SSA16-Thermaikos Gulf
Formulation Step

1. Formulation of the natural system

For the purposes of Formulation the area was separated into four spatial compartments. The main one includes the mussel farming area and is receiving directly the agricultural runoffs through the pumping station, the left compartment is receiving the river input and the right one the inputs from the WWTP. The last compartment is the reference one and it is used to represent the exchanges of the mussel farming area with the "open sea". A network of sampling stations is providing data for all the compartments, concerning temperature, salinity, nutrients, chlorophyll-a, bacteria and other parameters, although information is often incomplete and inconsecutive.

Exchanges between the compartments – Circulation

Formulation: Using water velocity data available for the water column in several points of the area, a calculation of the flow between the compartments will take place and through that exchange coefficients will be created between all the compartments (Qr, Qt, Qo). These coefficients will be used to quantify the effects of the rivers, the WWTP and the "open sea" to the concentrations of crucial variables into the mussel farm area compartment.

Challenges-Obstacles: The data necessary for this analysis were very recently acquired and the process is at progress. At the same time there are thoughts about the accuracy of this approach, mainly if during the evolvement of the formulation it will be able to support other model components (i.e. the mussel-farm component).

Ecological component

Formulation: Based on the Conceptual model of the DS, an ecological feedback loop was constructed that was later evolved in a simple formulation of the dynamics of Inorganic Nitrogen, Phytoplankton, Bacteria and Total Organic Carbon and the interactions between them. These components were also connected to the Mussels, through the estimation of the growth rate of the mussel population and the consumption of phytoplankton, bacteria and TOC from this population.

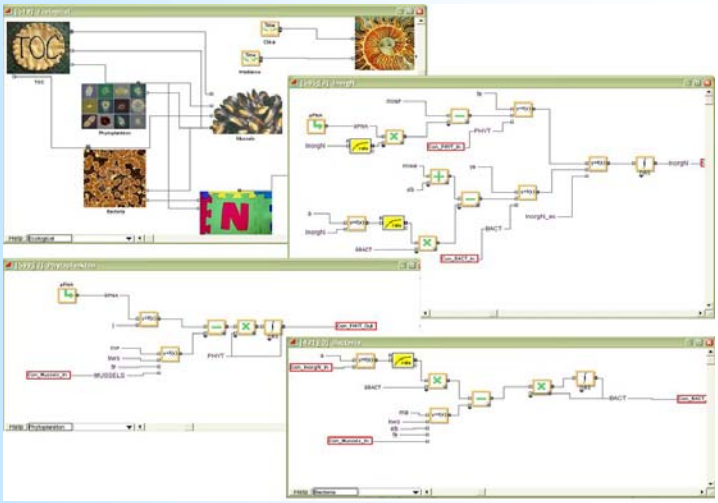
Challenges-Obstacles: Although there are available data for most of the variables of the ecological component, the time series are not complete and scattered in time, making calibration a tricky process. The connection of the equation representing the mussel growth rate to the concentrations of the main state variables is weak as it is totally theoretical and unsupported from field data.

Mussel Component

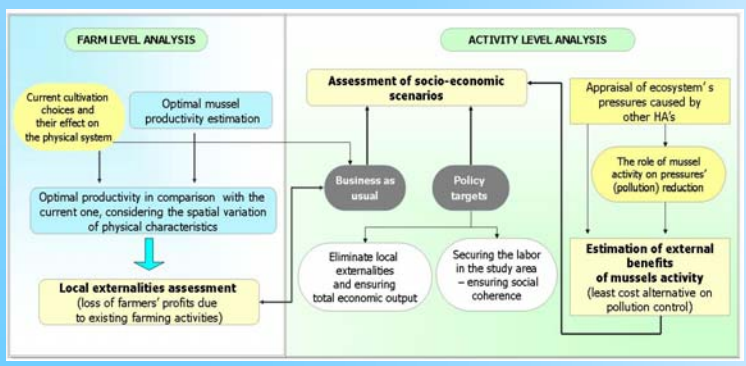
Formulation: Two different approaches were considered for the mussel component. The first one was based in a former Italian work that calculated the mussel growth through the available energy for the mussels (food) and the anabolic processes of the organisms. The second one was simpler, trying to calculate not the mussel population but the mussel growth rate, based only on the concentrations of the available food and the mortality factors (mostly temperature as we are referring to cultivation conditions).

Challenges-Obstacles: Both approaches are incomplete at the current time, due to lack of important data and a series of considerations regarding the formulation. The two most important issues that came up are i) the dependency of the mussel growth from the cultivation techniques (the distances between the near by farms, the distances of the ropes and bunches inside the individual mussel farm, the orientation of the farm and the quantity of the cultivated mussels), factors that are not taken in account in any of the aforementioned approaches, and ii) the connection of the physical component to the economical component, that will happen through the mussel production, but is not yet specified how (see economical formulation).

What we finally want to create is an EXTEND block that will incorporates all of the individual farm characteristics.



2. Formulation of the economical system



The economic dimension of SSA_16 is based on two levels of analysis: i) the individual farm level and ii) the mussel farming activity level. The aim of the first level is to "calculate" the productivity by taking into account the inputs on mussel's production (spawn, labour, capital), the cultivated area and the physical conditions. The second level takes into account the spatial population dynamics of mussels (with emphasis on the effect of the cultivation techniques) and their effect on the area's total productivity.

There are two main problems considering the economic analysis: a) there is an almost absolute lack of economic data and b) due to this lack of data, the correlation between economic and physical variables is still quite unclear.

Although a "production function" is constructed that represents the total stock of a given mussel farm, it is obvious that the aforementioned economic analysis will also lead to a second "production function" derived from "economical" variables rather than from "physical" ones. So, in order to represent the real case scenario, it is necessary to form a unique function that will incorporate the dependency of mussel productivity both on physical and economical parameters.

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