Changes in hydrological properties of the Mediterranean Sea over the last 10 years with focus on the Levantine Intermediate Water and the Atlantic Water

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Outline

1. **Introduction** à The Mediterranean Sea and its main water masses: the Atlantic Water (AW) and the Levantine Intermediate Water (LIW)

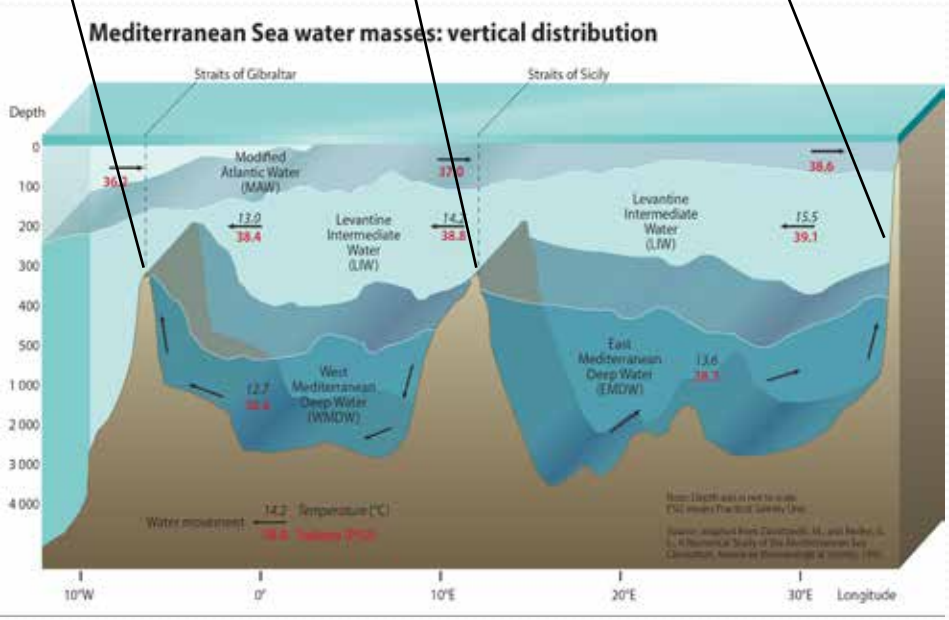
2. **Dataset** à Argo data between 2004 and 2014

3. **Methods** à identification of the water masses (LIW and AW) and trends (salinity and depth) computation

4. **Results** à ten years mean (salinity and depth) in 2X2 degrees boxes and trends in the various sub-basins of the Mediterranean Sea

5. **Conclusions**

1. Introduction



- Med Sea: semi-enclosed sea composed by two basins (EMED and WMED) with connection to the Atlantic Ocean and Black Sea

- Due to strong evaporation, the Mediterranean Sea is characterized by large salinity values and deep water formation

- Thermohaline changes of the deep water are caused by changes in the near-surface and intermediate levels characterized by the presence of two of the most important water masses (AW, LIW)

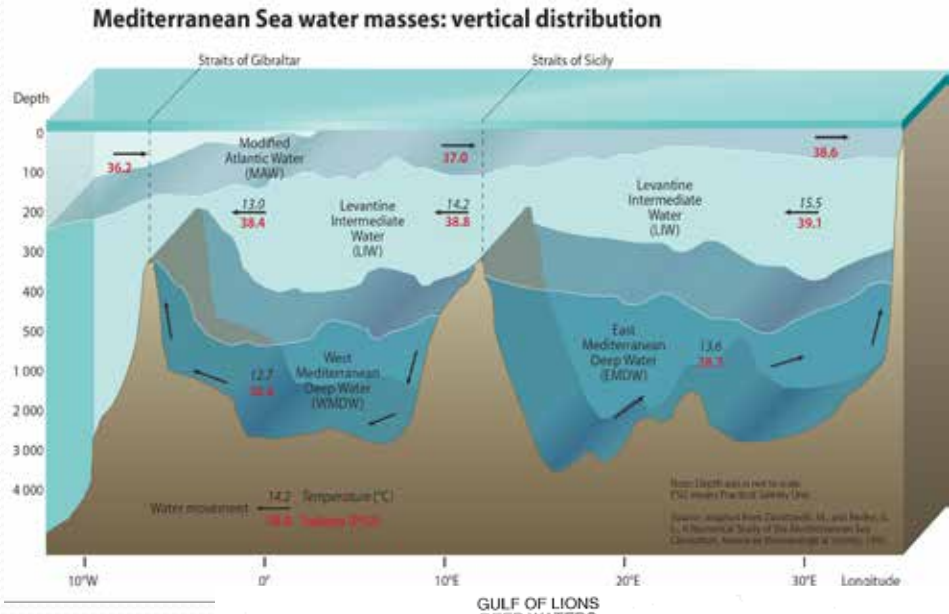
1. Introduction

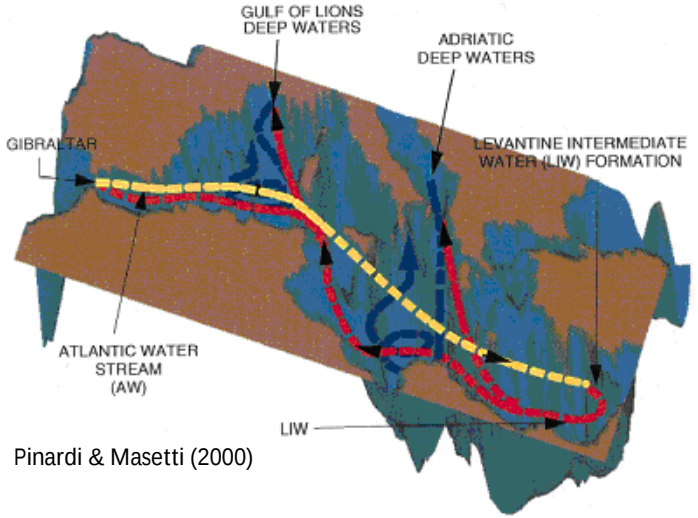
AW: near-surface layer (50 m), eastward path, characterized by the salinity minimum (36.2 at Gibraltar, 38.6 in the Levantine)

LIW: intermediate layer (350 m), westward path, characterized by the salinity maximum (39.1 in the Levantine, 38.4 at Gibraltar)

Aim of the study:

• investigate the recent (10 years) hydrological changes of the AW and LIW using Argo data à try to identify any significant salinity (the water masses' signature) and depth trends of these two water masses

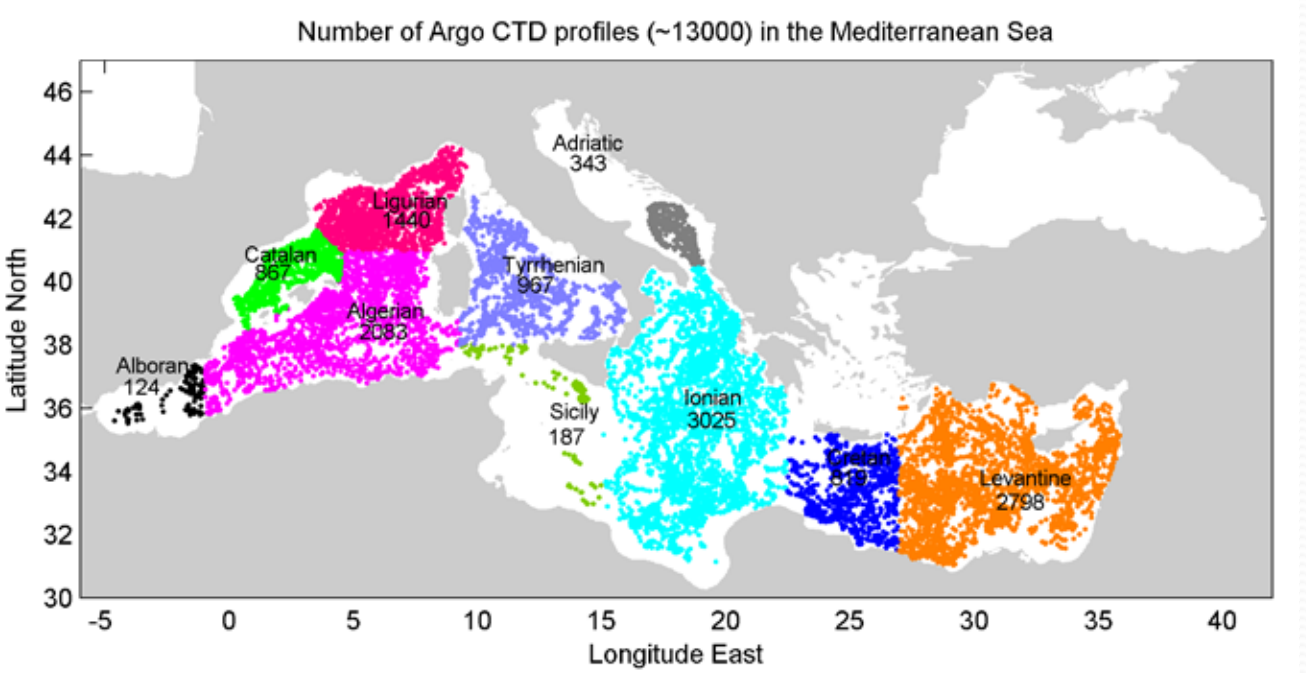




Pinardi & Masetti (2000)

2. Dataset

- ~ 13000 Argo salinity profiles (2004-2014)
- Sea Bird CTD sensor with accuracies of ± 0.002° C, ± 0.002 and ± 2 dbar for T, S and P
- cycle lenght 5 days, drifting depth 350 m, max profiling depth 2000 m



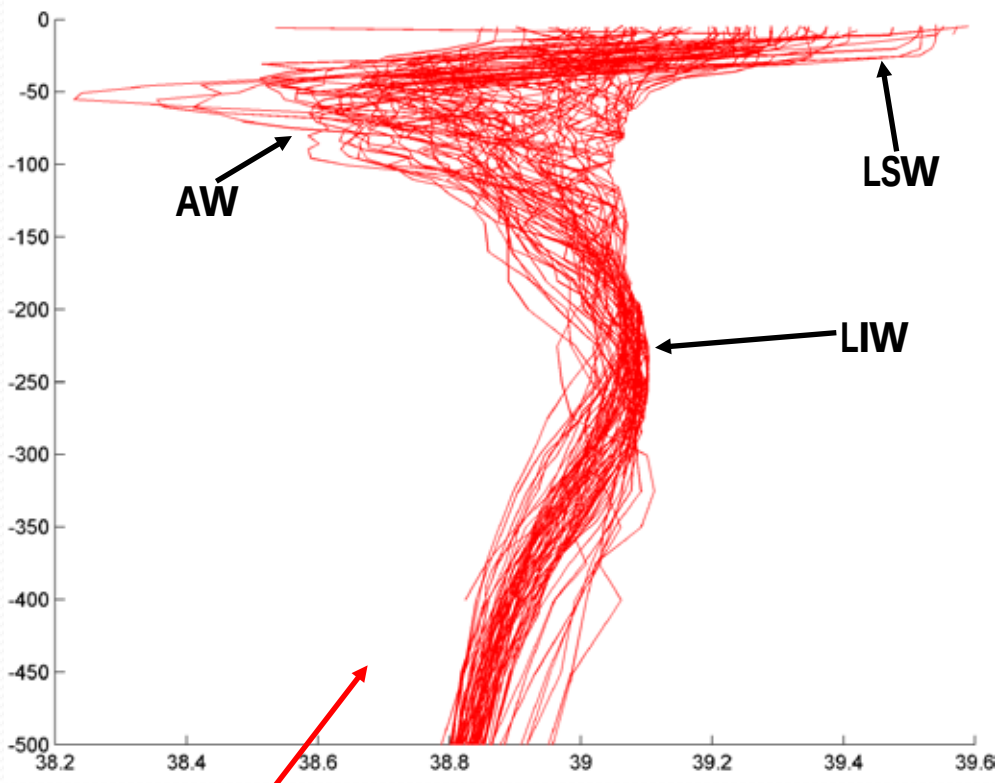
3. Methods

• Identification of the core of AW and LIW à salinity signature approach, by looking at the min and max values for AW and LIW respectively

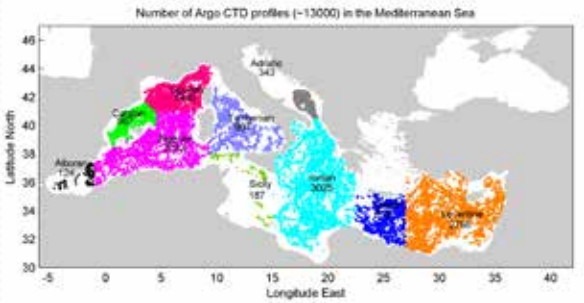
• Coastal and shallow profiles are excluded to assure that the selected profiles have enough observations in the water column

• Threshold for the min-max difference in order to have a distinct signal of the two water masses

• S min and max selection is based on the typical mean depth of AW and LIW in the sub-basins of the Mediterranean Sea



Areas	Depth ranges (dbar)		Sub-basins
	AW	LIW	
Western Part	0-50	200-600	Alb, Alg, Cat, Lig, Tyr
Central Part	0-100	100-400	Sic, Ion, Adr
Eastern Part	0-100	100-300	Aeg, Cre, Lev



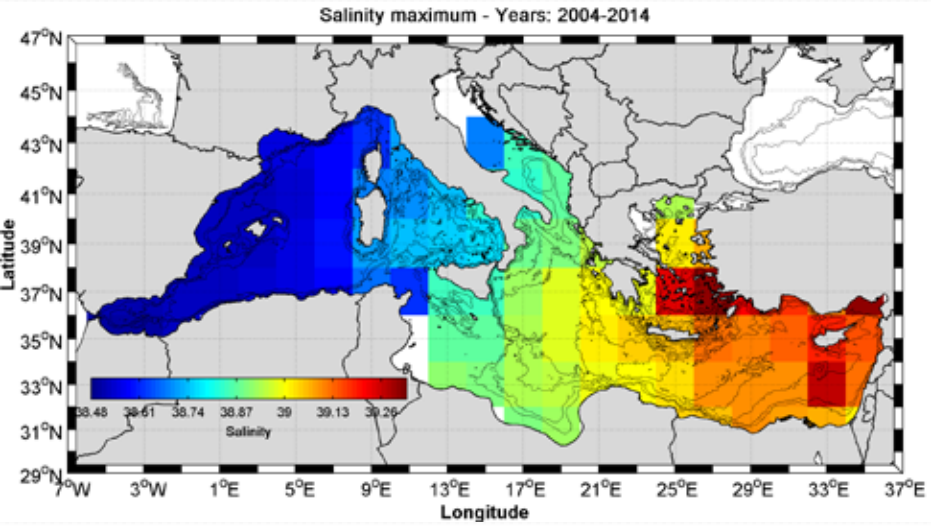
3. Methods

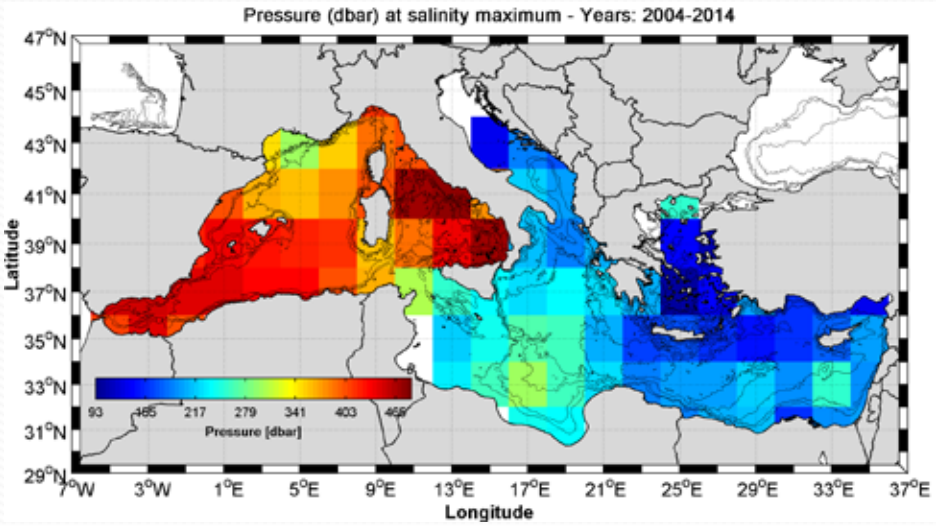
1. ten years depth and salinity means of the LIW and AW cores were computed in 2X2 degrees boxes

2. trends (2004-2014) analysis of the AW and LIW salinity and depth:

- weighted least squared regression to fit the seasonal cycle on a basis of monthly mean values (weights à number of profiles in each month)
- seasonal cycle is removed when the regression is significant (mostly for AW)
- monthly means of the salinity max (LIW core signature) and salinity min (AW core signature) and the respective depths are computed again
- trends are computed by the weighted least squared regression

4. Results: 10 years mean (LIW)

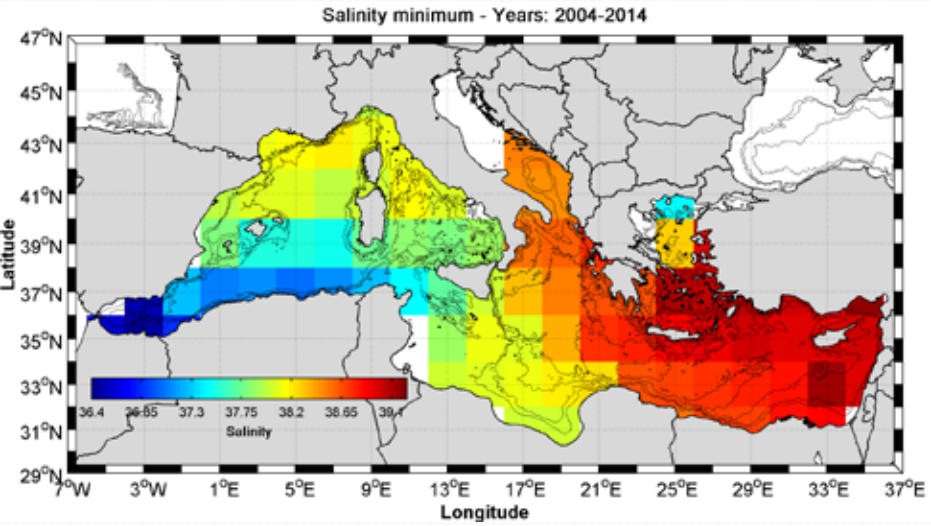


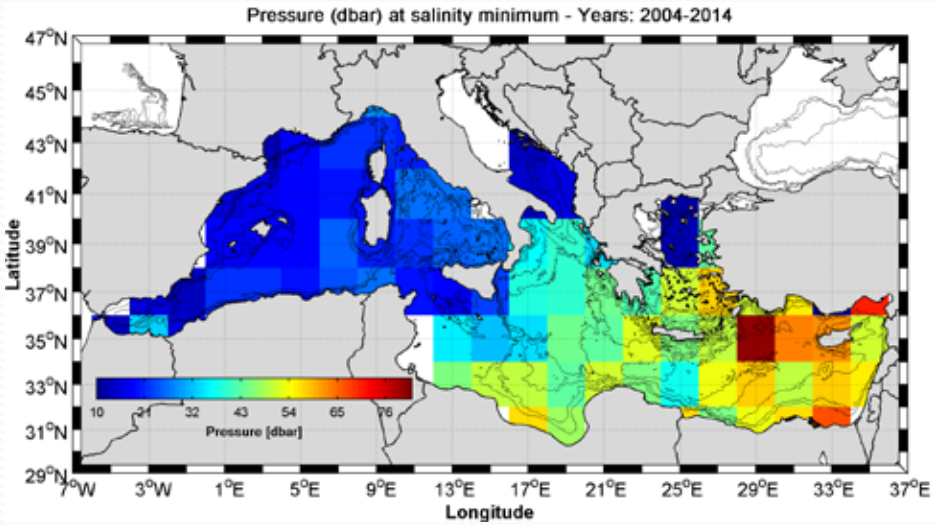


- **<u>ten years salinity and depth mean of LIW core in 2X2 degrees boxes</u>**

- LIW gradually sinks and decreases in salinity along its path, from the formation site (Levantine) to the Alboran Sea

4. Results: 10 years mean (AW)

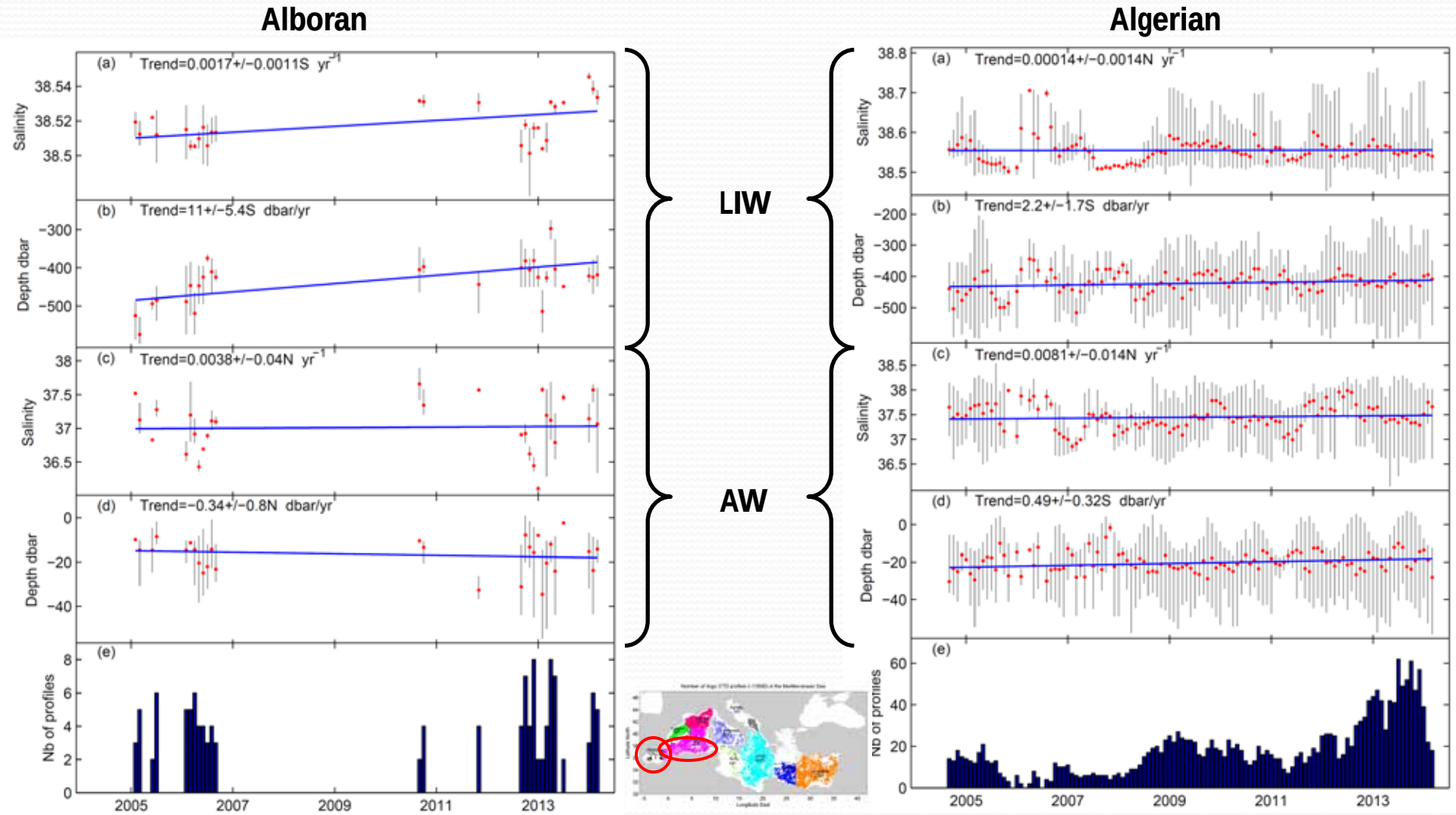




- **ten years salinity and depth mean of AW core in 2X2 degrees boxes**

- The entrance of the AW in the Med Sea is detectable by the low salinity values east of the Gibraltar Strait and along the Algerian Coast

4. Results: trends



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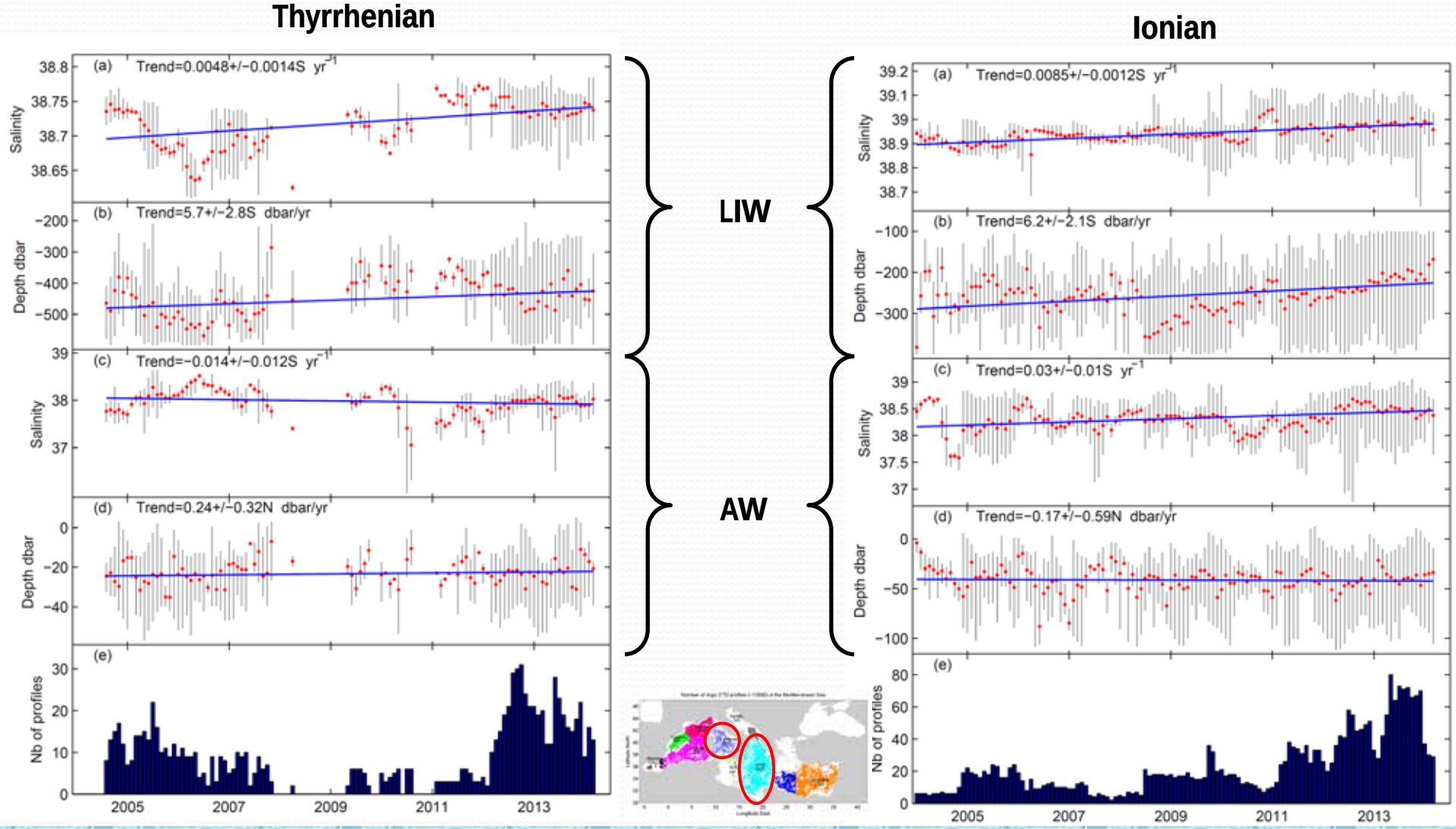

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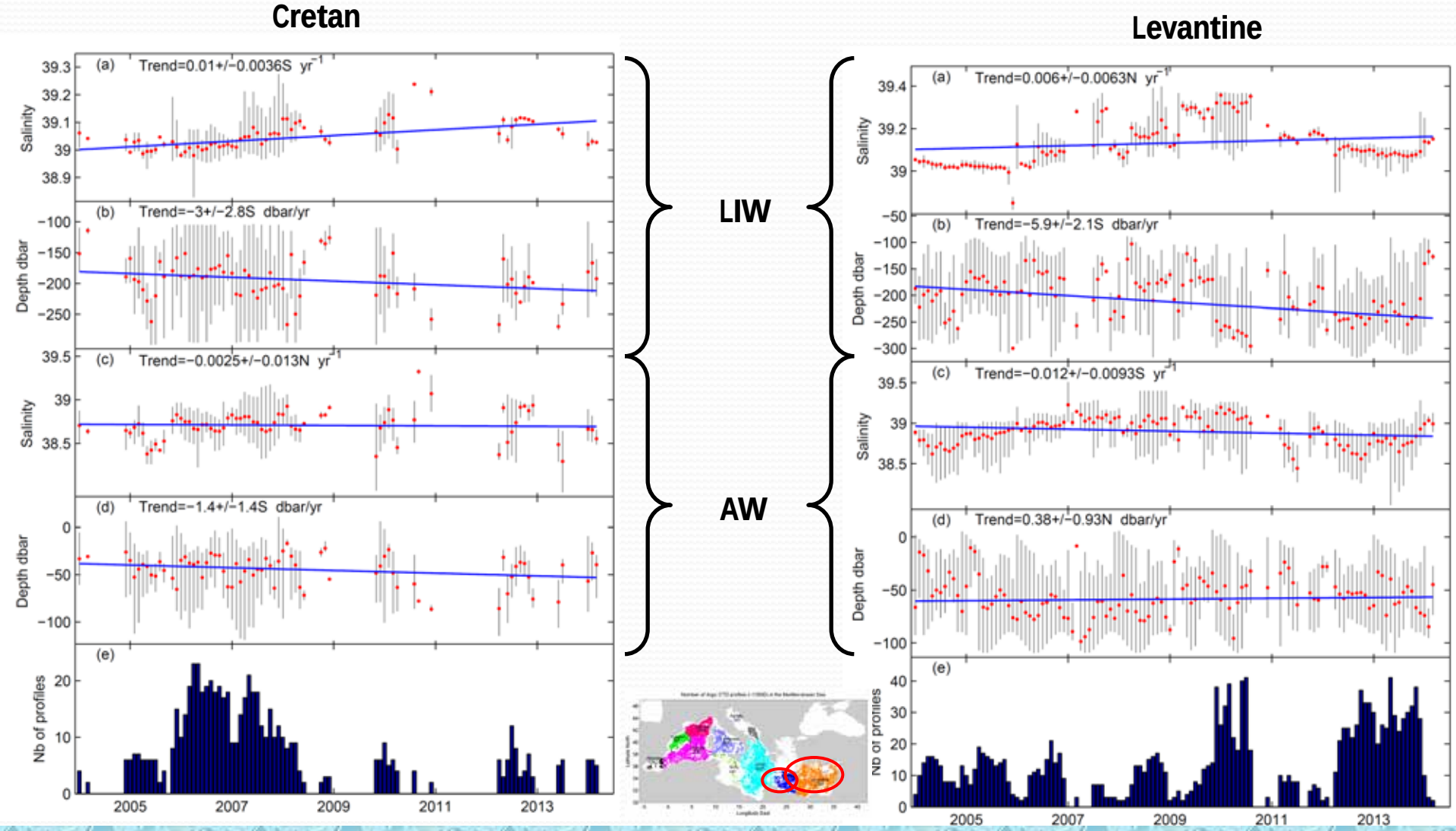

5. Conclusions

1. **The LIW core**
   - It exhibits a positive salinity trend in several sub-basins
   - the salinification is more important in the Eastern basin with respect to the Western basin
   - Increase in salinity is quite large in Ionian and Cretan Passage (~ 0.01 yr^{-1})
   - Depth of the LIW core is rising in the Western and Central part of the Mediterranean Sea over the last 10 years with a mean annual rate of about 6 dbar

2. **The AW core**
   - Its salinity mimimum does not show any trend in the Western Mediterranean
   - there is a strong salinification of the AW in the Ionian at a rate of 0.03 per year
   - Depth of the AW core exhibits interannual fluctuations and no trend is detected in any of the sub-basins