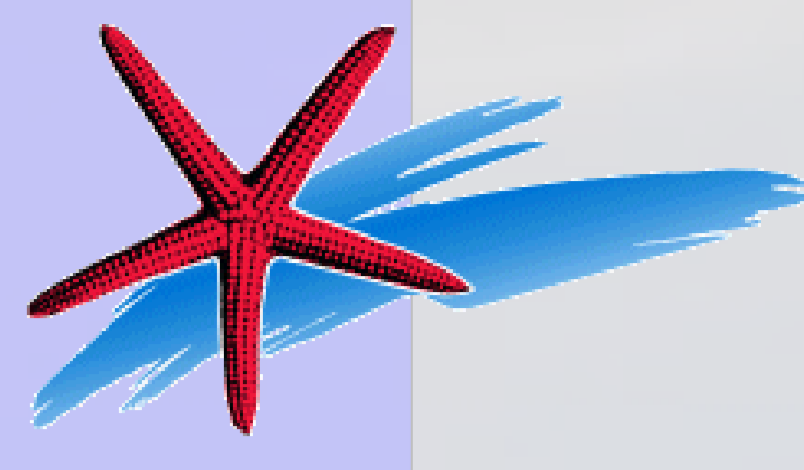
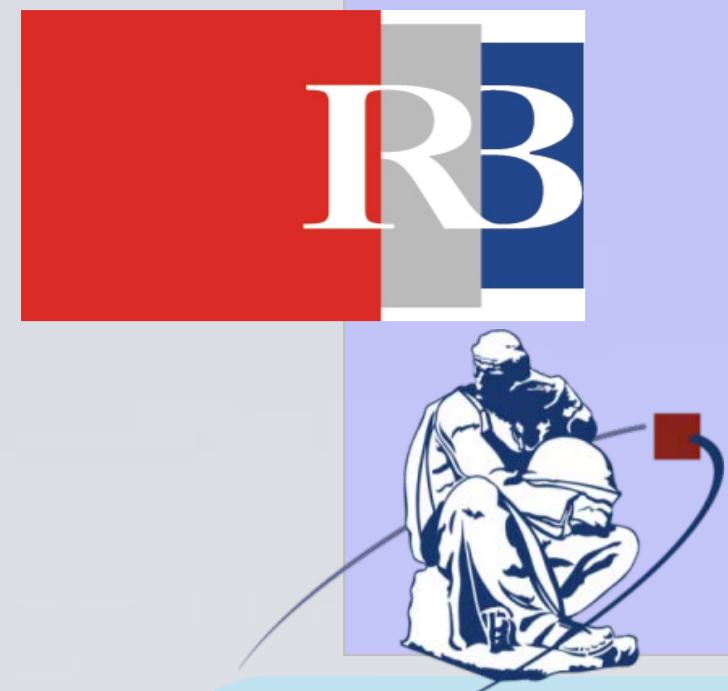


OCEANOGRAPHIC CONDITIONS RELATED TO THE EXTREME WARM SPRING-SUMMER OF 2016 AND 2017 IN THE NORTHERN ADRIATIC

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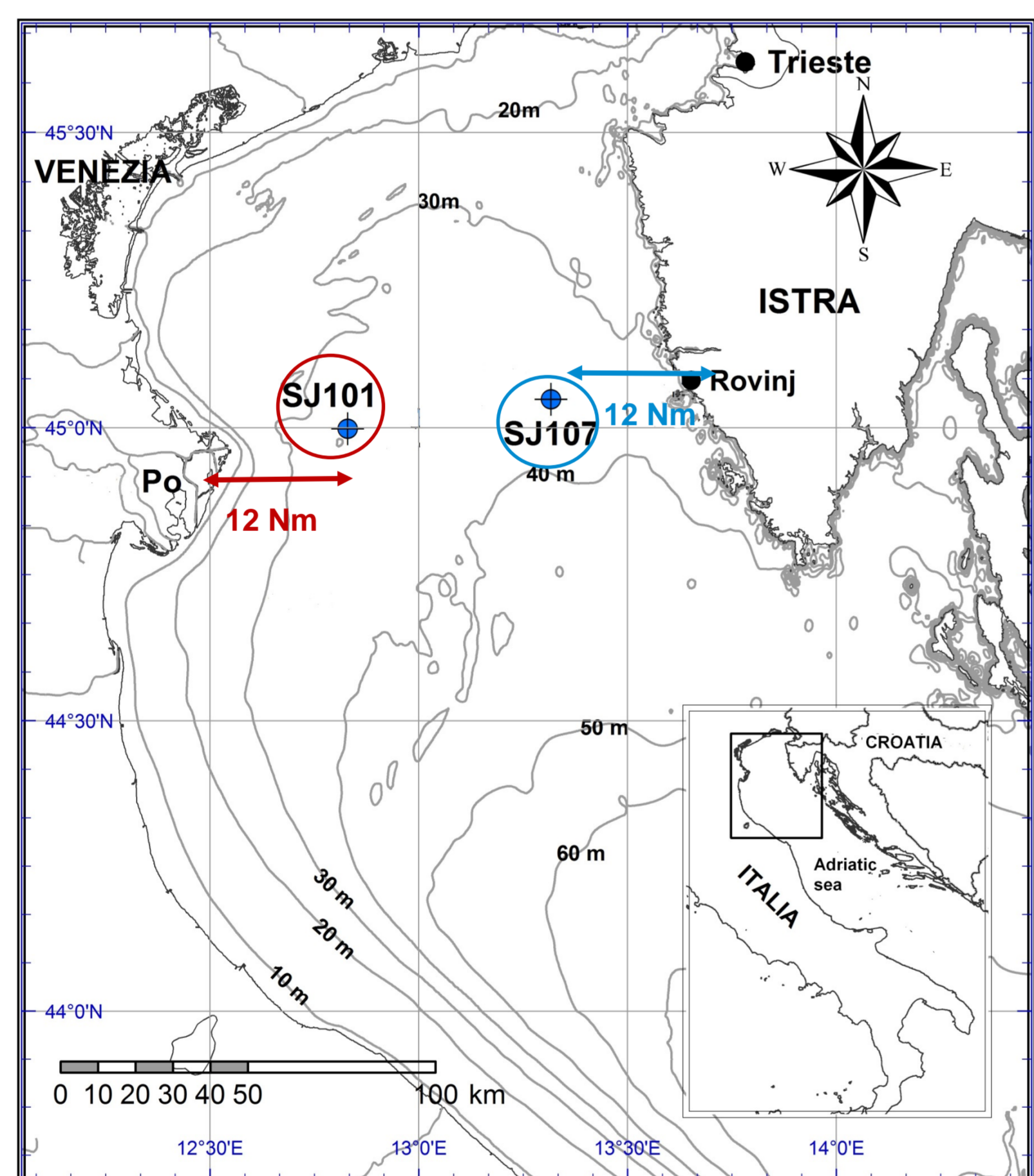
Abstract

Temperature, salinity, total inorganic nitrogen (TIN), orthophosphate (PO₄) and chlorophyll a (chl a) concentrations in the surface, and oxygen saturation in the bottom layer of two stations in the northern Adriatic (NA) were measured in 2016 and 2017 and compared with long-term data (1972-2015). Unusually high surface temperature and salinity, as well as very low nutrient and chlorophyll a were observed, particularly in spring.

Introduction

- The oceanographic conditions in the NA mostly depend on: air-sea fluxes, Po River discharges and the water advection from the central/southern Adriatic [1].
- While the **western station SJ101** is **mesotrophic** due to influence of Po River waters, the **eastern station SJ107** is predominantly **oligotrophic** due to advection of higher salinity oligotrophic waters from central Adriatic (Fig. 1).
- **Extremely warm weather was recorded in 2016 and particularly in 2017, during spring and summer** (data from the Rovinj meteorological station). To verify if this atmospheric event had a significant impact on the NA, oceanographic parameters, measured in 2016 and 2017 at two stations were compared with long-term data (1972-2015).

Figure 1. Northern Adriatic map and station locations.



Methodology

Data from two stations of different eutrophication level (located along the transect Po River delta - Rovinj) were used: station SJ101 is 12 Nm off the Po River delta, Italy and station SJ107, 33.5 Nm off the Po River mouth and 12 Nm offshore the Istrian coast, Croatia (Fig.1).

Water samples for temperature (T), salinity (S), dissolved oxygen (DO) and nutrients measurements were collected on a monthly scale in the period 1972-2017 and determined by standard oceanographic methods [2].

References

- [1] Degobbis, D.; Precali, R.; Ivančić, I.; Smoljaka, N.; Fuks, D.; Kveder, S., 2000. Long-term changes in the northern Adriatic ecosystem related to anthropogenic eutrophication. *Int. J. Environment and Pollution*, 13(1-6), 495-533.
- [2] Parsons T.R., Maita Y., Lalli C.M., 1985. *A Manual of Chemical and Biological Methods for Seawater Analysis*. Pergamon Press. Oxford, New York, Toronto, Sydney and Frankfurt, 173 pp.

Results

- **Sea surface temperature** was at both stations generally **higher** than the average, particularly in summer 2017 (Fig. 2).
- **Surface salinity** at station **SJ107** was **generally higher** than usual (Fig. 2, right). This occurred less frequently at SJ101, although still dominantly.
- As expected, the nutrient conc. distributions were correlated to the described oceanographic conditions (Fig. 2):
 - At **SJ101** the **TIN** concentrations were mostly remarkably **below the averages**, while at **SJ107**, the differences were **reduced**, although still significant.
 - The **PO₄** concentration at **SJ107** were near the **analytical limit, as typically**. Some **increased** values were observed in the fall 2016 at **SJ101** (Fig. 2, left).
- The **chl a** concentration was **close or below the long-term average**. Occasionally higher values were correlated with nutrient concentration increases, e.g. in June (SJ101) and November (SJ107) of 2016 (Fig. 2).
- Only during spring and summer 2017, as well as in October 2016 the bottom **oxygen saturation ratios** at **SJ101** were **lower** than the averages (Fig. 2, left).

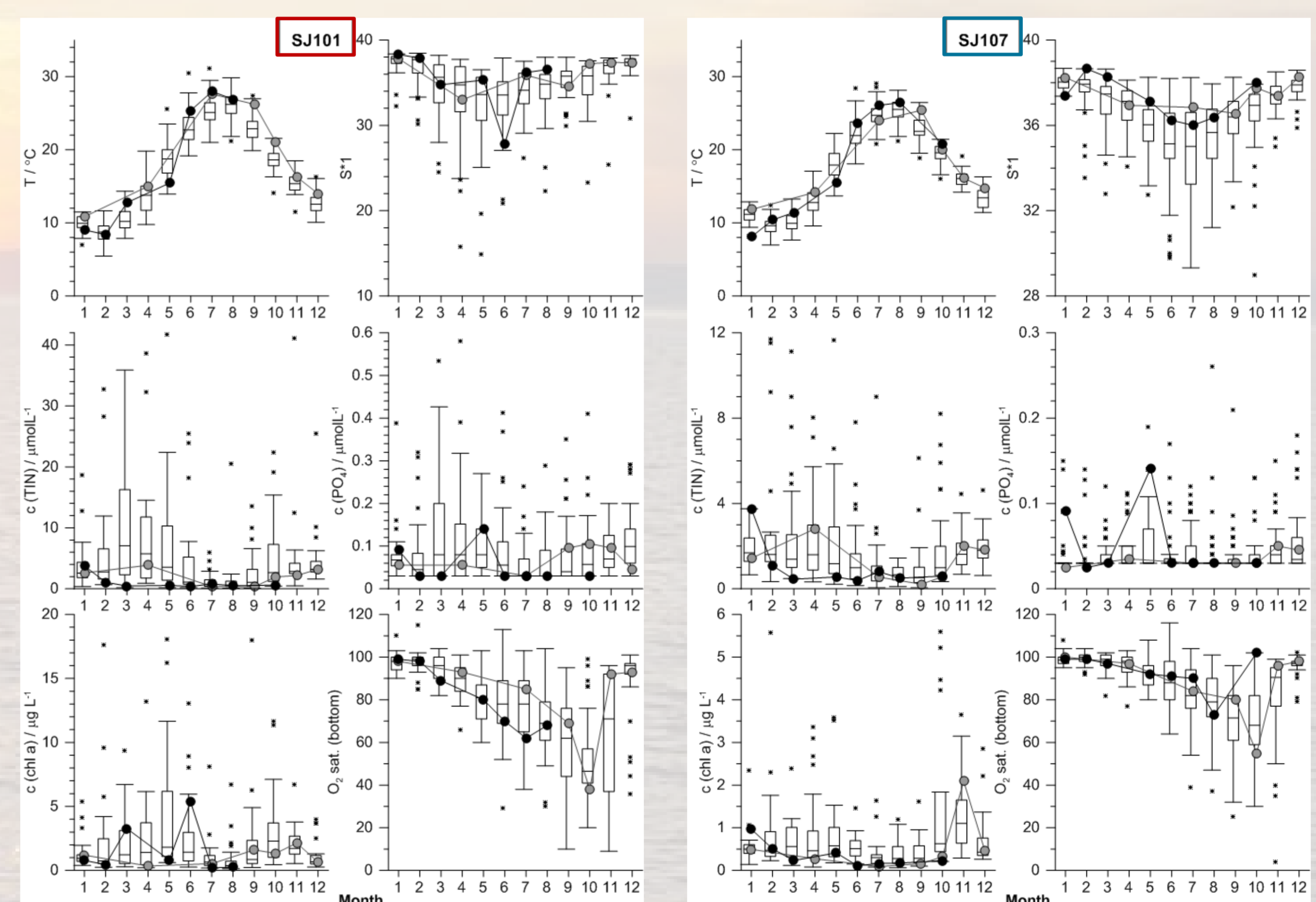


Figure 2. Long term data (1972-2015; Box-Whisker plot), 2016 (grey) and 2017 (black) monthly values of oceanographic parameters at the stations SJ101 (left) and SJ107 (right).

CONCLUSIONS

- In 2016 and 2017 unusually high salinity and low nutrients concentration in the surface layer was observed, especially in spring. Phytoplankton bloom was very modest.
- Oceanographic conditions in the NA during 2016 and 2017 were probably affected by increased heat input from the atmosphere and by advection of high salinity waters from the central Adriatic concurrently with a reduced Po River influence, particularly in spring and summer.

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