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The role of dams in the water stability and oxygenation of semi-enclosed bays

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It is well known that dams were constructed in order to provide significant domestic and economic benefits. Apart from the advantages of these constructions, such as the hydroelectric power production, the flooding control and the storage of water for irrigation, there are also important impacts. Among the most serious of them upstream, is the conversion from a river system to a lake, the sediment transport and changes in the river's temperature and oxygen. However due to the irregular discharge resulting from the dams operation, there are also changes in biodiversity and in bio-geochemical cycle of carbon, oxygen, nitrogen and phosphorus thereby causing changes in temperature, turbidity, stratification, dissolved oxygen, nutrients and heavy metals, downstream.
In order to determine how the existence of dams affects both the water stability and the dissolved oxygen conditions, we studied the enclosed bay of Amvrakikos Gulf in Western Greece. The gulf receives freshwater inputs from north by two rivers along which there are three dams. Before the dams, the maximum discharges into the Amvrakikos Gulf were during late winter and spring months. During autumn and early winter stratification was weak and mixing could take place within the entire gulf. After the dams construction, the rivers have been discharging large amounts of freshwater into the gulf in accordance to the Public Power Corporation's needs. Due to the fact that large volumes of fresh water discharged into the system during summer and autumn, much later than would occur without the presence of dams, the water column is characterized by stratification during those periods. As a consequence, the pycnocline which is characterized by high static stability, prevents both the mixing between the surface and the bottom layer and the oxygenation of the isolated water near the bottom. On the other hand due to the limited hydropower needs during spring, the volume of fresh water which discharged into the system is less than it should be, leading to smaller density gradient and smaller static stability in the depth of the pycnocline.
The controlled discharge of fresh water by dams, affects significantly the systems existing downstream of the river. On one hand it leads to changes in the hydrodynamics and the water stability of enclosed bays, as a result of the existed stratification during autumn and on the other hand these changes also affect the oxygen conditions at the bottom layer, as it remains isolated for longer period and the result is late existence of hypoxia or even anoxia in the deeper layers.