Hydrodynamic Environment and Ecosystem Diversity at two Deep-Sea Marine Protected Areas in Southern Biscay

Cesar Gonzalez-Pola[1] (cesar.pola@gi.ieo.es), Greg Ivey[2], Nicole Jones[2]
Francisco Sanchez[1], Samuel Kelly[3], Cynthia Bluteau[2],Raquel Somavilla[1]

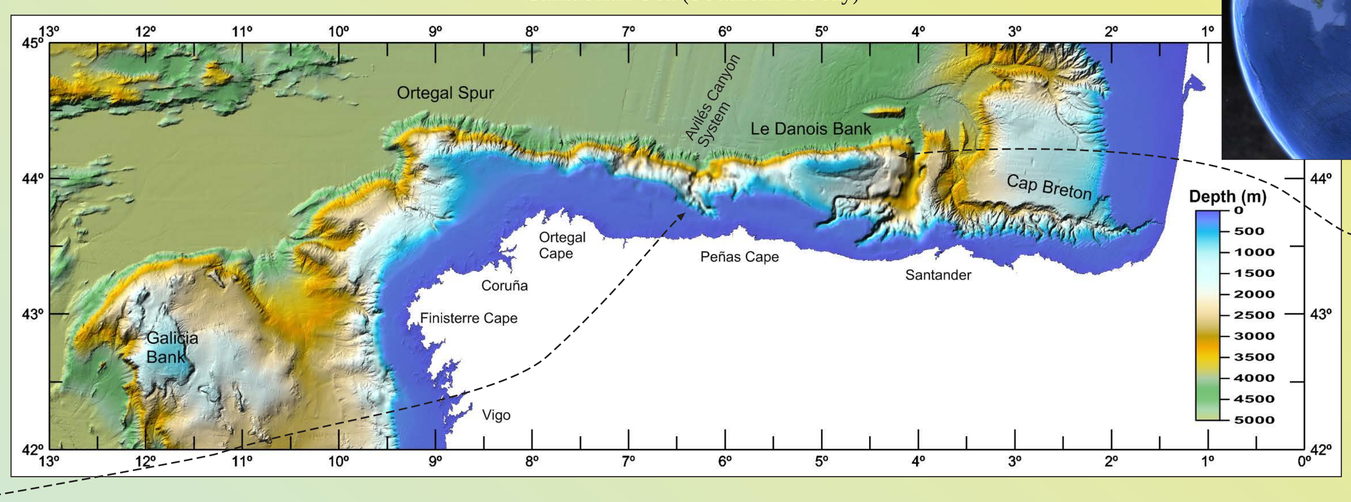
[1]Spanish Institute of Ocenography
[2]The University of Western Australia
[3]University of Minnesota Duluth

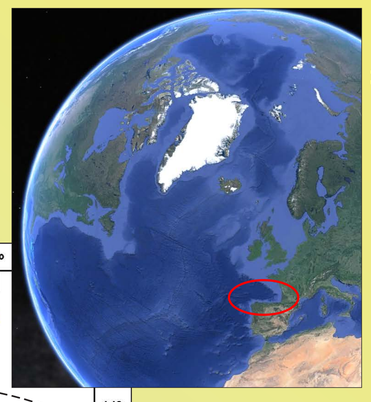
2016 OCEAN SCIENCES MEETING
AGU • ASLO • The Oceanography Society
21–26 February • New Orleans, Louisiana, USA

Poster ME34B-0806

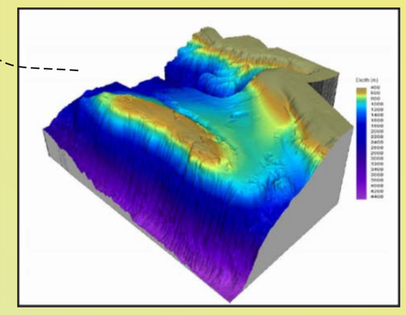
1. Le Danois Bank and Aviles Canyon System MPAs

In the early 2000`s Spain acknowledged the need of creating deep offshore marine protected areas (MPAs). In the Cantabrian Sea (southern Biscay) two hotspot areas, hosting valuable ecosystems, focused the attention. The first one is Le Danois Bank, an elongated seamount-like feature connected to the continental shelf by a saddle. The second one is the Aviles Canyon System (ACS) that breaks the continuity of the northern Spanish continental shelf.

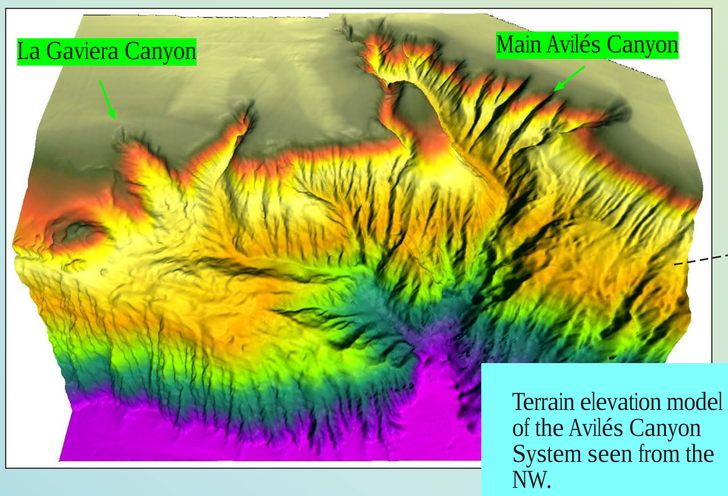




Study region



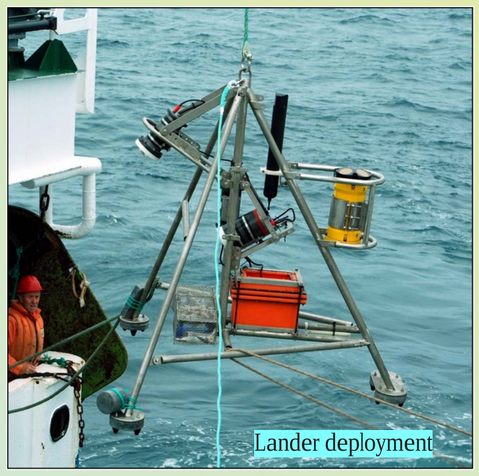
Terrain elevation model of Le Danois Bank seen from the NW



Terrain elevation model of the Avilés Canyon System seen from the NW.

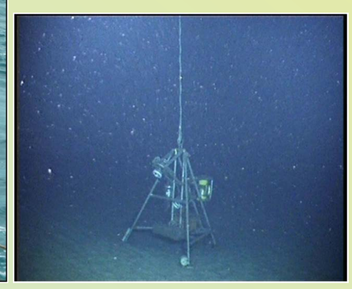
2. Sampling strategy

Observational multidisciplinary programs carried out allowed a detailed identification of habitats and biological communities. As a long-term goal these programs aimed to understand the ecosystem functioning as a whole with the implicit focus in associated circulation and dynamics.



Lander deployment

The observational record includes deep sea photogrametry as well as standard hydrography and long-term mooring lines. A lander system provided high-frequency currents and thermal structure tens of meters above bottom, together with time lapse photographs, at selected sites.

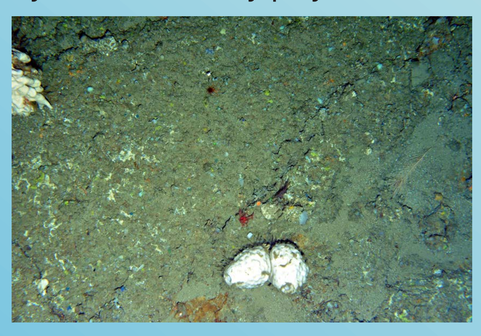


Trawled sled

3. Main Results

Le Danois

Le Danois Bank main feature is an anticyclonic recirculation area associated to the summit, a rocky outcrop at the western side. Habitat is characterized by sponge aggregations and gorgonia. Intense short-term dynamics certainly play a role.

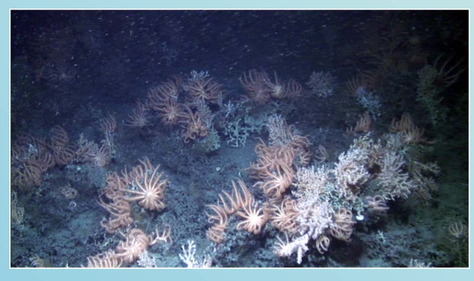


Stationary surface roughness seen on radar, probably caused by an internal solitary wave breaking

Comet-like sediment signature

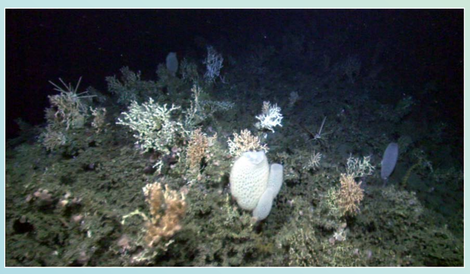
Aviles Canyon

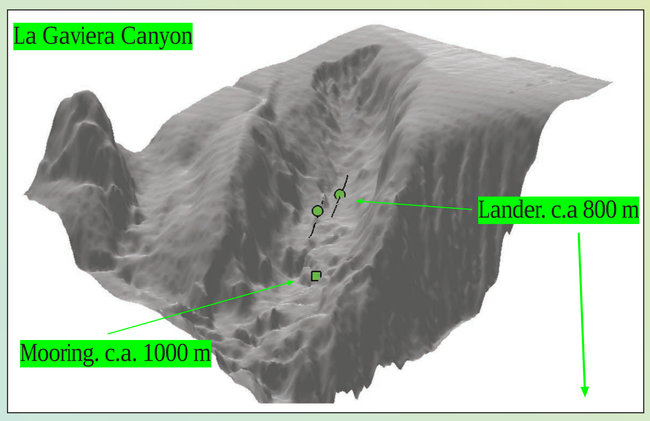
The head of main Avilés Canyon is the main hake fishing ground of the Cantabrian Sea. Coral structures exist at the steepest flanks, but sediment is smooth and dominant species are suspension feeders, like brisingella seastars.



La Gaviera Canyon

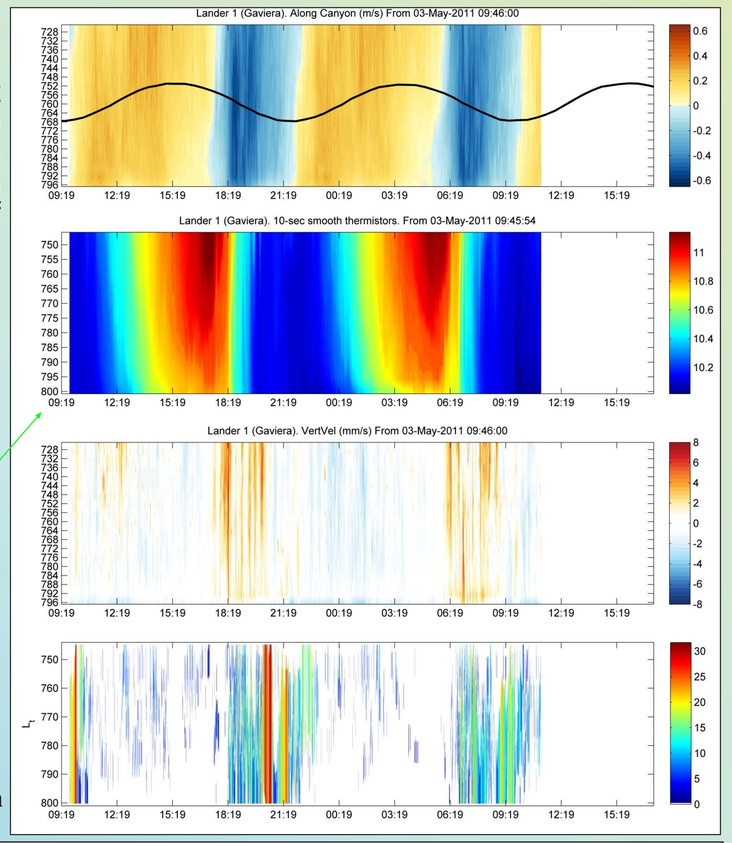
Noteworthy structured coral reefs only appeared in a relatively small area in one of the tributaries of the ACS (La Gaviera Canyon). Bottom seafloor there is markedly different from somewhere else, characterized by sand ripples.



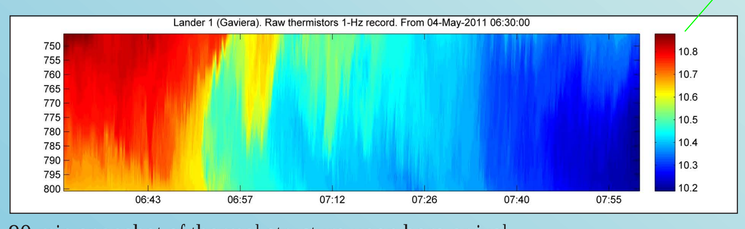


Bottom landers at these sites showed distintive dynamics, the development and violent breaking of an internal tidal bore was the main feature of La Gaviera Canyon.

25 hours lander record on La Gaviera Canyon, from top: along-canyon current (negative upslope), thermal structure, vertical velocity, Thorpe scales.



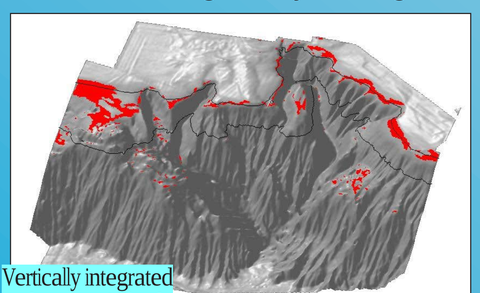
Tidal phases are strongly assymetric, being the upslope short and violent. Upon the arrival of the upslope phase overturns exceed the range of the thermistors chain, being estimated well above 100 meters, and stand several minutes. Local Kz within overturns reach 10^{-1} m^2 s^{-1} .



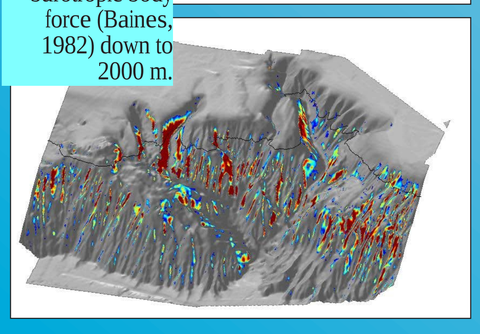
90-min snapshot of thermal structure upon bore arrival

4. Discussion: Understanding the hydrodinamic constrains

Analytic estimates confirmed that La Gaviera is the only canyon were large patches of the seafloor are critical or near-critical to the semidiurnal internal tide. Nearby upper flanks show also large patches of critical seafloor and large body forcing.

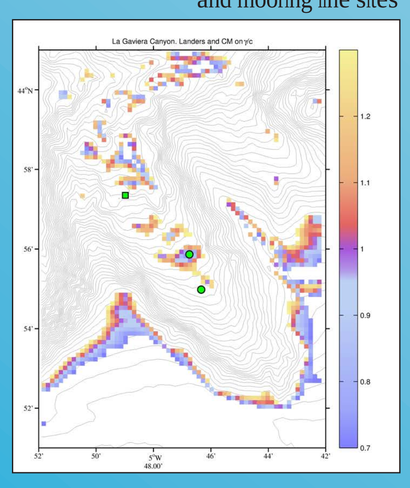


Vertically integrated barotropic body force (Baines, 1982) down to 2000 m.



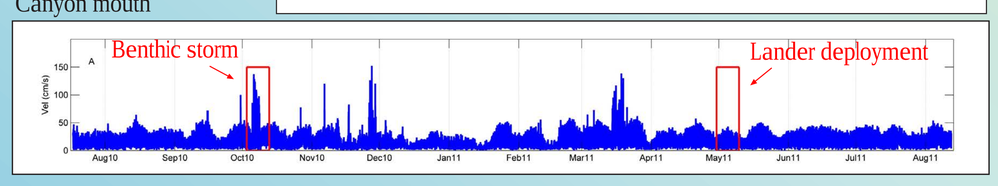
Near critical sites ($0.7 < \gamma/c < 1.3$). γ is seaoor steepness and c angle of propagation of M2 IT beam

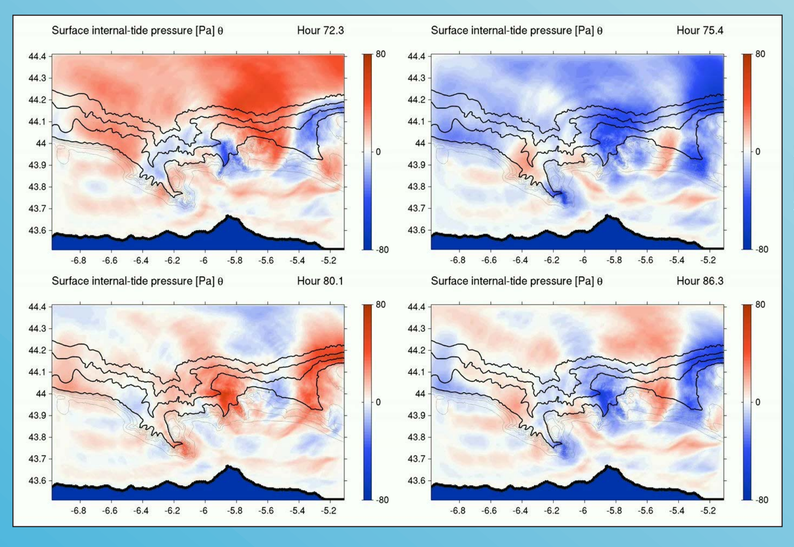
γ/c zoom at La Gaviera canyon together with lander and mooring line sites



A year-long near-bottom current record captured the development of three benthic storms, events lasting several days in which currents increases up to 3-fold the tidal max speeds and direction swings rapidly, losing the uniformity of tidal regime.

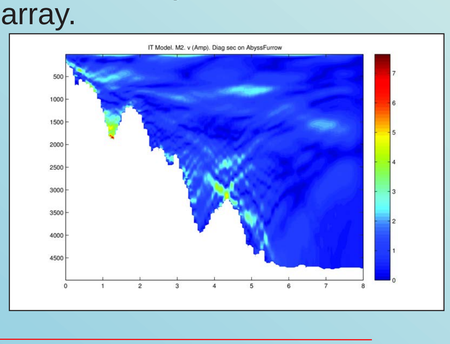
13 month near-botttom current speed at La Gaviera Canyon mouth





A MITgcm model run of the internal tide, forced by M2 alone, shows agreement with the dynamics recorded by the current-meters array.

Surface internal-tide pressure at different snapshots.



IT beams (M2 amplitude) along a section crossing Avilés and Gaviera canyons

Field work was conducted under several projects, mainly ECOMARG (REN2002-00916/MAR, Spanish Science call) and INDEMARES (07/NAT/E/000732, UE LIFE+ call). Part of the analyis was carried out during a stay at the University of Western Australia (PRX12/00662, Spanish movility call). Support for results dissemnitaion was provided by the Principado de Asturias under GIDEP Research Group (GRUPIN14-144)

See Gonzalez-Pola et.al.2012 (10.1016/j.dsr.2011.10.001) for Le Danois and Sanchez et.al. 2014 (10.1016/j.dsr2.2013.12.014) for La Gaviera Canyon. Further information in www.ecomarg.net