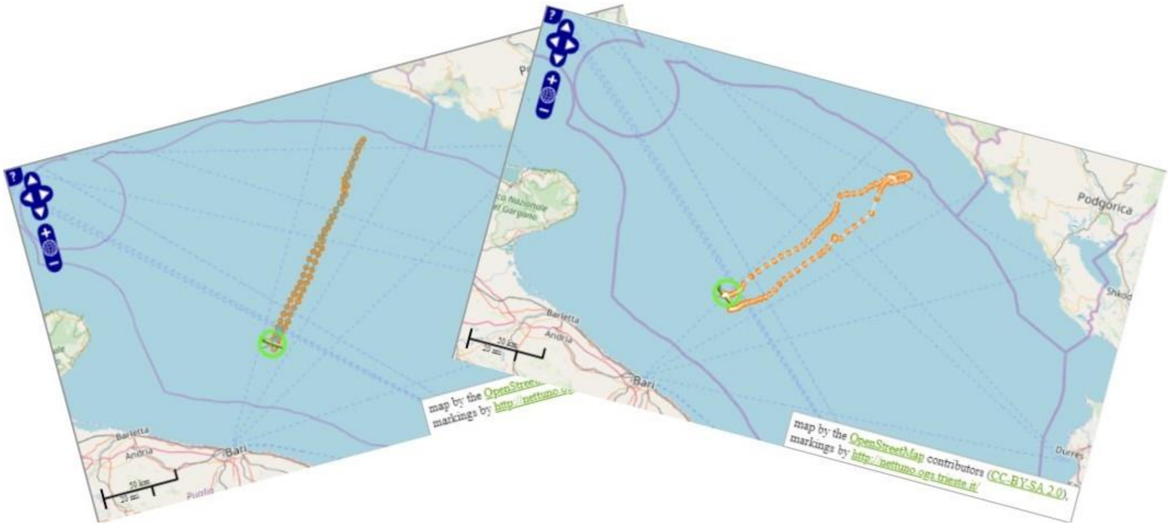

The PreConvex19 and Convex19 glider missions in the South Adriatic Sea (November 2018 and February 2019)

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INDEX:

1. Introduction

As part of the South Adriatic monitoring program, a glider was deployed in the Southern Adriatic Sea from November 22 to December 4, 2019 (PreConvex19 mission) along the Molfetta – Dubrovnik transect. The mission had the aim to assess the hydrographical characteristics of the study area in that period in order to evaluate the pre-convection condition in the area.

In the same area a glider was deployed from January 29 to February 9, 2019 (Convex19 mission) to explore the hydrographical characteristics during the convection period. These phenomena represent a key process in the sea, deeply influencing the hydrographical characteristics of the area.

During the missions the glider was equipped with a Sea-Bird 706 CTD sensor for temperature, salinity and pressure, with an Aanderaa Optode 4831 oxygen sensor to measure dissolved oxygen and a WetLab ECO Triplet FLBBCD-SLK sensor to measure chlorophyll fluorescence at 470/695 nm, back-scattering at 700nm and Colored Dissolved Organic Matter (CDOM) at 370/460 nm.

The Adriatic Sea is a semi-enclosed basin, mainly orientated in the northwest-southeast direction, located in the central Mediterranean Sea, between the Balkans and the Italian peninsula. Some of the Adriatic water masses are originated inside the basin and some other come from outside the basin. The most peculiar water masses present in the South Adriatic, are the saline Levantine Intermediate Water (LIW), coming from the eastern Ionian Sea and entering in the South Adriatic Pit (SAP) at a general depth of 200 – 500 m and the low saline Atlantic Water (AW), coming from the western Ionian Sea, flowing in the surface layer (0 – 150 m). Their inflow is partially controlled by the cyclonic or anticyclonic behavior of the North Ionian Gyre (NIG). The most important water masses originated in the Adriatic Sea are the dense bottom waters, which are the main source of the Eastern Mediterranean bottom waters. These water masses are characterized with respect to their temperature, salinity and density, and defined according to their geographic origin; they are: the North Adriatic Dense Water; the Mid-Adriatic Dense Water and the South Adriatic Water, better known as Adriatic Deep Water.

2. PreConvex19 mission

The PreConvex19 mission (Fig. 1) started in November 22 at 12:01 UTC at 41.5266°N and 17.2334°E. The glider was headed toward Dubrovnik and then again toward the Italian Coast where it was recovered on December 4 at 07:02 UTC at 41.505°N and 17.097°E (Fig.1).

The glider performed about 164 dives with maximum depth varying from 30 to 950 m. The WetLab sensor was programmed to record the optical parameters from the surface down to 200 m.

Figure 1: The glider trajectory along the Bari-Dubrovnik transect during the Pre-CONVEX19 mission.

2.1 Results

The temperature data (Fig. 2) collected along the Bari-Dubrovnik transect show well stratified conditions, characterized by high temperature area at surface on the Croatia side with temperature increasing from 17- 17.5 to 18.5°C.

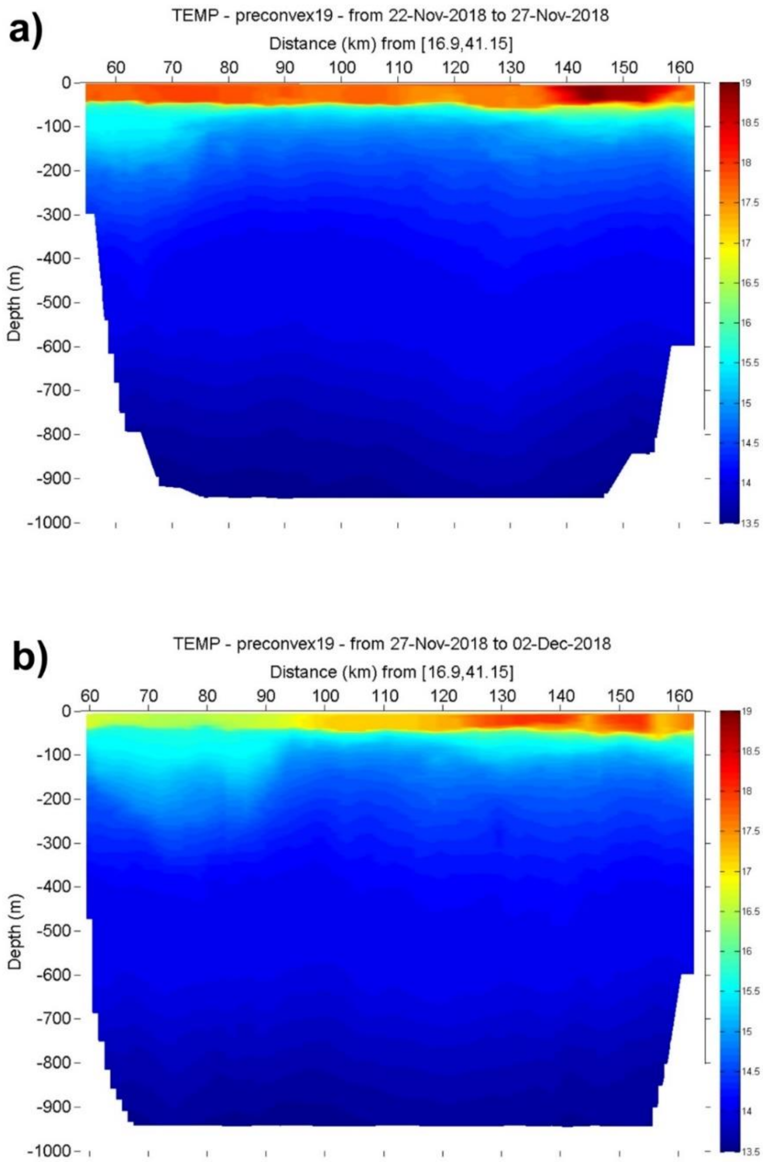


Figure 2: Temperature profiles collected during the Pre-CONVEX19 mission. a) Bari-Dubrovnik transect; b) Dubrovnik-Bari transect.

The salinity distribution (Fig. 3) along the transect highlights a thin layer of low salinity, which extends from the surface down to 50 m depth (38.55 psu), the layers below it present instead the highest salinity concentrations that reach 38.9 psu.

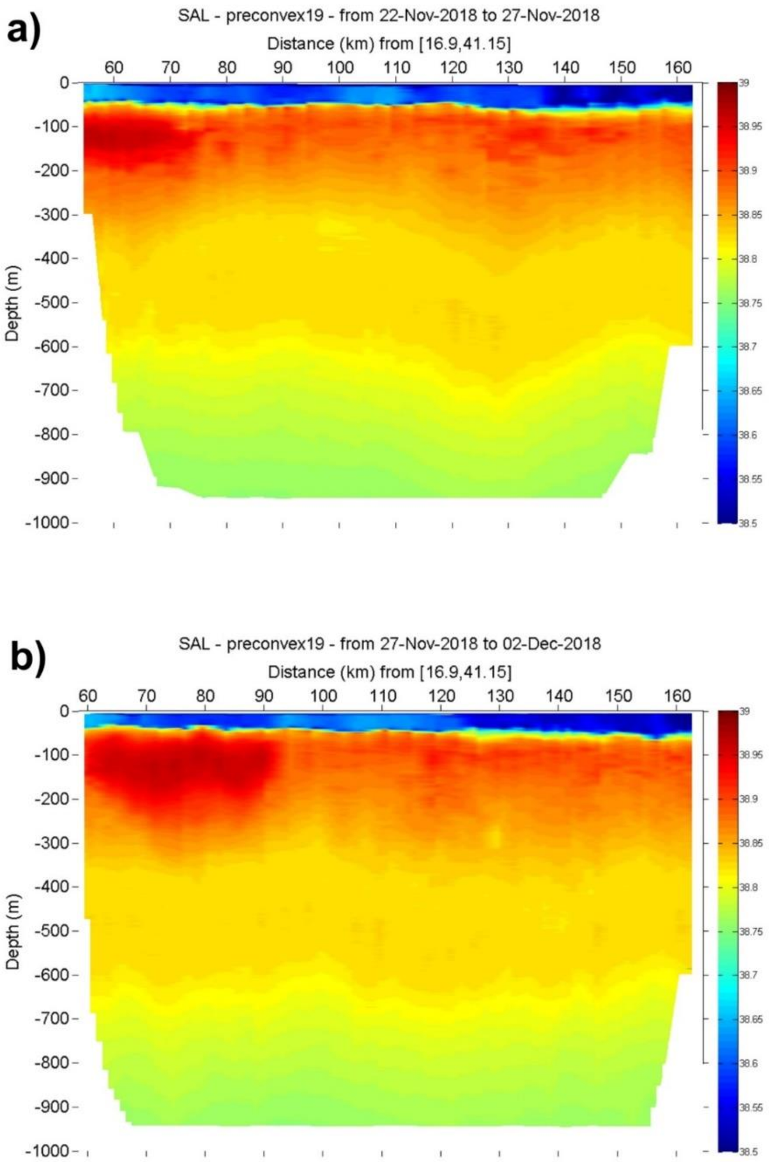


Figure 3: Salinity profiles collected during the Pre-CONVEX19 mission. Bari- Dubrovnik transect; b) Dubrovnik-Bari transect.

The salinity gradually decreases until the bottom. Temperature and salinity plots depict nuclei of high temperature and high salinity near the Italian coast at 80-200m depth eventually extending deeper down to 350 m.

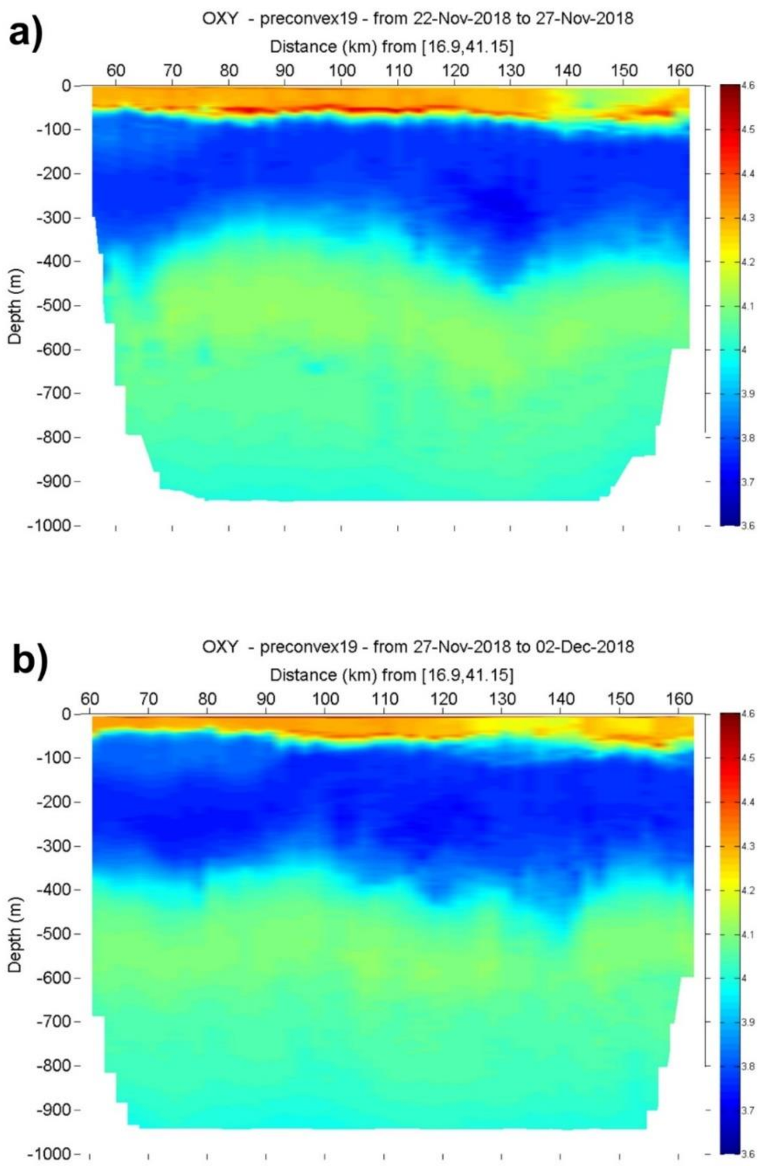


Figure 4: Dissolved Oxygen profiles collected during the Pre-CONVEX19 mission. Bari- Dubrovnik transect; b) Dubrovnik-Bari transect.

A layer of high oxygen values (4.6 ml/l) covers the top 60 m, while a second deeper and thicker layer of relative high oxygen is depicted at mid-column depths, between 300 and 650 m (Fig. 4).

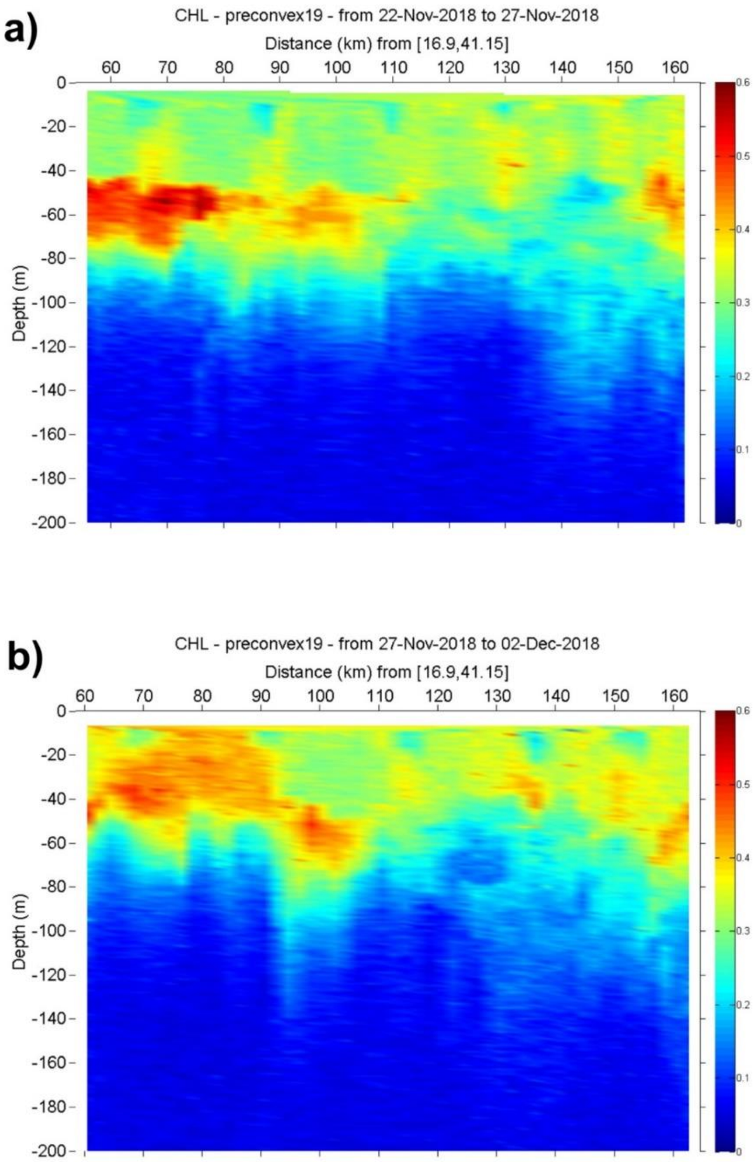


Figure 5: Chlorophyll profiles collected during the Pre-CONVEX19 mission. Bari- Dubrovnik transect; b) Dubrovnik-Bari transect.

The highest Chlorophyll (Fig. 5) concentrations (0.6 µg/l) are observed between 40 m and 60 m, especially near the Italian coast, lower concentrations are instead observed in the center of the pit. Below 60 m the chlorophyll reaches the lowest values (less than 0.1 µg/l).

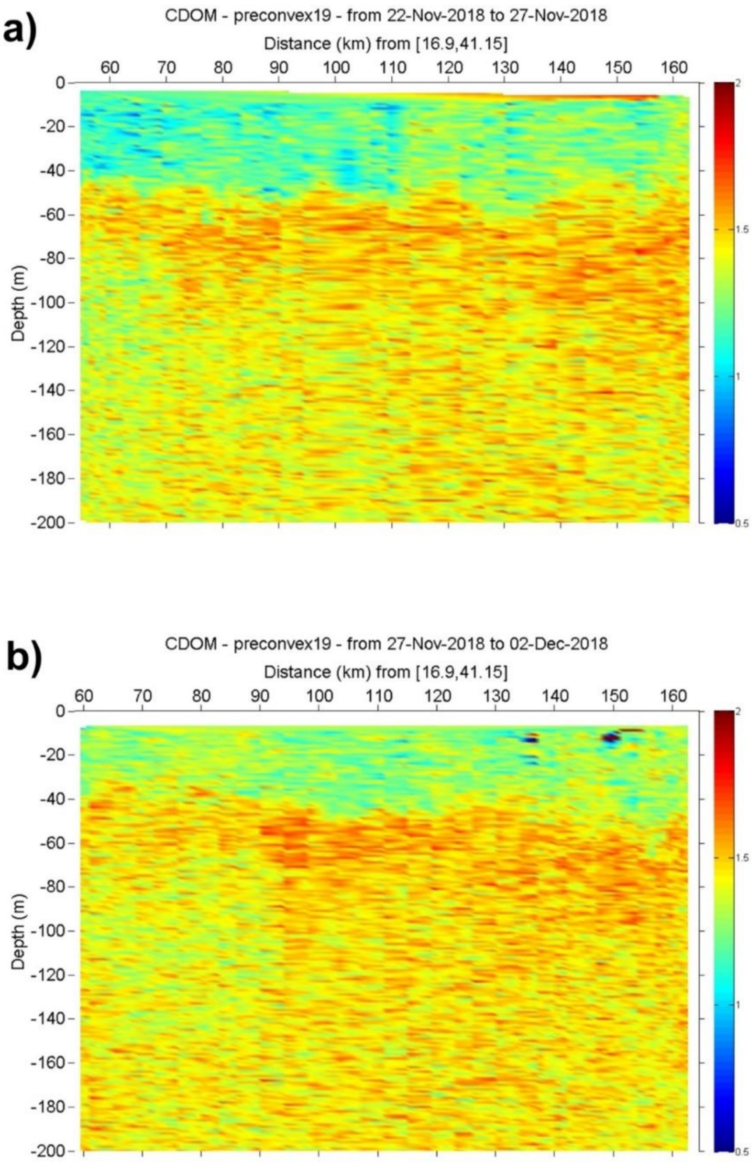


Figure 6: CDOM profiles collected during the Pre-CONVEX19 mission. Bari- Dubrovnik transect; b) Dubrovnik-Bari transect.

The CDOM (Fig. 6) distribution highlights a surface layer characterized by the lower concentrations. Between 40 and 80 m depth the CDOM presents the higher concentrations (≈ 2 ppb) and below that the CDOM presents homogeneous concentrations of about 1.5 ppb

3. Convex19 mission

The glider was deployed on January 29 at 11:49 UTC at 41.546867°N and 17.243333°E and it was recovered 12 days later on February 9 at 7:05 UTC at 41.604733°N and 17.202467°E (Fig. 7).
During the Convex19 mission, more than 200 profiles with maximum depth varying from 30 to 950 m were performed. The WetLab optical data were recorded from the surface down to 200 m during the first 4 days, down to 400 m for other 2 days and then down to the maximum depth reached by the glider for the remaining part of the mission.

Figure 7: The glider trajectory along the Bari-Dubrovnik transect during the CONVEX19 mission.

3.1 Results

During the CONVEX19 mission, the water column along the Bari-Dubrovnik displays sub-mesoscale features evolving in a few days. Temperature distribution (Fig. 8) highlights a water column in which temperature varies about 1°C, from 14.7°C at the surface layer to 13.6°C at about 950 m. Warmer and colder structures are spaced in the top 200 m along both transects.

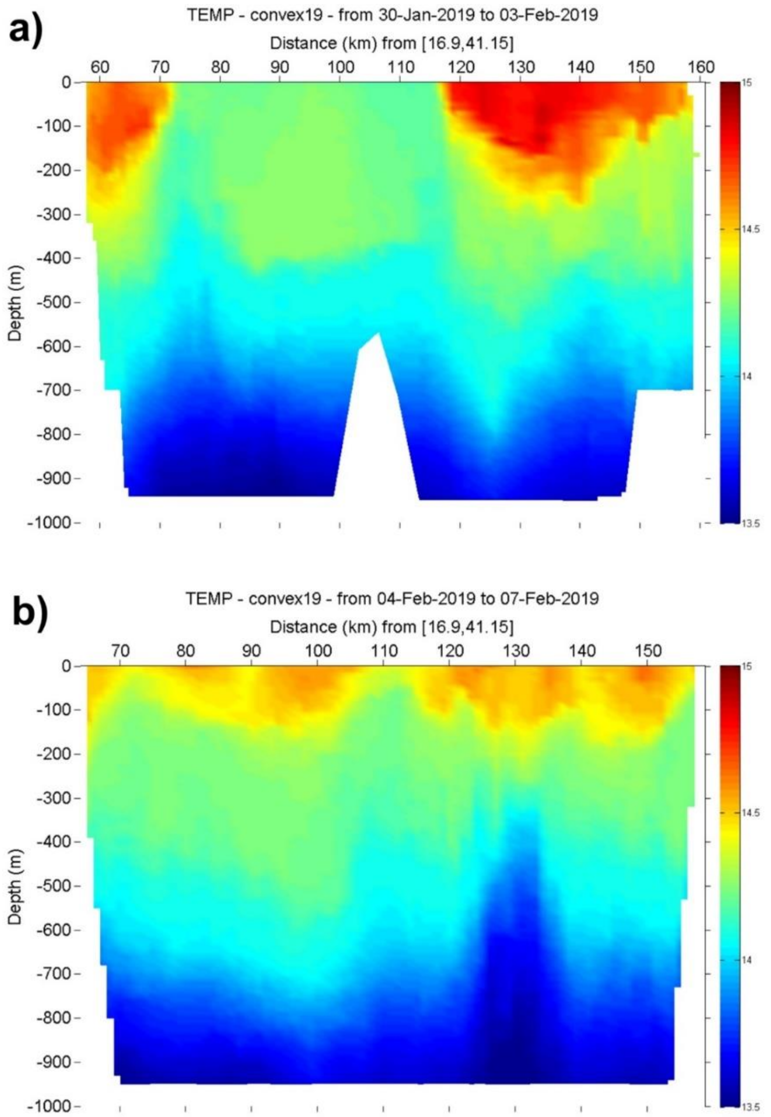


Figure 8: Temperature profiles collected during the CONVEX19 mission. Bari- Dubrovnik transect; b) Dubrovnik-Bari transect.

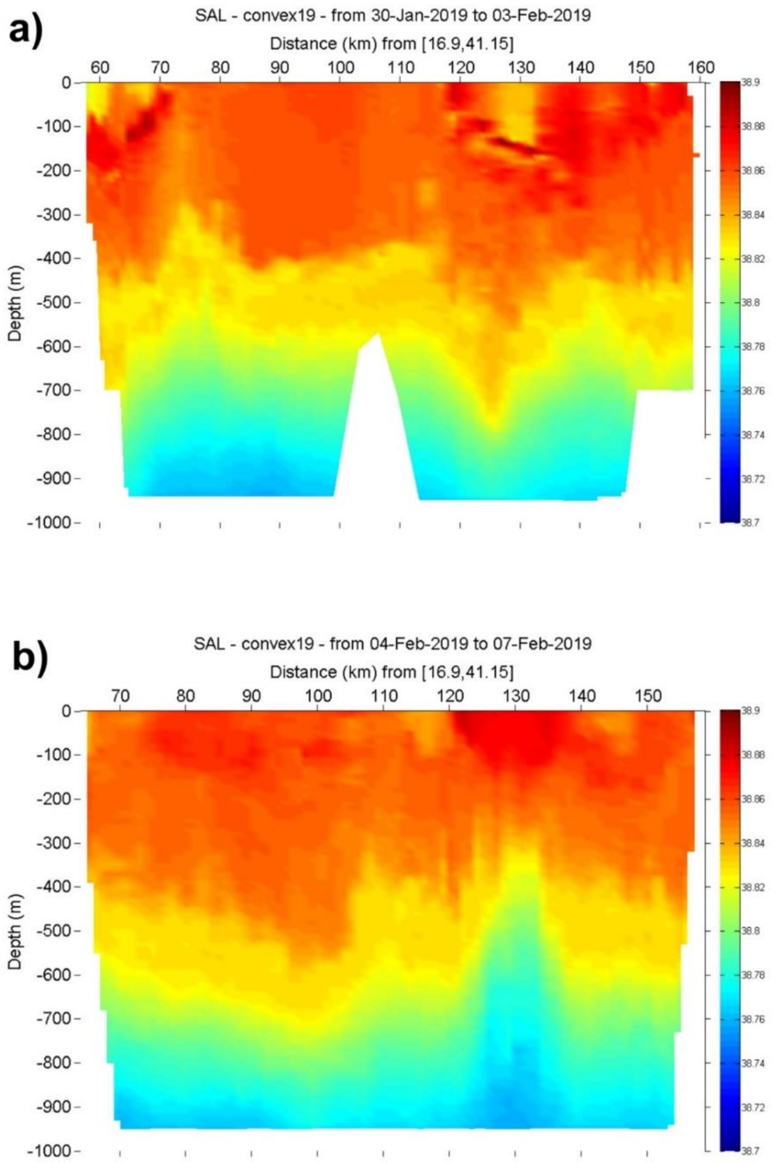


Figure 9: Salinity profiles collected during the CONVEX19 mission. Bari-Dubrovnik transect; b) Dubrovnik-Bari transect.

Salinity vertical distribution (Fig. 9) presents marked surface-bottom gradients. Higher salinity (38.85 psu) is evident at the surface down to about 500 m, in which nuclei of higher salinity are evident in the first 150 m. Below that layer, the salinity decrease gradually until 950 m.

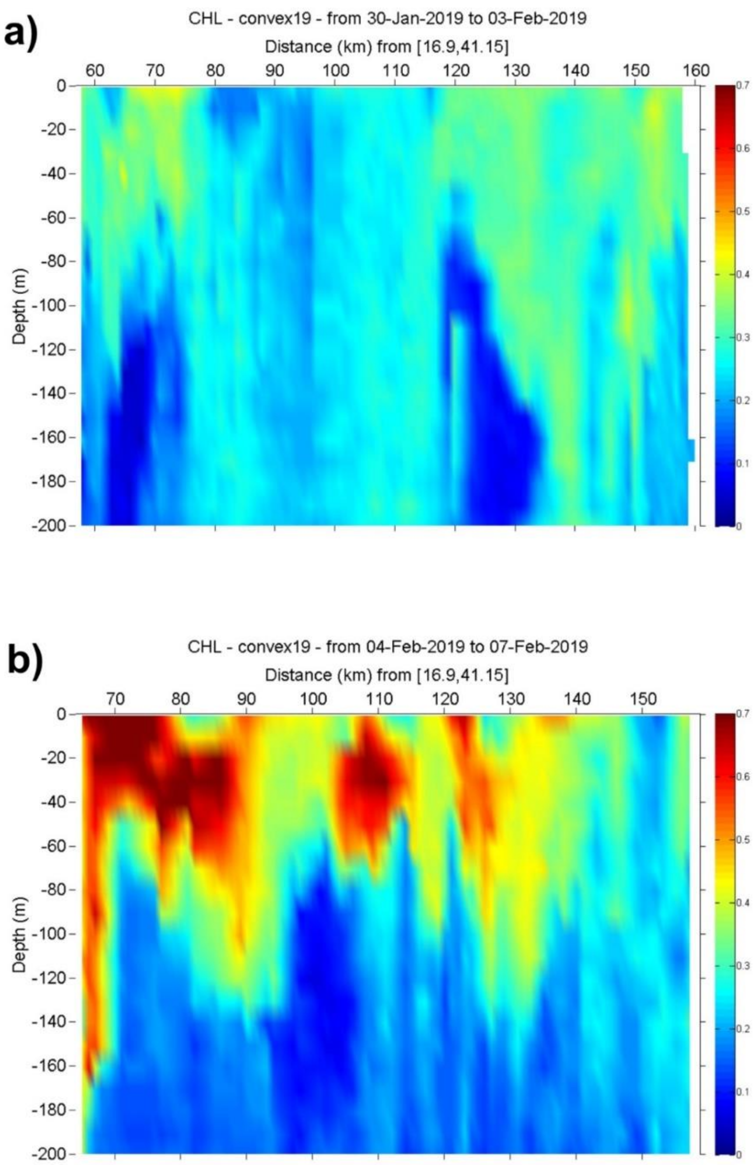


Figure 10: Chlorophyll profiles collected during the CONVEX19 mission. Bari- Dubrovnik transect; b) Dubrovnik-Bari transect.

Chlorophyll vertical distribution (Fig. 10) presents the highest concentration between the surface layers and the 200 m isobaths (0.6 µg/l).

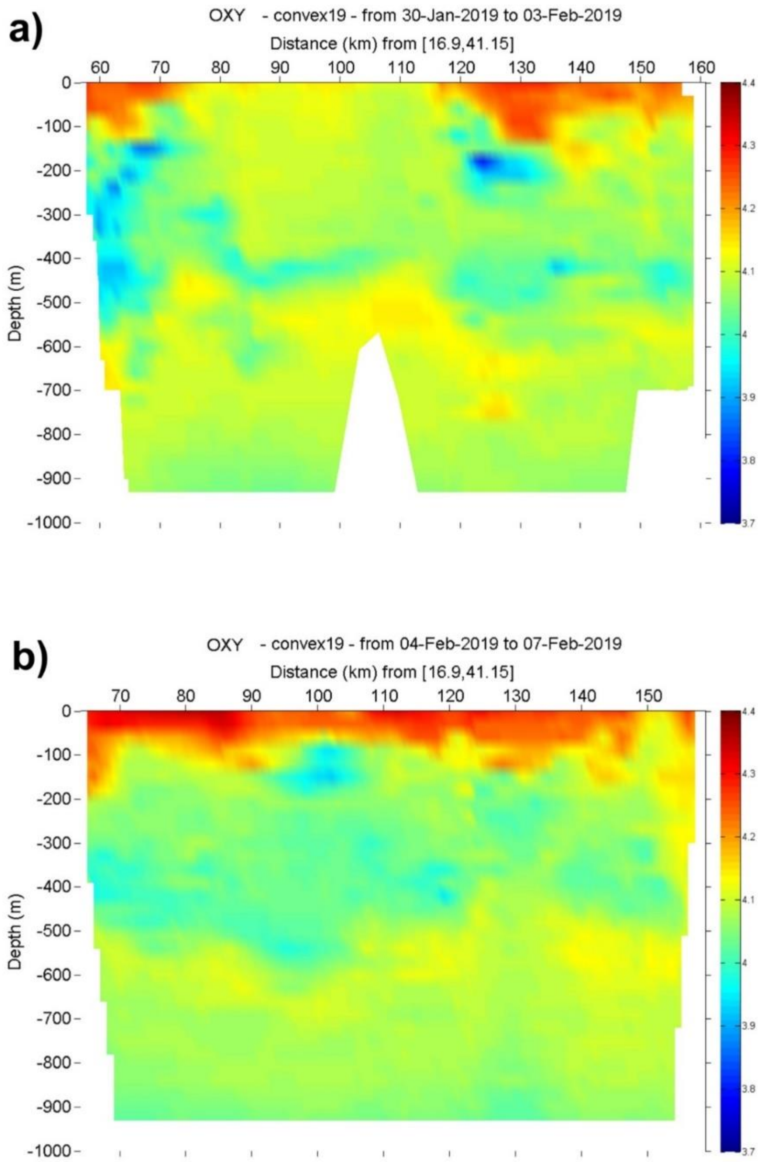
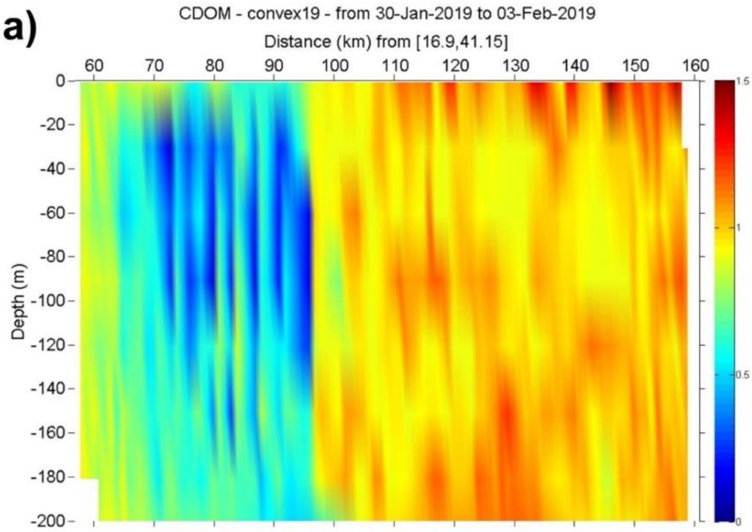


Figure 11: Dissolved Oxygen profiles collected during the CONVEX19 mission. Bari- Dubrovnik transect; b) Dubrovnik-Bari transect.

Interesting to note, is the increase in the chlorophyll concentration during the second half of the mission, with the values reaching 0.8 μg/l, between the surface and 100 m. Below 200 m isobath the chlorophyll concentration is less than 0.1 μg/l.



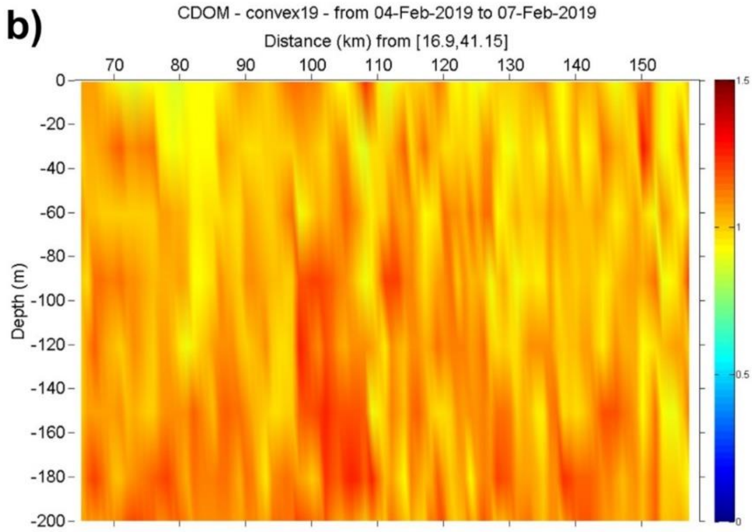


Figure 12: CDOM profiles collected during the CONVEX19 mission. Bari- Dubrovnik transect; b) Dubrovnik-Bari transect.

A clear trend, similar to that observed in the chlorophyll distribution, is observed in the dissolved oxygen distribution (Fig. 11). The highest concentrations are present in the surface layer (4.4 ml/l). Moving deeper along the water column, the vertical distribution is inhomogeneous reaching the lowest values (4 ml/l) between 200 m and 500 m depth. The CDOM (Fig. 12) distribution, besides the high noise of the signal, highlights a market difference between the first part of the mission characterized by the lowest concentrations (0.5 ppb) in the surface layer and the last transect where the concentration is higher (1.5 ppb). Along the water column the CDOM is distributed in patches and characterized by higher concentrations below the 200 m isobath.

4. Ongoing collaborations

The data series along the Bari-Dubrovnik transect, started in 2014, has allowed us to establish working collaborations with the Croatian colleagues from Dubrovnik and Split institutes. We contributed to a join project proposal for Croatian Science Foundation with dr. sc. Mirna Batistic from the 'Institut za more i priobalje' of Dubrovnik (UNIDU), to share the past and future glider data. We are also collaborating with dr. Hrvoie Mihanovic and dr. Ivica Vilibec from 'Institut za oceanografiju i ribarstvo' of Split (IZOR) to analyze the glider physical data contributing to a hydrografical joint paper on the Adriatic Sea.

5. Acknowledgments

We would like to acknowledge our Croatian colleagues prof. dr. sc. Nenad Jaspica and dr. sc. Mirna Batistic for their help, the Italian Embassy in Zagreb for supporting us in the process of permits procedure and the Croatian authorities for issuing the permits.