BLACK AND AEGEAN SEAS: AN IMPACT OF THE LARGE-SCALE ATMOSPHERIC FORCING ON THE LONG-TERM VARIABILITY OF WINTER SURFACE TEMPERATURE

Alexander S. KAZMIN and Andrei G. ZATSEPIN

P.P.Shirshov Institute of Oceanology, Russian Academy of Sciences
36 Nakhimovsky prosp., Moscow 117997, Russia
E-mail: akazmin@ocean.ru

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MOTIVATION

- The Black and Aegean Seas, while closely located geographically, have significant differences in hydrology and ecosystem. The variability of the temperature in the upper layer of both basins is one of the major hydrological processes that affect ecosystem and productivity (e.g., Oguz et al., 2003; Oguz, 2005).
- As a result of scientific interest and practical importance, the variability of the temperature and associated physical processes on the scales from synoptic to seasonal are reasonably well established (e.g., Poulos et al., 1997; Theocharis and Kontoyiannis, 1999; Oguz et al., 2005).
- However, information on the longer-term variability of SST and its connection with the large-scale atmospheric forcing is limited (e.g., Ginzburg et al., 2004; Oguz, 2005; Kazmin and Zatsepin, 2007) and specific mechanisms of correlation between the local SST and the large-scale atmospheric processes are still poorly investigated.

The goal of this study is to compare the general patterns of the long-term winter-mean SST variability in the Black and Aegean Seas during 1982-2004, and associate them with the major large-scale atmospheric forcing (air temperature, surface wind and NAO and EAWR indices).

DATA and APPROACH

- MCSST

Monthly-mean satellite multichannel SST at ~18 km resolution based on AVHRR night-time measurements for the period 1982-2004

- NCEP/NCAR reanalysis

Monthly-mean surface air temperature and surface wind components from NCEP/NCAR Reanalysis Project for the period 1982-2004

- NAO index

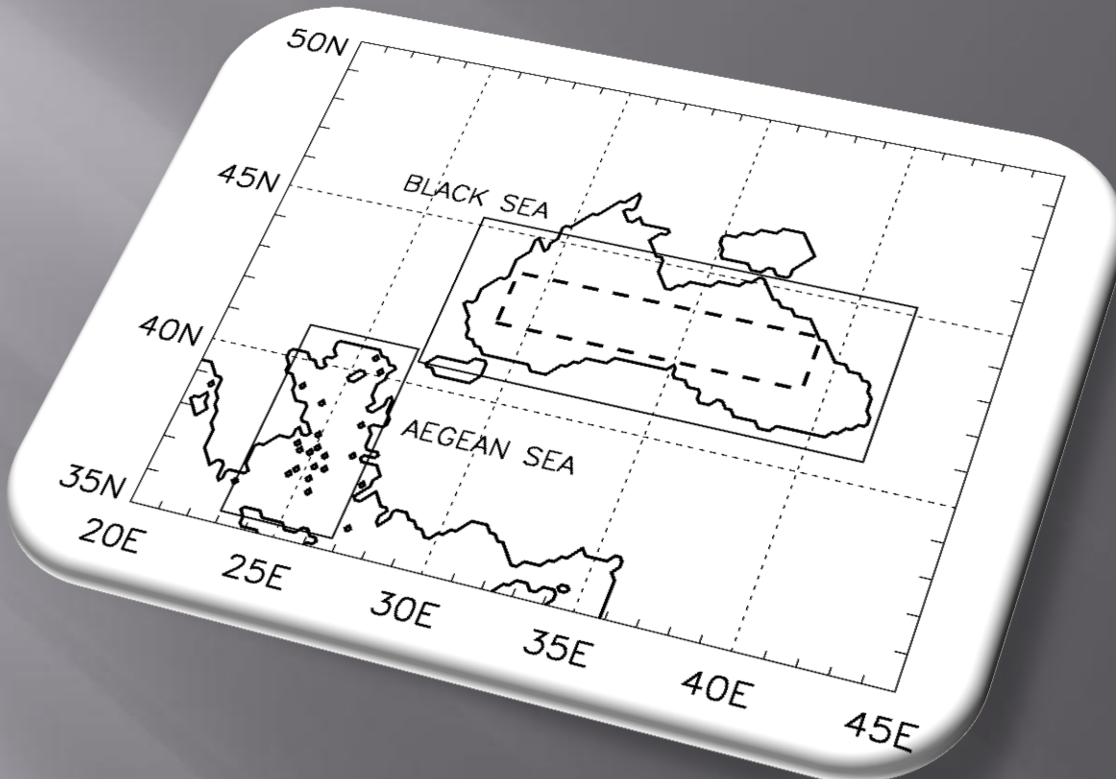
Winter (D,J,F,M) index for the period 1982-2004 was obtained from Climate Research Unit of the University of East Anglia, U.K.

- EAWR index

Winter (D,J,F,M) index for the period 1982-2004 was obtained from NOAA Climate Prediction Center

INTEGRAL APPROACH: **In order to suppress the mesoscale features and reveal the general patterns of the long-term variability we applied heavy spatio-temporal averaging and smoothing to SST, air temperature and surface wind components. Earlier this integral approach was successfully used to detect the gross features of decadal variability both in the large-scale oceanic frontal zones (Nakamura and Kazmin, 2003) and in the local area of Canary upwelling (Santos et al., 2005).**

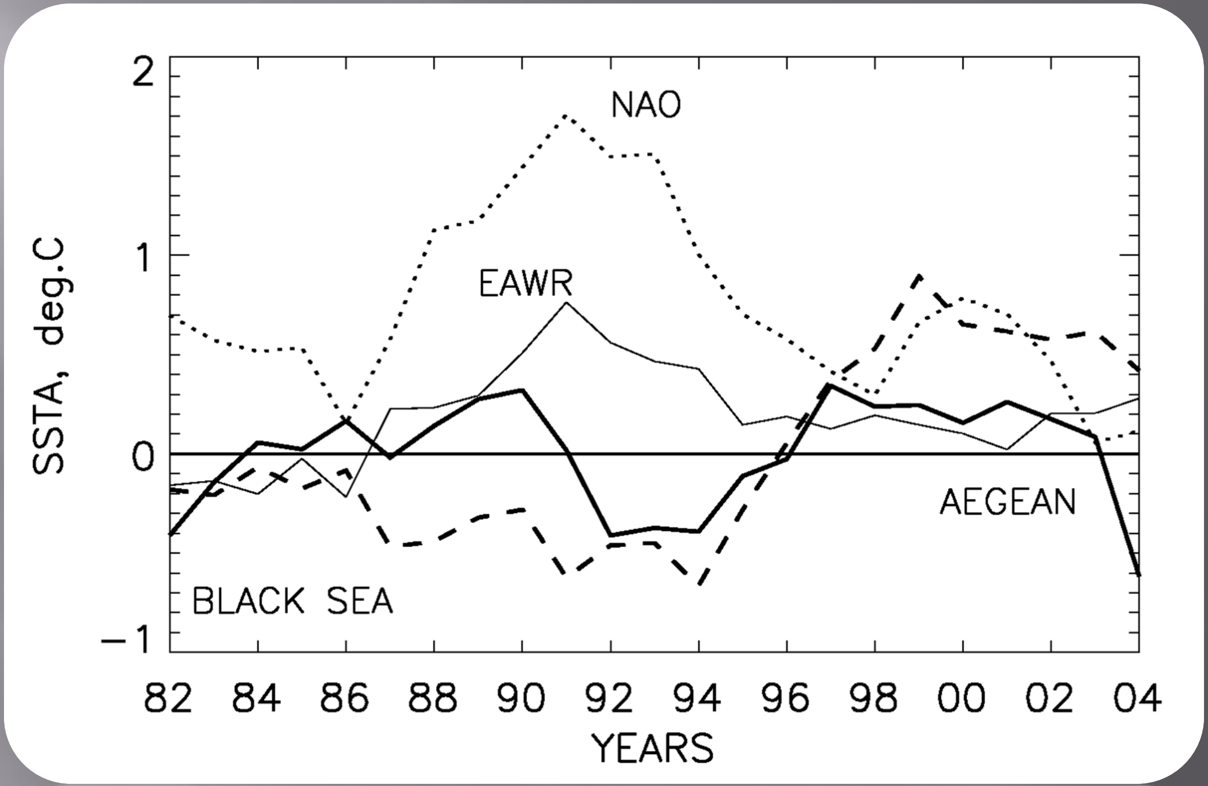
STUDY AREA



Dashed box indicates the area of spatial averaging of SST for the Black Sea. Solid boxes indicate the area of spatial averaging of SST for the Aegean Sea and SAT and surface wind components for both basins.

Then, all data were averaged for winter season (D,J,F) and smoothed with a 3-year moving average filter

WINTER-MEAN SST ANOMALIES in the BLACK and AEGEAN SEAS

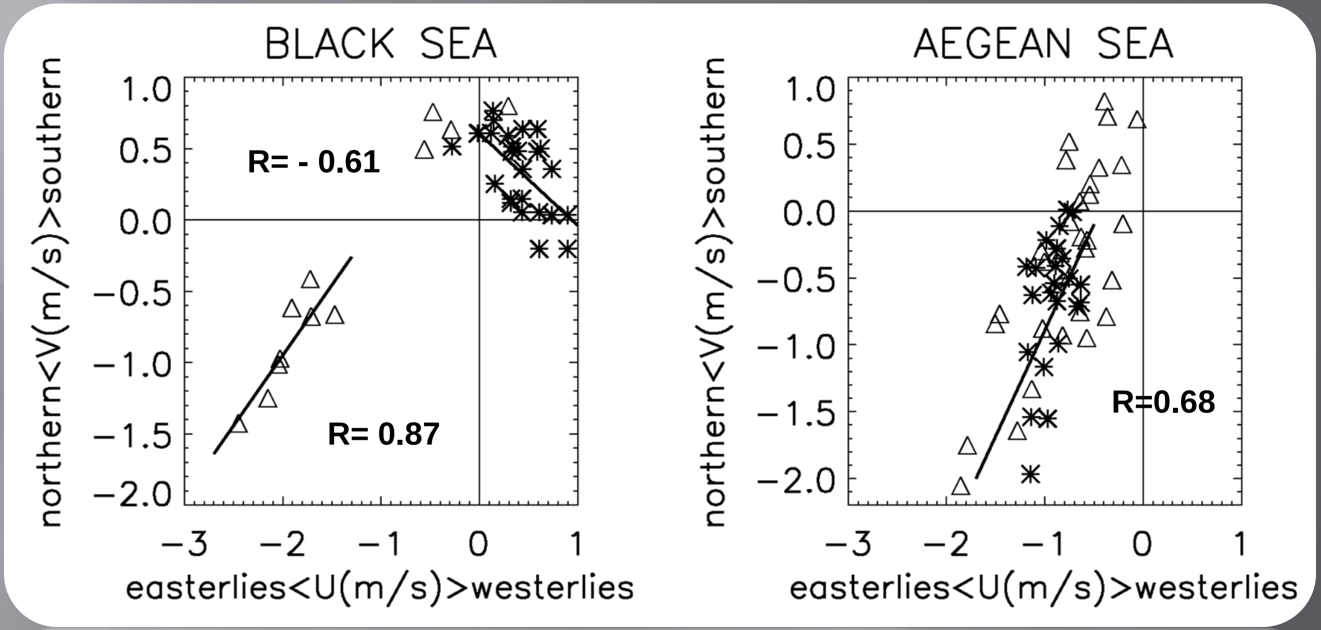


Three-years moving average filtered time series of basin-mean winter SSTA in the Black (dashed) and Aegean (solid, bold) Seas and NAO and EAWR indices.

Note:

During investigated period NAO and EAWR were in positive (enhanced) phase.

WIND FIELD STRUCTURE over the BLACK and AEGEAN SEAS (WINTER)



Scatter diagrams between spatially averaged zonal (**U**) and meridional (**V**) component of surface wind over the Black and Aegean Seas.

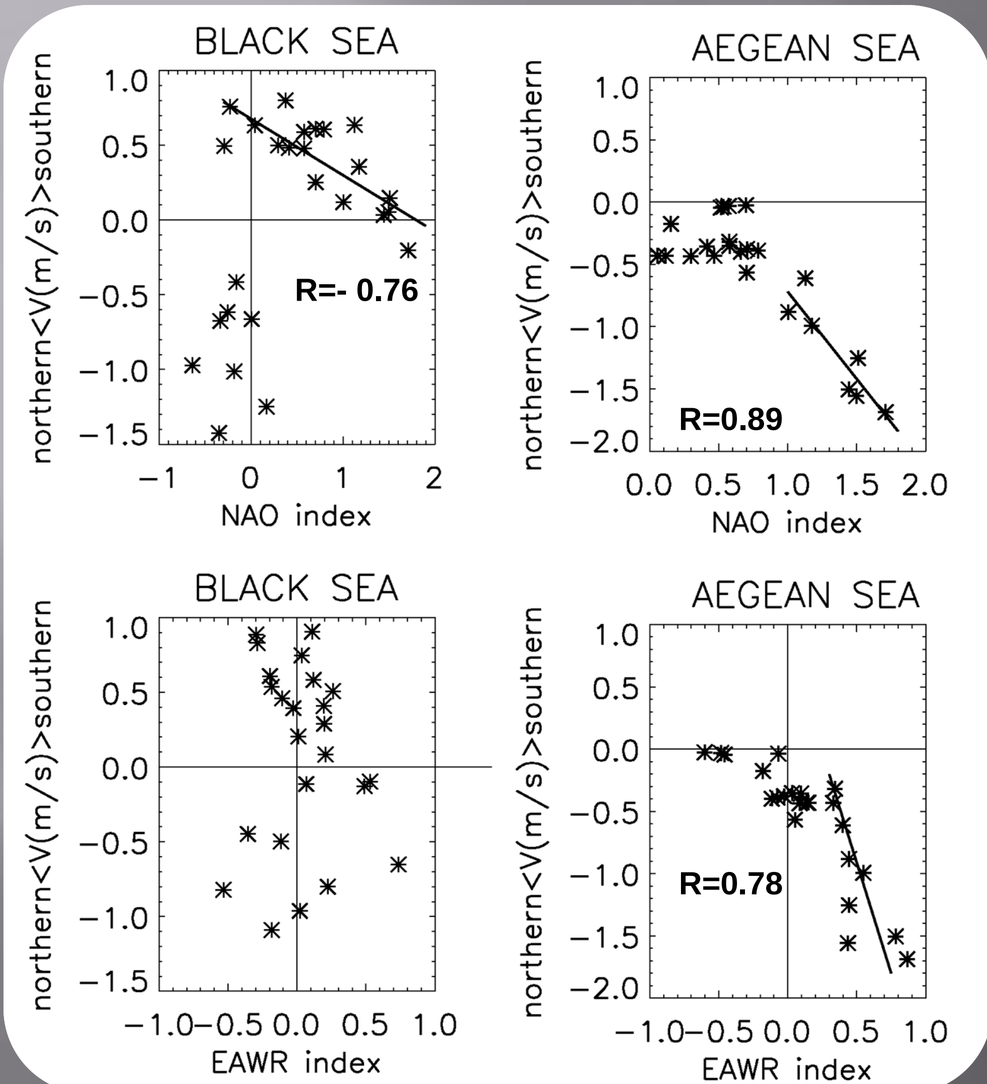
Δ - data for the period of 1950-1981 * - data for the period of 1982-2004

Note:

(1) an existence of the two distinct major surface wind regimes over the Black Sea (i.e., SW and NE) and prevailing of NE winds over the Aegean Sea;

(2) during the investigated period (1982-2004) the dominating wind regimes were SW over the Black Sea and NE over the Aegean.

CORRELATIONS between NAO and EAWR indices and MERIDIONAL COMPONENT of SURFACE WIND



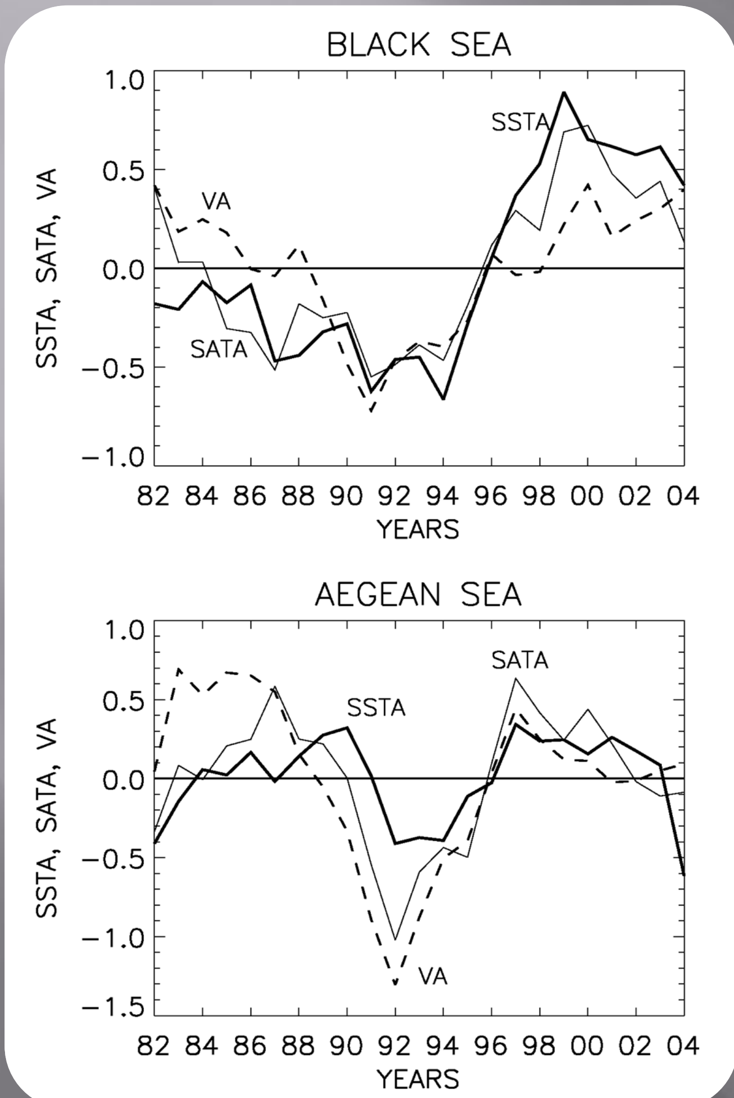
Scatter diagrams between NAO and EAWR indices and meridional component of the surface wind over the Black and Aegean Seas.

Note:

(1) in the Black Sea meridional (Southern) component exhibit high negative correlation with NAO (i.e., Southern wind weakening with the NAO index increase, and vice versa). No any pronounced correlation between wind and EAWR was found.

(2) on the contrary, in the Aegean Sea meridional (Northern) wind is highly positively correlated with both NAO and EAWR (i.e., Northern wind strengthening with NAO/EAWR increase.

WINTER-MEAN ANOMALIES of SST, AIR TEMPERATURE and MERIDIONAL WIND COMPONENT in the BLACK and AEGEAN SEAS

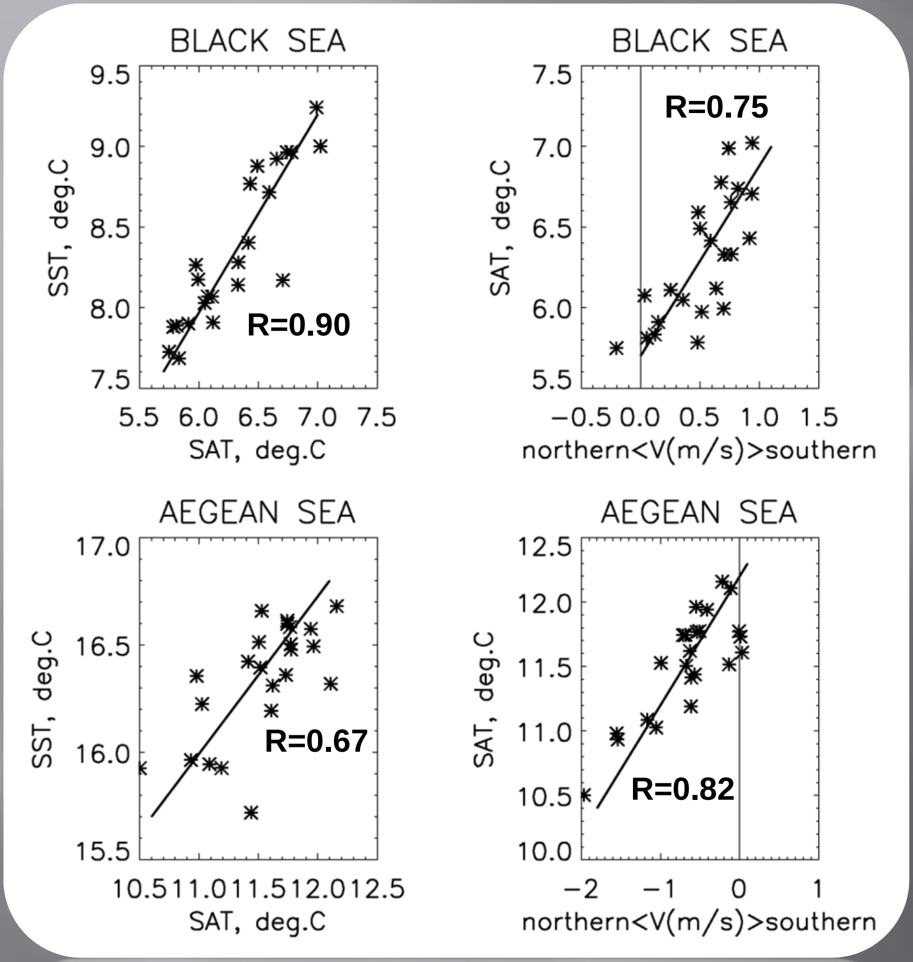


3-years moving average filtered time series of basin-mean winter anomalies of SST (SSTA, bold solid lines), surface air temperature (SATA, solid lines) and meridional component of surface wind (VA, dashed lines) in the Black and Aegean Seas.

Note:

in spite of some discrepancies in the beginning and the end of the observational period, the major climatic event (i.e., SST decrease below the climatic mean followed by sharp SST increase occurred during the period of 1986-99) and its connection with the atmospheric forcing (V, SAT) are evident both for Black and Aegean seas.

CORRELATIONS between SST and SAT (left) and SAT and MERIDIONAL COMPONENT of WIND (right)



Scatter diagrams between SST and surface air temperature (SAT, left panels) and SAT and meridional component of the wind (right panels).

Note:

SST is well correlated with SAT in both basins. In turn, SAT is well correlated with meridional component of the wind. However, in the Black Sea an increase/decrease of the SAT is associated with the strengthening/weakening of the Southern wind. On the contrary, in the Aegean Sea an increase/decrease of SAT is provided by weakening/strengthening of the Northern wind

CONCLUSION

We suggest the following simple basic scheme of influence of the large-scale atmospheric patterns on the long-term SST variability during the positive NAO and EAWR situation:

In the Black Sea, NAO intensification results in the weakening of the Southern wind. In turn, it provides the SAT decrease due to the reduction of the meridional heat atmospheric transport into the area which results in SST decrease. On the contrary, NAO weakening produces an intensification of the Southern wind and corresponding increase of SAT and SST.

In the Aegean Sea the situation with the wind variability is an opposite, but leads to the similar SST variability pattern. An intensification of the EAWR (NAO) results in the strengthening of the Northern wind which, in turn, provides both SAT and SST decrease. On the contrary, EAWR (NAO) weakening results in the weakening of the Northern wind and, consequently, SAT and SST increase.

Thank you for your attention!