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SOLICITUD DE BUQUE OCEANOGRÁFICO PLAN DE CAMPAÑA

DATOS DEL INVESTIGADOR PRINCIPAL:

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DATOS DEL PROYECTO:

Título del proyecto: Study of the Vertical Oceanic Pump in mesoscale eddies (PUMP)

Coordinador del proyecto: Pablo Sangrà Inciarte

PLAN DE CAMPAÑA.

Documento de formato libre en el que se describirá con suficiente detalle el plan de campaña, adjuntando uno o varios mapas detallados así como todas las coordenadas de aquellos lugares en que se desarrolle la labor.



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Cruise plan of survey PUMP: August 28-September 22, 2014 (26 days)

The first goal is to obtain physical and biogeochemical data on scales sufficient to resolve submesoscale processes that are responsible for the eddy's ageostrophic secondary circulation (ASC) and mixing. A second goal is to determine how the eddy's physical and biogeochemical properties evolve in time. We will pay special attention to the coupled sampling of physical and biogeochemical properties. As sketched in the attached figure and explained below once located, we plan first to conduct a SeaSoar survey of the entire eddy, then to perform its biogeochemical sampling that will be repeated three times. Between repeated biogeochemical samplings two SeaSoar surveys will be conducted at the eddy edges. The estimated total time for the survey is 26 days, 23 days for the sampling ($4+(5 \times 3)+(2 \times 2)$) and 3 days for navigation (two ways) until the eddy location (well developed eddies non wind wake perturbed may be located as far 150 nm).

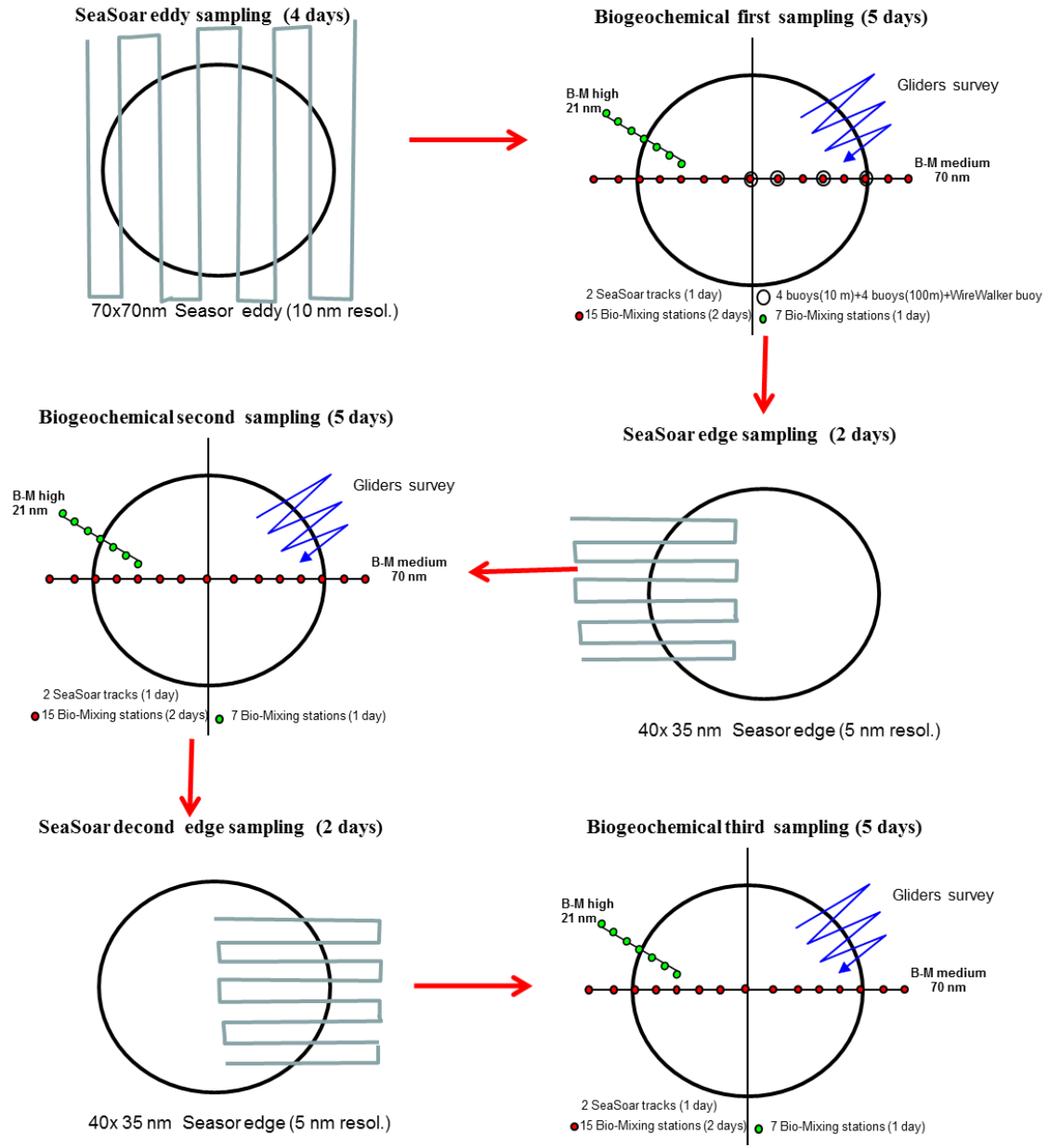


Figure 1 PUMP Cruise plan see details below



Sampling summary

- 1 SeaSoar 70 x70 mn grid
- 6 SeaSoar transect (70 nm)
- 2 SeaSoar 45 x 35 nm grid
- 3 Biogeochemical cross-eddy transects (70nm). 15 stations 5 nm apart each
- 3 Biogeochemical eddy edge transects (21 nm). 7 stations 3 nm apart each
- 66 total CTD-Rosette casts
- 66 Turbulence profiler casts
- 66 Submersible cytometer casts
- 9 buoys deployment (1 recovered/maintained once a week)
- 2 Gliders deployment and recovery

1. Eddy location and SeaSoar sampling(4 days)

We plan to sample an eddy sufficiently far from the islands to survey a well developed structure unperturbed by the islands' wind wakes. For eddy location prior to and during the campaign we will use the operational system developed by the Division of Robotic and computational Oceanography (IUSINAI) of the ULPGC, which integrates remote sensing, meteorological information and operational models (www.seasnet.org, <http://www.afrimet.org/marinemet/>). Particularly useful are SSHA products that resolve mesoscale variability and, when assimilated in an operational model, provide 72 hours projections. Anticyclonic eddies are permanent features in our study region and during the planned survey period (September/October) there is almost 100% likelihood of locating a well developed anticyclonic eddy. Once located it will be sampled with a square 70x70 mn SeaSoar grid with 10 nm tracks apart. This will take 4 days at an average speed of 8 knots. See the figure above for the location of the survey area

2 Eddy first biogeochemical sampling (5 days)

We plan to conduct two perpendicular high resolution fast transects crossing the eddy center using the SeaSoar, then one biogeochemical-mixing (CTD-Rosette-LADCP, Turbulence profiler) medium resolution ($\Delta x=5$ nm) transect (B-M medium) crossing the whole eddy and finally a high resolution ($\Delta x=3$ nm) biogeochemical-mixing transect (B-M high) crossing the eddy periphery region.

a) SeaSoar transects (1 day)

Two transects are necessary, rather than one, to locate with accuracy the eddy center and to detect possible radial asymmetries in the velocity (ADCP data) and hydrographic fields (SeaSoar Data). A submersible cytometer (CYTOSUB) will be mounted on the SeaSoar to measure planktonic organisms (from pico- to microplankton) in continuous mode. ADCP recording will be configured to obtain



vertical cells with bins of 8 meters resolution and an average maximum depth of 600 m. The length of these transects will be c.a. 70 nm (observed eddies diameters range between 30-60 nm).

b) Biogeochemical-Mixing transect crossing the eddy: B-M medium (2 days)

The Biogeochemical-Mixing transect will consist of 15 stations 5 nm apart over a length of 70 nm. At each station we will carry out CTD+LADCP casts down to 1000 m depth, recording salinity, temperature, oxygen, fluorescence, transmittance, turbidity, coloured dissolved organic matter (CDOM) and water horizontal velocity. A submersible cytometer (CYTOSUB) will be lowered, independently of the rosette sampler, to 200 m to obtain profiles of the plankton community structure. Water samples will be collected at 10 depths to provide samples for salinity, dissolved oxygen, nutrients, extracted chlorophyll, particulate organic carbon and nitrogen (POC/PON), dissolved organic carbon (DOC), CDOM, enzymatic respiratory activity (ETS), phytoplankton and microheterotrophs abundances and biomasses. Finally, we will launch a turbulent velocity profiler to measure the shear mixing. The profiler includes CTD and fluorescence sensors, has a maximum depth range of 200 m and has the advantage that it also records data while ascending, hence providing values in the surface layers.

c) Buoy deployments

We will deploy 4 buoys drogued at 10 meters (Ekman layer) and 4 buoys drogued at 100 meters (eddy interior), each equipped with a 12 meters long holey sock, along the biogeochemical transect, at different distances from the eddy center. A WireWalker drifting buoy will be deployed at the eddy center in order to monitor the eddy core battery will be recharged once a week.

d) Biogeochemical-Mixing transect crossing the eddy periphery: B-M high (1 day)

In order to resolve the submesoscale variability a high resolution ($\Delta x=3$ nm), biogeochemical-mixing transect will be conducted across the eddy periphery along a 21 nm transect (B-M high).

The estimated times for the eddy sampling are 5 days

- Seasor transects $(70\text{nm}+70\text{nm}+40\text{nm}(\text{transit}))/8$ knots = 1 day
- B-M medium, $(70\text{nm}/10\text{knots})+(15\text{stations}*2.5\text{hours})=2$ days
- B-M high, $(21\text{nm}/10\text{knots})+(7\text{ stations}*2.5\text{ hours})=1$ day
- 1 buffering day

3 Eddy repeated biogeochemical sampling (5+5=10 days)

We plan to repeat the above sampling two times. This will allow us to study the variation of the ageostrophic secondary circulation (ASC) and mixing and its correlation with the wind forcing or other processes such as near-inertial waves trapping within negative vorticity regions. This will also permit us to establish if phytoplankton



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abundance/community structure is modulated by changes in mixing and changes in the ASC. For this stage it will be critical that all B-M medium transects cross the eddy center. This will be assured by first locating the center from the buoy trajectories, including the central WW buoy, and the two perpendicular SeaSoar transects across the eddy. The B-M high transect crossing the eddy periphery will be Lagrangian in the sense that it will follow the trajectory of the buoy deployed at the eddy periphery.

4 Eddy edge sampling with Seasor (2+2=4days)

Between the repeated biogeochemical sampling we plan to surveys two times the eddy edge with a high resolution 45x35 mn SeaSoar grid with 45 nm length tracks 5 nm apart. This will take 2 days an average speed of 8 knots,

5. Gliders survey of the eddy periphery (20 days)

Two gliders will be deployed coincident with the deployment of the buoy at the periphery and recovered ant the end of the survey.



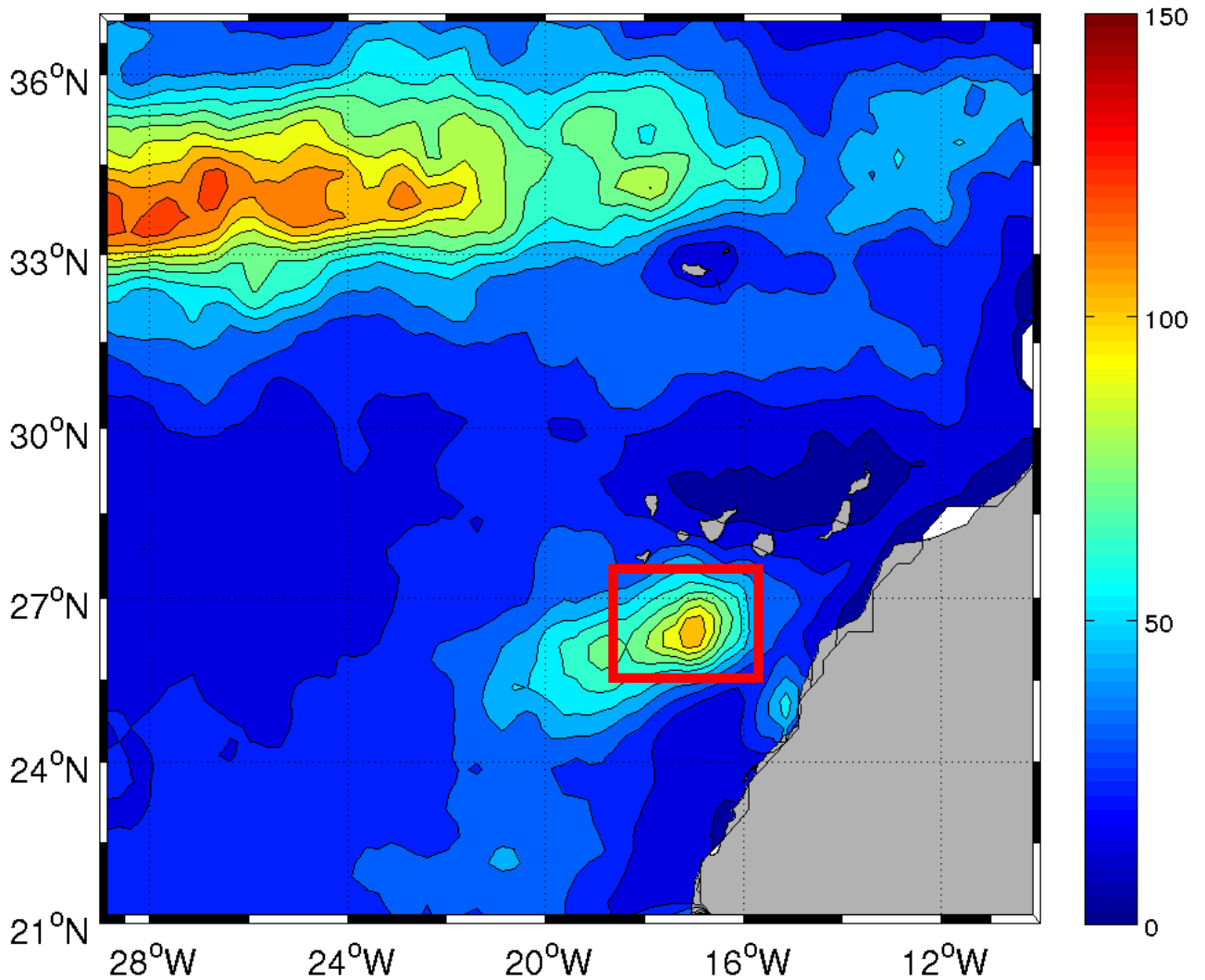
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Survey Area



Distribution of annual averaged EKE from altimeter data. Red frame indicated the planned survey area. Is the region of maximum probability to locate eddies as indicated by a region of maximum EKE.



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RESUMEN DEL PLAN DE CAMPAÑA (máximo 10 líneas)

Se planea muestrear interdisciplinariamente un remolino siguiéndolo durante 25 días. Primero se localizará mediante un sistema operacional y el barrido de una malla de XBT de 70x70 mn. En una segunda etapa primero se cruzará mediante dos transectos de 70 mn de resolución sinópticos haciendo uso del vehículo ondulatorio SeaSoar. A continuación se cruzará el remolino realizando un transecto de 70 mn de 15 estaciones físicas y biogeoquímicas distanciadas 5 nm. Se lanzarán 9 boyas y 2 planeadores (Gliders). Después se realizará un transecto de 70 mn de 7 estaciones físicas y biogeoquímicas distanciadas 3 nm en la periferia del remolino. Se repetirá esta segunda etapa 3 veces siguiendo el desplazamiento del remolino. Al final de la campaña se recuperan los planeadores y una de las boyas que incorpora instrumentación.