Ocean Acidification in the Gulf of Mexico

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Cuba-Mexico-USA Ocean Observing Workshop
Havana, Cuba
8 July 2017
Outline

- What is Ocean Acidification
- Gulf of Mexico Ocean Acidification Research Cruise
- Global Response – join us?
What is ocean acidification?

The ocean absorbs ~27% of carbon dioxide emitted by industry and deforestation each year.

Climate change

Carbon Dioxide (CO₂)

Ocean acidification
Ocean Acidification Past & Future

Results from Ciais et al., 2013
Model from Dunne et al., 2013

\[ \Omega_{\text{arg}} = \text{availability of minerals for shell building} \]

NOAA GFDL ESM2M RCP 8.5 Model Output
Ocean Acidification Past & Future

NOAA GFDL ESM2M pH RCP 8.5 Model Output

Model from Dunne et al., 2013
Results from Ciais et al., 2013
Why OA Matters

US Commercial Fisheries

2013 US Landings Revenue

2013 GoM Total Landings ($1,000)

- Shrimp
  - White
  - Pink
  - Brown

- Shellfish
  - Oysters
  - Stone crab
  - Blue crab
  - Spiny lobster

- Menhaden

- Finfish

TOTAL: $936,660,000

$503M (54%)

$179M (19%)

$65M (7%)

$95M (10%)

$179M (19%)
Decadal Mean Landings Values

Decadal Mean Landings Values (Inflation Corrected to 2008)

2017 Gulf of Mexico OA Cruise

- July 18 – August 21
- US, Mexican and Cuban scientists
- [http://www.aoml.noaa.gov/ocd/gcc/GOMECC3](http://www.aoml.noaa.gov/ocd/gcc/GOMECC3)
- Both ocean chemistry and biological processes will be studied
More Details on Mexico...

- **Participants**
  - Daniel Pech – ECOSUR
  - Sharon Herzka - CICESE
  - Linda Barranco, UABC – Mexico
  - Gabrielle Cervantes, UABC – Mexico
    - Alkalinity, underway pH
  - Frank Hernandez - CICESE. Eggs and larvae
  - Lucio Loman, Ecosur – Mexico. Pteropods and other zooplankton

- **5 lines of 7-10 stations each plus 4 net tows on each line.**
  - 2 of these lines have been previously sampled by our Mexican colleagues for carbon parameters so we will be able to compare our data with theirs
  - The lines will also allow us to complete the data gap we have particularly in the southwest GOM. The last line in Mexican waters, in the Yucatan channel, will allow us to characterize the waters going into the GOM (through the loop current).
More Details on Cuba...

- Cuban observers on board:
  - Mr. Jorge Luis Viamontes from GEOCUBA (in Havana)
  - Dr. Alain Muñoz from CEAC (in Cienfuegos).

- 4 stations in Cuban waters in the Yucatan channel transect and another 4 in the Florida straits transect.

- In the transit between these two lines we will take underway samples every 3-4 hours. Parameters will include: T, S, O2, all 4 carbon parameters, nutrients, chl-a, CDOM, microbiology, ichtyoplankton, etc.
Global Response to OA...

“What you don’t measure, you cannot manage”
Track the chemical changes

- Temperature
- Salinity
- Pressure (depth)
- Oxygen
- OA specific #s
  - pH, pCO2, Alkalinity, Dissolved Inorganic Carbon
- Use those to calculate Mineral Saturation State

\[
\Omega_{phase} = \frac{\left[ Ca^{2+} \right] \left[ CO_3^{2-} \right]}{K_{sp,phase}^*}
\]
Track the Biological Changes

Geoduck Larvae

King Crab Larvae

Fish Larvae
In UN SDG context

<table>
<thead>
<tr>
<th>Goal 1</th>
<th>Goal 2</th>
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<tbody>
<tr>
<td><strong>OA conditions</strong></td>
<td><strong>Ecosystem response</strong></td>
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</table>
| **L1:** carbonate-system constraint, T, S, O, fluorescence, irradiance | SDG 14.3  
| **L2:** nutrients, bio-optics, transport, meteorology, trace metals... | **L2:** species; processes incl. growth, grazing & respiration  
| **L3:** capability-specific     | **L3:** capability-specific            |

**SDG 14.3**

WWW.GOAA-ON.Org
NEW GOA-ON Data Portal
www.GOAO-ON.org
Ocean Acidification Observing

• Buoys
• Ships
• New technologies
• Satellites
Calling all Gulf of Mexico PIs!
Northern GOM mooring
Observatorio Ciudad del Carmen
Puerto Morales
Self-Forming Regional Networks

North America
OA-Africa
LAOCA
Cristian Varghese, Chile
EU
WestPAC
South Pacific/Southern Ocean

- Deployed Mooring
- Planned Mooring
- Float/Pier/Time Series Station
- VOS/SOO Cruise
- Ship-Based Time Series/Hydrographic Cruise
Network of 370 scientists from 67 countries

Since 2013, network has doubled

New: Pier2Peer Mentorship Program
GOA-ON...as of 2013

Network of ~150 scientists from 31 countries

Data from validated 1st & 2nd GOA-ON workshop participant lists (Seattle, Washington 2012 and St. Andrews, UK 2013)

Excluding representatives of UN bodies
GOA-ON...as of June 2017

Data from www.goa-on.org current members list

Excluding representatives of UN bodies
Expanding Platforms

Ships, buoys, gliders
NEW low cost options for nearshore deployment

Recent training in Mauritius

Instrument deployed just offshore
**Mission:** A scientific mentorship program supporting the expansion of ocean acidification observing capacity through two way sharing and capacity building activities.

**Pier2Peer Activities**

- Professional Engagement
- Directed Lab Trainings
- Strengthen GOA-ON
IAEA Technical Cooperation project supporting GOA-ON
IAEA-GOAON INT project

- Carlos Manuel Alondo Hernandez
  - Laboratorio de Vigilancia Radiológica-Ambiental
  - Centro de Estudios Ambientales de Cienfuegos
  - Ministerio de Ciencia, Tecnologia y Medio Ambient
  - Cuba
We are testing some concepts but still many scientific questions...
Protect and Enhance Seagrass Beds

Manzello et al. 2012
Cultivate Tolerant Breeds

In US: Molluscan Broodstock Program @ Oregon State University
Questions?

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