Data, Information, Services for the Marine Environment



0.0105

2.236E-

Cosimo Solidoro csolidoro@inogs.it In spite of new measurement technique, the ocean is – and it is bound to be- largely under- sample

3 sensible actions

USE the data you have

keep on MEASURING data

EXTRACT the most from your data

FREELY DISTRIBUTE !!

two EU initiatives:









What is EMODnet?





MARITIME AFFAIRS



unlock fragmented & hidden marine data by making data more easily accessible, reusable and interoperable produce data products of common interest

Network of +110 organizations assembling data & data products from different sources in a uniform way

Long-term initiative as part of Blue Growth strategy (Marine Knowledge 2020)

| 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|------|------|------|------|------|------|------|------|------|------|------|
| Phase 1 – limited sea basins (ca 6 MEuro) | | | | | | | | | | | |
| | | | | | | | | | | | |



How does it work?



Developed by 7 thematic assembly groups with thematic data portals

Supported by a common central portal





Aims to collect, aggregate, **standardize**, check the **quality** of data developing new services to **share** information and products

| Collects data on: | | Group | Examples | | |
|------------------------|------------------------|---|--|--|--|
| In 3 matrices: | Eutrophication | nutrients, dissolved gasses | N, P, Si, Oxy, Chl-a | | |
| - water column; | Ocean acidification | acidity | pH, pCO2 | | |
| - biota; - sediment | Contaminants | hydrocarbons, heavy metals, pesticides, | anthracene, fluroanthene, Me, Cd, Pb, TBT, DDTs | | |
| Scament | Marine Litter | beach litter, seabed litter, microlitter | | | |

Data products generation are organized at Regional level

MORE DATA & REANALYSIS might be an (the?) answer



CMEMS means Observation, Monitoring, Forecasting, Reprocessing and Reanalysis of Marine Data



A Pan-European network of existing infrastructures, *value-added by* the Copernicus *initiative*, coordinated and with common quality standards

Models for space/time interpolation of data What is available for the Mediterranean and Black Seas on the CMEMS web-portal today?

...click on http://marine.copernic <u>us.eu/</u> And select ONLINE CATALOGUE



IN SITU products (2+2):

- Variables: temperature, salinity, currents, SSH, chlorophyll, oxygen
- Resolution: NRT + yearly DM

SATELLITE products (22+22):

- Variables: SLA, SST, WIND, surface chlorophyll, attenuation coefficient, reflectance
- Resolution: 1-7 km; NRT + daily/weekly + REP

<u>MODEL products - PHY (3+2) + BIO (2+2) + WAV</u> (1+1):

- Variables PHY: temperature, salinity, current, SSH, Stokes drift velocity, mean wave number, MLD, bottom temperature
- Variables **BIO**: chlorophyll, nitrate, phosphate, primary production, phytoplankton biomass, oxygen, pCO2, pH
- Variables **WAV**: significant wave height, wind and primary/secondary swell wave significant wave height, periods, direction, Stokes drift velocity
- Resolution: MED=1/16° BS=1/36x1/27; hourly/daily/monthly

INSITU_MED_TS_REP_OBSERVATIONS_013_041 MEDITERRANEAN- IN-SITU OBSERVATIONS YEARLY DELIVERY IN DELAYED MODE (1990-2015) OBSERVATION L2 ST ① undefined km x undefined km (discrete depth levels) From 1990-01-01 to 2015-12-31 instantaneous MORE MORE ① MORE ① MORE ① MORE ①







WHY do we need the Copernicus MODEL

1212211

WHICH TYPE OF OUTPUT ?



CHL Chlorophyll [mg/m³] concentration_of_chlorophyll_in_sea_water

Chlorophyll (CHL) is a signature of the abundance of phytoplankton in the ocean

CHL in CMEMS-MED-MFC is computed as the sum of chlorophyll contents of 4 phytoplankton functional types of BFM (diatoms, flagellates,

picophytoplankton and dinoflagellates)

MEAN MONTHLY VALUES IN MED: between 0.05 mg/m³ (summer) and 0.20 mg/m³ (spring), with local spring bloom (> 1 mg/m³) in NorthWestMed



Snapshot of daily surface CHL from operational (an/fc) products.

CHL Chlorophyll [mg/m³]



concentration_of_chlorophyll_in_sea_water

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Mediterranean Sea is characterized by a Deep Chlorophyll Maximum longitudinally and seasonally modulated [picture taken from Lazzari et al. 2012].

pH – ocean acidity [-]

ocean_acididity_expresses_as_seawater_ph_reported_on_sea_ water_scale

Ocean acidity at in situ condition reported on the sea water scale

Indicator for acidification in climate change

pH in CMEMS-MED-MFC is computed as diagnostic output of the carbonatic system module of the BFM model (DIC and alkalinity)

Seasonal cycle can be signicant at surface, forced by T, Carbonate system (DIC and Alkalinity dynamics)

Insitu = at the T, S and press of the seawater Other pH scales: NBS, Total, Free





pCO – pCO2 [ppm]

seawater

alkalinity)

Diagnostic output of the

BFM model (DIC and

Strong seasonal cycle:

thermal effect on solubility

ocean_pco2_expresses_as_carbon_dioxide_partial_pressure

Partial pressure of CO2 in Jan2015 carbonate system module of Range of variability: 250-550 ppm; atm pCO2 is ~400 ppm



Small-size patterns due to local drivers (rivers, coastal and small-size circulation patterns affecting DIC and Alcalinity)

Monthly mean pCO2 value [ppm] at surface



...THAT'S NICE... BUT CAN I TRUST THE PRODUCT QUALITY ?

Validation activities at CMEMS-Med-MFC-Bio: present <u>delivery</u> for NRT (AN/FC) and Multi-Year products





VALIDATION AGAINST INDIPENDENT DATA





- CLASS 4 metric: quantitative comparison model vs float data
- Useful as a quality indicator to show model behavior wrt float data along the mission at seasonal scale





Conclusions

- Validation / Quality assessment of CMEMS-MED-BIO **products** (*in 2014 we had only CHL!*) is presently feasible and spans the 4 GODAE Classes:
 - at different levels: from climatological basin-scale consistency to analysis accuracy and forecast skill assessment
 - at different spatial/temporal scales: basin sub-basin transects mooring/point
- Different variables have different levels of accuracy and skill:
 - CHL/NUT/OXY at weekly scale and down to sub-mesoscale
 - NUT at seasonal/annual scale at deep levels to see anomalies
 - CARB at sub-basin scale at quarterly/annual scale
 - NPP/PhyBiom only as consistency for model functioning over climatology

| Droducto | Internal Metrics | | | | | External Metrics | | | | |
|---------------|------------------|----|----------|--------------|---------------------------------------|------------------|---------|------------------|--|--|
| Products | Consistency | | Quality | | Performance | | Benefit | | | |
| CHL | \odot | ОК | \odot | ОК | \odot | ОК | \odot | ОК | | |
| NO3/PO4 | \odot | ОК | \odot | ОК | $\stackrel{\textcircled{\bullet}}{=}$ | In progress | \odot | ОК | | |
| ΟΧΥ | \odot | ОК | \odot | ОК | : | In progress | \odot | ОК | | |
| CARB: pCO2/pH | \odot | ОК | \odot | ОК | $\stackrel{\textcircled{\bullet}}{=}$ | Data-limited | : | For clim purpose | | |
| NPP | \odot | ОК | : | Area-limited | 8 | No data | : | For clim purpose | | |
| Phyto biomass | \odot | ОК | 8 | No data | 8 | No data | 8 | Less reliable | | |



FREE ACCESS

① marine.copernicus.eu/services-portfolio/access-to-products/ COPERNICUS OK Search terms MARINE ENVIRONMENT MONITORING SERVICE European Providing PRODUCTS and SERVICES for all marine applications Commission SHORT-CUT MARKETS & SCIENCE & TRAINING & SERVICES ABOUT US NEWS. TO SERVICES BENEFITS MONITORING EDUCATION PORTFOLIO FIRST VISIT **ONLINE CATALOGUE** MY CART CATALOGUE PDF 0 ? Found 30 products matching your criteria. YOUR SEARCH TYPE YOUR SEARCH MEDSEA ANALYSIS FORECAST PHYS 006 001 MEDITERRANEAN SEA PHYSICS ANALYSIS AND FORECAST **REGIONAL DOMAIN** . MODEL • • • X X X MED Mediterranean Sea Potential Temperature ("C) 01 03 2017 00:00 UTC 3DUV S SSH T 1 PARAMETERS 0.063 degree x 0.063 degree (72 depth levels) TEMPORAL COVERAGE From 2013-01-01 to Present -10.16 1992-01-0 To 2017-07-2 daily-mean, hourly-mean From 100 If checked, the search results will only MORE ADD Sub-WMS show products containing the whole selected INFO TO setting 18 11 12 13 14 15 16 17 18 19 20 CART time range PRODUCT WITH DEPTH LEVEL MEDSEA ANALYSIS FORECAST WAV 006 011 MEDITERRANEAN SEA WAVES HINDCAST AND FORECAST MODEL XXXXXX MED Spectral Significant Wave Height Init 11/52/2016 12:00 UTC SWH MWT VMDR WW SW1 SW2 VSDXY 1 41% 0.042 degree x 0.042 degree (Surface only) 10% in the From 2016-08-01 to Present in the ini mi

hourly-instantaneous

10.75

1000

FREE RE-USE :

Operational

oceanography &

Allocating suitable zones for shellfish aquaculture in the Adriatic Sea

Maps for

Deterministic









Brigolin, D., Porporato, E.M.D., Prioli, G., Pastres, R., 2017. Making space for shellfish farming along the Adriatic coast. ICES-Journal of marine science. 10.1093/icesjms/fsx018

FREE RE-USE:



ISPRA: Italian agency for environmental protection

Use of reanalysis products for the initial assessment of the MSFD descriptor 5 (Eutrophication): average concentration of nutrient (nitrate) along the Italian coastal zone



CMEMS SUPPORT DESK

INFO AND SUPPORT ON PRODUCT OF CMEMS (focus on MED-MFC)



AND/OR EMAIL TO COSIMO SOLIDORO CSOLIDORO@INOGS.IT