Development and evaluation of Iridium SVP-B mini and other versions of drifters

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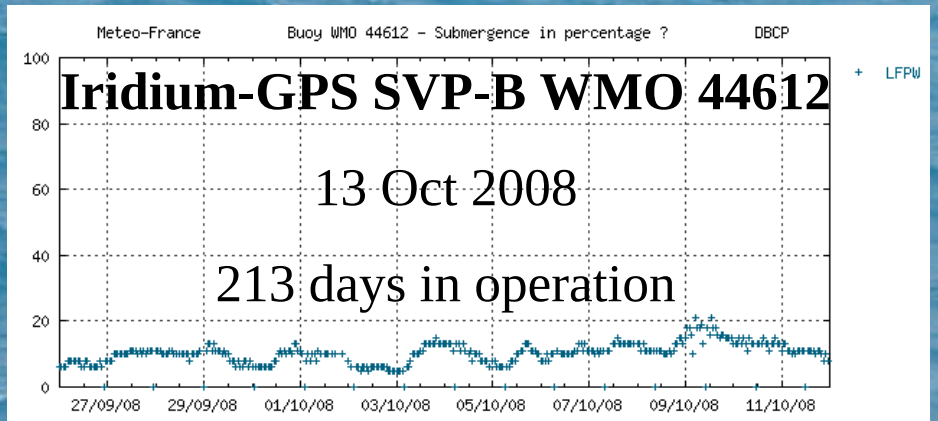
The jobs to be completed according to the 2008 DBCP Workplan

1. **Participation in the Iridium Pilot Project**
2. **Approach to drifter to be deployed from 20m height, when ship has 25 knots speed**
3. **Development and evaluation of new drifters**

The smaller buoy, the easier way to be automatically deployed

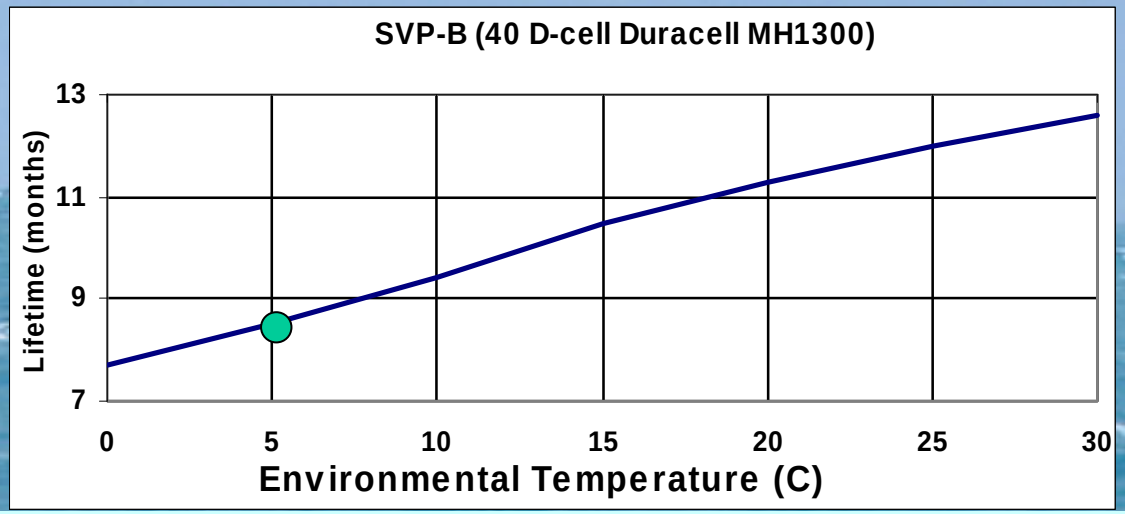


The parameters of first prototype of Iridium SVP-B mini drifter

- 34-cm float, 61-cm drogue, 0.4cm OD tether
- Drag area ratio on level of 40
- Modified barometric port with vertical membrane
- Iridium modem 9601-D, MM400 measuring module and MT9601 matching unit with Trimble Lassen iQ GPS receiver
- 5*8 =40 D-cell Alkaline-Manganese Dioxide Batteries
- Hourly samples of AP, APT (as for 3 hours ago), SST, BV, Subm and GPS fixes.
- Version 3.0 of Iridium data transmission format
- Switching ON 20 min before round hour
- 12 months theoretical lifetime if mean SST ~ 20°C.

The results of SVP-B mini buoy evaluation

(Drake Strait 2.12.07 – 10.08.08)



- 252-day lifetime, when mean SST ~ 5°C
- Drogue was lost on 132 day
- According to the ECMWF the AP RMS ~ 0.8 hPa without fallings or scattering of AP data
- Similar for SST the RMS ~ 0.4°C
- Iridium provided continuous set of hourly samples
- GPS provided fixes if submergence was smaller than ~15%

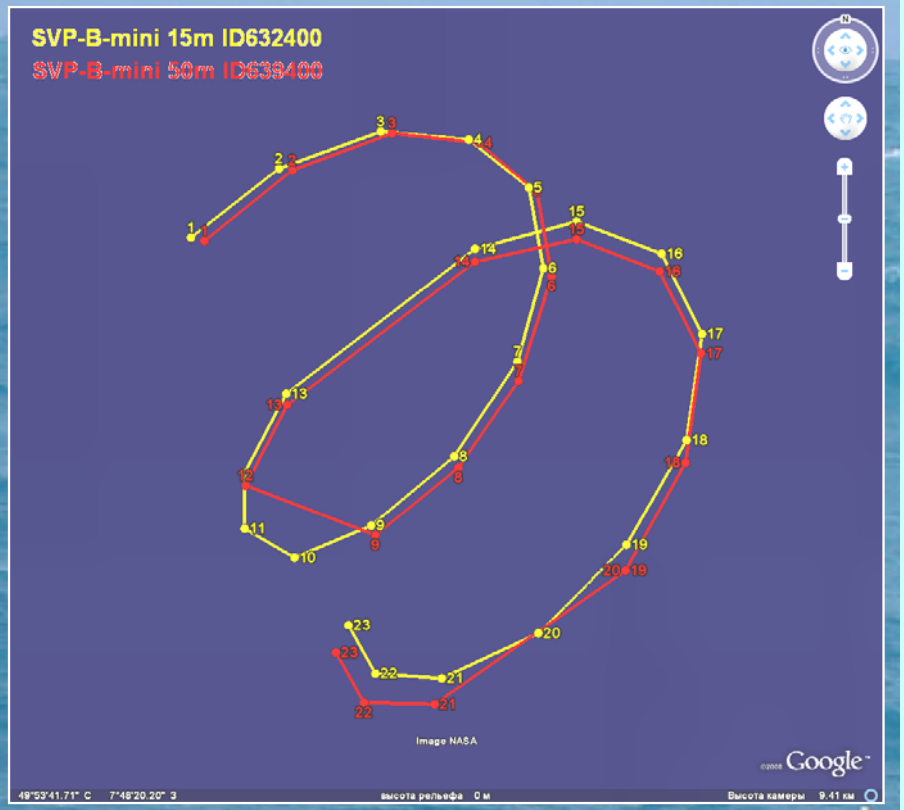
SVP-B mini drifter can be a reliable tool

The results of the experiment to be updated for second prototype

- Absence of hourly observation took place sometimes
- Doubled SBD sessions took place sometimes
- Necessity to switch on a buoy 20 minutes before round hour
- Absence of fresh GPS locations if level of submergence > 15%
- Absence of old fixes in data if no fresh locations
- It would be desirable to have longer lifetime

Creation and testing of SVP-B mini of second prototype

2 buoys for SAMS with 15 and 50-m drogues



Novelties

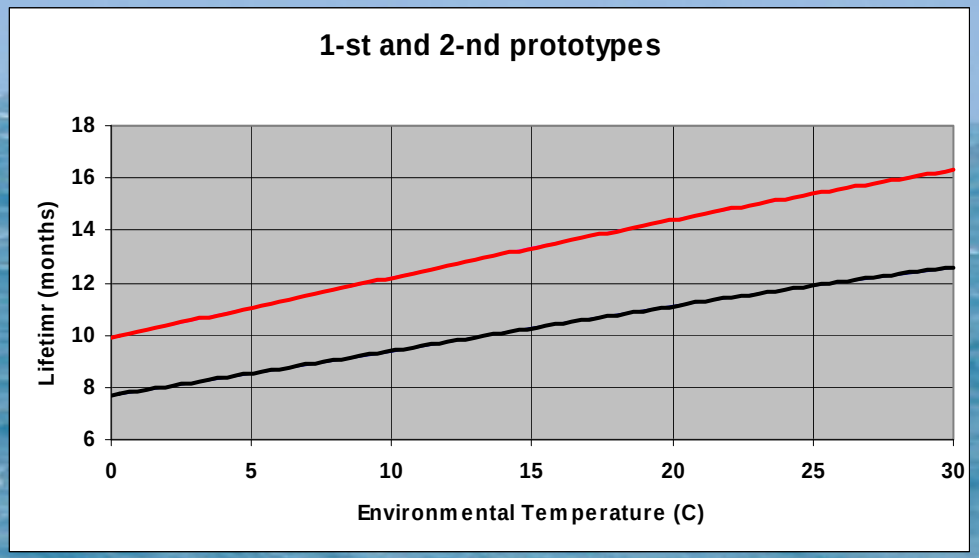
- Old GPS fixes put in data if not fresh ones
- RTC with GPS synchronization is used for samples at round hours

Advantages

- Meteorology according to the WMO requirements
- Oceanography- good tool for study of shear currents (the fixes at same time – no interpolation)

Further improvement of second prototype of SVP-B mini drifter

5 buoys for Meteo-France



- 6*7 =42 D-cell Alkaline-Manganese Dioxide Batteries
- Updating on-board software
- Longer lifetime (+30%)
- Version 3.2of Iridium data transmission format
- Elimination of multiple hourly reports sent via Iridium;
- Disposition of Iridium and GPS antennas at the top of float

Argos drifter and data timeliness as for round hour (fragment of data from Caspian buoy)

UTC	Delay due to switch on (min)	Time of samples	No. Sat	Satellite (Receiving station)	Delay due to passes (min)	Total delay (min)	Locations
00:00	18	0:18	K L	0:27 1:15	9 57	27* 75	+ +
01:00	18	1:18	K	2:12	54	72	+
02:00	18	2:18	L	3:00	42	60	+
03:00	18	3:18	-	-	-	-	-
04:00	18	4:18	-	-	-	-	-
05:00	18	5:18	M A	5:18 5:27	0 9	18* 27	- +
06:00	18	6:18	M A	6:57 7:12	39 54	57* 72	- +
07:00	18	7:18	N	8:06	48	66	+
08:00	18	8:18	-	-	-	-	-
09:00	18	9:18	N	9:40	22	40	-
10:00	18	10:18	L	11:06	48	66	+
Mean delay (if 2 or more passes took place, the time of first delay having the sign * was used for processing)						50	

Disadvantages of Argos drifter without RTC

- Total delay depends on two components: time of activation and time of satellite pass
- Delay due to the time of activation has fixed value within interval from 0 to 59 min. This delay is quasi-constant during full lifetime
- Delay due to the time of satellite pass can vary from zero to 59 minutes for buoy with hourly samples
- Total delay can vary from 0 to 120 minutes
- There are samples, which cannot be sent to a user within one-hour interval, because of feature of satellite passes
- Sometimes, the data of same hourly sample are twice (three times) re-transmitted with different satellites

Argos RTC drifter and data timeliness as for round hour (fragment of data from BOM buoy)

UTC	Delay due to switch on (min)	Time of samples	No. Sat	Regional receiving station	Delay due to passes (min)	Total delay (min)	Locations
00:00	0	00:00	N	00:25	25	25	+
01:00	0	01:00	-	-	-	-	-
02:00	0	02:00	N K	02:05 2:25	5 25	5 25	+ +
03:00	0	03:00	-	-	-	-	-
04:00	0	04:00	K L	04:05 04:34	5 34	5 34	+ +
05:00	0	05:00	K	05:50	50	50	-
06:00	0	06:00	A M	06:19 06:40	19 40	19 40	+ -
07:00	0	07:00	-	-	-	-	-
08:00	0	08:00	A M N	08:02 08:20 08:37	2 20 37	2 20 37	+ - -
09:00	0	09:00	A	09:41	41	41	+
10:00	0	10:00	M N	10:02 10:11	2 11	2 11	+ +
Mean delay (if 2 or more passes took place, the time of first delay having the sign * was used for processing)						19	

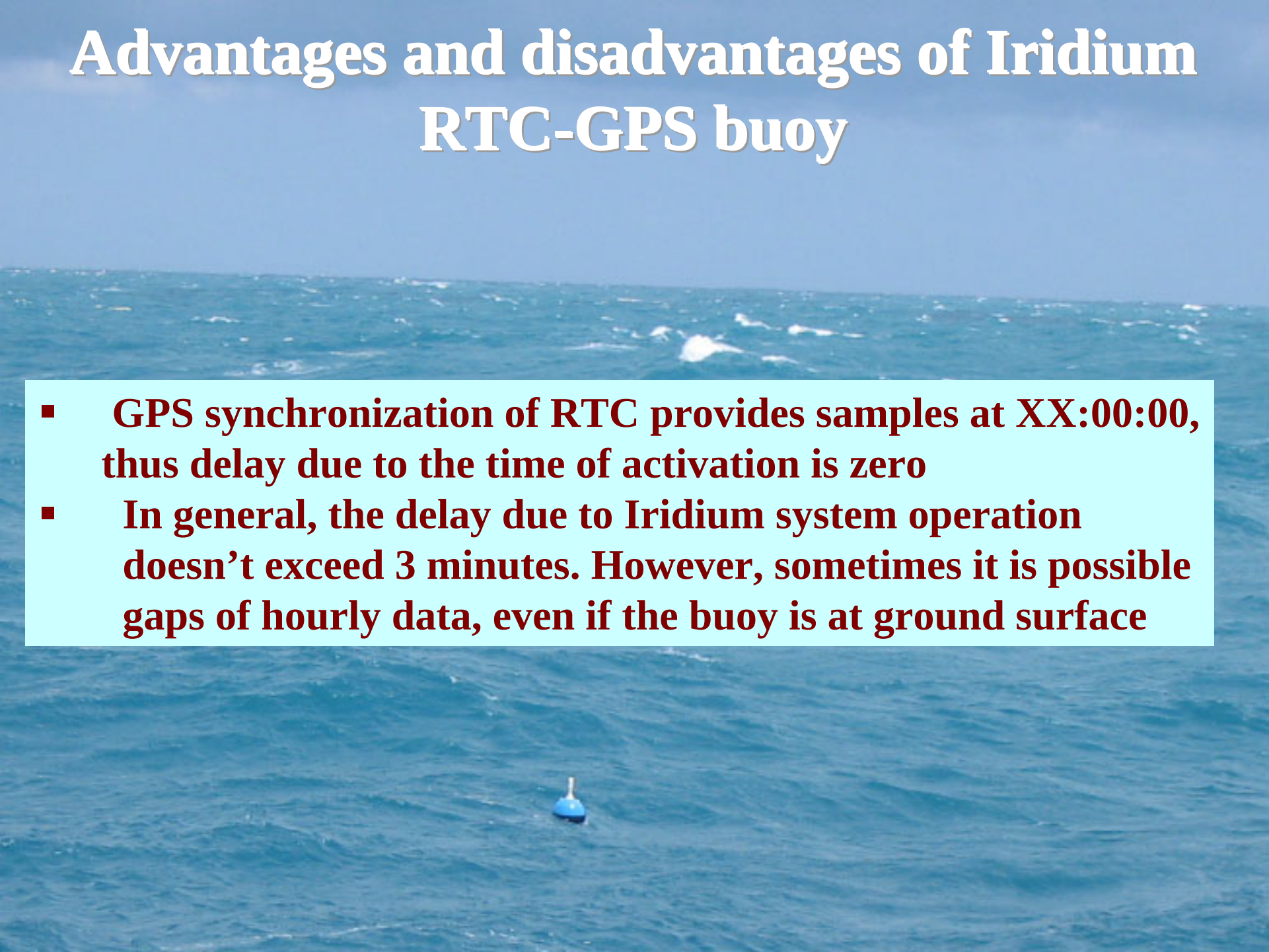
Advantages and disadvantages of Argos buoy with RTC

- Delay due to the time of activation is zero
- Delay due to the time of satellite pass continues to be from zero to 59 minutes
- Total delay for this buoy depends on one component only: time of satellite pass and cannot be larger than 60 minutes

Iridium RTC-GPS buoy and data timeliness as for round hour (fragment of data from Meteo-Fr. buoy)

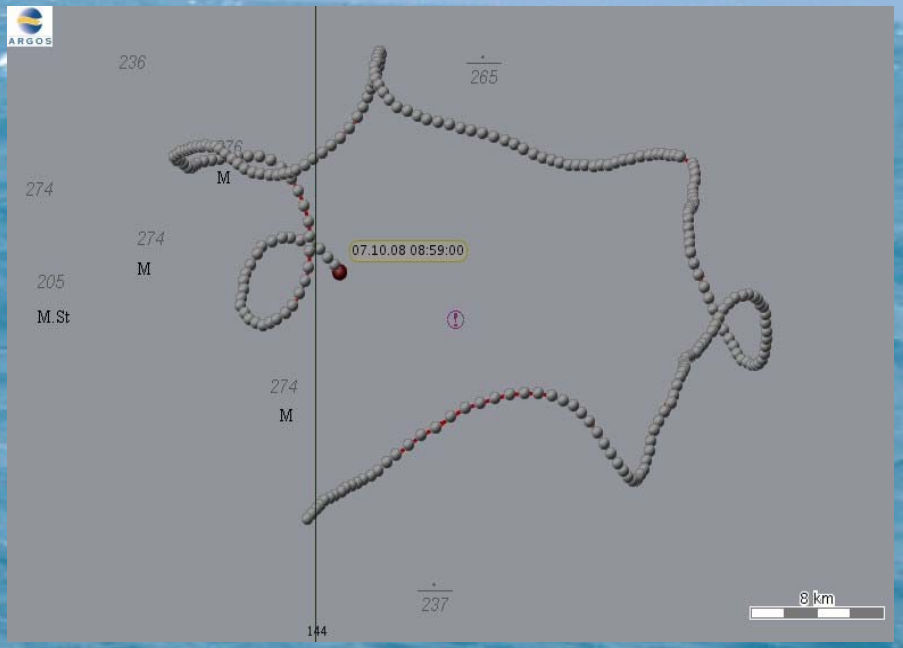
GMT	Delay due to switch on (sec)	Time of samples	Delay in system (mm:ss)	Total delay (mm:ss)	Locations
00:00:00	0	00:00:00	02:09	02:09	+
01:00:00	0	01:00:00	01:22	01:22	+
02:00:00	0	02:00:00	01:22	01:22	+
03:00:00	0	03:00:00	01:49	01:49	+
04:00:00	0	04:00:00	01:18	01:18	+
05:00:00	0	05:00:00	01:23	01:23	+
06:00:00	0	06:00:00	02:06	02:06	+
07:00:00	0	07:00:00	01:18	01:18	+
08:00:00	0	08:00:00	01:17	01:17	+
09:00:00	0	09:00:00	01:15	01:15	+
10:00:00	0	10:00:00	01:25	01:25	+
			Mean delay	01:31	

Advantages and disadvantages of Iridium RTC-GPS buoy

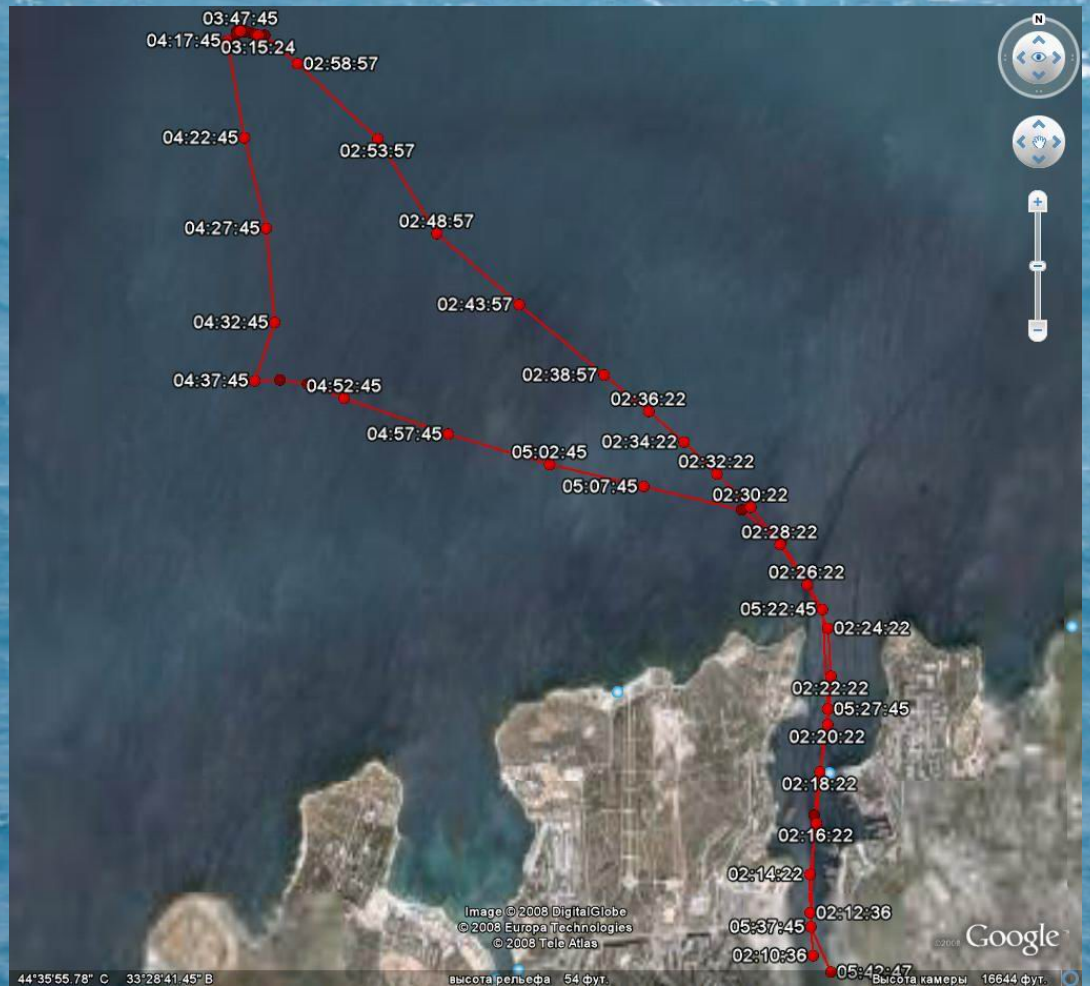


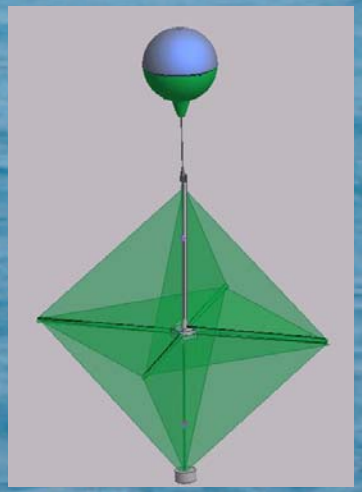
- GPS synchronization of RTC provides samples at XX:00:00, thus delay due to the time of activation is zero
- In general, the delay due to Iridium system operation doesn't exceed 3 minutes. However, sometimes it is possible gaps of hourly data, even if the buoy is at ground surface

Development of Argos-GPS marker for ice tracing



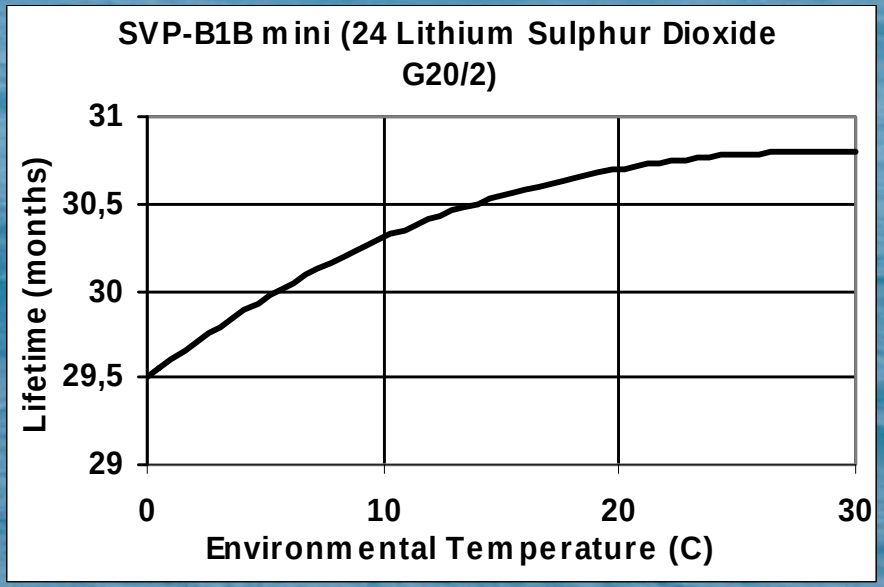
Development of coastal drifters equipped with GSM modems and GPS receivers





Next efforts 1

- **Evaluation of the second prototype of Iridium buoys (Meteo-France) operation in-situ**
- **Using of Lithium batteries instead of alkaline ones. Lifetime should be up to 30 months with small dependence as for environmental temperature**



Next efforts 2

- Using of new materials for increasing of reliability of drogue connection with tether to have the drogue longer attached
- Deployment in the Black Sea under E-Surfmar support two SVP-BTC temperature profiling drifters in version: Iridium-GPS-RTC
- Development and evaluation fixing capabilities of new GPS receivers with higher sensitivity and faster building of almanac
- Discuss a Rank integration to the Version 3.2 data format to avoid gaps of hourly samples and keep a continuity of data
- Discuss an using of BV=5+0.2*n equation for data transfer via Iridium

Conclusions

1. First prototype of Iridium GPS SVP-B mini drifter showed good reliability of AP samples during full lifetime of buoy
2. Lifetime of second prototype is near 30% longer in contrast with buoy of first prototype
3. RTC allows to have measurements at round hours and improve data timeliness for Argos as well for Iridium
4. Most effective is RTC, which has GPS synchronization with Greenwich time
5. Iridium drifters equipped with RTC-GPS synchronization have small delay when data transfer from buoy to operator
6. Essential increasing of the buoy lifetime can be achieved if lithium batteries are used instead alkaline ones
7. Iridium GPS-RTC mini drifter can be an unified platform for long meteorological and oceanographic investigations in the Ocean


Thanks