3d progress meeting
LAMAR project (LAMAR-DRCT/FRCT- M2.1.2/F/008/2007)
14.05.2008

List of participants and co-authors:

DOP:

Adriano Cordeiro <acordeiro@notes.horta.uac.pt>;
Ana Martins <anamartins@uac.pt>;
Ana Mendonca <amendonca@uac.pt>;
Ana Filipa <anafilipa@uac.pt>;
Catia Pereira <catiaalpereira@gmail.com>
Clara Loureiro <c.angela.m.loureiro@gmail.com>
Estela <estelacanet@uac.pt>;
João Guimaraes <jguimaraes85@gmail.com>;
Igor Bashmachnikov <igorb@uac.pt>;
Miguel Figueiredo <olliegator@hortanet.com>;
Paula Aguiar <aguiar@uac.pt>;
Sandra Sequeira <sandrasequeira@uac.pt>;
Silvia Lino <silvialino@uac.pt>;
Guilherme Lopes <patanisca@gmail.com>;
Patricia Amorim <pamorim@uac.pt>;
Paolo Lombardi <plambardi@uac.pt>;

St.Petersburg University:

Victor Robertovich Foux <victorvf1285@yandex.ru>;
Tatiana Vasilievna Belonenko <btvlisab@yandex.ru>;
Aleksey Koldunov <koldunovaleksey@gmail.com>;
Alexandra Cherkasheva <aynask@gmail.com>

1. Diagnostic formula was discussed:

$$\frac{\partial P}{\partial t} = \left[a_1 u \frac{\partial P}{\partial x} + a_3 v \frac{\partial P}{\partial y} \right] + \left[a_2 \frac{\partial P}{\partial x} + a_4 \frac{\partial P}{\partial y} \right] + \left[a_5 + a_6 P + a_7 P^2 \right],$$

where P is phytoplankton primary production, (u,v) are the vectors of ocean current, and $a_{1\text{-}7}$ are the coefficients to evaluate.

P (the method is available in MODIS web-site http://modis.gsfc.nasa.gov/data/atbd/atbd_mod24.pdf) is computed from satellite data, using information on Chlorophyll-a (Chl-a), temperature (SST: P_{opt}(SST)) and available photosynthetic radiation (PAR) [Behrenfeld, MJ, PG Falkowski, Photosynthetic rates derived from satellite-based chlorophyll concentration, Limnology and Oceanography, 1997a, Volume 42: 1-20: http://web.science.oregonstate.edu/ocean.productivity/index.php, VGPM (Vertically Generalized Production Model)]:

$$NPP = Chl \cdot P_{opt}^{b} \cdot DayLength \cdot \left(0.66125 \cdot \frac{PAR}{PAR + 4.1} \right) \cdot Z_{eu},$$

where

Chl *– satellite-based chlorophyll concentration [mgChl/m³]*

P_{opt}^{b} *– chlorophyll optimal carbon fixation value [mgC (mg Chl)-1 hour-1].*

DayLength – *duration of daylight [hours].*

PAR – *photosynthetically active radiation [mole particles/m²/day]*

Zeu – *euphotic layer depth [m].* Morel and Berthon (1989) .

Presently the computations are done, using SST and Chl-a from MODIS, PAR from SeaWiFS. 9km horizontal and 8-day spatial resolution.

It was suggested that further complication of the equation is not desirable and can be misleading, since there is little data available to support the results.

2. Computations of *P*:

The important task is to provide well filtered satellite data for computations. In principle, it will be better to derive all the parameters from one satellite to assure simultaneous data. At the same time presently this is not possible. Besides, weekly to monthly data will not probably be much affected of non-simultaneous measurements of various parameters.

The standard MODIS SST does not seem to be very well filtered and has a lot of noise. **It was suggested**, that P-computations may be improved by the use of filtered monthly data for OC/SST. (For SST one may also use AVHRR?). The work needs to be done during the next month. OC from MODIS proved to be much less noisy and error-containing then that from SeaWiFS.

It was suggested, re-processing of MODIS data using new algorithm is in progress (Miguel Figueiredo).

The possibility for using IPAR parameter from MODIS (http://modis.gsfc.nasa.gov/data/dataprod/pdf/MOD_22.pdf or http://oceancolor.gsfc.nasa.gov/forum/oceancolor/topic_show.pl?pid=1441, which can be converted into PAR) was considered, but this product presently is not available (Miguel Figueiredo).

For computations may be used monthly means (?).

3. Validation of satellite OC:

One of the major tasks is to validate satellite Chl-a data against in-situ data. The major problem is that satellite OC data do not always reach the Chl-a maximum layer and, thus cannot be considered as Chl-a mean values for all the photic layer. At the same time, they may be representative (in the open ocean, at least) as a certain approximation for the total Chl-a in the layer with certain corrections coefficients, as well as correctly reflect the horizontal Chl-a gradients upper water.

The **available information** on the Chl-a data is collected and methodology of a match-up analysis with the satellite data is under development. Please, send any literature

information you may encounter to Ana Mendonça. Very few Chl-a data is already in the AZODC database (http://oceano.horta.uac.pt/azodc/oceatlas.php).

4. Validation of derived *P*:

Another important task is to validate the productivity (*P*). Not so much information on that subject is available, but the data collection is under way. Please, send any literature information you may encounter to Ana Mendonça.

5. Chemosynthesis and other types of photosynthetic primary production:

In this equation, productivity (*P*) takes only into account photosynthetic data from primary producers that contain chlorophyll a. However, there is growing evidence that chemosynthetic primary production is as significant as the photosynthetic primary productivity. Furthermore, even the photosynthetic primary production is being underestimated since it only takes in to account oxygenic photoautotrophy (Chlorophyll a containing organisms).

It was suggested to presently leave the chemoautotrophic and other photoautotrophic productivity results outside of the model, since this will complicate it. Besides, there is no quick assessment comparable to OC to infer values for regional productivity due to chemosynthesis. Currently, all estimates have to be done with in-situ measurements what yields a much lower number of data per region. Still the results are planned to be included in the following ways (Paula Aguiar's group):

- as an additional correction term when evaluating the final productivity maps,
- evaluate their role by competing for the resources and living space (terms a_5 and a_7)

Virus, fungi and other heterotrophic microorganisms play a key role on the nutrients availability and in predation on the primary producers mentioned above. An evaluation of these microplankton components will be carried for the region determine an approximate real weight of predation and resources partition (terms a_5 and a_7).

6. Nutrients analysis:

The results of nutrients analysis from our cruises may be ready in June (Ana Filipa). Some data is available in the AZODC. This data will not probably enter into direct model computations, but may be correlated with the obtained levels of productivity (*P*) and intensity of competition (term a_7) to check the results for consistency.

7. Validation of currents *(u,v)*:

The figures below showed that **altimetry and in-situ currents are not the same**. The reasons for the difference observed may be related to:

- The period of averaging. The CTD data were collected from several decades (form 1900, but the major part is from 70s-80s up to 2005), while altimetry data were collected from 1992 to 2007 (16 years).
- Spatial distribution. The CTD data were chaotically distributed in space and time, and objectively interpolated into 1^o lat-lon mesh. Altimetry data were obtained from regular measurements (5-7km along track and about 100km across track).

Different tracks were made in different time and the results were combined in 7-day mean gridded data-sets, with ~0.16^o lat. (Azores region) and 0.30-0.40^o lon. regular grid. All those procedures imply a certain smoothing (which should decrease the current speeds), but it would be expected that in-situ data will be stronger smoothed.

- Geostrophic computations. In-situ data computations were made using 1300m and 2000m reference levels, where the current speeds were assumed to be 0, which in real ocean is not exactly the case.
- Due baroclinic vertical variability, the currents obtained from altimetry may not adequately represent the ones in the photic layer (about 100m depth) and the advection may not be correctly estimated. Also altimetry currents include a barotropic part (not taken into account by density differences), and under certain conditions this may oppose the baroclinic one.

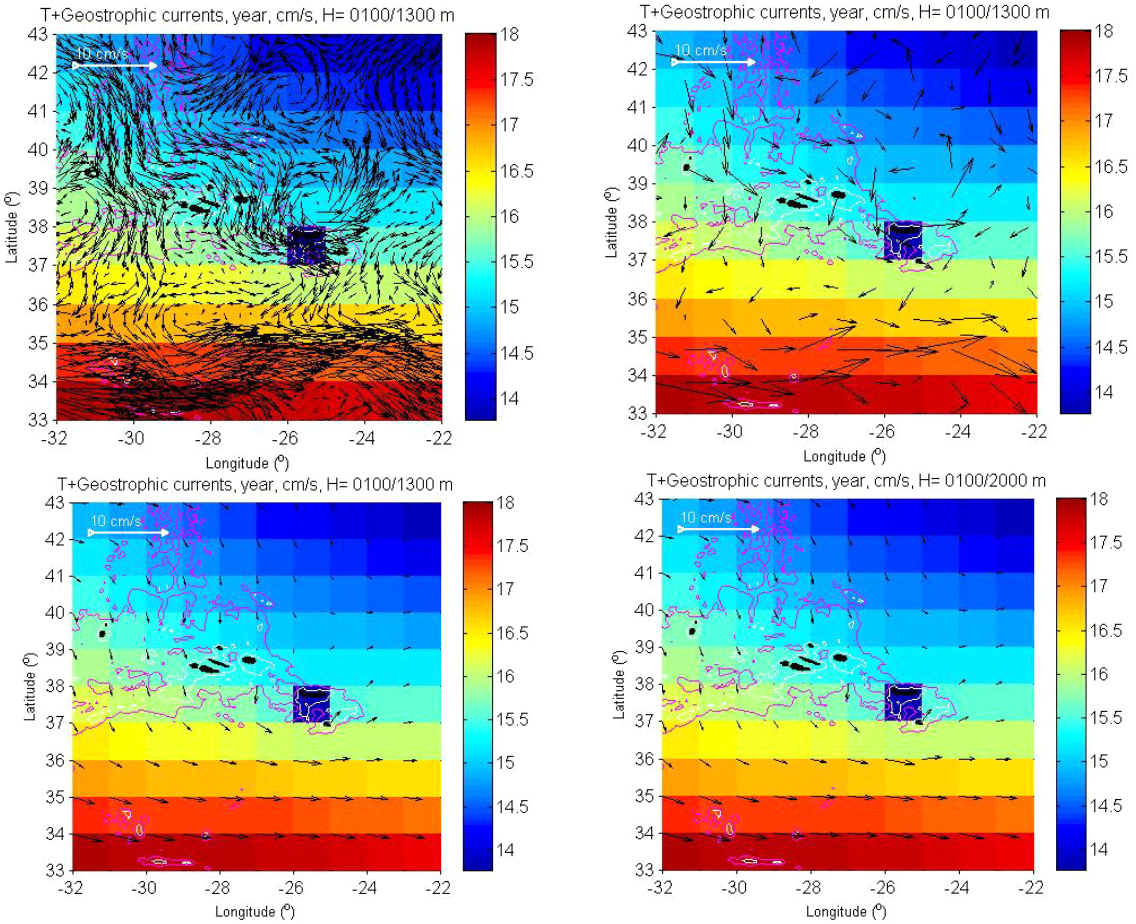


Fig. Altimetry and in-situ (100m depth) geostrophic currents.

The altimetry/in-situ differences need to be explored further, to fetch model with correct data.

Several ways may be suggested:

- to find correlation/correction coefficients for the altimetry data,
- to improve in-situ computations using inverse model technique,

- to improve in-situ computations using data from AZODC to produce finer mesh for in-situ currents (around 0.30^{o} lat-lon, or even the same as in altimetry). The first step will be to compute number of available points for the suggested mesh on annual, seasonal and monthly basis from AZODC, to see if the task is feasible (Guilherme Lopes, Sandra Sequeira).
- to use in-situ direct current observations by floats or current meters.

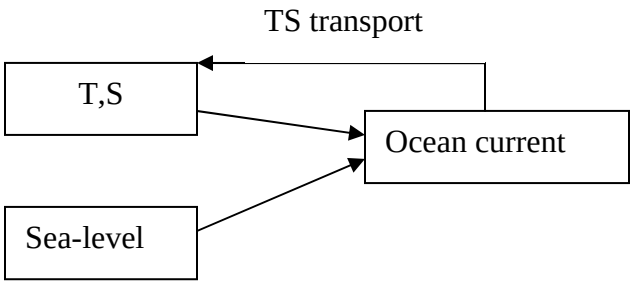
8. LAMAR web-site (Guilherme Lopes):

The LAMAR web-site (http://oceano.horta.uac.pt/lamar/) should become a source of information exchange and a working tool for the participants of the project to store/get information of common interest. This will include **literature overviews** under selected topics (see below) and **PDFs of related articles**.

The topics to cover:

- ***T-S and water masses,***
- ***Ocean currents,***
- ***satellite SST and OC filtered monthly images,***
- ***nutrients,***
- ***phytoplankton biomass and productivity,***
- ***bacteria-plankton,***
- ***zooplankton*** *(if available).*

Besides **schematic diagrams** of in/out flows which show main interdependences for various parameters are suggested.
For example:



9. Next meeting

The next LAMAR meeting planned end-June, around the planned Workshop.