

Integrated Coastal Management Initiative as a Measure of Adaptation to Climate Change.

Program sponsored by the
UN DECADE FOR THE OCEANS 2020-2030

ID:10

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RESILIENCE AND ADAPTATION

OBJECTIVES:

RECOVER

the environmental services
of the marine-coastal
ecosystems

1) coral reefs,

2) seagrasses,

3) beaches and dunes

in the Mexican Caribbean
affected by Climate change.

RESILIENCE AND ADAPTATION

An aerial photograph showing a wide beach completely covered in a thick layer of brown and orange Sargassum seaweed. The seaweed extends from the water's edge towards the shore. In the background, the blue ocean meets a clear sky with some light clouds. A few palm trees are visible on the left side of the frame.

**When impossible
to return to pristine conditions,
DETERMINE the measures
to be taken
to ADAPT to the
Climate change induced “NEW NORMALITY”**

BEACH AFFECTED BY SARGASSUM. Puerto Morelos, Riviera Maya

INSTITUTO DE CIENCIAS DEL MAR Y LIMNOLOGÍA (ICML), UNAM.

Multidisciplinary Consortium (Mexico)

Integrated Coastal Management
Climate Change adaptations,
Improvement of local communities standard of living.

Socialization and linking

- Ecotrinum (Logistic Coordination Systems, Environmental Education, Communication)
- Yóok'ol Kaab (International Linking, Divuligation, Funding Management Schemes).

Ecosystem restoration

- ICML (seagrasses, coral reefs)
- OCEANUS INTERNATIONAL (beaches, subaquatic parks)
- UAM/IGAM (Beach design)
- CEA, CRIAP-INAPESCA (corals, seagrasses)
- Ecotrinum (Coastal management, shelters)

Research and monitoring

- ICML (Seagrasses, Sargassum and Macrofauna, Oceanographic Data,)
- IG (GIS and satellite detection)
- CCA (Numerical modelling, H2S emissions and greenhouse gases)
- FC (Biology and ecology of Sargassum)
- FC-UMDI (Benthos mapping)
- UAM/IGAM (Coastal geomorphology)
- Yook'ol Kaab (Water quality and dynamics, Systematic monitoring)
- Terrasat (Aerial monitoring)
- IGeol (Sargassum composition)

Sargassum integral management

- Soltec (Technological design)
- GMM/SCPPP/CoopCA (Maritime and land operation)
- PIPA (Leachate treatment)
- II-UNAM, Tecnosilicatos (Collection, disposal and conversión, power generation)
- Beach Trotters (Boat and beach cleaning machine)

FIRST TASK

The *Sargassum* problem is holistically approached to find real solutions to a problem of unknown magnitude

study the massive *Sargassum* arrivals as an emblematic subject of the application of Integral Management to fight this huge plague

WHY?

- 1) Because they affect seriously the other coastal ecosystems we have: coral reefs, seagrasses, beaches and dunes. It was urgent to get involved in the solution of this plague first at the national then at the international level
- 2) No one knew what had hit us, its basic characteristics on this scale, and how it would evolve, what to expect.
- 3) Because it affects seriously our economy based on tourism.
- 4) Because we needed financing since the endorsement does not imply any

What are the
bases
for an
“integral
management”?

“of the coastal
zone”?

To take the problem from its origin and
fight it from there to the solution

In this case :

What is it and Where does it comes from?

Where does it go?

What happens when it reaches the shore?

What are its short and long term effects?

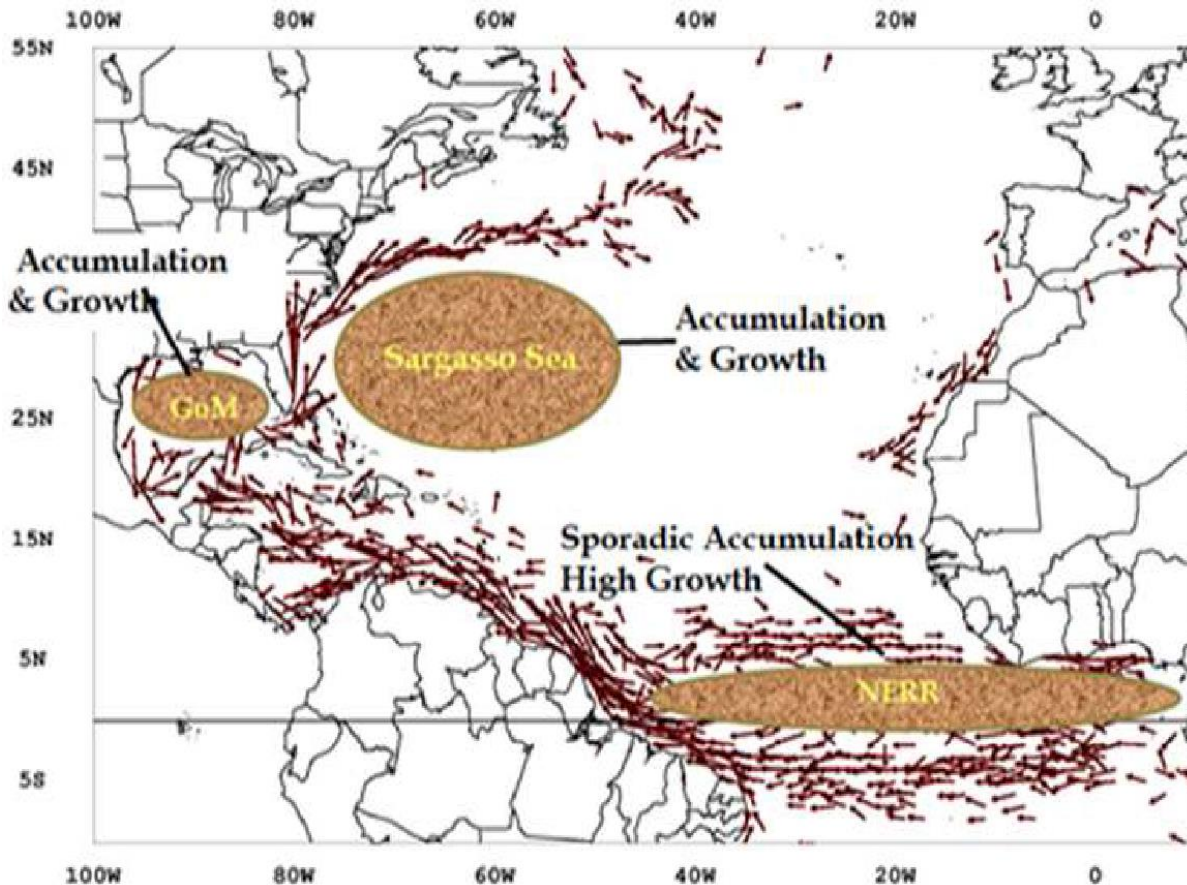
What can we do to stop the damage done?

What do we do with it, in the end?

WHAT IS IT AND WHERE DOES IT COMES FROM:

ORIGIN

Does It Originate with ...Global Climate Change?
(Wang et al 2019)



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HOW CAN WE DETECT IT WHEN IT APPROACHES OUR COASTS?

- **SATELLITE DETECTION**
- **SMALL PLANES**
- **HYDROSTATIC BALLOONS**
- **DRONES**
- **OBSERVATION FROM SHORE**
- **BUOYS IN THE SARGASSUM PATCHES**

With photos, videos and radio signals

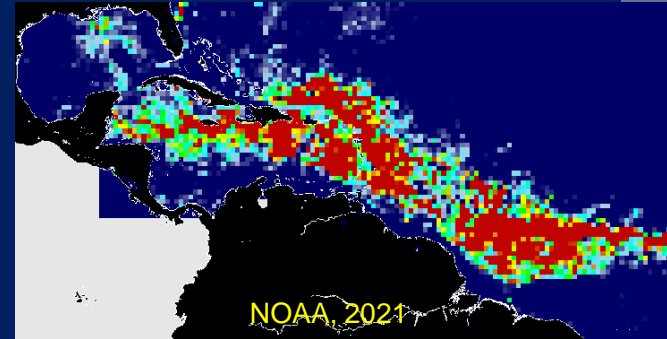
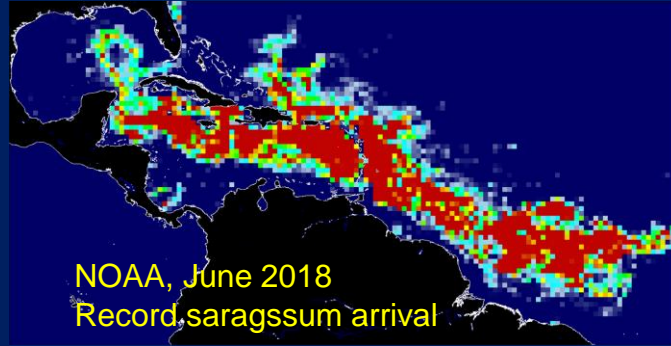
+ high computer power

**We can make very high resolution modelling,
to generate early warnings of its arrival.**

DETECTION AND EARLY WARNING

COLLECTING DATA IN HIGH SEAS

2) SMALL PLANES



1) SATELLITE IMAGING

3) DRONES



4) AEROSTATIC (HOT AIR)-BALLOONS from ships or shore

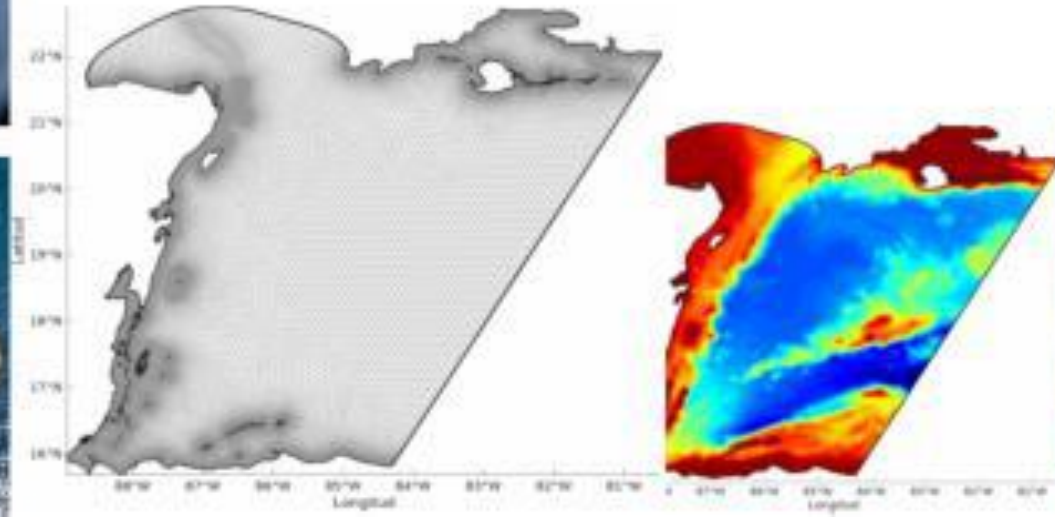


COLLECTING DATA CLOSE TO SHORE

STUDY OF CURRENTS AND TOPOHYDROGRAPHY



- Systematic satellite and aerial sargassum detection.
- 20 or 30 day early arrival warnings.
- Operational modeling for logistic coordination.

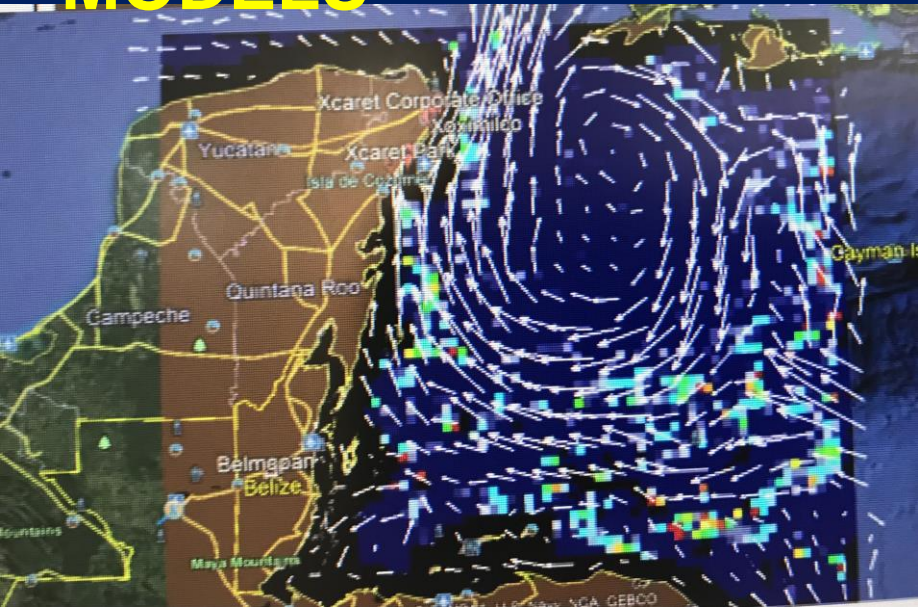


RESULTS IN EARLY WARNING

- **INSTITUTE OF GEOGRAPHY: SATELLITE DATA COMPILATION AND PROCESSING (Metadata), FORECASTING.**
- **ICML-UNAM: “SAMMO” REAL TIME DATA BASE DEVELOPED AND NESTED IN OUR INSTITUTE BRANCH OF THE CARIBBEAN. IT COLLECTS OCEANOGRAPHIC DATA FROM SEAWATER AND AIR.**
- **ATMOSPHERIC SCIENCE INSTITUTE: PHYSICAL MODELLING OF CLOSE TO SHORE WATER DYNAMICS (2 PhD THESE SO FAR), DETERMINES WHICH PATCH WILL CRUSH TO THE BEACH, WHICH WILL CONTINUE NORTHWARDS IN HIGH SEAS**
- **UAM: TOPOHYDROGRAPHY, CURRENT MODELLING**

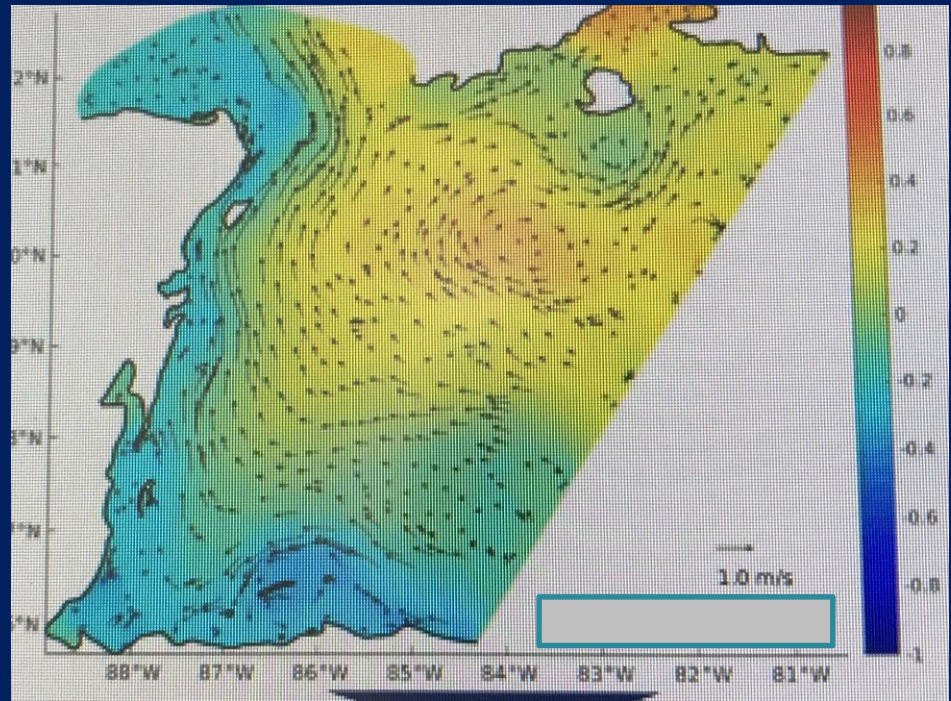
MATHEMATICAL MODELS

SOME RESULTS



UAM: TOPOHYDROGRAPHY,
CURRENT MODELLING

ATMOSPHERIC SCIENCE INSTITUTE: PHYSICAL MODELLING





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Where does it comes from?

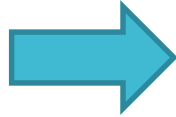
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SHORT AND LONG TERM EFFECTS

- ❖ TOURISM IS SEVERELY AFFECTED, ESTHETICALLY AND BY FOUL SMELLS RELEASED BY PRODUCTION OF H₂S WHEN IT ROTTS .
- ❖ TOXICITY FOR HUMANS, WHEN EXPOSED DAILY
- ❖ DAMAGE TO ELECTRONIC DEVICES ON LAND (H₂S)
- ❖ MASSIVE DEATHS OF SHALLOW MARINE ORGANISMS
 - i.e. FISHES, SEAGRASSES, TURTLES, CORALS...
- ❖ EROSION OF THE BEACHES
- ❖ REMOVAL OF SAND ADHERING TO THE PLANT
- ❖ INLAND POLLUTION BECAUSE THE SARGASSUM IS DISCARDED IN THE JUNGLE, CLANDESTINELY

Three complex problematics: Ecologic, economic, social.

40-75% is sand

EROSION



POLLUTION

TURBIDITY

MORTALITY



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COLLECT AT SEA



SINCE 2019

BARRIERS



SARGASSUM COLLECTOR BOATS

“SARGACERAS”

HAVE TO BE THERE ALSO

They collect and crush the sargassum



THEY COLLECT
CRUSH AND BAG THE SARGASSUM

**WHATEVER WE DO,
SOME SARGASSUM
WILL REACH THE
SHORE**

WHAT NOT TO DO



NO COLLECTING BY HAND



NOR WITH
HEAVY EQUIPEMENT



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CRUSHED
SARGASSUM



IN LAND, COLLECTION AND DISPOSAL OF 100% OF THE HARVESTED SARGASSUM.

- Processing of the collected sargassum.
- Retention of leachates
- Disposal of 100% at specialized collection centres.



RESIDUES

USE & RECYCLE

- Biodigestion.
- Biogas.
- Bio-fuel.
- Vitrification.
- Alginate compounds
- Building blocks
- Decoration (soaps to crafts, notebooks...)
- Other ideas for recycling



**AND THIS
COULD RESULT
IN RESILIENCE**

REHABILITATION OF CORALS, BEACHES AND DUNES.

- Scientific research and specialized monitoring.
- Ecosystem impact evaluation.
- Litoral ecosystem restoration.
- Evaluación of risks and climate change adaptation measures.



International context



HIGH LEVEL PANEL for
**A SUSTAINABLE
OCEAN ECONOMY**



**2021
2030** United Nations Decade
of Ocean Science
for Sustainable Development



United Nations
Educational, Scientific and
Cultural Organization



Intergovernmental
Oceanographic
Commission

UN-OCEANS

An interagency collaboration mechanism on ocean and coastal issues within the UN system



Thank you for your attention !

