THE INFLUENCE OF BLACK SEA WATER INFLOW AND ITS SYNOPTIC TIME SCALE VARIABILITY IN THE NORTH AEGEAN SEA HYDRODYNAMICS

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1. Introduction

The exchange flow between the Black Sea and the North Aegean Sea through the Dardanelles Strait constitutes an essential feature of the regional general circulation. The low-salinity Black Sea Water (BSW) inflow in the Aegean can also affect the deep water formation processes, creating a buoyant surface layer which may significantly reduce the dense water formation activity [1] and may influence the Eastern Mediterranean thermohaline structure .

2. Data & Methodology

The Princeton Ocean Model (POM) with a resolution of 1º/60 is used in order to evaluate the influence of the synoptic time-scale variability of the BSW inflow and the role of the atmospheric forcing. A series of experiments are performed aiming at investigating the response of the North Aegean dynamics to different BSW inflow conditions (Fig.1).

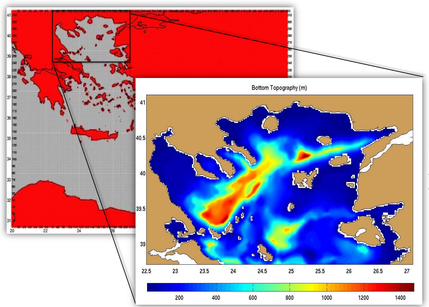

Figure 1: The North Aegean model domain and bathymetry (nested in the ALERMO operational system).

The experiments (Table 1) are carried out for the period from August 2008 to October 2009, using observed upper- and lower-layer fluxes at the Dardanelles strait [2] and high resolution atmospheric forcing and boundary conditions, derived from the ALERMO operational system [3].

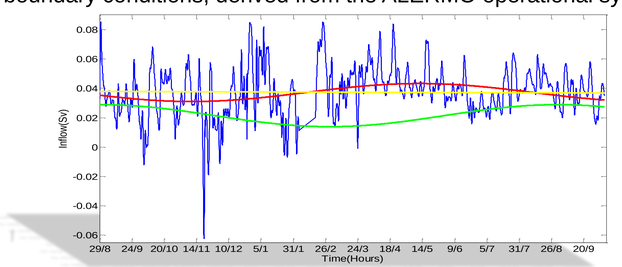

Figure 2: Observed BSW fluxes (blue; positive values flux toward the Aegean Sea), seasonal cycle of them (red), mean value of the observed data (yellow) and an older parameterization of the Dardanelles inflow (green).

The results are also compared with an older parameterization of the Dardanelles inflow [4] with no synoptic time scale variability that also presents different seasonality from the observed time series (Fig.2).

	Inflow/Outflow	Atmospheric forcing
Experiment I	Observed Dardanelles fluxes	Synoptic time-scale data
Experiment II	Seasonal cycle of observed data	Synoptic time-scale data
Experiment III	Constant mean value of observed data	Synoptic time-scale data
Experiment IV	Parameterization of the Dardanelles flow	Synoptic time-scale data
Experiment V	Seasonal cycle of observed data	Seasonal cycle

Table 1: List of experiments

3. Results

The main features of the large-scale circulation pattern of the North Aegean are present in all experiments, showing that the BSW inflow variability can be “absorbed” on the basin scale (Fig.3).

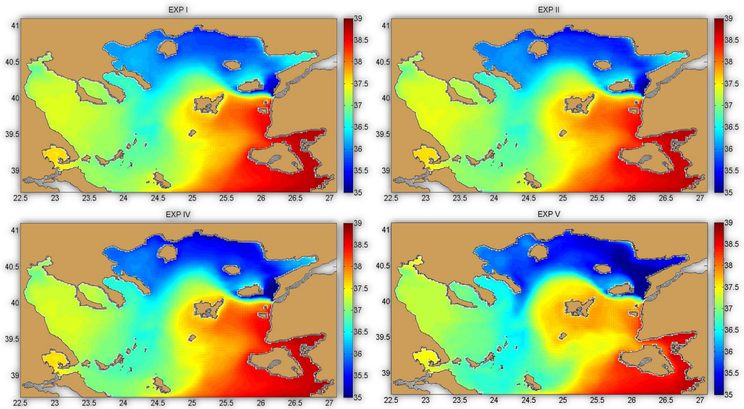

Figure 3: Mean annual salinity field (10m) a. Experiment I, b. Experiment II, c. Experiment IV, d. Experiment V

However, the differences among the experiments reveal important changes and the most important are observed between EXP I and EXP II. As shown in Fig.4, the basin-average kinetic energy of EXP II is considerably increased as compared to the inflow with synoptic time-scale variations (EXP I). The presence of steady seasonal inflow (EXP II) enhances the along-front current and eddies. A northward displacement of the front between the BSW and the high-salinity waters of Levantine origin is evident in the results (Fig. 5) in the absence of synoptic variability in the Dardanelles flow.

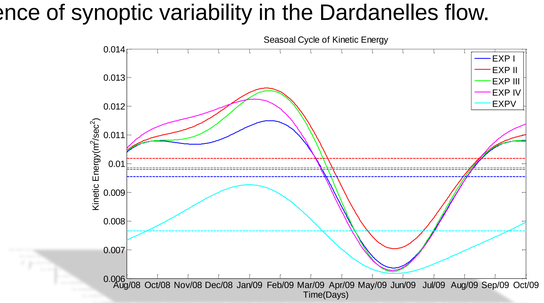

Figure 4: Annual distribution of basin-average kinetic energy for the five experiments.

The main path of BSW inflow in EXP II is displaced to the northwest of the Lemnos island(Fig.5d), as indicated by the kinetic energy difference. A patch of higher salinity water is observed in the region north of Lemnos.

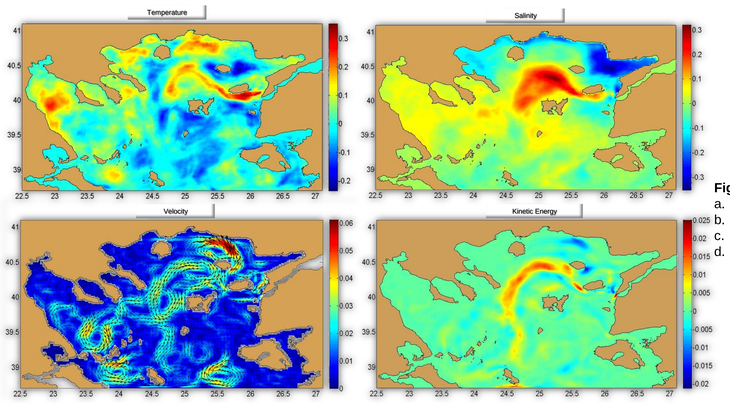

Figure 5: Difference between EXP II- EXP I
a. Mean temperature field,
b. Mean salinity field,
c. Mean velocity field,
d. Kinetic Energy of the mean flow.

The different seasonality of the Dardanelles inflow plays an important role in the North Aegean circulation characteristics. Although the influence of the inflowing BSW is mainly identified in the surface layer, the whole water column is eventually affected (Fig. 6).

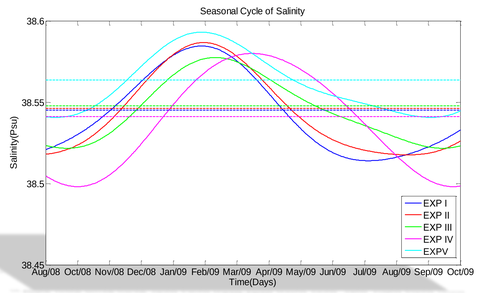

Figure 6: Annual distribution of basin-average salinity

The synoptic time-scale atmospheric variability is significant in determining the strength and variability of the regional circulation patterns. The absence of short time-scale atmospheric variations (EXP V) affects the distribution of the inflowing waters in the basin and significantly changes the characteristics of water column(Fig.4 and Fig. 6)

4. Conclusions

Although the main circulation of the North Aegean basin is robust and evident in all experiments, the discontinuity of the fluxes associated with the synoptic time-scale variability weakens and displaces the frontal activity and other structures of the circulation. Changes in the seasonality of the BSW inflow and the synoptic variability of the atmospheric forcing significantly affect both the surface and 3-D circulation as well as the water column characteristics.

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