2ND SUBMARINER Conference

Better off Blue

#BetterOffBlue17

Creating synergies for a biobased society

A multi-criteria methodology for site selection in aquaculture

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BLUEFARM

Background

- The selection of sites for shellfish culture is a relevant issue for the sustainable development of this activity.
- Shellfish culture, being organic extractive, does not require feed input but, on the other hand, needs more space, in comparison with finfish aquaculture.
- Furthermore, it needs good water quality and relatively high concentrations of feeding particle, i.e. phytoplankton and non-living organic particle, as well as a moderate hydrodynamic circulation
- This requirements may lead to use conflicts, in particular in highly urbanized coastal areas, where space demand is high for other activities, such as tourism, navigation, seabed mining. ...

AquaSpace

http://www.aquaspace-h2020.eu/

Background

- Bluefarm, spin-off of Ca' Foscari University, has developed tools for siting shellfish farms in the framework of two recent projects: Ca' Foscari e AMA, in due progetti:
- 1) H2020 "Aquaspace
- 2) "SMART" (Sustainable Management of Aquaculture through Remote sensing Technologies), funded by the European Space Agency, in collaboration with AMA (Associazione Mediterranea Acquacultori) and ACRI-HE (France)
- In both cases, we used, as far as possible, satellite data, for a cost-effective preliminary assessment of shellfish potential growth.
- These data presents two key advantages:

  - **wide spatial coverage**, **temporal continuity**, e.g. ESA long term Sentinel programme and **good frequency**;

  - **low costs**, as high quality data are made available free of charge by both NASA, and, in the EU, by the services offered by Copernicus (http://www.copernicus.eu/), funded by the EU.

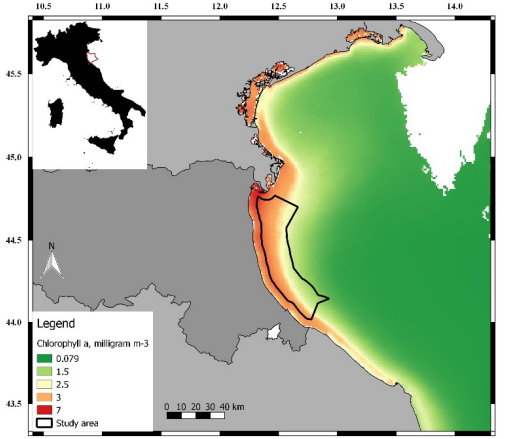
The AquaSpace project

- In this talk I will focus on the results obtained in the **H2020 project AquaSpace (http://aquaspace-h2020.eu).**
- AquaSpace, a 3 year long collaborative project which started in March 2015**,** aims at **providing** to regulators, operators and investors **tools for facilitating the aquaculture planning process**.
- The effectiveness of these tools is being assessed in **16 case studies** in collaboration with local stakeholders, at a variety of scales and in different environments, with a range of space-related development constraints.
- The Consortium, **led by SAMS** (Scotland-UK), includes **18 European partners, including Von THUENEN-INSTITUT (DE) and three non-european ones**, from Canada, Australia and China. NOAA (US) is participating as Third Party.

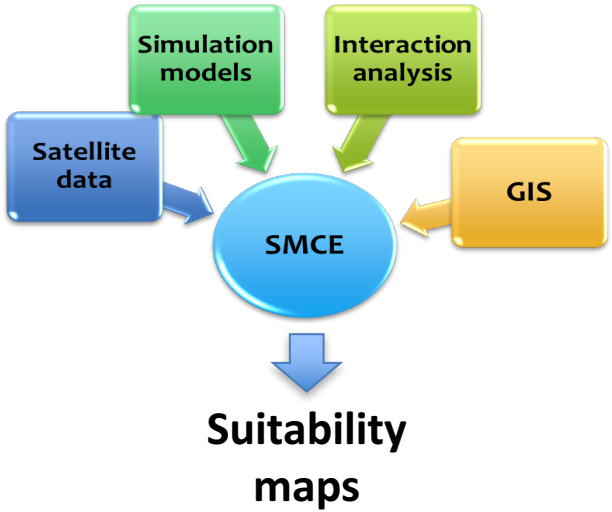
Aquaspace: the Italian case study

- In Aquaspace, Bluefarm developed a case study concerning the **expansion of off-shore shellfish farming along the Northern Adriatic coastline**, with special focus on the area facing the Regione Emilia-Romagna.
- Compared with other oligotrophic Mediterranean areas, this zone is enriched by nutrients discharged by the Po river.
- This enhances primary production and, therefore, the potential for shellfish farming.
- We identified 2 main issues, in collaboration with stakeholders:

1. The **siting** of new long-line mussel farms **in the area comprised between 3 and 12nm from the shore**;
2. The need of **diversifying shellfish production**: to this regard we investigated the possibility of co-farming mussel and Pacific oyster. (*Crassostrea gigas*);



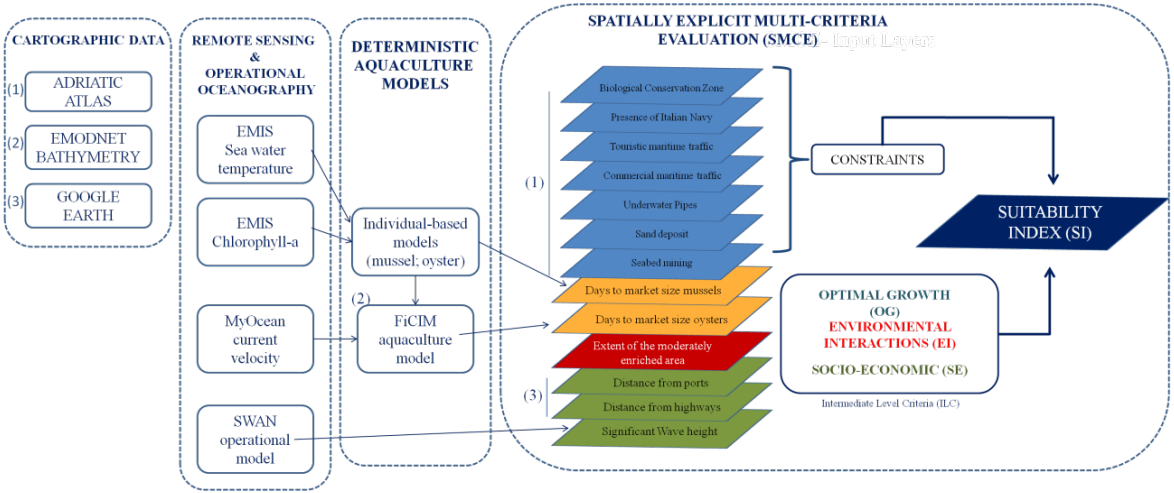
Aquaspace: Spatial MultiCriteria Evaluation



Scenario analysis:

- Lease of off-shore areas between **3 and 12 NM**
- Diversification, **i.e. co-cultivation of mussel and Pacific oysters**

Aquaspace: from data to information



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Making space for shellfish farming along the Adriatic coast

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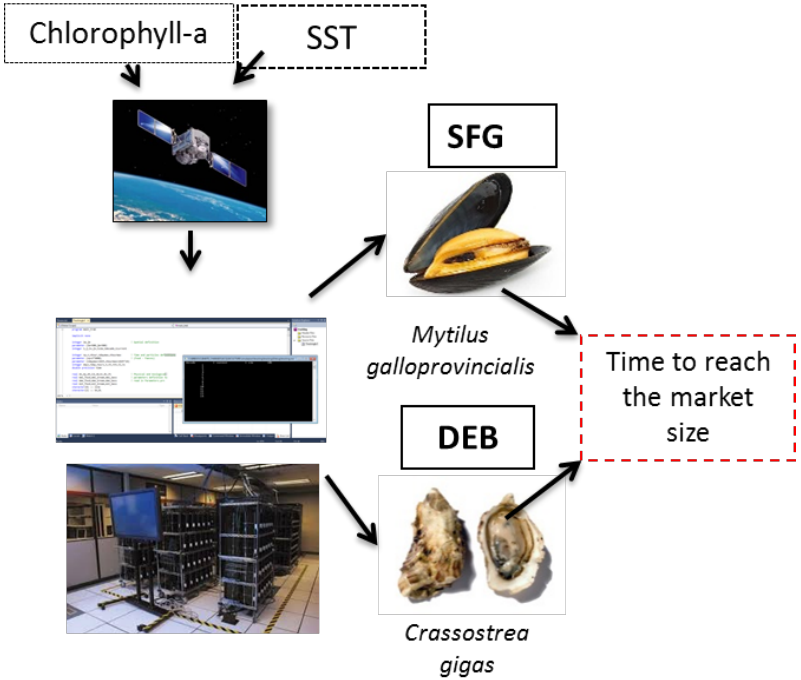
Estimating potential shellfish growth from sat data



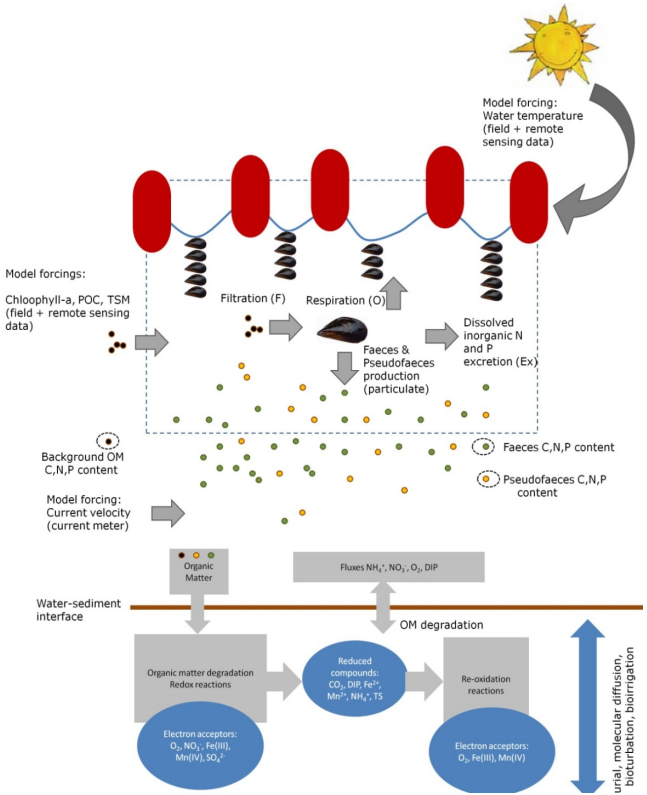
We selected the “time to reach the market size” as the main criteria for assessing the potential biomass production of a give site. This criterion was estimated by means of two eco-physiological individual models.

1) Mediterranean mussel: a model developed by our team during the FP6 project ECASA and validated in the area (Brigolin et al., 2009).

2) Pacific oyster: the DEB (Dynamic Energy Budget) presented in (Pouvreau et al., 2006)

Both models were forced using data freely downloadble from :EMIS http://mcc.jrc.ec.europa.eu/emis/

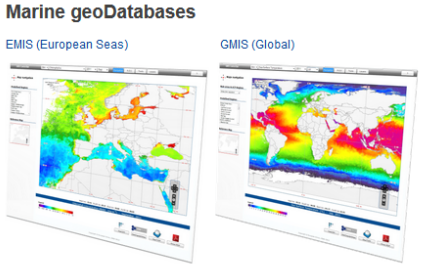
Estimating the direct impact o the seabed

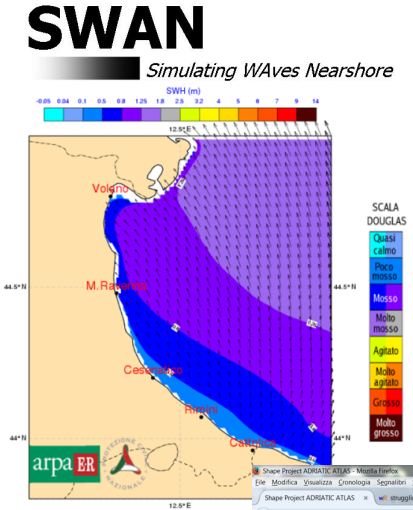


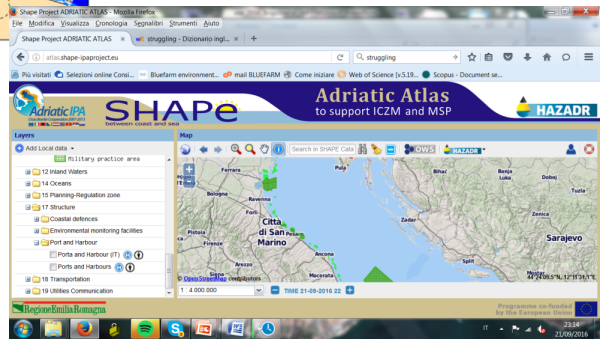
The massive presence of shellfish in confined areas may lead to organic enrichment of the surface sediment.

We estimated such potential impact using a deposition model which tracks faeces and pseudofaeces. The modell was adapted from a (Brigolin et al. 2014 Aquac. Environ. Interact).

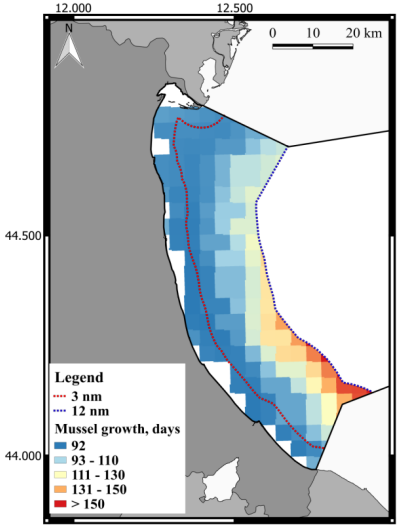
Storm risk and contraints



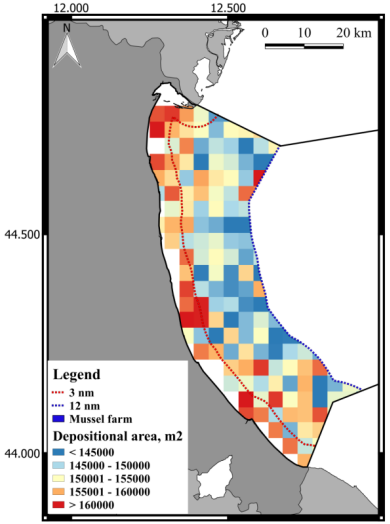




Aquaspace – mapping the criteria

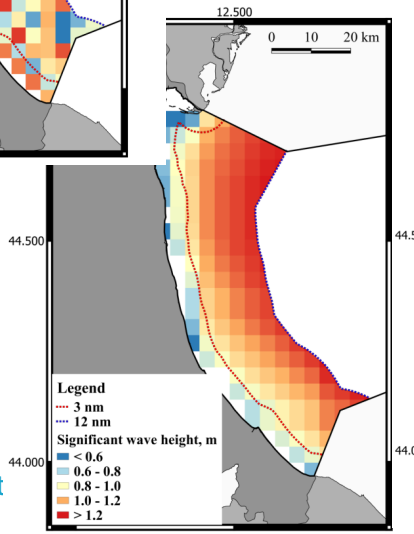


growth performance

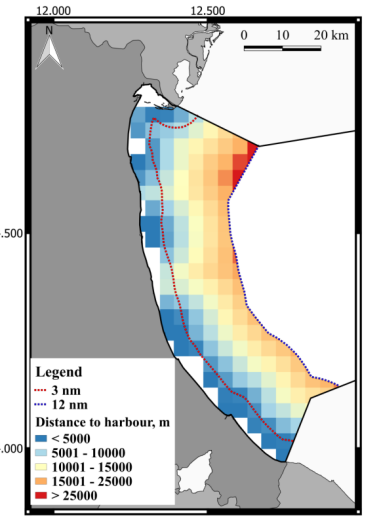


Enriched seabed area

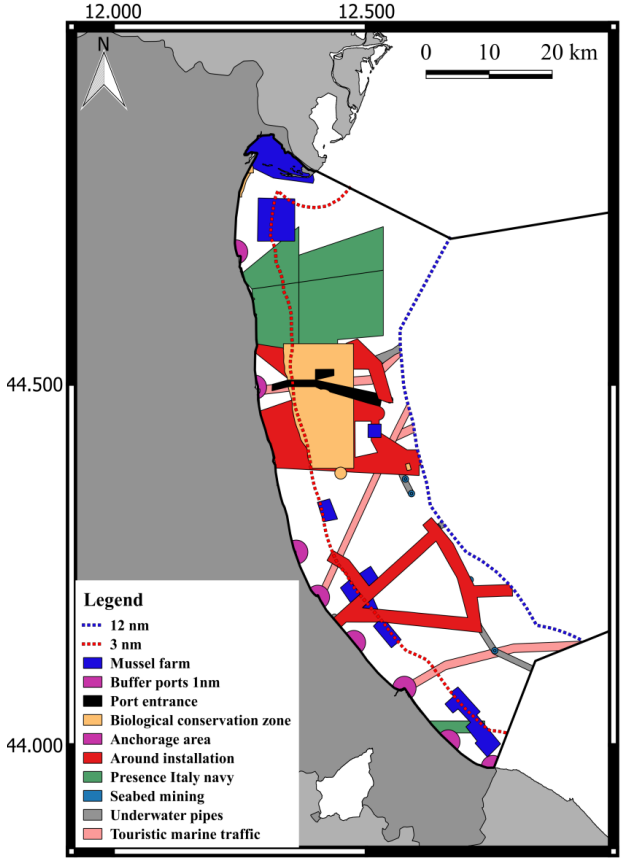
Wave exposure



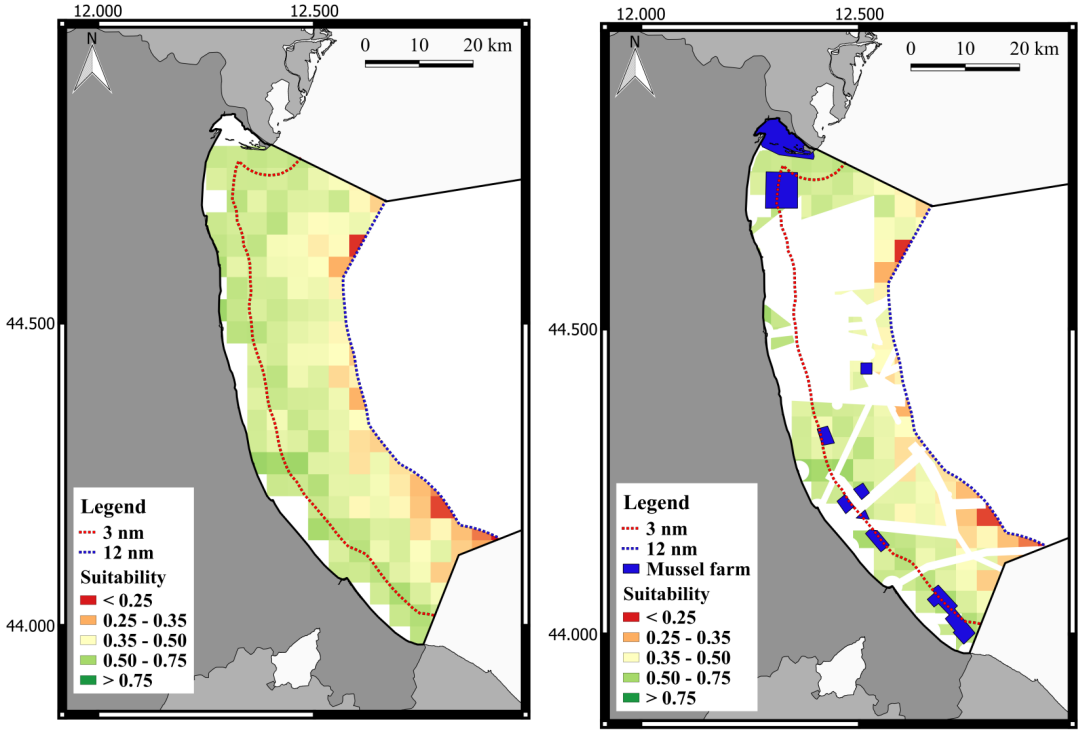
Distance to facilities



Mapping the constraints



Suitability map



3-12 nm total area = 1561 KM²

Available area = 835 KM²

Regulator feedback and improvement

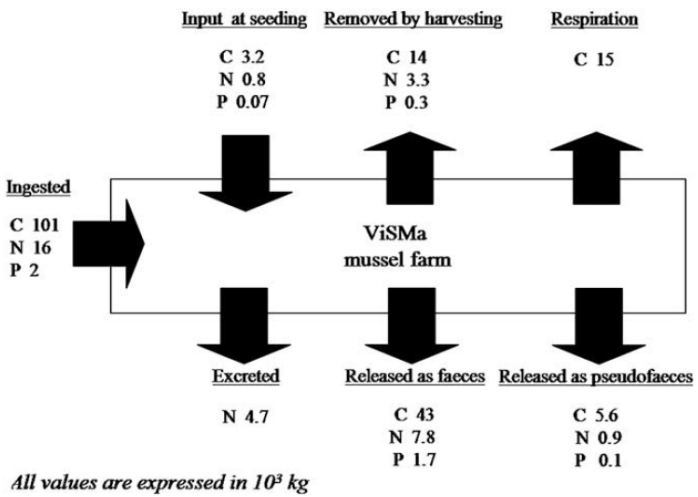
- Our preliminary results were presented to the Regione Emilia Romagna authorities in March 2017.
- Based on these findings, we were invited to participate to a more complex spatial planning exercise, led by the Italian National Research Council (CNR-ISMAR) and carried out in the framework of the Italian research project RITMARE.
- We are currently improving our results by:

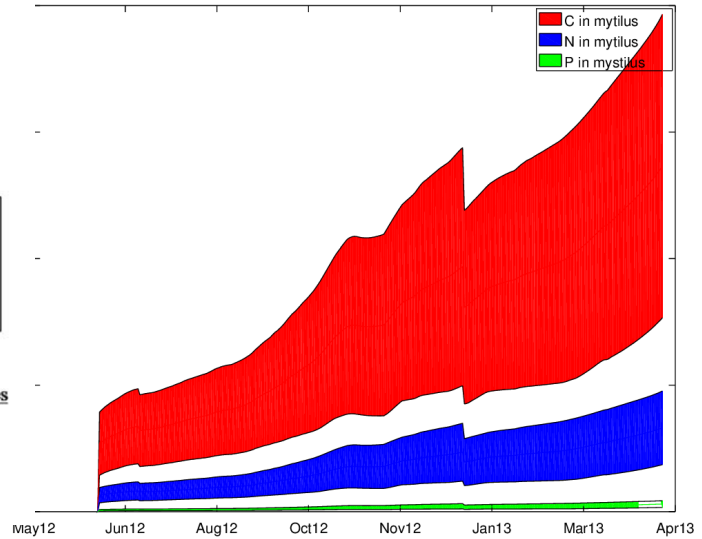
➢ Increasing the spatial resolution of potential growth estimates, using Sentinel 2 data.

➢ Using the result of a high resolution hydrodynamic model for obtaining better prediction of the area impacted by mussel farms.

➢ Developing a plug-in for a user-friendly implementation of the multi-criteria methodology

Shellfish ecosystem services





We are also introducing a " nutrient removal counter", for estimating in "quasi real time" the daily amount of Nitrogen and Phosphorus removed by a shellfish farm.

Conclusions

- The results obtained thus far, in out opinion, support the following concluding remarks :
- The integration of sat data and ecophysiological model allows one to map indicators of potential shellfish productivity.
- These spatial layers can be integrated with other criteria concerning potential risks for the activity, e.g. HABs, storms, stress due to climatic fluctuations, criteria concerning the profitability of he activitiy and constraints in order to obtain suitability maps, ot be used as input in Maritime Spatial Planning.
- The availability of sat data in “quasi real time” will open up the possibility of improving management practices and accurately evaluating shellfish ecosystem services, e.g. Nutrient removal.