

Features of GPS use on Argos-2 and Iridium telemetry equipped drifters

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Aim of the study (2006 – 2013):

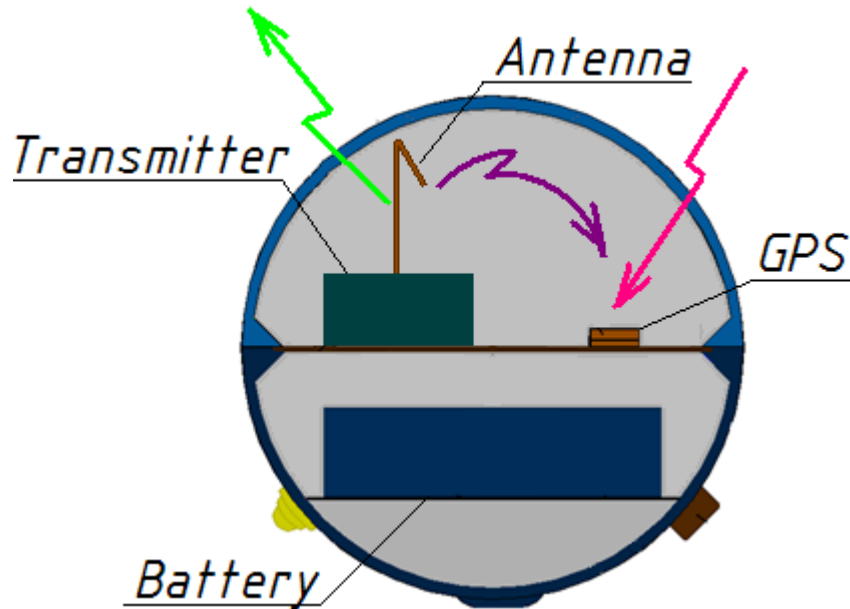
Increasing of spatio-temporal resolution, when use of long-living barometric drifters

Tasks of the study:

- 1. Determination of the reasons, which restrain use of GPS on drifters.**
- 2. Development and evaluation in-situ of the drifters, producing hourly GPS fixes and equipped with Argos-2 and Iridium telemetry.**
- 3. Determination of capabilities of different drifters under variety of environmental weather conditions.**

The reasons, which restrain use of GPS on drifters

1. Radio-compatibility of emitting telemetry transmitter with GPS receiver, mounted together in small float



Issue

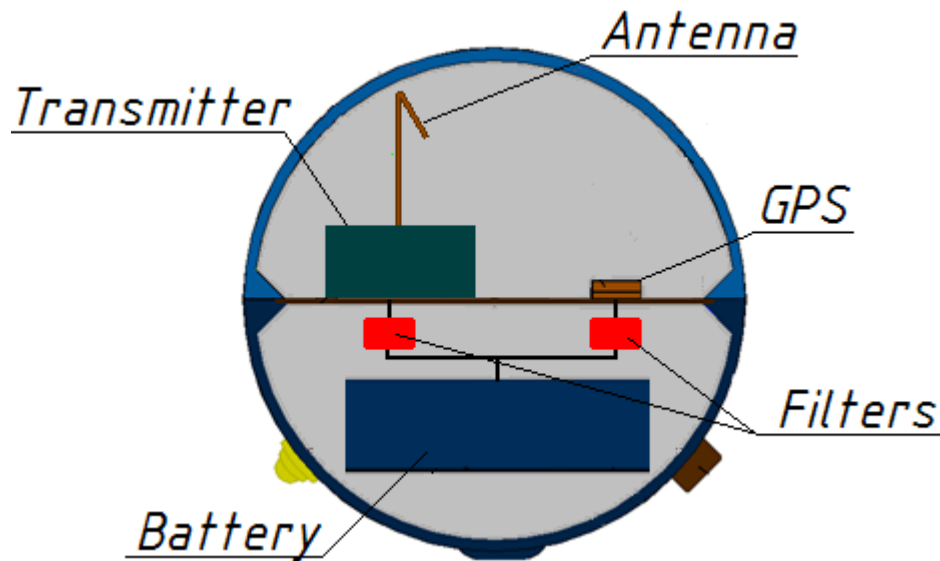
Damage of GPS's preamplifier because of influence of emitting transmitter

Solution

1. Use of GPS with protected front-end.
2. Optimal location of both antennas

The reasons, which restrain use of GPS on drifters

2. Electro-compatibility of telemetry transmitter with GPS receiver, when both have power supply from common battery



Issue

Damage of GPS's power supply electronics, when voltage jumps take place because of emitting antenna mismatch during submergence of buoy

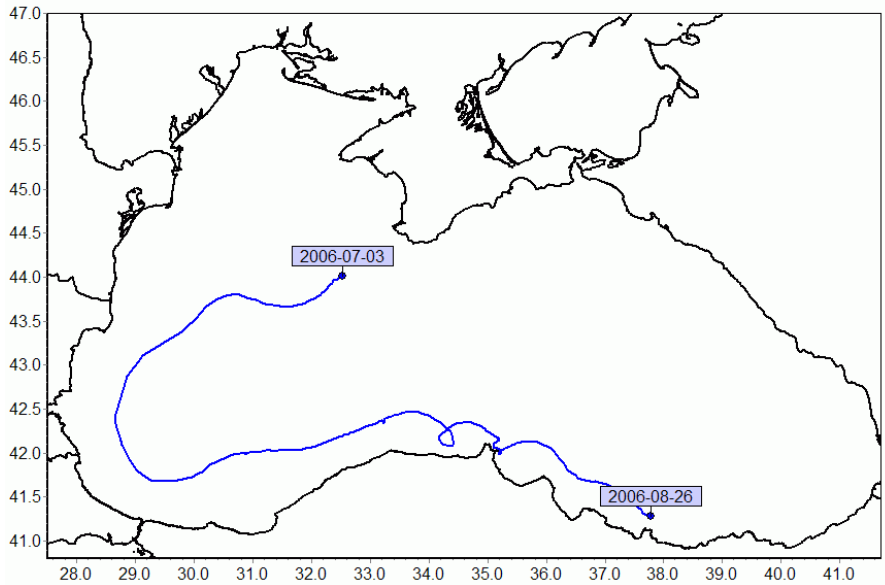
Solution

Better electrical filtration of power supply circuits for transmitter and GPS receiver

The reasons, which restrain use of GPS on drifters

3. Large power consumption of GPS, even if energy-conserving receiver is used

Near 2 months only operation of first Argos-2/GPS drifter in the Black Sea (2006)



Issue

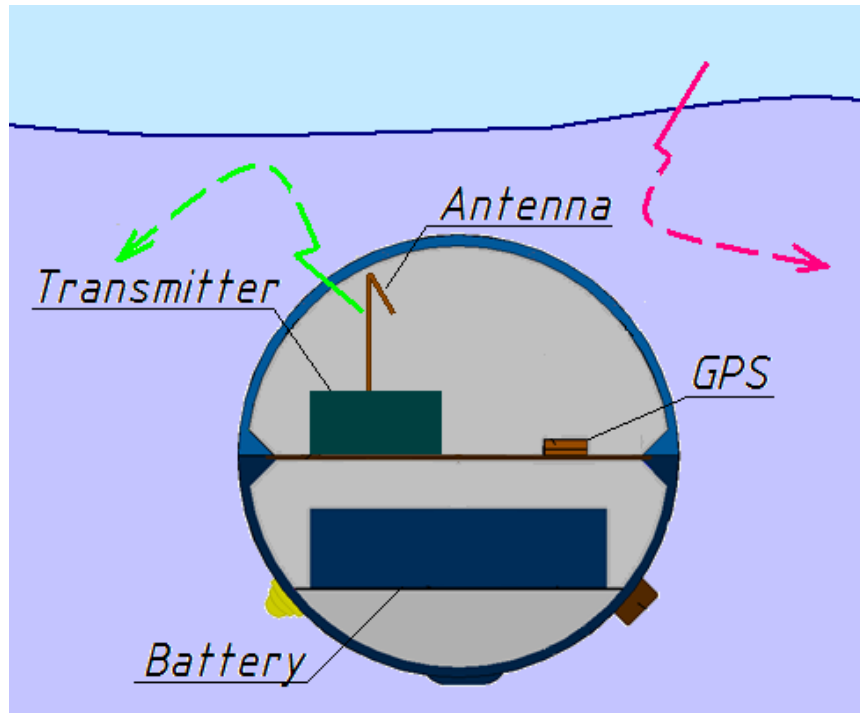
To keep continuity of GPS fixes when rough weather conditions take place, the GPS should be switched on continuously that is a reason for shortened lifetime.

Solution

Discontinuous duty cycle mode for GPS receiver

The reasons, which restrain use of GPS on drifters

4. Submergence of buoy, when there are not radio contacts between buoy and both satellite constellations



Issue

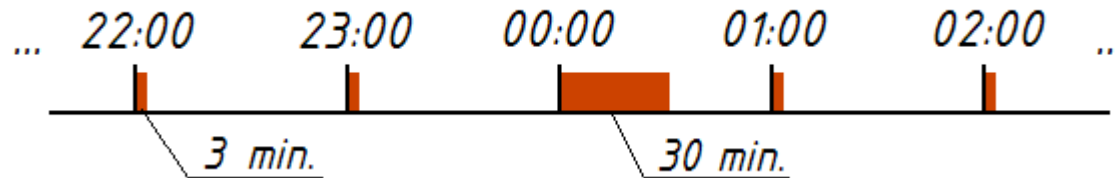
Decreasing of efficiency of GPS used under discontinuous duty cycle mode

Solution

Use of GPS receiver with fast recover time and controlled discontinuous duty cycle mode depending on the level of submergence

Fixed discontinuous duty cycle mode and types of drifters

(all the buoys had RTC to get samples and GPS fixes at round hours)



Micro buoy with 20-cm OD hull

Ice/Marine Parachute



Ice/Baro



SVP(B) mini, 34-cm OD hull

Tristar (1m)



Holey Sock (15m)



SVP(B) standard, 41-cm OD hull

Holey Sock Drogue (15m)



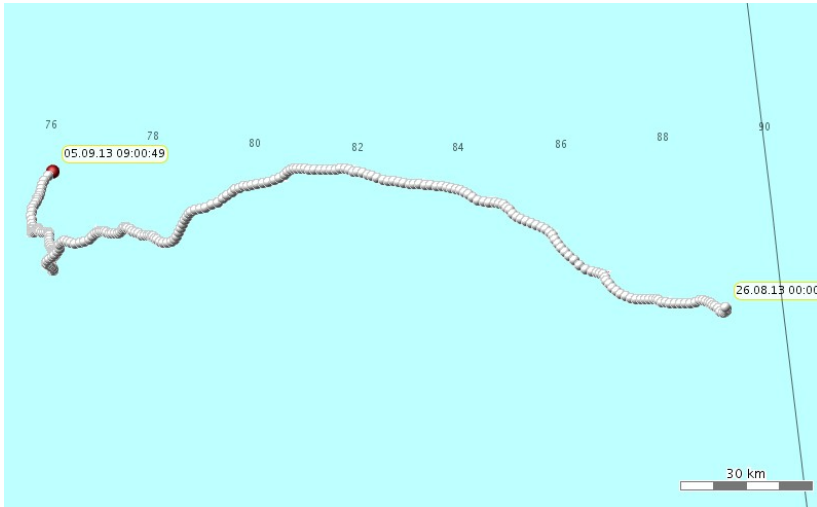
80-m thermistor chain below drogue



Perfect continuity of GPS fixes for Argos-2/GPS buoys, which do not have or have small level of submergence

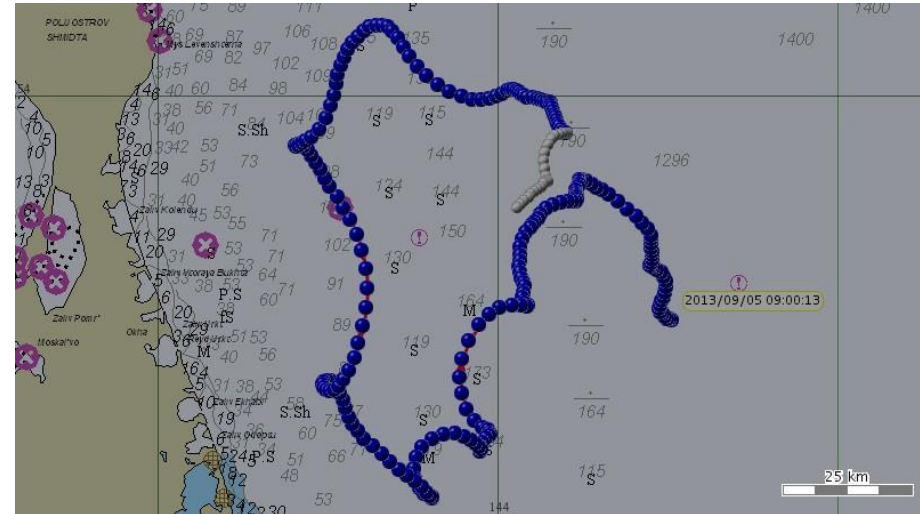
**Argos-2/GPS micro buoys,
used for ice and sea
application**

**(6-month lifetime with
hourly fixes in polar areas)**



**Argos-2/GPS SVP(B) mini
drifter with Tristar drogue at
1-m depth**

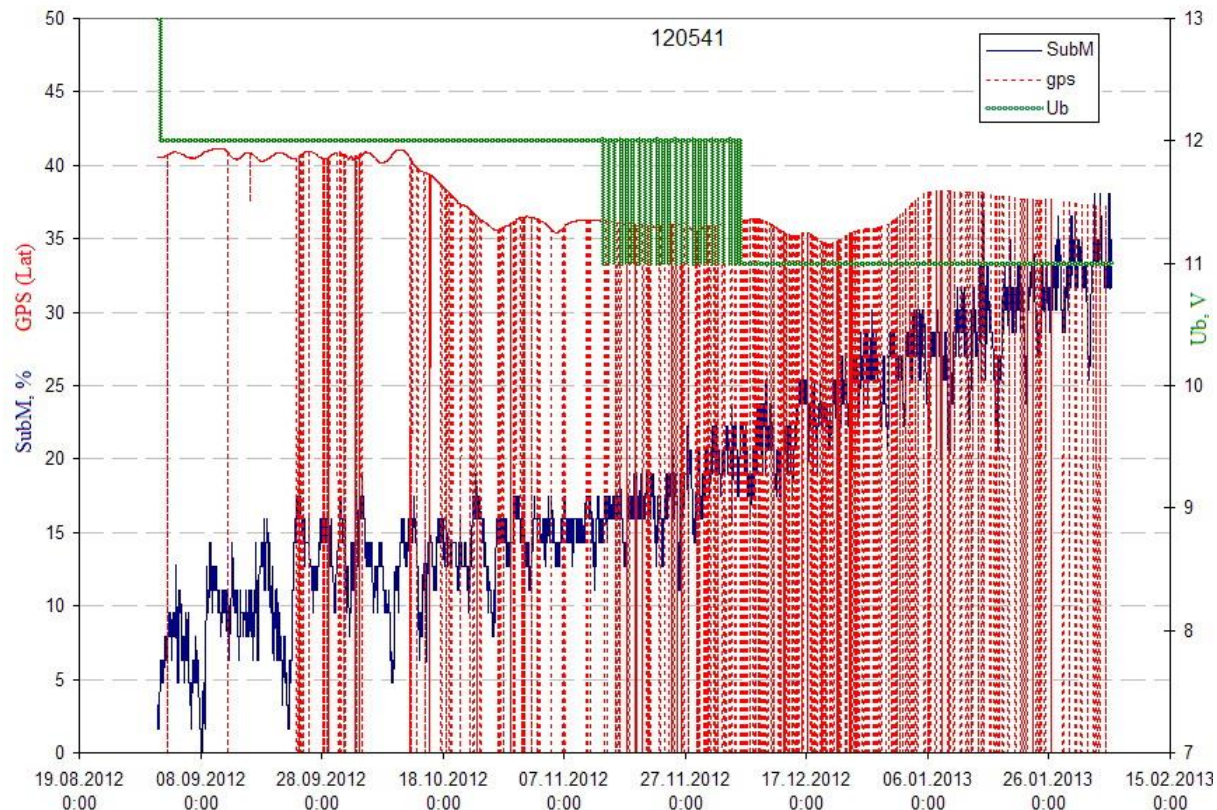
**(18-month lifetime at least with
hourly fixes)**



Limited continuity of GPS fixes for Argos-2/GPS SVP(B) mini drifter, equipped with Holey-Sock drogue at 15-m depth

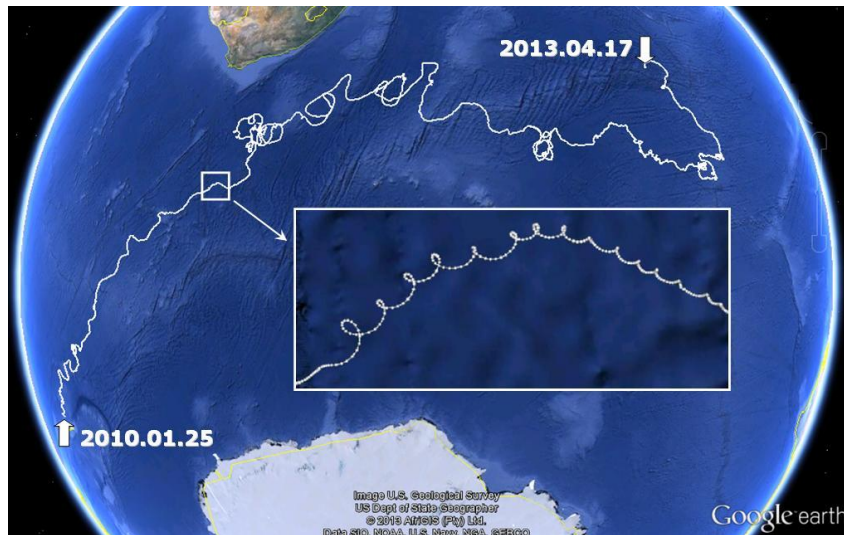
Reasons to be limited:

- 1. Worsening of continuity, when SubM > 15%.**
- 2. Getting more submergence because of biology fouling of drogue, when float with limited reserve of positive buoyancy cannot compensate additional sinking force.**

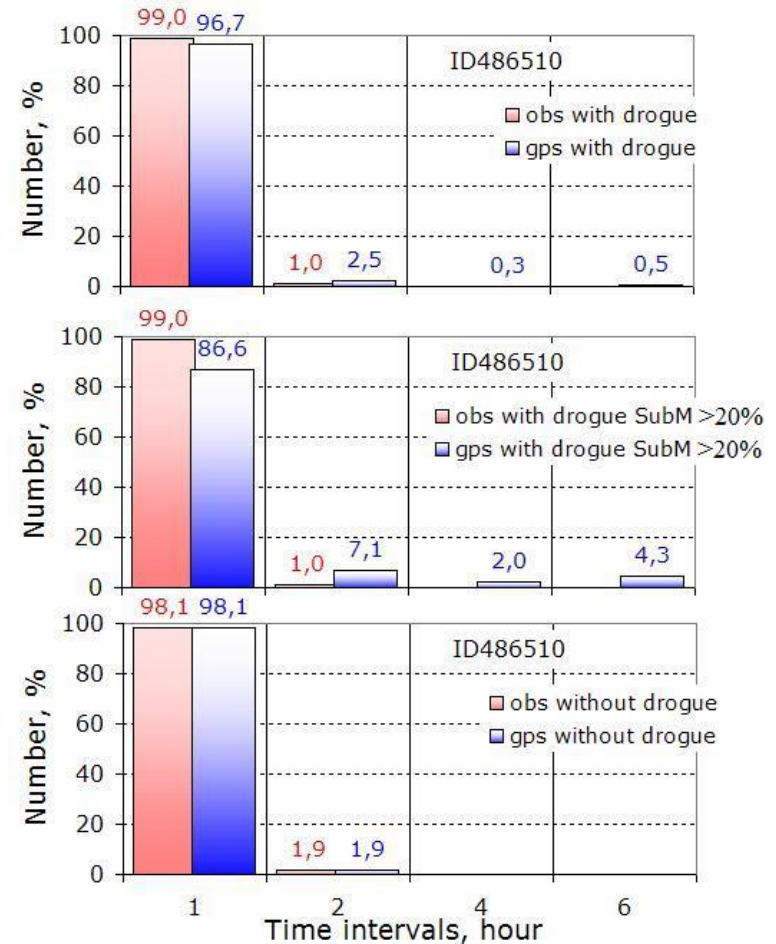


Iridium SVP-B/RTC/GPS standard drifter with Holey-Sock at 15-m depth

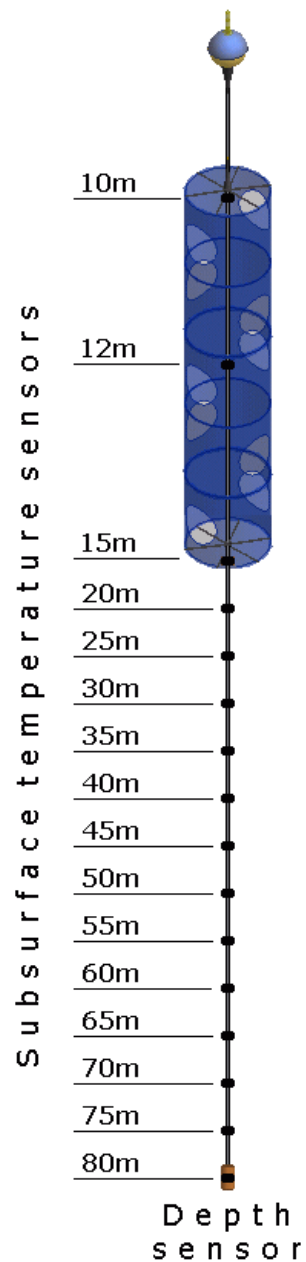
1250-day track with hourly GPS fixes in South Ocean under rough weather conditions



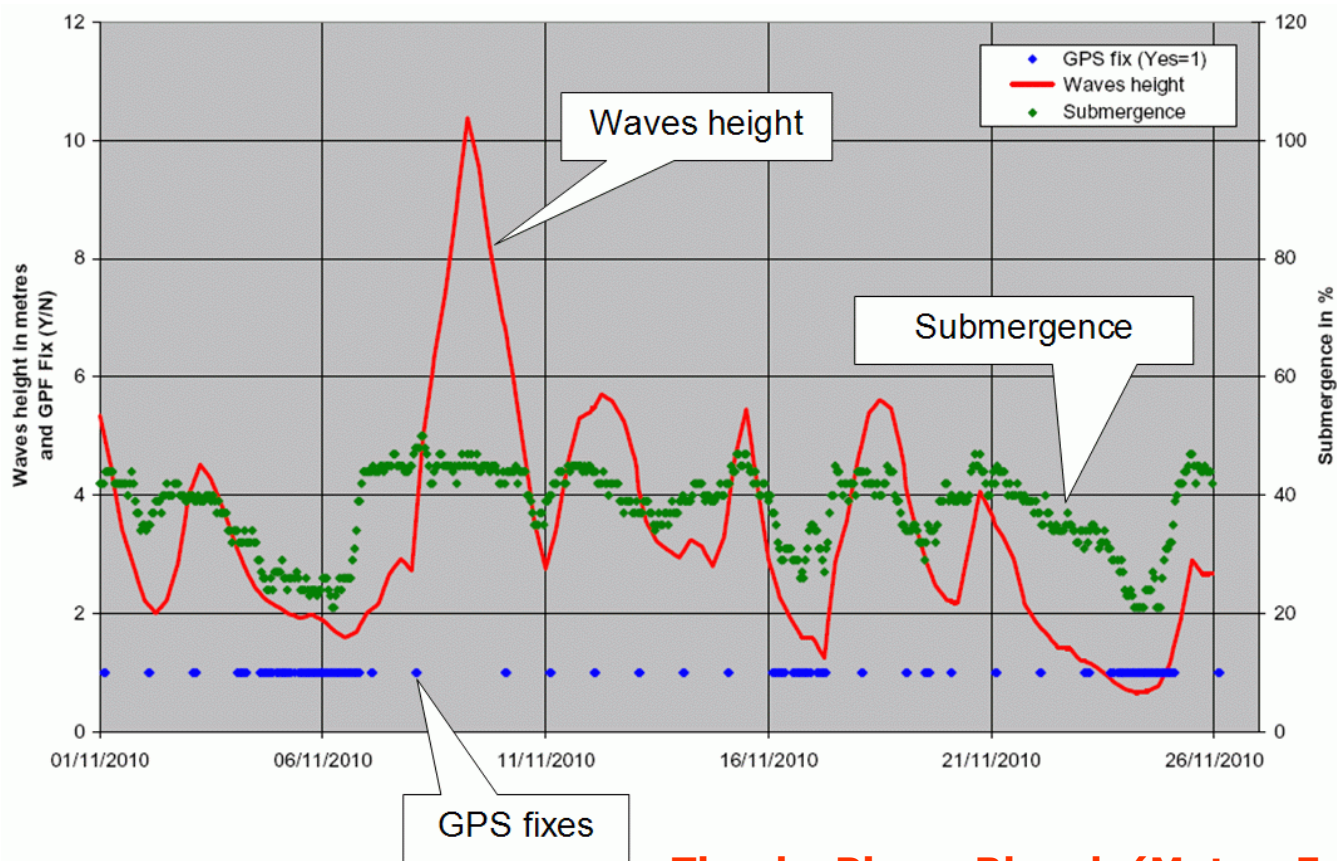
Continuity of hourly samples and GPS fixes



Iridium SVP-BTC80/RTC/GPS drifter with Holey-Sock and thermistor chain

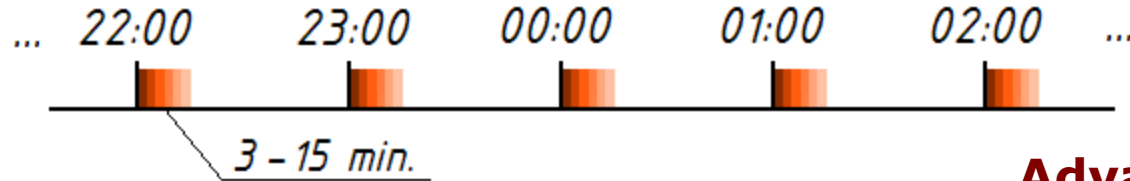
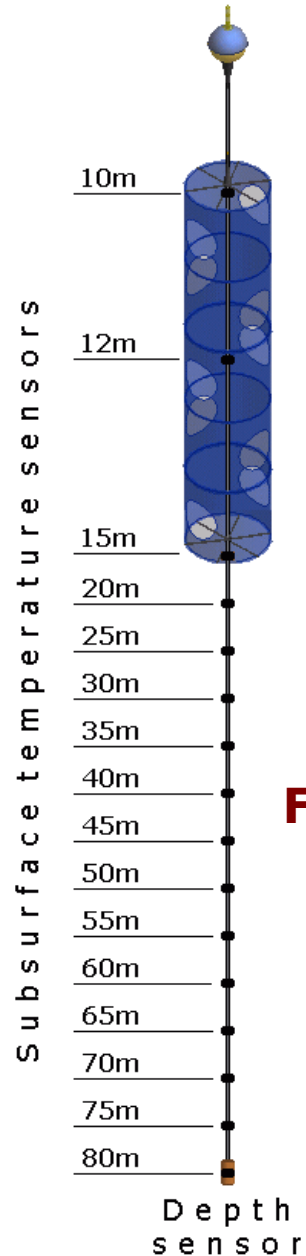


Continuity of hourly GPS fixes is lost, when wave's amplitude reaches 3-m height (Subm >30%)

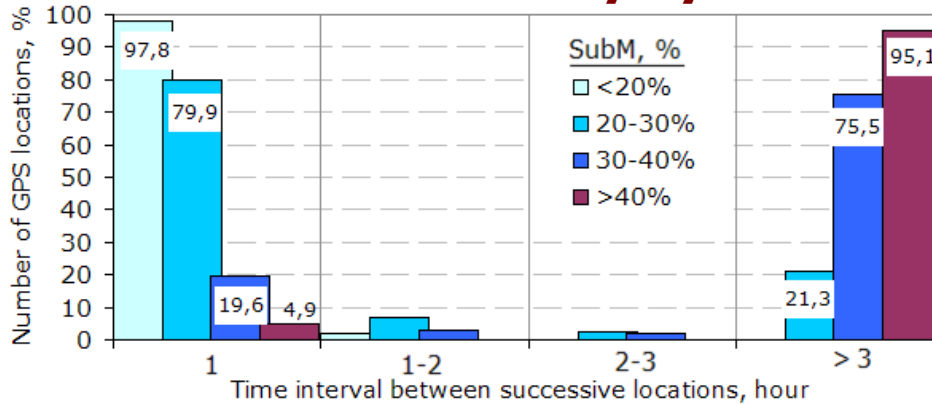


Thanks Pierre Blouch (Meteo-France), who built this graph

Flexible vs fixed discontinuous duty cycle modes for 2 buoys, deployed in the South Ocean



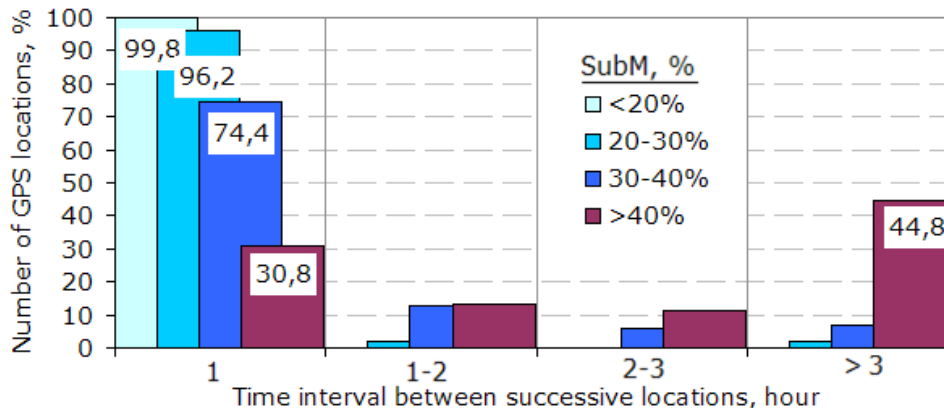
Fixed discontinuous duty cycle mode



Advantage of flexible mode

Subm	Hourly fixes
<20%	+2%
20-30%	+20%
30-40%	3.8 times more
>40%	6.3 times more

Flexible discontinuous duty cycle mode

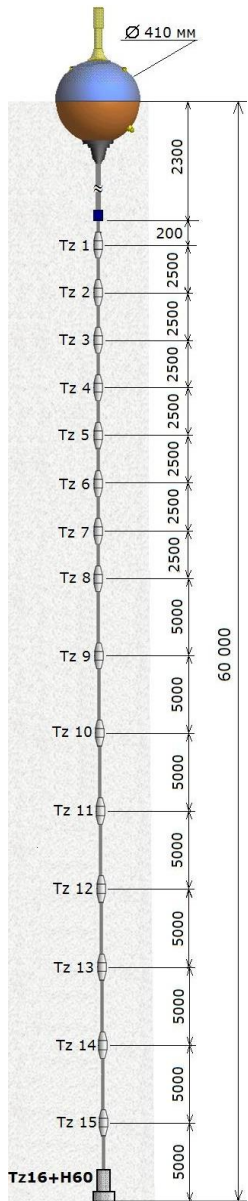


Disadvantage of flexible mode

10-50% shortened lifetime depending on the level of subm.

Advantage of the flexible discontinuous duty cycle mode for ice buoy with thermistor chain without submergence

One year in operation (Sep.4, 2012 – Aug.24, 2013) in Arctic with alkaline batteries and hourly GPS fixes



Conclusion

- 1. New technical solutions and methods to control power supply allow building of GPS equipped long-live drifters, having reliable continuity of locations under rough weather conditions.**
- 2. Argos-2/GPS ice buoys, floats without drogue or having Tristar drogue at small depth keep continuity of hourly locations during full lifetime.**
- 3. Argos-2/GPS SVP(B) mini drifters with Holey Sock drogue at 15-m depth have limited applications for GPS tracking because of loss of locations, when waves have 3-4 m height at least, as well as increased submergence as a result of biology fouling.**
- 4. Iridium/GPS SVP(B) standard drifters are the perfect tool, which keeps continuity of hourly locations under any weather conditions during 3-year lifetime at least.**
- 5. Iridium/GPS SVP-BTC80 drifters with thermistor chains keep continuity of hourly locations except extremely rough weather conditions, when height of wave is higher of 6-8 meters with fast restoration of tracking capabilities, when height of waves become smaller.**

11-page article on this issue in the 2013 DBCP Workshop proceedings

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Introduction

Modern GOOS needs more and more in the results of environmental study with increased spatio-temporal resolution that includes surface and subsurface currents, sea surface temperature with high resolution (HRSST), vertical and horizontal heat exchange and so on.

One of the main parameters is the continuity of data, or in other words, all the samples, gathered by data platforms shall be delivered to users without loss. Moreover, each sample has to be connected with the point, where the measurements are carried out.

Additional requirement is the lifetime of autonomous data platforms and first of all this requirement is valid for drifting buoys, which are today main tool for both applications: oceanography and hydrometeorology in the open Ocean. In spite of increased power consumption, because new types of drifters are equipped with new sensors and more data have to be gathered and transferred, the efforts of designers directed on creation of the drifters, which shall provide long term reliable operation in-situ with higher spatial-temporal resolution.

A wide-angle photograph of the ocean under a bright blue sky filled with fluffy white clouds. The water is a deep blue-green color with gentle waves and white foam from a boat's wake visible in the foreground. The horizon line is straight and divides the image roughly in half.

Thanks for your attention