The technical developments in 2009-2010 according to the DBCP Pilot Projects Plans

Lunev E., Motyzhev S., Tolstosheev A.

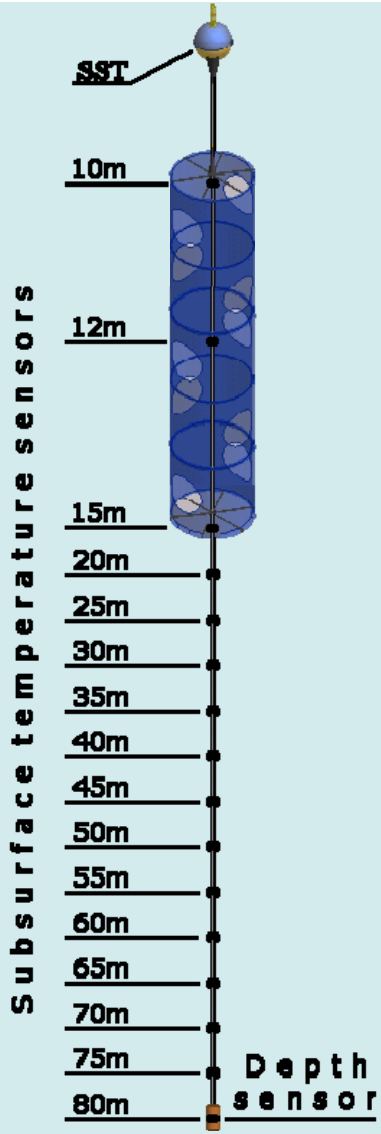
Marine Hydrophysical Institute NASU / Marlin-Yug Ltd,

Directions of investigations of the technical developments completed in 2009-2010

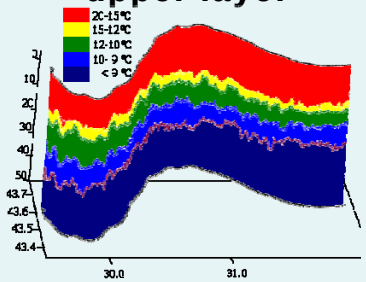
1. Iridium SVP-BTC80/RTC/GPS drifter (third prototype)
2. Iridium SVP-B/RTC/GPS drifter (third prototype)
3. Argos-3 SVP-B/RTC (first prototype)
4. Argos-3 SVP-B/RTC (second prototype)
5. Method of Argos and Iridium Doppler locations filtration
6. Wave-estimating drifter
7. Mini buoy for polar areas

Iridium SVP-BTC80/RTC/GPS drifter (third prototype)

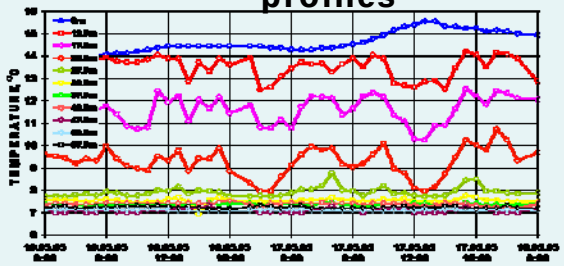
Purpose: 3D synchronous thermodynamic monitoring of upper layer with high space-time resolution by means of cluster of drifters



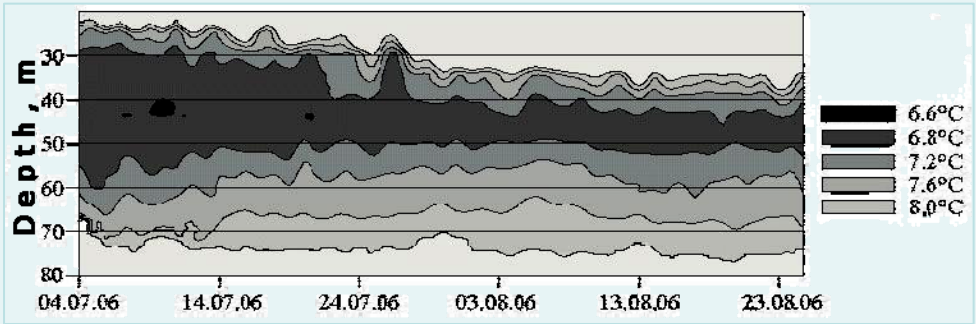
Thermal stratification of upper layer



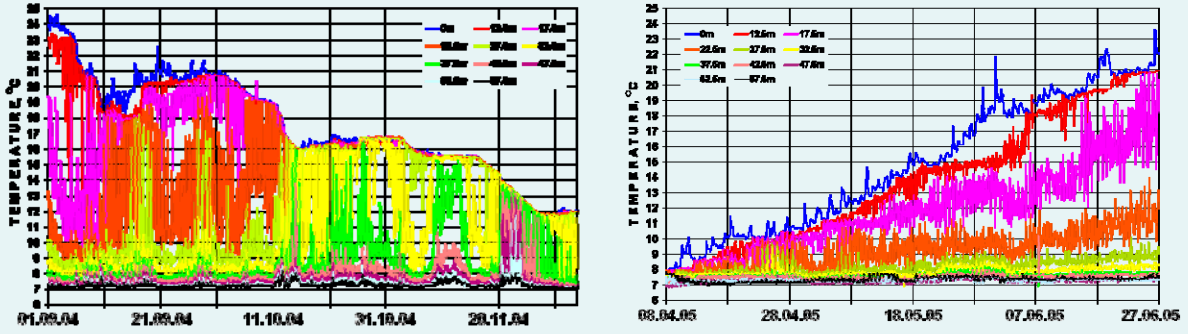
Influence of meteoparameters on variability of the temperature vertical profiles



Cold intermediate layer

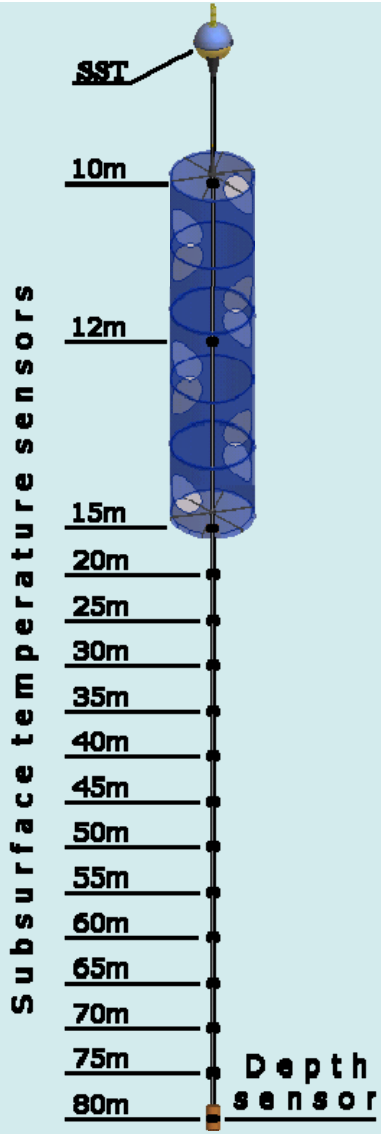


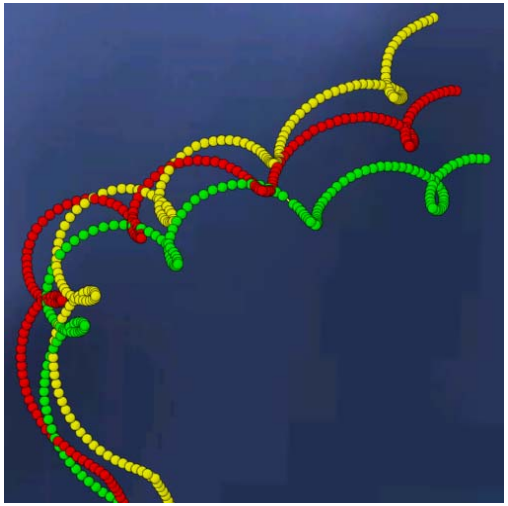
Season and interseason thermodynamic variability within active layer



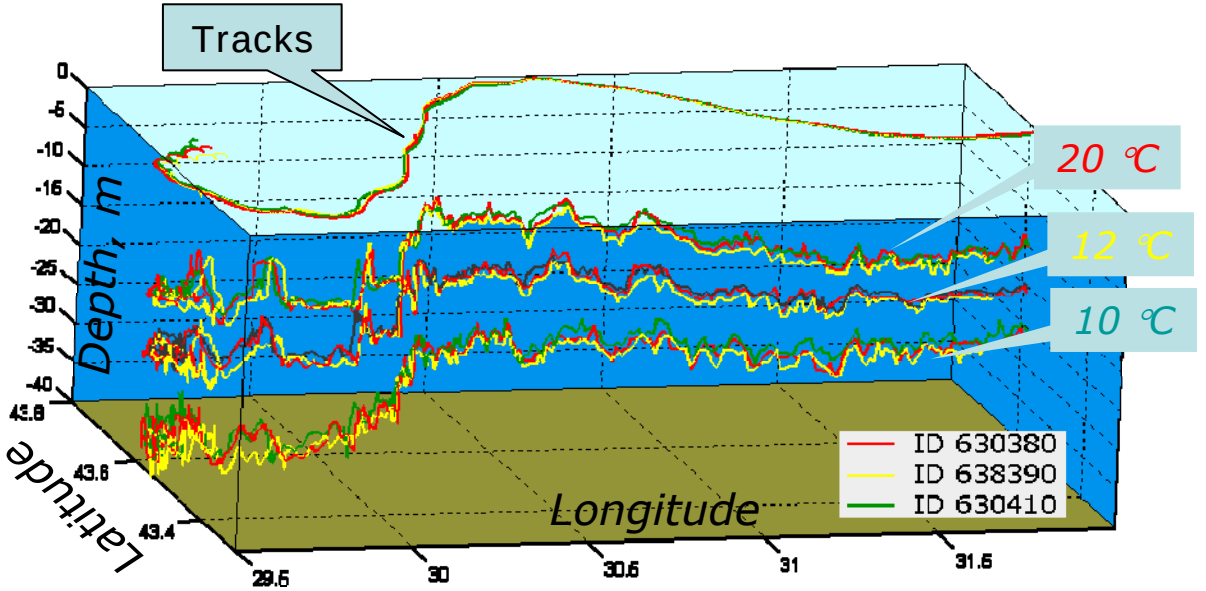
Iridium SVP-BTC80/RTC/GPS drifter (third prototype)

Three drifters were tested in the Black Sea (Aug 2009 - Nov 2009)





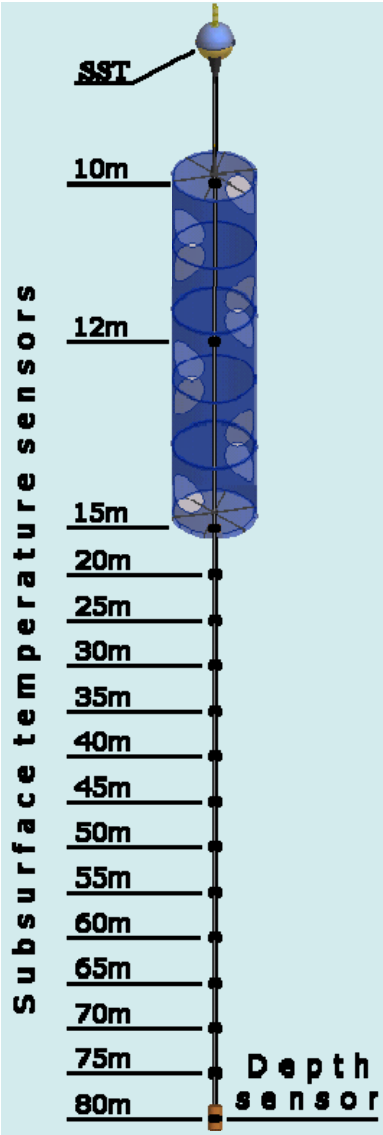
Data Format	Version 4+
RTC – Real Time Clock	GPS synchronization
Depths of temperature sensors depending on the chain's vertical deflection	Processing inside a buoy with temperature-depth data output
GPS receiver	A1080 (SIRFstarIII)
Period of samples	30 min



Iridium SVP-BTC80/RTC/GPS drifter (third prototype)

Purpose: Investigation of new tools in the Ocean

Meteo-France drifter 6200510 in the Atlantic Ocean (May 2010 - Sep 2010)



Data from http://www.meteo.shom.fr/qctools/

METEO FRANCE
Toujours un temps d'avance

THERMISTOR STRING BUOYS DATA

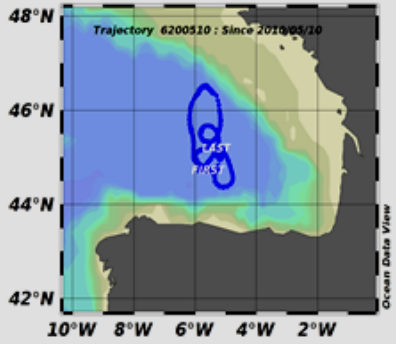
METEO FRANCE : Quality Control Tools : Thermistor String Buoys data

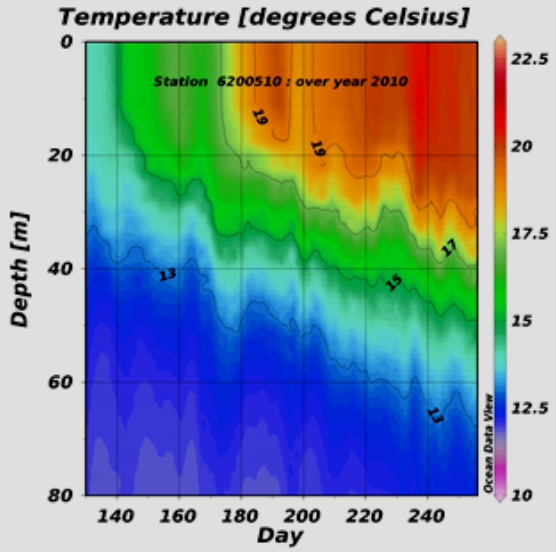
BUOY 6200510 : Trajectory and Temperature in depth for the year 2010 and zoom on the last 30 days for available data.

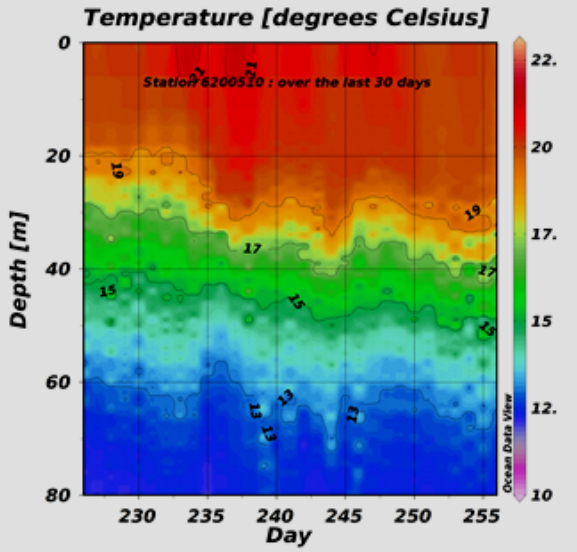
On the trajectory map , 'First' annotation indicates the first postion of the buoy for the analysed period and 'Last' annotation indicates the last position recorded when update was performed.

All graphs are produced through ODV application.

Last update : 2010/09/13 15:47







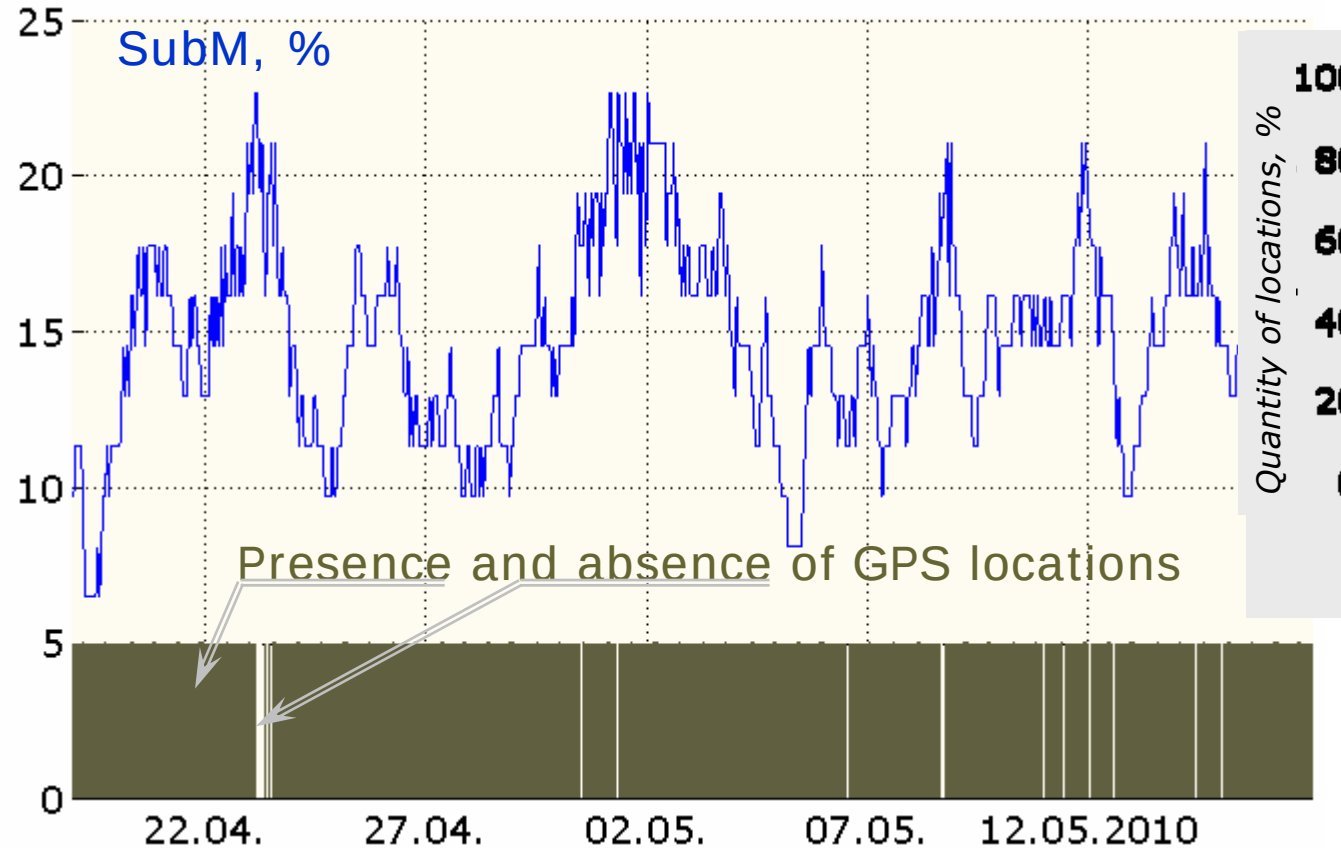
Data since 2010/05/10 Zoom on data for the last 30 days

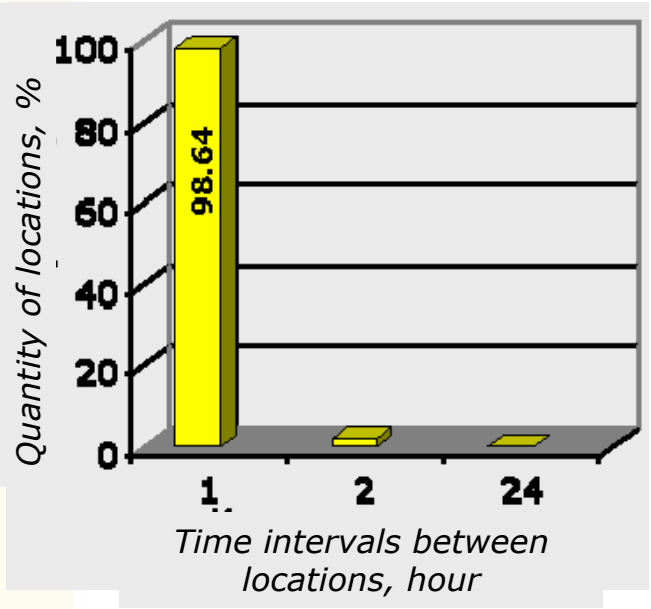
Iridium SVP-B/RTC/GPS drifter (third prototype)

Purpose: Estimation as a whole of data link and GPS receiver capabilities to provide continuity of GPS locations under different weather conditions

Estimated parameter of the continuity is the relation of locations quantity with hourly intervals to total quantity of locations

Basis for estimation: two SAWS GPS drifters deployed in the South Atlantic (Dec 2009 - Sep 2010)



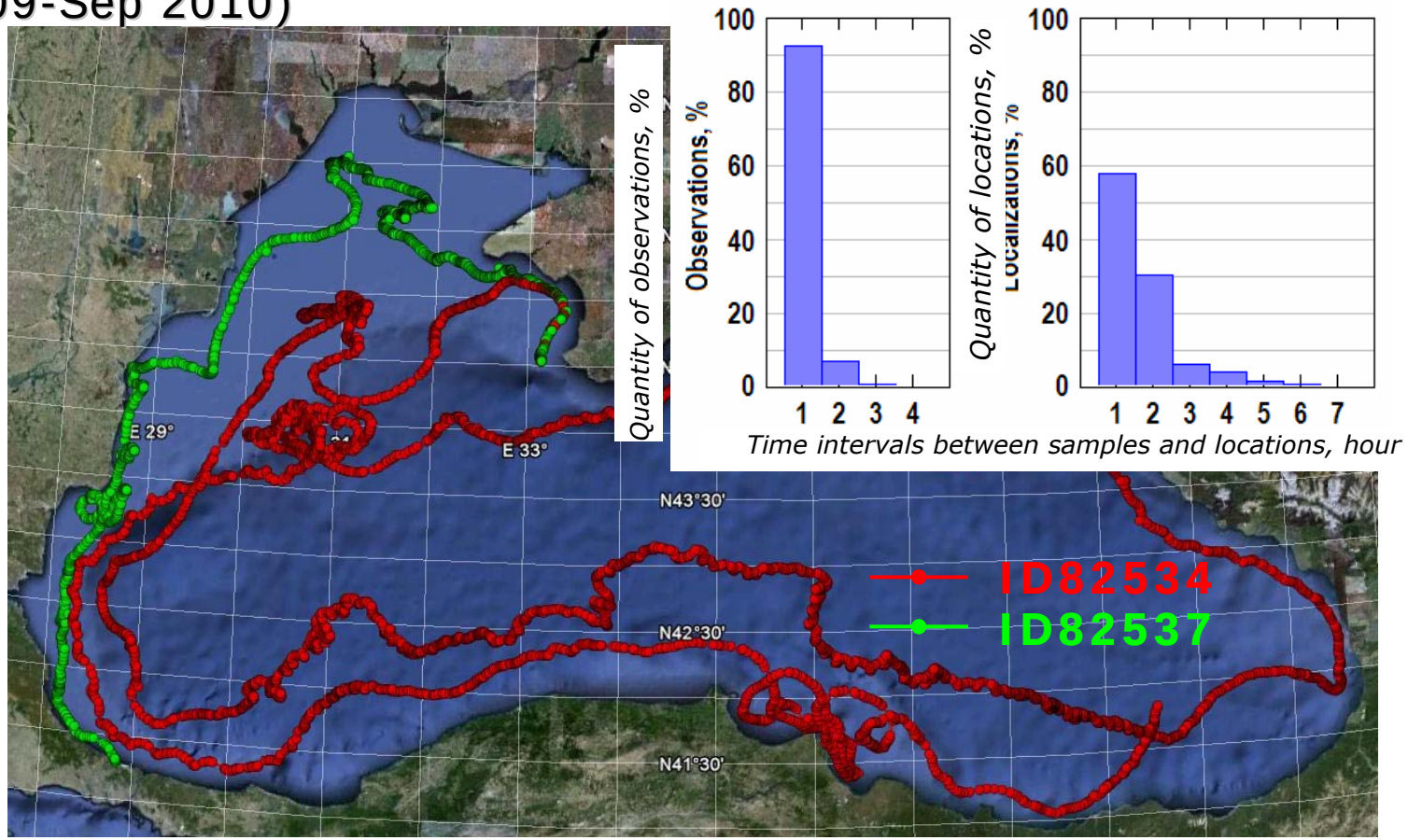


Argos-3 SVP-B/RTC drifter (first prototype)

Purpose: Estimation as a whole the data link capabilities to provide continuity of hourly samples and Doppler locations under different weather conditions.

Estimated parameters: Relation of hourly samples (locations) quantity to total quantity of samples (locations).

Basis for estimation: Two drifters, deployed in the Black Sea (Nov 2009-Sep 2010)



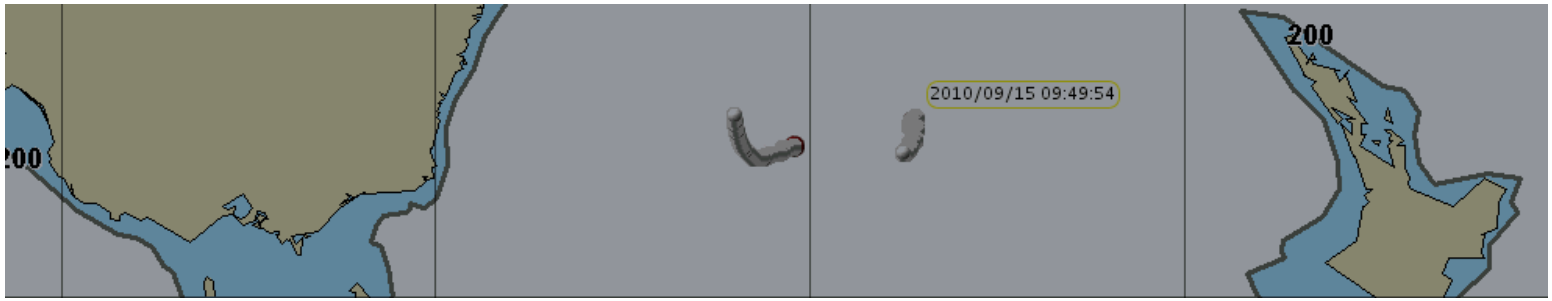
Argos-3 SVP-B/RTC drifter (second prototype)

Purpose: Approach to the buoy capable to be deployed from a ship of opportunity by means of 20-m height drop when 25 knots velocity.

Estimated parameter: Keeping to be in operation after drop.

Basis for estimation: 2 NZ MetService drifters successfully deployed in Tasman Sea on 2 Sep 2010. 4 buoys will be deployed soon.

Parameters of drops: 15.5 knots velocity, 5 meters height above the sea level



Evaluation of MHI processing technique for the Argos and Iridium Doppler locations

Purpose: Improvement of sea surface currents reconstruction by using Doppler locations in Argos and Iridium satellite systems with additional MHI processing technique *(Local Regression Smoothing Procedure)*

Validation:

- Comparison of MHI processed Argos locations vs GPS locations
- Comparison of MHI processed Iridium locations vs GPS locations

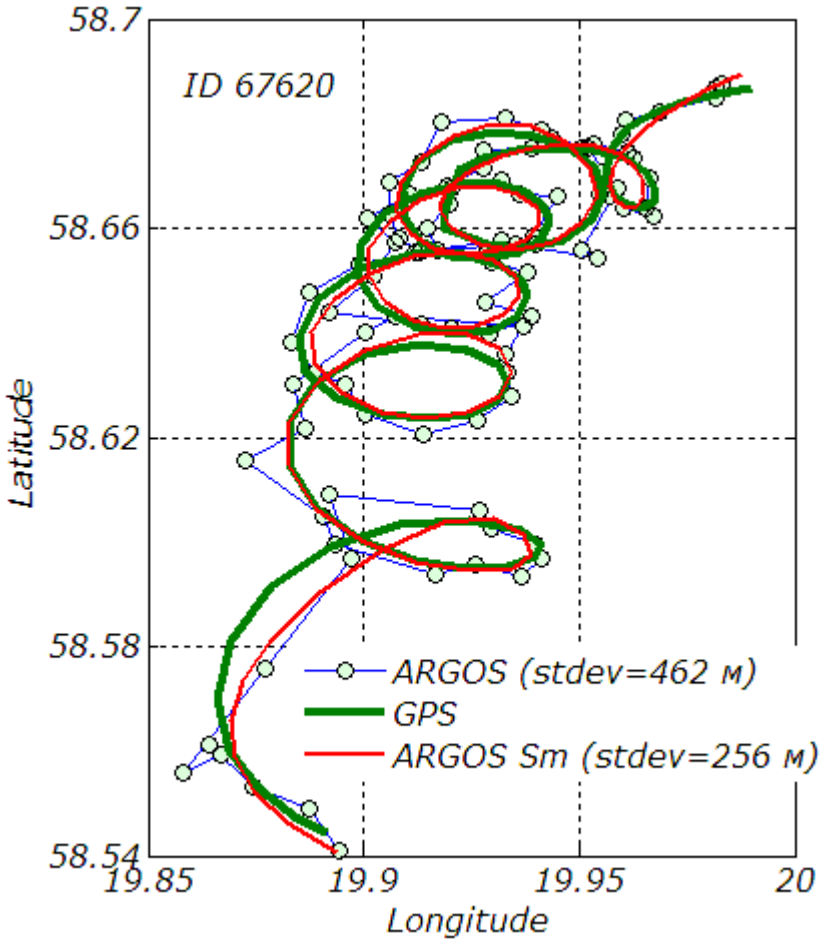
Estimated parameter:

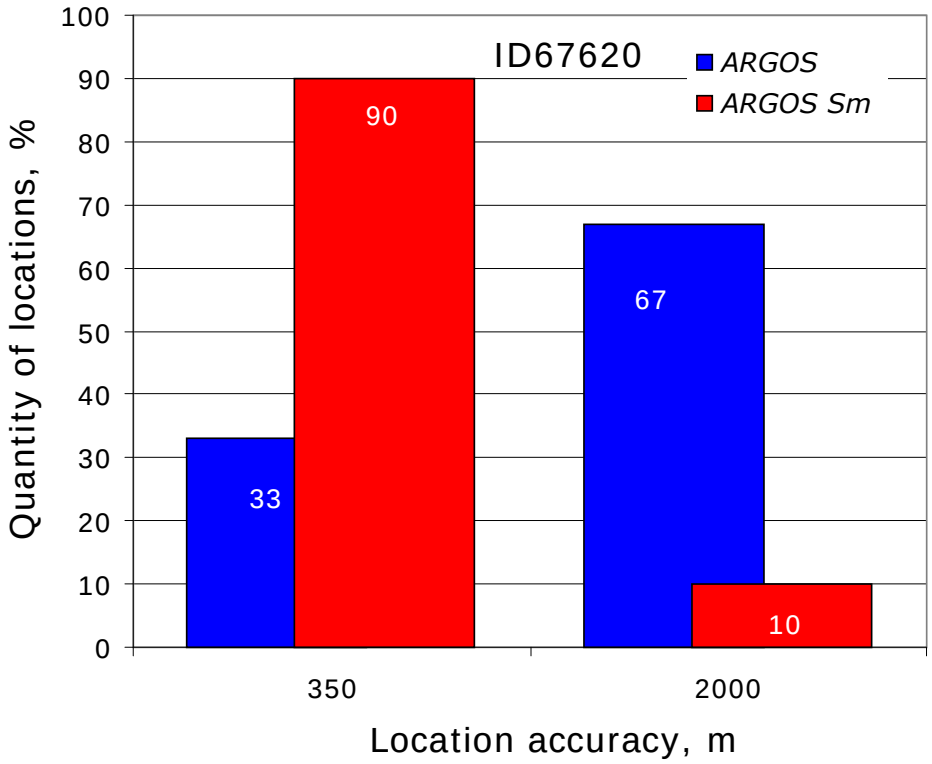
Increasing of locations quantity with better accuracy and decreasing with worse accuracy

Evaluation of MHI processing technique for Argos Doppler locations

ARGOS Doppler locations (*blue*) vs ARGOS Doppler locations after processing (*red*) in comparison with GPS locations (*green*)

SVP-B/GPS ARGOS-2 drifter ID67620 in the Baltic Sea (Aug 2010-Sep 2010)

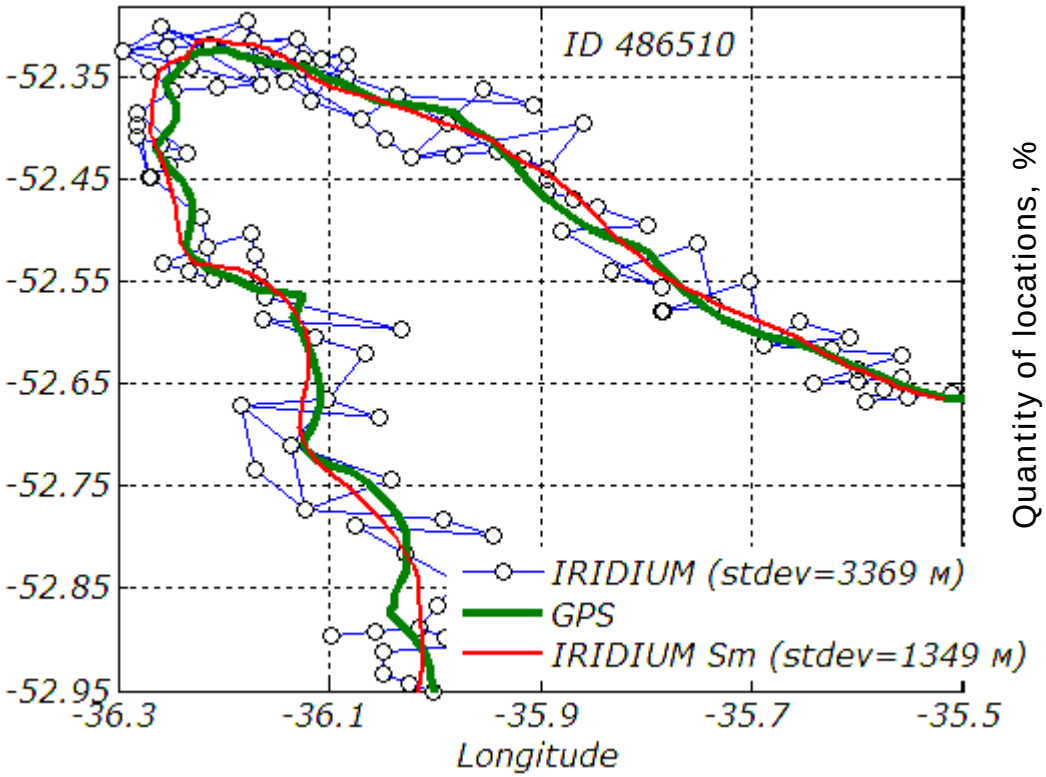


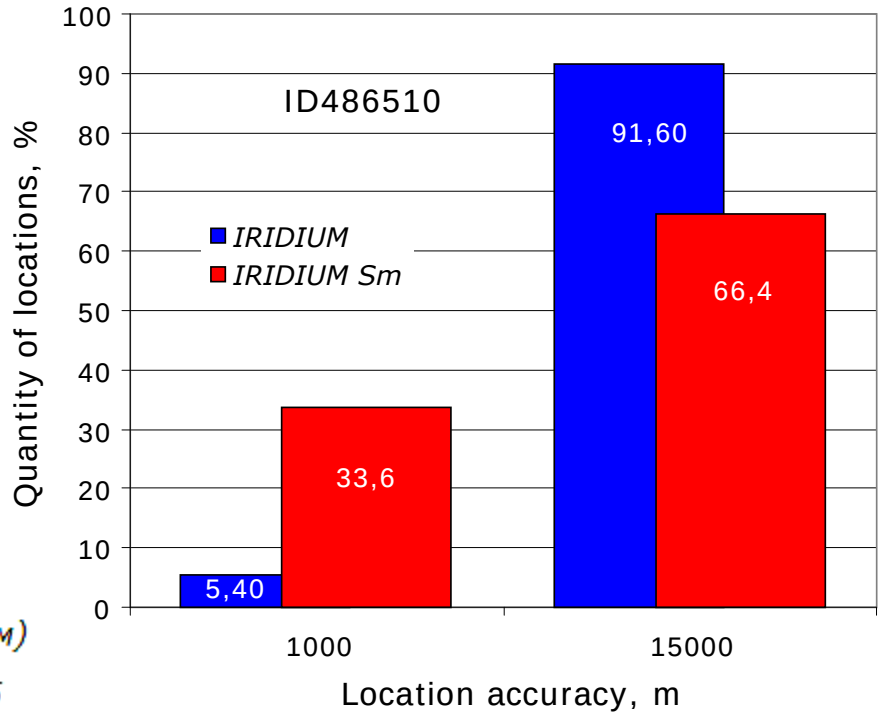


Evaluation of MHI processing technique for Iridium Doppler locations

IRIDIUM Doppler locations (*blue*) vs IRIDIUM Doppler locations after processing (*red*) in comparison with GPS locations (*green*)

SVP-B/GPS IRIDIUM drifter ID486510 in the South Atlantic (Dec 2009-Sep 2010)

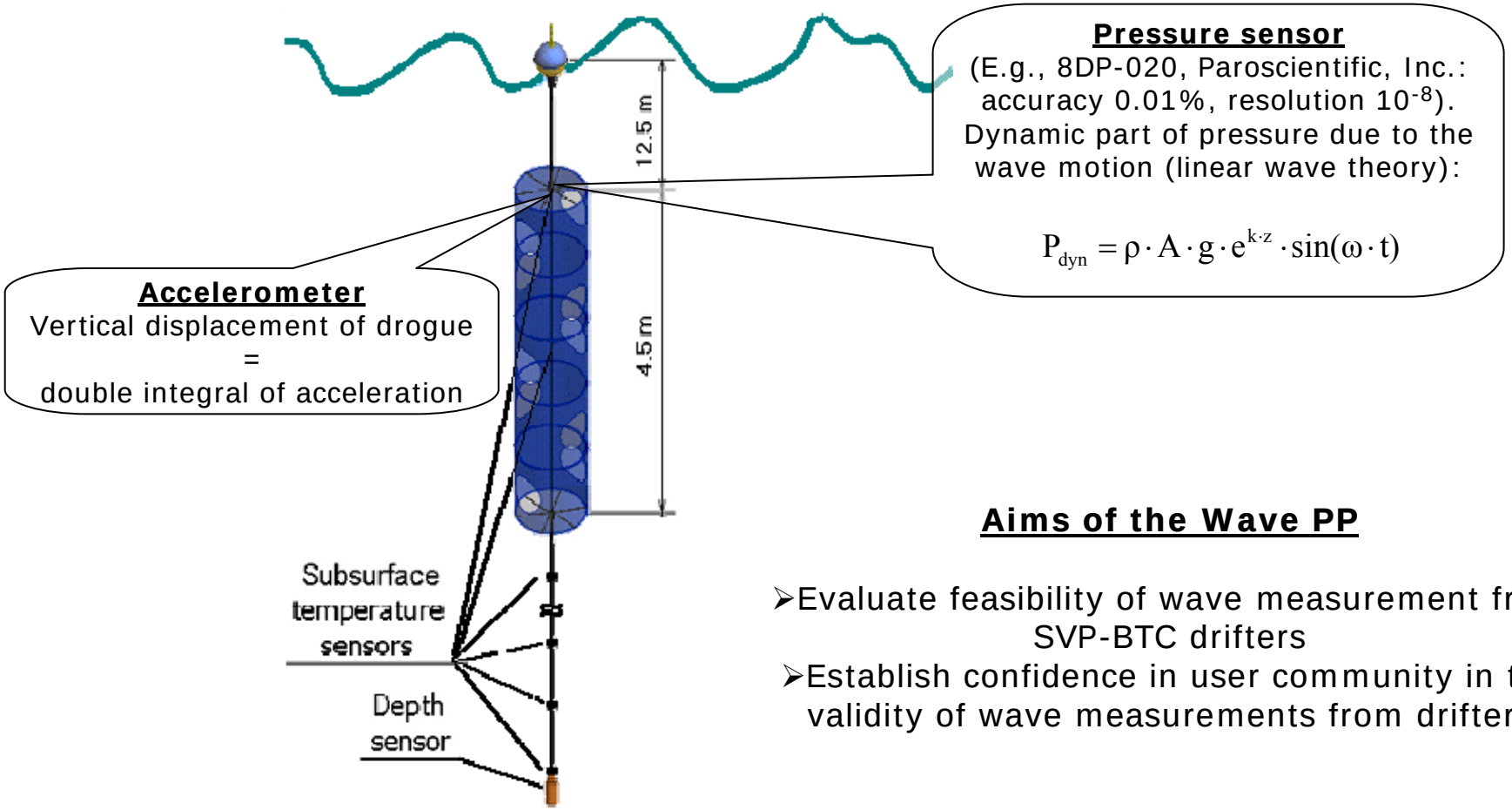




Wave-estimating drifter based on SVP-BTC80

Purpose: Investigation of the ways to study surface waves parameters by means of WOCE technology drifters

The technical paper of the drifter has been prepared and sent to the chairman of PP-WMD for evaluation



Pressure sensor

(E.g., 8DP-020, Paroscientific, Inc.: accuracy 0.01%, resolution 10^{-8}). Dynamic part of pressure due to the wave motion (linear wave theory):

$$P_{dyn} = \rho \cdot A \cdot g \cdot e^{k \cdot z} \cdot \sin(\omega \cdot t)$$

Accelerometer

Vertical displacement of drogue = double integral of acceleration

Aims of the Wave PP

- Evaluate feasibility of wave measurement from SVP-BTC drifters
- Establish confidence in user community in the validity of wave measurements from drifters

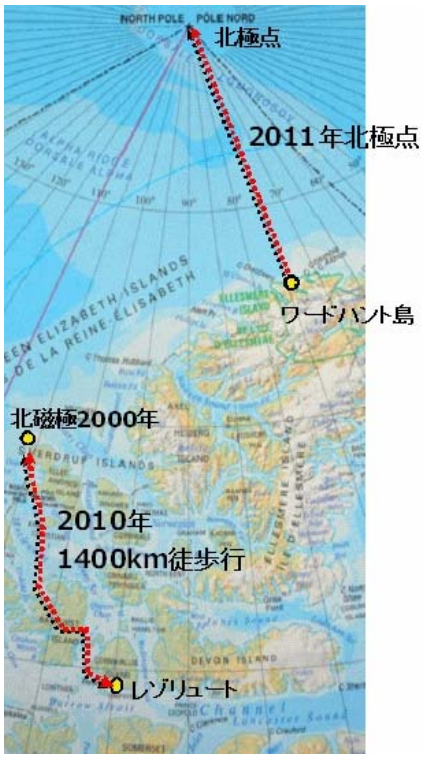
Meteorological Argos-2 GPS Ice Marker (JAMSTEC, Japan)

Purpose: Creation and test of compact autonomous device for polar investigations

Agita-San in Tokyo before trip

Afoot to Magnetic North Pole

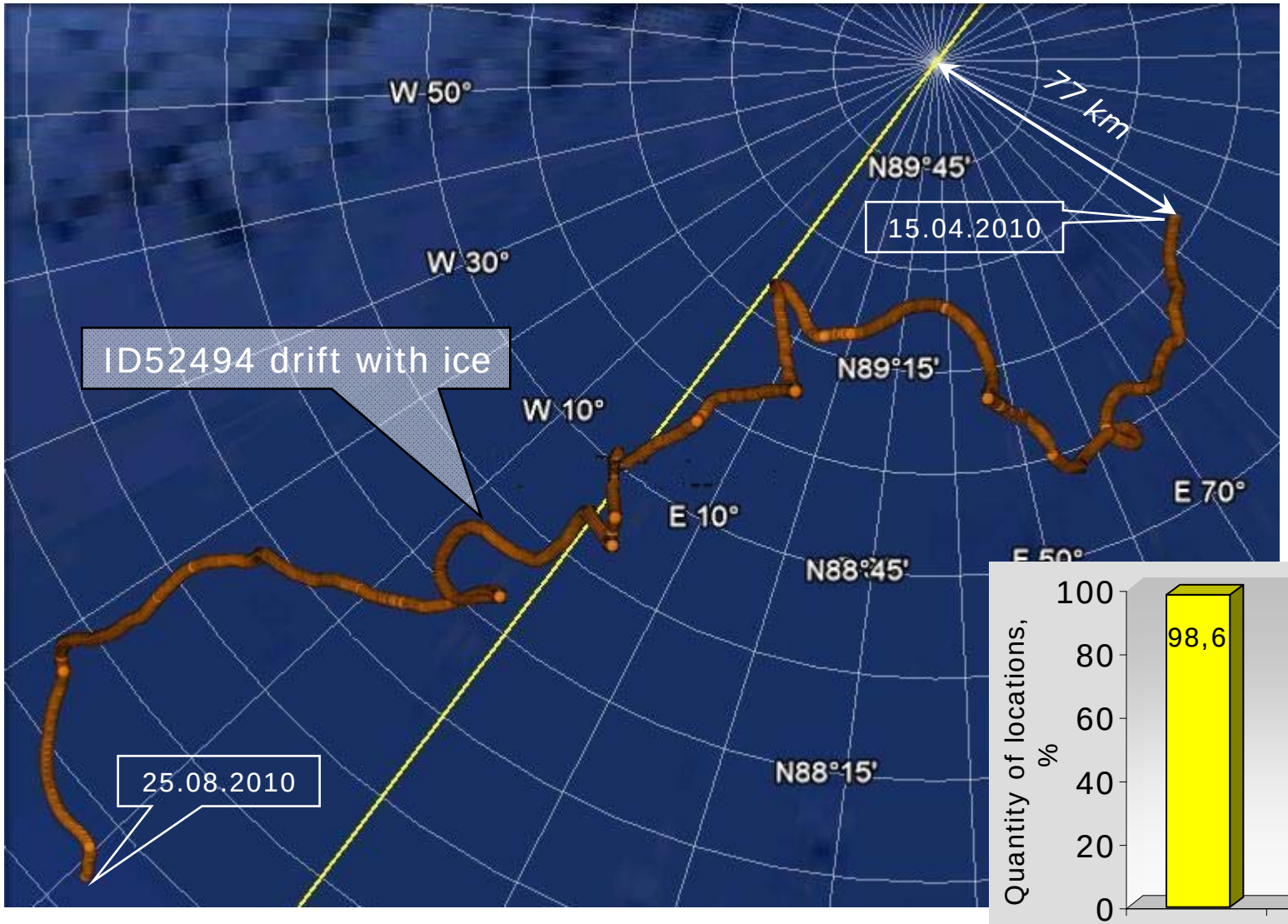
Placing of marker No.1

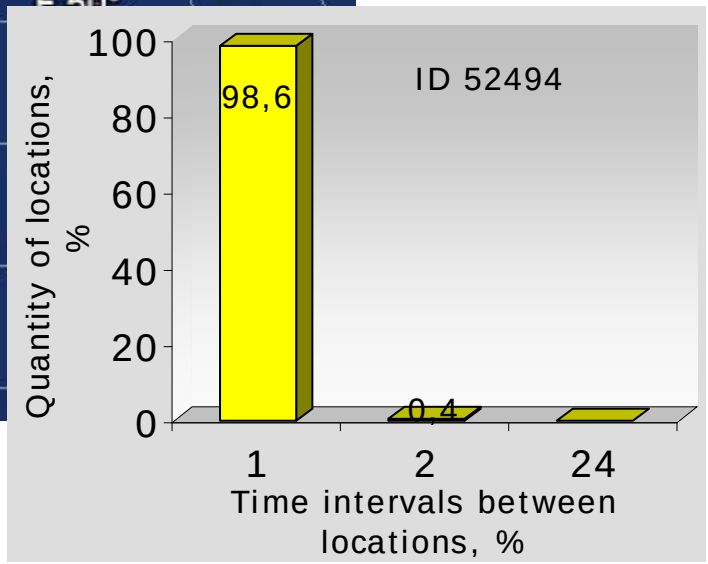


Technical parameters	
Communication	Argos-2
Data transfer	1/3 duty cycle
Data acquisition	Continuous
GPS	Trimble Lassen iQ
RTC	GPS synchronization
Air pressure	850 to 1054.7 hPa
Surface temperature	Minus 30 to +10.88ºC
Air pressure tendency	-25.5 to 25.6 hPa
Battery voltage	7.5 to 11.0 V
Period of samples	1 hour
Lifetime	6 months
Expected lowest environmental temperature	-30ºC
Weight	2.2 kg
Sizes	20 cm diameter 44 cm max height

Meteorological Argos-2 GPS Ice Marker (JAMSTEC, Japan)

Purpose: Determination of hourly data and GPS locations continuity





Conclusions

1. Different types of Iridium/GPS drifters of third prototype provide stable operation under tough weather conditions
2. Argos-3 SVP-B/RTC drifter demonstrates reliable operation also when different weather conditions
3. Next approach was completed to get the automatically deployable drifter after drop from a ship of opportunity
4. Method of Argos and Iridium Doppler locations filtration was developed to increase space-time resolution when study of currents
5. The wave-estimating drifter was developed and suggested to be evaluated in-situ under PP-WMD
6. Mini meteo buoy for polar areas was created and successfully tested


Thank you!

Local Regression Smoothing Procedure

The local regression smoothing process follows these steps for each data point:

1. Compute the *regression weights* for each data point in the span. The weights are given by the tricube function shown below.

$$w_i = \left(1 - \left|\frac{x_k - x_i}{d(x_k)}\right|^3\right)^3$$

x is the predictor value associated with the response value to be smoothed,
xi are the nearest neighbors of *x* as defined by the span,
d(*x*) is the distance along the abscissa from *x* to the most distant predictor value within the span.

The weights have these characteristics:

- The data point to be smoothed has the largest weight and the most influence on the fit.
-Data points outside the span have zero weight and no influence on the fit.

2. A weighted linear least squares second degree polynomial regression is performed.
3. The smoothed value is given by the weighted regression at the predictor value of interest.

Using this method with a span of five, the smoothed values and associated regressions for the first four data points of a generated data set are shown below.