Citizen science and crowdsourcing in the field of marine scientific research – the MaDCrow project

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Introduction

MaDCrow (Marine Data Crowdsourcing) is a marine technology research and development project co-funded by the European Regional Development Fund (ERDF), that aims to create an innovative technological infrastructure for the acquisition, integration and dissemination of data on the marine ecosystem of the Gulf of Trieste based on a citizen science paradigm.
Citizen science is the process whereby citizens are involved in science as researchers (Kruger & Shannon, 2000) and in this perspective one very important issue is the participatory attitude of volunteers (Conrad & Hilchey, 2011).

The project aims, at the same time, to develop the tools to allow such perspective to take place and to increase public awareness of environmental issues and in particular of climate changes as drawn within goal 13.1 of the UN Sustainable Development Goals, "Improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning".

The activities of the project are linked also to the priorities of the POR (Programma Operativo Regionale), within its target «Investments towards a growth in employment» 2014-2020 Axis 1 – "To strengthen research and development growth", Activity 1.3 – "To support R&D collaborative activities for the development of new sustainable technologies, new products and services".
In this perspective an aspect that is also particularly important within MaDCrow is to support open innovation between public institutions and private companies, basing it on environmental awareness and blue economy. In this perspective MadCrow aimed also at creating new competences in the field of marine technologies for already existing small and medium enterprises (SME).

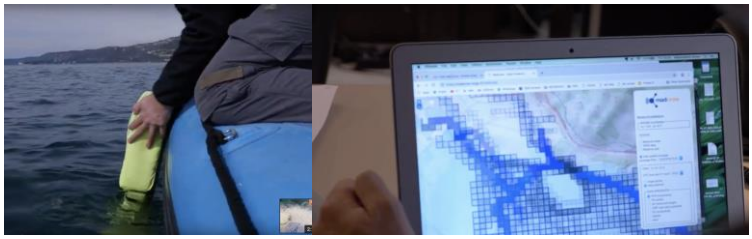

Figure 1: Marine data acquisition and transmission allows near real time data visualization on the MadCrow platform

The system

The MadCrow project developed all the tools that cover all the phases from acquisition, to processing to data visualization and access. A specific sensing and transmission box has been developed with innovative materials that can be easily deployed on small private boats (be it a recreation boat, a fisherman ship or else) without interfering with the normal activities of the vessel. The sensing box contains pH, temperature, dissolved Oxygen and salinity sensors. Others, such as for example turbidity

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will be soon included. The acquisition system is based on Arduino system that takes care also of GPS data geo-referencing and time-stamping. Both the sensor box and the acquisition system are packed in a specifically developed bag that is deployed attaching it to the hull of a ship through adjustable straps. There, the sensors are directly in contact with the sea water while the electronics are closed within a waterproof case. The sensors can be placed approximately at depths ranging from 50 cm to 1 meter, but of course the movements of the ship can change this and can sometimes even bring the sensors outside the seawater. The system therefore has limitations in its use in relation to sea conditions. It must be said also that volunteers hosting the system probably will not go at sea in conditions that are not compatible with the acquisition system. Anomalous recordings that come from these types of problems are common and suggest the need of a careful phase of quality control on the raw data. In addition, precision and accuracy of sensors worsen when vessels travel at velocities larger than 9-10 knots. A first step in data quality control is therefore checking the vessel position and speed. Issue can be due to errors in the GPS or the actual speed while both can be handled essentially in the same way: when positioning show velocities that exceed the acceptable speed, these measurements are automatically removed. A second quality check consist in controlling the range of measurement, when this show values that are outside the expected range they are automatically removed. Further quality check steps are performed superimposing a grid that allows to bin values pertaining to the same cell. The cells have dimensions of 200x200 metres per one hour. Measurements corresponding to the same cell are statistically averaged and the output is assigned to the cell as the representative value. Of course, statistics works best if there is a sufficient number of points in each cell. This is often not the case since depends very much on how many platforms acquire data at the same time; an issue that is intrinsic in any citizen-science based project. Further validation is under development, in order to check data upon what is available using traditional method. After validation, data are made available, almost in real-time, through standard OGC web services (WFS, WMS) and through a dedicated portal that allows to map data geographically and in time. We are currently working on the integration of MadCrow with other data sharing initiatives such as for example SeaDataNet or EMODnet starting from the standardization of web services that have been implemented already in the project.

First tests at sea

MadCrow was aiming mainly at developing a prototype (TRL 6), while the outcomes obtained went further, resulting in a fully operative infrastructure. This was tested in several test surveys, with 3 platforms simultaneously and showed to be robust and resilient even in complicated sea conditions. We tested the system on different types of boats, with different success; smaller boats performed better that larger ones which suggested that also other methods of deployment should be considered. Although MadCrow was mainly targeting at a relatively small area such as the Gulf of Trieste (Northern Adriatic Sea) the infrastructure can be easily scaled to larger and different areas.

Volunteers are provided at no cost with the acquisition system while the rest of the infrastructure is maintained by the Italian National Institute of Oceanography and Applied Geophysics – OGS and the private company Transpobank.

Being a project aiming at citizen-science, after having developed the technologies behind the infrastructure, we will now tackle the issue of building a fleet of volunteers. In this, two paths will be followed and namely (I) a commercial approach: where some additional serviced will be made available only to specific end users, and (II) a completely voluntary based approach, where ethical rewarding mechanisms will be tested. All raw data will be made available to the scientific community.

Conclusions

Madcrow demonstrated non only the feasibility but also the vast possibilities that the citizen science approach can have from the perspective of providing researchers with large quantities of data covering large geographical areas with very low costs.

MadCrow web site: http://www.madcrow.it

[1] National Institute of Oceanography and Applied Geophysics

References

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