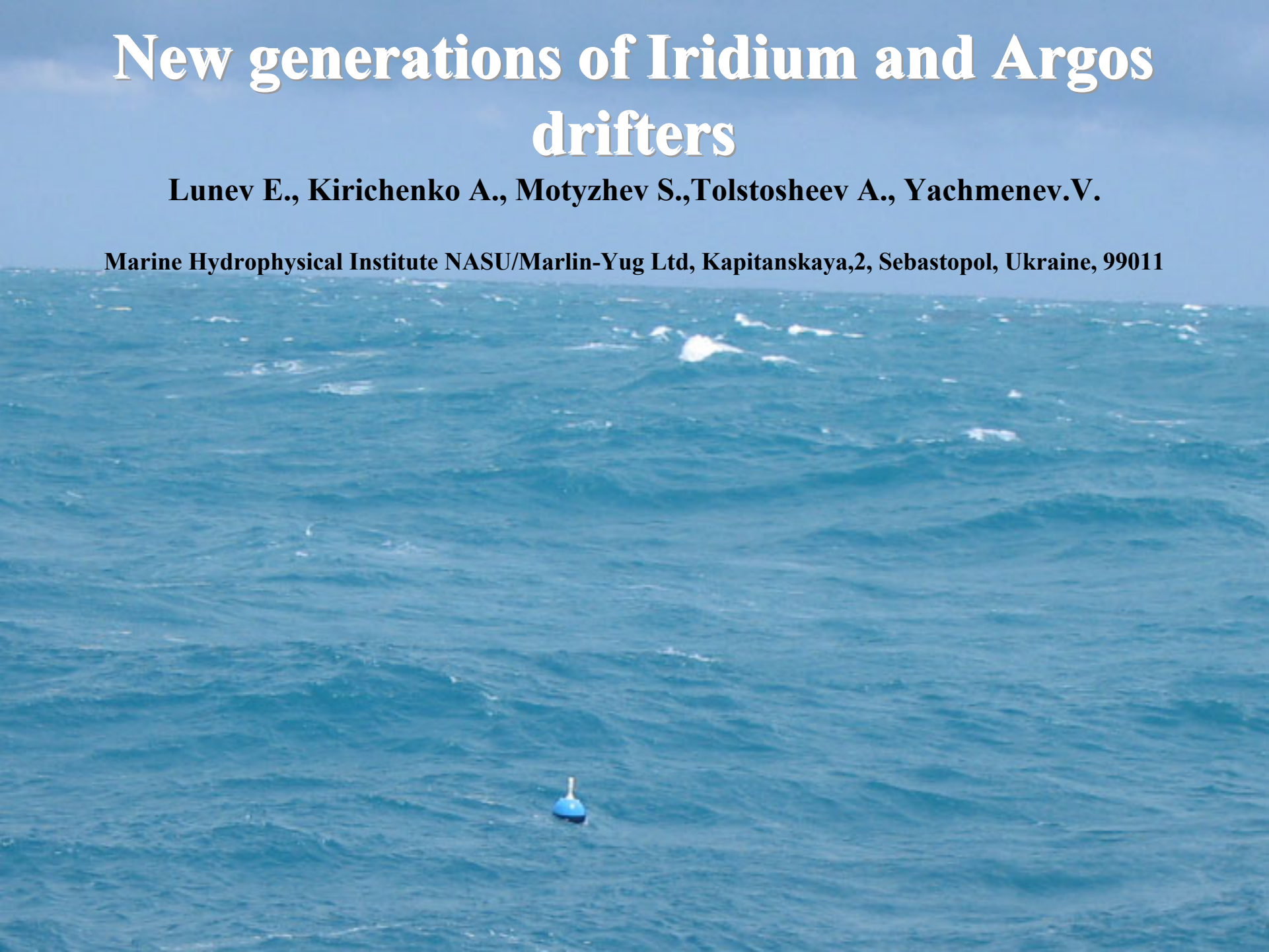
New generations of Iridium and Argos drifters

Lunev E., Kirichenko A., Motyzhev S.,Tolstosheev A., Yachmenev.V.

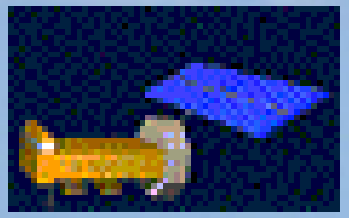
Marine Hydrophysical Institute NASU/Marlin-Yug Ltd, Kapitanskaya,2, Sebastopol, Ukraine, 99011



Areas of activity in 2007

1. *Development of Argos user's segment*
2. *Participation in Iridium Pilot Project*
3. *Updating of SVP-BTC 80 drifter*
4. *Evaluation of the novelties in-situ*

Development of Argos user's segment



Variants of data transfer

(Multifunctional PTT)

Testing of buoy before and after deployment

(Argos checking device)

Development of Argos user's segment

MT105A is Basic PTT certified by CLS Argos

- **MT105AM – only for data transfer and locations with smaller power consumption**
- **MT105AMR - with installed real-time clock (RTC) with 4-year lifetime**
- **MT105AMG – with low power consumption GPS receiver**
- **MT105AMRG – with both capabilities above**

Development of Argos user's segment

Argos tester MACD 150

Reception within visibility

Waterproof case

Waterproof USB connection for PC

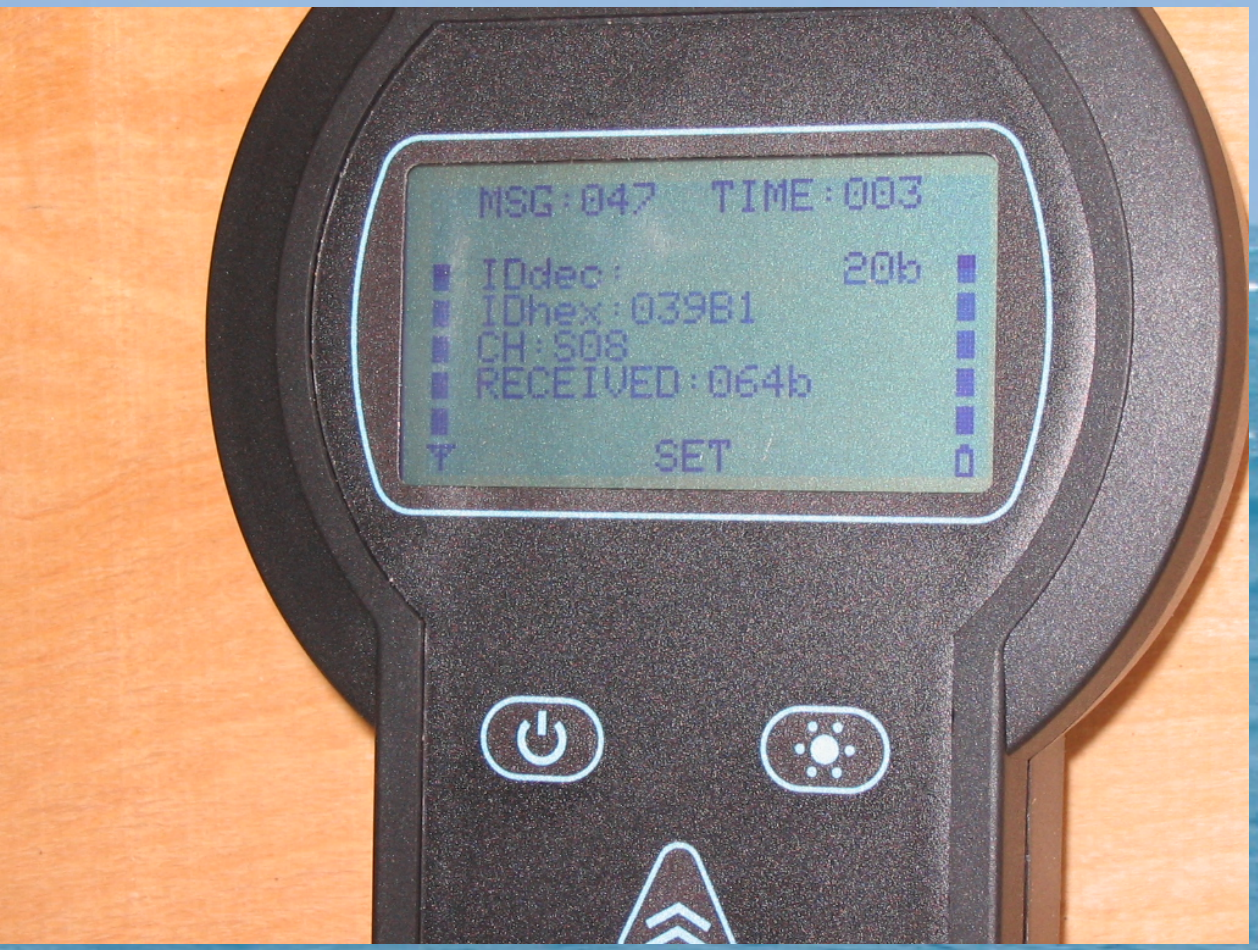
Flexible antenna

Evaluation of PTT parameters and reception of data

Development of Argos user's segment

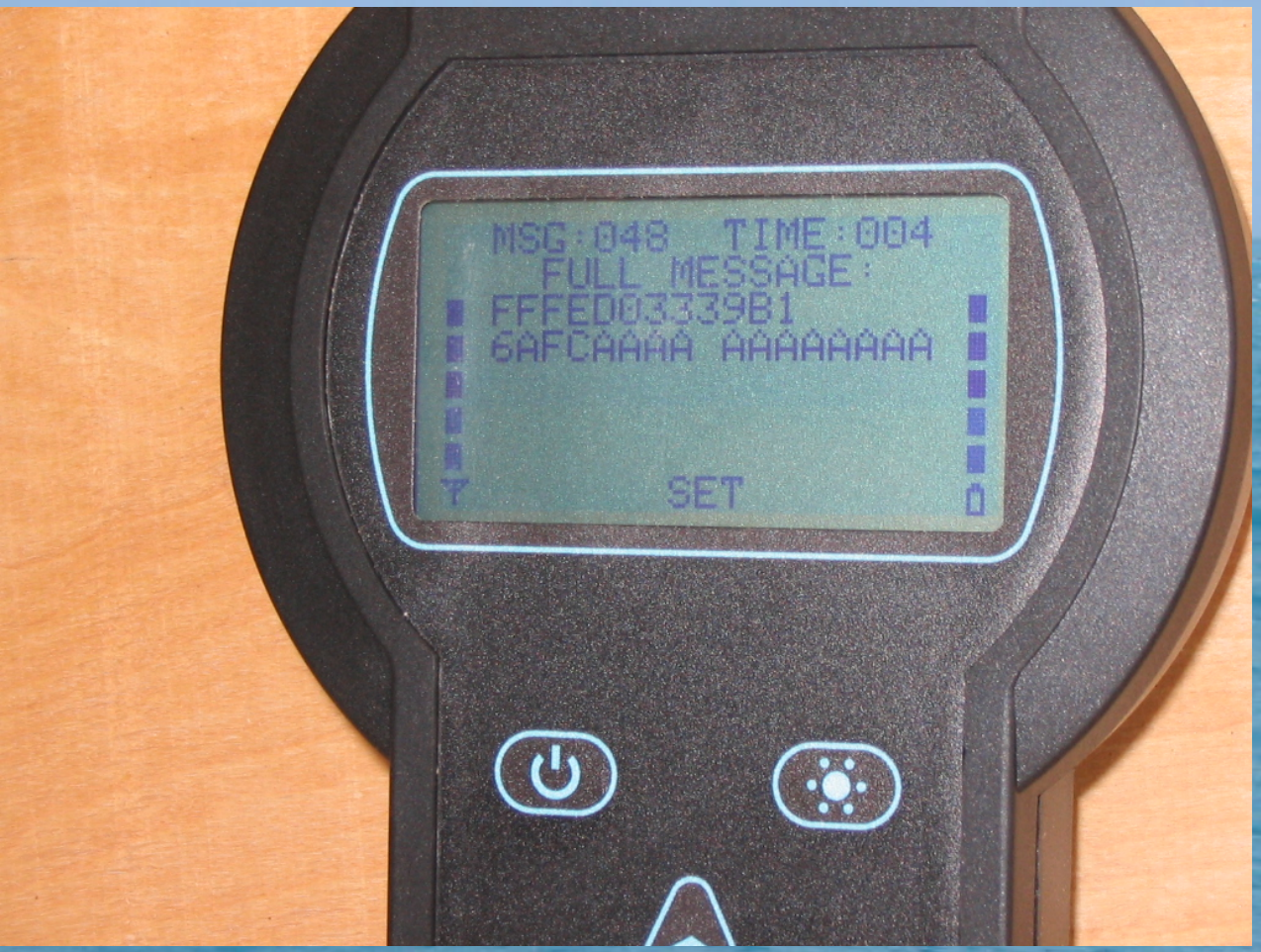
Parameters of transmitting signal

Development of Argos user's segment



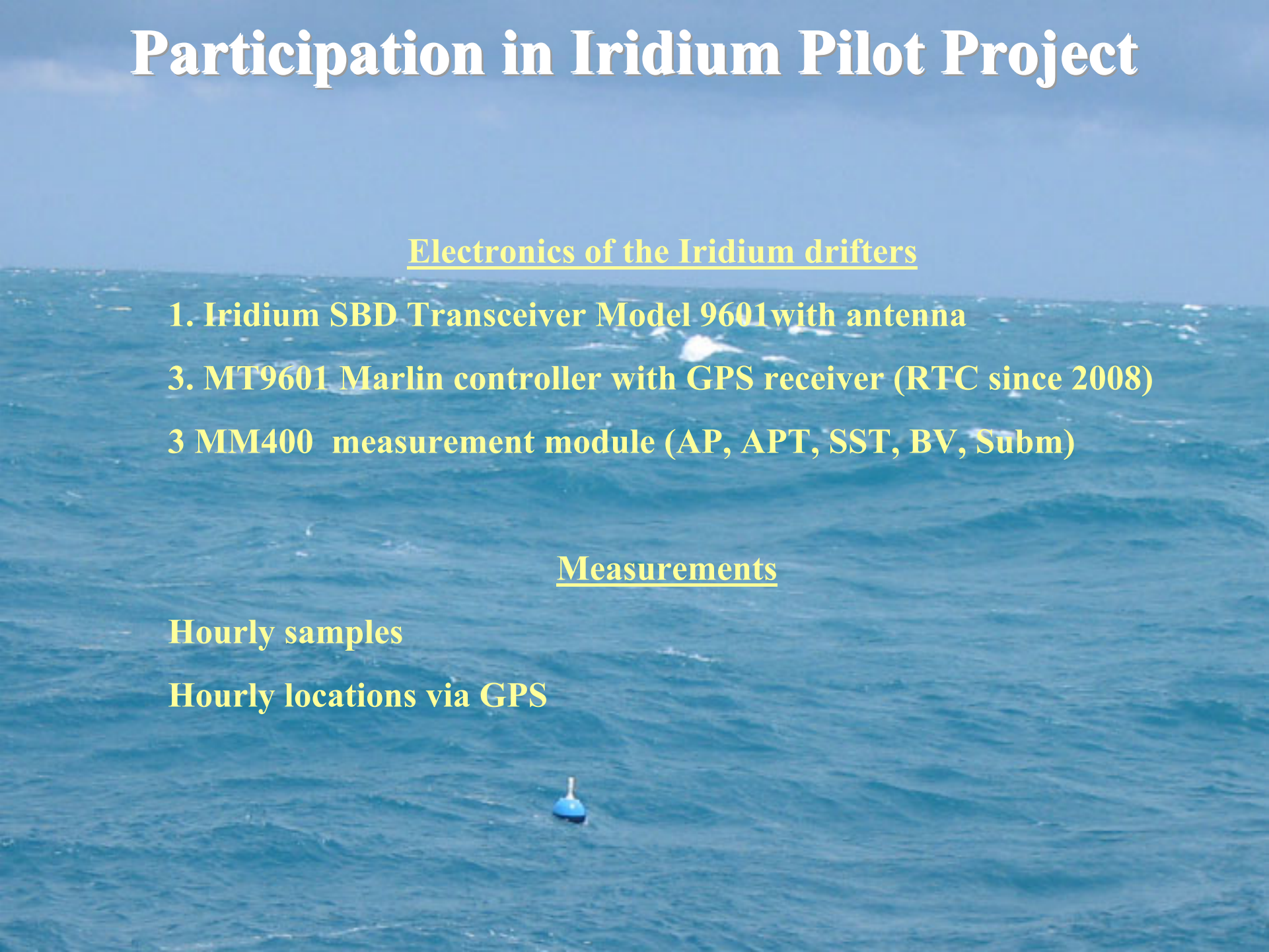
Information about platform

Development of Argos user's segment



Data transmitted

Participation in Iridium Pilot Project



Electronics of the Iridium drifters

1. Iridium SBD Transceiver Model 9601with antenna

3. MT9601 Marlin controller with GPS receiver (RTC since 2008)

3 MM400 measurement module (AP, APT, SST, BV, Subm)

Measurements

Hourly samples

Hourly locations via GPS

Participation in Iridium Pilot Project

Format *(version 3 – used on the 1+3 new prototypes)*

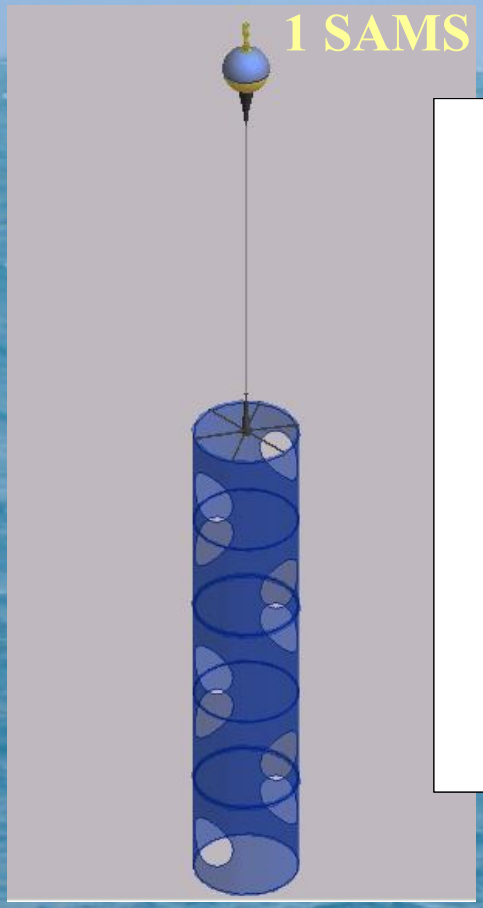
Parameter	Bits	Pos	Min	Max	Formula
Mode	3	0	0	7	Fixed = 3 (0011)
Observation time since 1st of January at 00:00	16	3	0	16383	Hour (UTC) = n * 0.25
Air pressure	11	19	850	1054.7	AP (hPa) = n*0.1 + 850
SST	9	30	-5	35.88	SST (°C) = n*0.08 - 5
Pressure tendancy	9	39	-25.5	25.6	dP (hPa) = n*0.1 - 25.5
Submergence count	6	48	0	100	Subm. (%) = n * 1.6129
~~Battery voltage~~	~~6~~	~~54~~	~~10.75~~	~~17.15~~	~~Vbat (V) = n*0.1 + 10.75~~
Battery voltage	6	54	7.0	13.3	Vbat (V) = n*0.1 + 7.0
Iridium transmission duration	8	60	0	255	SBDT (s) = n
GPS fix time since 1st of January at 00:00	16	68	0	16383	Hour (UTC) = n * 0.25
GPS Latitude	20	84	-90	98	Lat (deg) = n*0.00018 - 90
GPS Longitude	21	104	-180	197	Lon (deg) = n*0.00018 - 180
~~Time to first GPS fix~~	~~7~~	~~125~~	~~0~~	~~254~~	~~TTFF (s) = n * 2~~
GPS satellite number in view	7	125	0	254	GPSSatNum = n

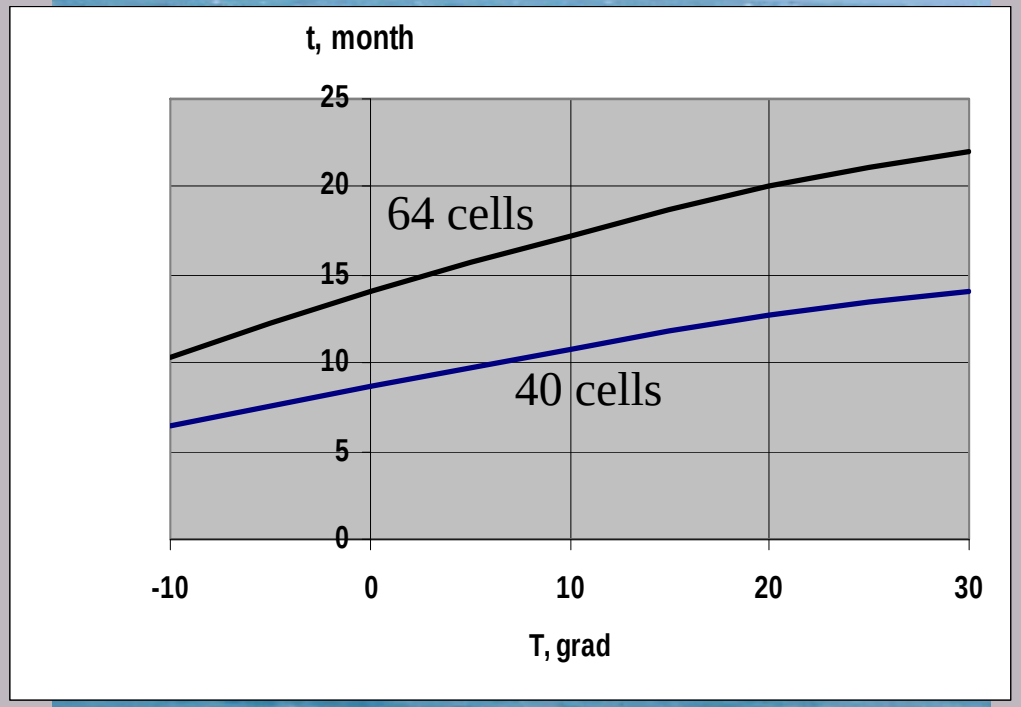
Participation in Iridium Pilot Project

Iridium SVP-B (64 Alc. D cells)

2 Meteo-France

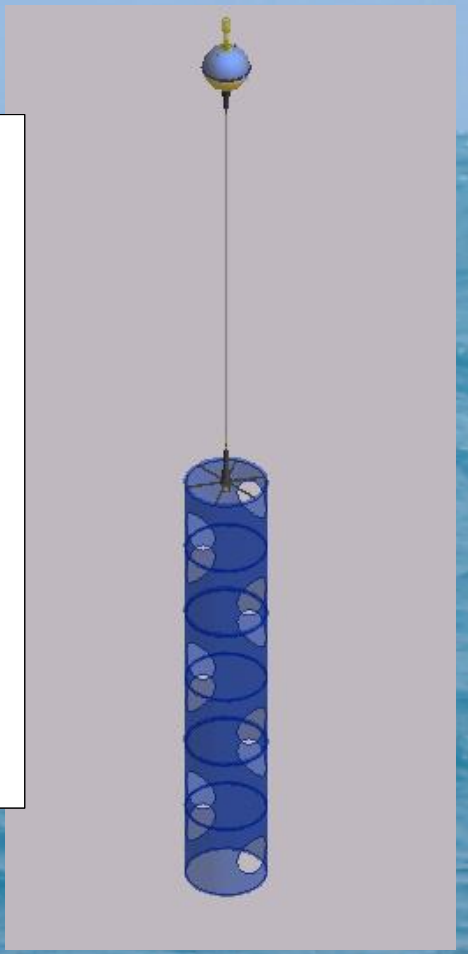
1 SAMS Research Services Ltd





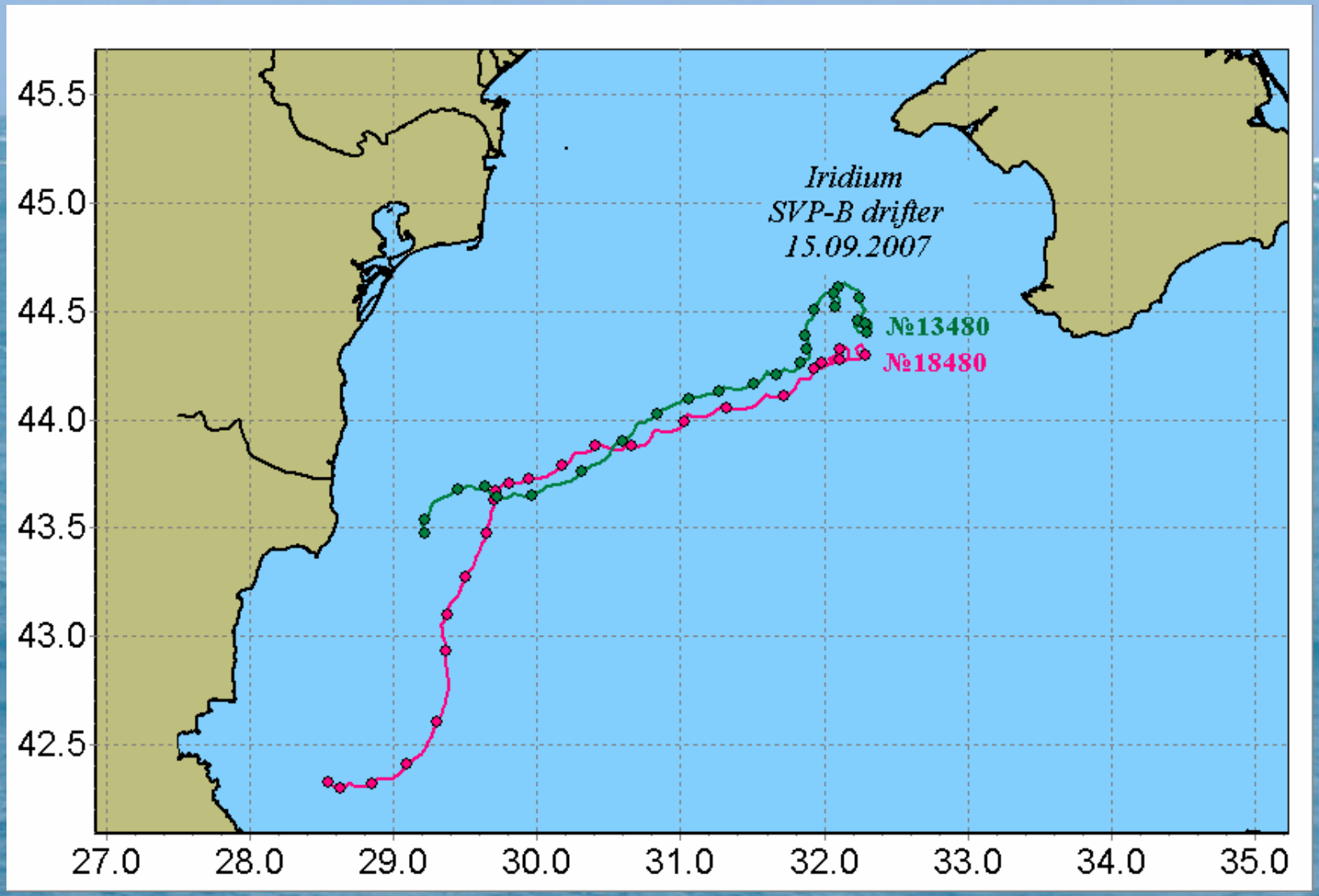
Iridium SVP-B mini (40 Alc. D cells)

1 SAMS Research Services Ltd



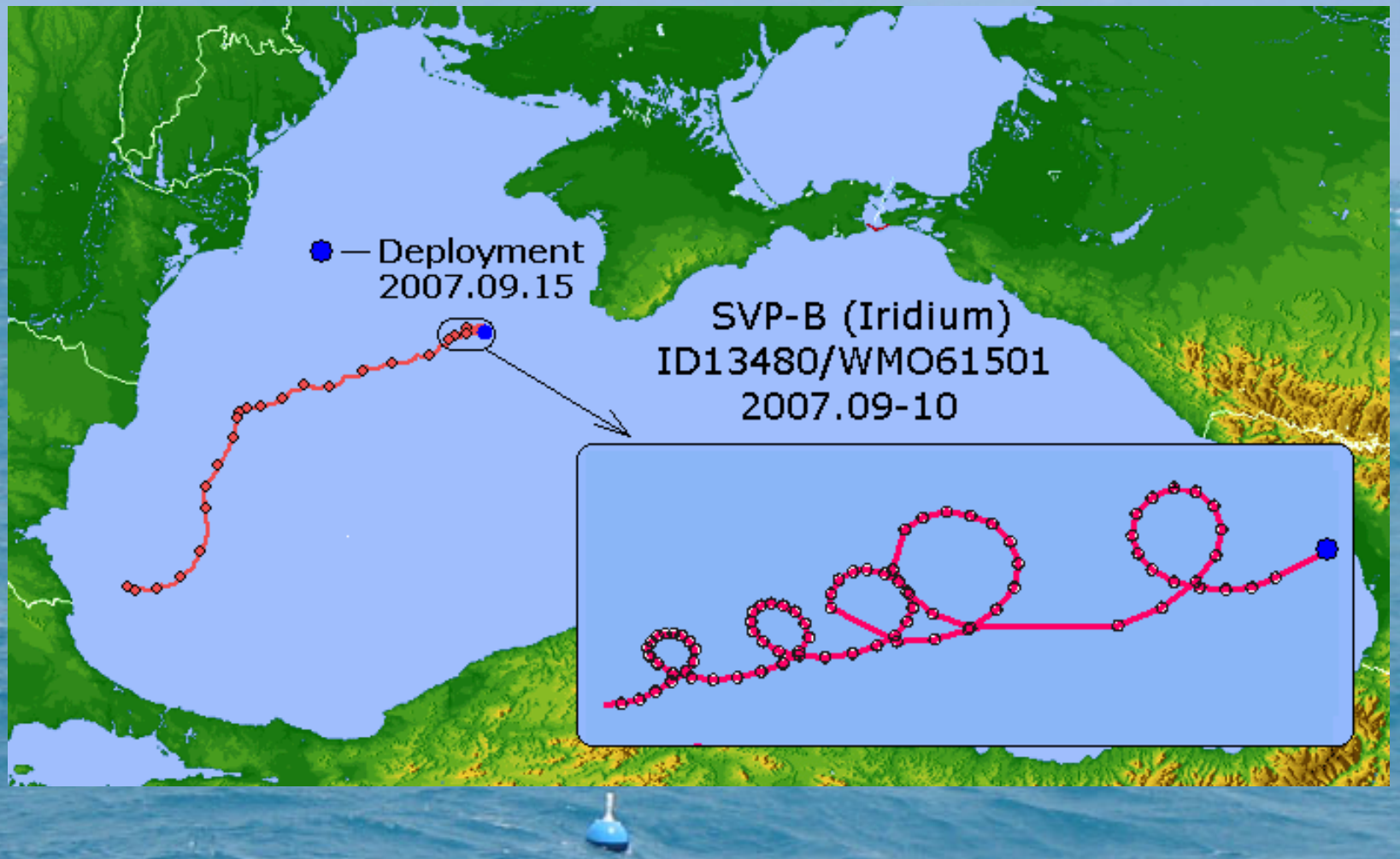
Participation in Iridium Pilot Project

Deployment of Iridium drifters in the Black Sea



Participation in Iridium Pilot Project

Tracing of buoy by means of hourly GPS locations



Participation in Iridium Pilot Project

The problems with Iridium using

1…3%

Absence of observation

Mode	ObsTime	AP	SST	APT	SubM	UB	SBDT	GPSTime	Lat	Lon	Sat
3	6396.00	1017.3	20.36	-0.5	2.0	11.8	21	6396.00	44.33382	31.90014	5
3	6397.00	1017.2	20.28	-0.4	2.0	11.8	22	6397.00	44.32968	31.89762	6
3	6398.00	1017.2	20.28	-0.1	2.0	11.8	23	6398.00	44.32608	31.89384	8
3	6399.00	1017.3	20.28	0.0	0.0	11.8	21	6399.00	44.32338	31.88970	8
??											
3	6401.00	1017.4	20.12	0.2	3.0	11.8	5	6401.00	44.32212	31.88358	6
3	6402.00	1017.4	20.12	0.1	3.0	11.8	19	6402.00	44.32248	31.88286	6
3	6403.00	1017.2	20.12	-0.2	3.0	11.8	21	6403.00	44.32284	31.88376	7
3	6404.00	1017.1	20.04	-0.3	3.0	11.8	19	6404.00	44.32284	31.88592	6
3	6405.00	1016.7	20.04	-0.7	2.0	11.8	22	6405.00	44.32230	31.88934	5

The roots of event are questionable (Buoy's software? Data processing in link?)

Some feature: Small value of SBDT for next observation?

Participation in Iridium Pilot Project

The problems with Iridium using

4…5%

Double observations sent

Mode	ObsTime	AP	SST	APT	SubM	UB	SBDT	GPSTime	Lat	Lon	Sat
3	6355.00	1021.8	20.52	-0.1	3.0	11.9	20	6355.00	44.50086	31.93488	8
3	6356.00	1021.7	20.52	-0.4	3.0	11.9	22	6356.00	44.49528	31.93362	5
3	6357.00	1021.3	20.52	-0.8	3.0	11.9	23	6357.00	44.49060	31.93182	5
3	6358.00	1021.0	20.52	-0.8	3.0	11.9	21	6358.00	44.48628	31.92966	6
3	6359.00	1021.0	20.44	-0.7	3.0	11.9	22	6359.00	44.48142	31.92696	4
3	6359.00	1021.0	20.44	-0.7	3.0	11.9	22	6359.00	44.48142	31.92696	4
3	6360.00	1020.8	20.44	-0.5	3.0	11.9	20	6360.00	44.47692	31.92336	5
3	6361.00	1020.6	20.44	-0.4	3.0	11.9	22	6361.00	44.47152	31.91922	6
3	6362.00	1020.6	20.44	-0.4	3.0	11.9	21	6362.00	44.46684	31.91364	6
3	6363.00	1020.8	20.44	0.0	5.0	11.9	21	6363.00	44.46288	31.90590	6

The roots of event are questionable (Buoy's software? Data processing in link?)

Participation in Iridium Pilot Project

The problems with Iridium using

Mistiming of observations time

Mode	ObsTime	AP	SST	APT	SubM	UB	SBDT	GPSTime	Lat	Lon	Sat
3	6579.00	1021.3	19.56	-0.4	3.0	11.6	22	6579.00	43.85394	30.51738	7
3	6580.00	1021.4	19.56	-0.1	3.0	11.6	20	6580.00	43.84368	30.50892	7
3	6581.00	1021.5	19.48	0.2	3.0	11.6	22	6581.00	43.83432	30.49722	7
3	6582.00	1021.8	19.48	0.5	3.0	11.6	23	6582.00	43.82514	30.48426	5
3	6583.00	1022.1	19.56	0.7	3.0	11.6	22	6583.00	43.81614	30.46968	6
3	6583.75	1022.2	19.56	0.7	3.0	11.6	22	6583.75	43.80804	30.45348	6
3	6584.75	1022.2	19.56	0.4	2.0	11.6	22	6584.75	43.80102	30.43656	5
3	6585.75	1022.3	19.64	0.2	3.0	11.6	22	6585.75	43.79598	30.42018	6
3	6586.75	1022.0	19.64	-0.2	3.0	11.6	17	6586.75	43.79202	30.40398	4
3	6587.75	1022.0	19.72	-0.2	2.0	11.6	21	6587.75	43.78914	30.38778	6

The roots of event are clear (Buoy's software will be updated)

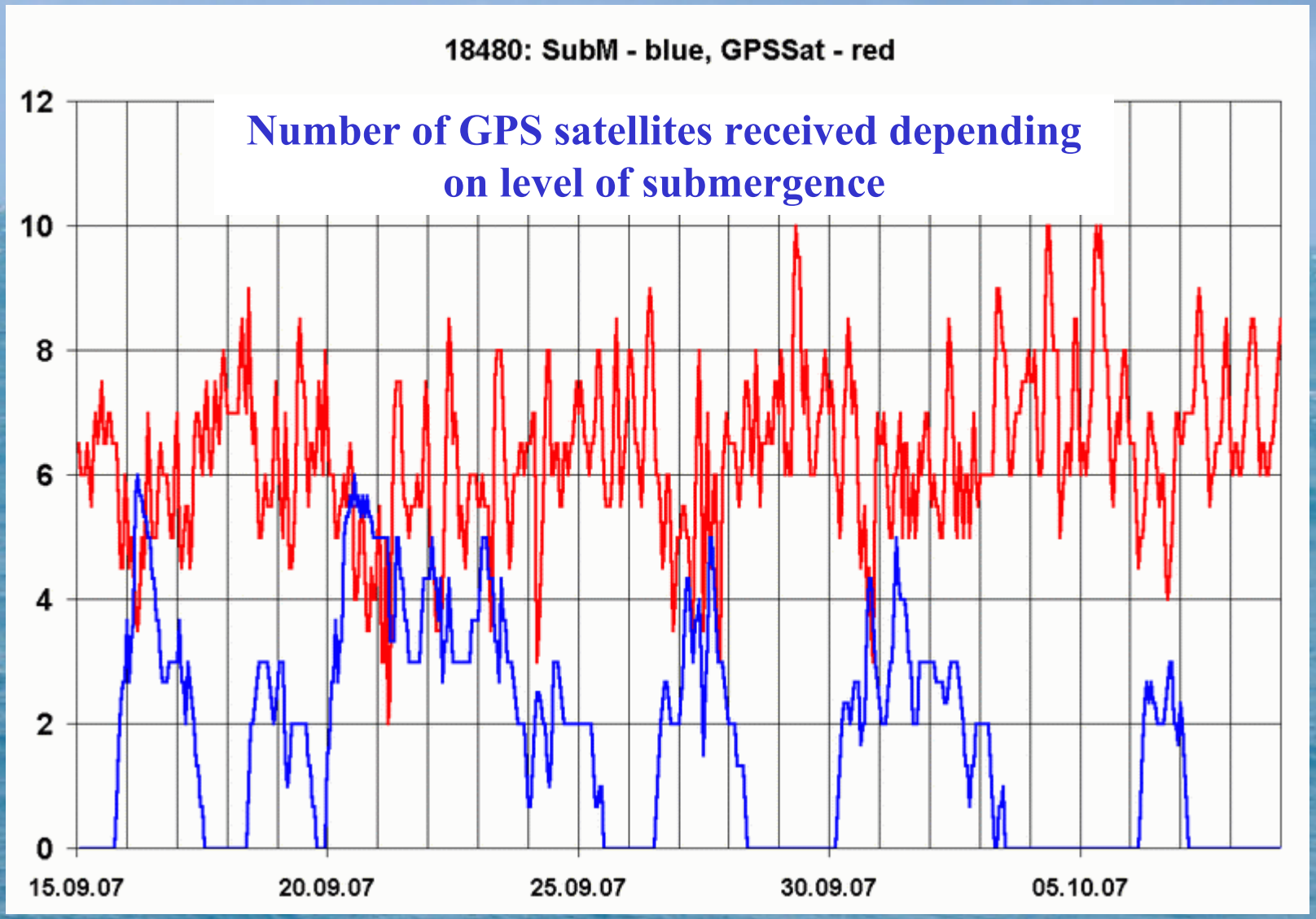
Participation in Iridium Pilot Project

The problems with Iridium using

Absence of GPS locations, when there is observation **1…3%**

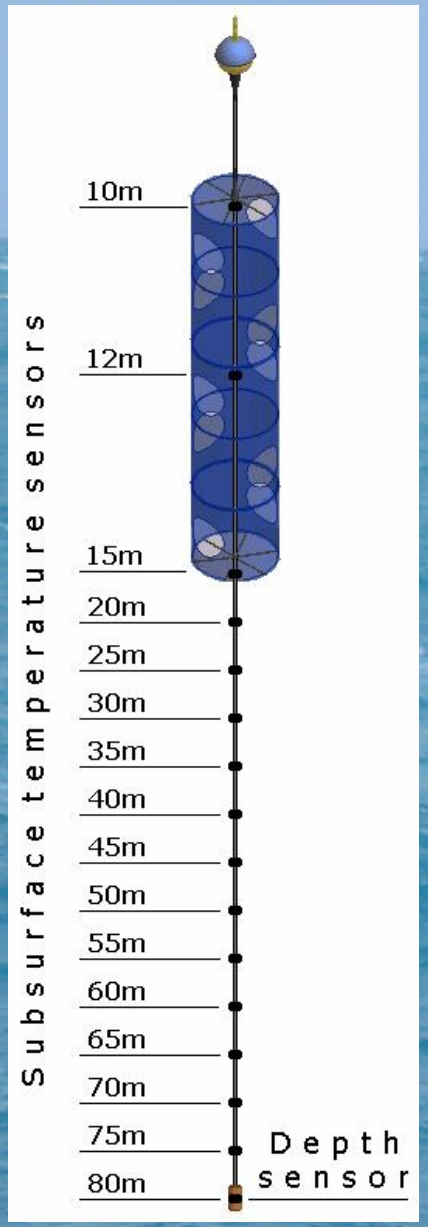
Mode	ObsTime	AP	SST	APT	SubM	UB	SBDT	GPSTime	Lat	Lon	Sat
3	6550.00	1021.3	19.72	-0.9	3.0	11.7	20	6550.00	44.00442	30.79512	6
3	6551.00	1021.2	19.64	-0.8	3.0	11.7	20	6551.00	43.99992	30.78216	5
3	6552.00	1021.1	19.64	-0.6	5.0	11.7	21	6552.00	43.99542	30.76776	3
3	6553.00	1021.1	19.64	-0.2	5.0	11.7	22	6553.00	43.99272	30.75318	6
3	6554.00	1021.4	19.56	0.2	3.0	11.7	21	0.00	-90.00000	-180.00000	1
3	6555.00	1021.5	19.56	0.4	3.0	11.7	21	6555.00	43.98714	30.72906	5
3	6556.00	1021.6	19.48	0.5	3.0	11.7	20	6556.00	43.98480	30.71844	7
3	6557.00	1021.8	19.40	0.4	2.0	11.7	20	6557.00	43.98282	30.70926	7
3	6558.00	1022.2	19.40	0.7	2.0	11.7	22	6558.00	43.98084	30.70134	6

Participation in Iridium Pilot Project



In general the roots of event are clear (It's possible a few ways for solution)

Updating of SVP-BTC 80 drifter



1. Barometric port with vertical orientation of membrane
2. Real-time clock to have samples at round hours
3. GPS receiver to increase time-spatial resolution
4. Two-message Argos format compatible with DBCP-M2 format
5. Strengthened of tether connection with hub
6. Upper and bottom rings with strengthened plastic tubes
7. Modernization of chain design

Updating of SVP-BTC 80 drifter

Argos 2-message data format

SVP-BTC80-GPS Technical file

DBCP-M2 format/28-bit ID/standard 56 bits(1st, 2nd blocks)/extra 160 bits (3rd, 4th, 5th, 6th, 7th, 8th blocks)

Format = 0 (SVP-BTC80)

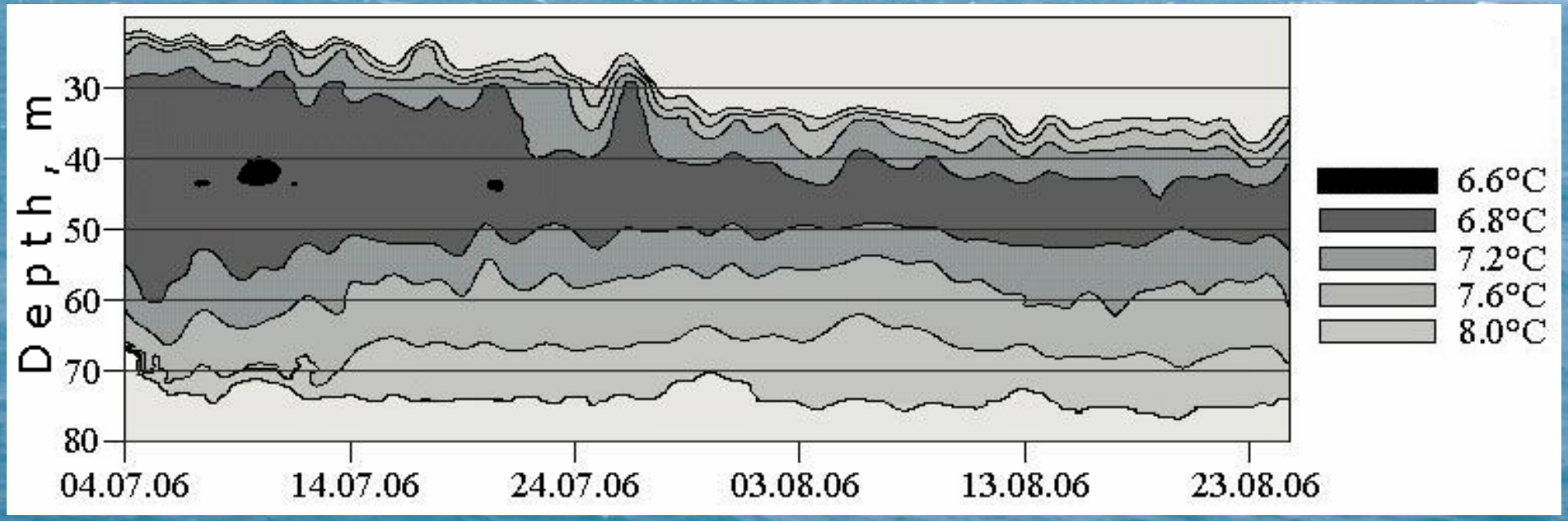
Parameter	Bits	Byte	Bits location	Argos processing	Low value		High value		Formula
					Raw	Physical	Raw	Physical	
Checksum1	8	1	0-7	A2	0		255		Lower 8 bits of the sum of bytes 2-7
Rank	4	2	8-11	A2	0		15		Rank=0,1,2
AgeB	6	2-3	12-17	A2	0	0	63	59	Age(minutes)=n
Barometric Pressure	11	3-4	18-28	A2	0	850,0	2047	1054,7	BP(hPa)=0,1n+850
Sea Surface Temp	9	4-5	29-37	A2	0	-5,0	511	35,88	SST(°c)=0,08n-5
Air Pressure Tend	9	5-6	38-46	A2	0	-25,5	511	25,6	APT(hPa)=0,1n-25,5
Sumbergence Count	6	6-7	47-52	A2	0	0	63	100	SubM(Percent)=100n/63
Battery Voltage	3	7	53-55	A2	0	7	7	14	BV(Volts)=n+7
Checksum2	8	8	56-63	A2	0		255		Lower 8 bits of the sum of bytes 9-31
Format	8	9	64-71	A2	0		255		Format=0 (SVP-BTC80)
T1	10	10-11	72-81	A2	0	-5	1023	35.92	T1(C)=0.04n-5
T2	10	11-12	82-91	A2	0	-5	1023	35.92	T2(C)=0.04n-5
T3	10	12-13	92-101	A2	0	-5	1023	35.92	T3(C)=0.04n-5
T4	10	13-14	102-111	A2	0	-5	1023	35.92	T4(C)=0.04n-5
T5	10	15-16	112-121	A2	0	-5	1023	35.92	T5(C)=0.04n-5
T6	10	16-17	122-131	A2	0	-5	1023	35.92	T6(C)=0.04n-5
T7	10	17-18	132-141	A2	0	-5	1023	35.92	T7(C)=0.04n-5
T8	10	18-19	142-151	A2	0	-5	1023	35.92	T8(C)=0.04n-5
T9	10	20-21	152-161	A2	0	-5	1023	35.92	T9(C)=0.04n-5
T10	10	21-22	162-171	A2	0	-5	1023	35.92	T10(C)=0.04n-5
T11	10	22-23	172-181	A2	0	-5	1023	35.92	T11(C)=0.04n-5
T12	10	23-24	182-191	A2	0	-5	1023	35.92	T12(C)=0.04n-5
T13	10	25-26	192-201	A2	0	-5	1023	35.92	T13(C)=0.04n-5
T14	10	26-27	202-211	A2	0	-5	1023	35.92	T14(C)=0.04n-5
T15	10	27-28	212-221	A2	0	-5	1023	35.92	T15(C)=0.04n-5
T16	10	28-29	222-231	A2	0	-5	1023	35.92	T16(C)=0.04n-5
Depth	8	30	232-239	A2	0	0	63	63	Depth(m)=n
Unused	8	31	240-247						
Total	248								

Format = 1 (SVP-B-GPS)

Parameter	Bits	Byte	Bits location	Argos processing	Low value		High value		Formula
					Raw	Physical	Raw	Physical	
Checksum1	8	1	0-7	A2	0		255		Lower 8 bits of the sum of bytes 2-7
Rank	4	2	8-11	A2	0		15		Rank=0,1,2
AgeB	6	2-3	12-17	A2	0	0	63	59	Age(minutes)=n
Barometric Pressure	11	3-4	18-28	A2	0	850,0	2047	1054,7	BP(hPa)=0,1n+850
Sea Surface Temp	9	4-5	29-37	A2	0	-5,0	511	35,88	SST(°c)=0,08n-5
Air Pressure Tend	9	5-6	38-46	A2	0	-25,5	511	25,6	APT(hPa)=0,1n-25,5
Sumbergence Count	6	6-7	47-52	A2	0	0	63	100	SubM(Percent)=100n/63
Battery Voltage	3	7	53-55	A2	0	7	7	14	BV(Volts)=n+7
Checksum2	8	8	56-63	A2	0		255		Lower 8 bits of the sum of bytes 9-18
Format	8	9	64-71	A2	0		255		Format=1 (SVP-B-GPS)
Year	4	10	72-75	A2	0	2005	15	2020	UT Year = n+2005
Month	4	10	76-79	A2	0	1	15	12	UT Month = n
Day	5	11	80-84	A2	0	1	31	31	UT Day = n
Hour	5	11-12	85-89	A2	0	0	31	23	UT Hour = n
Minute	6	12	90-95	A2	0	0	63	59	UT Minute = n
Second	6	13	96-101	A2	0	0	63	59	UT Second = n
Latitude	21	13-16	102-122	A2	0	-90	2097151	90	Latitude(deg)=0,0001n-90
Longitude	22	16-19	12--144	A2	0	0	4194303	359,9999	Longitude(deg)=0,0001n
GPSSatNum	4	19	145-148	A2	0	0	15	15	Number of GPS satellites
Unused	99	19-31	149-247	A2	0		0		Unused bits (always zero)
Total	248								

Updating of SVP-BTC 80 drifter

Isotherms near Cold Intermediate Layer in the Black Sea



Basic results in 2007

1. Multifunctional Argos PTT allows to widen areas of the system applications (e.g. more space-time resolution of measurements)
2. Real-time clock provides samples at round hours independently of activation time during full lifetime of a buoy
3. Argos tester is the device with flexible capabilities for variety of user's needs.
4. Reliability of temperature-profiling drifters is increased to have longer lifetime.
5. Theoretical lifetime and abilities of Iridium drifters, equipped with GPS is comparable with Argos similar buoys.
6. Evaluation of new Argos as well as Iridium drifters in-situ shows effectiveness of novelties developed.
7. However, there a few things that need deeper evaluation (e.g. double Iridium messages, wrong GPS locations, etc.).