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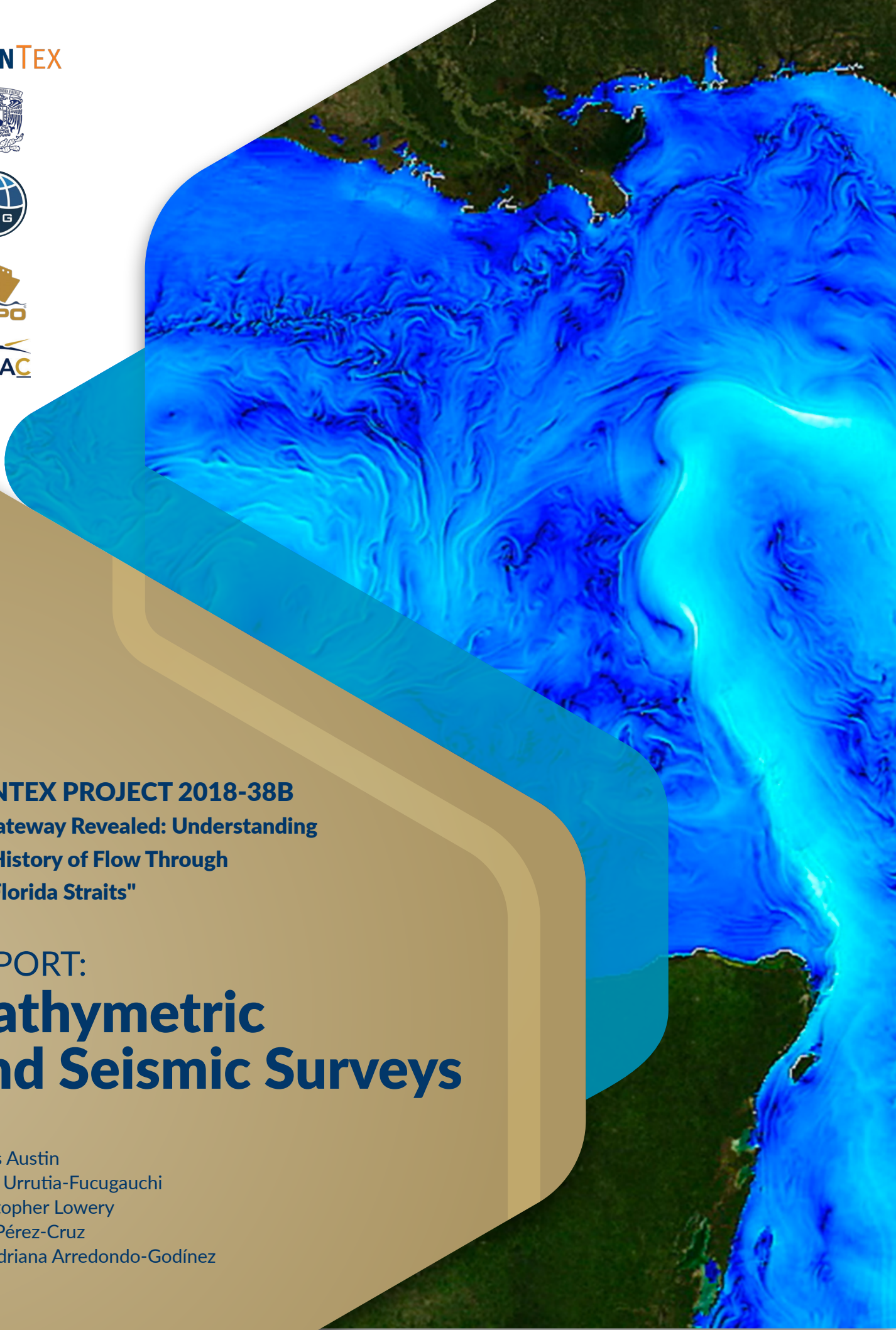

CONTEX PROJECT 2018-38B

"A Gateway Revealed: Understanding the History of Flow Through the Florida Straits"

REPORT:

Bathymetric and Seismic Surveys

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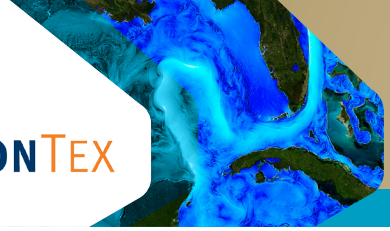


Introduction

The SE-GoM – ENEPY geophysical campaign "A Gateway Revealed: Understanding the History of Flow Through the Florida Straits" was carried out from July 17 to 26 on board UNAM research vessel RV Justo Sierra. High vertical resolution multichannel seismic reflection data, as well as multibeam bathymetric data, were acquired to investigate the presence, extent, and age of current AMOC-related features in the southeastern Gulf of Mexico and correlate them with specific climatic and tectonic events.

The Loop Current in the eastern Gulf of Mexico plays a central role in the regional and global climate. Through collaborative analyses and interpretations, which are the foci of this proposal, of new geophysical data from this region, and through planned scientific ocean drilling these data will support, we will investigate the following hypotheses:

Changes in GoM circulation through time are recorded in Mesozoic-Recent sediments preserved in the western approaches to the Florida Straits.

Imaging and sampling these deposits, both sediments and underlying basement, will allow us to determine when the modern LC was established, what hydrographic regime came before it, and how that evolution relates to the formation of the crucial gateway linking the South Atlantic/ Caribbean/southeastern GoM basin with the North Atlantic.

3. Recorded changes in circulation in the western FS can be related to global climatic and regional tectonic events elsewhere, with the ultimate objective of understanding how the Earth's present warming phase relates to previous such episodes documented for the Cretaceous and the Paleocene-Eocene.

Hypothesis 3 makes this investigation relevant to global climate studies, addressing the potential to understand anthropogenic input to modern climate evolution using past, naturally-driven examples of similar warming.

Based on the morphology, we may elucidate the surface hydrologic processes and environmental conditions across the peninsula during global glacial conditions. The bedform morphology of these sediments will provide information on current hydrodynamic conditions (bottom currents) and the signals of hurricanes and tropical storms that transport a significant amount of sand.

The bathymetric survey included the area in the Yucatan Platform (Fig. 1), following the procedure for multibeam data collection described below.

Bathymetric Survey

1. Quality control and corrections to echo soundings

Before the cruise, the operation of the hydroacoustic (echo sounders), hydrographic (CTD and SVP), and navigation (Seapath) systems were checked to ensure they were operating correctly.

Software in the hydroacoustic instruments was updated, and communication systems were configured to ensure good transmission. The configurations of the parameters in the different systems were adjusted and backed up. The multibeam (Kongsberg EM302 and EM2040C) and single beam (EA640) echo sounders (MBES); the sub-bottom profiler (TOPAS PS18); positioning, and navigation system (the Seapath 330+), and the Synchronization Unit (the K-sync) were appropriately configurated and synchronized.

To operate the remote operation of the SIS Helmsman complement (Fig.1) the computer on the command bridge was reconfigured (Figure 1).

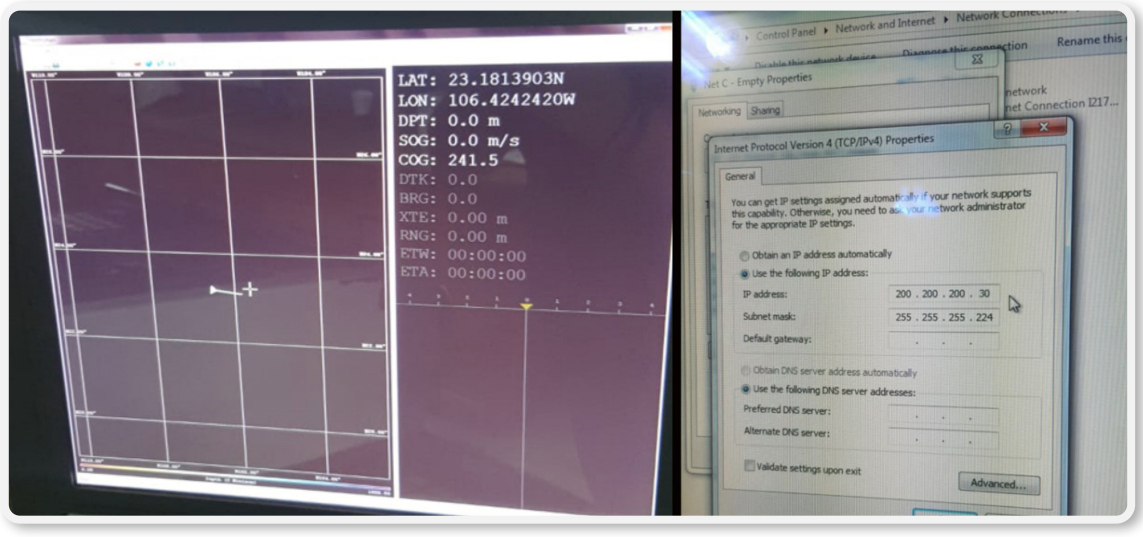


Figure 1 | *Configuration of the SIS Helmsman complement on the command bridge.*

2. Hydrographic instruments

The operation of the CTD SBE 9plus Seabird unit (with conductivity, temperature, pressure, and oxygen sensors; and 24 Hz sampling rate) was verified, as well as the sound velocity profiler (SVP) MinosX AML Oceanographic. Communication was established between the CTD, its unit on deck (SBE11 plus V2 console) in the Central Laboratory.

Prior to the bathymetric survey, the sound velocity profile was obtained in the study area at a maximum depth of 1000 m using the SVP MinosX coupled to the CTD rosette (Fig. 2) at 22°5.04' N latitude, and 86°2.64' W longitude.

The SVP recorded the data, which were later uploaded into the software that controls the MBES (EM302 and EM2040C). The calibration was done with the sound velocity profile obtained (Fig. 3).

Figure 2 | *CTD in the rosette and SVP MinosX.*

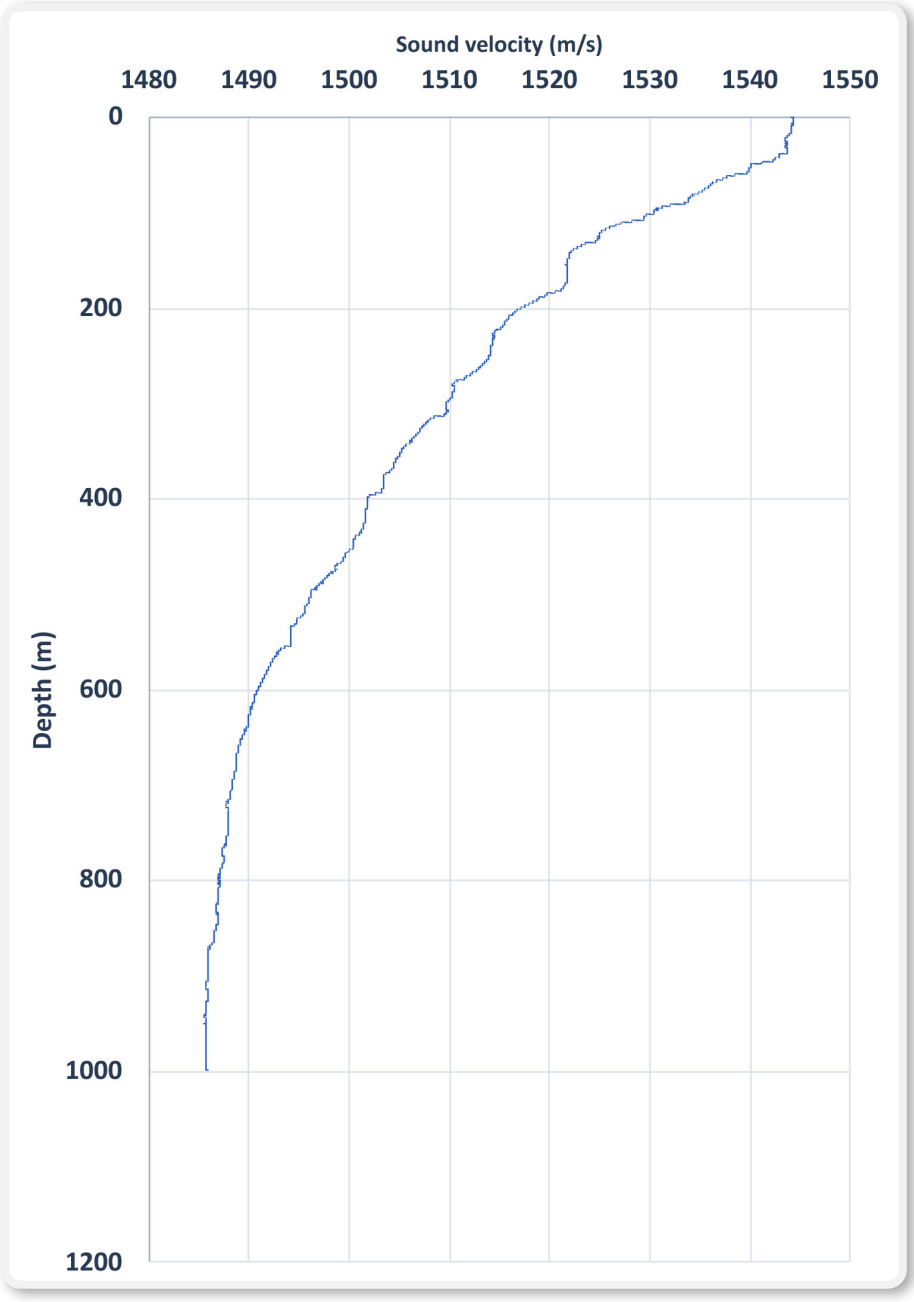


Figure 3 | Sound velocity profile in the study area.

Also, Depth, Conductivity, Temperature and Oxygen profiles in the column water were obtained with the CTD (SBE 9plus Seabird) (Fig. 3).

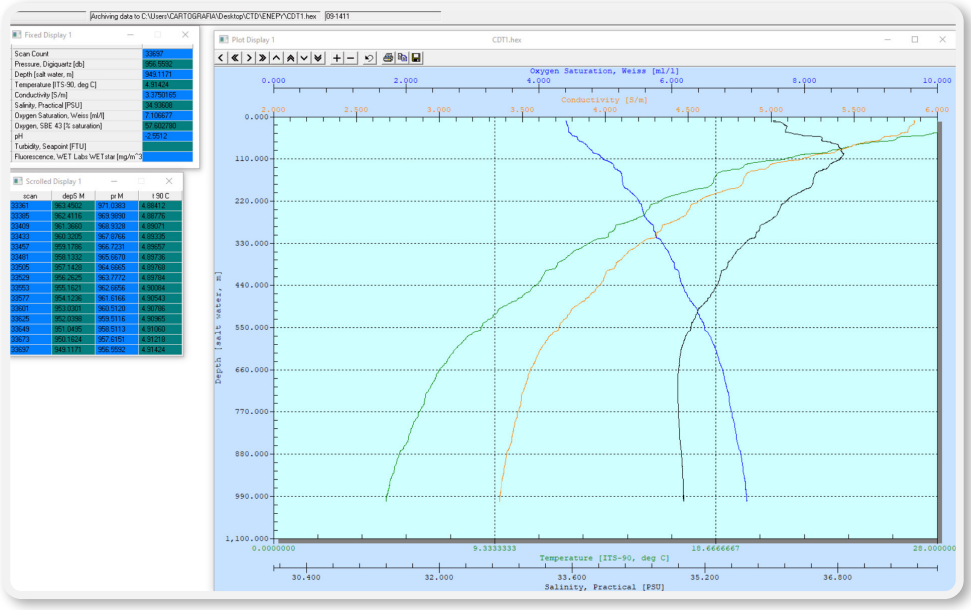


Figure 3 | Typical descent profiles of depth, temperature, conductivity and salinity prior to correction.

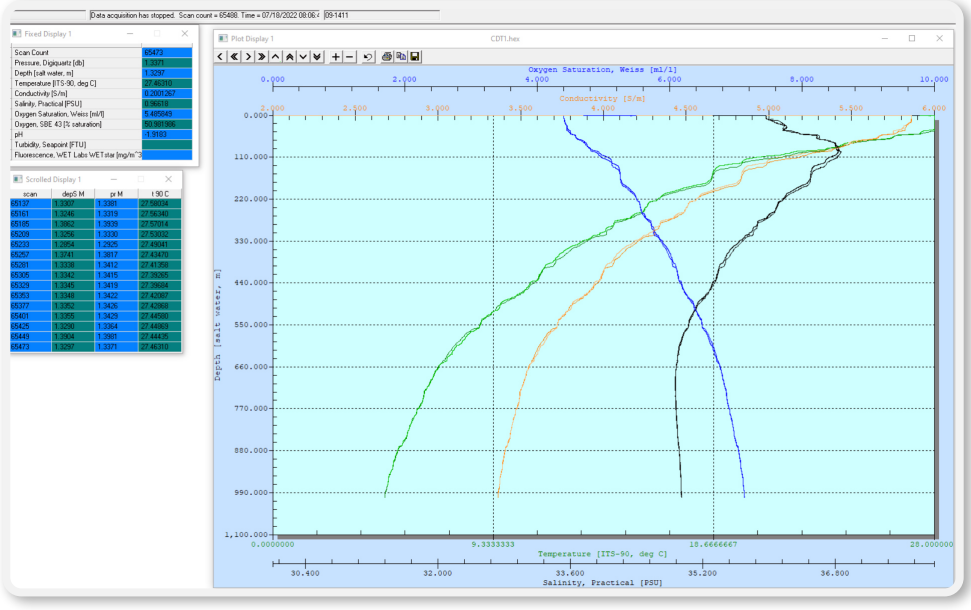


Figure 4 | Ascent and descent profiles prior to corrections.

3. Data acquisition

The bathymetric survey was in the SE of the Gulf of Mexico, on the northern end of the Yucatan platform, near the NE edge of the Campeche escarpment, in the region between 23°51.18' N and 24° 14.58' N latitude, and between 86°34.14' W and 87°48' W longitude.

The original survey planning consisted of 19 lines (Fig.5) of which 4 had orientation from NW to SE and 15 from SW to NE.

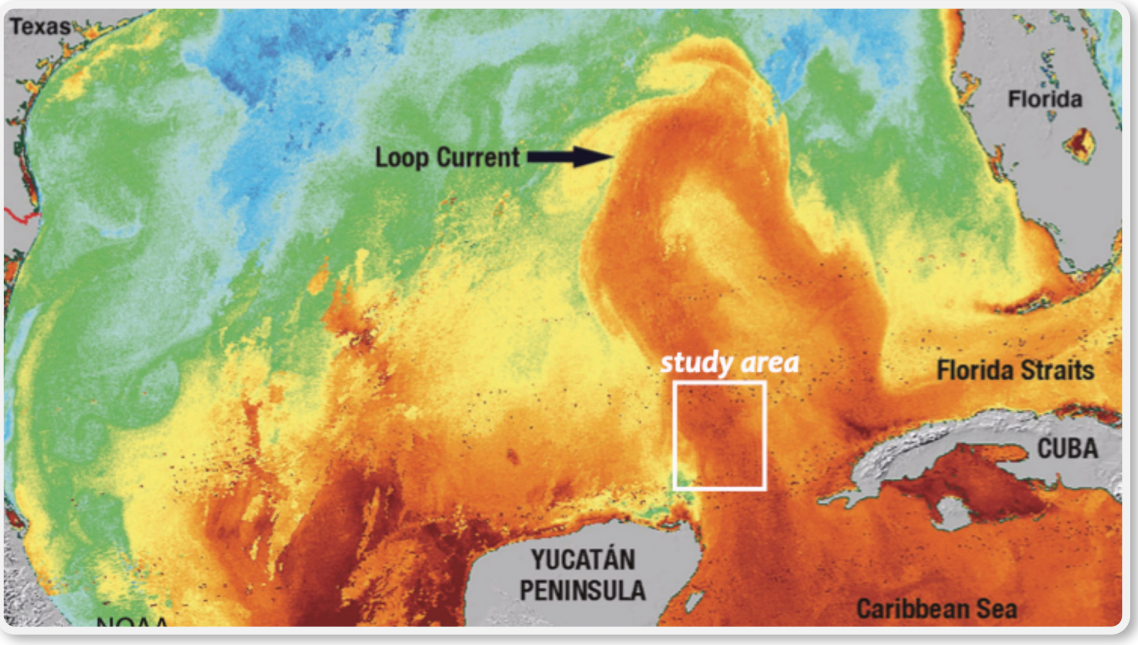


Figure 5 | *Study area.*

To optimize the acquisition time and obtain a wide coverage of the study area, the plan was modified reducing the lines to 8, of which 2 had a NW to SE orientation and 6 from SW to NE (Fig. 6).

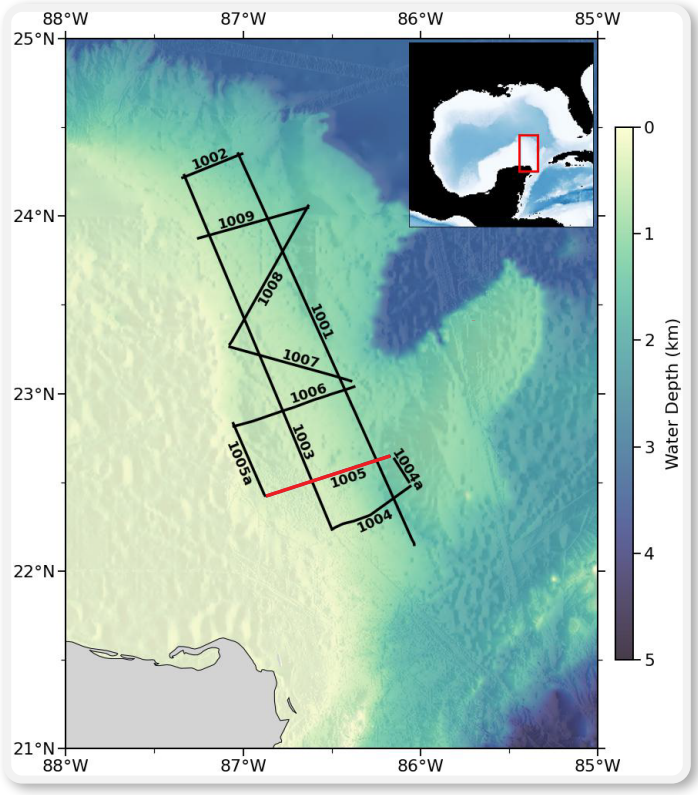


Figure 6 | *Final seismic and bathymetric survey planning.*

The main survey planning was created using the Seafloor Information System from the Kongsberg EM302 MBES (Fig. 7).

The survey was undertaken using a 300 kHz Kongsberg EM302 multibeam echosounder (MBES) onboard UNAM research vessel RV Justo Sierra. This MBES is designed to perform mappings between 10 and 6,000 m deep, establishing the parameters of operation, data acquisition, and graphic display for an efficient survey.

The EM302 MBES settings were optimized for the expected water depths in the survey area and to maximize swath coverage to ensure accuracy and efficiency; it operated with its standard frequency of 300 kHz. The angular range was set to 120°, with a central HD distribution pattern of 60°/60°, allowing a coverage of ~3,000 m depth.

The distance between longitudinal lines was 18.15 nm. For the NW-SE oriented lines, the distance between them was ~136 nm, while those oriented from SW to NE were ~42.88 nm, covering an approximate area of 18,195.54 km2. The maximum depths recorded in the area were 2,931 m and the minimum of 211 m with an acquisition speed of ~4 kt during the entire survey.

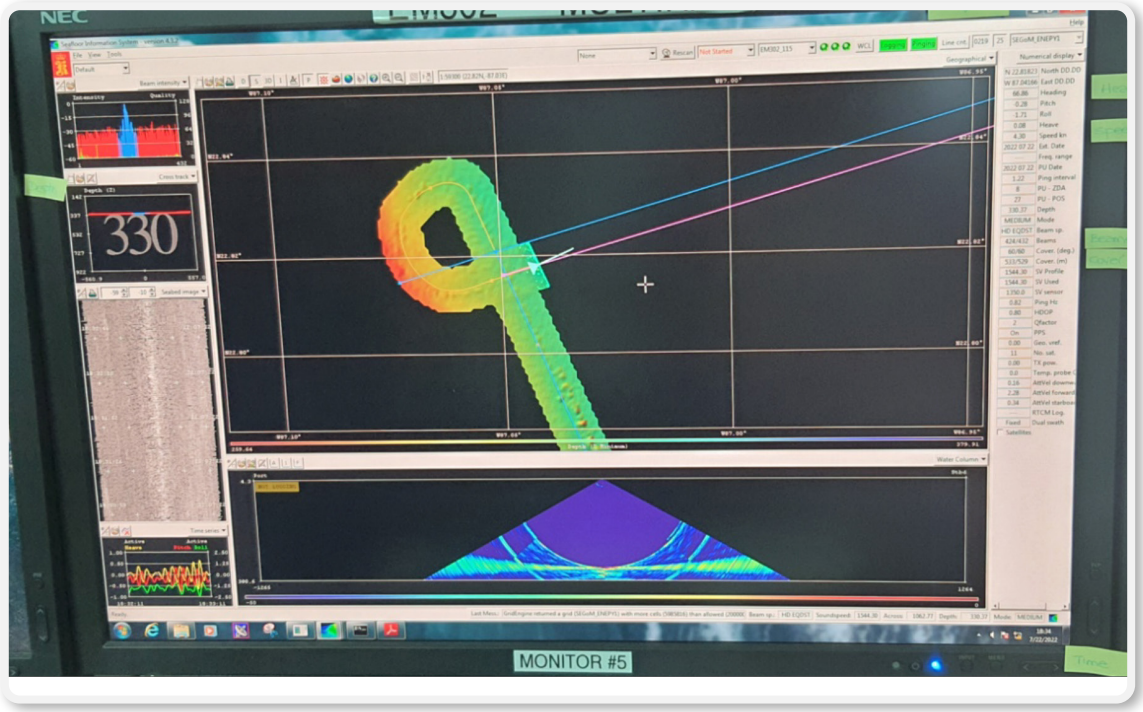


Figure 7 | *Bathymetric data acquisition.*

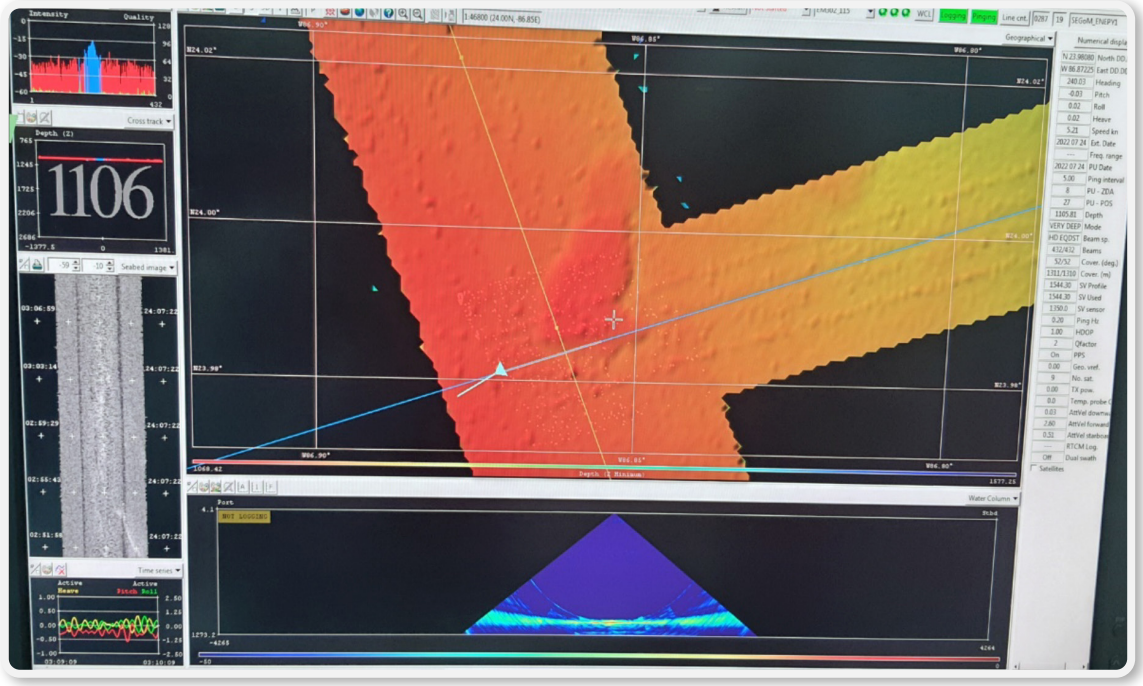


Figure 8 | *Bathymetric data acquisition overlapping only at lines crossings.*

In addition to the bathymetric survey with the MBES, sub-bottom profiler records were obtained with TOPAS at 18 kHz (Fig. 9).

Through an “external” trigger mode and a chirp pulse type (LMF) achieved a penetration of ~25 m below the seabed (Fig.10). At the beginning of the survey, the equipment presented very noisy data, probably due to the seismic source, however, by modifying and synchronize the parameters through the K-sync unit, the acquisition improved.

Figure 9 | *Acquisition of bathymetric data and TOPAS PS18 profiler same section.*

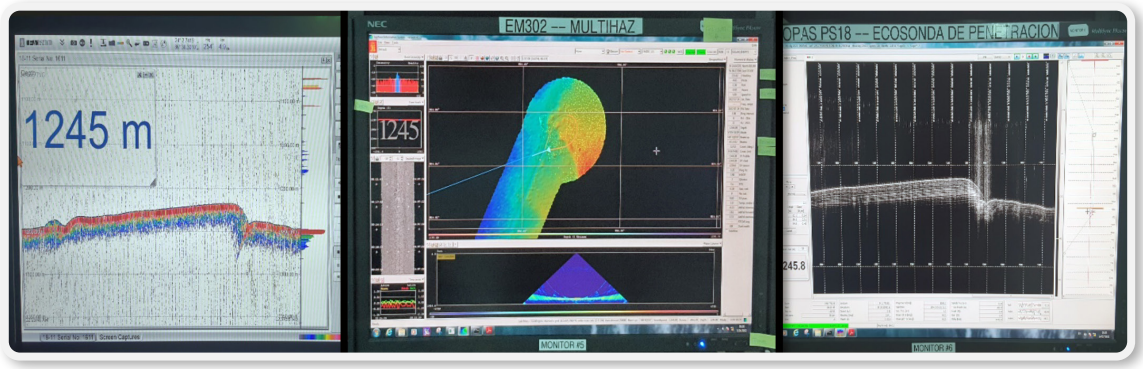
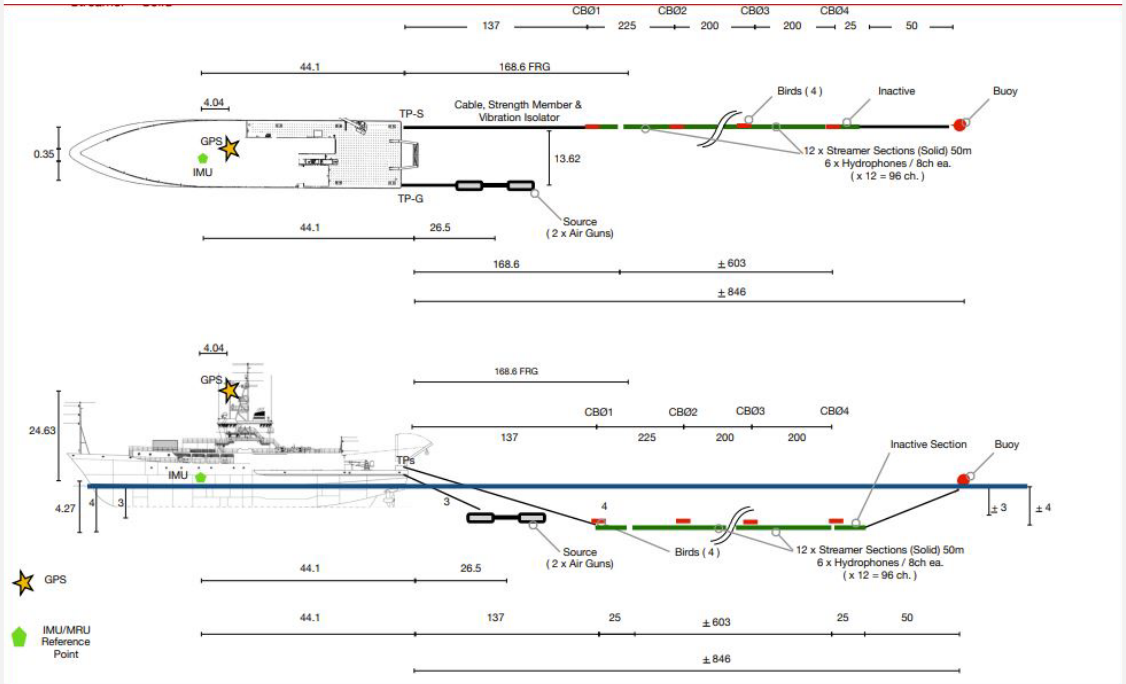


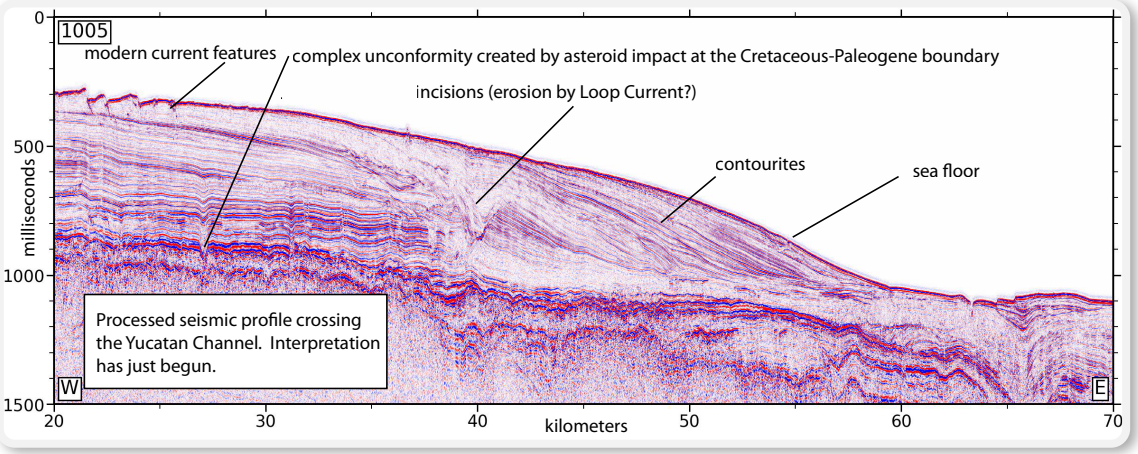
Figure 10 | Example of *bathymetric acquisition with the EA600 and EM302 MBES and TOPAS PS18.*

Next

The data will be processed by UNAM students using the Software Qimera ver 2.5, this will allow describing the main features in the area and their interpretation.



The Scripps Institution of Oceanography high-resolution multichannel seismic system. The imae data are acquired using small "generator-injector" (compressed) air guns, sending out energy to a 96-channel receiving system of hydrophones. The resulting data were of extremely high quality, because the weather was good through the survey, with minimal sea state.



Participants of the Cruise SE GOM-ENEPY1, on board of UNAM R/V “Justo Sierra”.

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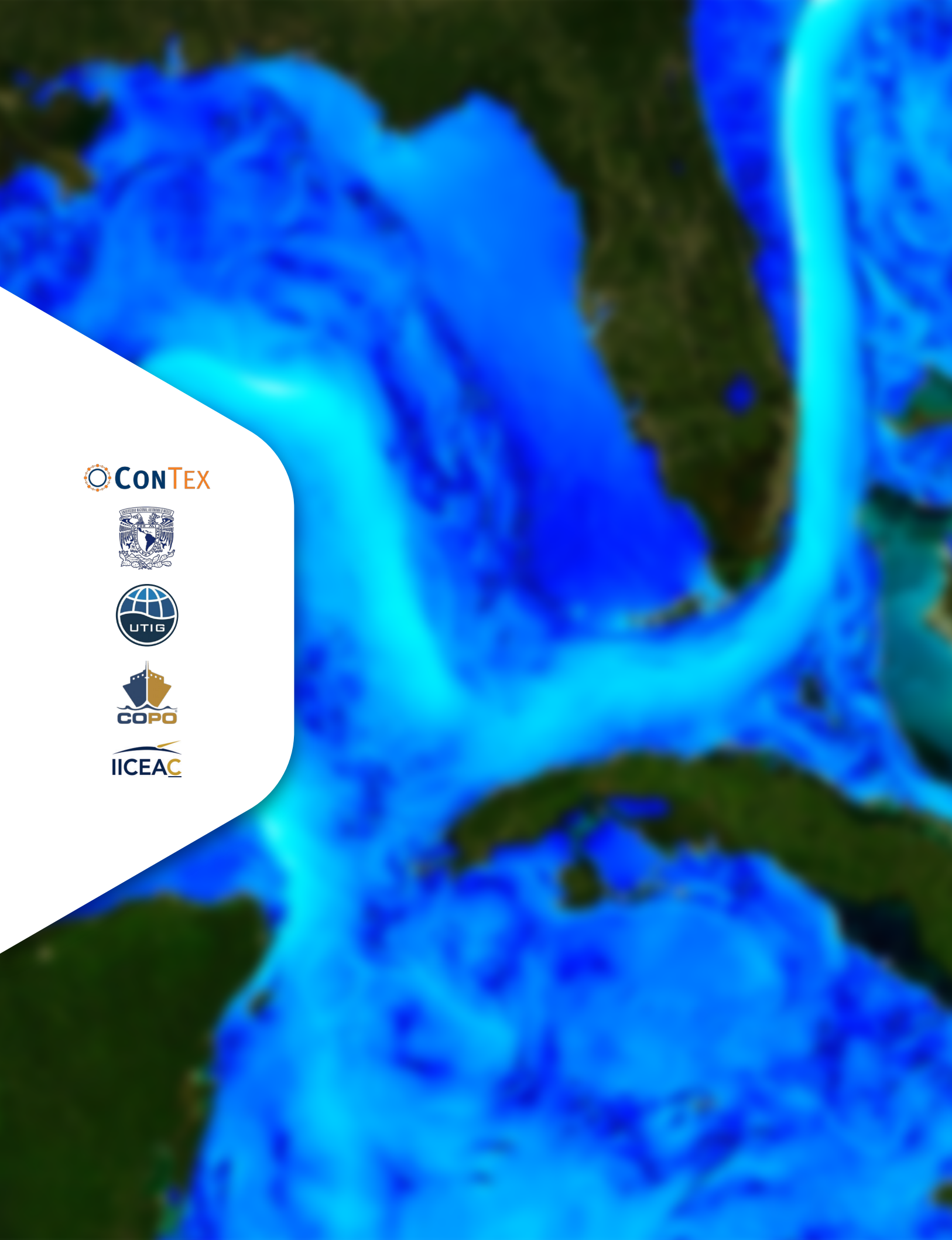
Of course, to Master David Calles Castillo and the R/V “Justo Sierra” crew for their support in completing the course of the cruise.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