SEA SURFACE TEMPERATURE AND SALINITY RISE IN THE LEVANTINE BASIN

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Abstract
Increases in sea surface temperatures (SSTs) have been recorded to occur globally, with the Mediterranean SSTs rising about twice as much as those of the global oceans. Here we analyse and compare satellite remote sensing SST data with in-situ data for the period 1996-2009 in the Levantine Basin. Further, temperature and salinity profiles from oceanographic cruises in this region were extracted from various databases, in order to study the interannual variability at the surface layer (0-10m). We show that the Levantine Basin has undergone SST as well as sea surface salinity (SSS) increases, during the last 14 years, occurring at both interannual and seasonal time scales. The driving mechanisms of these changes need to be investigated, as they may be driven by changes in latent heat losses and by the variability in regional wind speeds.
Keywords: Surface Waters, Temperature, Salinity, Remote Sensing, Levantine Basin

Preface
The reality of global warming since the industrial era is manifested in part by changes in global surface temperatures. Past studies have documented global SST increases between 0.3ºC and 1.0ºC over the last millennium [1], with the most rapid warming occurring over the past 30-40 years [2, 3]. Regional SST increases have also been reported in the Mediterranean for each of its two basins [4, 5]. Overall, SSTs across the Mediterranean as a whole have been rising about twice as much as those of the global oceans [6].

Results and Discussion
Analyses of annual mean SST data indicate that over the last 14 years (1996-2009) a general warming has occurred over the Levantine Basin, and occurred at an average rate of approximately 0.05°C per year. This increase in average SSTs is also seen in the seasonal averages, especially during the summer. Spatial variability in the decadal warming is depicted in the SST anomalies, with positive anomalies dominating most of the Levantine during the later part of the 14-year time period. An area southeastern of Cyprus is seen during some years to be warming up much more strongly than the rest of the Levantine Basin. This area corresponds with the Cyprus warm core eddy [7]. Empirical Orthogonal Function (EOF) analysis was performed on the seasonal SST data to examine their spatial and temporal patterns of variability, as well as on the annual data. The spatial eigenfunctions of mode 1 show that the seasonal and annual SSTs across the entire Levantine share high positive eigenfunctions and thus varied in a spatially coherent manner over time. Therefore, the SST variability is characterized by a broad, basin-wide warming (mode 1). The seasonal principal component (PC) of the same mode (PC1), which depicts the time variation of the first mode, varied over the years supporting the fact that the Levantine is experiencing a strong seasonal cycle. The PC1 of the annual data supports the fact that higher than average SSTs were observed across the Levantine during the later part of the 14-year time period. An asymmetry in the N-to-S direction is depicted in the spatial eigenfunctions of mode 2. Areas in the northern Levantine are out of phase from areas in the southern parts of the basin, creating a dipole pattern of heating and cooling at interannual and interseasonal time scales. Analysis of the in-situ SST and SSS data does not reveal any time-scale patterns. However, the pattern of in-situ SST variability is shared by the patterns of SSS. Further, satellite SST data are strongly correlated with the in-situ SST data. The driving mechanisms of these changes need to be investigated, as they may be driven by changes in annual latent heat losses and by the variability in regional wind speeds. Finally, it will be valuable to investigate future trends in SSTs to determine whether the observed patterns of SSTs represent a continued pattern of persistent warming or a new direction for an ever-changing Levantine Basin.

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