Science and Policy Integration for COastal Systems Assessment

SPICOSA

SIXTH FRAMEWORK PROGRAMME

SSA 18

Danube Delta-Romanian-Bulgarian Black Sea Coastal Zone

CASE STUDY VARNA BAY

Virtual & Real systems of Varna Bay

Policy Issue

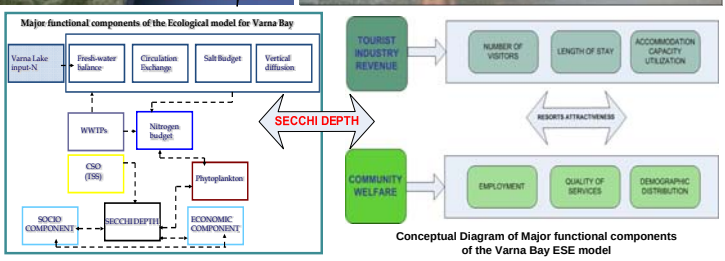
How to maintain a good quality of bathing waters in Varna Bay?

Human Activities- TOURISM

Exceeding maximum capacity of sewage treatment plants (WWTPs); increase in nutrient discharge

Extend model- constructed to represent water transparency (a proxy of WQ) as a function of TSS and phytoplankton biomass, in response to the formulated scenarios, primarily having to do with nutrient discharges. This involves predictive simulations of the phytoplankton biomass and TSS and their impact on the Secchi depth as a result of the WWTP and the SS options

The output of the ecological component- water transparency (Secchi depth) feeds the socio-economy component, which is based on the assumption that the loss of aesthetic values and amenities will level down the recreation and leisure attractiveness of the destination (loss of reputation) resulting in reduced tourist visits and related loss of direct municipal income, loss of investment interest, unemployment and community welfare



Conceptual Diagram of Major functional components of the Varna Bay ESE model

Comparison between the modeled results and the respective measured values

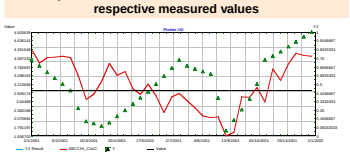


Fig. Modeled Secchi depth [m] (red line) versus measured values (green symbols) for the test year 2001. The black line is the 3m Secchi depth- a tourist perception value in the scenarios

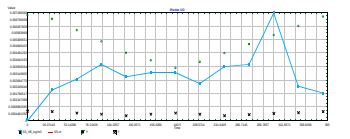


Fig. Modeled TSS (kg /m3)- blue line, measured max- green and min seasonal averages- black symbols (IO-BAS data)

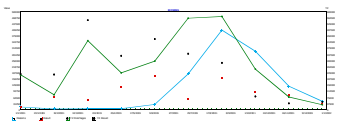


Fig. Modeled results of the two phytoplankton groups biomass [kgC in the modeled water volume]: diatoms (blue line), dinoflagellates (green line) and the respective measured values- red and black symbols over the test year 2001 (IO-BAS monthly data from 2 sampling stations)

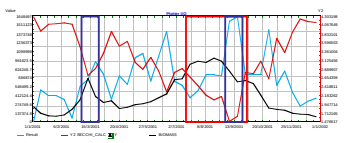


Fig. Relationship between Phytobiomass- TSS- Secchi depth: Biomass [tot.kgC]- black, TSS [Kg]- blue and Secchi calculated [m]– red line. When the Phytobiomass and the TSS are over-imposed it is demonstrated that the Secchi depth < 3m is related to extremes mainly in TSS in late spring- early summer. In autumn, it is a combined effect of Phytobiomass and TSS (down to values < 1.5m). The summer low Secchi is predominantly related to the phytoplankton biomass

Improvement of WWTP technological level (denitrification)- the **scenario** is designed to answer the question if the up-grade of the WWTP along the resorts (75% denitrification of waste water in conformity to the EU standards), will contribute to improvement of WQ

Fig. Response of Secchi calculated [m]- red, and total Phytobiomass [tot.kgC]- black, if denitrification is applied, CSO (TSS) is not changed (test year 2001), tourists= 558 858, corresponding to real data for 2006

Application of sewerage system (SS) options in addition to Improvement of WWTP (denitrification) reducing the TSS input to the system (by 50%)

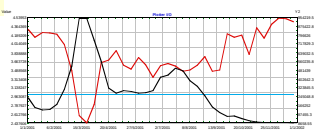


Fig. Response of Secchi calculated [m]- red and total Phytobiomass [tot.kgC]- black, if denitrification is applied and CSO (TSS) is reduced by 50%, tourists= 558 858, corresponding to real data for 2006

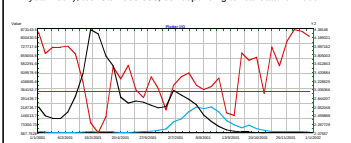


Fig. Response of diatoms biomass-blue, Dinoflagellates- black [tot.kgC], Secchi calculated [m]– red, if denitrification is applied, CSO (TSS) is not changed, tourists= 558 858, corresponding to real data for 2006

The model indicates that at the current state of direct release, at least doubling the capacity of sewage system is necessary along with the WWTPs upgrade in order to maintain the Secchi >3m in summer. Although the model simulations could not provide precise quantitative assessment it demonstrate that the technological upgrade of the WWTPs in the resorts should not be neglected (now postpone for after 2015) and good bathing WQ could be achieved only if in addition the TSS input is reduced at least by 50%.

Baseline Scenario: Business as usual, nothing changes- How the system is working now under standard conditions and projections for the socio-economic indicators for the period 2007-1015)

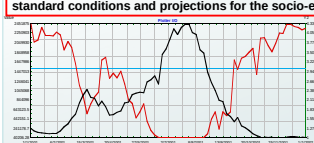


Fig. Response of Secchi calculated [m]– red; total Phytobiomass [tot.kgC]- black, WWTP, CSO (TSS) are not changed and the tourists= 558 858, corresponding to real data for 2006

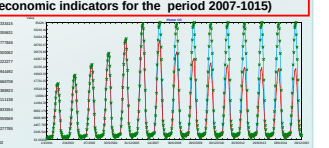


Fig. Projected tourists' flow decline after 2006 (red line); green symbols in case of management options

The tourist flow within the simulated period matching the reported values (2001-2006) and the projected tourists decline (forecasting the period 2007-2015)

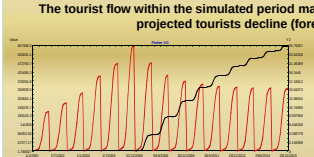


Fig. Projected tourists decline (red line), percent of tourist not coming (black line)

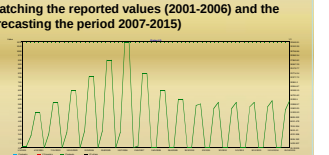


Fig. Employees [number] in the tourist sector (model data): real data for 2001-2006, projection (model simulation) for the period 2007-2015

For the period after 2006 till 2015, the model calculates the possible cumulative revenue from the tourist sector in the case of Secchi depth never <3 m, to be 1.327.467.243 € (for 9 yrs), and the losses to be 576.017.681 € (for 9 yrs), if the Secchi is < 3 m. This trend is consistent with the reported value for 2009- only for the summer it was by 18.2 % lower than that in 2008 (NSI, 2009). The tourists profile of preferences will change in favor of those coming for other activities rather than the beach, which further compromise the resort reputation (plots above). The assumption is that the deterioration of WQ and the related reduction of attracted tourists will result directly in reduction of the employment demand and indirectly in a disproportion of the profile of current employees in the tourist and services sector in the resorts thus reflecting negatively the common welfare of the local residents and the destination. The model simulation corresponds well to the reported data for the 2001-2006 (~7000 employees in 2001, increasing to 12 200 in 2006). The projection for 2015 is the employees to decrease to 6 500. The assumption is that the projected decline in the employment (tourist sector) will be proportional to the tourist decrease. It could be even higher due to additional factors (closure of hotels due to insufficient capacity utilization, not simulated).

Comment

Albeit the simplicity (especially in the socio-economic component) and the various assumptions, the selected scenarios illustrate the flexibility of SAF methodology and its relevance to the formulation of management options. A supply chain analysis employed illustrates the conversion of the linkage variable water transparency (environmental component) to direct economic loss (economic component) and the consequences to the local community welfare (social component) depending on the success/failure of the management strategies to optimize the ecological carrying capacity of Varna Bay.

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