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The impact of climate variations on the chemical characteristics of a coastal marine ecosystem in Aegean Sea

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The west sub-basin of Saronikos Gulf (west Aegean Sea) is basically an elongated north-south trough bounded by the coast of Peloponissos to the west and connected with the rest of the Saronikos Gulf to the east through a sea-passage between the Islands of Salamina and Aigina. The west sub-basin is the deepest part of Saronikos Gulf with maximum depth 420m.

The entire west sub-basin is the focus of marine environmental science because of its evolution into a sub-oxic/anoxic environment in the deep layers after 1992 till today. The west basin of Saronikos Gulf has a renewal period of about 5 years, which provides a mechanism of storage of nutrients in the deep layer (bellow 200m). The last observed winter deep mixing and oxygen renewal of the entire water column in the west Saronikos sub-basin occurred in March 1992, a period associated with extreme values in the NAO index and characterized as regime shift that lead to the afterwards atmospheric temperature take-off. A progressive isolation of the deep layer has occurred since then which resulted in oxygen depletion below1 mL/L at depths greater than 200 m, high nutrient concentrations and concomitant dissolved organic carbon decrease. It has been estimated that the annual DO consumption in the deep layer of the west sub-basin of Saronikos gulf is 0.6 mL/L.

Thirteen years after the last deep mixing, anoxic conditions have developed in the deeper layer with high nutrient concentrations (phosphate: 1.92 mmol/m^3, silicate: 44.5 mmol/m^3, nitrate: 9.99 mmol/m^3, ammonium: 0.10 mmol/m^3 and nitrite: 0.11 mmol/m^3). According to recent measurements in the area 20 years after the last deep mixing (June 2012), the deep layer of the western Saronikos Gulf was hypoxic (DO: 0.96 mL/L) and contained 1.70 mmol/$m^3$of phosphate, 49.0 mmol/m^3 of silicate, 3.50 mmol/$m^3$of nitrate, 0.45 mmol/m^3 of ammonium and 0.14 mmol/m^3 of nitrite.

Apart from the geomorphologic isolation of the entire west sub-basin of the Saronikos Gulf the isolation of the deep layers and the resistance to the deep mixing in the water column during winter has very likely been caused by climatic factors. The well-documented atmospheric temperature increase due to the global warming after the mid 90's has in fact decreased the upper-layer density (increased the water buoyancy). However, a possible deep mixing in the future would suddenly bring to the surface the nutrient load of the deep layers causing a substantial environmental disturbance.