DISSOLVED ORGANIC MATTER DYNAMICS IN THE ADRIATIC SEA

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Abstract
Vertical distribution of Dissolved Organic Carbon (DOC) and Fluorescent Dissolved Organic Matter (FDOM) was studied in the Southern Adriatic Sea in December 2015 and April 2016 (Eurofleets2-ESAW cruises). DOC showed a clear seasonality with the highest values in the mixed layer in December and a downward export due to vertical mixing in April. In the bottom layer (800-1200 m) DOC values in April were up to 13 µM higher than in December, even if no increase in oxygen was observed. The application of PARAFAC to the 330 excitation emission matrices (EEMs) allowed for the validation of a 6-component model, indicating the occurrence of 3 terrestrial and 1 marine humic-like components, 1 protein-like and 1 PAH-like components. Fluorescence indicates removal in the upper layers and a transformation of the DOM pool in the deep waters.

Keywords: Organic matter, Geochemical cycles, Warming, Adriatic Sea

Dissolved Organic Matter (DOM) represents the largest pool of reduced carbon on the Earth and the main source of energy for the heterotrophic prokaryotes [1]. The Adriatic Sea is a semi-enclosed basin strongly influenced by many factors such as river discharge, winds regime, and large-scale circulation patterns (e.g., BiOS-Bimodal Oscillating System). It is the major source of dense water for the Eastern Mediterranean Sea [2]. The main goals of this study are: 1) to report the first information about Fluorescent Dissolved Organic matter (FDOM) in the Middle and Southern Adriatic Sea; 2) to assess the seasonal variability of dissolved organic carbon (DOC) distribution in the Adriatic in relation to large-scale and long-term changes in water masses circulation and properties. Samples were collected from the surface to the bottom along 2 sections, located in the Middle and Southern Adriatic Sea, during 2 cruises (Fig. 1): ESAW 1 (December 12th to 15th 2015) and ESAW 2 (April 5th to 9th 2016) in the framework of the research project funded under the Eurofleets 2 EU-FP7.

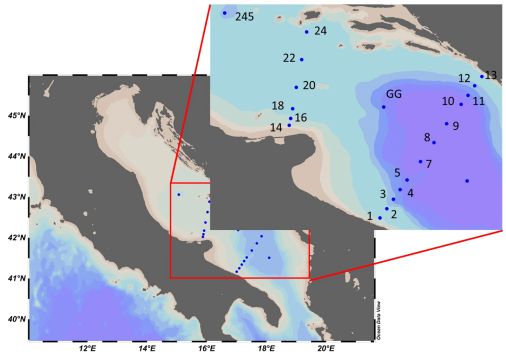

Fig. 1. Study area and sampling stations.

In December, DOC ranged between 44 and 84 µM with maximum values in the surface layer in correspondence with the riverine input and at station 10 (Fig. 2). At station 10, values of ~65 µM are observed down to 300 m, indicating the DOC vertical re-distribution by mesoscale features. The lowest values (44 µM) were observed in the core of the Levantine Intermediate Water (LIW) (400-600 m), in agreement with previous observations [4]. In April, the highest values (77-82 µM) were observed in the surface layer, close to the Italian coast, and at stations 7 and 8. Vertical mixing can explain the high values observed in the upper 400 m. The lowest values (48-50 µM) were still observed in LIW core. In the bottom layer (800-1200 m) DOC values were up to 13 µM higher than in December. Usually, an increase in DOC values in the deep layer of this area is observed after the arrival of newly formed dense water from the North Adriatic, but neither physical nor oxygen changes clearly supported this interpretation during winter 2016. The application of PARAFAC to the 330 excitation emission matrices (EEMs) allowed for the validation of a 6-component model. In order to identify these components, their spectra were compared with matching spectra obtained from OpenFlour database [5], with spectra reported in the literature and with spectra of commercial humic and fulvic acids and proteins. Four components were identified as humic-like of both marine (C1) and terrestrial (C2, C3 and C5) origin; one component (C4) was identified as protein-like; the last component (C6) was identified as PAH-like.

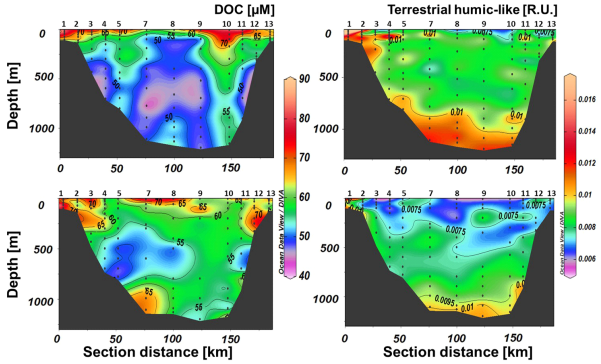

Fig. 2. Vertical distribution of terrestrial humic-like component (C3) and DOC in December 2015 (upper panels) and April 2016 (lower panels).

The vertical distribution of the terrestrial humic-like component (C3) is reported as representative of the other humic-like components (Fig. 2). FDOM was lower in April than in December along the whole water column. In both periods the highest values were close to the Italian coast (stations 1 and 2), in contrast the minimum was in the upper 50 m in December and in the upper 500 m in April due to photobleaching processes. Deep waters were characterized by markedly higher fluorescence in December than in April, suggesting the removal of FDOM between the two periods. Interestingly, a comparison with data collected in the same area 10 years before reveals an increase of ~10 µM in DOC concentration in the surface layer (0-50 m). DOC accumulation can be explained by a combination of factors such as the increase in temperature and in salinity (due to the phase of BiOS) and the enhanced riverine input.

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