



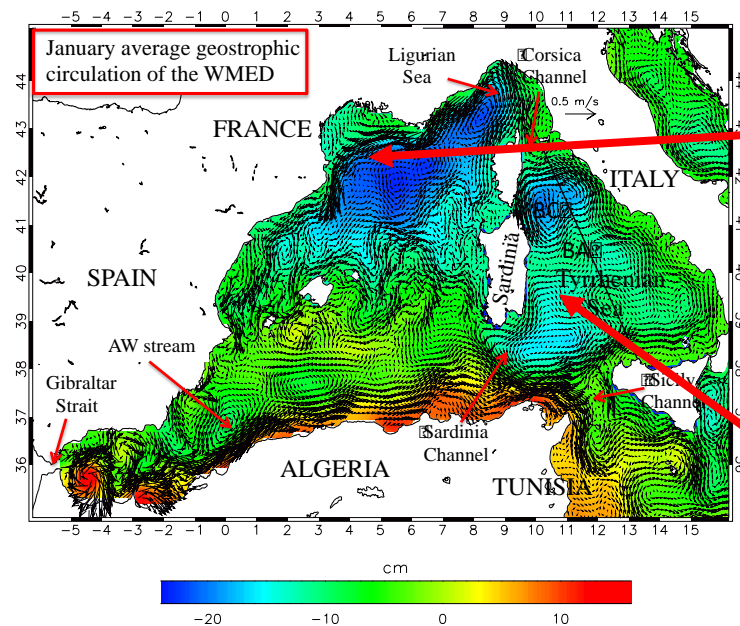
A study of the Tyrrhenian Intermediate Water (TIW) using ARGO floats, XBT and model data

Ernesto Napolitano(1), Roberto Iacono (1), Tiziana Ciuffardi(1), Franco Resegetti(1),
Pierre-Marie Poulain(2), Giulio Notarstefano(2)

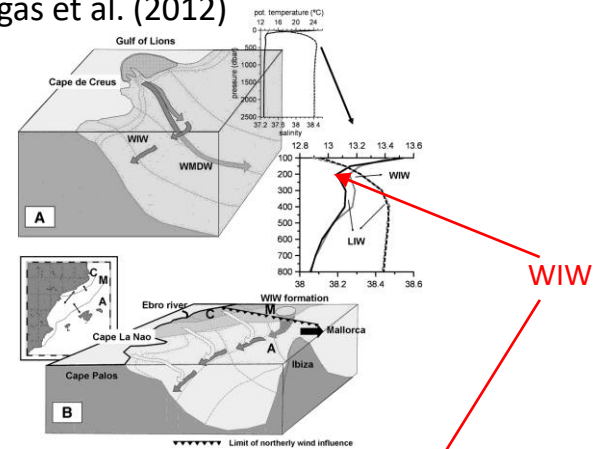
(1) ENEA – Italy

(2) OGS - Italy

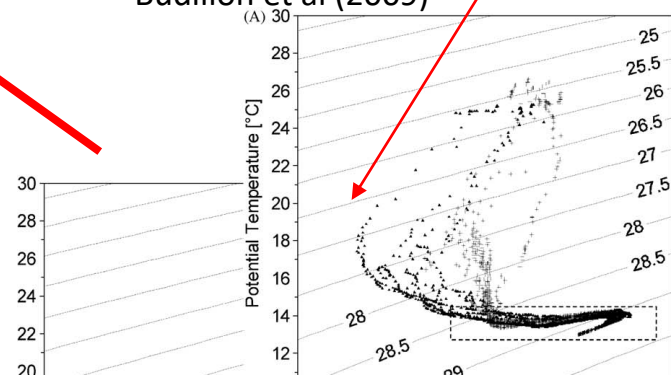
The *WIW* (Western Intermediate Water)...towards *TIW*



Vargan et al. (2012)



Budillon et al (2009)



Data and model

1) Argo float

Temperature and Salinity vertical profiles collected by Argo floats The data set consist of 3500 profiles collected by 49 Argo profiling float from 2004 to 2016.

2) XBT monthly data by the transect Genova-Palermo from 1999 to 2016

3) Oxygen data (NODC-NOAA historical ocean archive 1910-2012))

4) SST satellite data

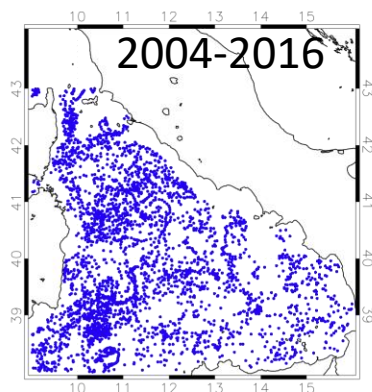
5) 1D Model simulations

6) NEMO Model outputs

ARGO profiles in Tyrrhenian Sea from 2004-2016

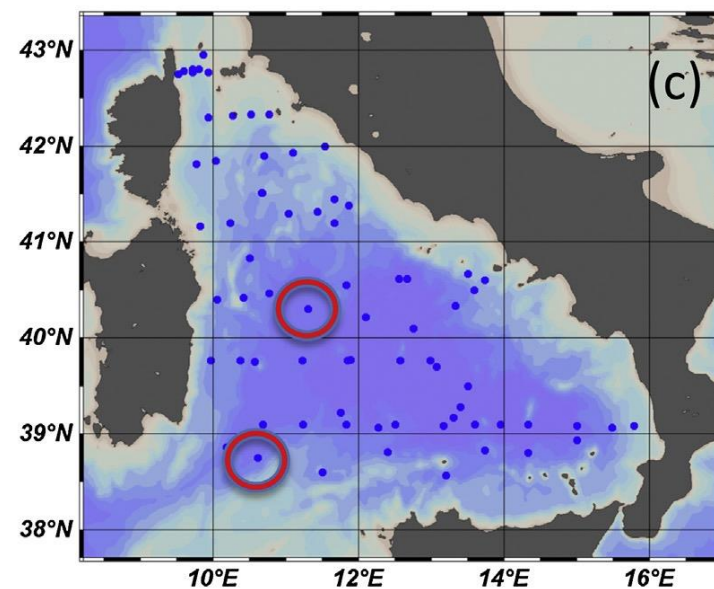
	Winter	Spring	Summer	Autumn
2004	41	55	24	48
2005	34	32	22	24
2006	26	28	24	18
2007	-	10	18	2
2009	29	28	18	26
2010	19	18	18	17
2011	23	70	96	87
2012	80	78	98	128
2013	155	184	188	146
2014	108	167	179	195
2015	222	255	283	291
2016				

ARGO float, XBT (ship opportunity) and Oxygen data (NODC archive)

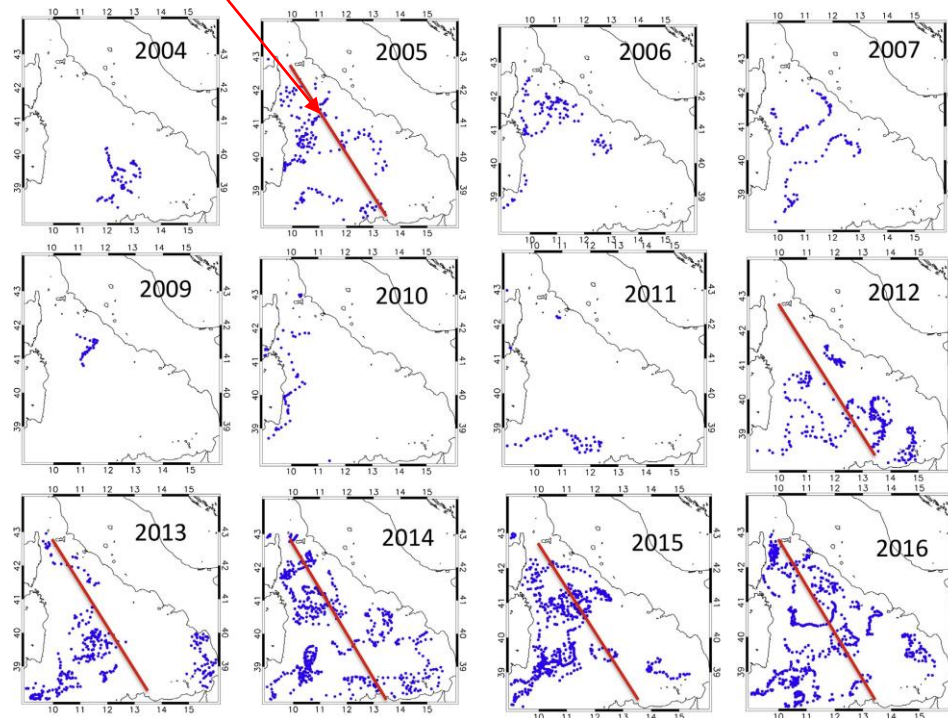


NOAA-Historical Data (1910-2016)

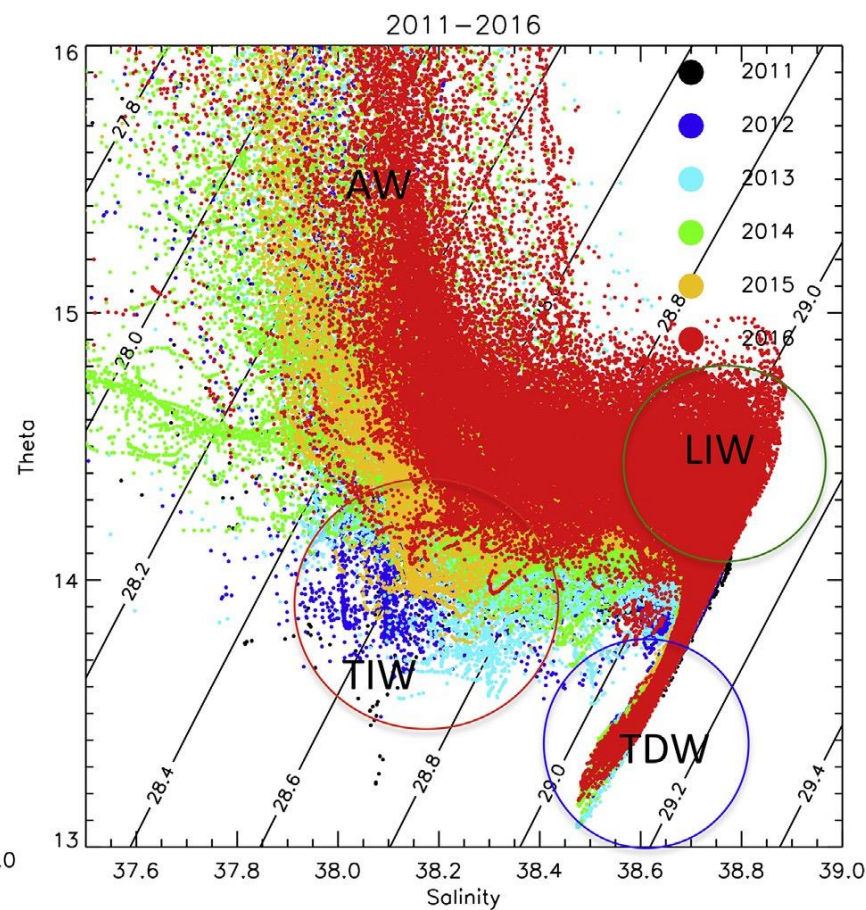
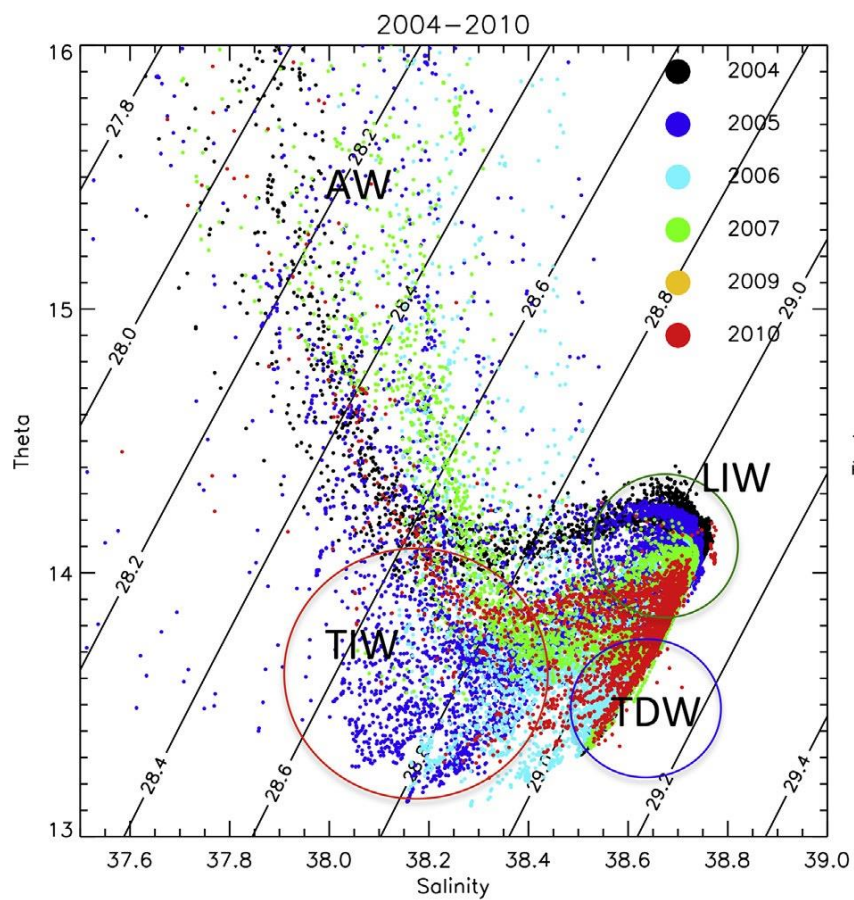
Oxygen [ml/l]



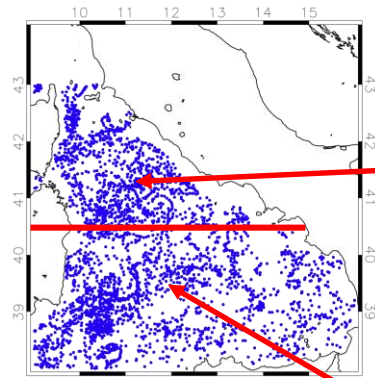
XBT transect
(by ship opportunity)



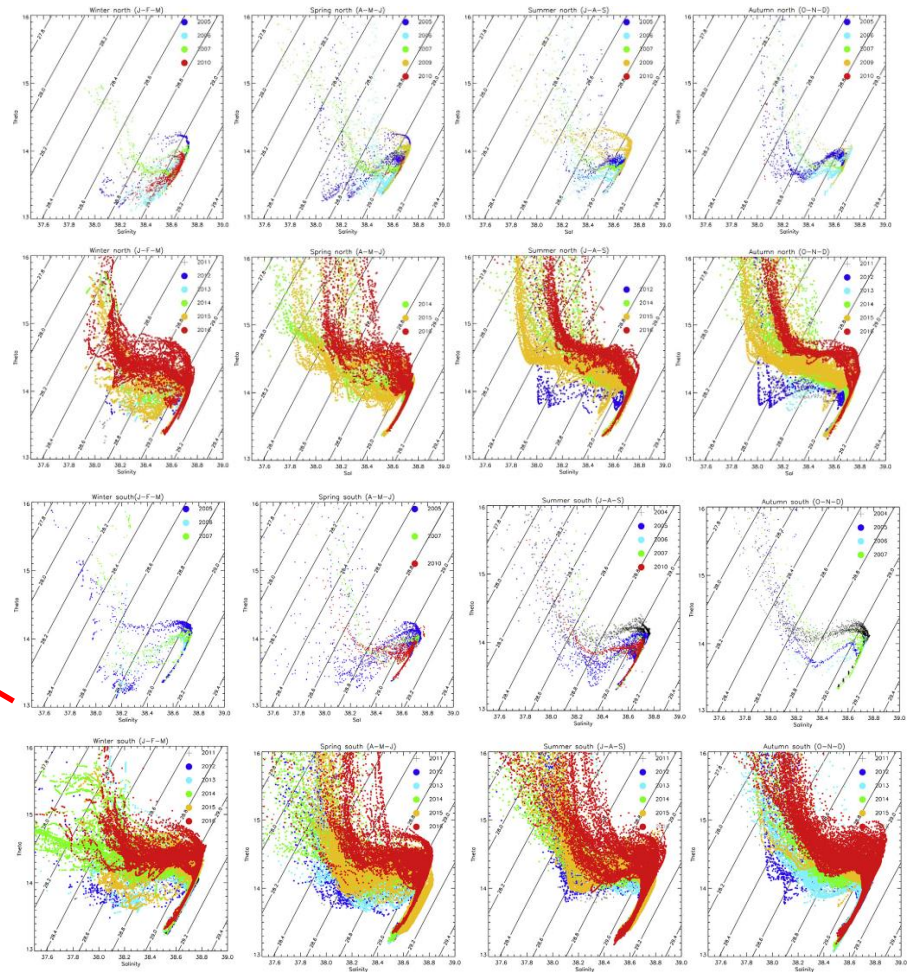
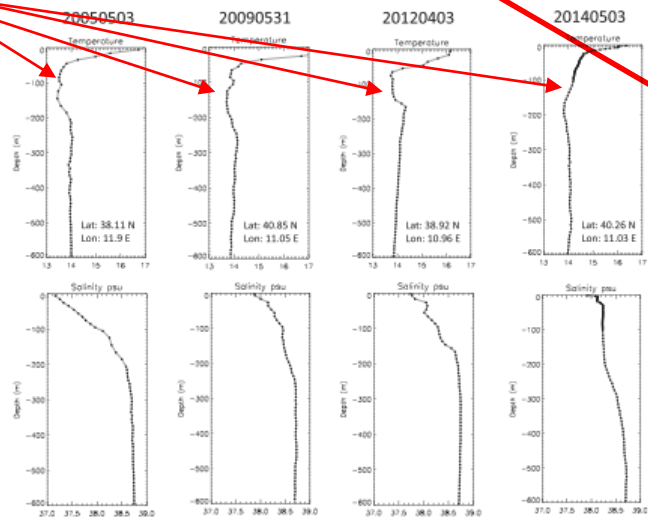
T-S diagram (ARGO data) in the Tyrrhenian Sea



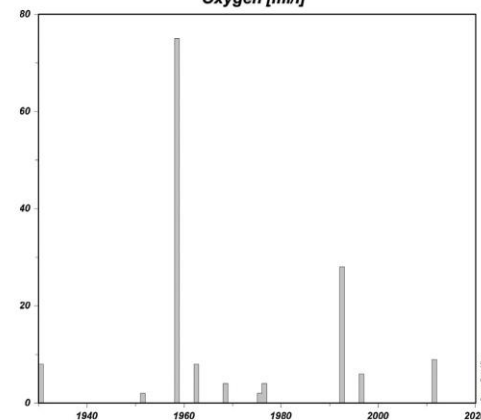
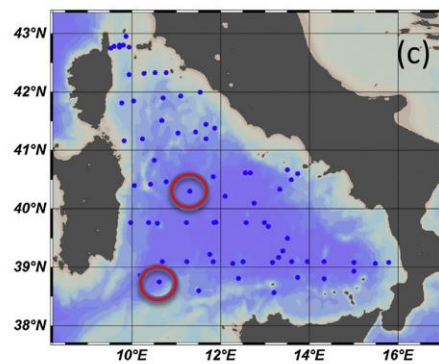
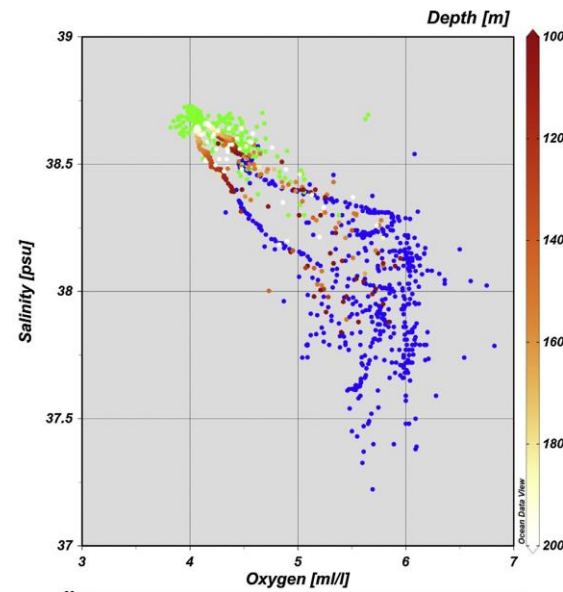
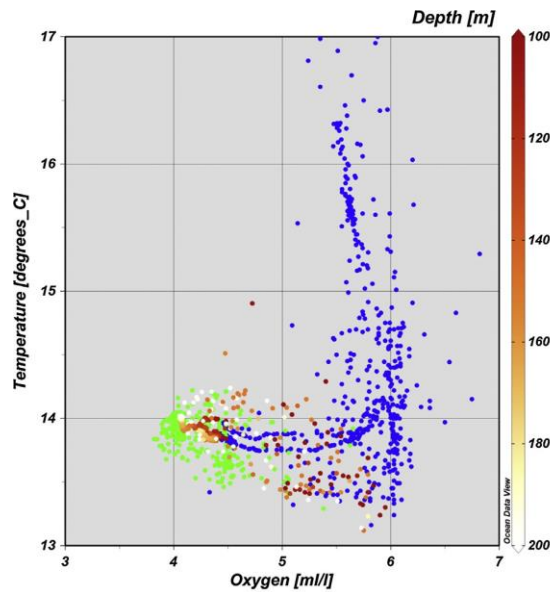
Seasonal T-S diagram and examples of profiles



TIW



Temp-Oxygen and Sal-Oxygen diagrams

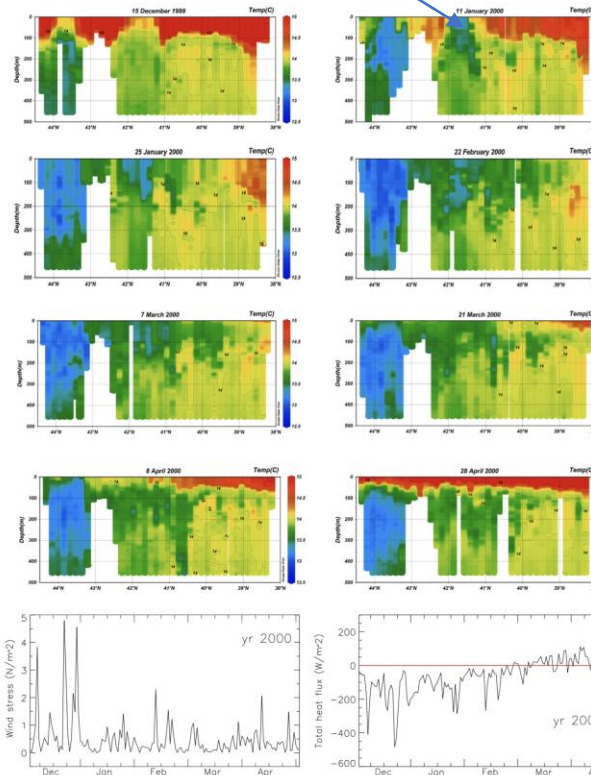


XBT transects (Genova –Palermo route). Two years as an example...

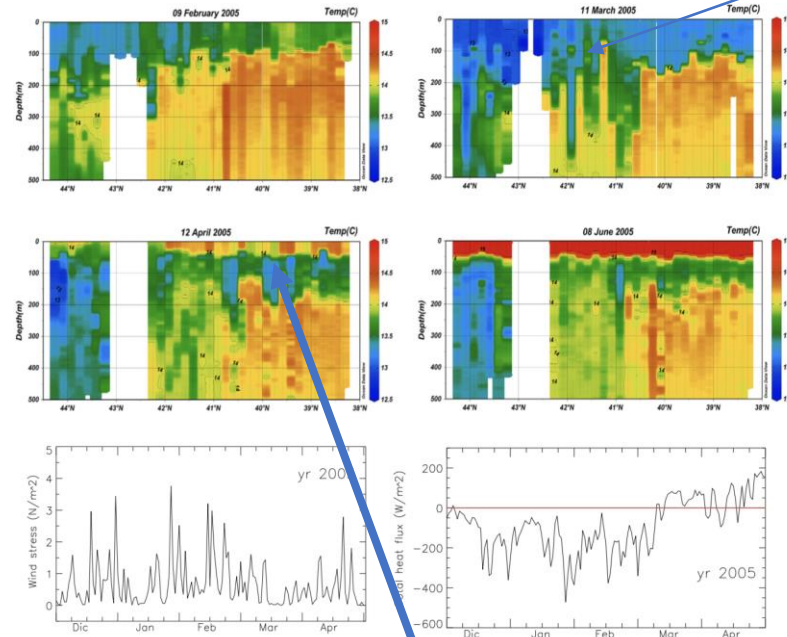
BG=Bonifacio Cyclonic Gyre

BG

2000



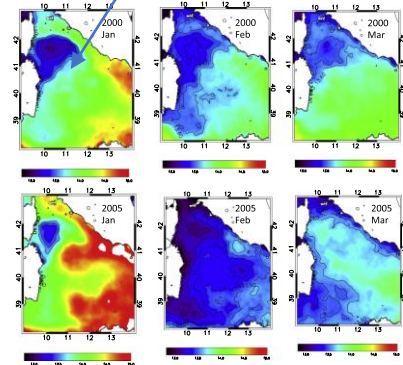
2005



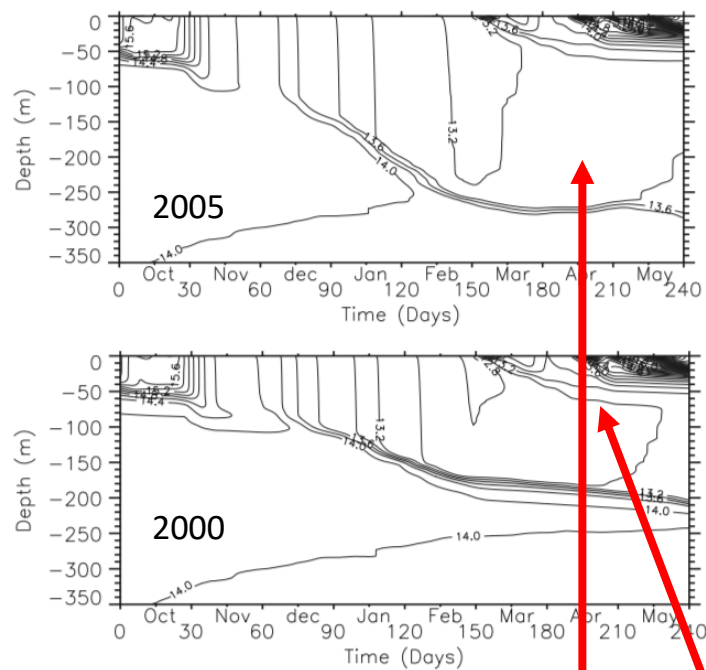
BG

BG

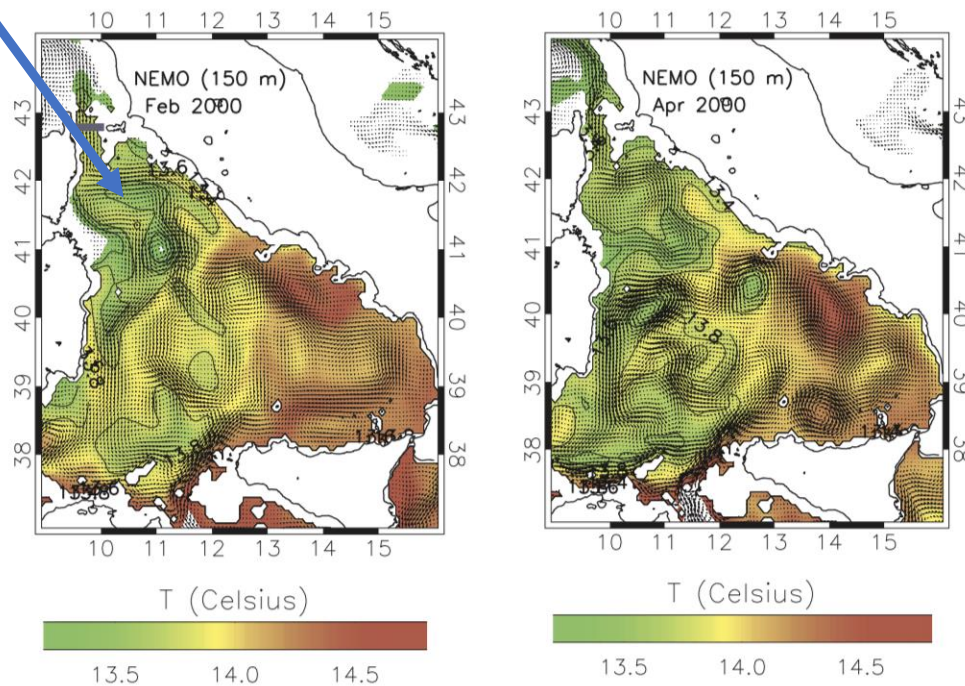
SST AVHRR data



TIW

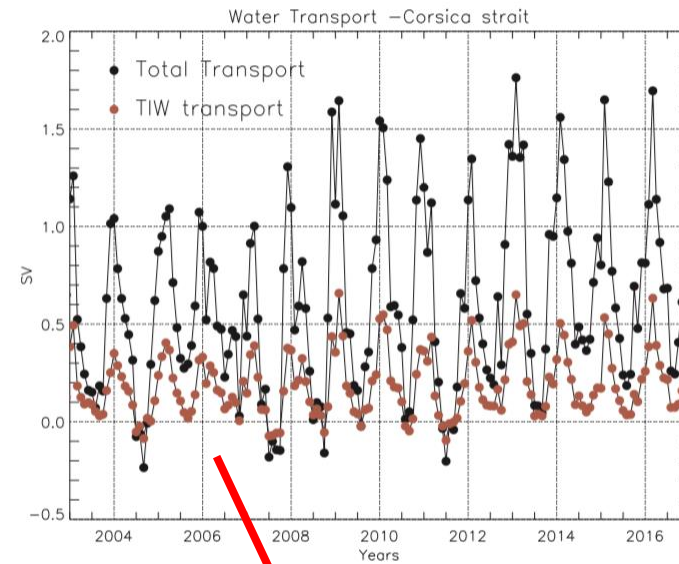
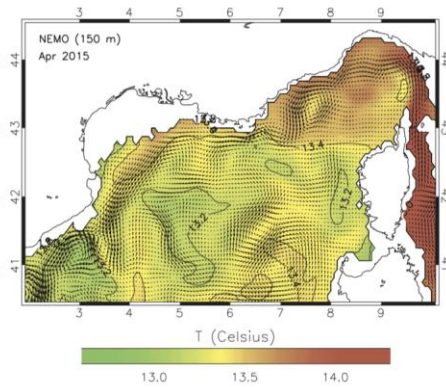
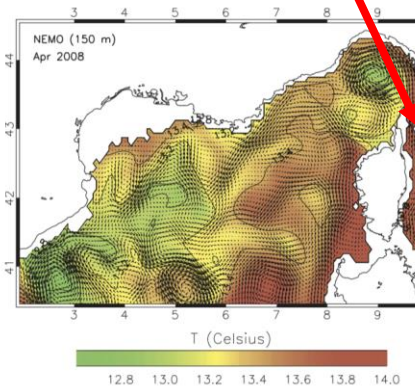
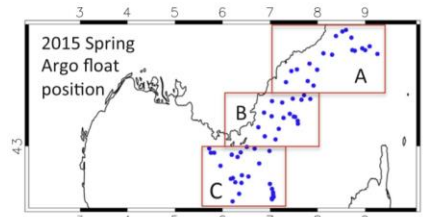
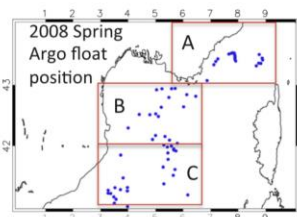
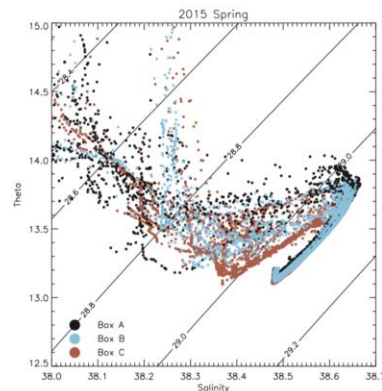
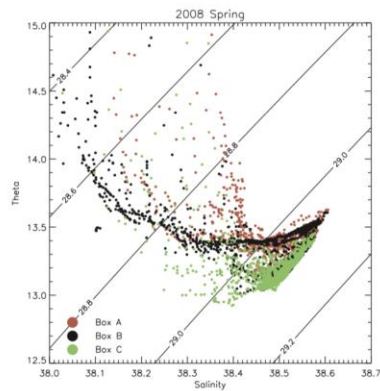
1D model simulations.**Stratification conditions of Bonifacio Cyclonic Gyre**

TIW newly formed water

Nemo model REANALISYS outputs

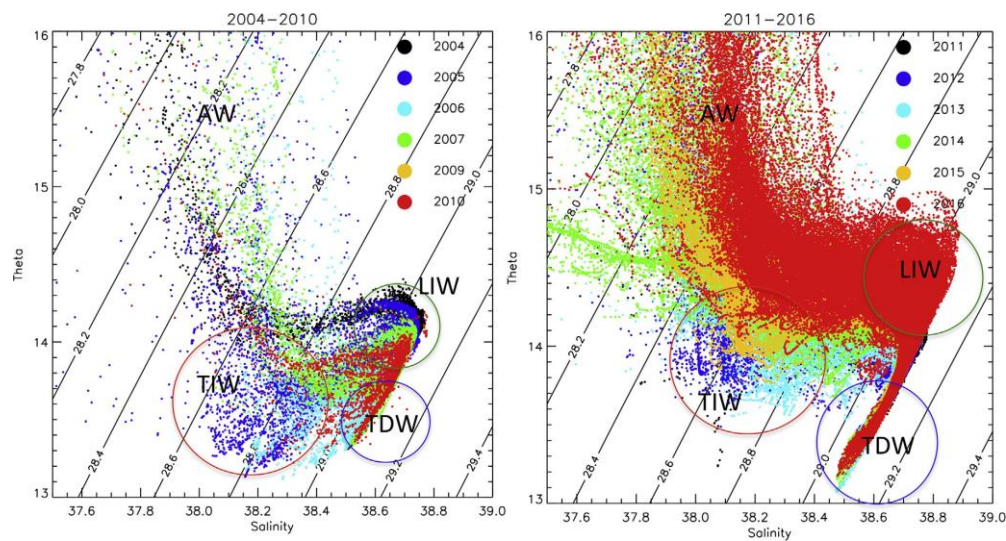
Export of TIW in the Liguro Provençal basin

ARGO floats in the Liguro Provençal Basin

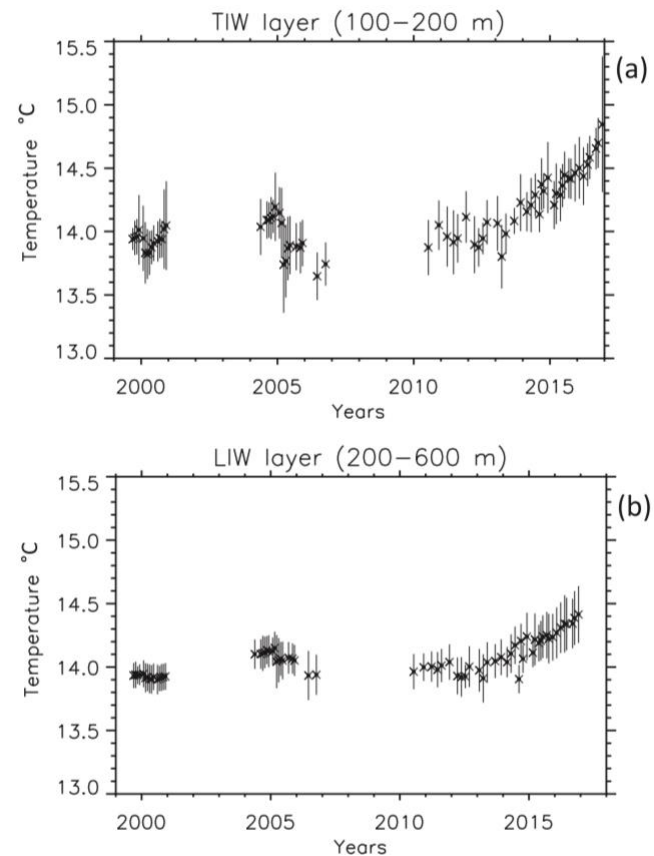


Recent changes in the intermediate waters in the Tyrrhenian sea

ARGO data



XBT data



Main results

- ARGO data shows that the TIW is present in a large portion of the TYS,*
- We have obtained strong evidence that the TIW is formed inside the TYS, through winter convection.*
- For the first time, we have shown (both using data and the 1D model) that the strong winter cooling produces deeper convection and mixing (down to 300-400 in the coldest years) in the northern region of the TYS,*
- Analyzing Argo measurements in the LPB and outputs from NEMO, we have shown that there is a robust TIW stream (which accounts for about one third of the total export from the Corsica Strait) that penetrates deep inside into the LPB,*
- Recent changes. TIW and LIW in TYS experienced a strong warming from 2004*

E. Napolitano, R. Iacono, T. Ciuffardi, F. Reseghetti, G. Notarstefano, P-M. Poulain (2018): **The Tyrrhenian Intermediate Water (TIW): Characterization and formation mechanisms,** *Progress in Oceanography*, <https://doi.org/10.1016/j.pocean.2018.10.017>