Glider and drifter activity during 2018 in the framework of the MELMAS project.

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SOMMARIO:

MELMAS Project description:

The main goal of the MELMAS project (Monitoring of the Eastern Levantine with Mobile Autonomous Systems) is to measure the currents and water mass properties in the eastern areas of the Levantine Basin (Eastern Mediterranean Sea). Previous projects in the same area evidenced the complex circulation features governing the dynamics near the coast and in the open sea. It is proposed to continue measuring vertical profiles of physical and biogeochemical parameters down to 1000 m using energy efficient mobile autonomous systems (glider) and other mobile autonomous systems. The project is planned for two distinct seasons in order to investigate seasonal variability. In this region, mesoscale and submesoscale eddies are predominant, and strongly interact with a persistent coastal current. The in-situ observations will be interpreted in concert with the distribution of tracers (sea surface temperature, chlorophyll), and altimetry data obtained from satellites.

On a purely scientific level, this project will advance the understanding of oceanic processes including (1) the formation of Levantine Intermediate Water that affects regional and global climate, and (2) air-sea interaction that affect regional precipitation. On the practical level, the proposed cost-effective multi-platform and multi-scale approach to be applied to the eastern Levantine will be easily relocatable to other areas of the Mediterranean. The new measurements will provide the necessary data and knowledge base to help fight pollution hazards (oil spills) and to predict precipitation in the Middle East.

MELMAS project contributes to the effort of observation in the Mediterranean, promoted and implemented in the frame of several international programs such as FP7-Policy-oriented marine Environmental Research for the Southern European Seas (PERSEUS), or coordination networks such as Mediterranean Operational Network for the Global Ocean Observing System (MONGOOS) and Everyone’s Gliding Observatories (EGO).

Activities:

During 2018, we conducted a 1st field experiment in the Eastern Levantine with mobile autonomous systems. Three ocean gliders (one Italian and two Israeli) were operated between May 24 and July 23, 15 surface drifters were deployed, and in parallel satellite data were analysed.

Italian Glider:

During 2018, the SeaGlider SG554 of the Istituto Nazionale di Oceanografia e di Geofisica Sperimentale – OGS was deployed south of Cyprus. The instrument was piloted and monitored 24/7 by the OGS glider teams. The instrument was steered along a path that optimize the monitoring of the mesoscale and submesoscale features and was fine-tuned by using ancillary data (mainly satellite products). The glider suffered for little deviations from the ideal track due to currents.

The OGS glider path is represented in Fig. 1. The glider was deployed near the coast off Protaras on 22 May at 35° 02.471’ N - 34° 05.412’E and was recovered in the vicinity of Ayia Napa on 23 July. The glider was equipped with a Sea-Bird Scientific GPCTD (temperature, salinity and density) and sensors for the measurements of the oxygen, backscattering, and fluorescence. During its 2-month mission, the instrument collected about 280 CTD, oxygen and optical profiles (see Figs. 2 to 8).

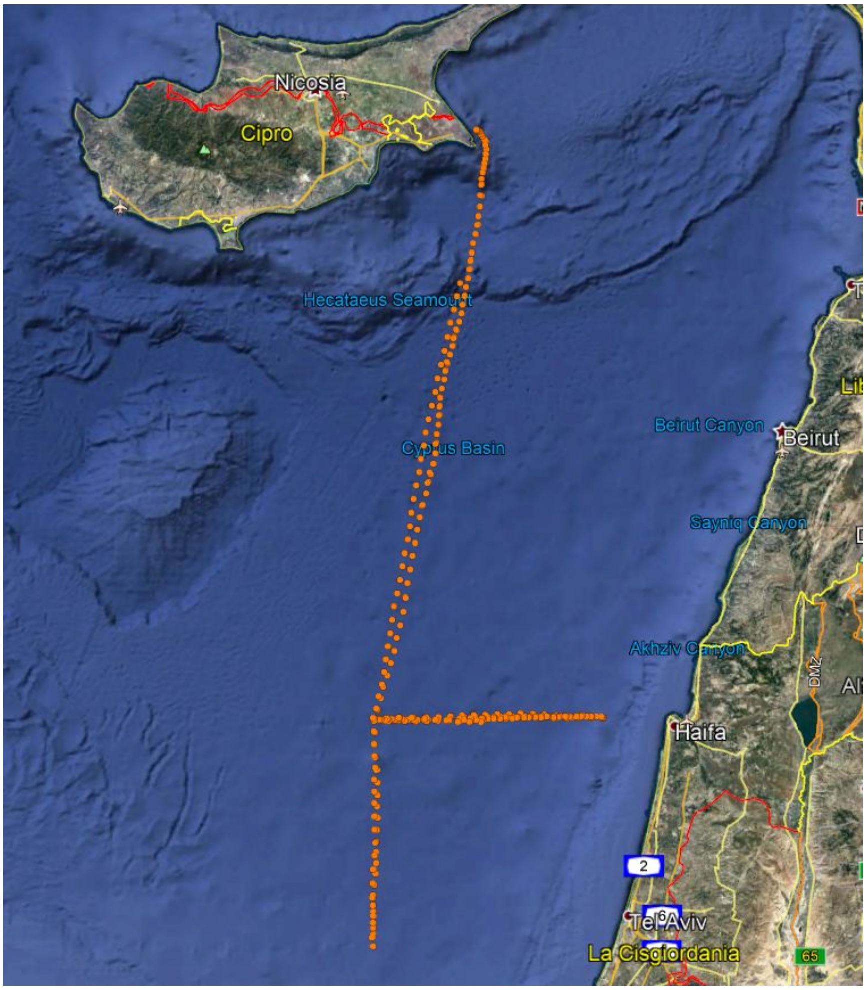

Fig 1. OGS glider path; the orange symbols represent the surfacing positions of the glider.

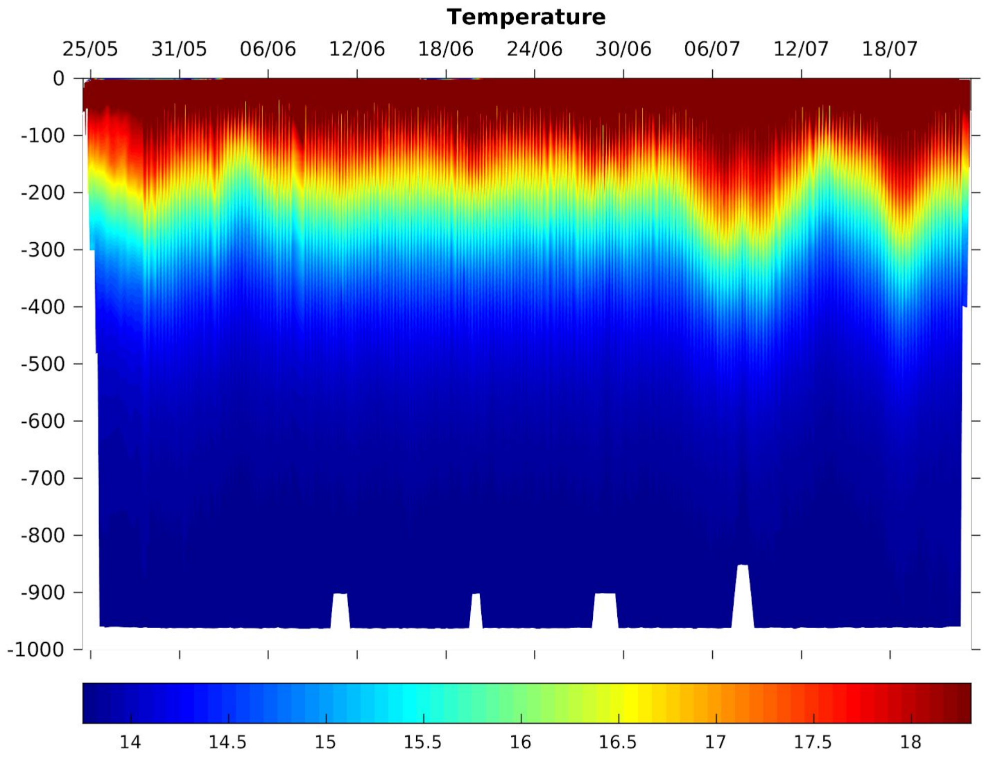

Fig 2. Temperature data as recorded by the OGS glider.

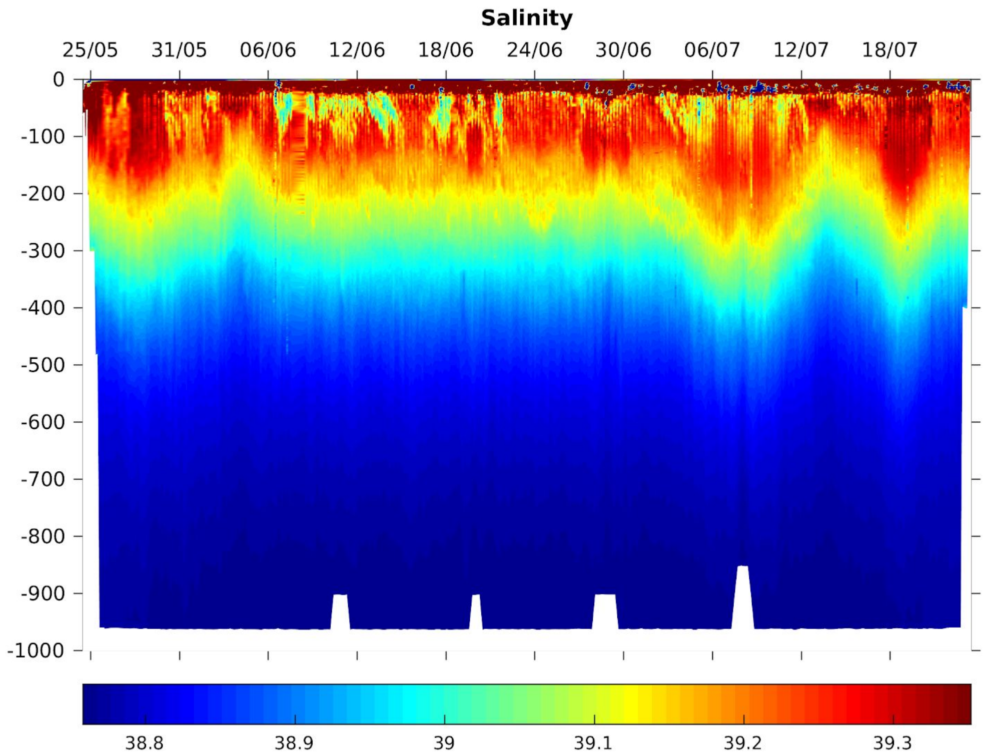

Fig 3. Salinity data as recorded by the OGS glider.

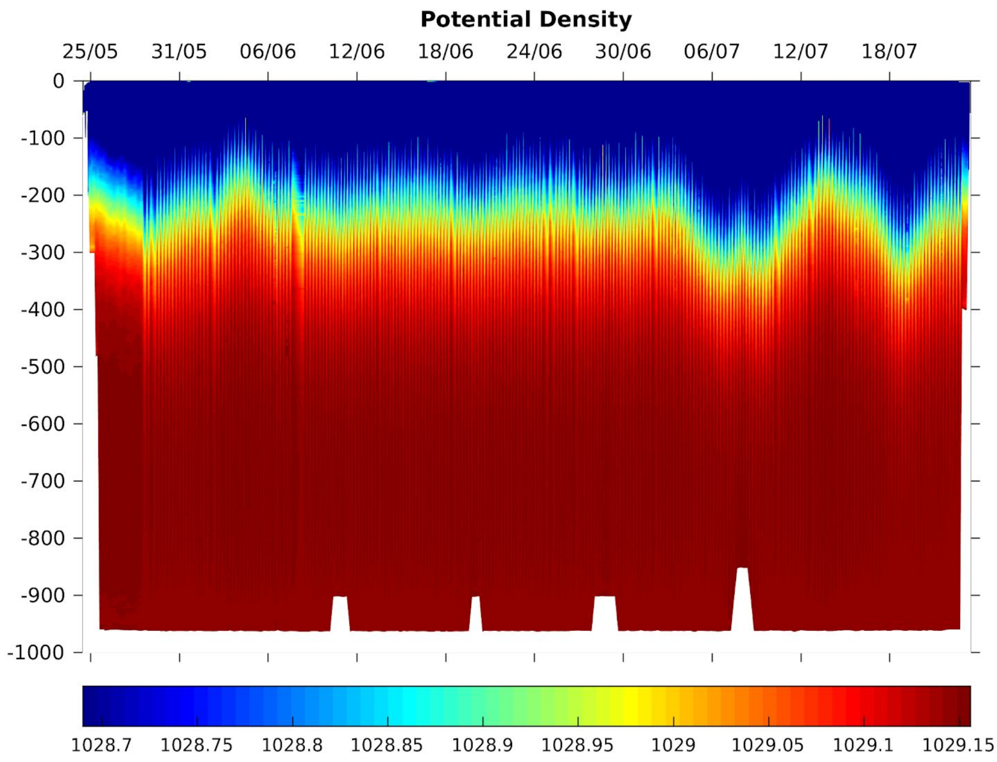

Fig 4. Raw potential density data as computed from the OGS glider data.

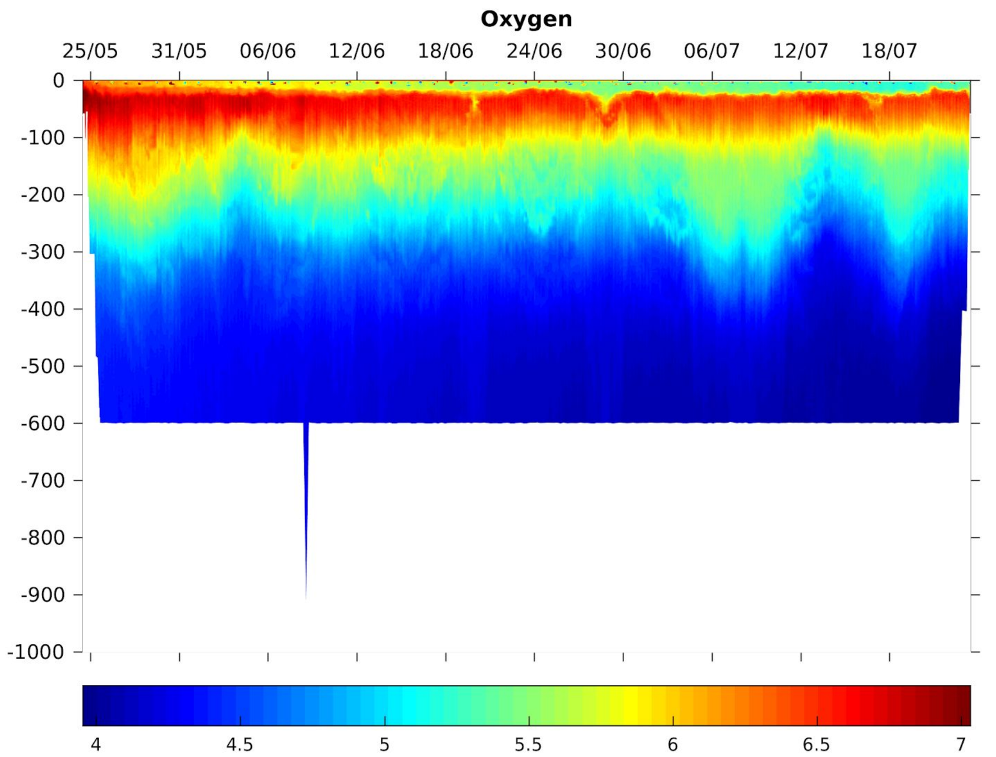

Fig 5. Raw oxygen data as recorded by the OGS glider.

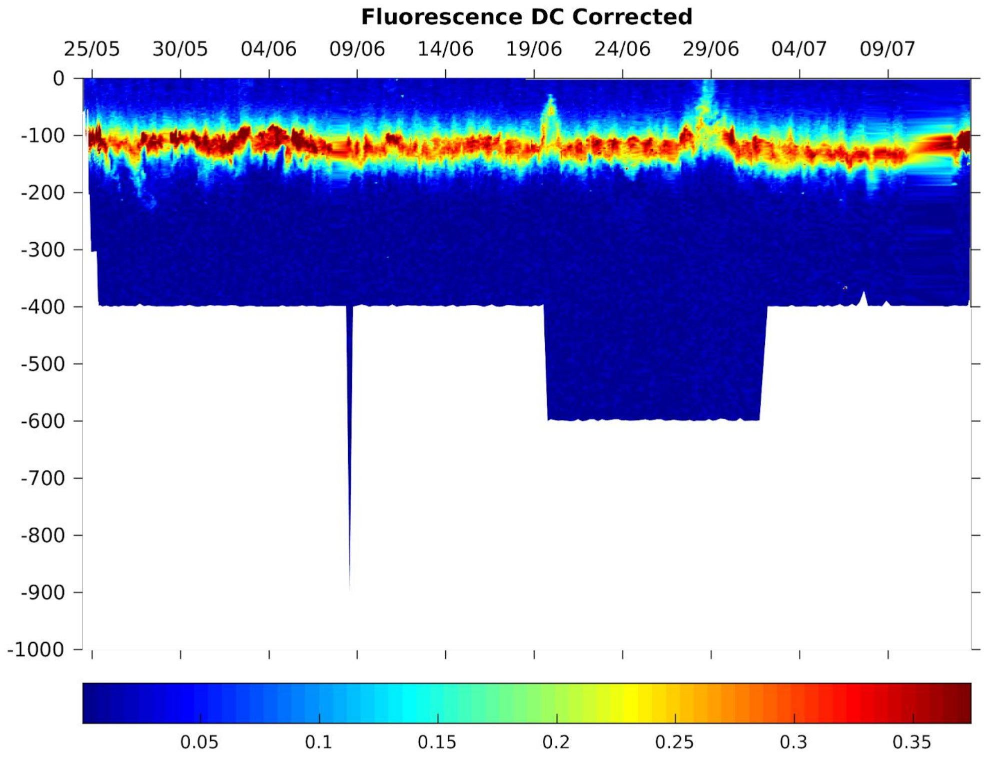

Fig 6. Raw fluorescence data as recorded by the OGS glider.

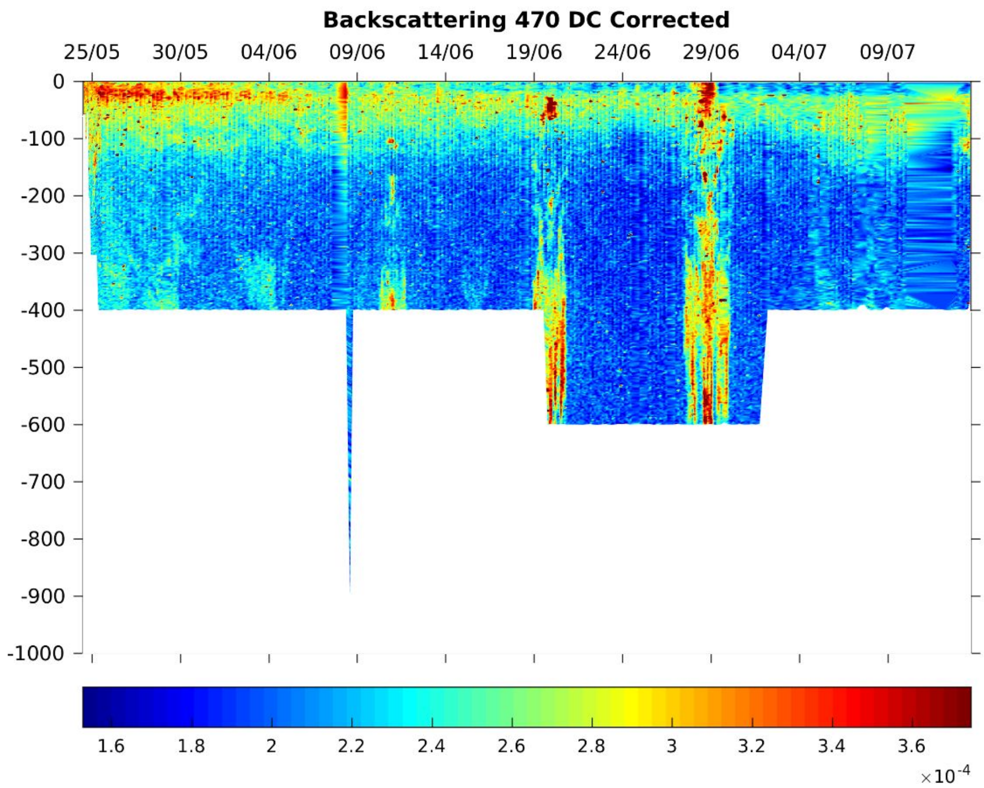

Fig 7. Raw backscattering data (470 nm) as recorded by the OGS glider.

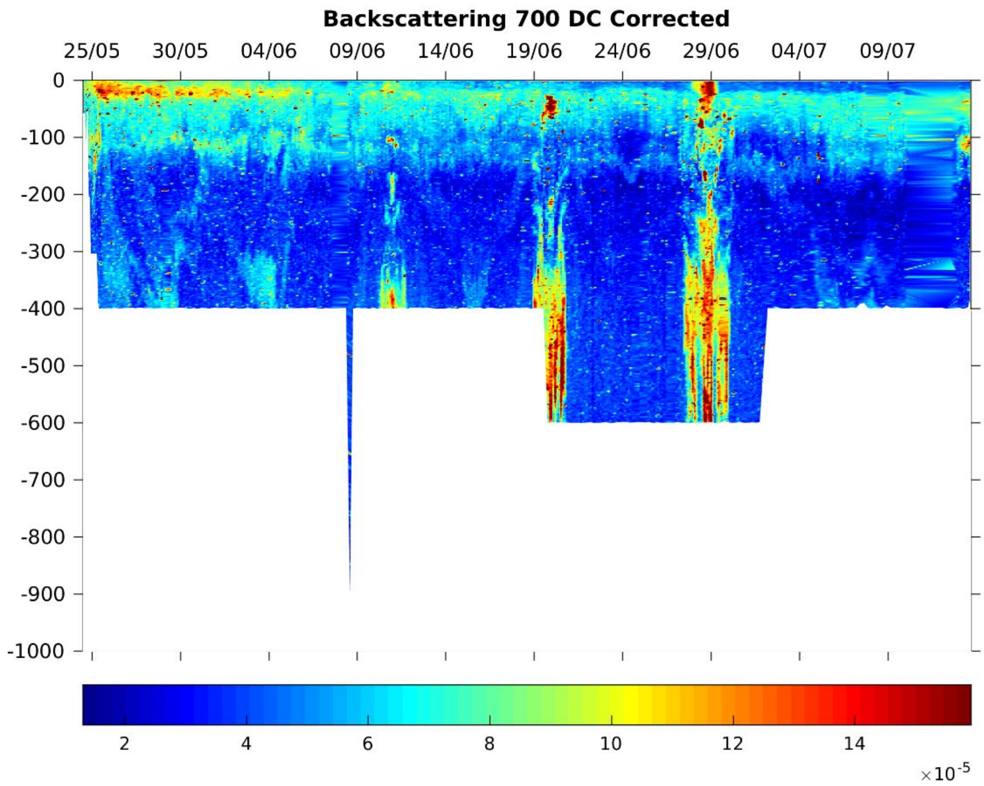

Fig 8. Raw backscattering data (700 nm) as recorded by the OGS glider.

Israeli Glider:

During 2018, two Israeli gliders were deployed off Israel. In particular, the SeaExplorer #13 was deployed in front of Tel Aviv on June 10, and was retrieved on July 7 and the SeaExplorer #12 was deployed in front of Haifa on June 14, and was retrieved on July 7. Due to shipping traffic, the original saw-tooth transects were modified to east-west transects. The paths of the Israeli gliders are shown in Fig. 9.

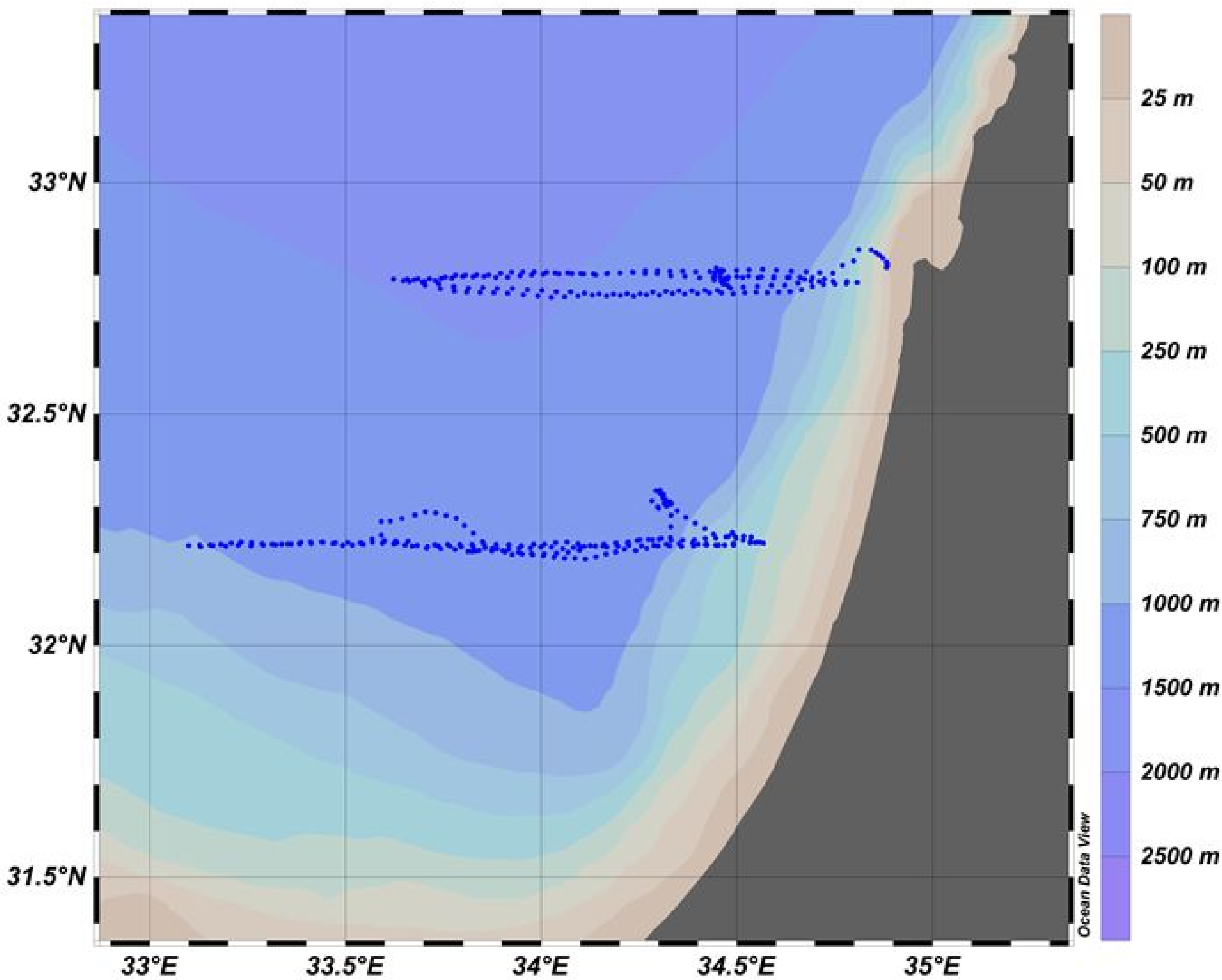

Fig 9. Israeli glider paths; the blue symbols represent the surfacing positions of the two gliders.

The plot of the temperature and salinity collected along the 4 northernmost transects are depicted in Figs. 10 and 11.

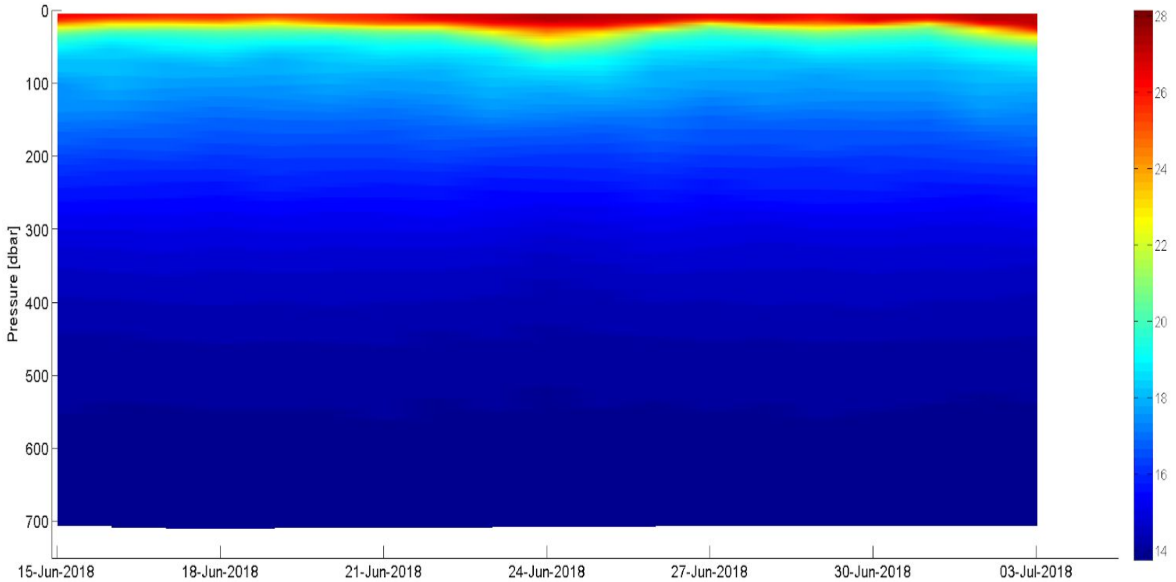

Fig 10. Temperature data as recorded by the Israeli glider #12 (M141).

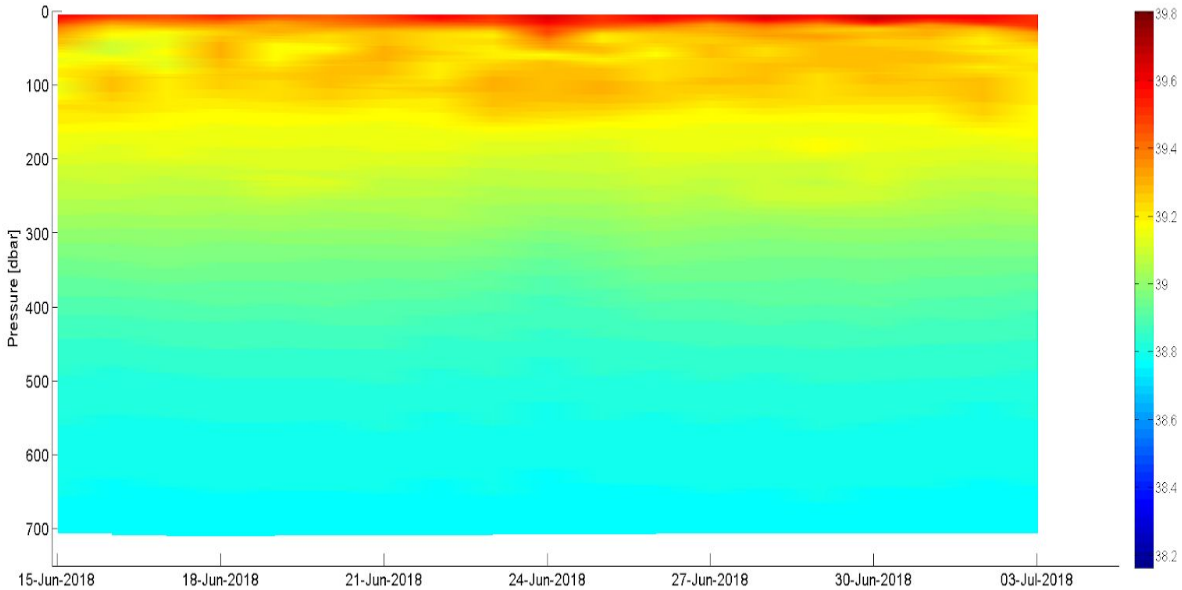

Fig 11. Salinity data as recorded by the Israeli glider #12 (M141).

Drifters:

During 2018, 15 surface drifters were deployed at pre-determined locations (15, 30, 45 and 60 miles from the coast). At 15 miles we deployed 3 CODE and 3 NOMAD drifters. Three additional CODE drifters were deployed at 30 miles. 3 SVP drifters were deployed at 45 miles and at 60 miles. Images of the 3 drifter types are shown in Figure 12.

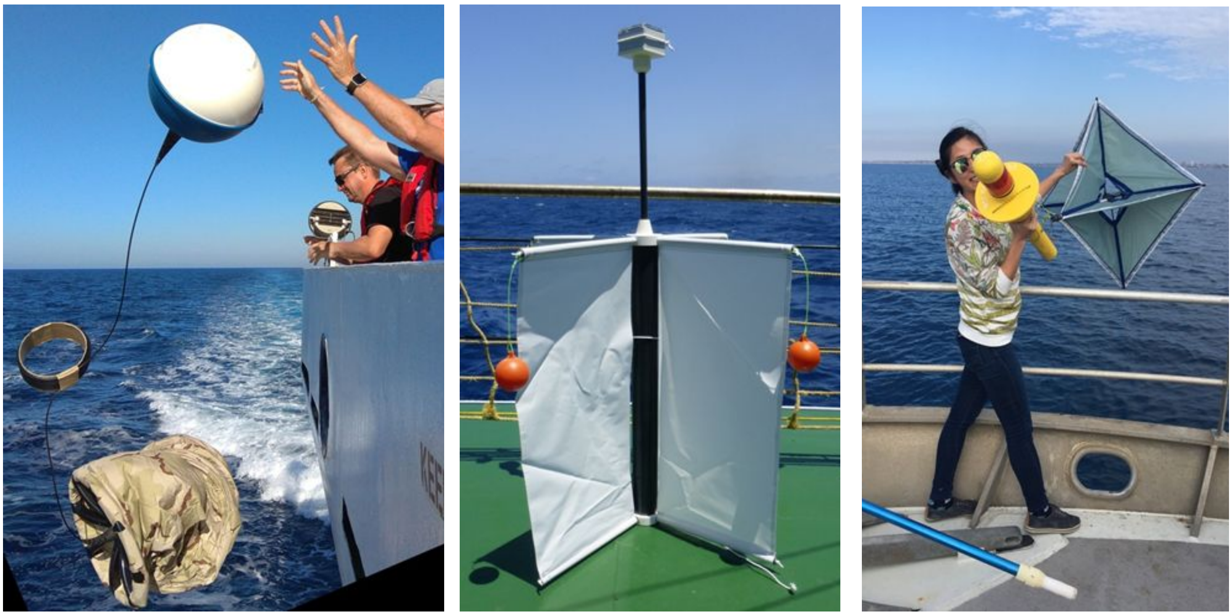

Fig 12. SVP (left), CODE (middle), and NOMAD (right) drifters.

The drifters demonstrated the existence of an eddy with a radius of tens of km, as can be seen in Figure 13 (left panel). In addition to the rotation around the core of the eddy, inertial oscillations are visible. Two of the drifters were apparently picked up by a ship. The other 4 escaped after some time inside the eddy and were trapped in a northward coastal current. An interesting observation is the existence of a narrow, coastally trapped southward current, demonstrated by the trajectories of 3 CODE drifters (Figure 13, right panel).

A comparison of the trajectories of the CODE and NOMAD drifters demonstrates that the NOMAD moved eastward much faster than the CODE (Figure 14).

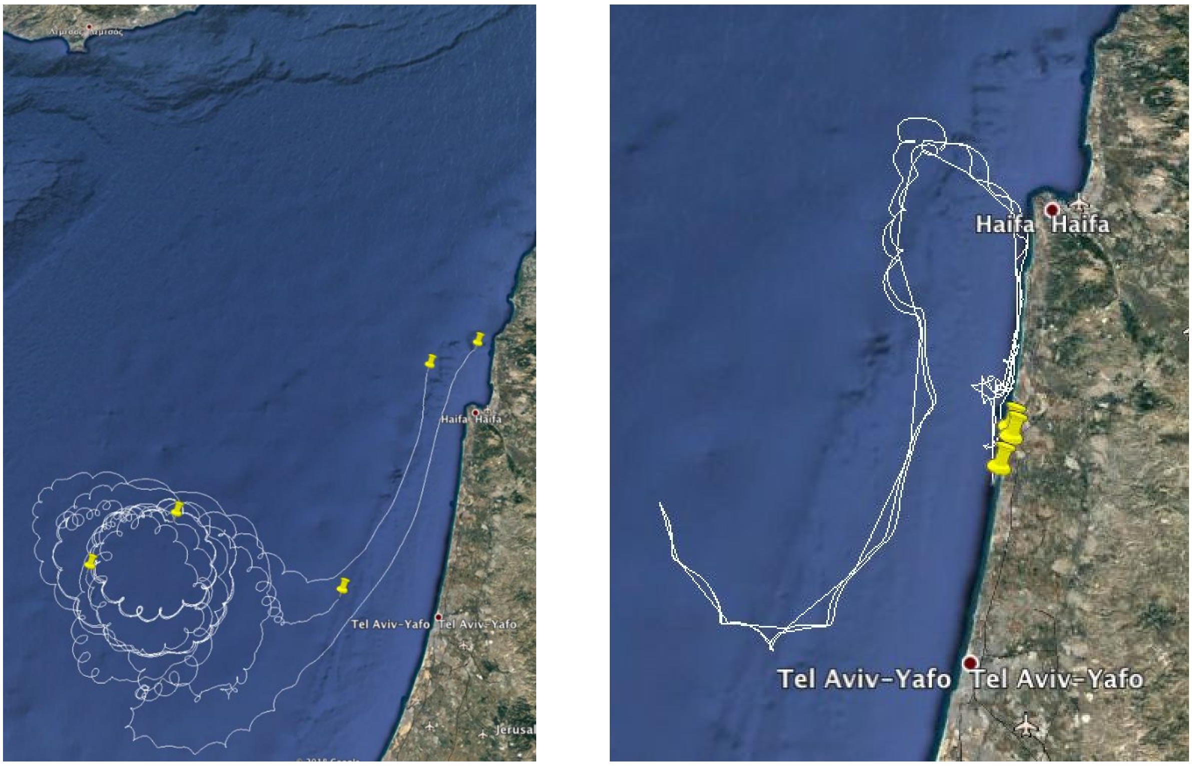

Fig 13. Trajectories of the 6 SVP drifters (left) and trajectories of 3 CODE drifters (right).

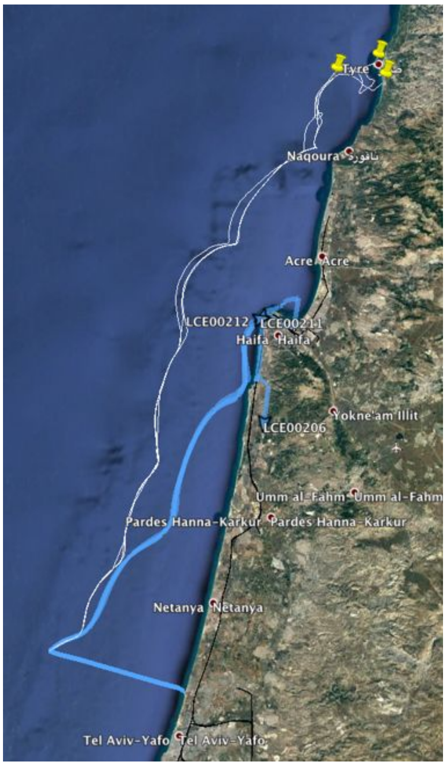

Fig 14. Comparison between CODE drifters (white) and NOMAD (blue) drifters.

Additional information:

Since one of our specific objectives is “To develop the capability for a coordinated, deployable and cost-effective responsive in-situ monitoring system”, following the detection of the eddy by drifters, we modified the missions of the gliders and direct them to cross the eddy. The Israeli glider from East to West and the Italian glider from North to South. The existence of the eddy was confirmed by both gliders which show that the subsurface eddy was located between ~100-500 m.

The analysis of satellite data shows the eddy at the exact position of the drifters and allows the determination of the eddy extension (Figure 15).

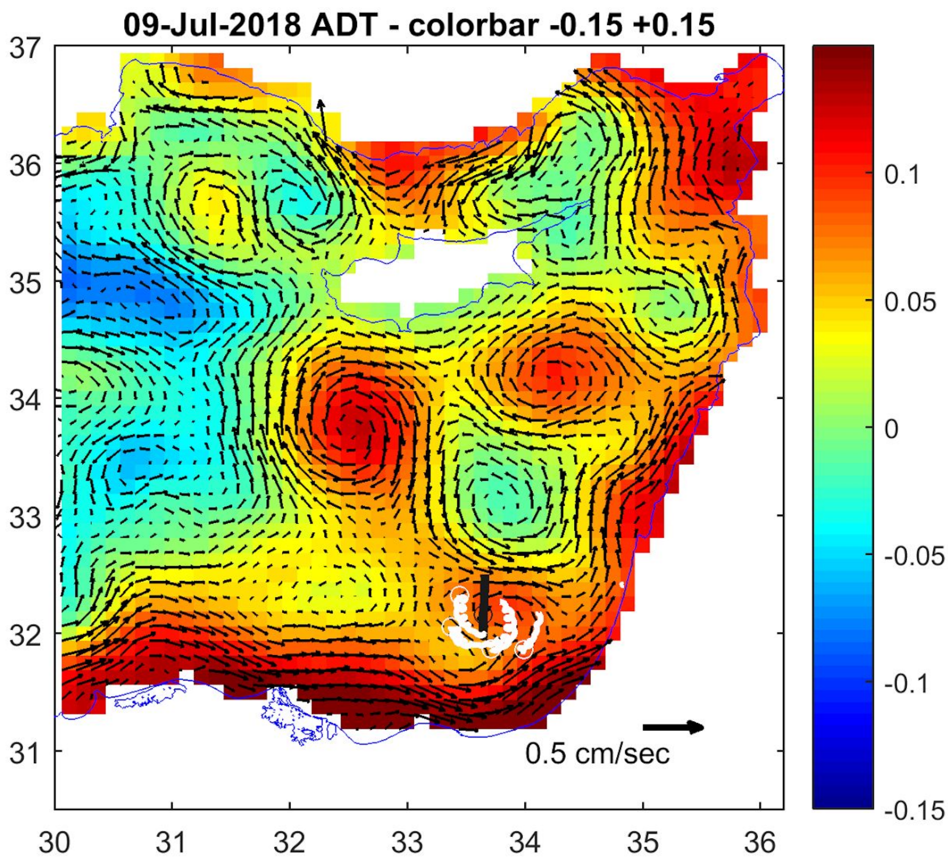

Fig 15. Drifter tracks (white), dynamic height (colour) and geostrophic currents (arrows).

Acknowledges:

We thank all the individuals who have been involved with the MELMAS project and those who have kindly shared their data with us.