First Data Buoy Cooperation Panel Mediterranean Training Workshop on Ocean Observations and Data Applications
2-4 May 2023. Tunis

30 years of monitoring a Mediterranean choke point: the CNR moorings in the Sicily Channel

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WHERE?

Mediterranean Sea

a miniature ocean

mid-latitude marginal sea

surrounded by continents

short turnover timescales

intense winter atmospheric forcings

dense water formation

thermohaline circulation

WHERE?

Mediterranean Sea

a climate change hotspot

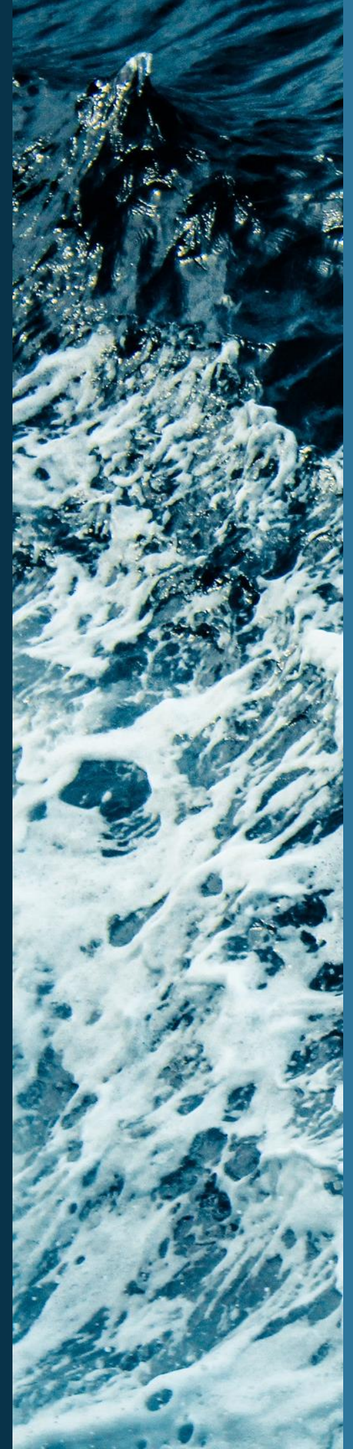
future Mediterranean sea level rise: 9.8 – 25.6 cm by 2040-2050

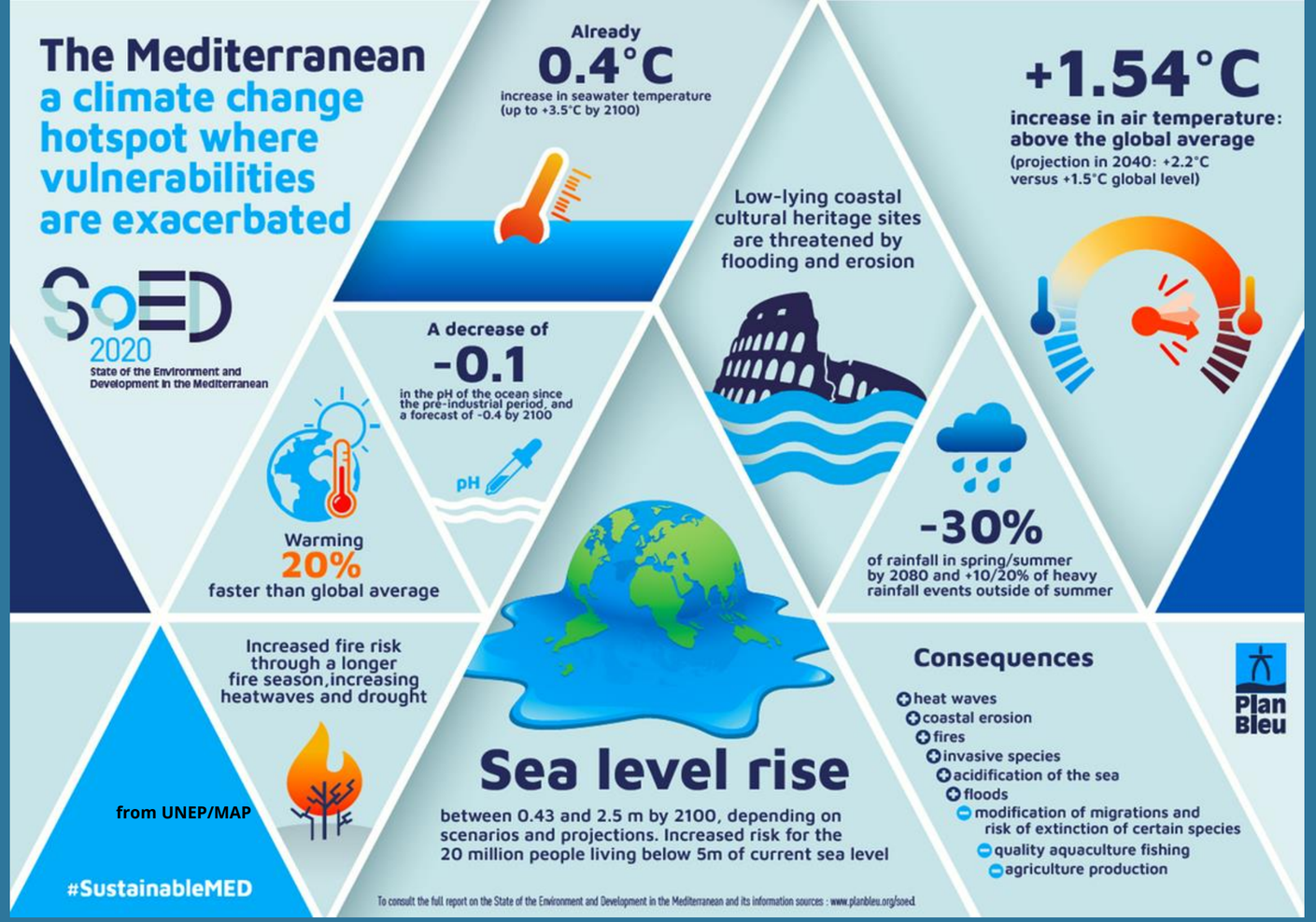
ΔT vs pre-industrial levels 1.54 °C (0.5 °C higher than global average)

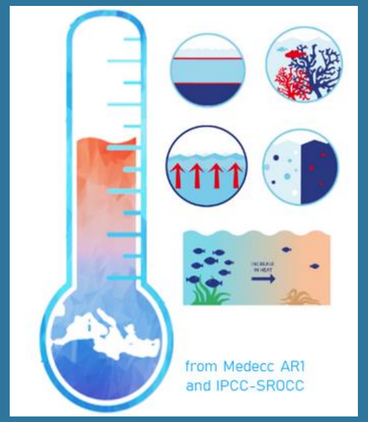
frequency and intensity of marine heatwaves is increasing

stratification, circulation, ventilation are changing

acidification is progressing







WHERE?

Mediterranean Sea

overturning circulation

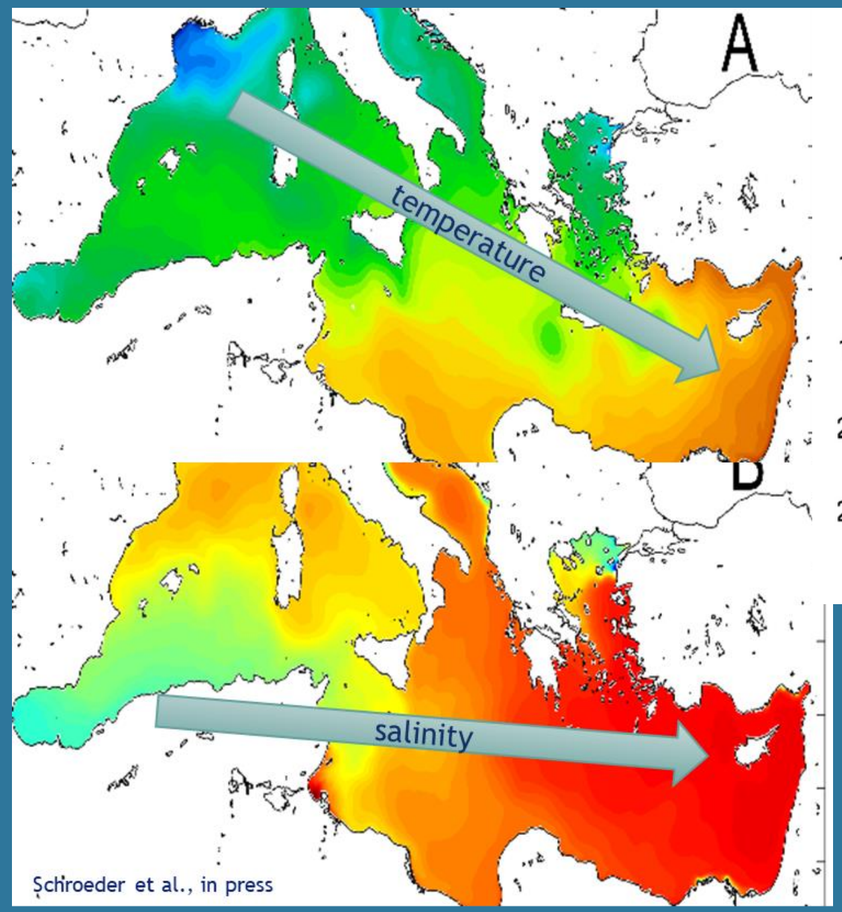
water masses

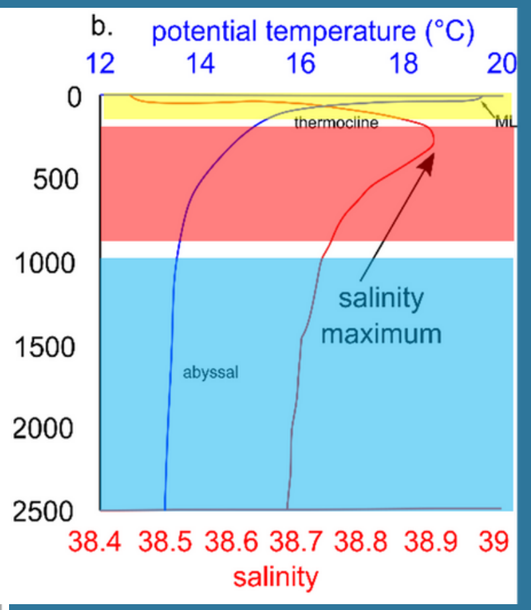
AW is modified while flowing east --> salty and warm Levantine Surface Water (LSW)

In the EMED, LSW is transformed into warmer and saltier IW

flowing back IW is diluted but is still identified in the whole Med by a subsurface S maximum

IW forms the bulk of the Mediterranean Overflow Water





Atlantic Water (0-150 m)

Intermediate Water (200-800 m)

Deep Water (1000 m-bottom)

WHERE?

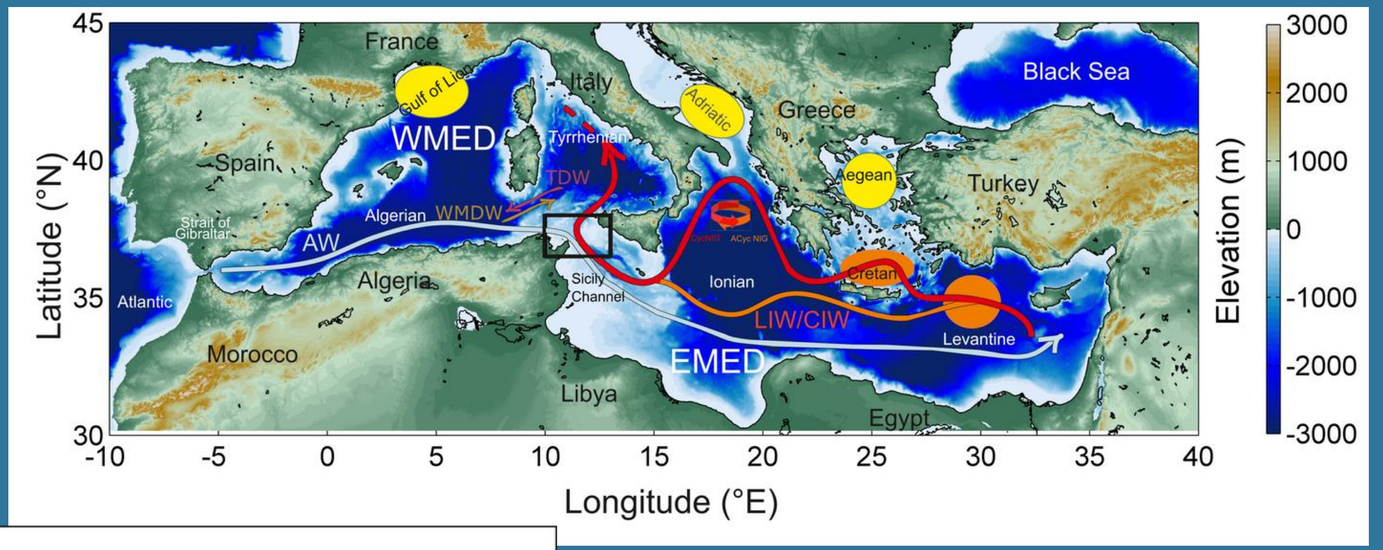
Sicily Channel

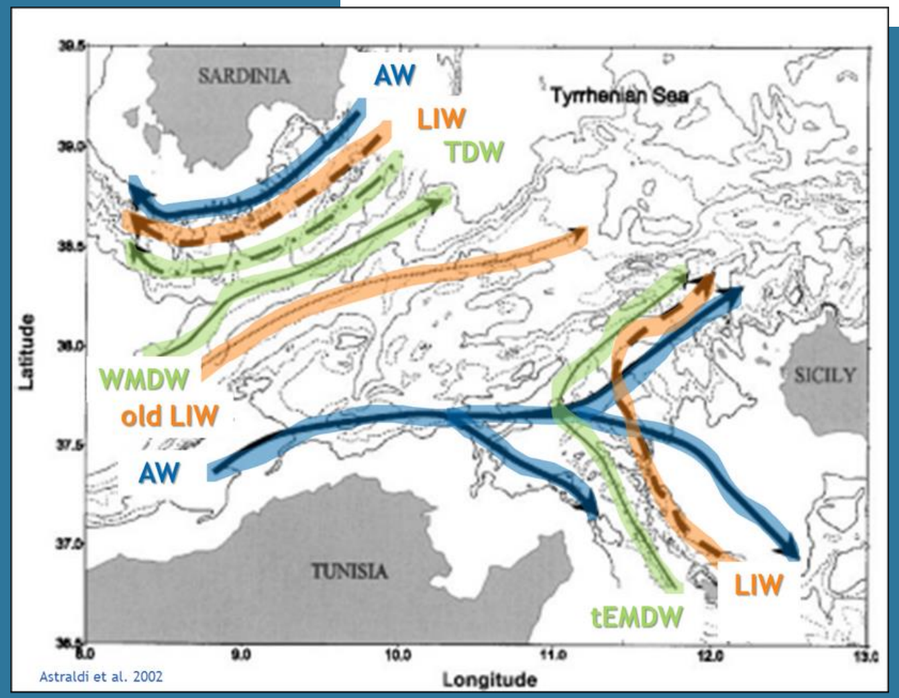
most important Mediterranean choke point after Gibraltar

divides EMED and WMED

intercept all water masses flowing between EMED and WMED

sill depth 400 m mainly prevents deep water exchanges



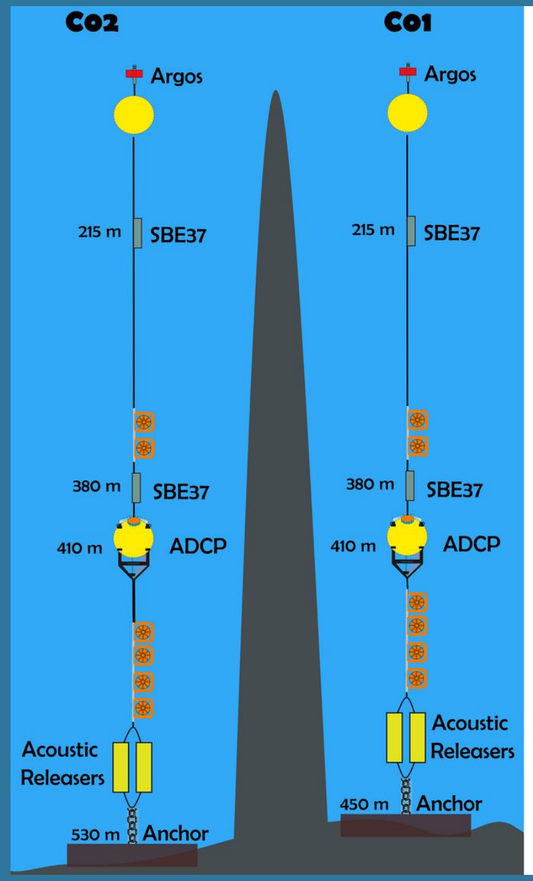


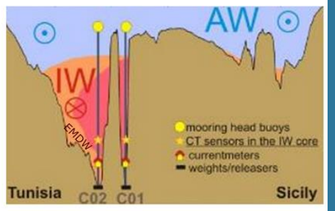
HOW?

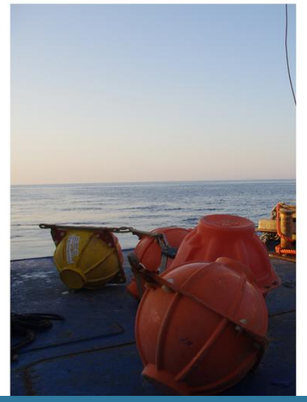
Sicily Channel Observatory-SiCO

twin-mooring system SiCO1 & SiCO2 (WMO Identifiers: 6101021 and 6101022)

First deployment: fall 1993







two moorings in two parallel trenches along the 150 km-long transect between Tunisia and Sicily

Equipped with current profilers and CTD probes

Continous monitoring of surface and intermediate waters

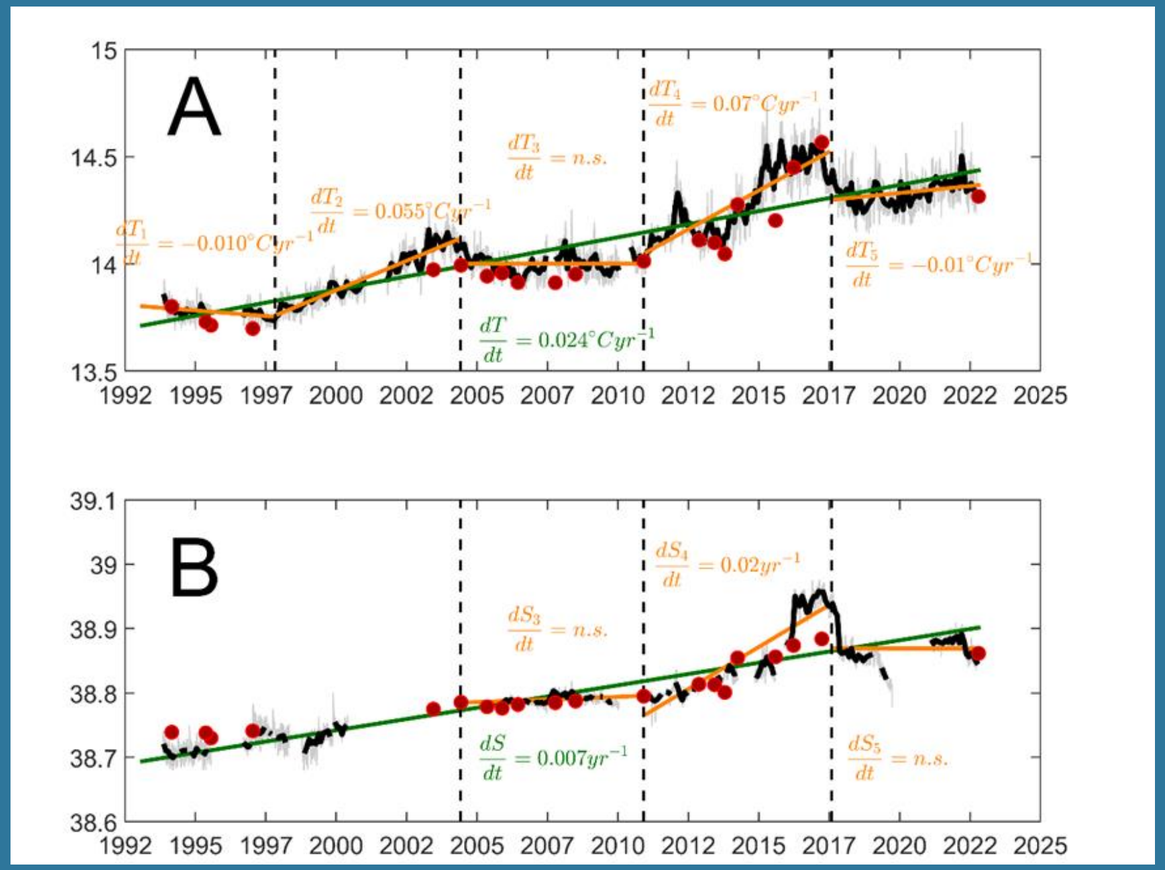
HOW?

Sicily Channel Observatory-SiCO

twin-mooring system SiCO1 & SiCO2 (WMO Identifiers: 6101021 and 6101022)

First deployment: fall 1993

1993-2022



@400 m depth

T and S co-vary

trends are subject to changes, slowdowns and accelerations

ΔT/dt=0.024°C/yr and

ΔS/dt=0.007 /yr

WHAT?

Sensors management and calibration

Mooring load analysis

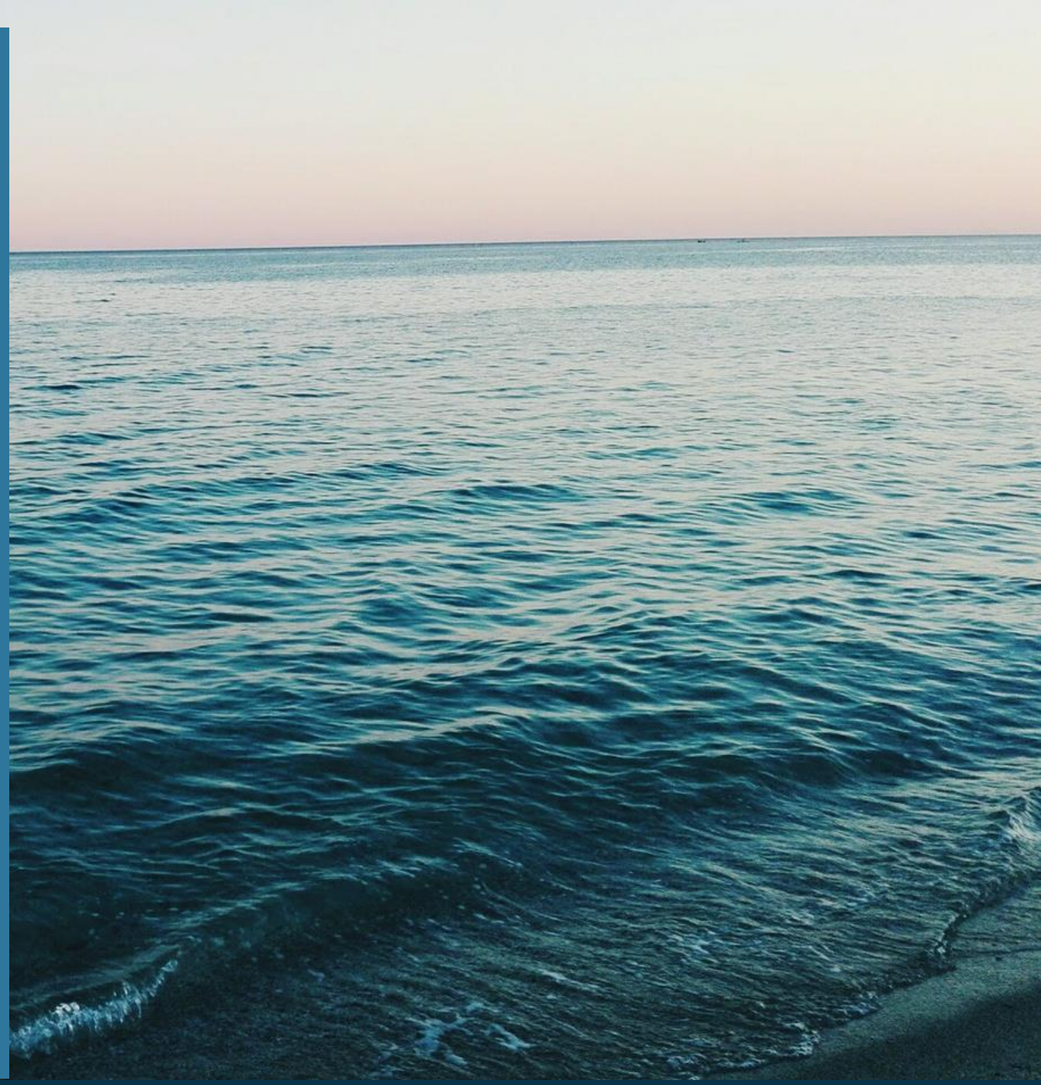
Power management

Galvanic Corrosion Prevention

Recovery and Deployment operations

Data acquisition, processing, storage

Quality Control



WHAT?

Sensors management and calibration

Calibration bath at CNR ISMAR

probes calibrated once a year

Calibration at manufacturer once every 5 yrs

WHAT?

Recovery and Deployment operations

every 6 months we plan the recovery and re-deployment operation of the moorings, with an adequate vessel (winches, crane, space at stern) and expert personnel (scientific, technical, and ship-crew)

6 months in advance diplomatic clearances is asked for to Tunisian authorities, who usually send an observer on board

we provide all service, cleaning, repairs, or adjustments to the mooring (line, shackles, instruments, buoys) after inspection for seaworthiness of all elements

data downloading, memory cleaning, battery changes

WHAT?

Recovery and Deployment operations

apply proper deployment techniques to reduce the risk of fouling the mooring in the propeller

for each mooring we use 2 train wheels as mooring ballast (which are not recovered)

record information on sensor configuration, mooring configuration and battery endurances as well as any changes made

maintain a checklist with serial numbers, dates/times and mooring diagram

WHAT?

Data acquisition, processing, storage - Quality control

Data retreival from instruments and check for malfunctioning before deployment

Check clocks are all set to UTC

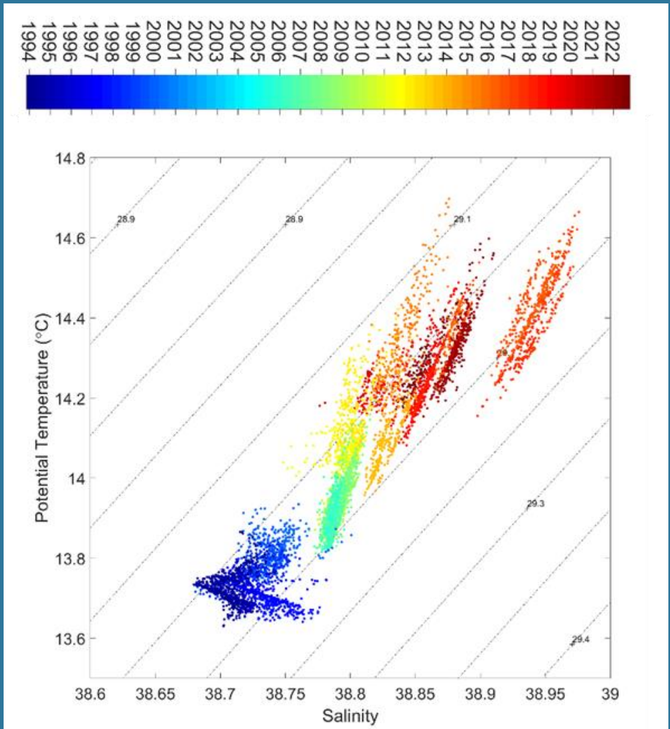
CTD casts prior and after mooring recovery/deployment for data comparisons

To protocol the quality control flagging we follow the OceanSITES recommendations

WHY?

Investigate and monitor changes in water mass properties

longest time series of subsurface T and S data in the Med



import of salt and heat from the EMED to the WMED has increased

this will enhance the tendency of the western DWF sites to produce warmer and saltier deep waters

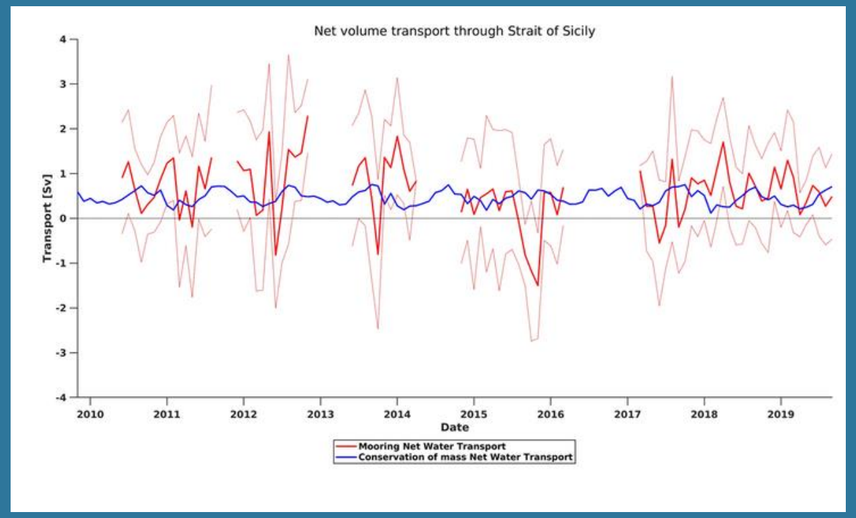
causes of the observed trends: role of a changing climate (warming, changes in the hydrological cycle) over the EMED, where IW forms: its modifications are transferred to all other water masses

WHY?

Measure the transport and variability through straits

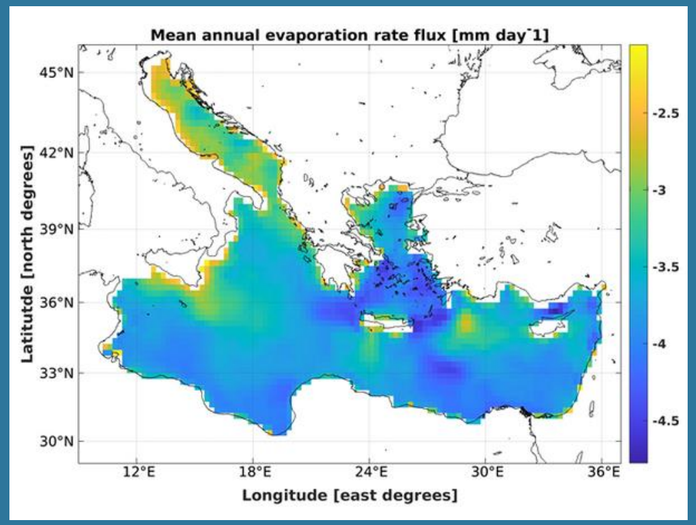
$$F(t) = \int_{y=0}^{W} \int_{z=bottom}^{0} u(y,z,t)dydz$$

ADCPs in the two trenches each measure about 50% of the total strait transport.
Velocities are rotated to derive along- and across-strait currents.
Along-strait component is integrated onto depth and width of the strait to obtain the volume transport



net transport =
0.615 ± 0.664 Sv

net evaporation =
0.465 ± 0.1572 Sv



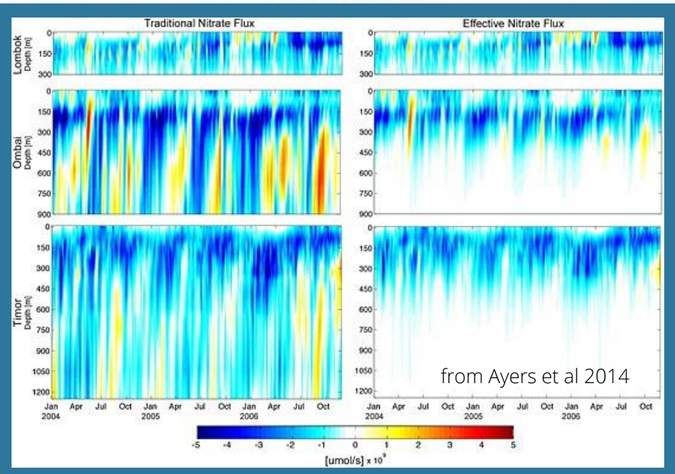
WHY?

Biogeochemical fluxes

Water flux (10^9 Kg/s ~ 1 Sverdrup) **X** **Nutrient concentration** (μmol/kg)

=

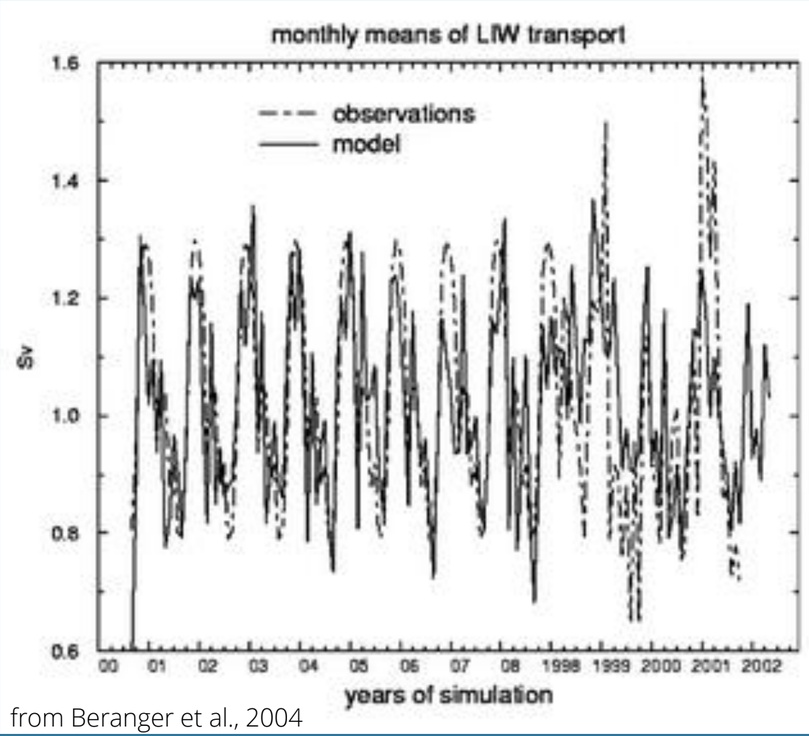
Nutrient flux (mol/s)



from Ayers et al 2014

WHY?

Comparison with models



from Beranger et al., 2004

Comparison between monthly means of transport from a numerical model and transport data from currentmeter data

The transport maximum occurs in November, the minimum in August

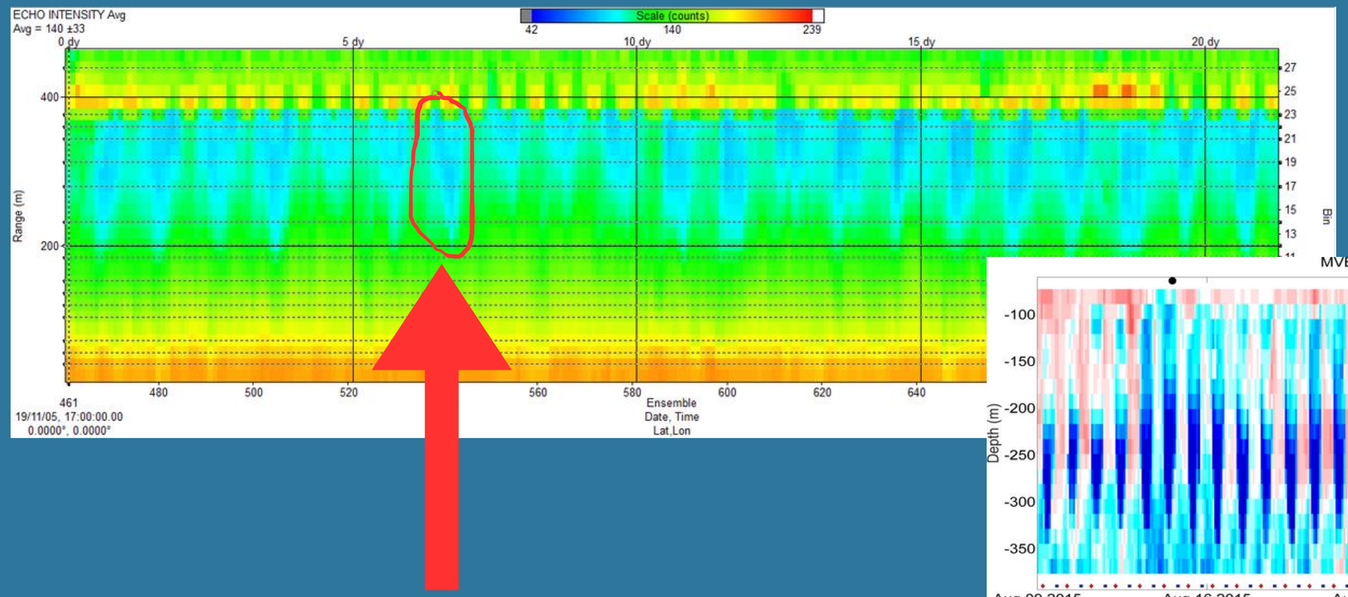
High interannual variability
Good agreement obs. vs model

WHY?

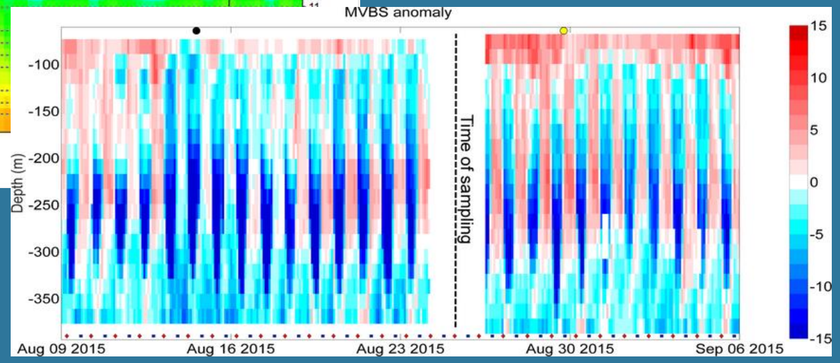
Biological research

Zooplanktion diel vertical migration over a few hundred metres can be seen by the acoustic backscatter strenght in ADCP data

Zooplanktonic biomass is proportional to the mean volume of backscatter (MVBS)



from Guerra et al., 2019



WHY?

Enable multidisciplinary and interdisciplinary research

deployment of different plastic materials to study their degradation

deployment of passive samplers for the in-situ preconcentration of hydrophobic organic chemicals

information on the dissolved (bioavailable) concentration of a range of chemical pollutants

deployment of sediment traps to study particle flux and C pump

comparison of different sensors for dissolved oxygen

JERICO

TNA

WHO?

Target stakeholders

- infrastructure managers
- researchers and the scientific community
- industry, innovators, technology developers
- decision-makers, including policy makers, public agencies, funders, planners, science managers/research managers
- media, to include science writers, journalists, documentarists
- the general public
- existing Research Infrastructures (RIs), EU projects
- World Ocean Council (WOC)
- World Meteorological Organization (WMO)
- representatives of national and European non-governmental organizations
- representatives of international non-governmental environment organizations
- Communities involved with ocean observing systems, research and mapping
- legislators, regulators
- key marine users

Government

Research and education

Industry

Civil society

EU and international networks and programs

Sicily Channel Observatory

CNR ISMAR
ISTITUTO DI SCIENZE MARINE

Acknowledgemnt

INSTM

WMO

DBCP WMO - IOC DATA BUOY COOPERATION PANEL

unesco
Intergovernmental Oceanographic Commission

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