SPATIAL DISTRIBUTION OF THE EVROS RIVER PLUME (NE AEGEAN SEA), USING SEASONAL SATELLITE DATA AND IN-SITU MEASUREMENTS

Aikaterini Karditsa [1]*, Serafim Poulos [1] and Nikolaos Aspiotis [1]
[1] Dept of Geography and Climatology, Faculty of Geology and Geoenvironment, Univ. of Athens, 15784, Greece - kkarditsa@geol.uoa.gr

Abstract
A three year (2006 -2008) Modis satellite data time series has been used to document the seasonal variability of the Evros river plume in the NE Aegean Sea. Satellite data were coupled with field measurements, providing the river plume distributional pattern, which leads subsequently to the quantitative estimation of plume concentrations. Winter plume is dispersed seawards towards south-west, in contrast to the summer plume, which is constrained primarily along the nearshore zone.
Keywords: Aegean Sea, River Input, Coastal Waters

Introduction - The transboundary Evros river drains a catchment of 52.000 Km2, being the largest river debouching in the North Aegean Sea. It discharges annually about 3,26 10^9 m^3 of freshwater and some 1,7 10^5 tones of sediment, mostly in suspension (Pehlivanoglou, 1989). During the last decade many studies have been referred to the Evros river plume using satellite data (Georgopoulos, 2002, Kanellopoulos, 2009) and discussed its influence on the sedimentation of the inner continental shelf of the NE Aegean Sea (e.g. Pehlivanoglou, 2000, Kanellopoulos, 2008). In general, Evros river plume follows the Samothraki anticyclonic circulation, either responding to the Coriolis Effect and/or to the local wind forcing, depending on its strength. The aim of this study is to identify the seasonal distribution pattern and the strength of the Evros River plume via the examination of inter-annual data set of MODIS images.

Data collection and methodology - All the available MODIS (Level 1A) swaths intersecting the region 40º28'-40º54'N and 25º31'-26º 12'E for the period of January 2006-December 2008 were downloaded from the Goddard Distributed Active Archive Center. These data were processed to Level 2 TSM product using default NASA coefficients and TSM_Clark standard algorithm, as implemented by SeaDAS. Monthly averages were calculated from available products and composited further into seasonal means, considering October–March and April–September, as winter and summer periods, respectively. Data were re-mapped to WGS'84 (Zone 35ºN) Mercator projection. The algorithm product was calibrated comparing filtered surface water samples, obtained from 12 stations, on the 8th and 11th of September of 2008 to the corresponding pixel value of the Level 2 TSM products for the same dates. Field data were filtered through pre-weighed 0.7μm (FG/G –Wattman, 47mm diameter)) glass-fibber filter and after dried, reweighed again for the determination of the Total Suspended Matter (TSM) concentration. A least-squares application provided the equation (1), which describes nearly the 89% of the variability. TSM= 0.1065 *pv+0.2423 (1) where, pv= L2 TSM product pixel value. Finally, in order to trace plume characteristics, a Natural Breaks classification method, with the use of a GIS tool, was applied to the output seasonal product, classifying four different TSM concentration classes.

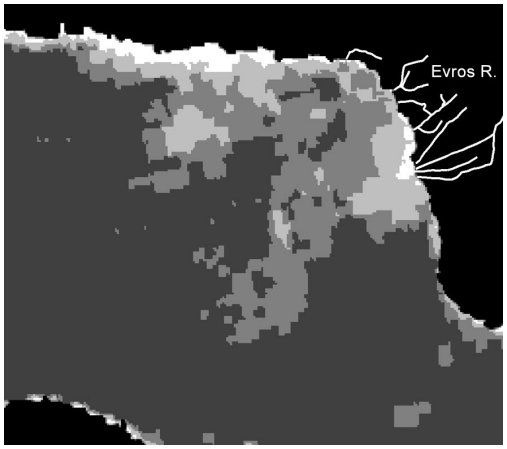

Fig. 1. Winter Evros River plume classification

Results

The spatial distribution of the winter plume had mainly a south-west orientation. On the basis of the spatial distribution of four water spectral classes the following water types were identified (Figure 1): (1) the immediate plume core; (2) the plume edges and nearshore waters; (3) the peripheral plume and the inner shelf water; and, (4) the offshore water. The first class refers to the main plume core, with values greater than 0.25mg/lt, functioning during the whole winter period. The second category (0.10-0.25mg/lt) depicts the intermediate region of the plume and the nearshore waters being turbid due to resuspension induced by the wave activity. The third type is the peripheral region of the plume (0.05-0.10 mg/lt) whilst the forth class regards to the common TSM offshore water values (<0.05 mg/lt).

The summer plume, being associated with low riverine water/sediment fluxes was mainly constrained close to the coast, coinciding with the nearshore zone.

Fig. 2. Summer Evros River plume classification

Conclusions - The systematic analysis of the satellite imagery data coupled by seasonal in-situ data show that the interannual plume pattern during winter extends seawards to the south-west; this is attributed to the high river discharge and the influence of the offshore anticyclonic circulation. During summer period, the weak riverine influxes restrict plume distribution within the nearshore zone at either side of the mouth area controlled by the coriolis effect and the directions of prevailing winds (mostly N/NE during summer).

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