Greek Argo
Ελληνική Υποδομή Αργώ

5th Euro-argo User Workshop

Brest, March 16-17 2015

Hydrological variability of the Eastern Ionian and Adriatic Seas derived from two new Argo missions in 2014

Kassis, D.[1,2], Perivoliotis L.[1] and Korres, G.[1]

[1] *INSTITUTE OF OCEANOGRAPHY, HELLENIC CENTRE FOR MARINE RESEARCH*

[2] *Department of Naval Architecture and Marine Engineering, National Technical University of Athens*

© HCMR/Yiannis Issaris

Greek Argo
Ελληνική Υποδομή Αργώ

5th Euro-argo User Workshop

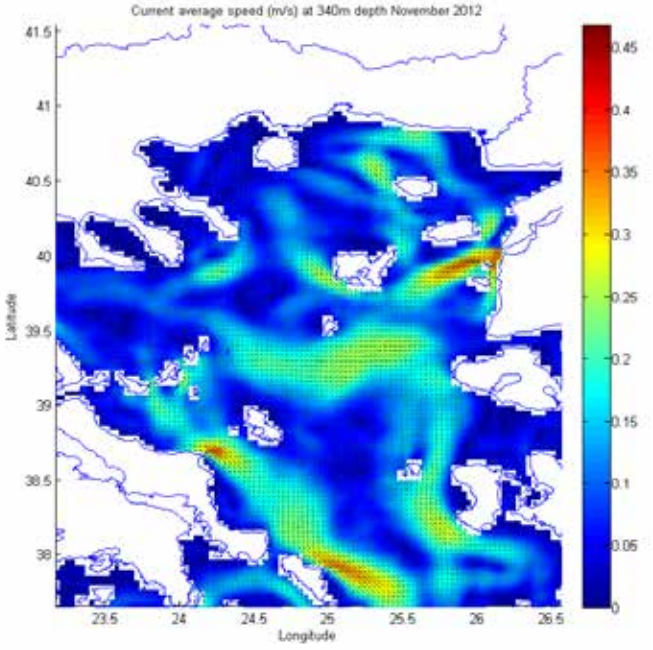
Brest, March 16-17 2015

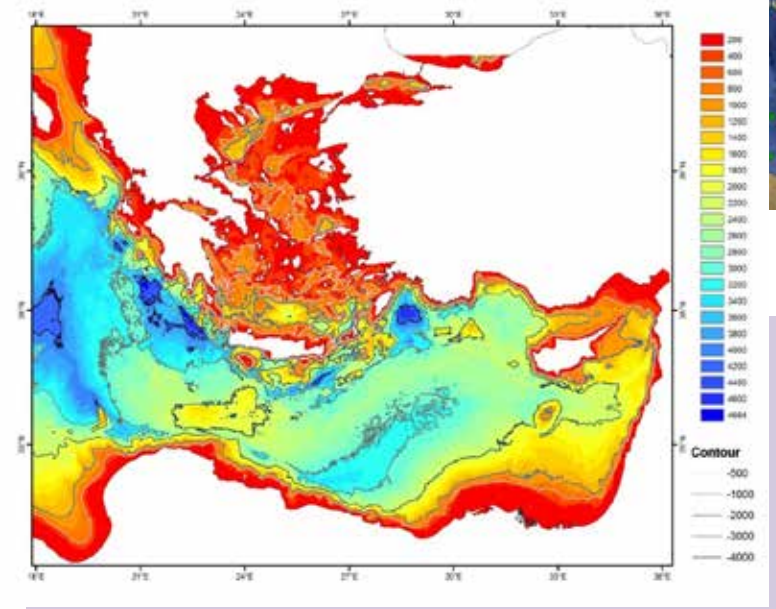
Greek Argo infrastructure (http://www.greekargo.gr/) was launched in 2012 funded by the National Strategic Reference Framework (NSRF) aiming to contribute to an enhanced monitoring over Aegean and Ionian seas as well as Eastern Mediterranean region in general.

The operational action plan of Greek Argo infrastructure included the purchase and deployment of 25 new floats for the next 5 years, covering in that way semantically the monitoring needs of the whole region.

In this plan it was taken into account:

- Ø The “gaps” need to be filled
- Ø The complex topography of the region
- Ø The general circulation features





An interesting statistic for the wider region of the Eastern Mediterranean Sea is the lifetime expectancy of the floats(approximately 100 cycles per float).

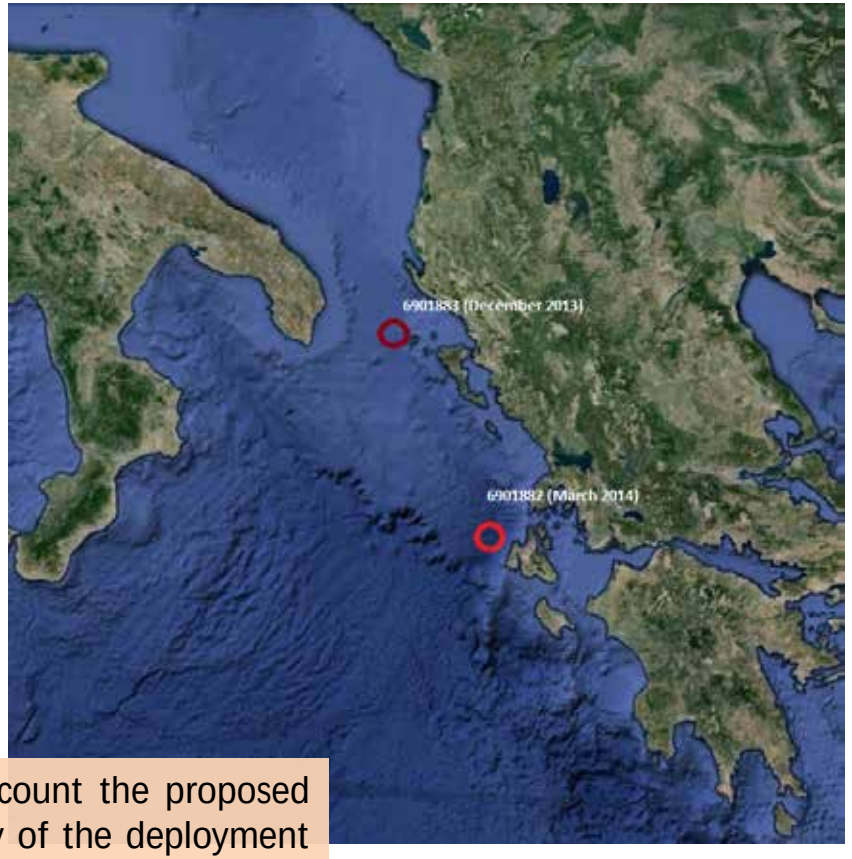
This appears to be 20% less than of those in the Western part. This fact is mainly due to complex bathymetry and topography of the region.

By becoming a member of Euro-Argo ERIC, the Greek-Argo infrastructure is fully aligned with the key objectives of the European infrastructure.

In the framework of IONIO INTERREG-III project, two Argo floats were deployed in the Ionian Sea basin during last year, under the Greek Argo Infrastructure coordination.

	NOVA
WMO	6901883 6901882
T range	-5°C to 45°C
T accuracy	±0.002 °C
T resolution	0.001°C
S range	2 psu to 45 psu
S accuracy	±0.005 psu
S resolution	0.001 psu
P range	0 bar to 2500 dbar
P accuracy	±1 dbar
P resolution	0.1 dbar

The NOVA type standard CTD floats were deployed in the Northern and Central Ionian basin, being the first Greek Argo floats in the area.

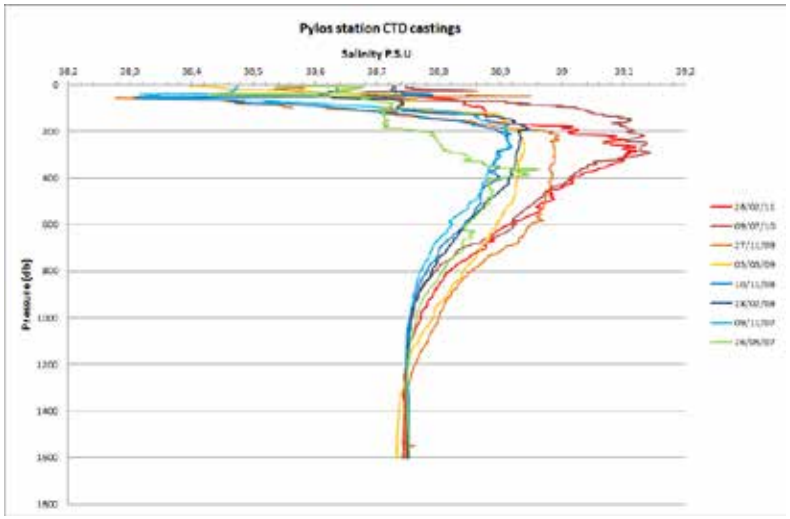


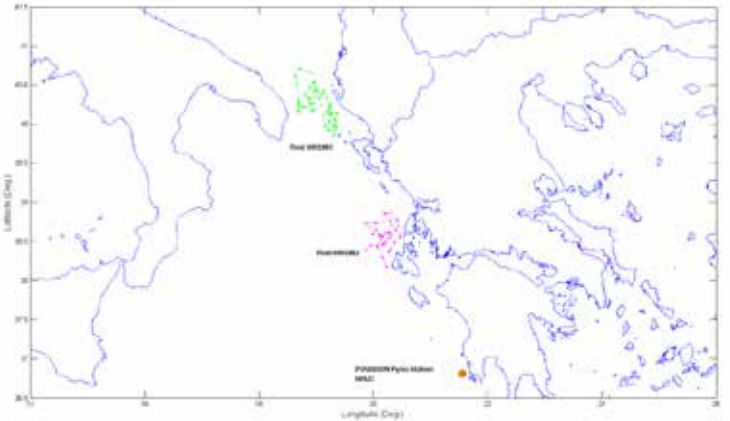
The floats are integrated in the MedArgo project taking into account the proposed sampling strategy for the Mediterranean Sea and the bathymetry of the deployment site and the adjacent areas, the mission parameters of the floats were set as follows: parking depth 350m, profiling depth to 1000m and cycle period 5 days (Molcard et al., 2003; Poulain et al., 2007). The raw data of the Greek float are delivered at the Coriolis data Centre where the real time quality control takes place while the delayed mode quality control of the data are processed by the MedArgo Centre at OGS.

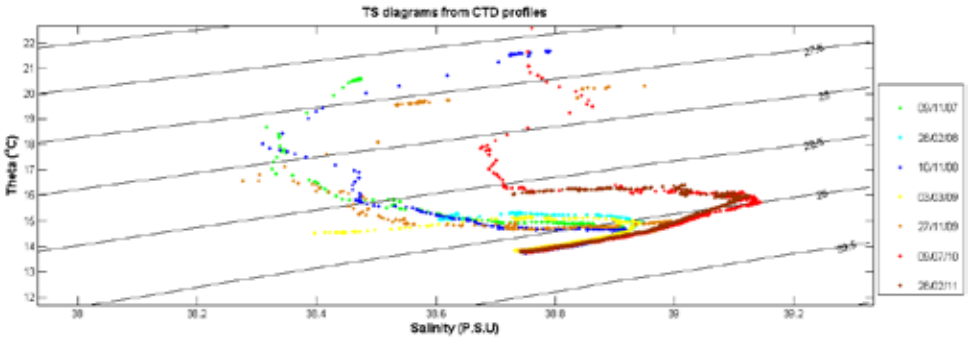
MedArgo

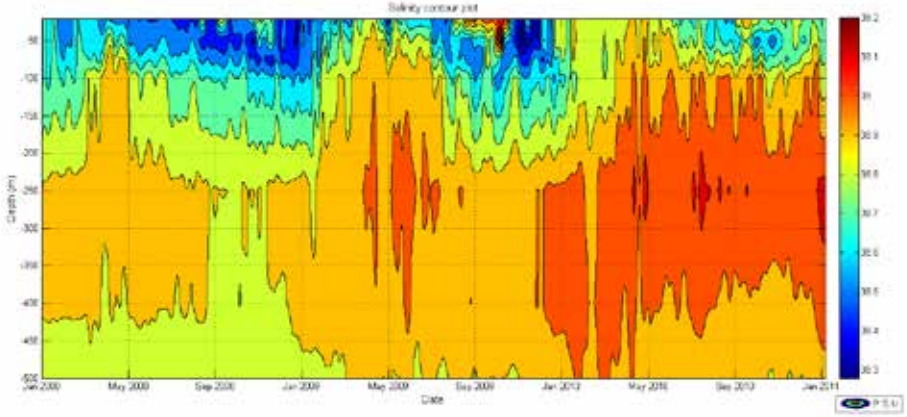
South Ionian features

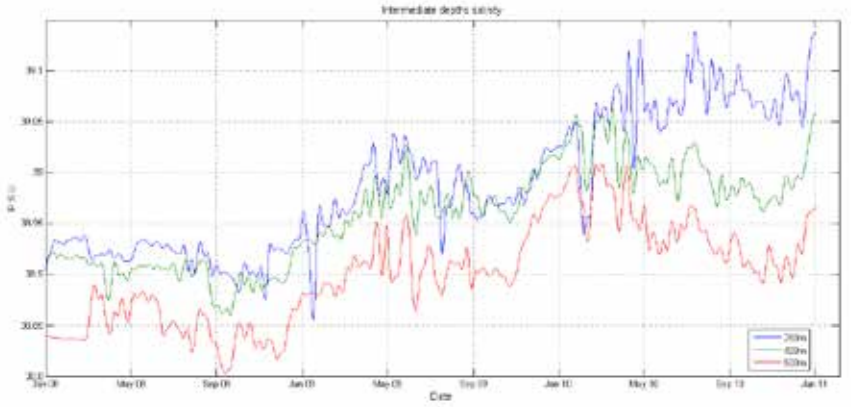
Inter-annual variability signals, such as a strong signal of LIW, are observed at intermediate depths introduced during the spring of 2009 and becoming dominant during 2010 covering the subsurface and intermediate depth area (Kassis et al., 2013).



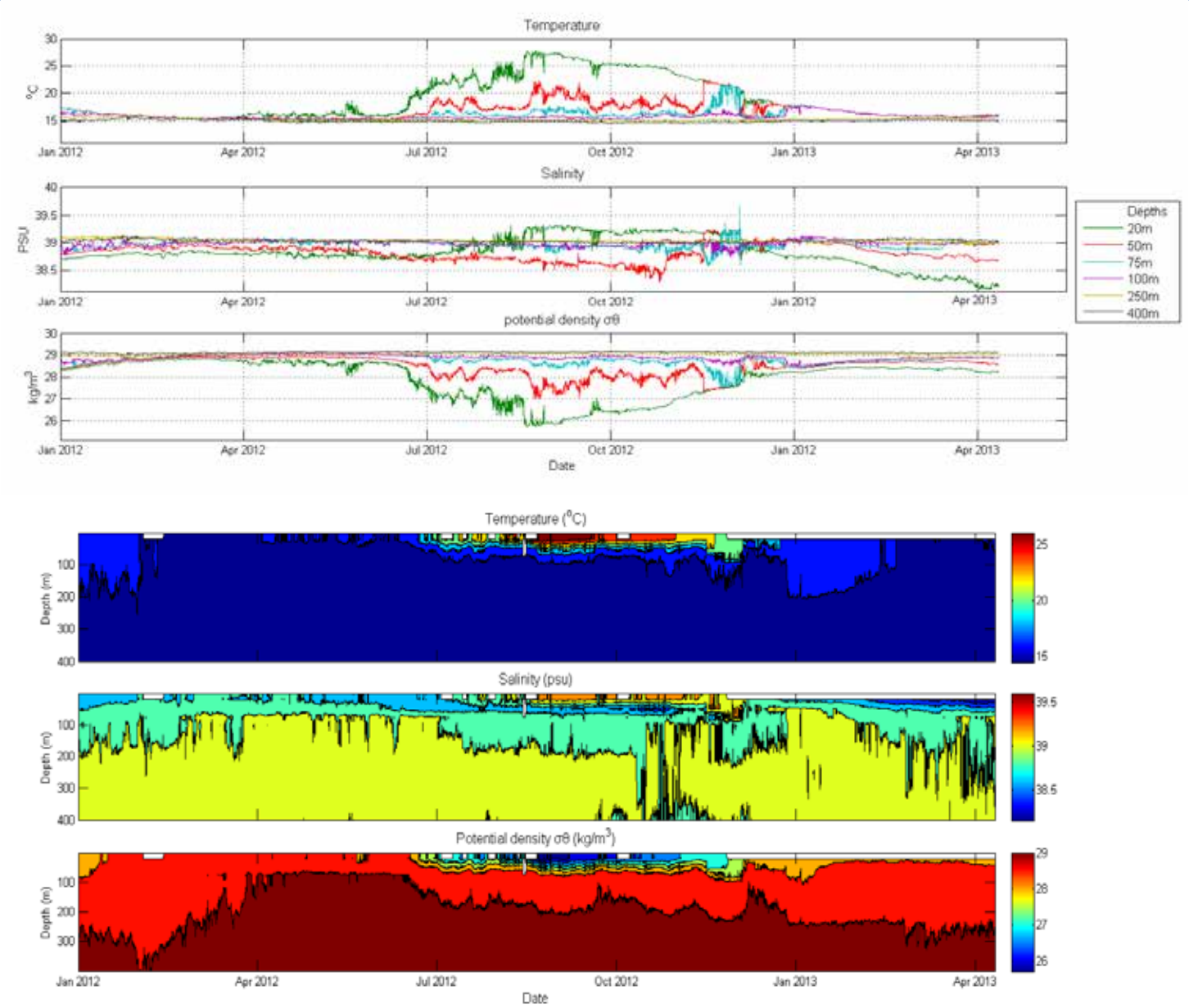




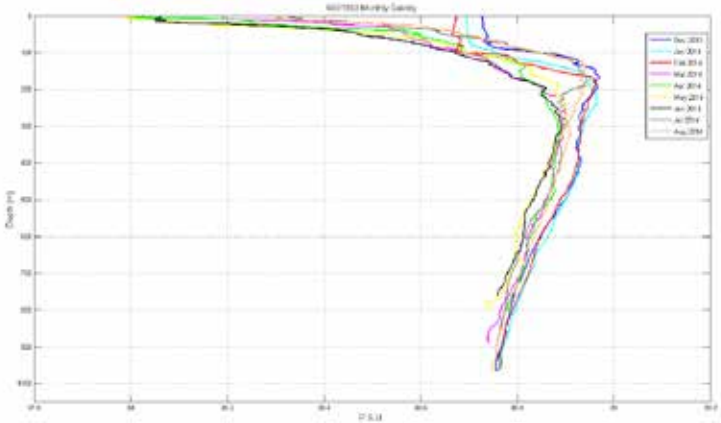


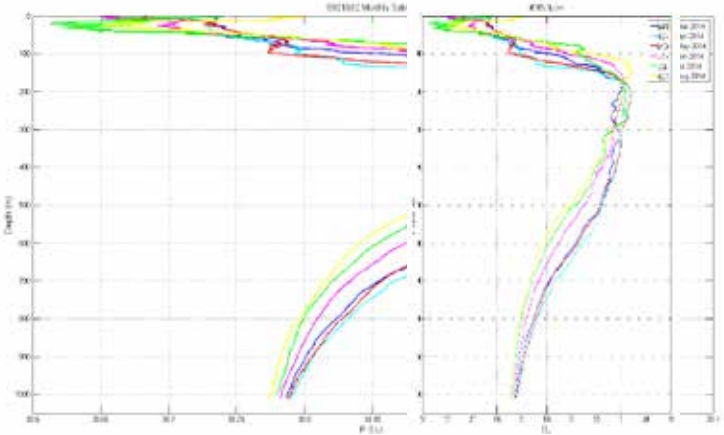


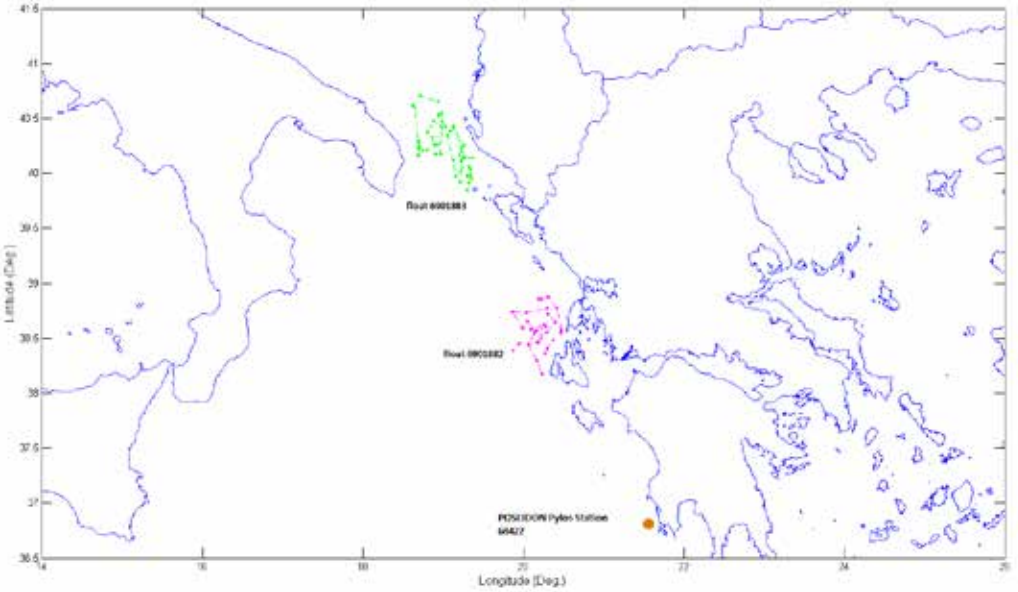
2012-2013

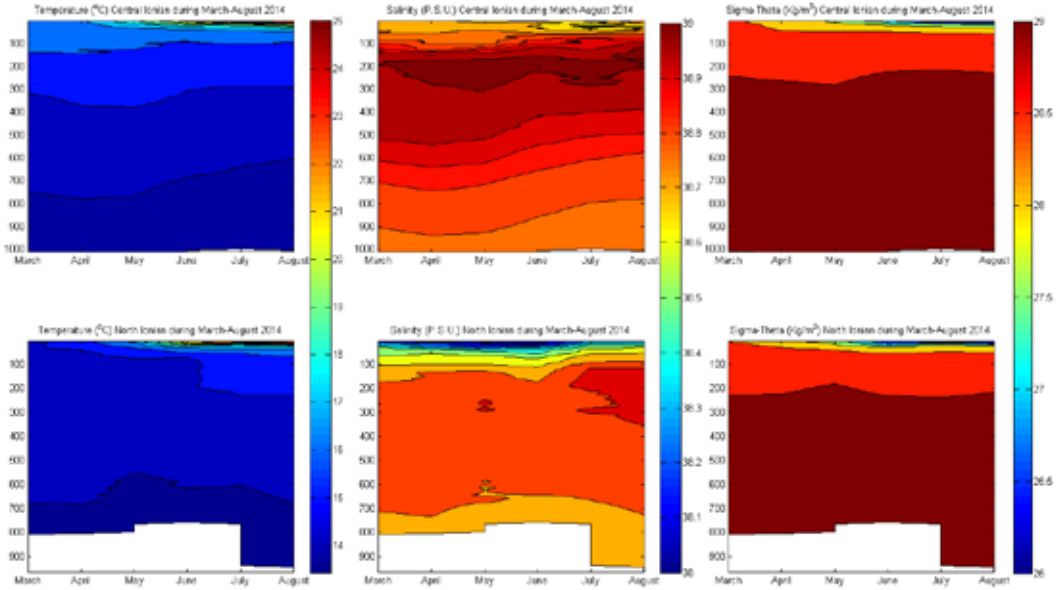

Temperature
°C
Salinity
PSU
potential density σθ
kg/m3
Jan 2012
Apr 2012
Jul 2012
Oct 2012
Jan 2013
Apr 2013
Date
Depths
20m
50m
75m
100m
250m
400m
Temperature (°C)
Salinity (psu)
Potential density σθ (kg/m3)
Depth (m)

Argo floats 1st period (March – August 2014)

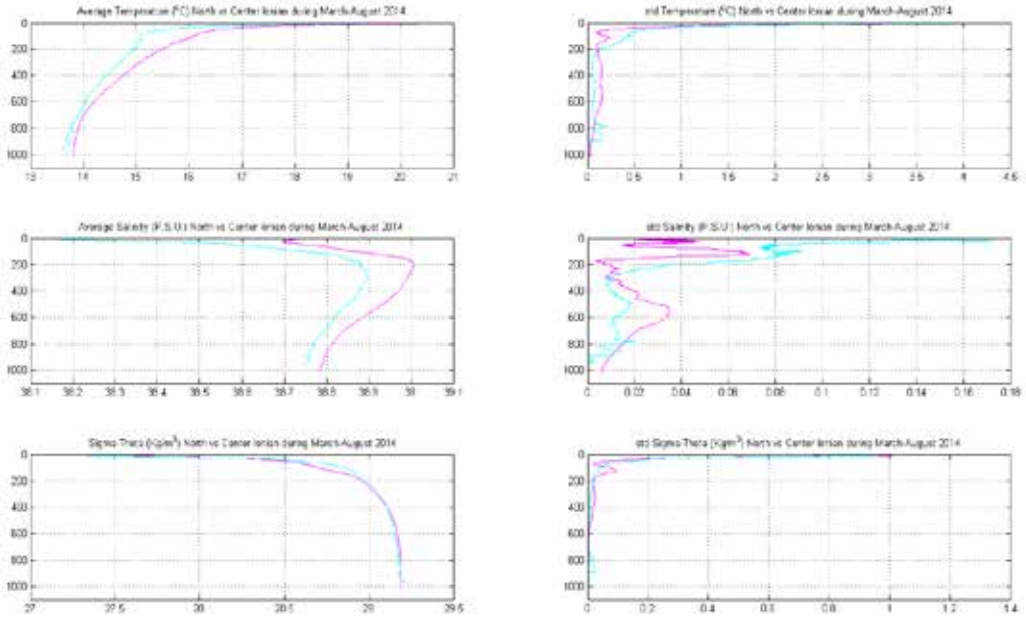








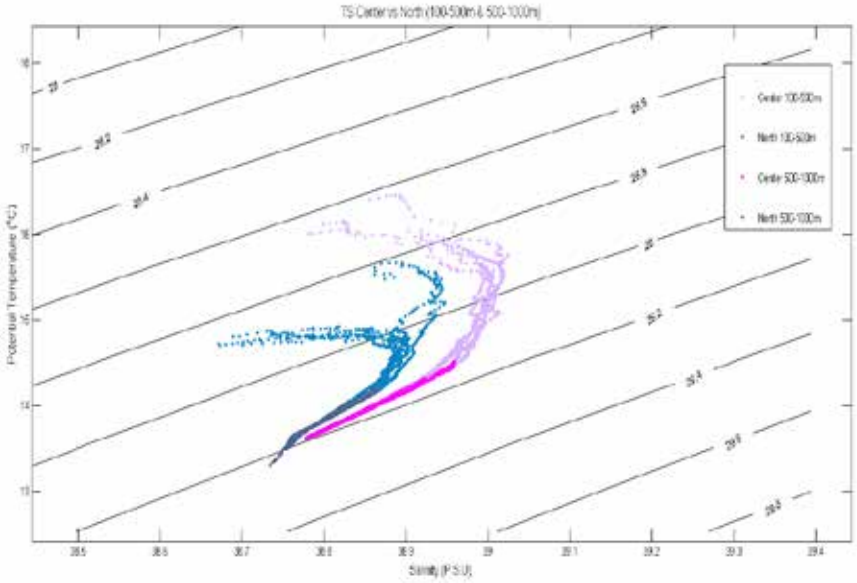
Ionian Argo floats 1st period (March – August 2014)



Differences in both temperature and salinity vertical distribution

Salinity: Strong LIW signal is presented in the central part that exceeds 39 psu at 200 m depth while at the northern boundaries this is still present reaching a maximum of 38.9 psu at 300 m

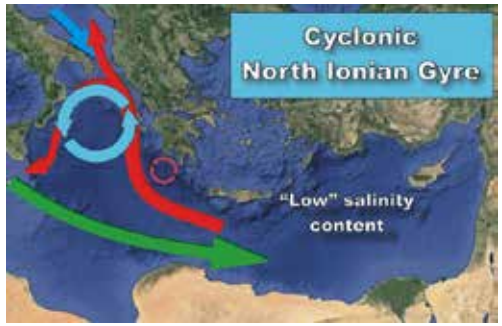
The largest temperature differences (~1.3 ºC) are shown within the 100 m depth zone which is also depicted in the density field with the northern part presented denser in these layers

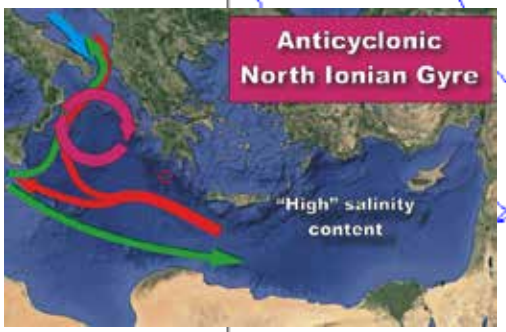


The Northern Ionian waters are denser in the 100-500 m layer while in the 500-1000 m layer this picture is reversed due to the saltier deep waters of the central part. Near 1000 m depth, the northern waters are presented denser (>29.2 kgm^{-3}) with characteristics similar to Adriatic Dense Water (AdDW) which is very likely to reach the Ionian in these depths. The 29.18 kgm^{-3} isopycnal at approximately 1100 m depth can be considered as the lower limit of the AdDW density in the Ionian (Gacic et al., 2014).

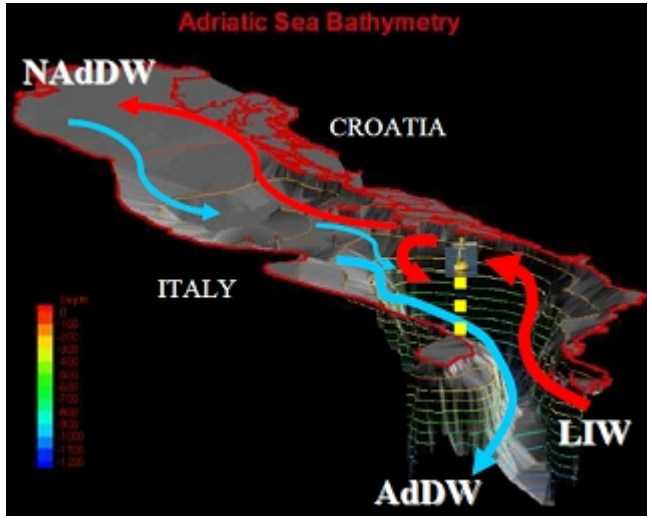
Ionian Argo floats 2nd period (August – December 2014)

Both float trajectories indicate a northward flow of water masses, at intermediate and deeper layers, towards the Otranto strait along the western Hellenic Arc.





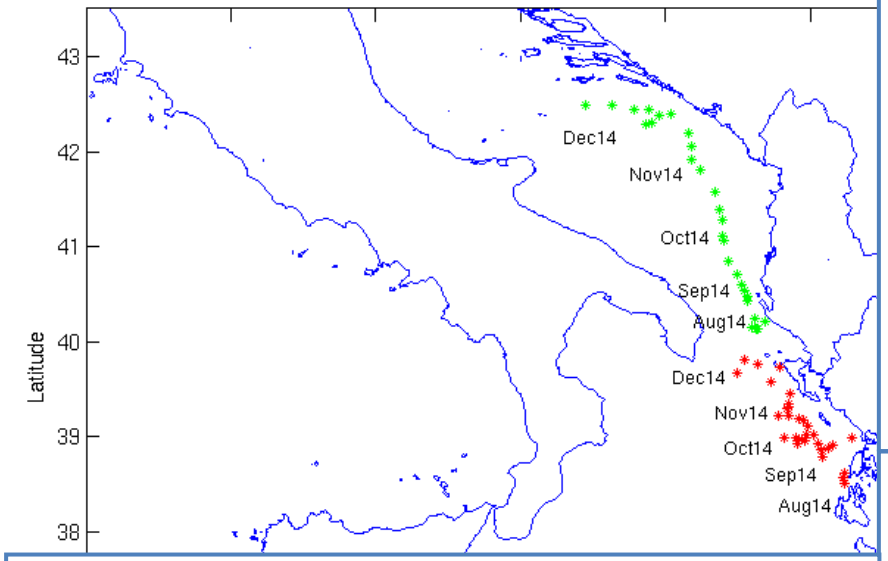
http://nettuno.ogs.trieste.it/e2-m3a/s_themes.html

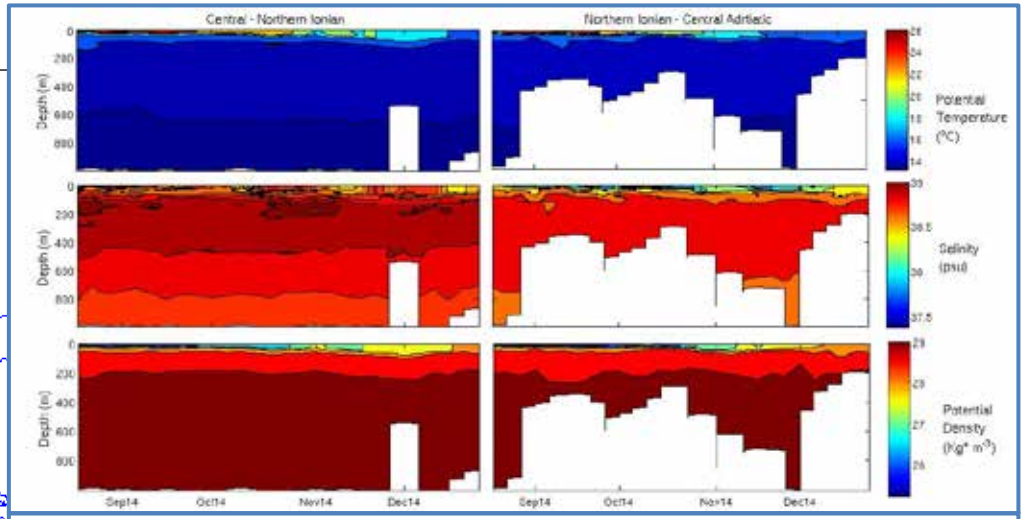


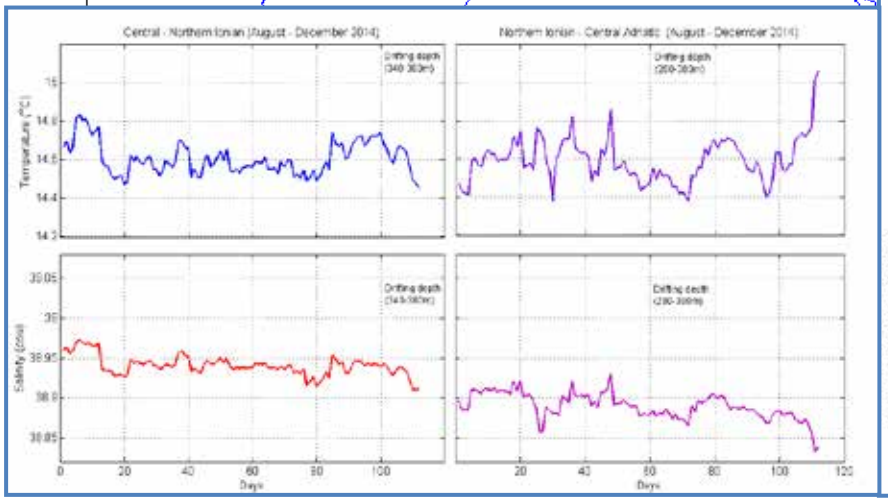
(Bensi et al., 2013)

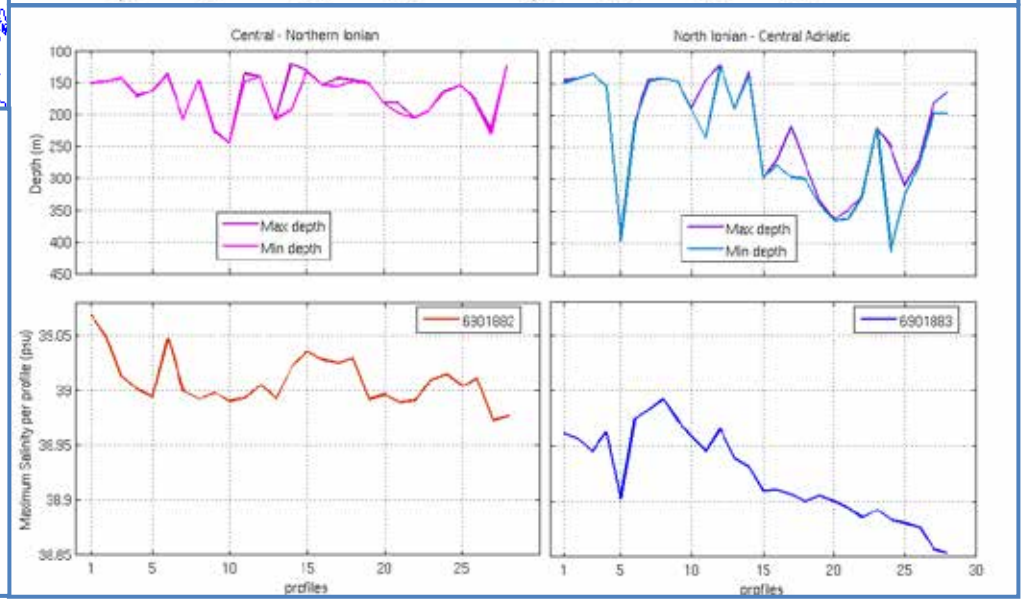
Altimetric maps showed that the last cyclonic mode started in 2011 but unexpectedly in 2012 reversed to anticyclonic (Gacic et al., 2014). This inversion was related to the extremely strong winter in 2012, which caused the formation of very dense Adriatic waters, flooding Ionian flanks in May and inverting the bottom pressure gradient. It is documented from altimetric data that the North Ionian Gyre circulation returned to a cyclonic one at the beginning of the 2013 (Gacic et al., 2014).

Ionian Argo floats 2nd period (August - December 2014)

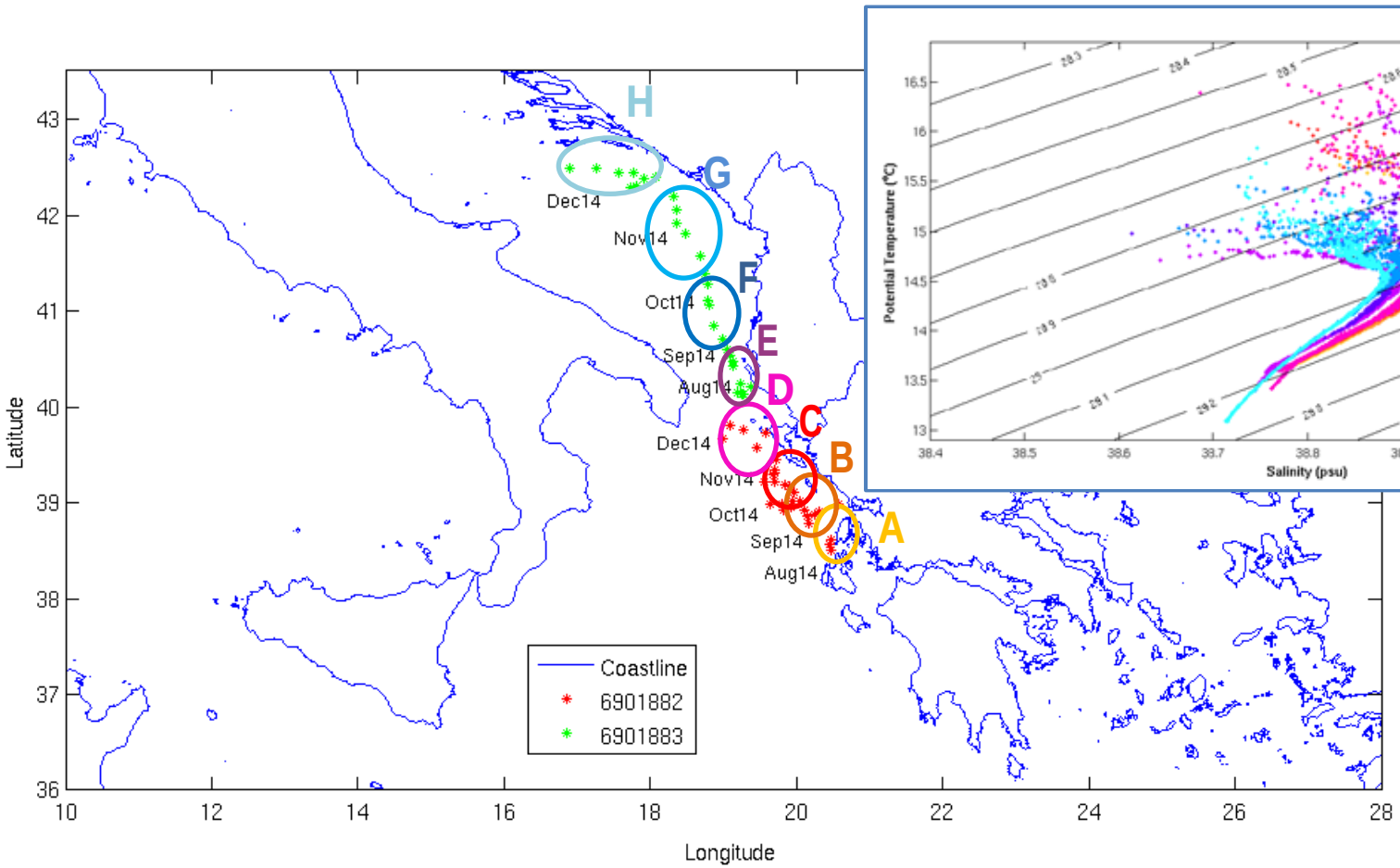








Ionian Argo floats 2nd period (August - December 2014)



100m-bottom

Summary - Discussion

The strong LIW signal (>39.1 psu) with characteristics similar to Cretan Intermediate Water (CIW) that was observed in the South Ionian Basin during 2009 & 2010 is still present during 2012-2014 but with reduced Salinity values (~0.1 psu less).

The circulation of the NIG presents a cyclonic pattern especially during the second half of 2014

LIW signal is also traced in the Adriatic Basin during the same period with salinity reduced by approximately 0.1 psu. Its core is presented in greater depths (150-350m) than in North Ionian (150-200m) probably due to mixing and cooling and fills the bottom layers of the shallow parts of the basin.

Regarding density field a discontinuity is presented on the border of the two basins. Adriatic waters are presented slightly less dense in all depth layers below 100m apart from the central eastern part of the basin where Adriatic Dense Water (AdDW) is observed with densities exceeding 29.2 $kg*m^{-3}$.

Northern Ionian waters are presented slightly denser in the 100-500 m layer while in the 500-1000 m layer this picture is reversed due to the saltier deep waters of the central part. Near 1000 m depth, the northern waters are presented denser (>29.2 kgm^{-3}) with characteristics similar to AdDW which reaches the Ionian in these layers.

Recent activity and future steps

Under Greek Argo two new floats were deployed (October 2014) in North and South Aegean while two more were deployed (November 2014) in South Ionian and Central Aegean Seas. The latter comprises a dissolved oxygen sensor.

Additional deployments in 2014

Aims and Targets

- A minimum of 3 new float deployments every year
- The new floats will fill gaps in under-sampled sea areas of the Eastern Mediterranean basin such as Aegean, Ionian and Western Levantine Seas.
- The use of these data will have short and long term benefits such as more comprehensive surveys of sea water processes and interactions, more reliable in situ data for operational modeling forecast and provide crucial information for climate studies.

hcmr
ΕΛΚΕΘΕ

References

Bensi, M., V. Cardin, A. Rubino, G. Notarstefano, and P. M. Poulain (2013), Effects of winter convection on the deep layer of the Southern Adriatic Sea in 2012, J. Geophys. Res. Oceans, 118,6064–6075, doi:10.1002/2013JC009432.

Gacic, M., Civitarese, G., Kovacevic, V., Ursella, L., Bensi, M., Menna, M., Cardin, V., Poulain, P.-M., Cosoli, S., Notarstefano, G., and Pizzi, C. (2014). Extreme winter 2012 in the Adriatic: an ex- ample of climatic effect on the BiOS rhythm, Ocean Sci., 10, 513–522, doi:10.5194/os-10-513-2014

Kassis D., Nittis K. and Perivoliotis L. (2012). Hydrodynamic variability based on the multi-parametric POSEIDON Pylos observatory of the south Ionian Sea. *Ocean Sci. Discuss*., 10, 883–921, 2013 doi:10.5194/osd-10-883-2013

Kassis D., Perivoliotis L. & G. Korres, 2014: Greek Argo: Towards monitoring the Eastern Mediterranean - First deployments preliminary results and future planning. In proceedings of the 7th International Conference on EuroGOOS, Lisbon – Portugal, 28-30 October 2014

Molcard A., Piterbarg, L. I., Griffa, A., Ozgokmen, T. M., and Mariano, A. J. (2003). Assimilation of drifter observations for the reconstruction of the Eulerian circulation field, *J. Geophys. Res*., 108(C3), 3056, doi:10.1029/2001JC001240.

Poulain, P.-M., Barbanti, R., Font, J., Cruzado, A., Millot, C., Gertman, I., Griffa, A., Molcard, A., Rupolo, V., Le Bras, S., and Petit de la Villeon, L. (2007). MedArgo: a drifting profiler program in the Mediterranean Sea, *Ocean Sci*., 3, 379-395, doi:10.5194/os-3-379-2007

Thank you

Acknowledgements

This work has been supported by the "Greek Research Infrastructure for Observing the Oceans – GREEK ARGO" project (ERDF 2007-2013) and the IONIO Interreg-III project funded by the European Territorial Cooperation Operational Programme "Greece-Italy" (2007 – 2013)

Greek Argo is coordinated by the Institute of Oceanography of HCMR and funded by the General Secretariat for Research and Technology (GSRT), Ministry of Education and Religious Affairs and the European Regional Development Fund (ERDF)

Euro-Argo website
http://www.euro-argo.eu
Greek-Argo website
http://www.greekargo.gr

Contact
Project coordinator:
Gerasimos Korres
gkorres@hcmr.gr

European Union
European Regional Development Fund

COMPETITIVENESS AND ENTREPRENEURSHIP OPC II
regions at the centre of development

NSRF 2007-2013
programme for development