# ASSESSMENT OF VERTICAL EDDY DIFFUSIVITIES THROUGH IDENTIFICATION OF POTENTIAL DENSITY OVERTURNS WITHIN THE FRAME OF SESAME PROJECT.

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## Abstract

In this work, an estimation of vertical eddy diffusivities and dissipation rates for the SESAME cruises is conducted. The method is based on tracing the 'genuine' overturn limits within potential density CTD profiles. The respective algorithm is applied on CTD data of the broader area encompassing the Greek Seas, the Black Sea, the Turkish Straits and Marmara Sea, acquired at 2 seasons (Winter and Summer 2008).

*Keywords: Coastal Processes, Aegean Sea, Black Sea, Marmara Sea, Vertical Profile*

The identification and vertical extent estimation of 'genuine' vertical overturns has already been used in literature [1, 2, 3] for assessing vertical eddy diffusivities and dissipation rates. Overturns are 'unstable' potential density (p. d) structures, in which heavier water masses temporarily overly lighter ones. Instability will cause the water parcels to move towards restoring a stable, increasing monotonically with depth, p.d profile (when all motions are 'included' within the overturn limits the overturns are referred to in literature as 'complete').

An algorithm has been developed, for tracing all possible complete overturns (by estimating their exact boundary limits) that are (in the form of onedimensional snapshots) part of a CTD measured p.d profile. The algorithm further sorts the traced overturns as 'genuine' or 'artificial', according to the Galbraith and Kelley method [1]. This method disqualifies overturns that are result either of instrumental noise, (being characterized by small on the average populations of spatially subsequent and kinematically correlated particles), or instrumental errors (being characterized by 'non-linear' T-S relation of their water masses). As a final step the algorithm estimates value pairs of vertical eddy diffusivities and dissipation rates, one value pair per overturn, according to turbulent scale analysis.

The algorithm was applied on the available SESAME 1 (Winter 2008) and SESAME2 (Summer - Fall 2008) CTD cruises for the Aegean Sea, the Cretan Sea, the Southern Ionian Sea, the Marmara Sea and the Black Sea, thus enabling both spatial and temporal variation studies. Stations that presented considerable number of overturning events were 'pooled together' in transects, for studying the vertical distribution of 'eddy diffusivities' and correlating turbulent events with local dynamic conditions, if and when possible (Figures 1 and 2).

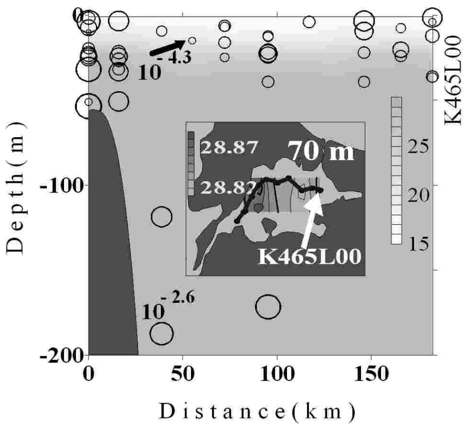


Fig. 1. Vertical distribution of eddy diffusivities (circles) along a transect (drawn in the inlay) in the Sea of Marmara, Turkey, in October 2008 (during the SESAME2-WP3 cruise). The circle sizes are analogous to the log (diffusivities). Overlaid is the vertical potential density (sth) and inlaid the horizontal sth distribution at 70 m.

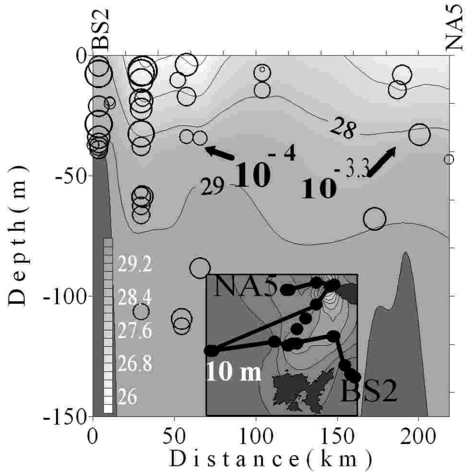


Fig. 2. Vertical distribution of eddy diffusivities (circles) along a transect (transect line is drawn in the inlay) in the North Aegean Sea, North off Lemnos islan, Greece, in April 2008 (during the SESAME1-WP3 cruise). The circle sizes are analogous to the log(diffusivities). Overlaid is the vertical potential density (sth) and inlaid the horizontal sth distribution at 10 m.

Histograms of overturns' frequency of occurence versus eddy diffusivities and dissipation rates showed peaks of highest frequency at $10^{-4}$ to $10^{-5}$ $m^2$ / sec and $10^{-6}$ to $10^{-7}$ $m^2$ / $sec^3$ for eddy diffusivity and dissipation rates respectively. Higher diffusivity values were observed in North Aegean, where surface Black Sea Water intermingles with subsurface Levantine Water. Higher diffusivity values were also observed in the proximity of the Turkish Straits (Dardanelles, Bosphorus). Most overturns were observed above the thermocline, however intermediate depth (200m to 300m or more) depth overturns were occasionally observed in almost all the study Seas. High resolution CTD data, comprising a dense horizontal grid, prove essential for future vertical diffusion studies. The method however is also valuable for historical diffusion studies.

## References

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