Upwelling events in the Gulf of Finland 2007 – 2011 on the basis of FerryBox observations Tallinn - Helsinki

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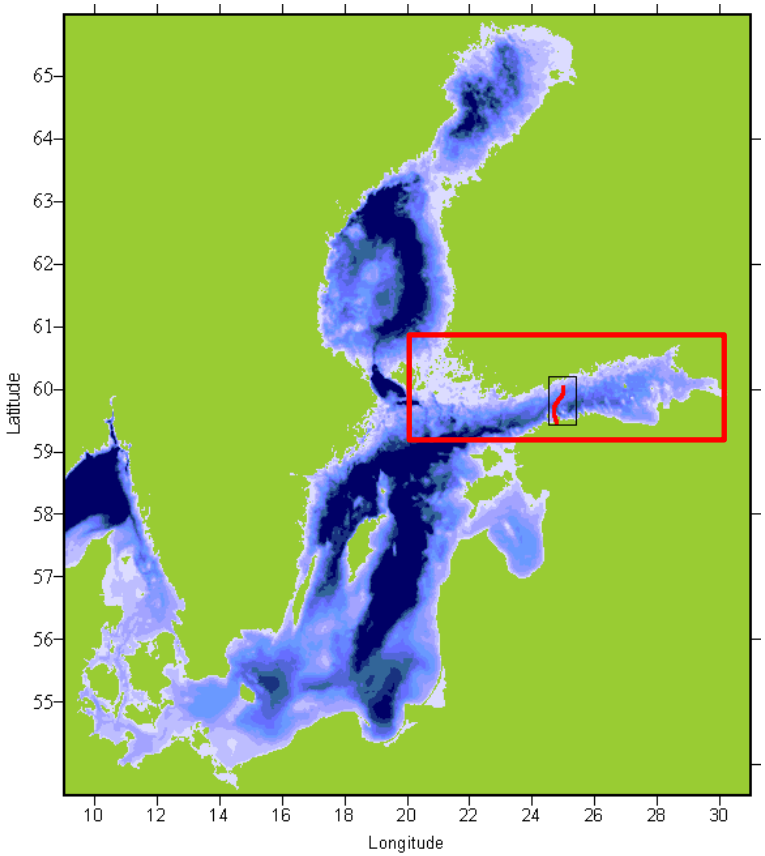
Study area – Gulf of Finland

The Gulf of Finland is a typical **deep/stratified** and **wide** estuary with a major fresh water inflow in the eastern end and relatively open water exchange with the Baltic Proper through the gulf's western boundary.

Vertical stratification is characterized by a permanent **halocline** at depths of 60-70 m, and a **seasonal thermocline**, which forms at the depths of 10-20 m in spring-summer

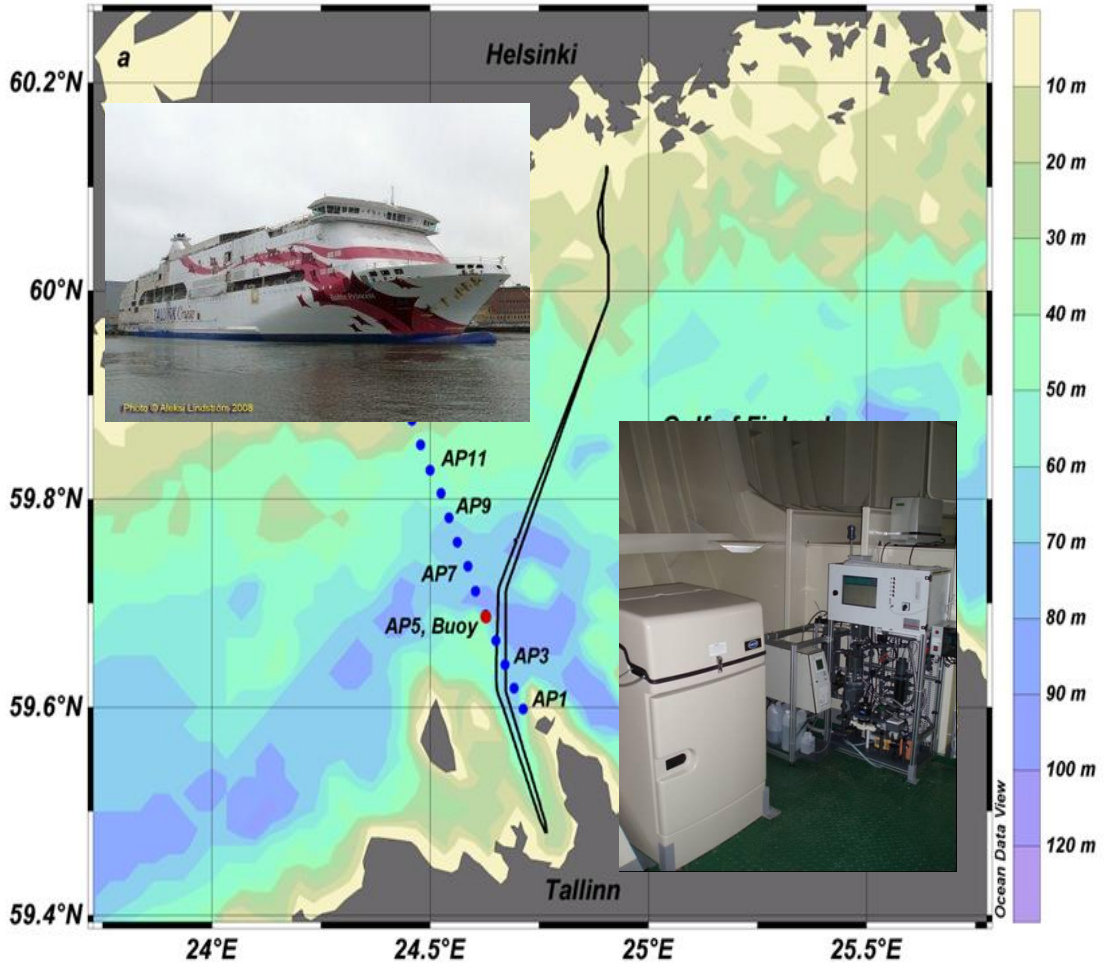
Residual circulation consists of an outflow of gulf's waters in the northern part and an inflow of open Baltic Sea waters in the southern part of the gulf.

Wind-driven circulation in the Gulf of Finland is highly variable and is characterized by intense **meso-scale features – eddies, upwelling/ downwelling, coastal and frontal jet currents**, which can cause significant advection and mixing of water masses and substances (e.g. nutrients and phytoplankton).

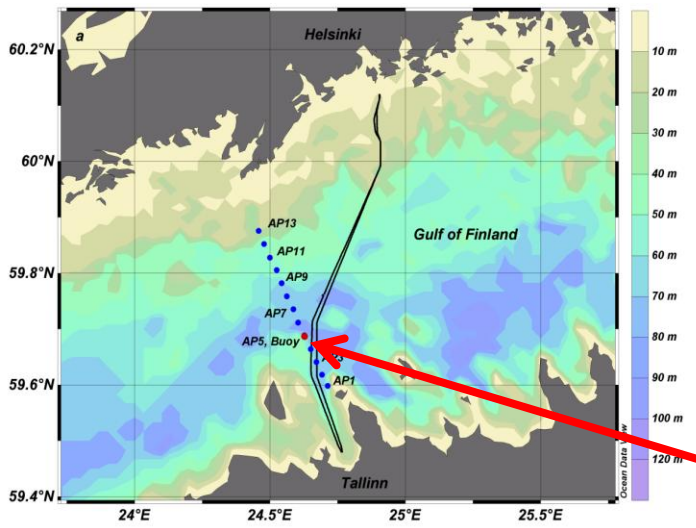


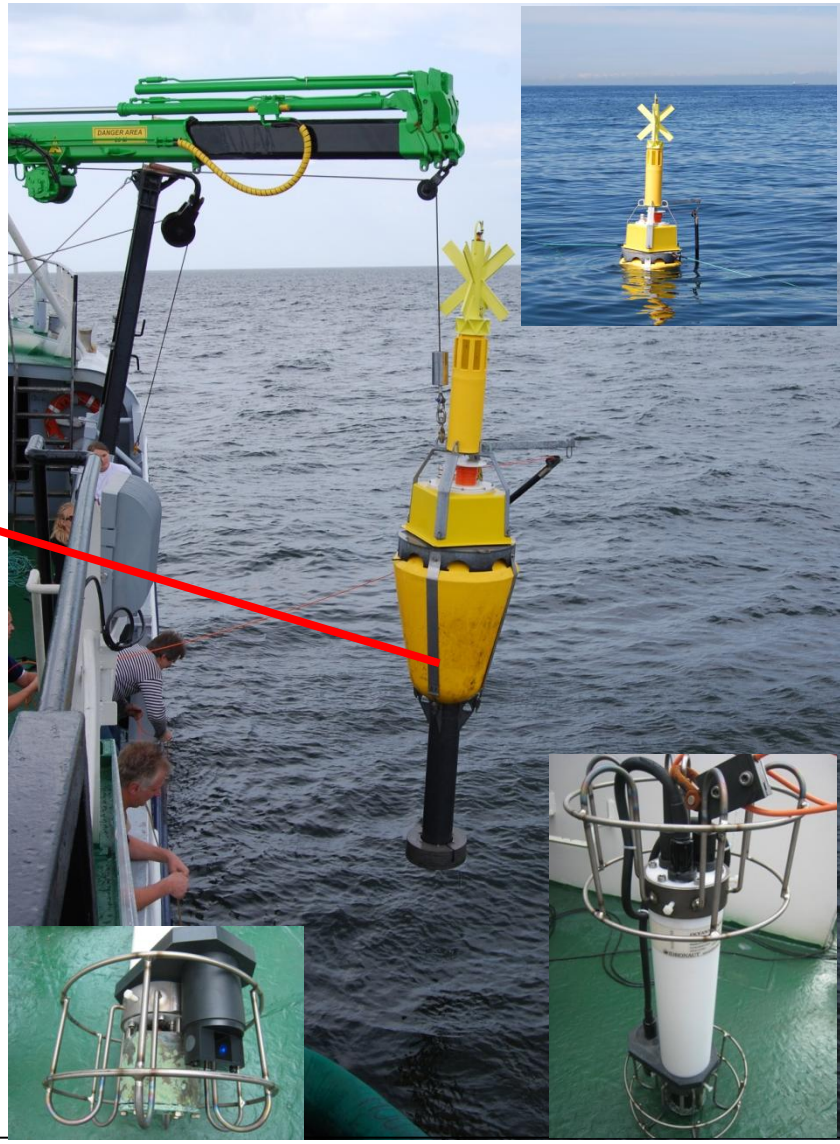
Measurment systems I (I – III): FerryBox

- Autonomous measurements, water intake from the surface layer (4 m) – sampling rate 20 s (spatial resolution about 150 m) - temperature (PT100, FSI thermosalinograph), salinity (FSI thermosalinograph), Chl *a* fluorescence and turbidity (SCUFA fluorometer) and since January 2010 pCO2 (Contros)
- Data retrieval once a day via GSM connection, delivered for operational models (http://sahm.ttu.ee/ferrybox/)
- Water samples once a week by Hach Sigma 900 MAX, 24 sampling points
- Nutrients (PO_4^-, NO_2^-+NO_3^-) nutrient analyzer µMac 1000 and autoanalyzer Lachat; Chl *a* analyses by spectrophotometer Thermo Helios γ; phytoplankton counting; salinity by Autosal



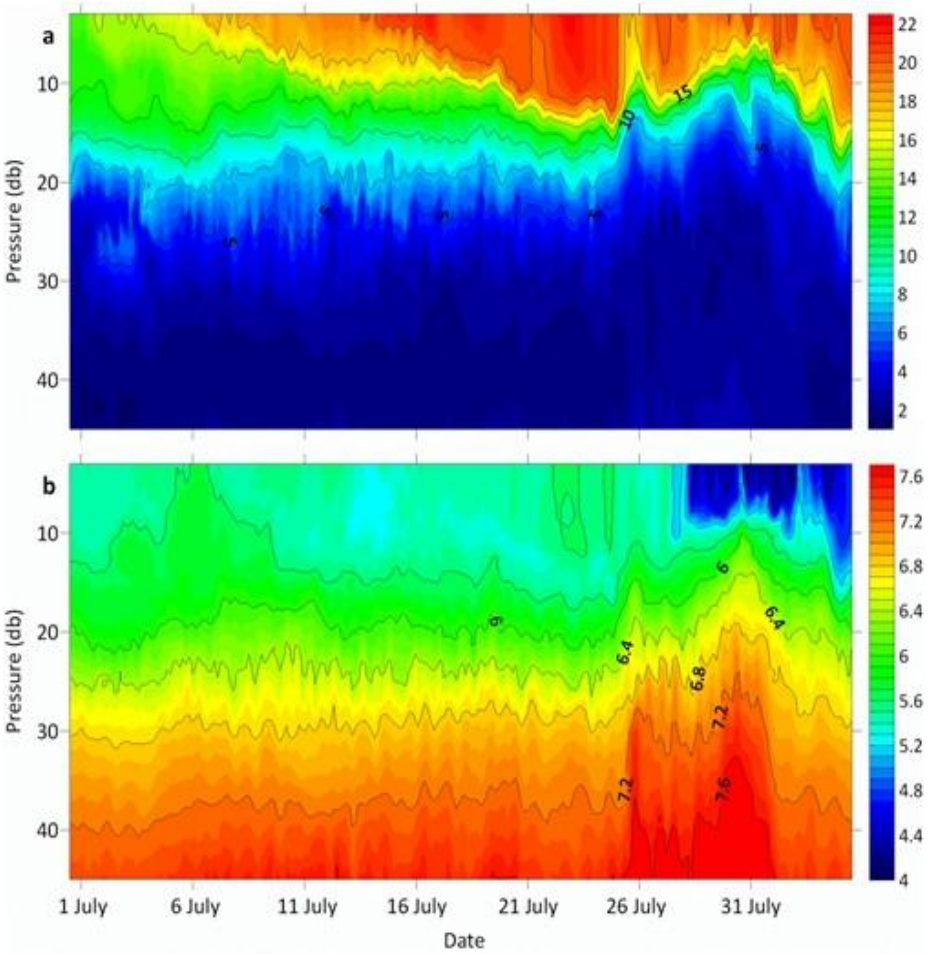
Measurment systems II (I – III): Buoy profiler

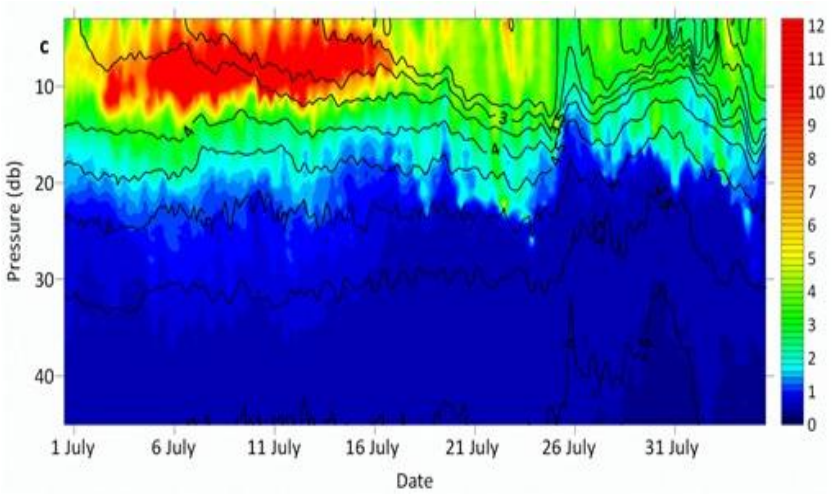




- Profiling system from *Idronaut s.r.l.* (Italy)
- Buoy designed and constructed by *Flydog Solutions* (Estonia)
- Measures T, S, Chl *a* fluorescence
- Measurement interval 3 hours
- Profiles from 2 to 50 (45) m
- Data delivered via GSM connection after every profiling
- Water sampling for calibration of sensors and identification of phytoplankton species (R\V Salme)

Vertical dynamics of temperature, salinity and Chl *a* in July 2010

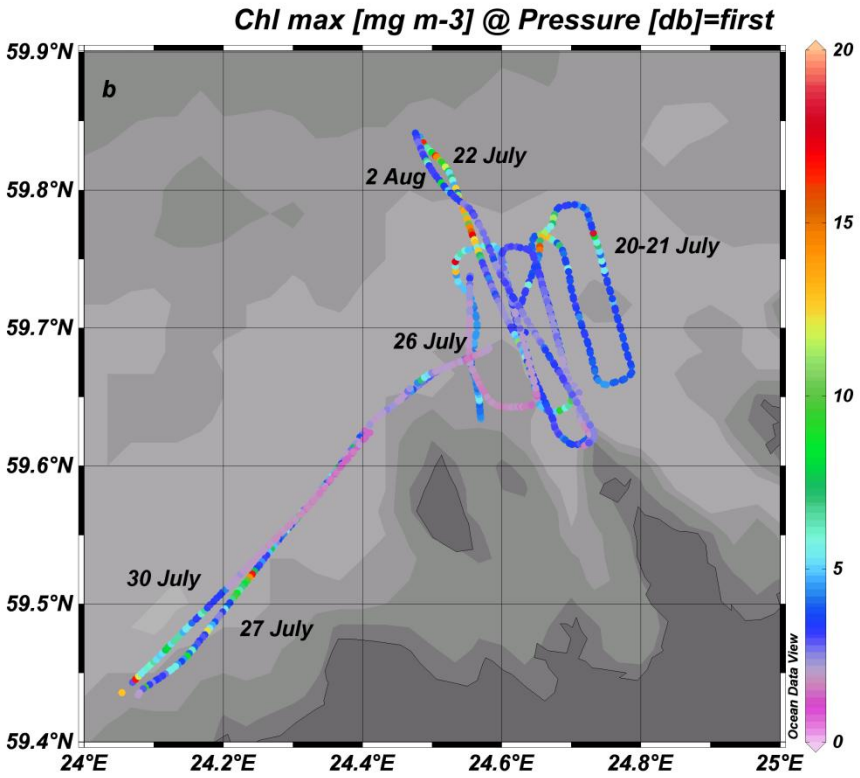




(Lips & Lips, *Deep-Sea Res*)

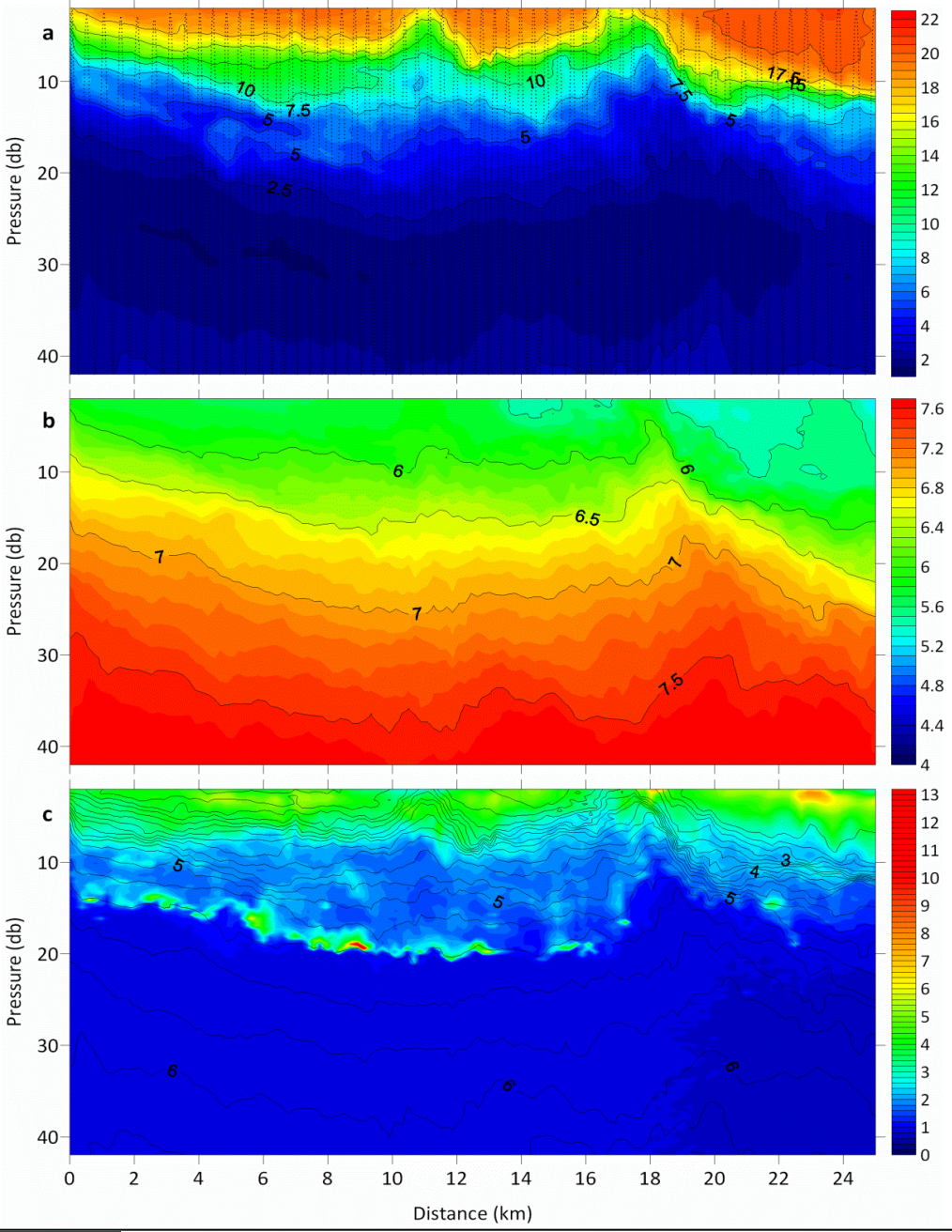
Measurment systems III (I – III): TUV

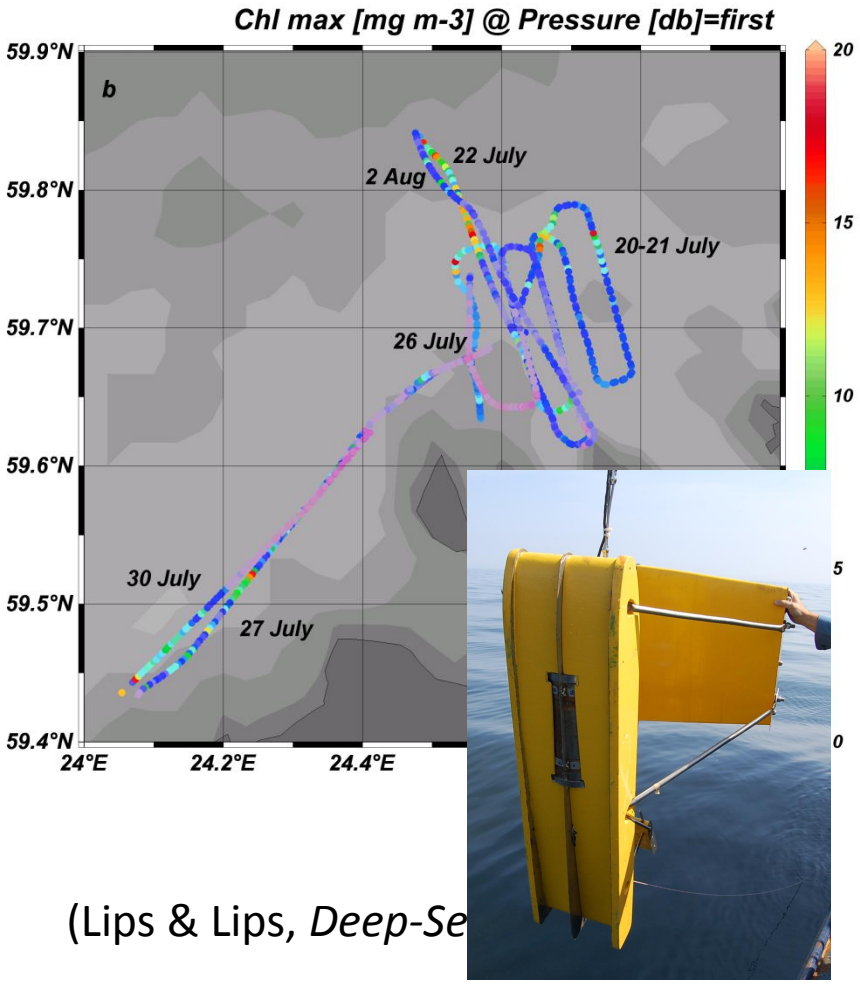
Towed undulating system measuring T, S, Chl a and phycosyanin



(Lips & Lips, *Deep-Sea Res*)

Vertical sections of T, S and Chl *a* on 27 July 2010





(Lips & Lips, *Deep-Se*

FerryBox data and setting criteria to identify upwelling events

- 2007 – 2011
- May to September

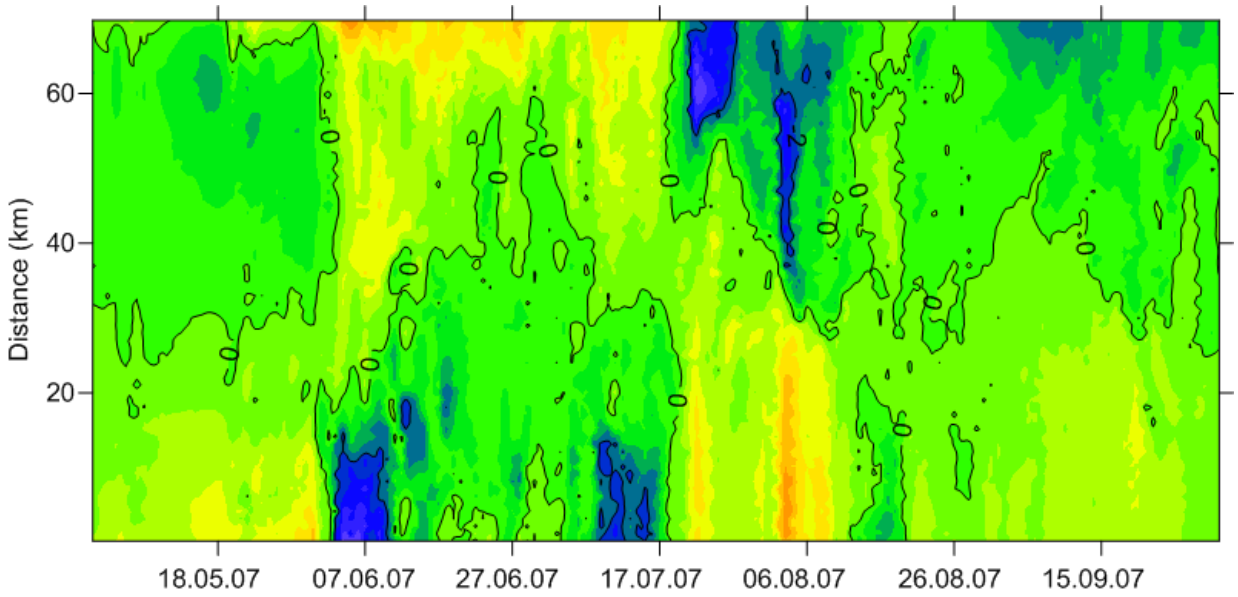
- Data averaged into 0.5 km
- Mean value of the crossing subtracted from inital values
- Setting criteria to ≤ -2 to find upwelling events

- 22 upwelling events were matching initial criteria (14 southern part and 8 for the northern)

FerryBox measurment results 2007

2 upwelling event

Helsinki



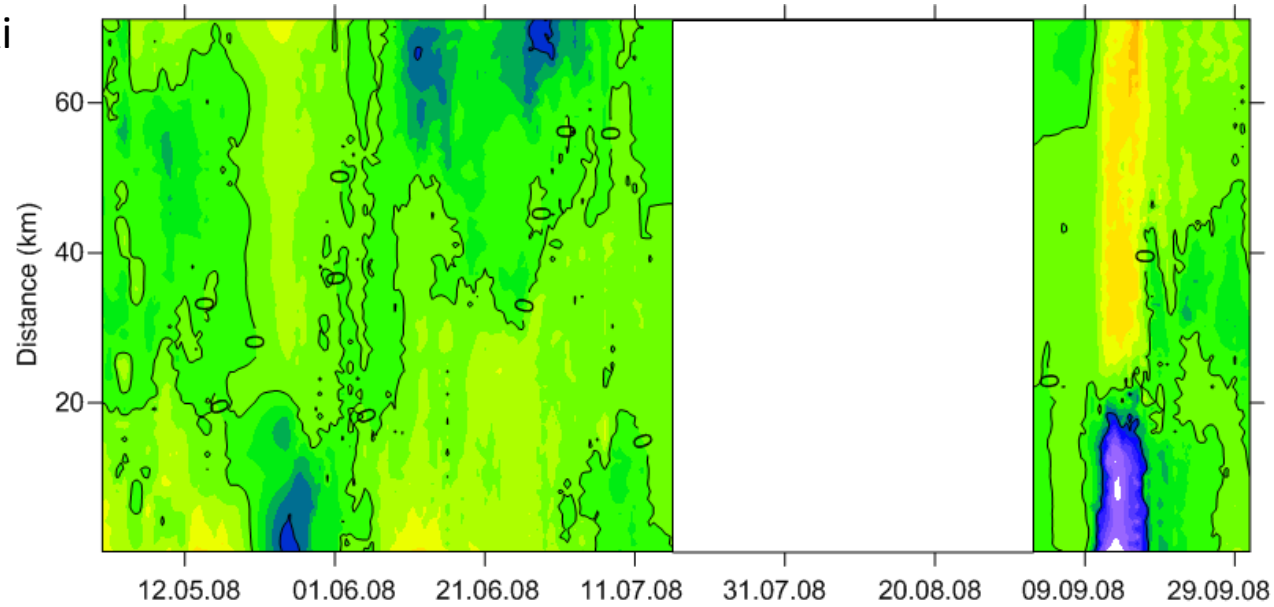
Tallinn

2 upwelling events

FerryBox measurments results 2008

1 upwelling event

Helsinki



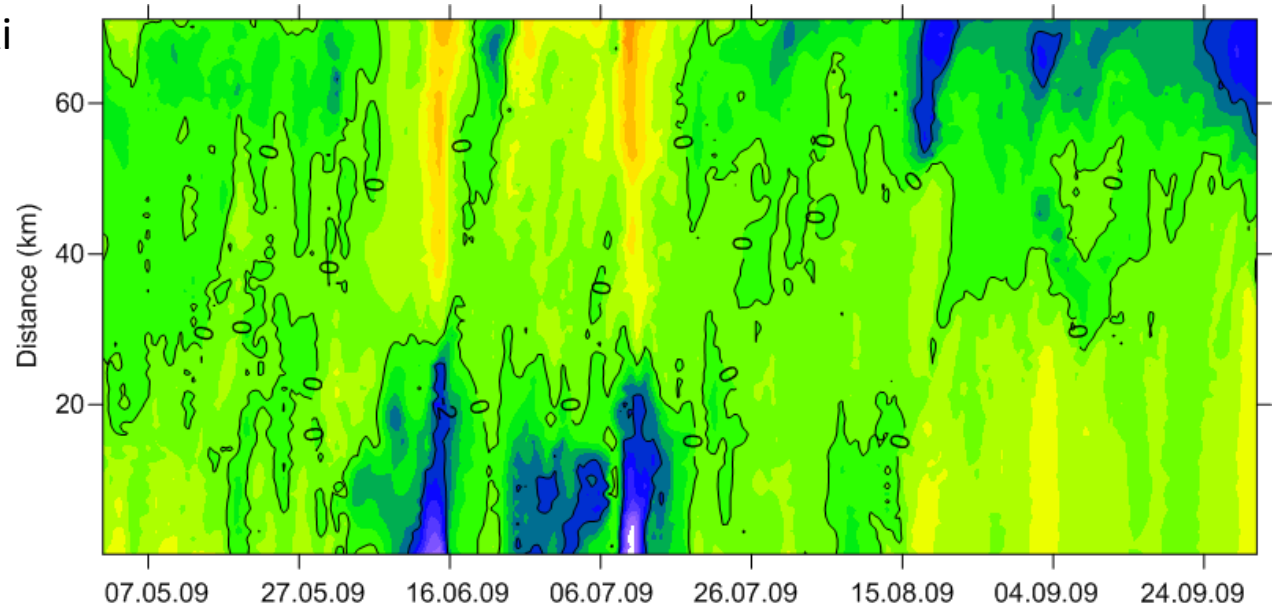
Tallinn

2 upwelling events

FerryBox measurments results 2009

3 upwelling event

Helsinki



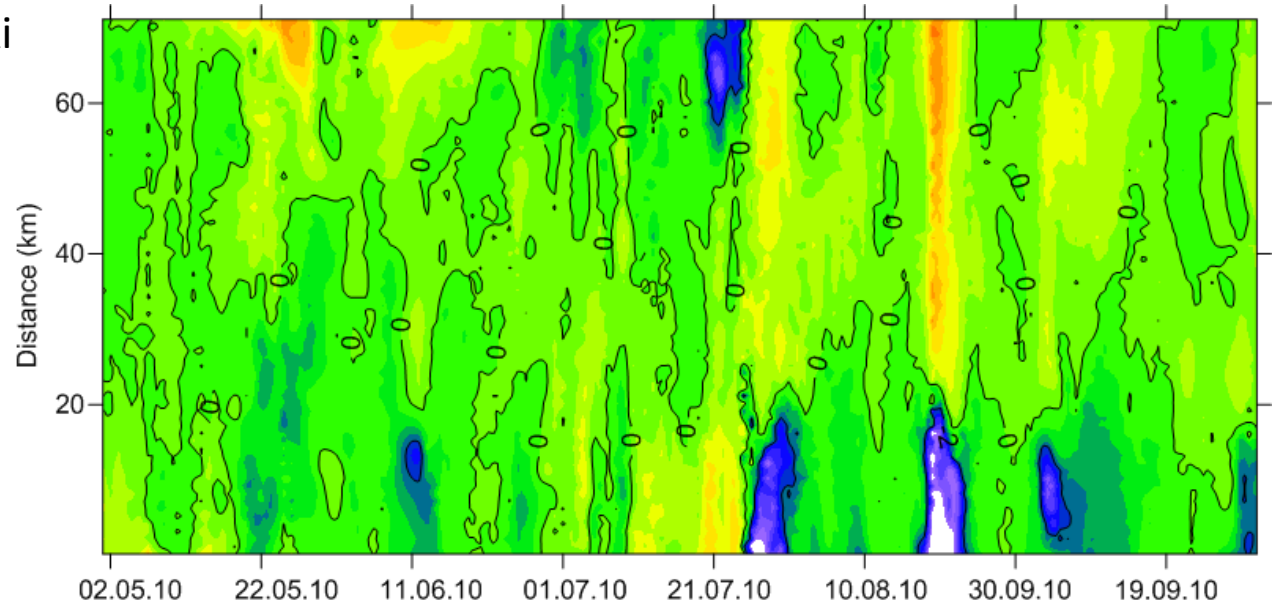
Tallinn

3 upwelling events

FerryBox measurments results 2010

1 upwelling event

Helsinki



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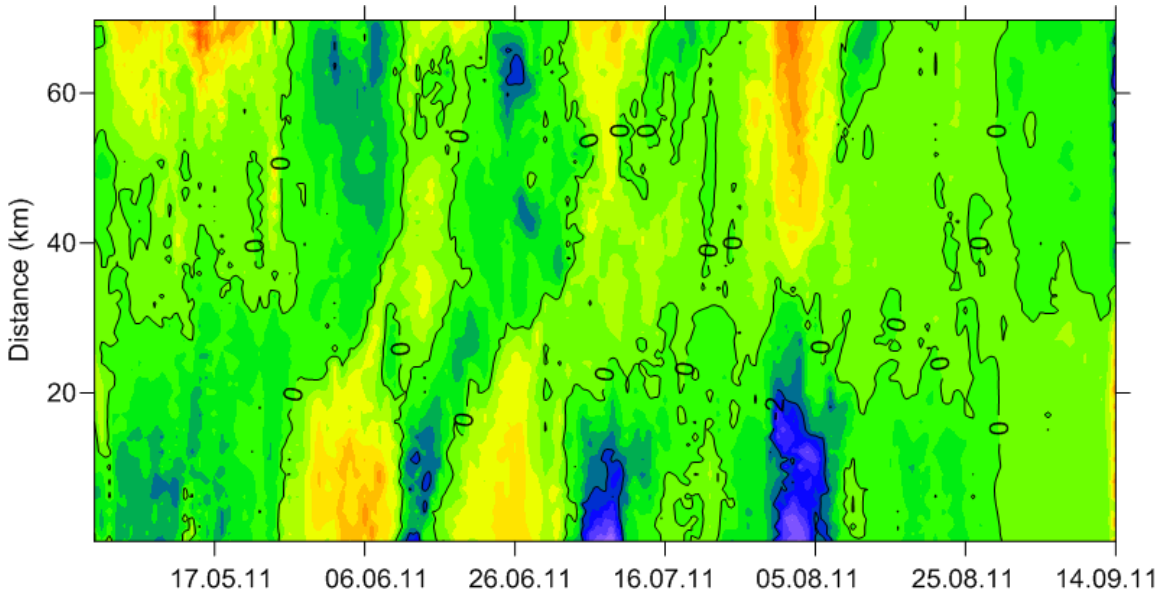
4 upwelling events

FerryBox measurments results 2011

1 upwelling event

Helsinki

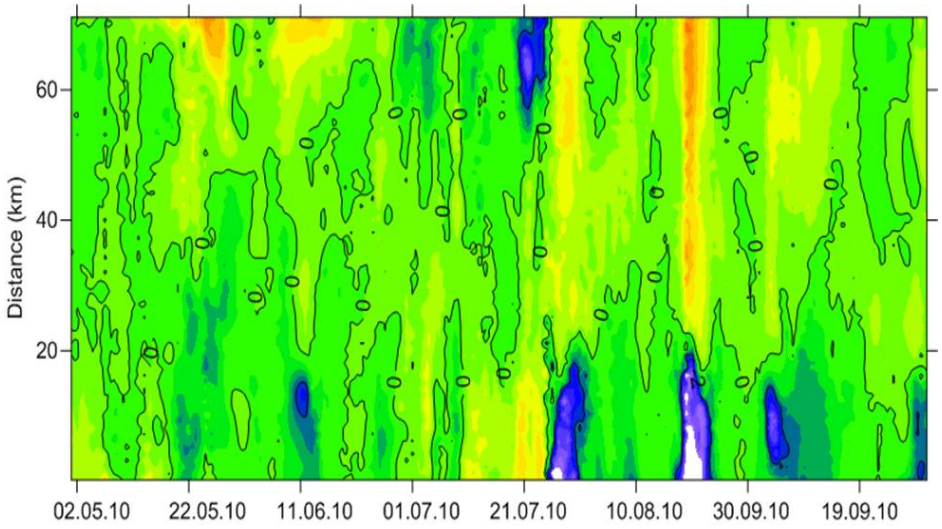


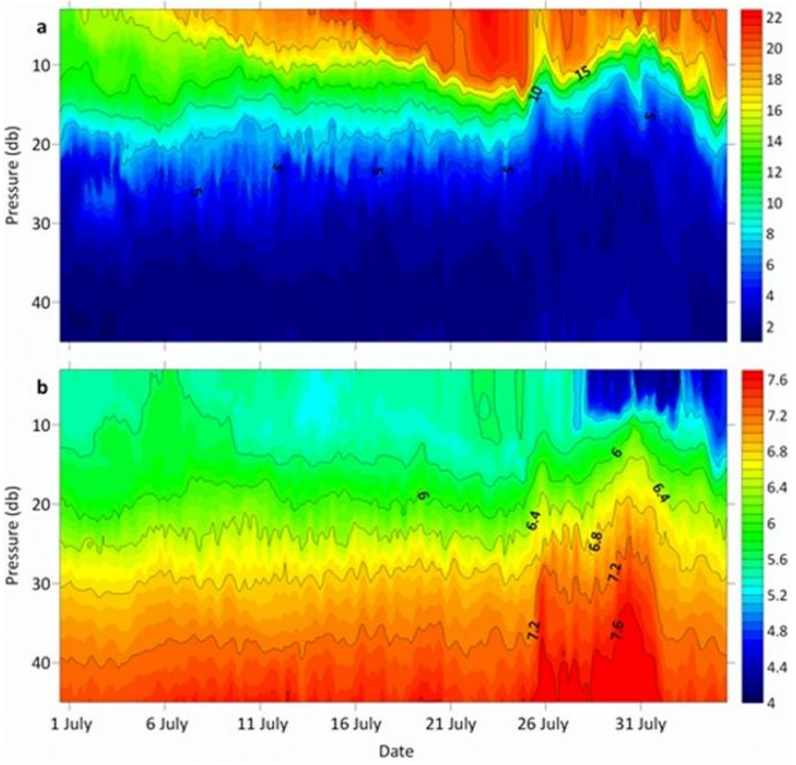
Tallinn

3 upwelling events

Comparing FerryBox and buoy data

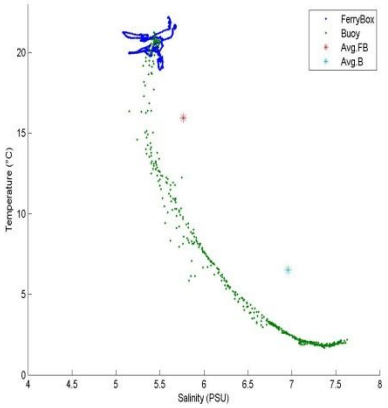
- Upwelling event taking place 24.07.2010 – 02.08.2010





Results I (I – IV)

19.07.2010



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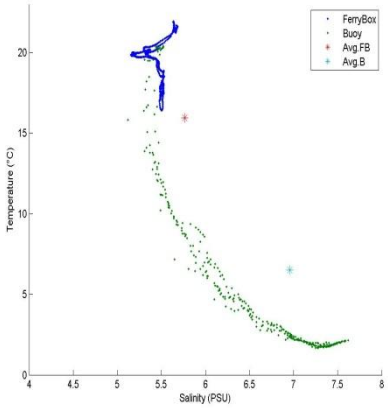

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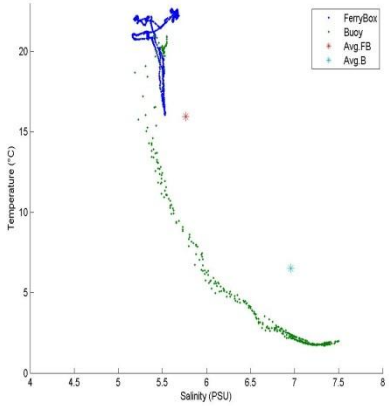

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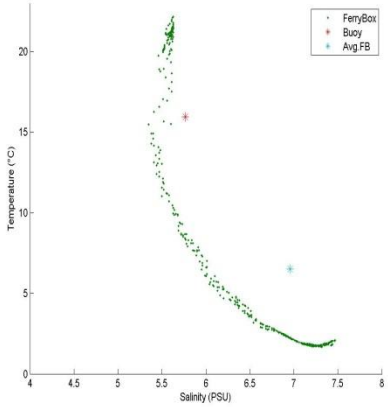

Results II (I – IV)

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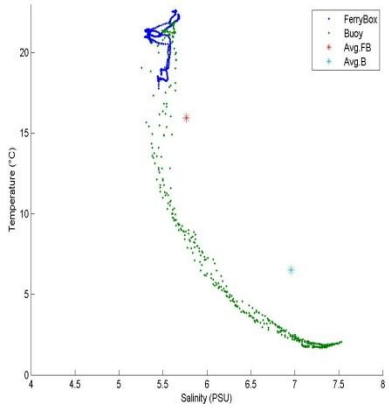

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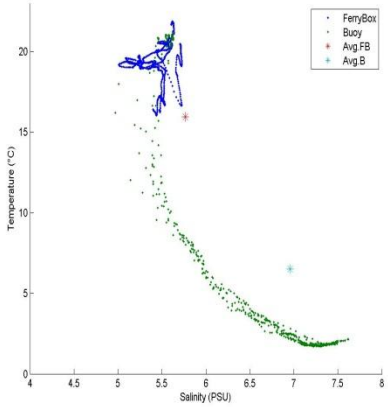

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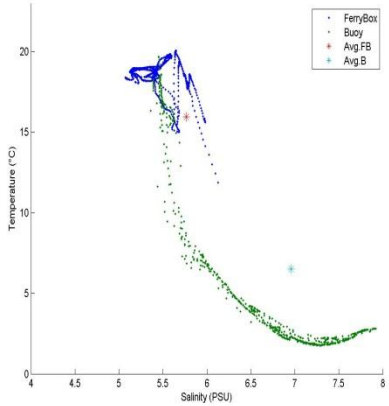

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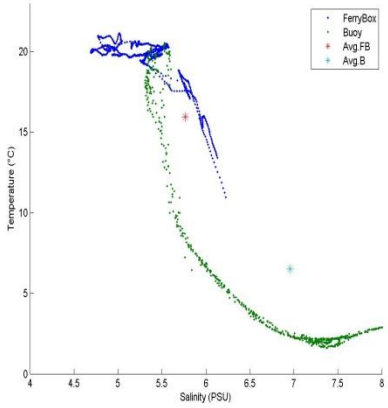
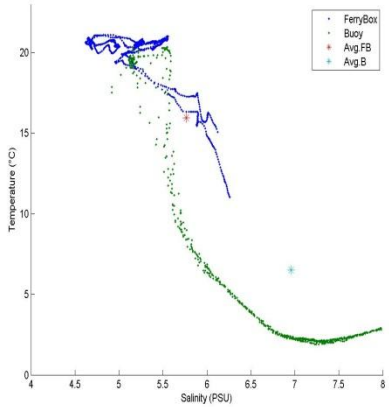


Results III (I – IV)

27.07.2010



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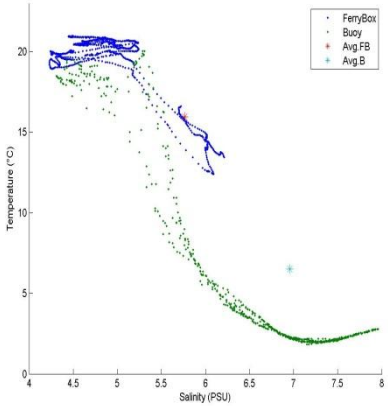

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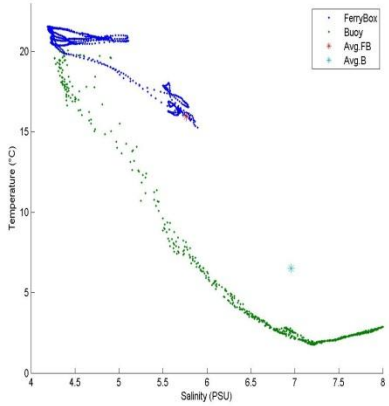

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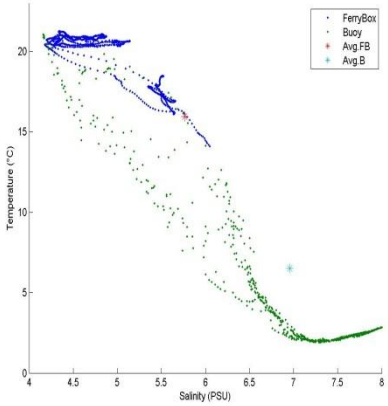
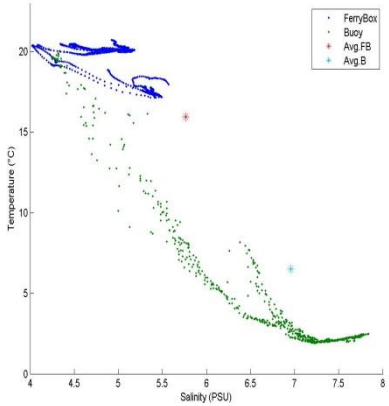
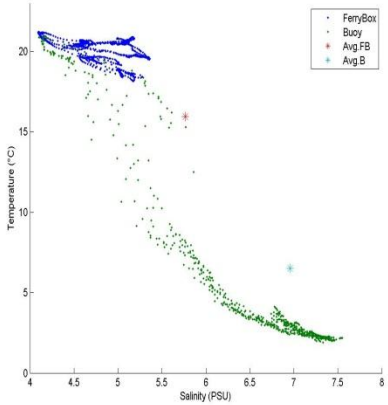


Results IV (I – IV)

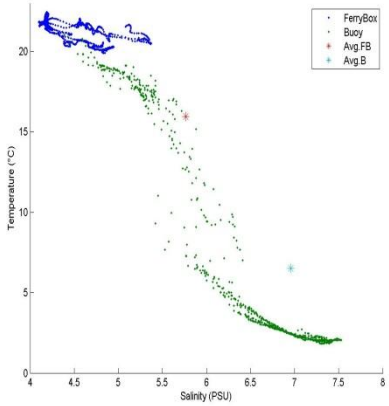
31.07.2010



01.08.2010



02.08.2010



Upwelling water not coming directly from the bottom, but rather mixing the water masses.

Conclusions

- Could provide upwelling statistics with given method
- Combing data with other measurments i.e. buoy, CTD probing – provides 3D data for detailed information
- Better understanding upwelling water properties for southern coast taking into account shore characteristcs

Thank you for attention.

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