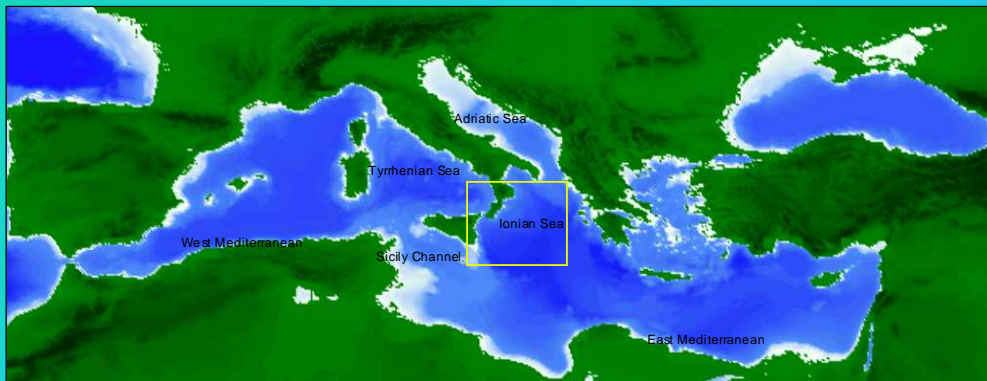


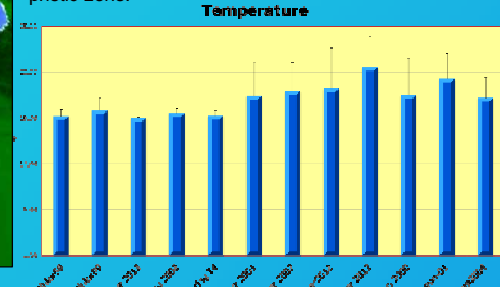
Seasonal and inter-annual changes of microbial activities in the Central Mediterranean Sea



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During 12 cruises carried out in the Ionian Sea and Central Mediterranean Sea from 1998 to 2013, different biochemical and microbial parameters involved in the biogeochemical cycles (C, P, N) were measured in the photic zone.

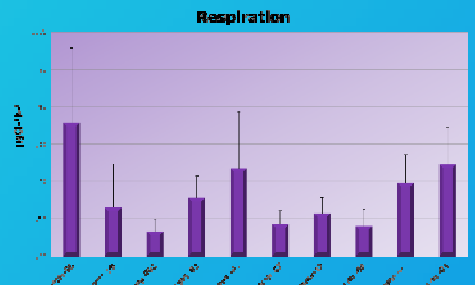
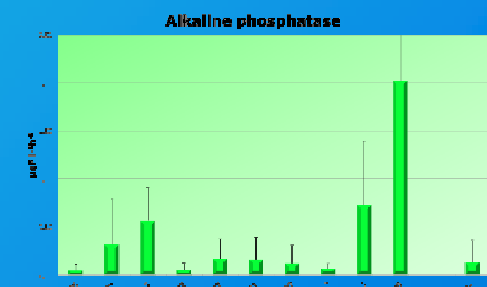
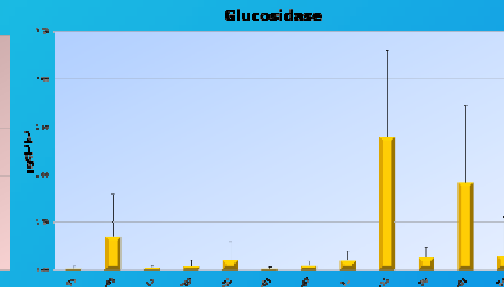
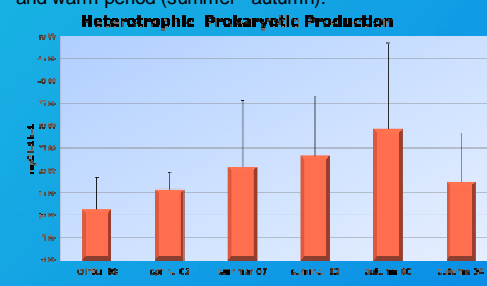
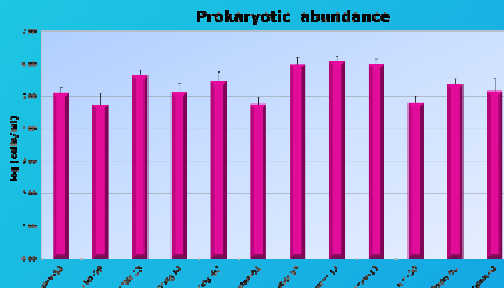
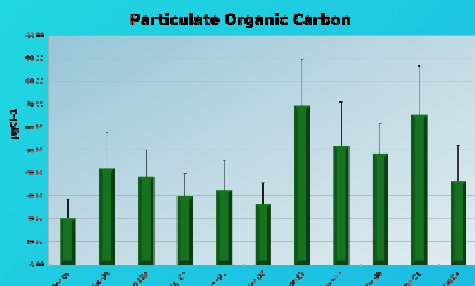


The variability of studied parameters was assessed by statistical analysis using Kruskal -Wallis test (non parametric ANOVA). No significant Temperature differences among winter and spring samplings were observed. Temperature registered in summer 2013 was significantly higher than in previous summers; also autumn 2001 showed high temperature values. Greater differences were found between cold (winter -spring) and warm period (summer -autumn).

The Mediterranean Sea is a semi-enclosed basin, approximately 3,680 km long, divided into the Western and Eastern basins separated by the straits of Sicily. In this area, several ocean processes (i.e. intermediate and deep water formation, upwelling, intense mesoscale activity) take place.

It is a very sensitive ecosystem, suitable for the study of several processes linked with climatic changes (high evaporation during summer, limited freshwater input, high (>12.8°C) deep-sea temperatures, oligotrophic conditions, changes in the circulation of water masses).

The euphotic layer of the water column is generally characterized by high variability of chemical, physical and microbiological parameters, due to seasonal variations, trophic processes, and exchanges with atmosphere.

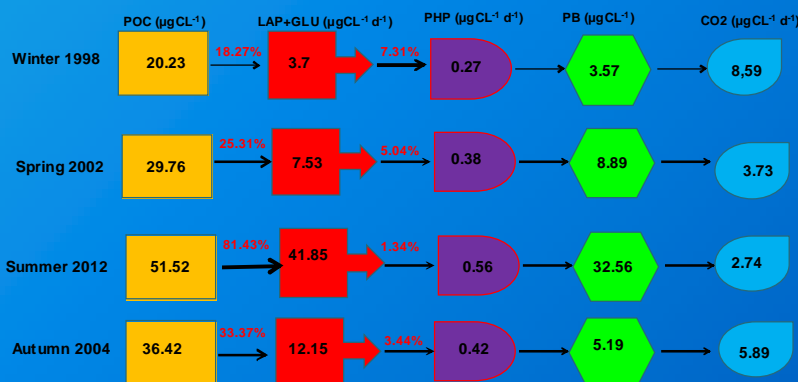


Particulate Organic Carbon (POC) was high in summer -autumn period and low values of C/N ratio (ranging between 5.9 and 9.4) were observed, suggesting the availability of fresh, labile compounds prone to prokaryotic decomposition. Seasonal changes in the euphotic layer for most of the studied microbial parameters were observed. Significant differences were found for all microbial parameters on both seasonal and inter-annual scales, except for the prokaryotic abundance during three summer cruises. Microbial enzymatic activities (LAP and GLU) showed peaks in summer 2013, when temperature increased significantly (20.52 °C). Alkaline phosphatase and Prokaryotic Heterotrophic Production (PHP) reached the highest values in Autumn 2004. The Respiration (CO₂) was higher in winter 1998.

The differences observed in the patterns of the microbial parameters are reflected in the estimates of Carbon flux, that varied seasonally, affected by the water temperature and the trophic conditions. The rising temperatures could cause an increase in remineralization in winter and autumn, with respect to the photosynthetic production, with a consequent predominance of a heterotrophic regime.

The Ionian Sea has been classified as an oligotrophic area of the Mediterranean Sea, due to low levels of chlorophyll and POC. In oligotrophic environments, it is assumed that the microbial community (both auto- and heterotrophic) plays a key role; the cycling within the microbial loop is reported as the dominant mode of nutrient transfer.

The variability in the microbial processes on seasonal scales suggests that the Central Mediterranean Sea is an unstable system reacting to changing environmental conditions.



Acknowledgments

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