 13	837-894	27
DB	20	23	760	118.3	127.5 ± 2.3	124.3-132.8	817 ± 14	797-849	35
DB	20	24	760	118.3	122.1 ± 2.9	115.6-127.0	783 ± 18	743-813	31
DB	20	25	760	118.3	118.0 ± 2.3	113.0-123.8	758 ± 14	727-794	48
DB	20	26	760	118.3	114.2 ± 2.5	109.3-118.6	735 ± 15	704-762	37
DB	20	27	760	118.3	111.1 ± 1.2	109.8-113.5	716 ± 8	707-730	9

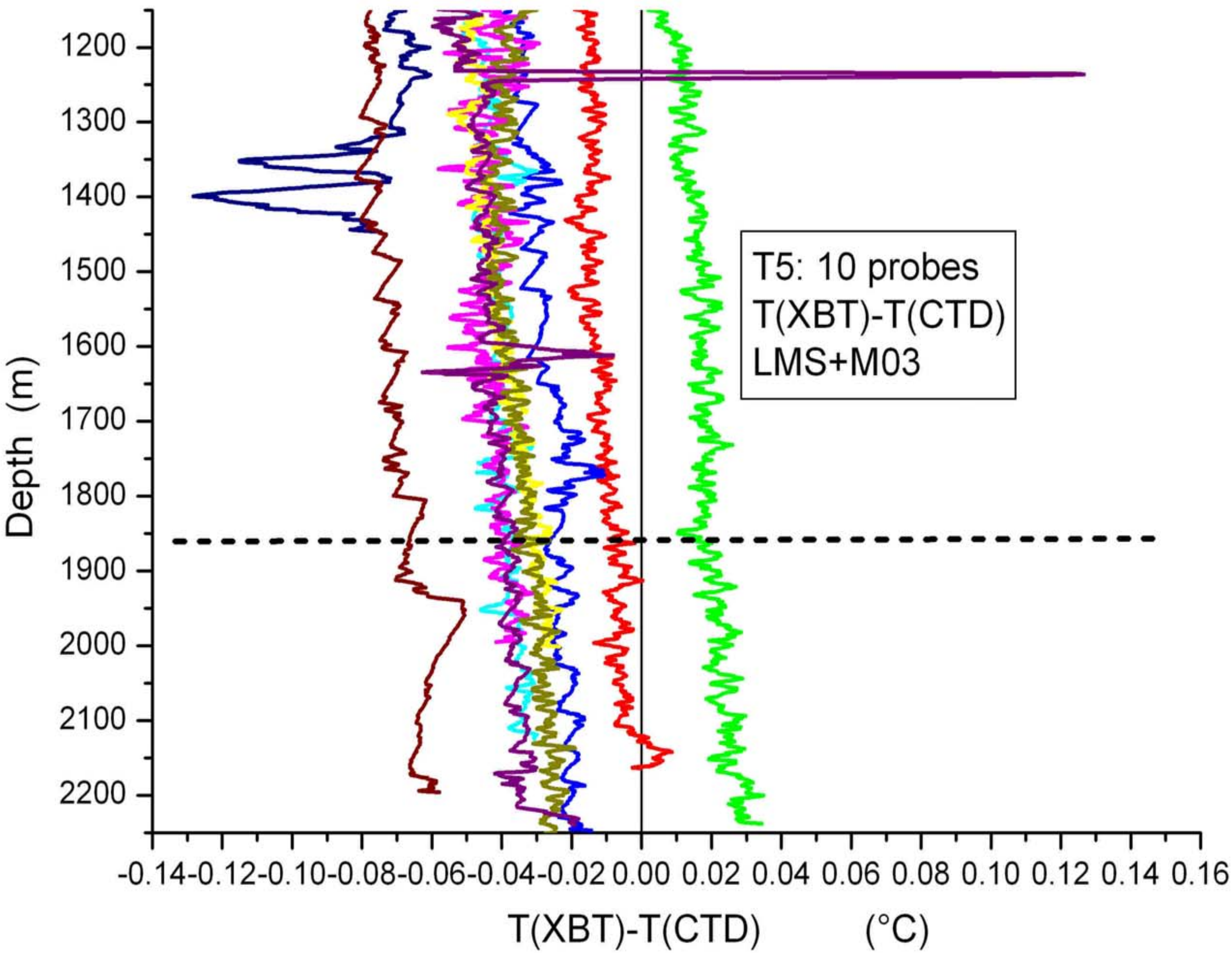

CTD= d919
XBT= TD_s3002
Depth (m)
Temperature (°C)
700
720
740
760
780
800
820
840
860
880
900
920
940
13.20
13.22
13.24
13.26
13.28
13.30
13.32
13.34
13.36
13.38



Depth (m)
150
200
250
300
350
400
450
500
550
600
650
700
750
800
850
900
950
-0.4
-0.3
-0.2
-0.1
0.0
0.1
0.2
0.3
0.4
0.5
0.6
T(XBT)-T(CTD) (°C)
DB 2008
Differenze singolo profilo



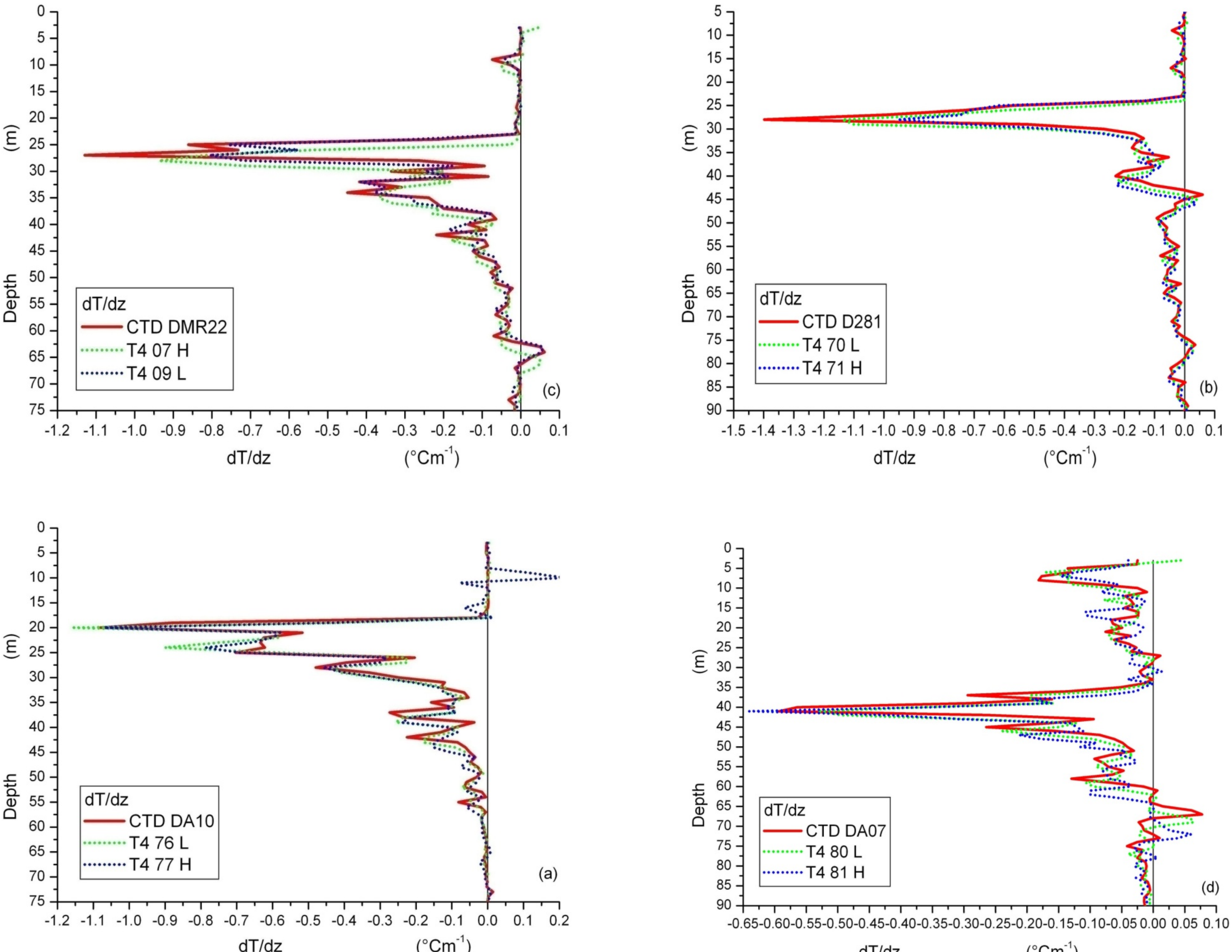
TD: 25 probes
T(XBT)-T(CTD)
H95+M03
Depth (m)
150
200
250
300
350
400
450
500
550
600
650
700
750
800
850
900
950
-0.21
-0.18
-0.15
-0.12
-0.09
-0.06
-0.03
0.00
0.03
0.06
0.09
0.12
0.15
0.18
0.21
T(XBT)-T(CTD) (°C)



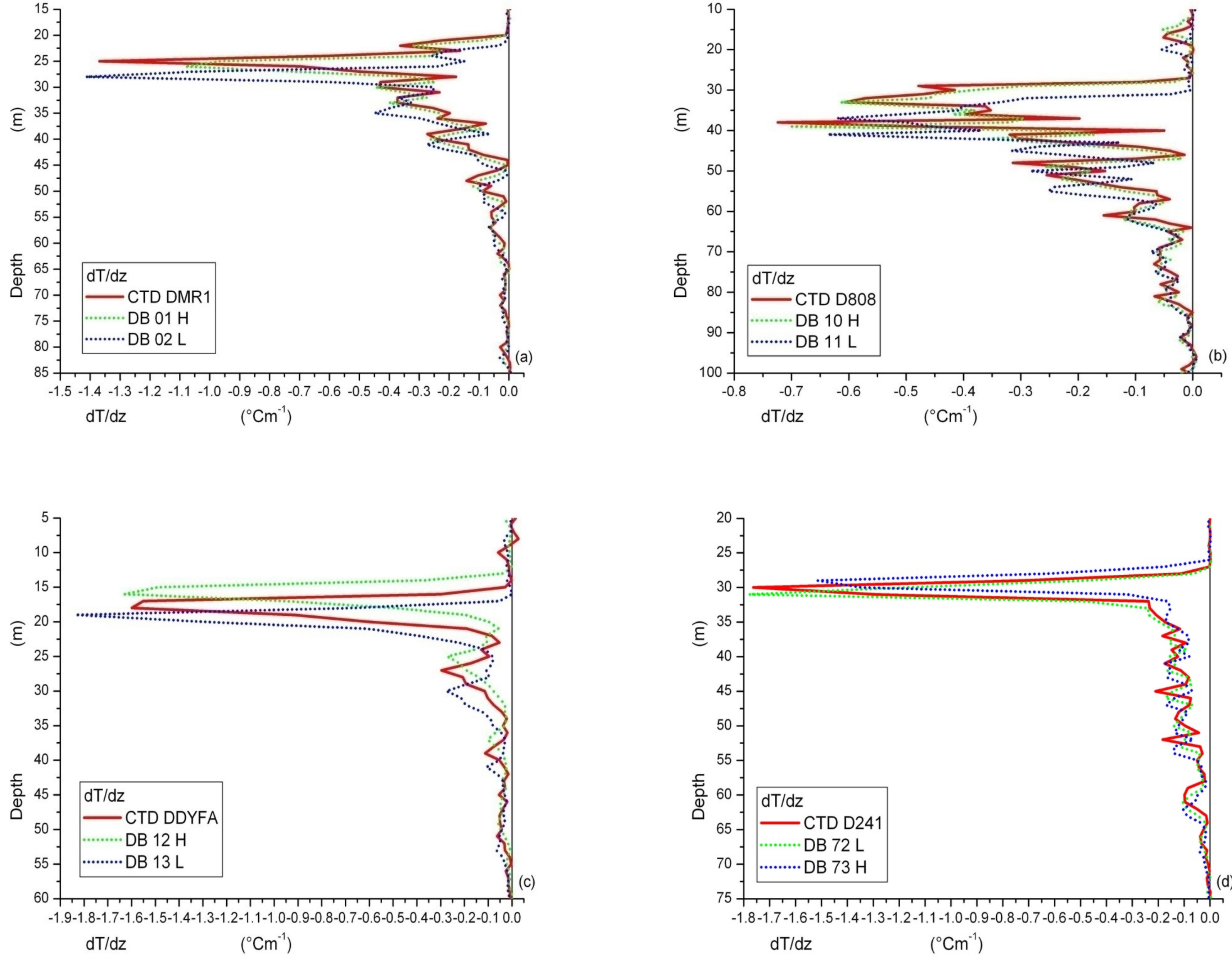
T5: 10 probes
T(XBT)-T(CTD)
LMS+M03
Depth (m)
1200
1300
1400
1500
1600
1700
1800
1900
2000
2100
2200
-0.14
-0.12
-0.10
-0.08
-0.06
-0.04
-0.02
0.00
0.02
0.04
0.06
0.08
0.10
0.12
0.14
0.16
T(XBT)-T(CTD) (°C)

Is the height of the launching platform a factor influencing the entry speed and the probes motion in the upper part?

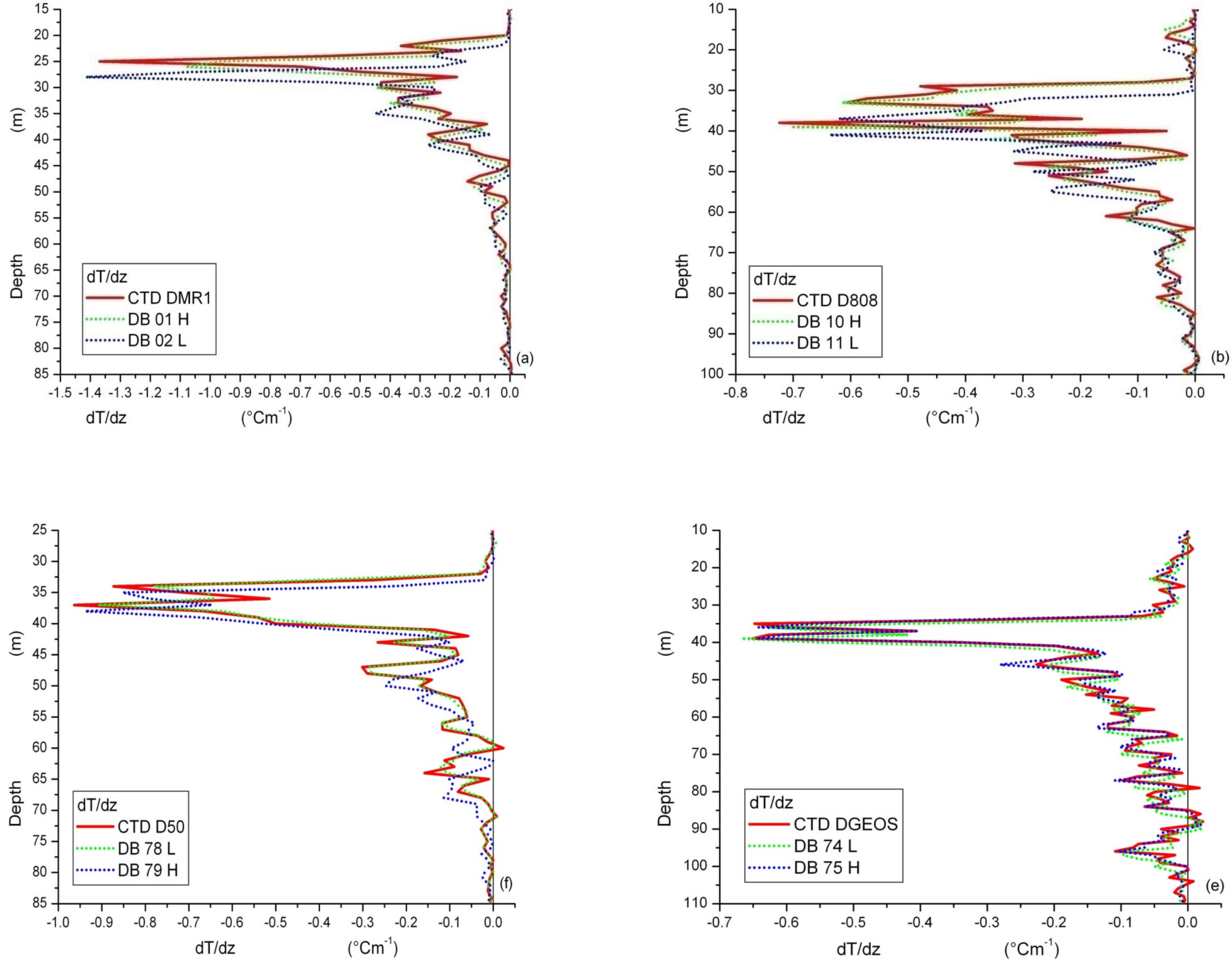
- Height 2.5 m: in MFSTEP the height varies from 4 to 14 m (with recent ships participating SOOP..from 25 to 31m).
- XBT probe should reach a stationary regime in seawater after ~ 1.5 s (~ 10 m), or a little bit more.
- Test: 10 pairs of probes were dropped from two different height (2.5 m and 8 m), within 5 minutes, during the same CTD cast.
- Comparison between twin profiles.
- dT/dz profiles: always,
  - in green the former,
  - in blue the latter



Depth (m)
dT/dz (°Cm-1)
dT/dz
CTD DMR22
T4 07 H
T4 09 L
(c)
dT/dz
CTD D281
T4 70 L
T4 71 H
(b)
dT/dz
CTD DA10
T4 76 L
T4 77 H
(a)
dT/dz
CTD DA07
T4 80 L
T4 81 H
(d)

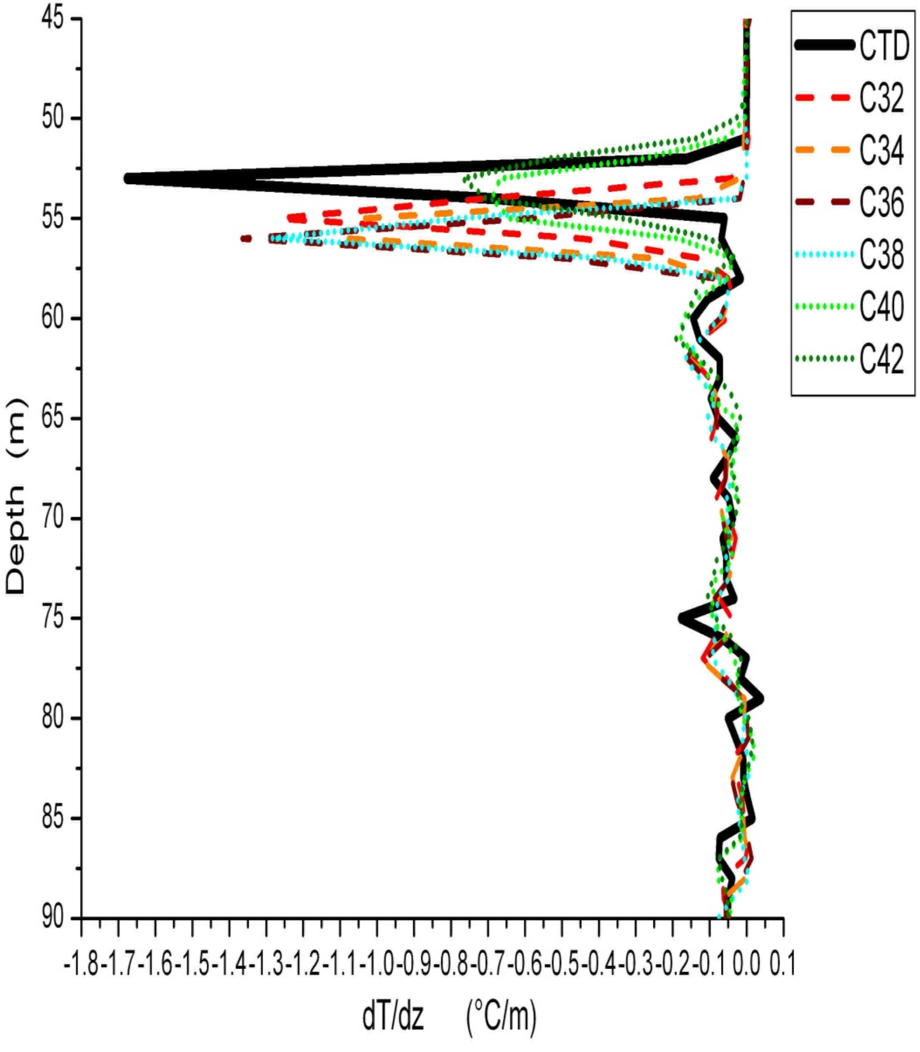


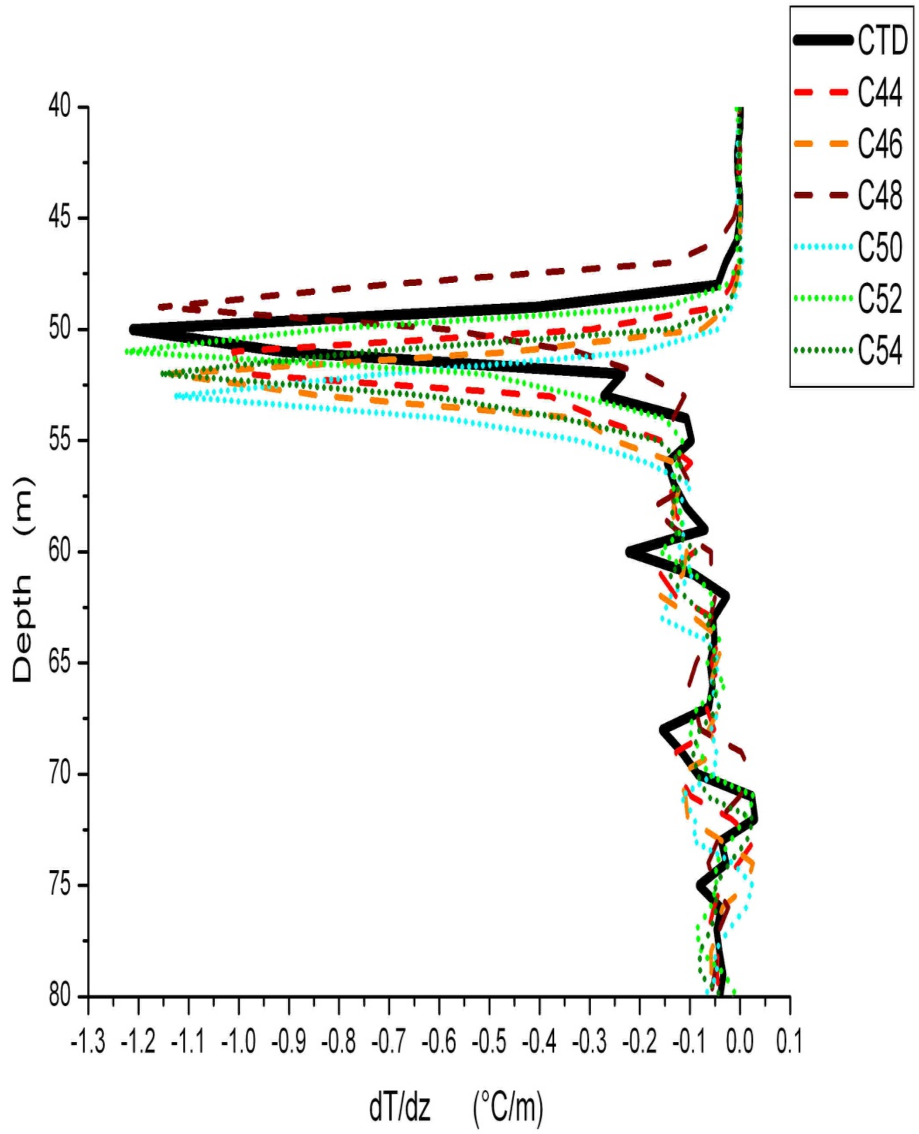
dT/dz
CTD DMR1
DB 01 H
DB 02 L
(a)
Depth (m)
dT/dz (°Cm^{-1})
dT/dz
CTD D808
DB 10 H
DB 11 L
(b)
Depth (m)
dT/dz (°Cm^{-1})
dT/dz
CTD DDYFA
DB 12 H
DB 13 L
(c)
Depth (m)
dT/dz (°Cm^{-1})
dT/dz
CTD D241
DB 72 L
DB 73 H
(d)
Depth (m)
dT/dz (°Cm^{-1})



Depth (m)
dT/dz (°Cm⁻¹)
dT/dz
CTD DMR1
DB 01 H
DB 02 L
(a)
dT/dz
CTD D808
DB 10 H
DB 11 L
(b)
dT/dz
CTD D50
DB 78 L
DB 79 H
(f)
dT/dz
CTD DGEOS
DB 74 L
DB 75 H
(e)

2008: 3 probes sequentially deployed from 2 platforms on the same CTD cast.(H95 FRE)





Depth (m) - Temperature (°C)		
0.0	17.54	1516.69
0.7	16.38	1513.25
1.3	15.98	1512.06
2.0	15.84	1511.64
2.7	15.82	1511.58
3.3	15.81	1511.58
4.0	15.82	1511.60

Depth (m) - Temperature (°C)		
0.0	17.64	1517.00
0.7	16.48	1513.56
1.3	16.14	1512.54
2.0	16.04	1512.25
2.7	16.01	1512.16
3.3	15.99	1512.13
4.0	15.99	1512.14

Depth (m) - Temperature (°C)		
0.0	18.24	1518.73
0.7	16.74	1514.34
1.3	16.25	1512.89
2.0	16.10	1512.44
2.7	16.06	1512.32
3.3	16.05	1512.29
4.0	16.03	1512.27

Depth (m) - Temperature (°C)		
0.0	22.72	1523.25
0.7	22.72	1523.27
1.3	22.83	1523.56
2.0	22.86	1523.66
2.7	22.88	1523.72
3.3	22.87	1523.69
4.0	22.84	1523.63

Depth (m) - Temperature (°C)		
0.0	23.10	1524.23
0.7	22.89	1523.70
1.3	22.68	1523.18
2.0	22.58	1522.92
2.7	22.23	1522.01
3.3	21.61	1520.38
4.0	21.13	1519.08

Depth (m) - Temperature (°C)		
0.0	20.54	1525.17
0.7	19.87	1523.34
1.3	19.57	1522.53
2.0	19.46	1522.24
2.7	19.43	1522.16
3.3	19.41	1522.12
4.0	19.41	1522.12

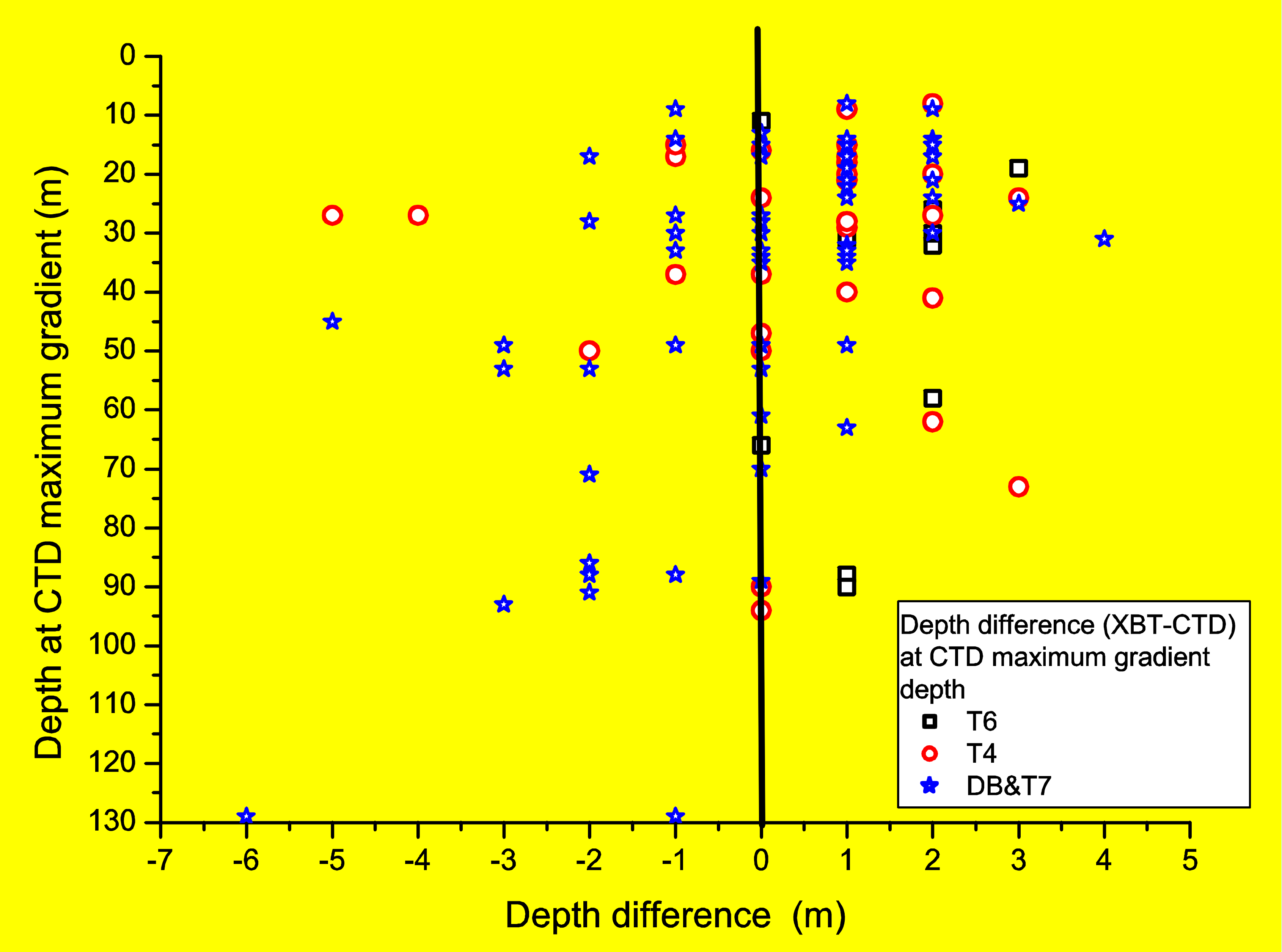
- **If this is only a depth error, the difference is very strong, because $(dT/dz)_{Max}$ can occur at ~ 25-35 m depth, therefore 2.0m/30.0 m ~ 7 % (even if the depth error in upper region is 5 m)**
- **The shift does not vary in the same way below the thermocline down to 100 m depth: frequently, it reduces or remains constant.**

YOUTUBE SECTION

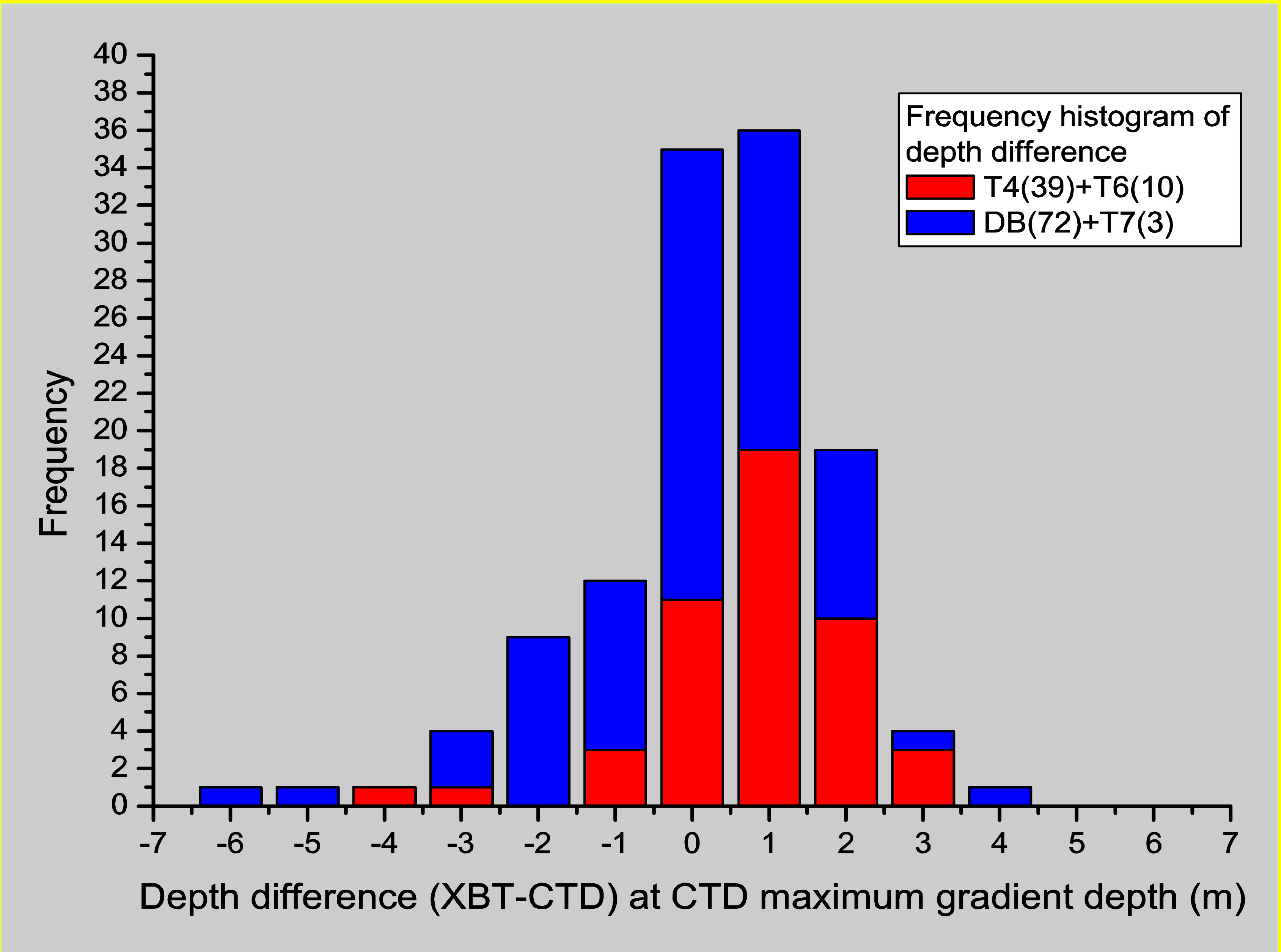
2010: 3 probes sequentially deployed from a ship participating SOOP

Probes (nr.)	Fall Time Range (s)	<Time> (s)	<T> Water	Depth Sippican (m)	Depth H95 (m)	Depth Measured (m)
3 DB	2.1-2.2	2.1	14.2°	13.58	14.04	15.20 ± 0.20
3 DB	2.2-2.3	2.2	15.4°	14.23	14.71	15.00 ± 0.20

Difference at the thermocline (Sippican FRE)



Difference at the thermocline (Sippican FRE)



Is the probe motion in near surface layer well described by the standard FRE?

Test in shallow water

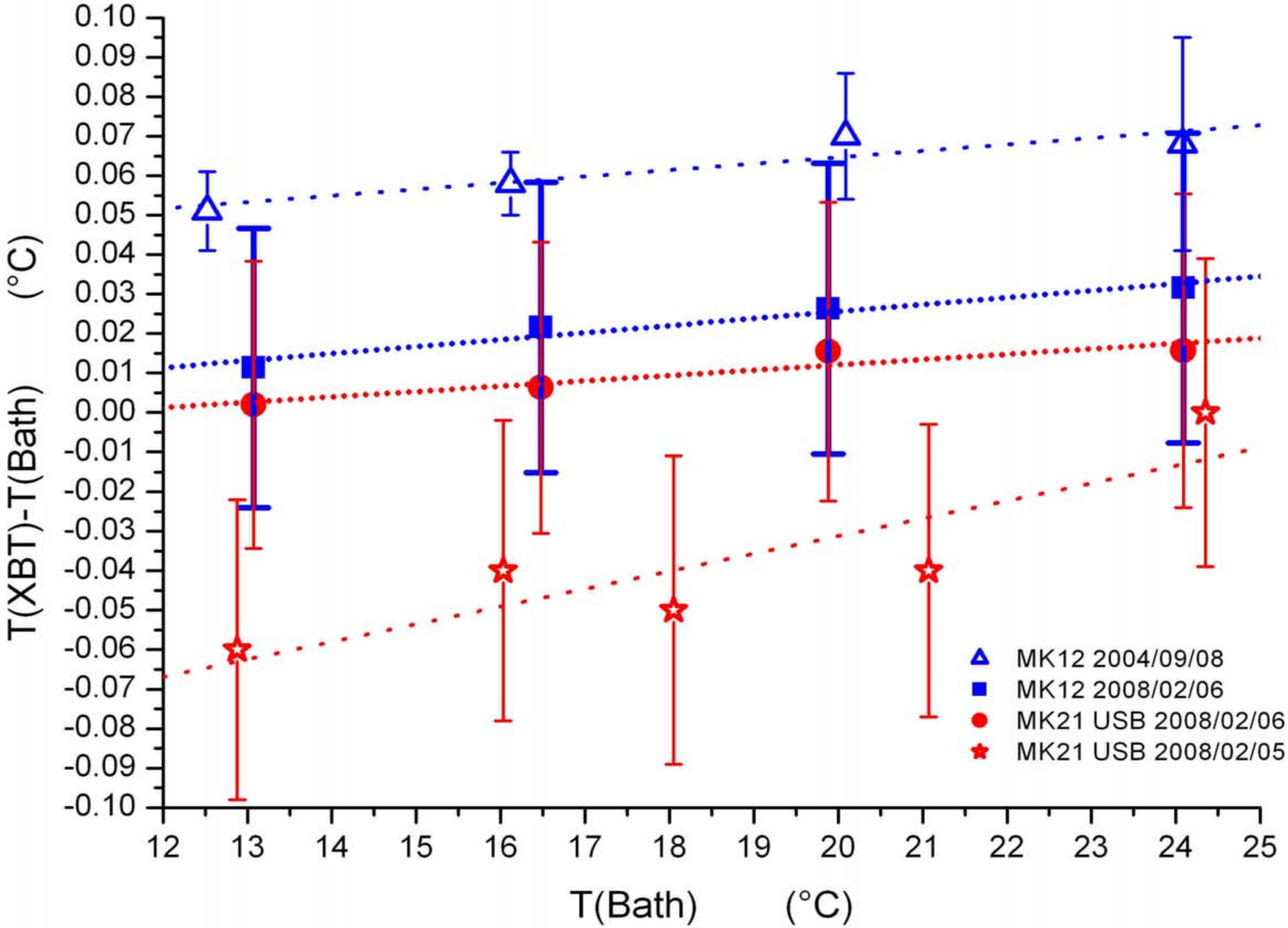
H = 2.5m

The impact angle varies from 0° to 90°

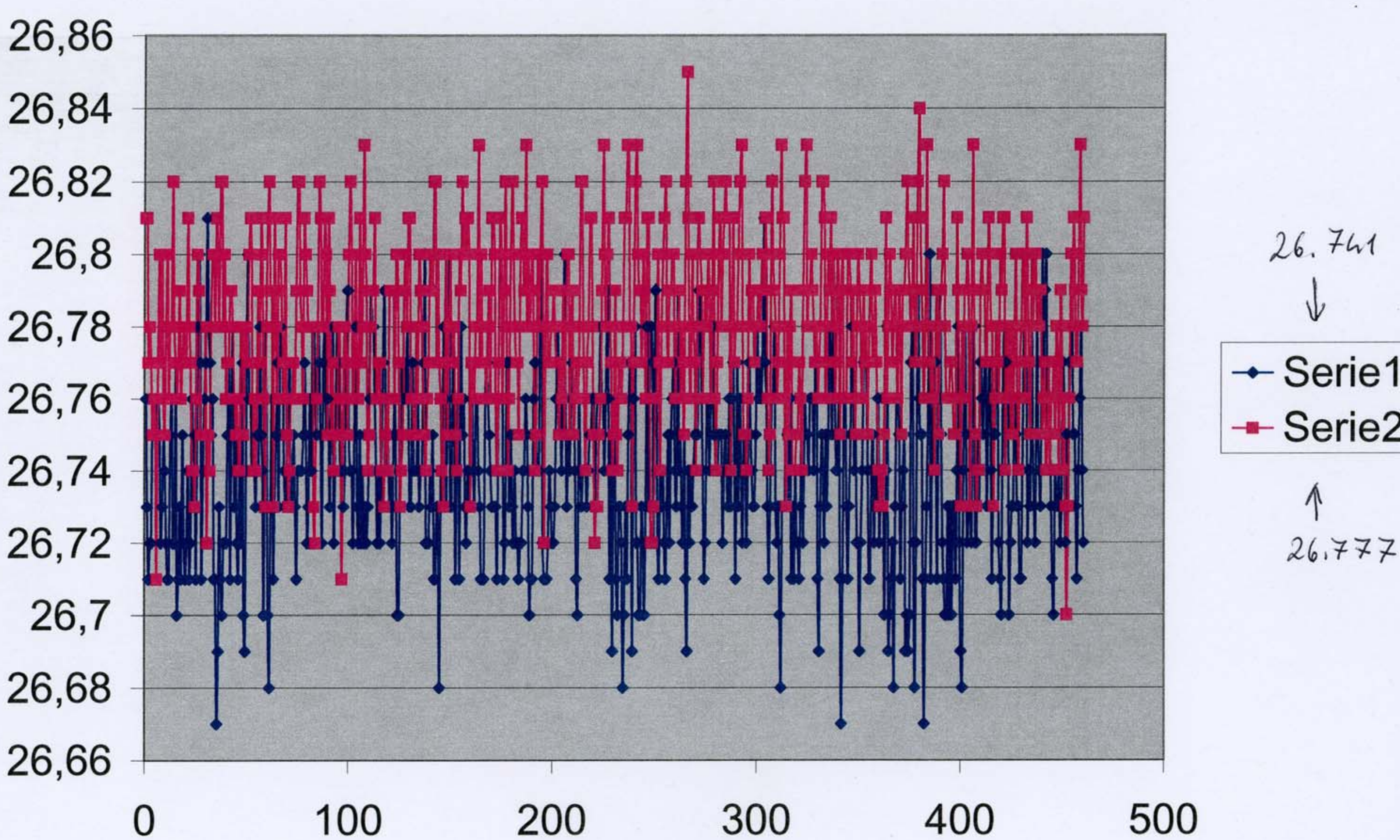
Poor statistics, but results are...

Probes (nr.)	Fall Time Range (s)	<Time> (s)	<T> Water column (° C)	Depth Sippican (m)	Depth H95 (m)	Depth Measured (m)
4 DB	1.1-1.3	1.2	19.0°	7.76	8.03	7.55 ± 0.10
3 DB	2.5-2.7	2.6	22.5°	16.81	17.38	15.30 ± 0.10
6 DB	2.2-2.6	2.4	17.0°	15.52	16.05	15.40 ± 0.10
8 DB	4.1-4.4	4.2	17.7°	27.14	28.05	27.30 ± 0.10
3 DB	4.5-4.7	4.6	21.5°	29.73	30.73	27.60 ± 0.10
3 DB	7.4-7.6	7.5	13.0°	48.42	50.06	47.20 ± 0.20

February 2008: different systems …

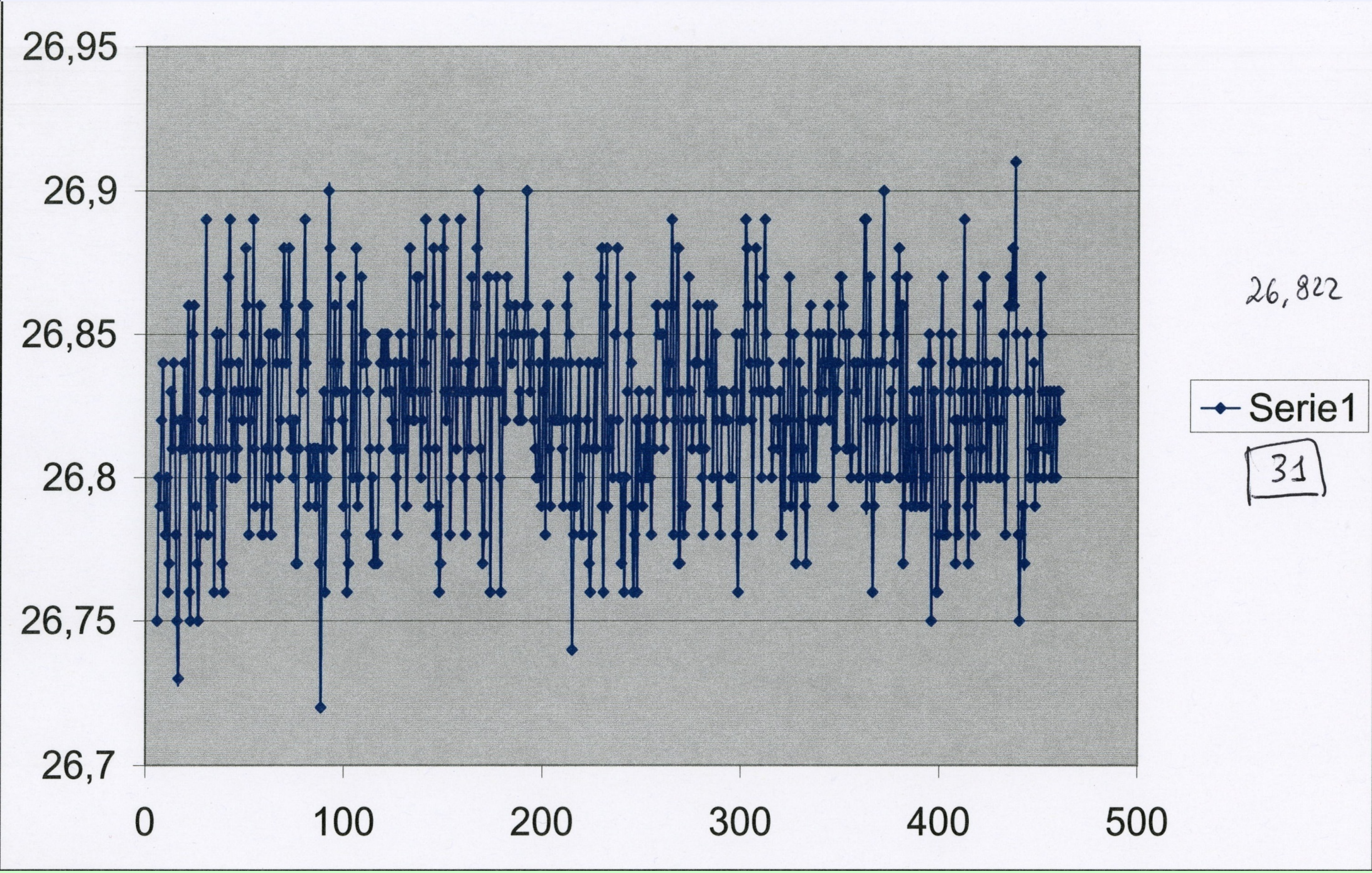


Test on MK21



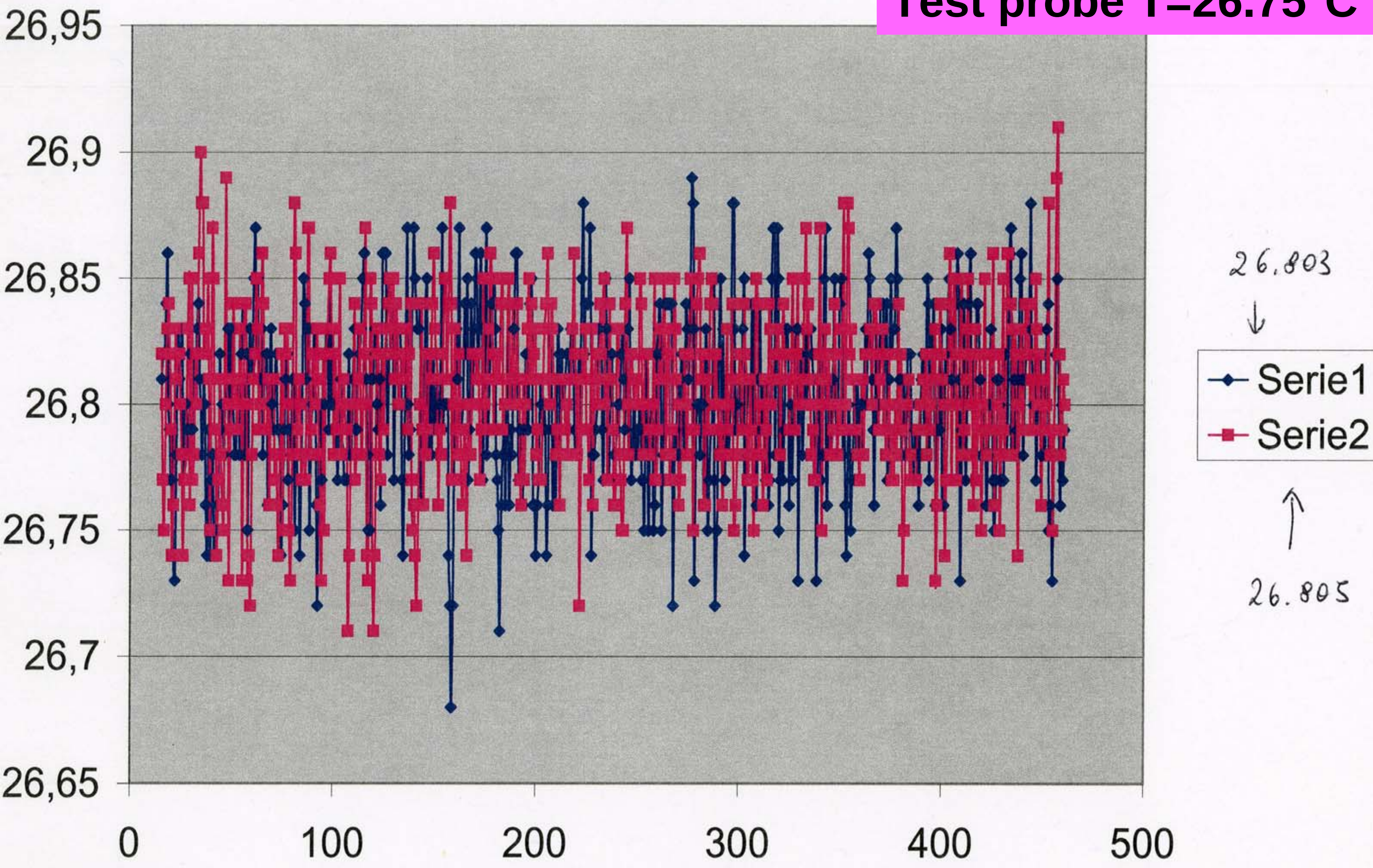
26,86
26,84
26,82
26,8
26,78
26,76
26,74
26,72
26,7
26,68
26,66
0
100
200
300
400
500
Serie1
Serie2
26.741
26.777

Test on MK21

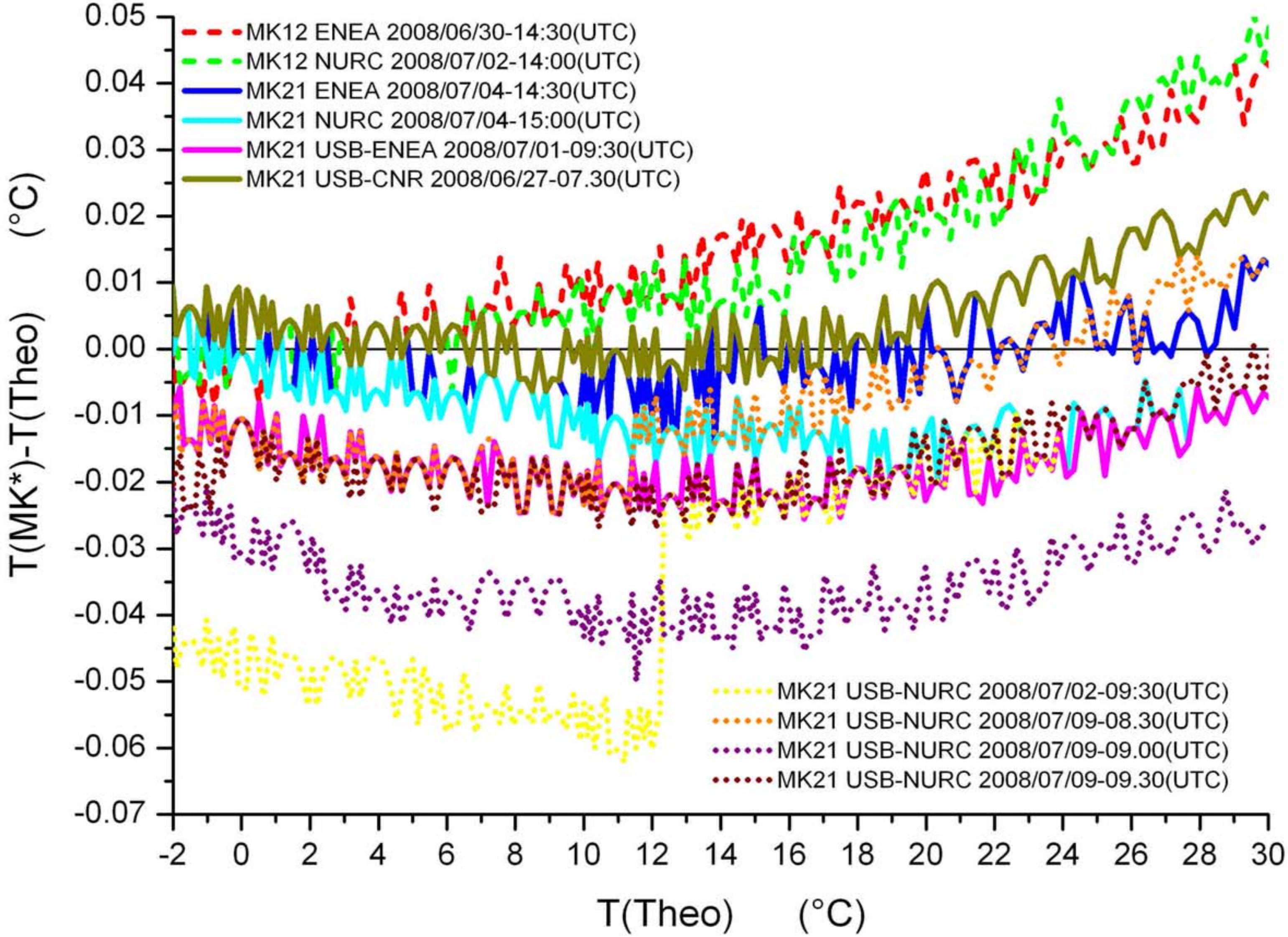

26,95
26,9
26,85
26,8
26,75
26,7
0
100
200
300
400
500
Serie1
26,822
31

Test on MK21

Test probe T=26.75°C

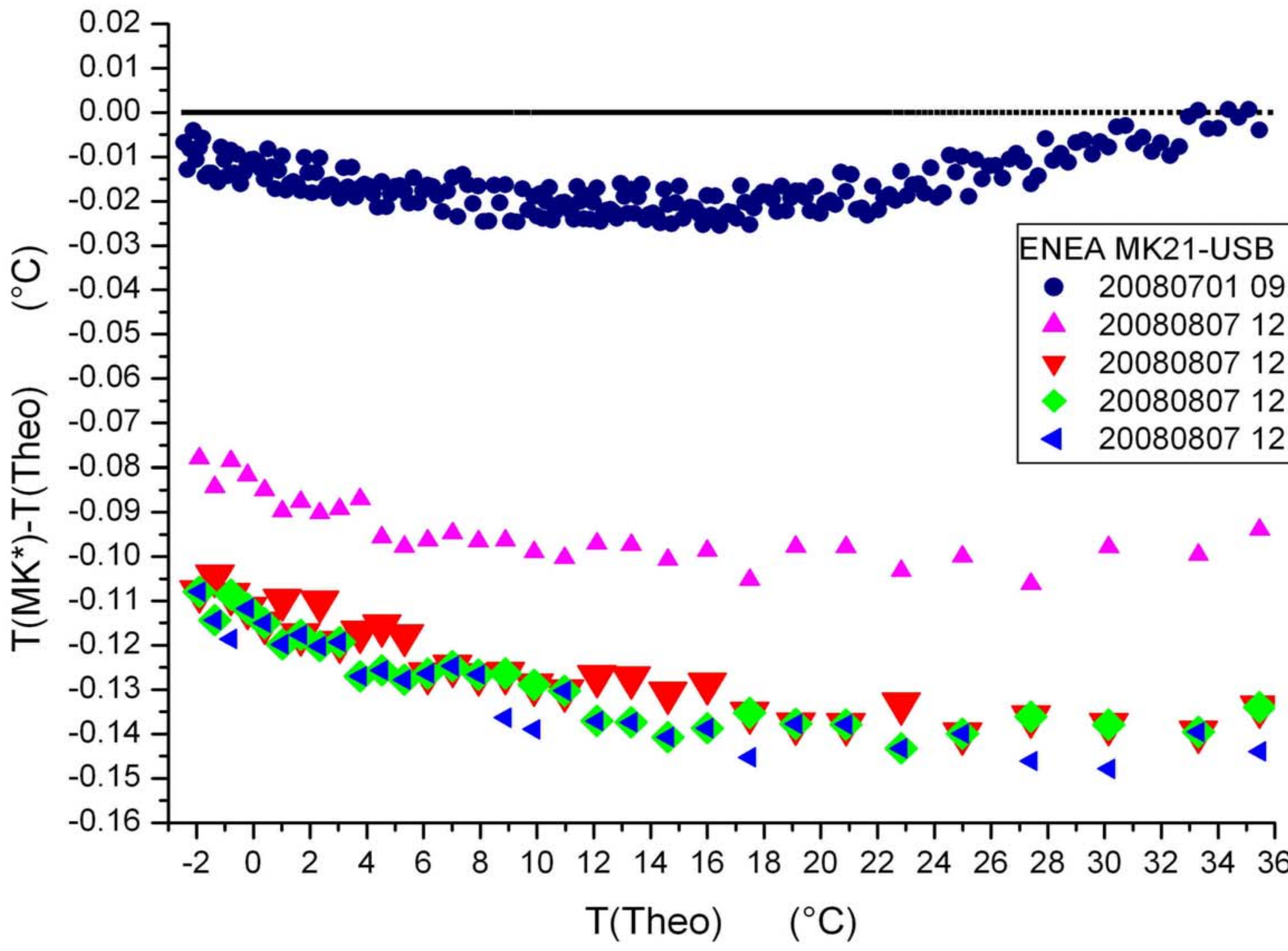


Test on MK21



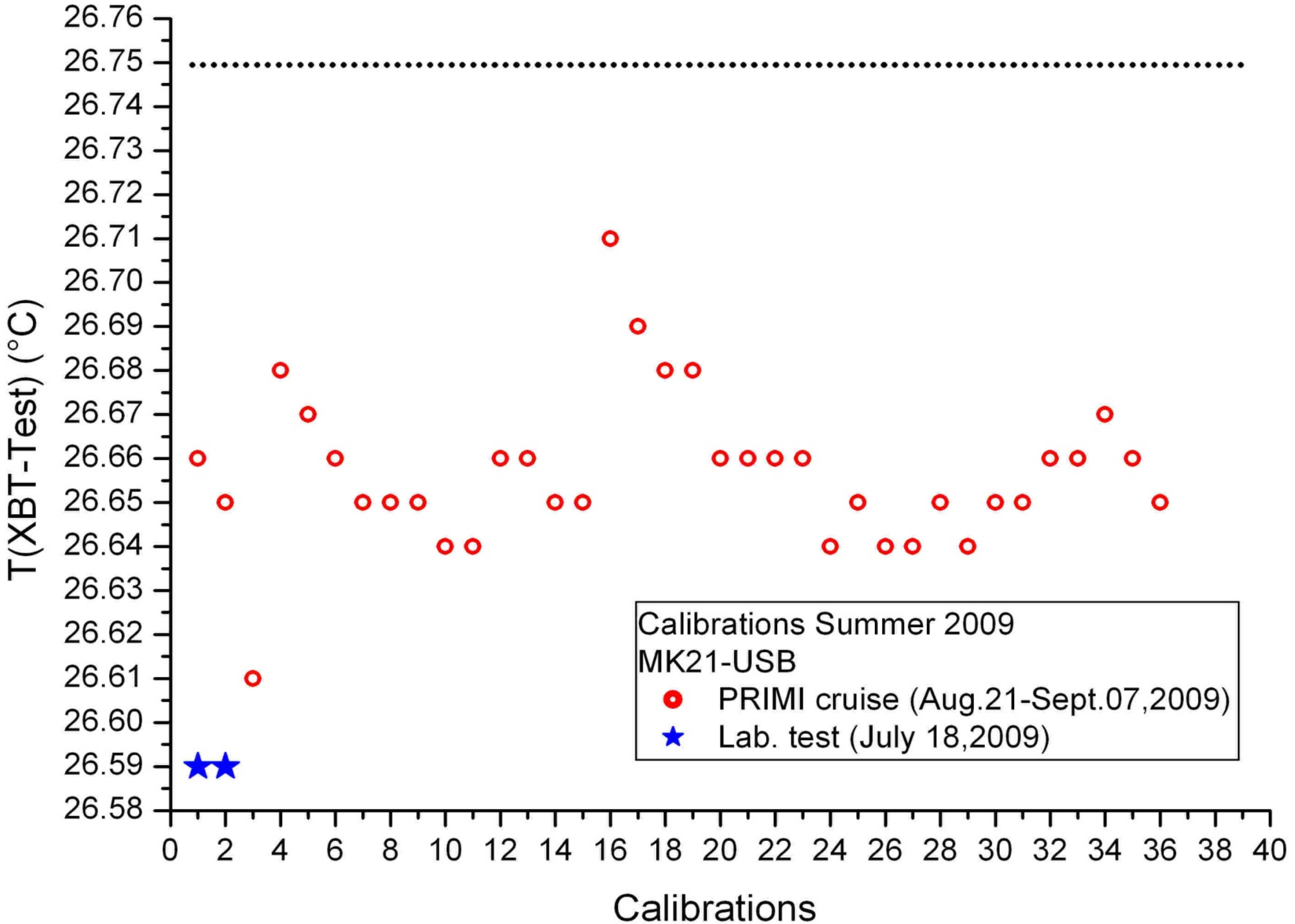
MK12 ENEA 2008/06/30-14:30(UTC)
MK12 NURC 2008/07/02-14:00(UTC)
MK21 ENEA 2008/07/04-14:30(UTC)
MK21 NURC 2008/07/04-15:00(UTC)
MK21 USB-ENEA 2008/07/01-09:30(UTC)
MK21 USB-CNR 2008/06/27-07.30(UTC)
MK21 USB-NURC 2008/07/02-09:30(UTC)
MK21 USB-NURC 2008/07/09-08.30(UTC)
MK21 USB-NURC 2008/07/09-09.00(UTC)
MK21 USB-NURC 2008/07/09-09.30(UTC)
T(MK*)-T(Theo) (°C)
T(Theo) (°C)
0.05
0.04
0.03
0.02
0.01
0.00
-0.01
-0.02
-0.03
-0.04
-0.05
-0.06
-0.07
-2
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30

Test on MK21



T(MK*)-T(Theo) (°C)
0.02
0.01
0.00
-0.01
-0.02
-0.03
-0.04
-0.05
-0.06
-0.07
-0.08
-0.09
-0.10
-0.11
-0.12
-0.13
-0.14
-0.15
-0.16
-2 0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36
T(Theo) (°C)
ENEA MK21-USB
20080701 09.30
20080807 12.11
20080807 12.28
20080807 12.46
20080807 12.59

Test on MK21


T(XBT-Test) (°C)
26.76
26.75
26.74
26.73
26.72
26.71
26.70
26.69
26.68
26.67
26.66
26.65
26.64
26.63
26.62
26.61
26.60
26.59
26.58
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
Calibrations
Calibrations Summer 2009
MK21-USB
PRIMI cruise (Aug.21-Sept.07,2009)
Lab. test (July 18,2009)

MK21-USB vs. MK150n vs. QUOLL

TEST PROBE (° C)	QUOLL Start cruise	QUOLL End cruise	MK21 USB Start cruise	MK21 USB End cruise	TSK MK150N Start cruise	TSK MK150N End cruise
12.755	12.759 ±0.001	12.760 ±0.002	12.63 ±0.01	12.64 ±0.01	12.751 ±0.001	12.749 ±0.002
27.953	27.955 ±0.001	27.956 ±0.002	27.81 ±0.01	27.84 ±0.01	27.946 ±0.001	27.947 ±0.002

Comparison with ARGO

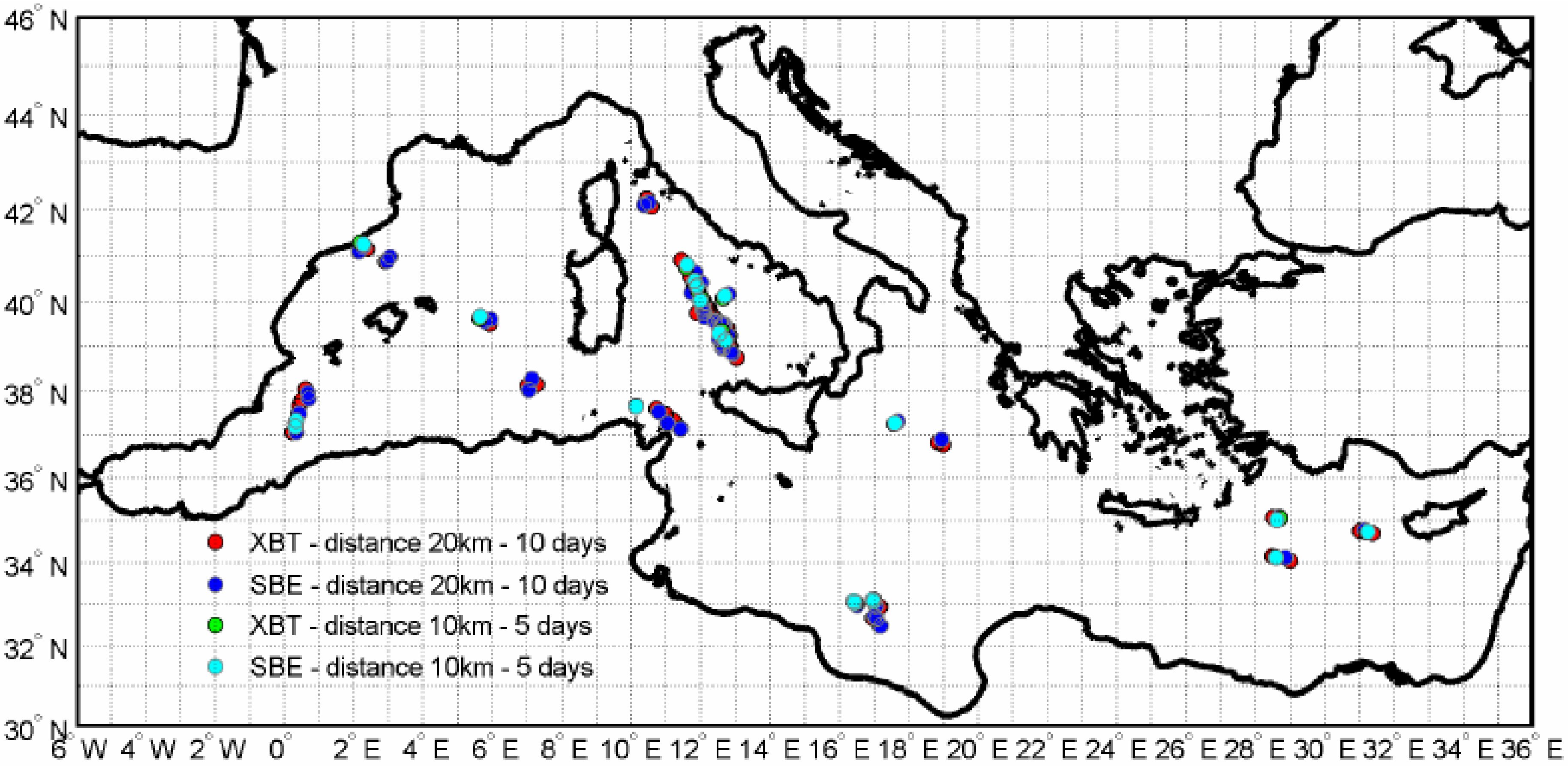
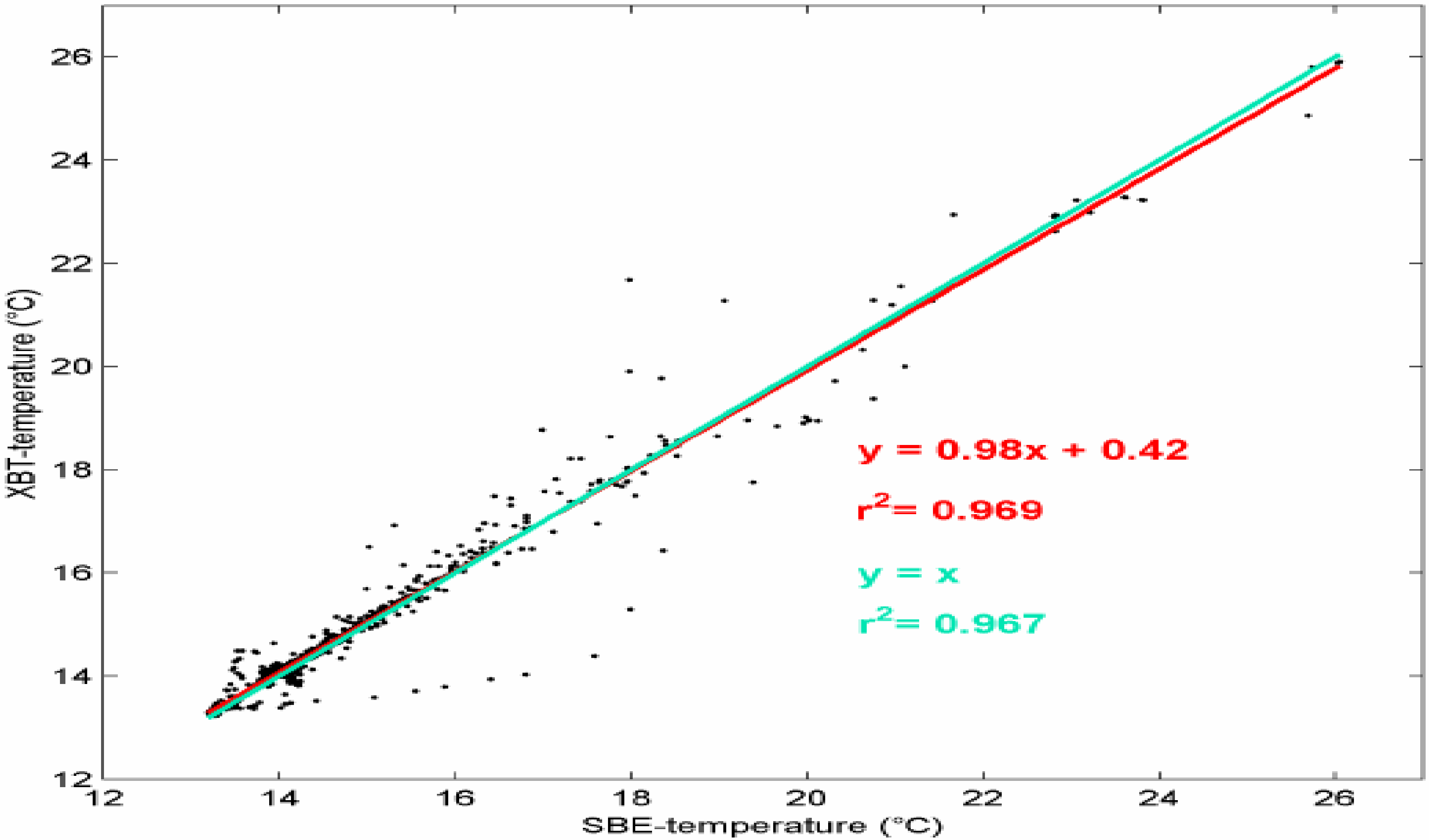


Figure 1: Spatial distribution of the float/XBT pairs considered in the Mediterranean Sea.

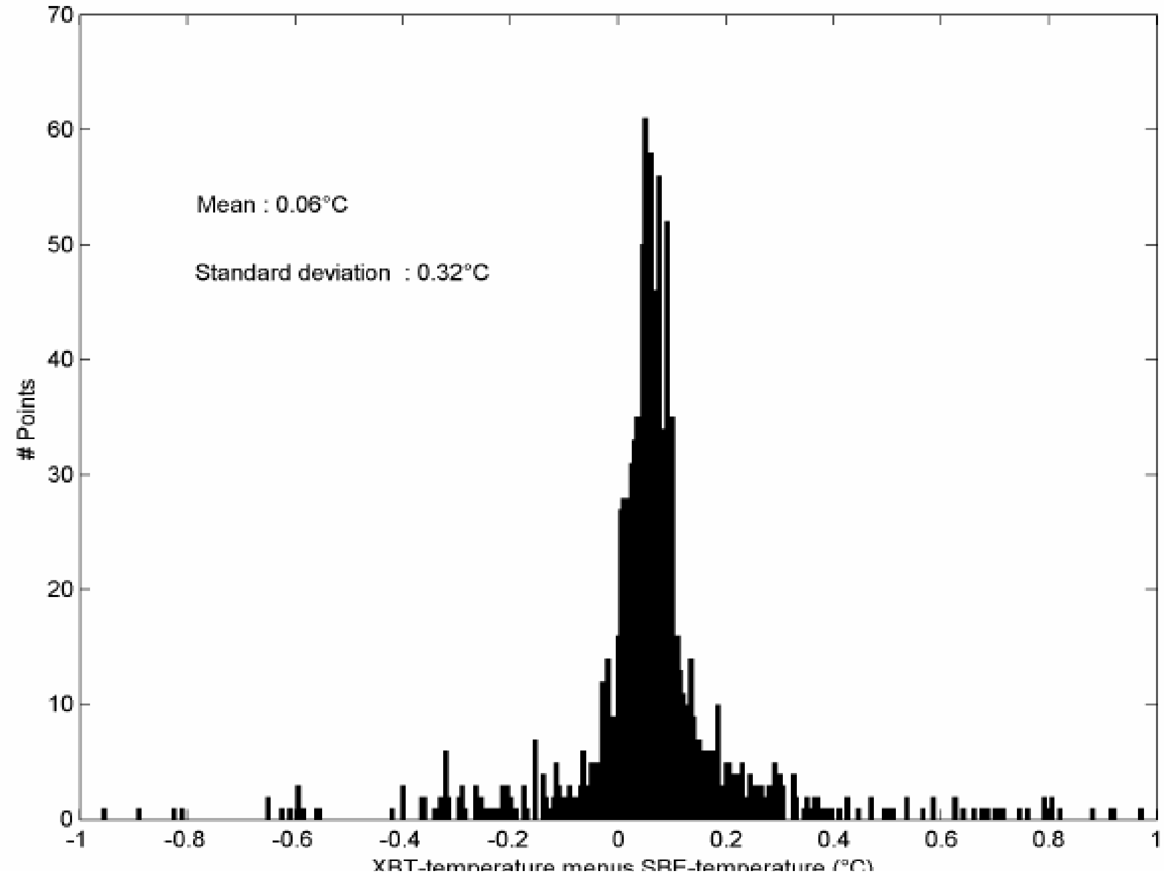
Further details in R.Barbanti-P.M.Poulain, rel 61/2005 OGA 31

Comparison with ARGO

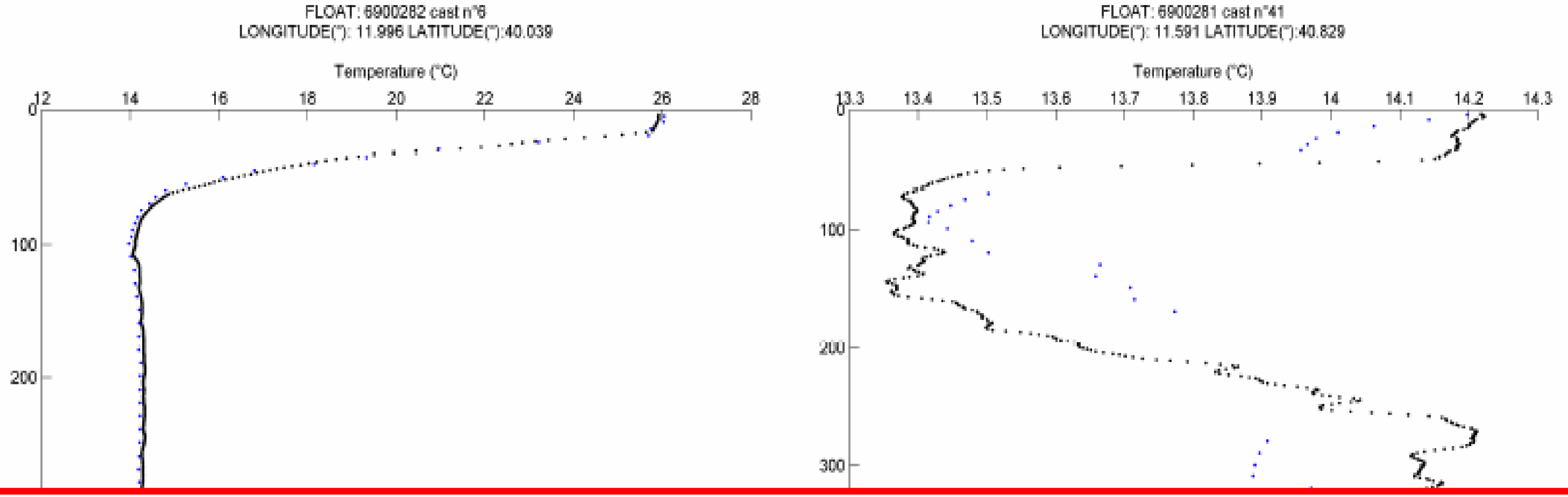


Further details in R.Barbanti-P.M.Poulain, rel 61/2005 OGA 31

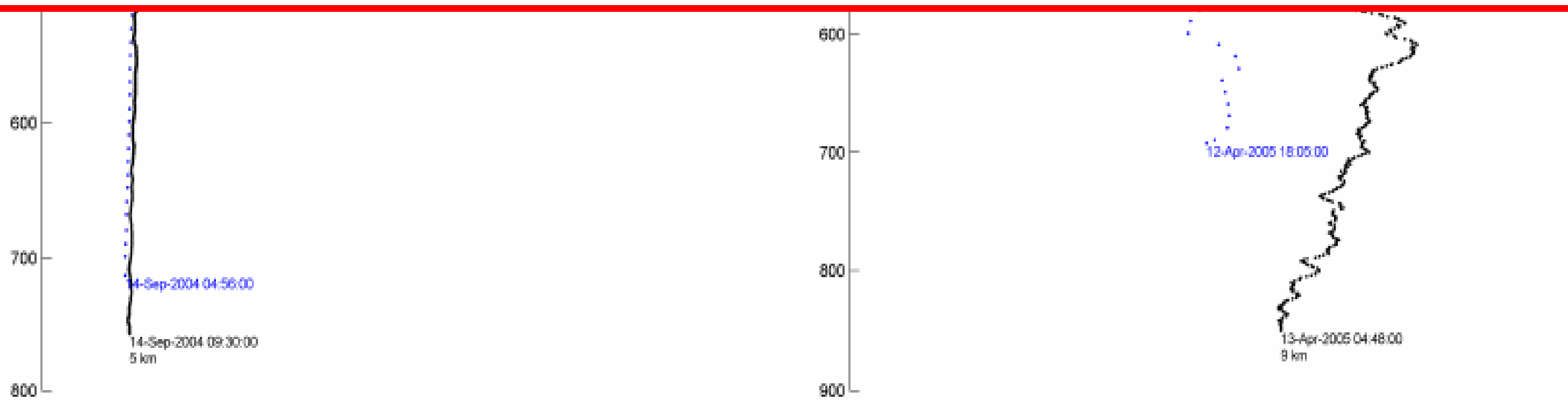
Comparison with ARGO



Maximum Separation	Depth (m)	0-100	100-200	200-300	300-400	400-500	500-600	600-700
10km-5days	mean	0.0482	0.0568	0.0435	0.0452	0.0679	0.0751	0.0744
	std	0.5974	0.1598	0.103	0.0837	0.0618	0.0578	0.0527
20km-10days	mean	0.2353	0.0421	0.0334	0.0541	0.0655	0.0578	0.0597
	std	0.8202	0.2321	0.1353	0.091	0.0541	0.0665	0.0793

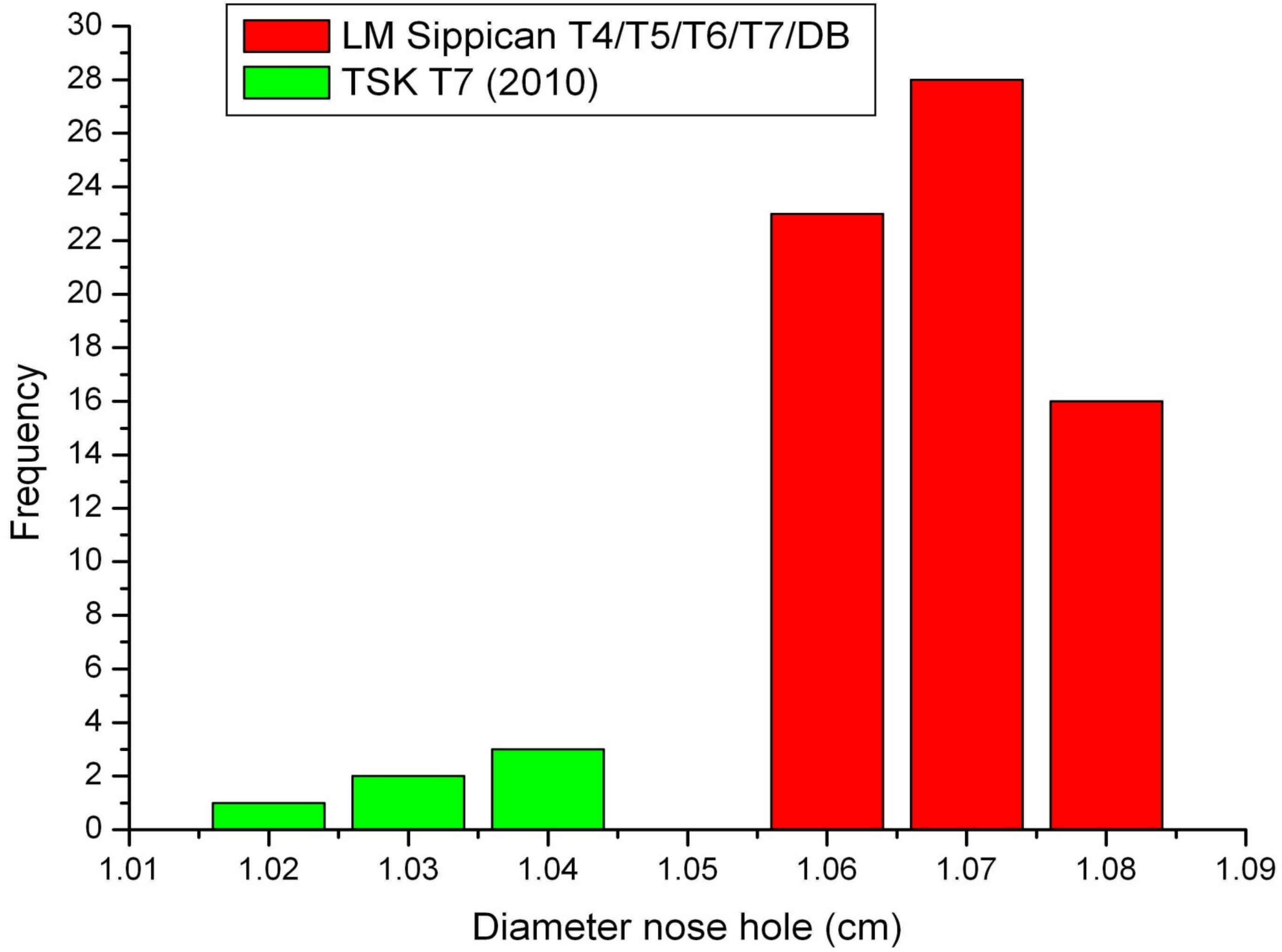


During the period July 2004 to July 2005, almost 7000 pairs of XBT and float CTD temperature measurements were found with distances less than 10 days and 20 km. All these observations were collected as part of the MFSTEP program throughout the Mediterranean Sea. Our statistical analyses reveal that the XBT temperatures obtained with Sippican Deep Blue probes are systematically warmer than the float Sea-Bird CTD readings, but that the offset is generally less than 0.1 °C which is the nominal accuracy of the XBT measurements.

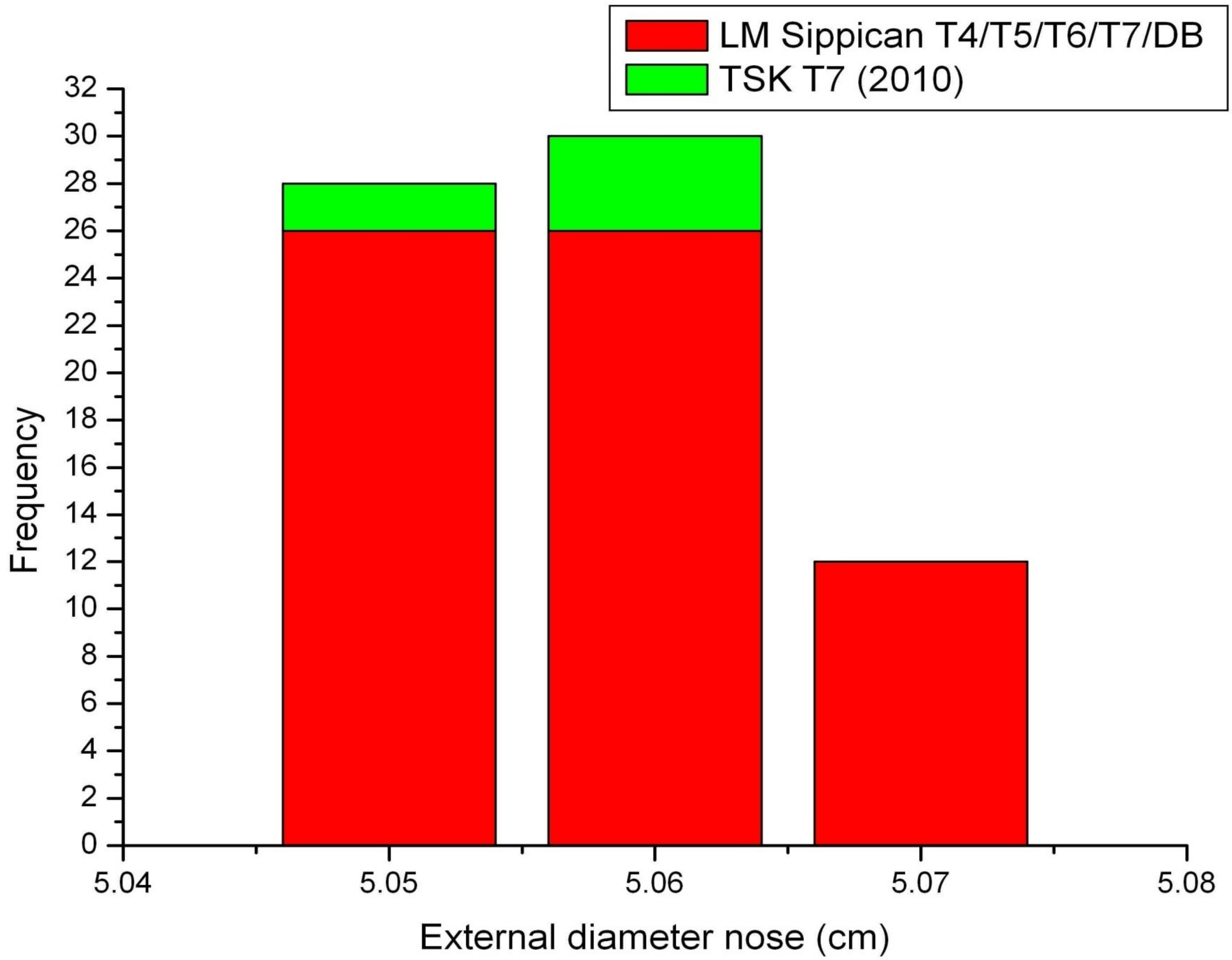


DB Sippican vs. T7 TSK (and vs. itself)

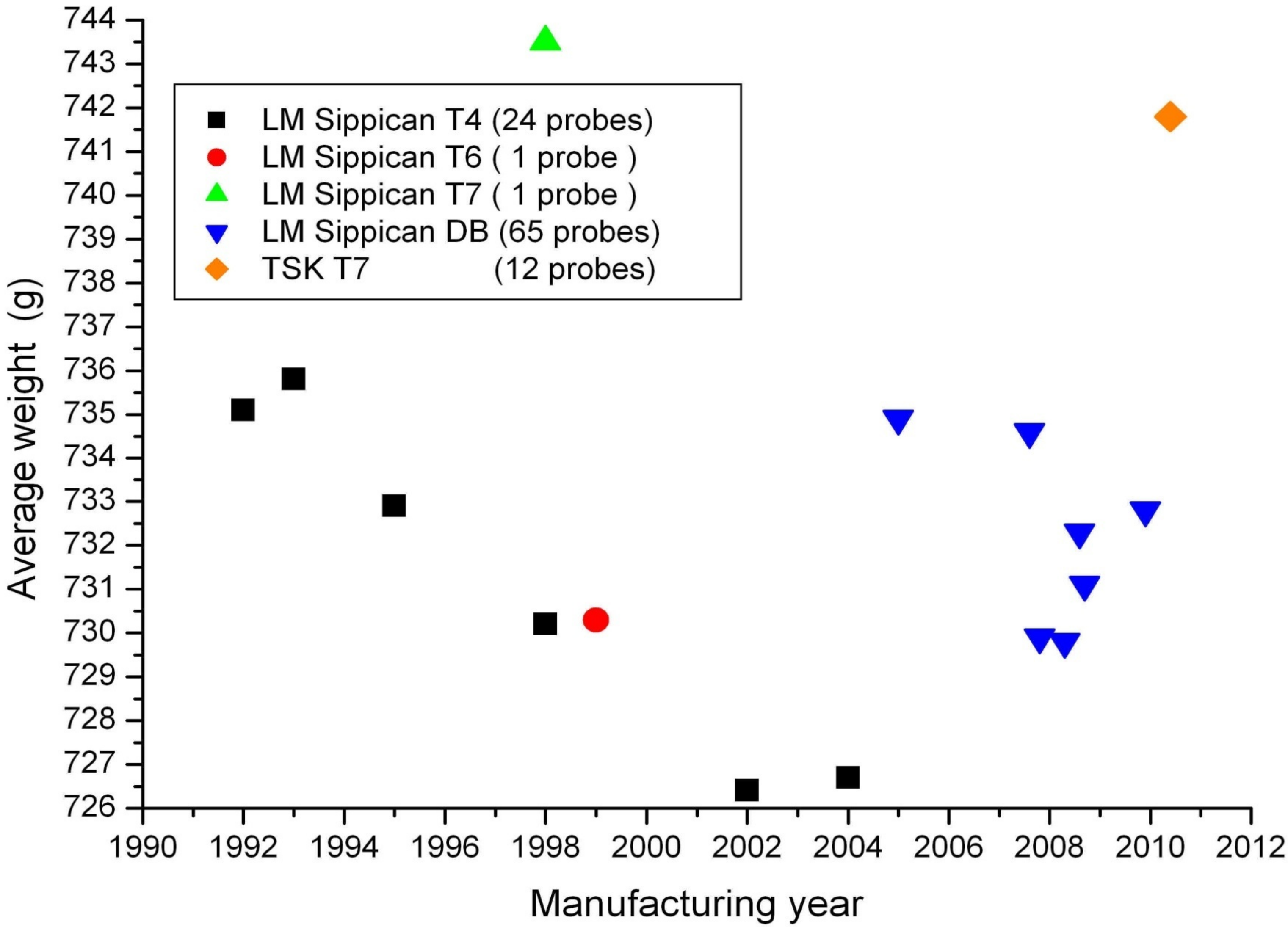
DB Sippican vs. T7 TSK (and vs. itself)



DB Sippican vs. T7 TSK (and vs. itself)

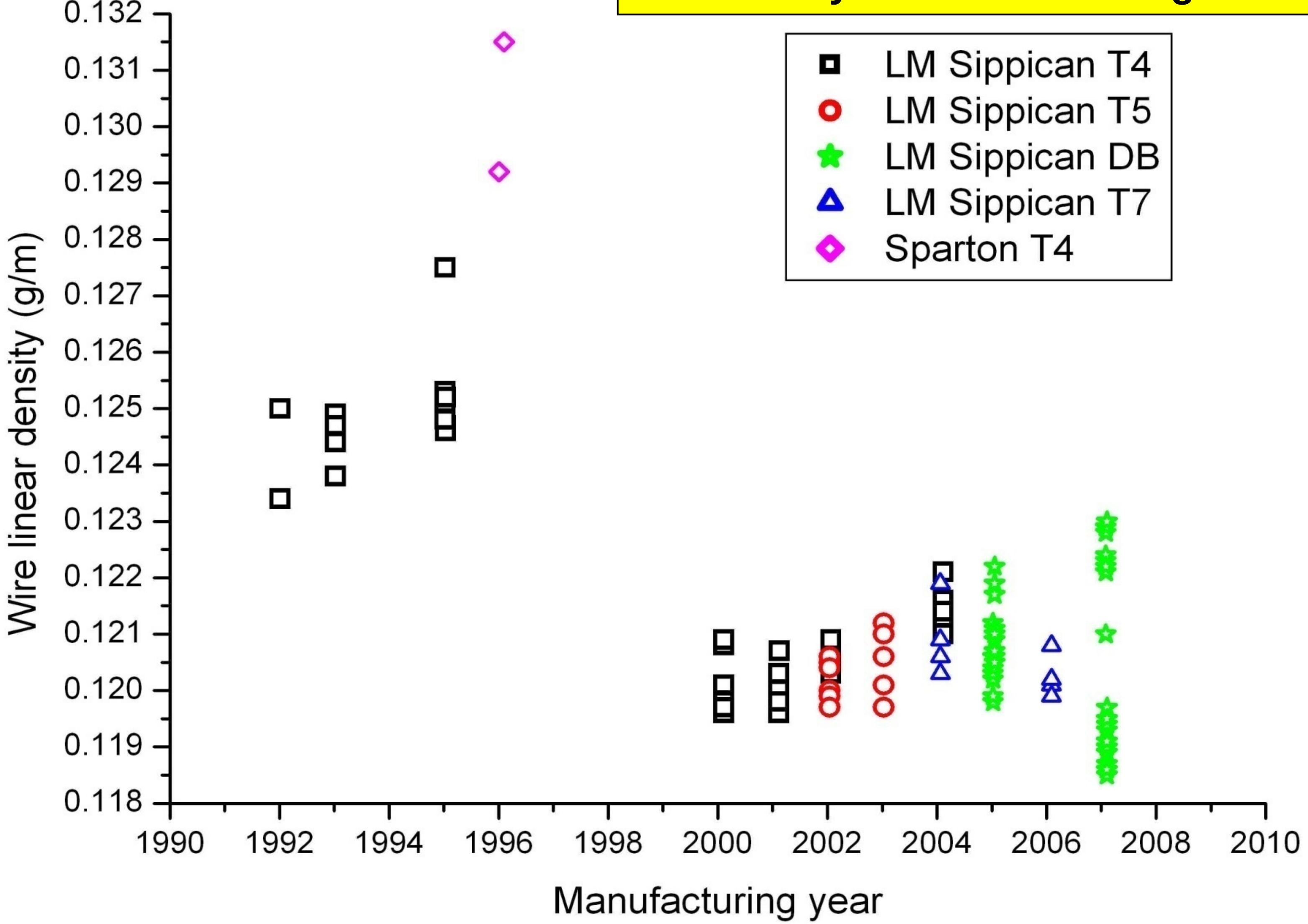


DB Sippican vs. T7 TSK (and vs. itself)



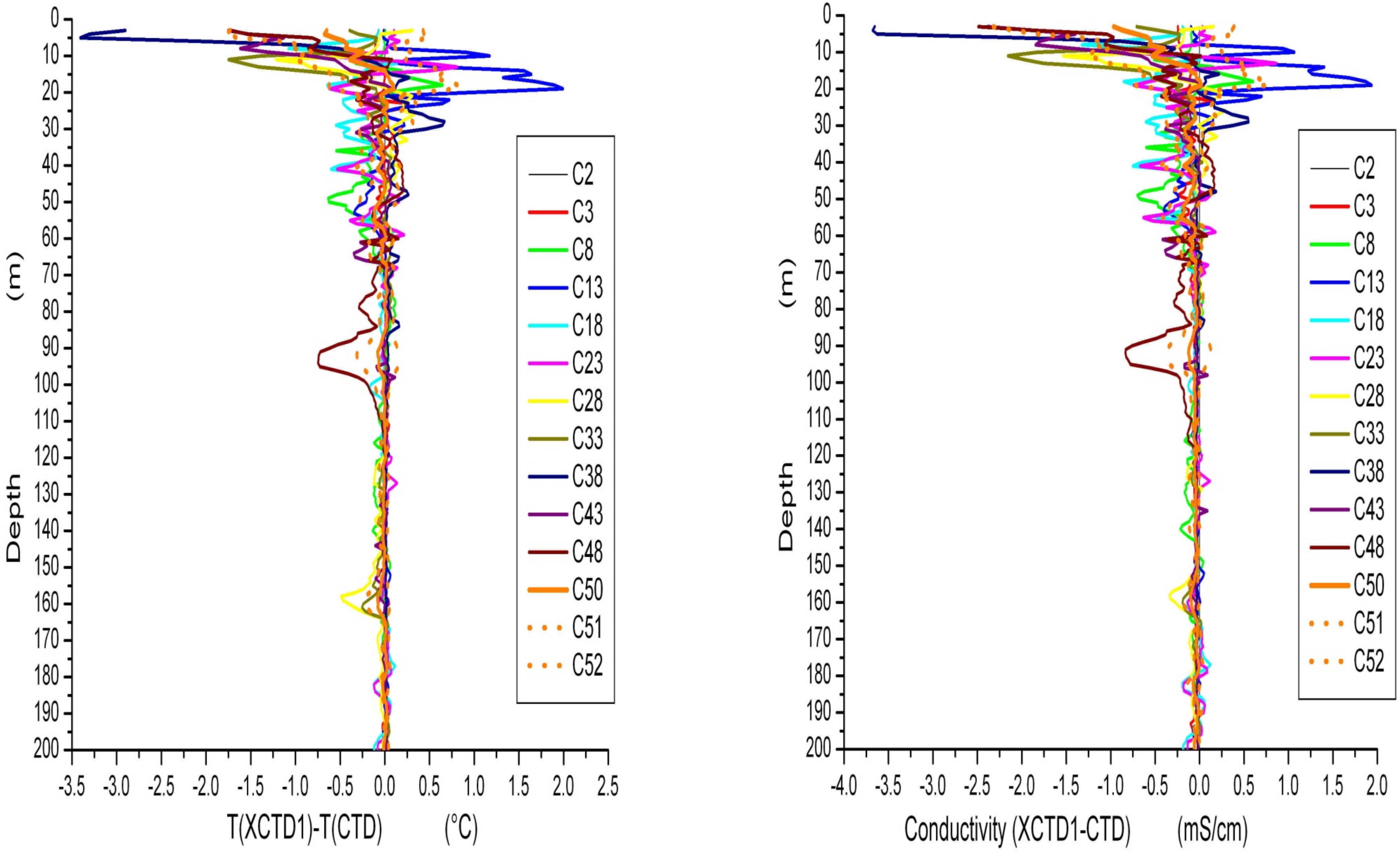
DB Sippican vs. T7 TSK (and vs. itself)

uncertainty on XBT wire length 1 cm/10 m
uncertainty on XBT wire weight 0.002 g/10m

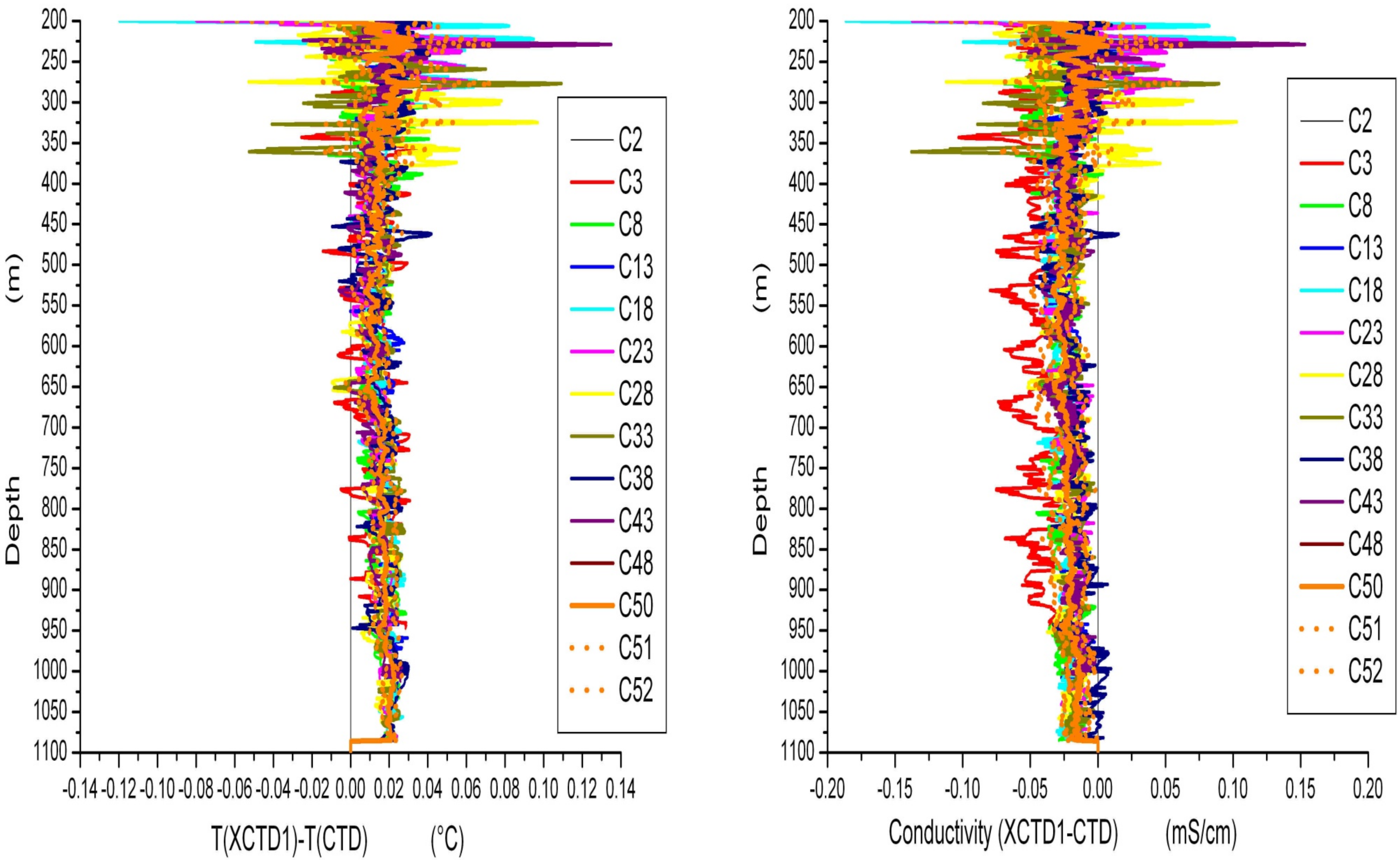


DB Sippican vs. T7 TSK (and vs. itself)

XCTD-1

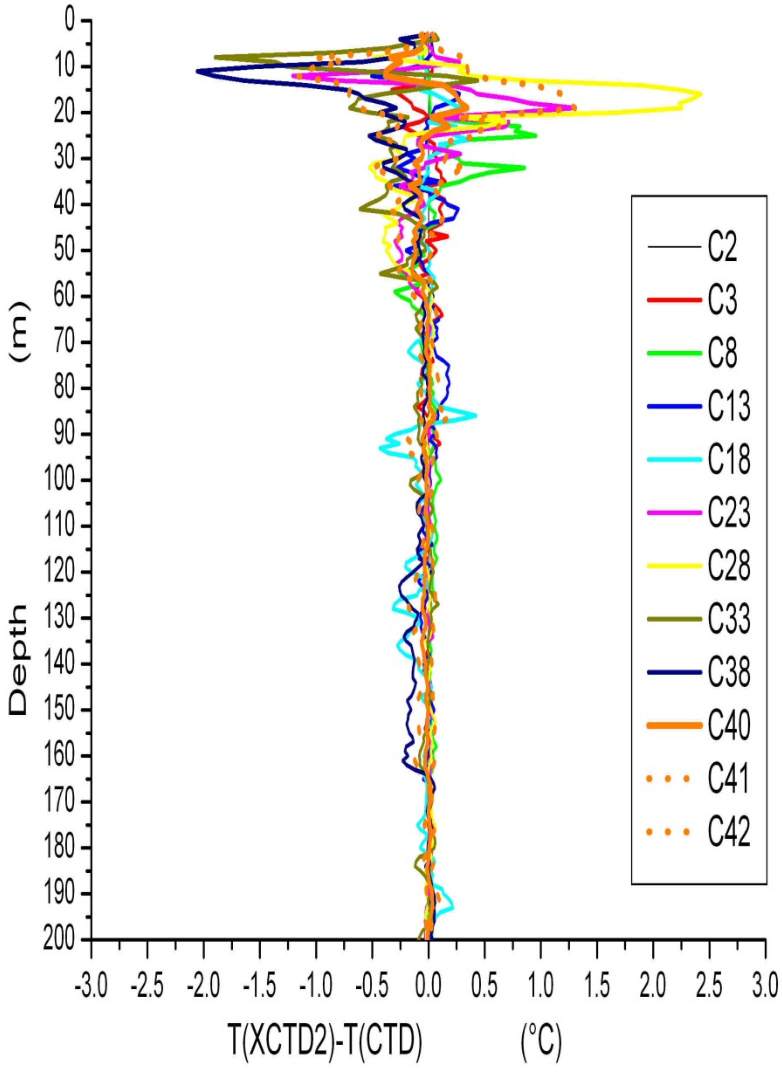

Depth (m)
T(XCTD1)-T(CTD) (°C)
Conductivity (XCTD1-CTD) (mS/cm)
C2
C3
C8
C13
C18
C23
C28
C33
C38
C43
C48
C50
C51
C52

XCTD-1

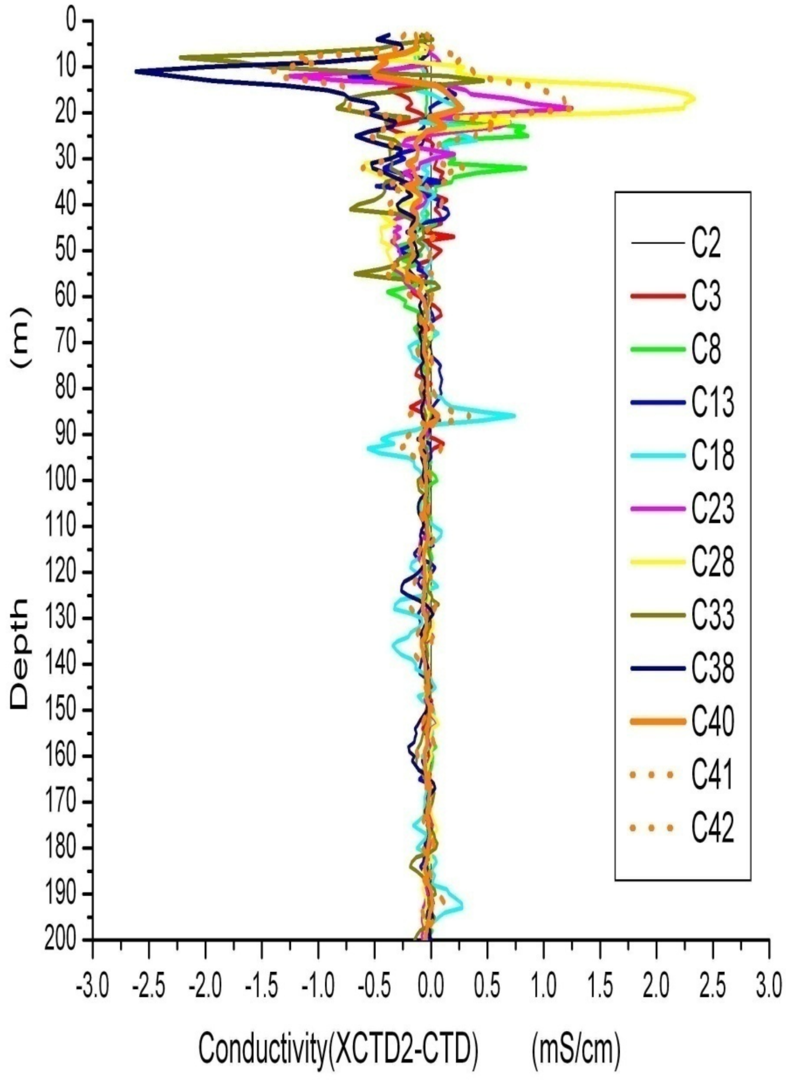


Depth (m)
200
250
300
350
400
450
500
550
600
650
700
750
800
850
900
950
1000
1050
1100
-0.14 -0.12 -0.10 -0.08 -0.06 -0.04 -0.02 0.00 0.02 0.04 0.06 0.08 0.10 0.12 0.14
T(XCTD1)-T(CTD) (°C)
-0.20 -0.15 -0.10 -0.05 0.00 0.05 0.10 0.15 0.20
Conductivity (XCTD1-CTD) (mS/cm)
C2
C3
C8
C13
C18
C23
C28
C33
C38
C43
C48
C50
C51
C52

XCTD-2

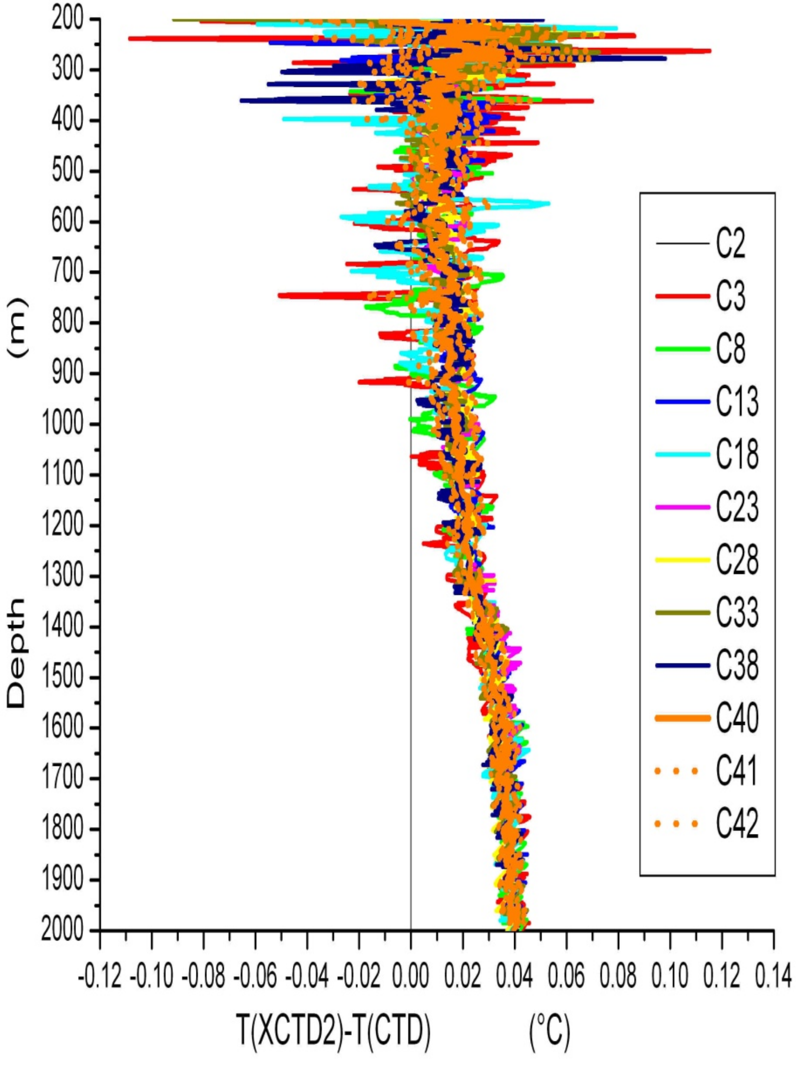


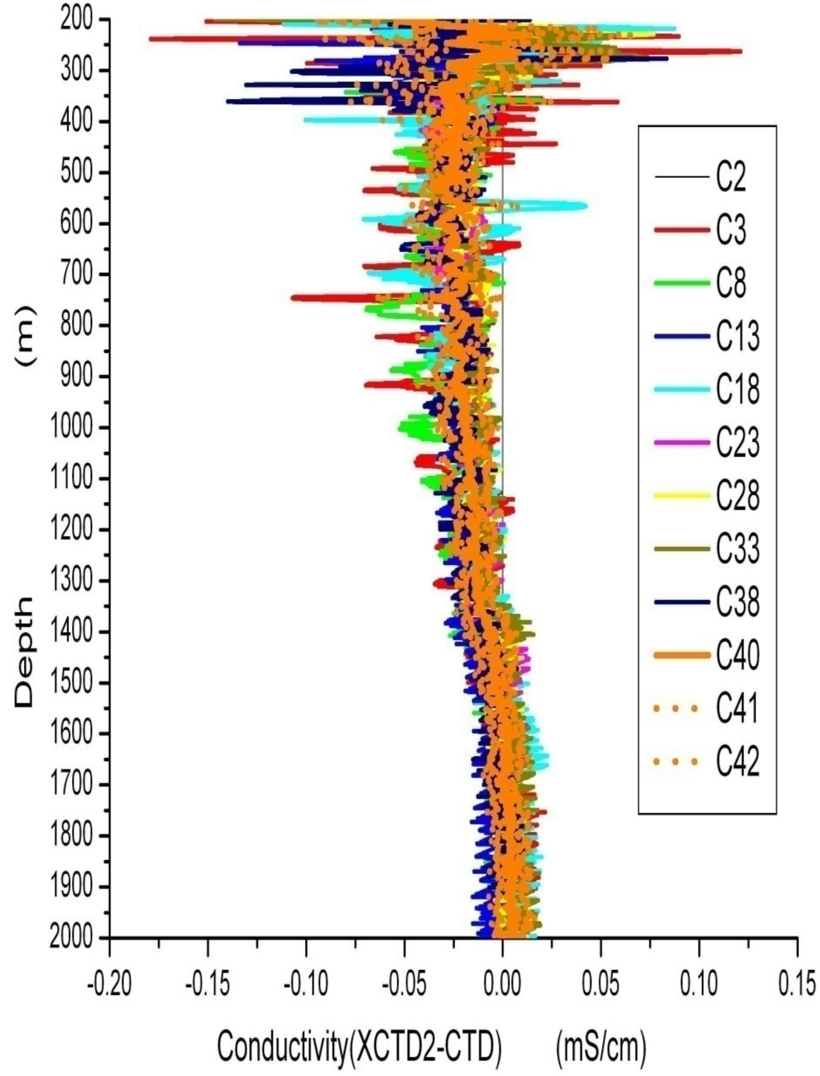
Depth (m)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
190
200
-3.0
-2.5
-2.0
-1.5
-1.0
-0.5
0.0
0.5
1.0
1.5
2.0
2.5
3.0
T(XCTD2)-T(CTD) (°C)
C2
C3
C8
C13
C18
C23
C28
C33
C38
C40
C41
C42



Depth (m)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
190
200
-3.0
-2.5
-2.0
-1.5
-1.0
-0.5
0.0
0.5
1.0
1.5
2.0
2.5
3.0
Conductivity(XCTD2-CTD) (mS/cm)
C2
C3
C8
C13
C18
C23
C28
C33
C38
C40
C41
C42

XCTD-2


Depth (m)
T(XCTD2)-T(CTD) (°C)
C2
C3
C8
C13
C18
C23
C28
C33
C38
C40
C41
C42


Depth (m)
Conductivity(XCTD2-CTD) (mS/cm)
C2
C3
C8
C13
C18
C23
C28
C33
C38
C40
C41
C42

Optimist: sunrise

Pessimist: sunset

Thank You very much for Your attention

That’s all

ENEA has no funds for operational oceanography activities, and I’ve no project funding that activity. Moreover, I’ve used probes for XBT tests, subtracting them from the SOOP activity in Mediterranean Sea. Anyway, my storage room has no more than 70 probes (a mix of DB-T5-T5/20, with the addition of 12 historical T4 probes)