Scholarship Completion Report July, 2024

Home Institution: Universidad Autónoma Metropolitana

Host Institute: University of Connecticut,

Supervisor: Prof. Dr. Heidi Dierssen

Visiting Period: 12-June to 7-August, 2023

Working Groups Interacted with at the Host Institute Coastal Ocean Laboratory for Optics and Remote Sensing (COLORS)

Title: Using Ocean color data to understand shrimp farms' water discharge in the coastal ecosystems of the Gulf of California.

Summary

The goal of the research project was to understand if it was possible to identify the effects of shrimp farms on the marine coastal zones of the e Gulf of California using remote sensing data obtained from the ocean color constellation from 2003 to 2022. For almost 20 years, this would allow a better understanding of how anthropogenic activities such as aquaculture or agricultural activities contribute to the nutrients, sediments, and other pollutants inputs into the coastal zone. This highlights that the Gulf of California is characterized by its high diversity of fish, crustaceans, and other organisms.

To achieve this goal, we evaluated both MODIS and composited ocean color data from the Ocean Colour Climate Change Initiative (CCI) compiled from 2003 to 2022. We focused initially on diffuse light attenuation (Kd490) to investigate changes in water clarity both from suspended material and phytoplankton (chlorophyll-a). Daily Kd_490 images at 1km resolution (CCI_ALL-v6.0-1km-DAILY) were downloaded from Ocean_Colour_CCI (Sathyendranath et al. 2021) derived using the Lee et al. 2005 approach. The CCI products are being used here because we wish to explore change in nearshore complex coastal waters where the POLYMER algorithm may provide less uncertainty in the atmospheric

correction. We have generated weekly and monthly averages for the product Kd_490 for the total region of the Gulf of California to explore both long-term changes over time related to climate and other environmental forcing and to explore potential changes in nearshore patterns related to the increase in shrimp farms along the coast.

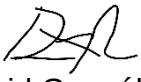
An important part of investigation involves evaluating patterns related to bathymetry and distance from the coast. Bathymetry data is from the General Bathymetric Chart of the Oceans (GEBCO) global gridded bathymetry. Distance to the coast was downloaded from NASA Ocean Biology Processing Group using the generic mapping tools package. From these two datasets, we are investigating how distances and coastal depths influence Kd_490 along the Gulf of California both in coastal and open ocean regions and also near shrimp ponds.

Since my return to Mexico, we have continued our collaboration and we have had near weekly meetings to discuss progress on the project. We have been working to evaluate how anthropogenic inputs from shrimps and agriculture can be statistically identified within the context of extremely high interannual variability in the Gulf of Mexico. The imagery reveals clear north-south and east-west changes in Kd490 related to ENSO and other climate forcing that make it challenging to isolate the smaller changes due to anthropogenic coastal development. These results will provide important insights on how to robustly identify environmental impacts of shrimp farming and other economic activities in the Gulf of California within a highly dynamic ecosystem using ocean color imagery.

We have presented our initial findings at the IOCS meeting in Florida in 2023 and will be presenting our new results at the Ocean Optics Conference in October 2024 in Las Palmas, Gran Canaria. We are also working on a draft manuscript of our results. Dr. Heidi Dierssen and the other members of the Lab COLORS have been providing me with valuable feedback, code, and approaches to process imagery and conduct spatial statistics.

For me it has been exciting all the learning and professional growth that I had during my stay in Connecticut working with the COLORS lab. I hope to contribute

to our understanding of the coastal ecosystems of the Gulf of California that currently few people in Mexico are working on. I am very thankful to Dr. Heidi Dierssen, her lab members, and all the people who granted me the Fellowship.



Dr. David González Rivas