



VARNA BAY COASTAL AREA

Varna Bay coastal area is one of the hot spots along the Bulgarian Black Sea coast, facing multiple environmental pressures. Impacted by industrial and urban discharges the ecological state of the Varna bay ecosystem suffered serious deterioration. Through the cascade system Varna lake-Varna Bay, the industrial waste waters bring excessive nutrients into the Bay. Since late 90-ies the internationally recognized resorts situated along the coast of Varna region represent another key source of nutrient inputs to the system through the coastal current due to the expansion of the tourist industry in the area.

Climate change poses further challenges for ecosystem and resource management. The substantial increase of the frequency and intensity of rain/storm events in relation to Sewer System (SS) current state of operation and drainage facilities' capacity emerged as environmental risk factor, as a source of nutrients, pollutants and Total Suspended Solids (TSS) into the coastal area, that has been paid less attention as a potential driver of ecological deterioration. The coupled ESE model captures the key features of the real system's response, when both the natural and human pressure exceed severely the carrying capacity of the area.

SYSTEM DESIGN

The first meeting held on October 4th, 2007 provided the base-line to catalyze discussion of possible options for coastal Black Sea ecosystems remediation towards achieving good ecological status by 2015. Starting with an evaluation of different environmental drivers in cause-effect relationships, provide a credible assessment of the environmental "cost" of the related activities and their prioritization. Personal interviews with the major stakeholders helped to identify tourism industry as a key priority; Data needs and availability and a conceptual scenario were set as a major prerequisite for the



Impact
 Significant deterioration of the bathing water quality



Policy Issue
 The Policy issue of how to maintain a good quality of bathing waters in Varna Bay has been selected based on the assumption that the bathing waters and beach quality is an amenity that drives the tourist industry in Varna region.

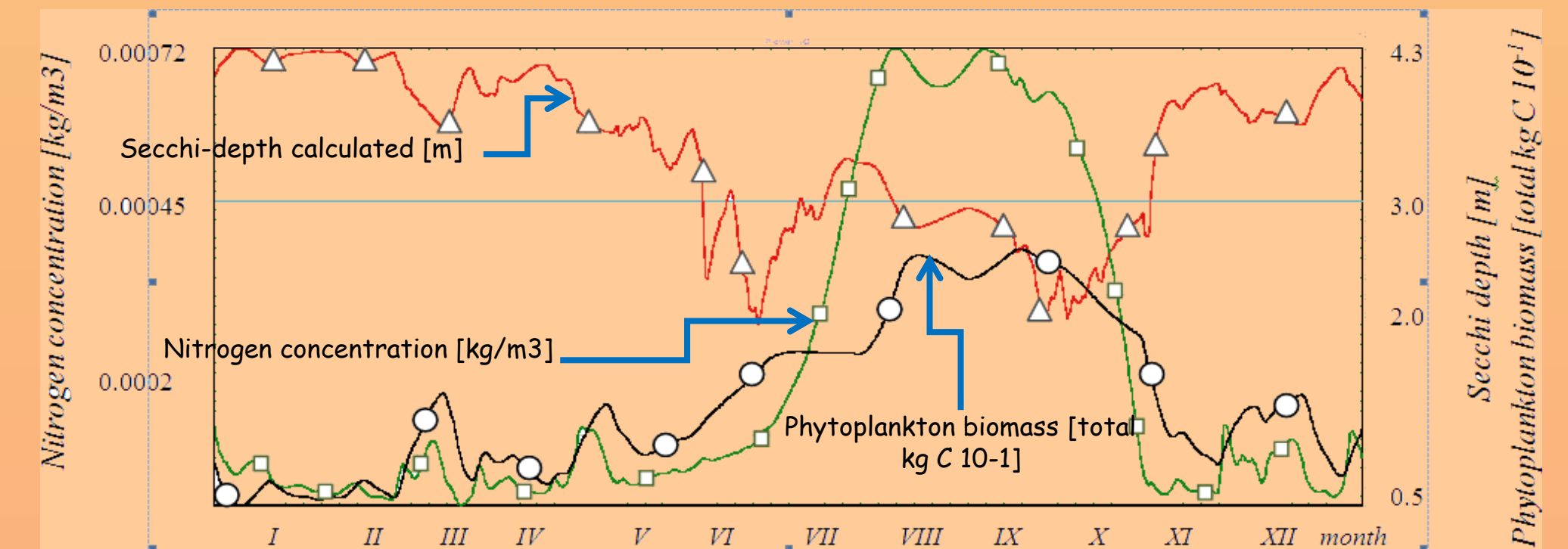
FORMULATION STEP

During the second meeting held on 20 June 2009, the status of WWTPs and the town sewage system and the related impact on the Black Sea coastal ecosystem were discussed as one of the top priority issues, included in the Black Sea Basin Directorate Management Plan for the period-2010-2015. The policy issue and the scenarios received the majority consent. Further efforts were made to stimulate cooperative dialogue with the stakeholders for the application of SAF approach in the management of Varna Bay area.



Scenarios
 The following scenarios are used in the model simulations of the ecosystem health considering Anthropogenic impact and Natural sources:

Baseline Scenario (anthropogenic impact in addition to meteorology conditions): WWTPs are maintained at the current state (without denitrification) and 80% direct runoff is assumed to be released into the system (only 20% go through the SS). Good inverse correlation between the phytoplankton biomass and the Secchi-depth is established, with the trend line of phytoplankton biomass very similar to the variability of the available nitrogen.



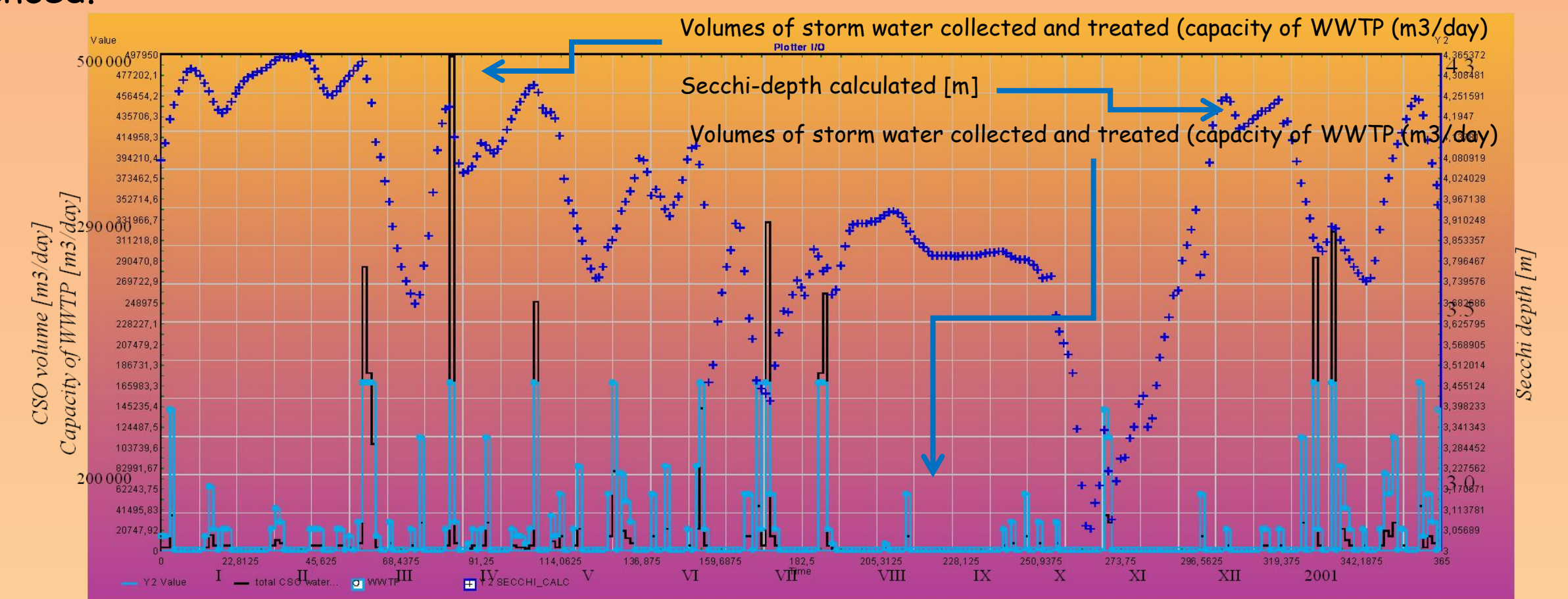
APPRAISAL STEP

The ESE model components were coupled together into a single model and the scenarios were simulated. Model sensitivity was tested and validated against field measurements. The model was run to make projections for the future trends of tourist visits and related socio-economic indicators for the period 2007-20015. The Extend Model results were presented during the SESAME Stakeholders Forum "Mediterranean & Black Sea: Science & Socio-Economic Management", 16 October 2009, The linkage between water transparency (environment component) with the economic loss (economic component) and the consequences to the local community welfare (social component) provoked a great interest among the stakeholders. Debates were focused especially on the assumption that the deterioration of WQ and the related downshift 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 depending on the success/failure of the management strategies to optimize the ecological carrying capacity of Varna Bay.



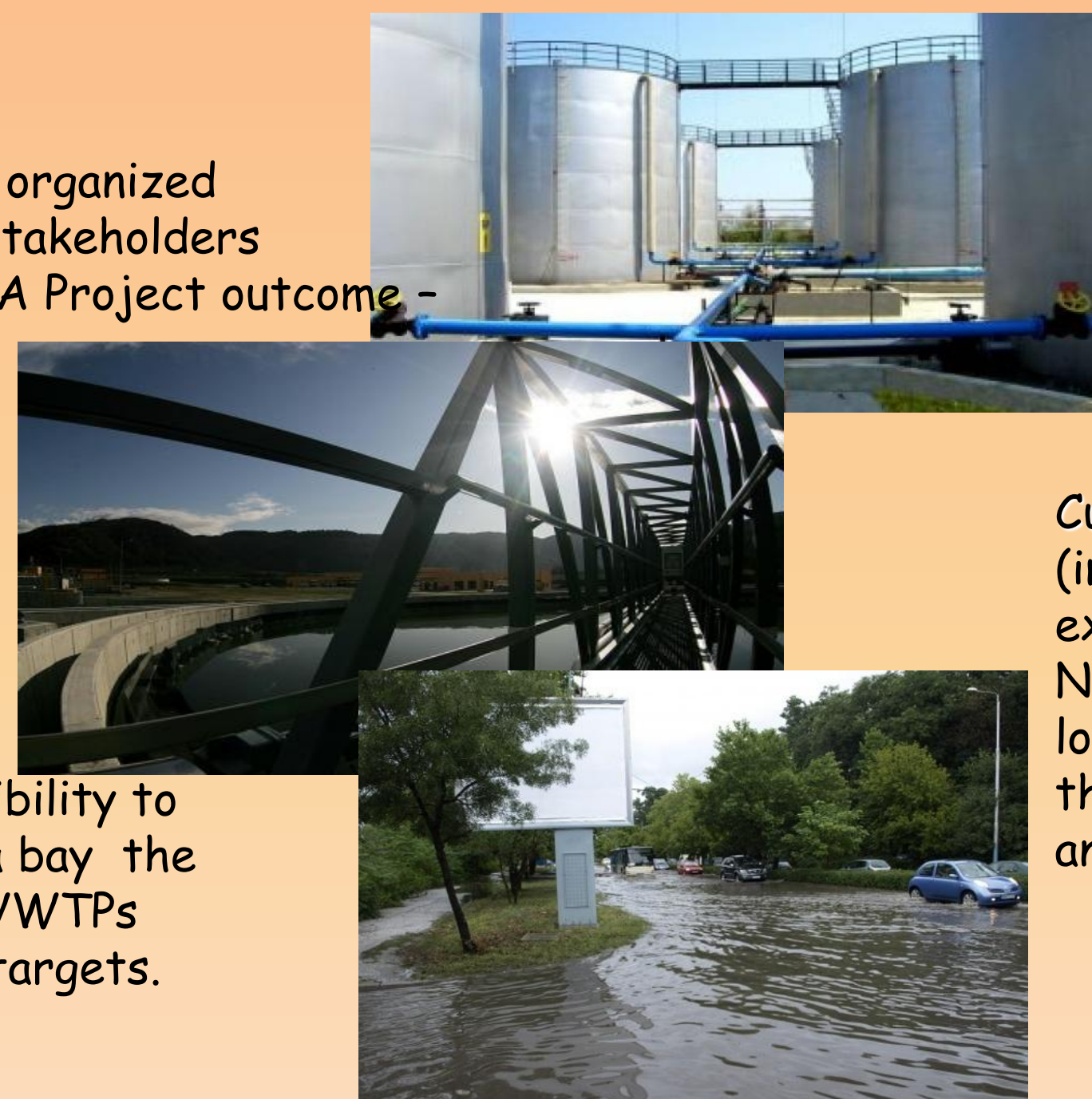
Reduced anthropogenic impact scenario (improvement of WWTP with tertiary treatment): The Up-grade of the WWTP along the resorts is in compliance to EU DIRECTIVE 98/15/EO (75% denitrification of the outflow) aimed at analysis of the effect of reduced nutrients on phytoplankton biomass. The assumption is that the frequency and duration of the phytoplankton blooms in Varna Bay driven by the nutrients surplus from the resorts will drop significantly provided the resorts WWTPs outflow concentration is reduced.

Reduced environmental impact scenario-natural sources/meteorology scenario (improvement of the drainage and SS): explores the effect of reduced TSS inputs (by 20%-50%) over the water transparency. The model indicates that at the current percent of direct release (80%), tripling elevation of WWTP capacity will have no effect on suspended matter removal, suggesting that TSS contributing to water visibility reduction is mainly from non-point sources. The key variable is the percent of storm waters originating from watershed area directly released into the Bay, because of SS inefficiency. Running the model simulation with 20% direct release only, results in a few occasions of insufficient capacity and the water transparency seems not to be directly influenced.

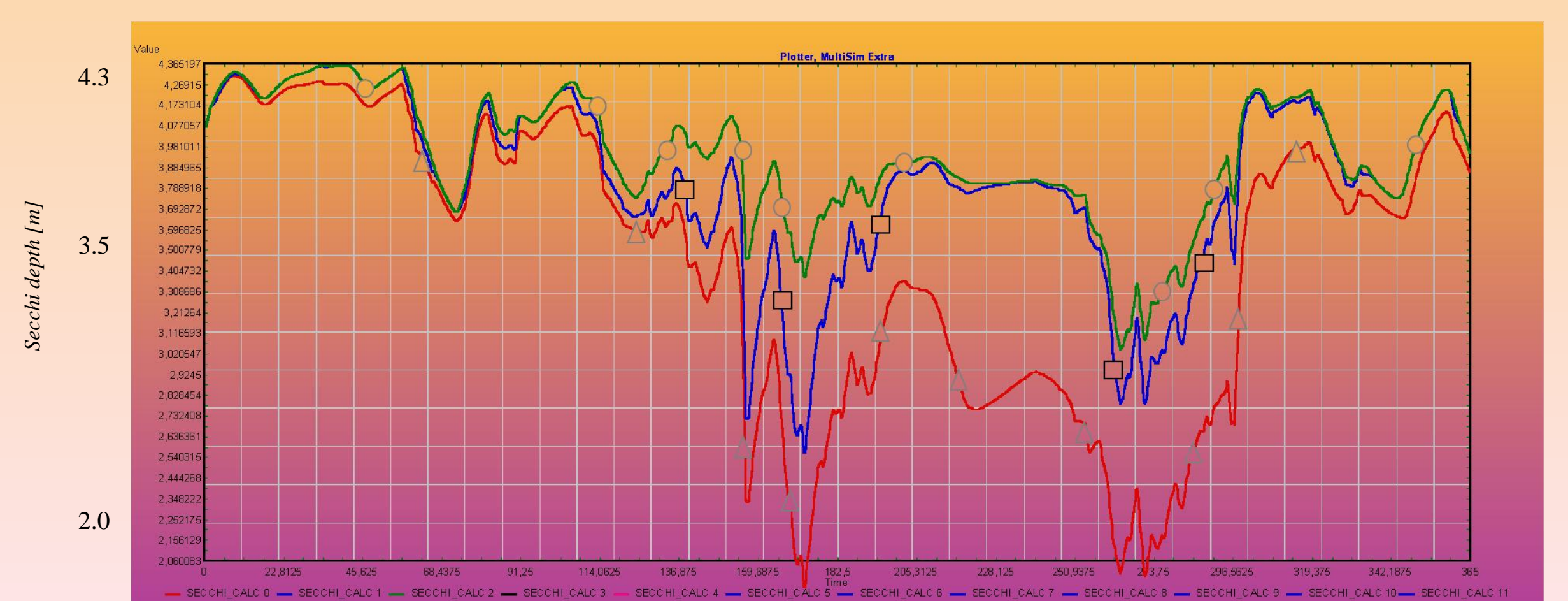


OUTPUT STEP

During the last stakeholders meeting held on 14 June 2010 organized in parallel with the annual meeting of BSBD members, the stakeholders were introduced with the latest model results and SPICOSA Project outcome - Management of coastal ecosystems - necessity for preparation of an adequate strategy for the sustainable tourism development. The output results were acknowledged to give effective solutions to the problems facing planners and decision makers, allowing for implementation of integrated management options. Further discussions explicitly pointed the importance of understanding the fundamental processes governing ecological state of the environment, thus giving enough credibility to science. As demonstrated by the model in the case of Varna bay the control of urban runoff should be complimentary to the WWTPs improvement/rebuilt for effective compliance to the WFD targets.



Cumulative effect of reduced environmental and anthropogenic impact scenario (improvement of the drainage and SS in addition to the WWTP improvement). As it is expected, the phytoplankton biomass does not drop at the same rate as the reduction of N during the summer (due to non-linearity of the processes), but reduction of nutrient loads substantially contribute to improvement of WQ- reducing phytoplankton stock and the attached to it Secchi-depth variability. Reducing both the environmental and anthropogenic pressures result in targeted improvement of Secchi-depth values.



The future

With the aid of SAF the communication between scientists and stakeholders was directed towards systems thinking, reducing existing uncertainties of the complex environmental problems and improving the communication with the stakeholders concerned about the socio-economic consequences. Innovative and user-friendly scenarios of the integrated ESE model can be further developed and used to address wide range complex problems. IO-BAS is officially represented in the Black Sea Basin Directorate Advisory Council where all core stakeholders are partners which along with the credit gained through the project output opens enough room for future collaboration towards integrated coastal zone management