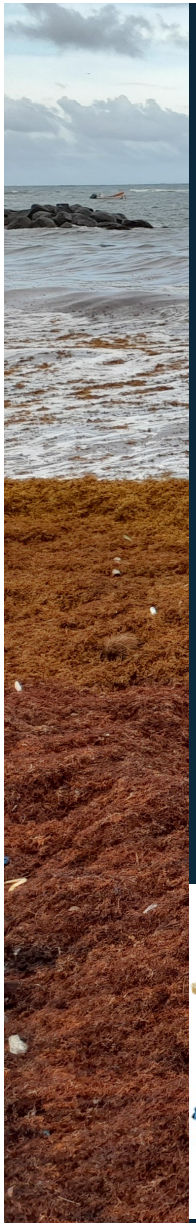


SARTRAC, MONISARG, SARCAP & SargSNAP!

3rd UWI Sargassum Symposium 2023

Bob Marsh & colleagues

10 March 2023

UNIVERSITY OF GHANA

THE UNIVERSITY OF THE WEST INDIES
AT MONA, JAMAICA

MGI BLUE COASTAL DYNAMICS MODELLING LABORATORY

CERMES UWI

UNIVERSITY of York

UNIVERSITY OF Southampton

MGI BLUE COASTAL DYNAMICS MODELLING LABORATORY

THE UNIVERSITY OF THE WEST INDIES AT MONA, JAMAICA

Prof Mona Webber (Biology)

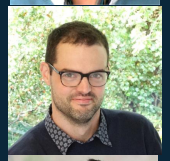
Dr Ava Maxam (Oceanography)

+ many others!

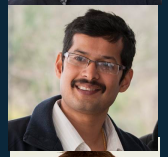
Romario Anderson (MGI)
Dr Winnie Sowah & Bernice Oppong (U. Ghana)

UNIVERSITY OF Southampton

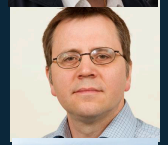
Prof Emma Tompkins (Geography)



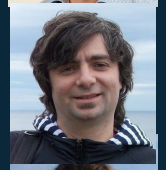
Prof Jack Corbett (Politics)



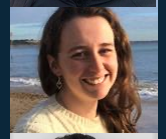
Prof Jadu Dash (Remote Sensing)



Prof Bob Marsh (Oceanography)



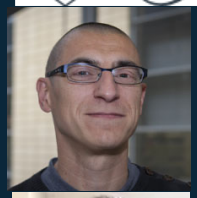
Dr Niko Skliris (Oceanography)



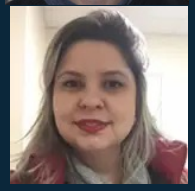
Dr Sien van der Plank (Environmental Man.)

Dr Subi Bandopadhyay (Remote Sensing)

UNIVERSITY of York



Dr Thierry Tonon (Biology)



Dcarla Machado (Biology)

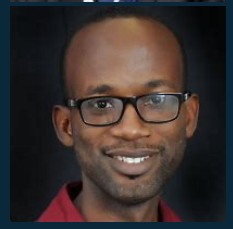
SARTRAC

Dr Vicky Rodgriguez Almela (Marine Biology)

+Lucy, Sarah, others!

UNIVERSITY OF GHANA

Prof Kwasi Appeaning Addo



Dr Philip-Neri Jayson-Quashigah

(Marine science, Coastal Geomorphology, Remote Sensing)

+ many others!

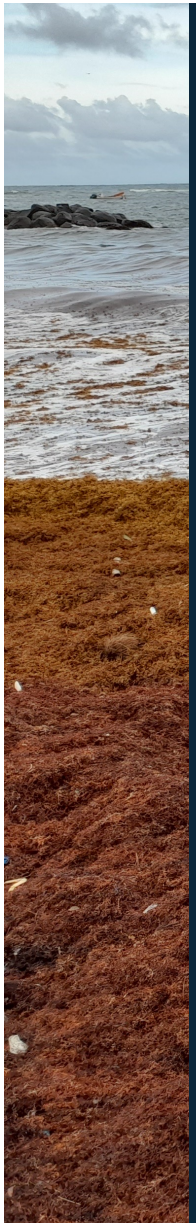
CERMES UWI

THE UNIVERSITY OF THE WEST INDIES AT CAVE HILL, BARBADOS

Dr Janice Cumberbatch (Environmental Management)

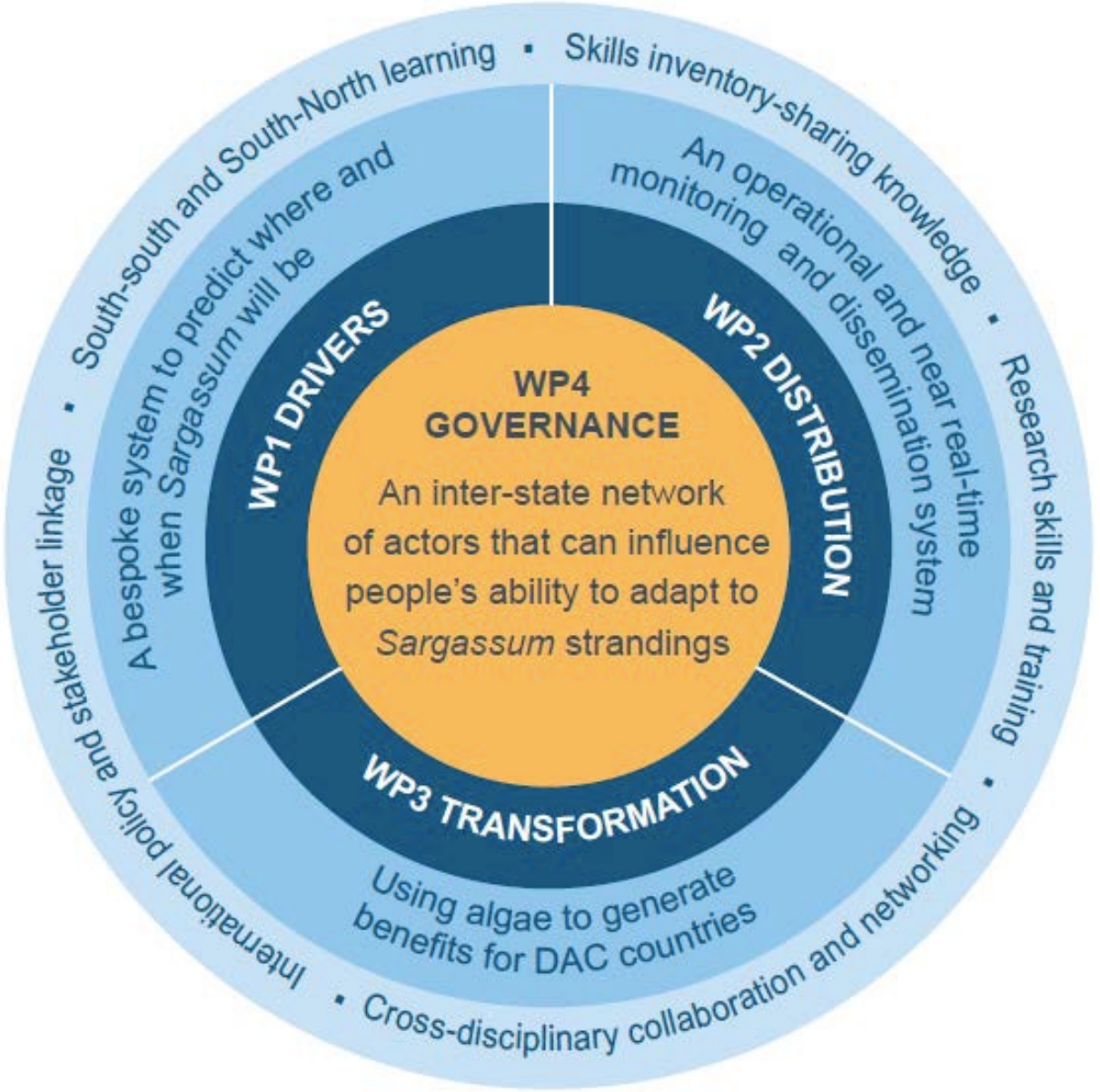
Prof Hazel Oxenford (Fisheries Science, Ecology)

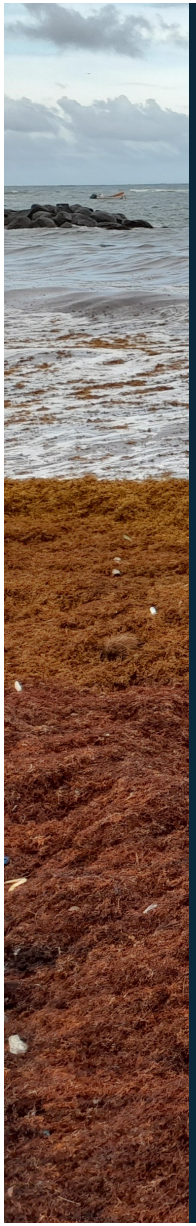
+ many others!



SARTRAC

- Organisation in four Work Packages
- Started Nov 2019, ending Sep 2023
- Funded by UK Economic & Social Research Council
- Annual Consortium Meetings, virtually held, July 2020-22
- In-person meetings & fieldwork:
  Barbados (Mar 22, 23)
  Ghana (Jun 22; Jan 23)
  UK (end Mar 23)





WP1: The SARTRAC Ensemble Forecast System (SARTRAC-EFS, Marsh et al. 2021)

(1) access and download AFAI maps

Input: AFAI maps (Central Atlantic, E. Caribbean, Jamaica, Gulf of Guinea)

Method: Matlab scripts for downloading image files, for selected days

(2) allocate particles in proportion to AFAI

Method: Matlab script for merging 1-km AFAI datasets, allocated to ORCA12 model gridcells; Fortran programme for translating AFAI data as numbers of (10 m^2) particles, distributed across ORCA12 gridcells

(3) run ensemble of 23 drift calculations, per hindcast year, with selected windage

Method: Ariane software, using namelist files (with % windage specified) to read selected hindcast data, providing currents and winds for moving particles from initial positions, over 90/180 days

(4) post-process particle data, with or without source/sink terms

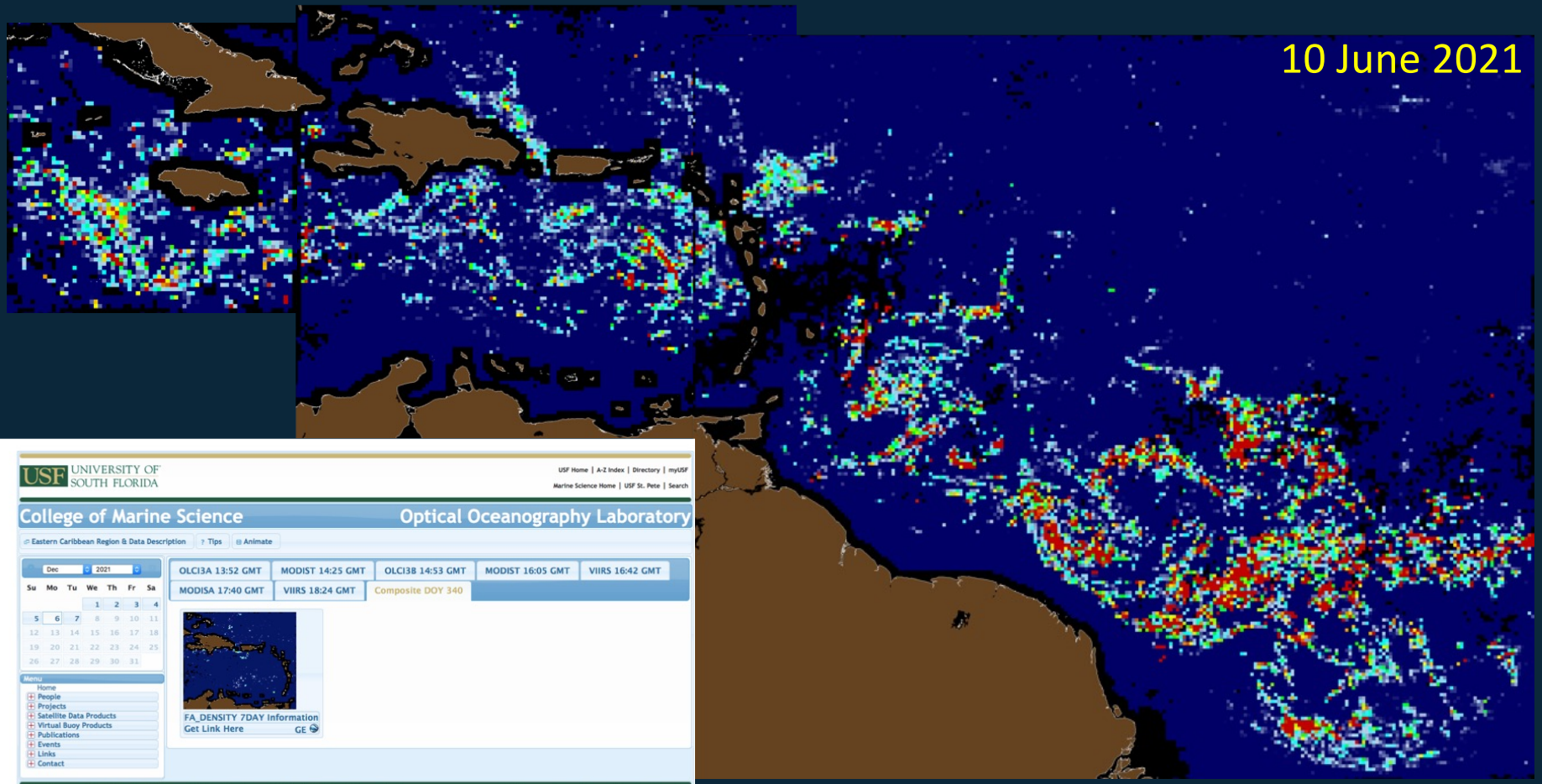
Method: Fortran programme for post-processing ensemble members, optionally altering area attributed to each particle according to source/sink terms, aggregating particle data in selected coastal regions

(5) prepare forecast graphics and data for sharing with stakeholders

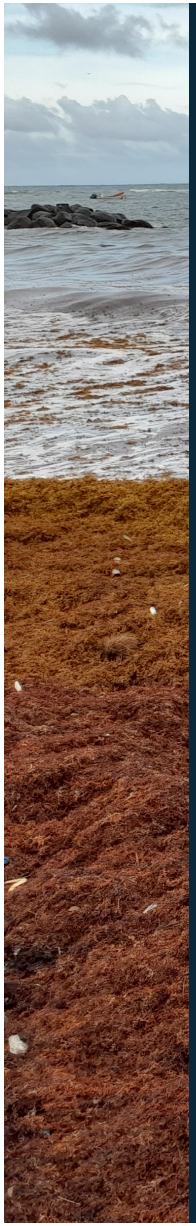
Method: Matlab scripts for plotting time slices of inferred AFAI, and for time series of total *Sargassum* area, for selected coastal regions

Output: Forecasts of Sargassum (location, timing by amount)

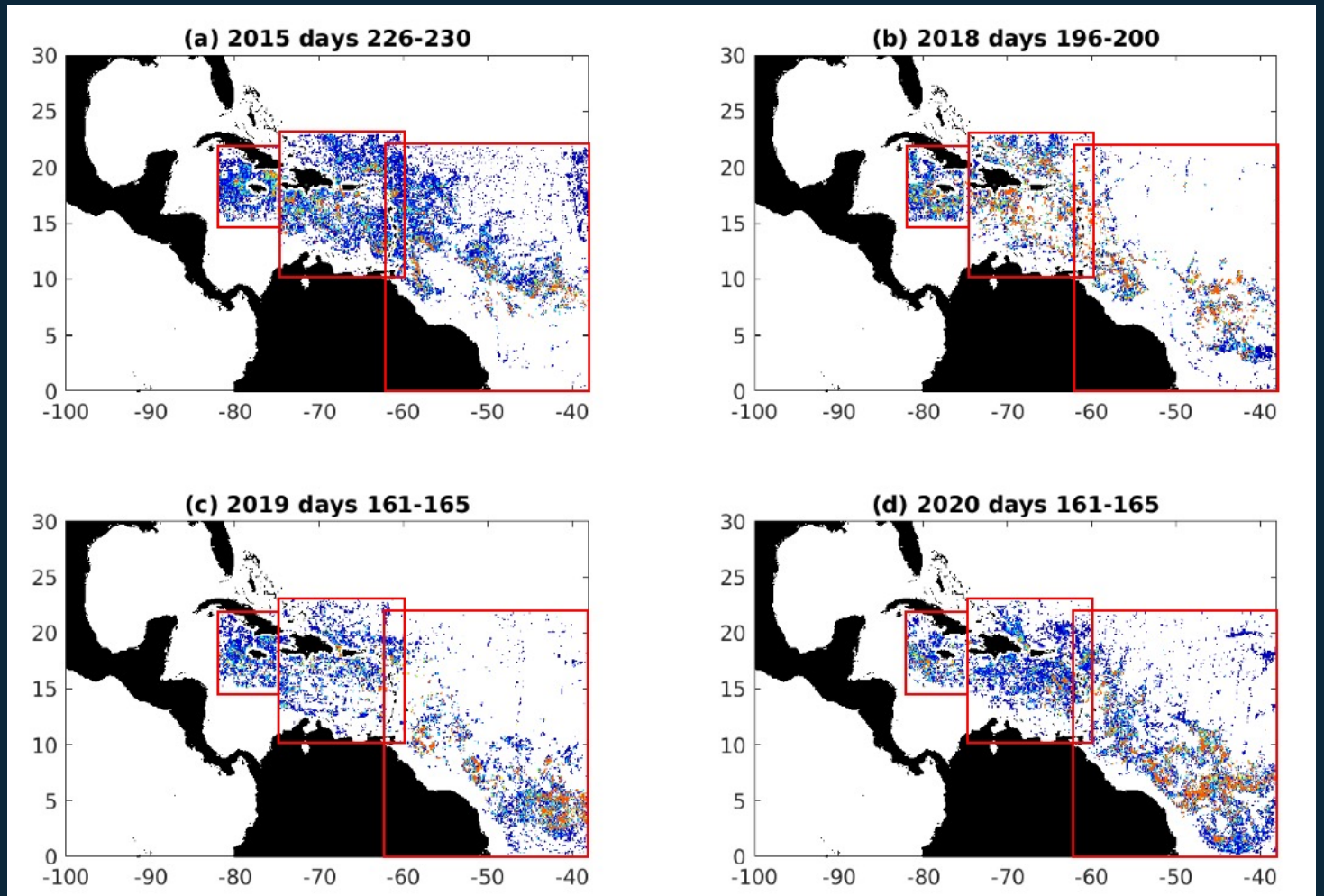
(1) Access satellite data



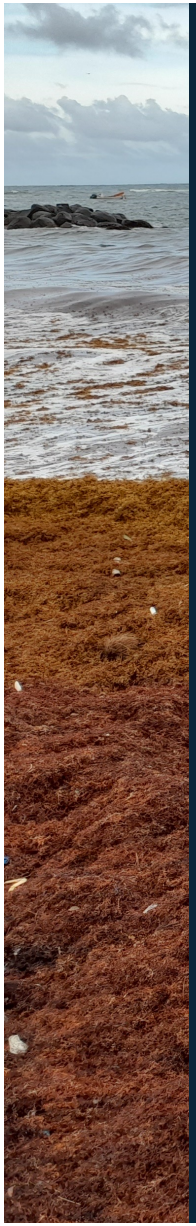
https://optics.marine.usf.edu



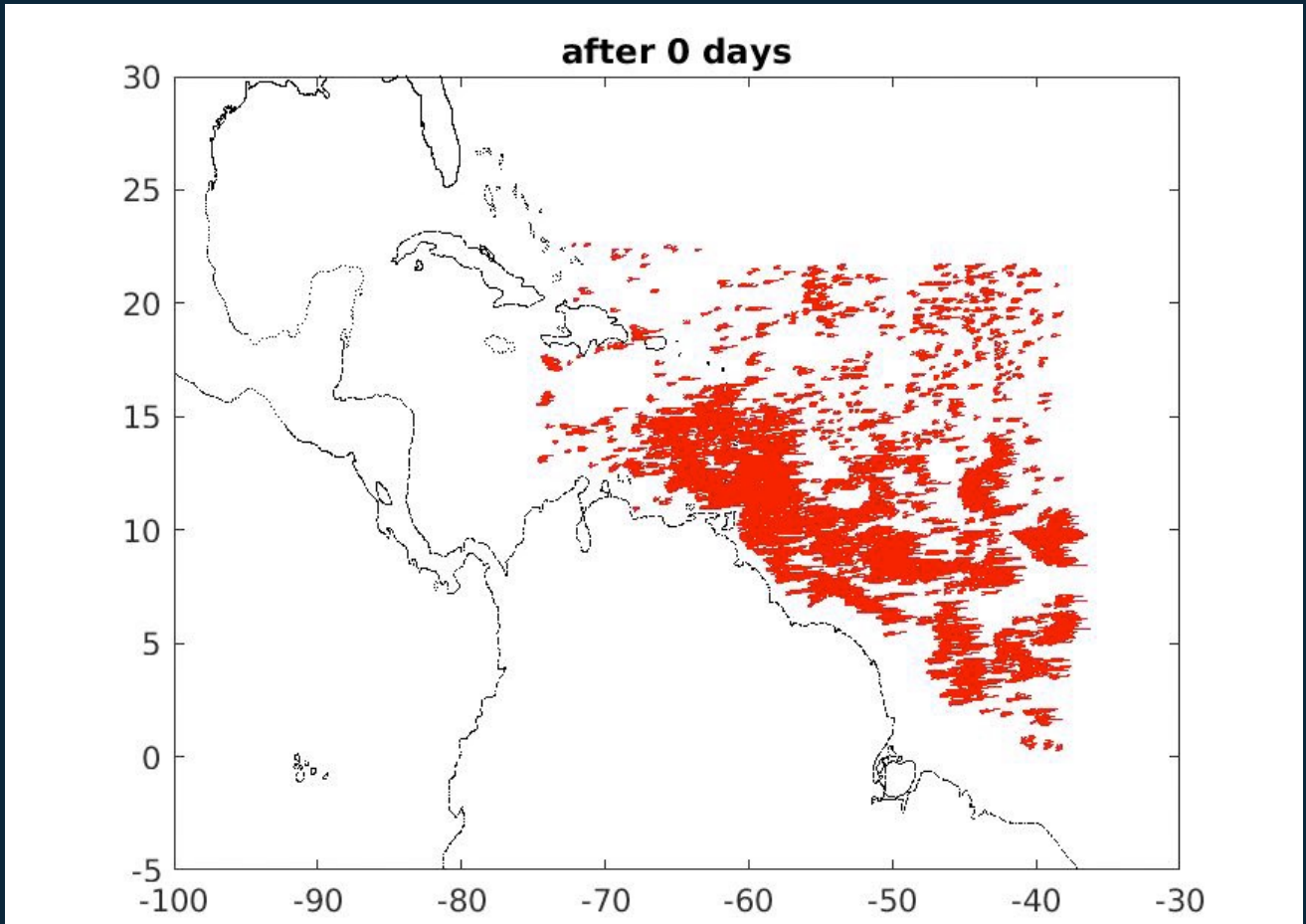
(2) Initialize ‘particles’



Allocate particles in proportion to gridded FAI data

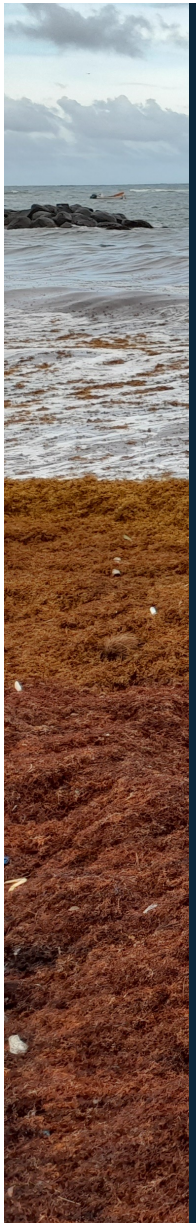


(3) Track the particles forwards

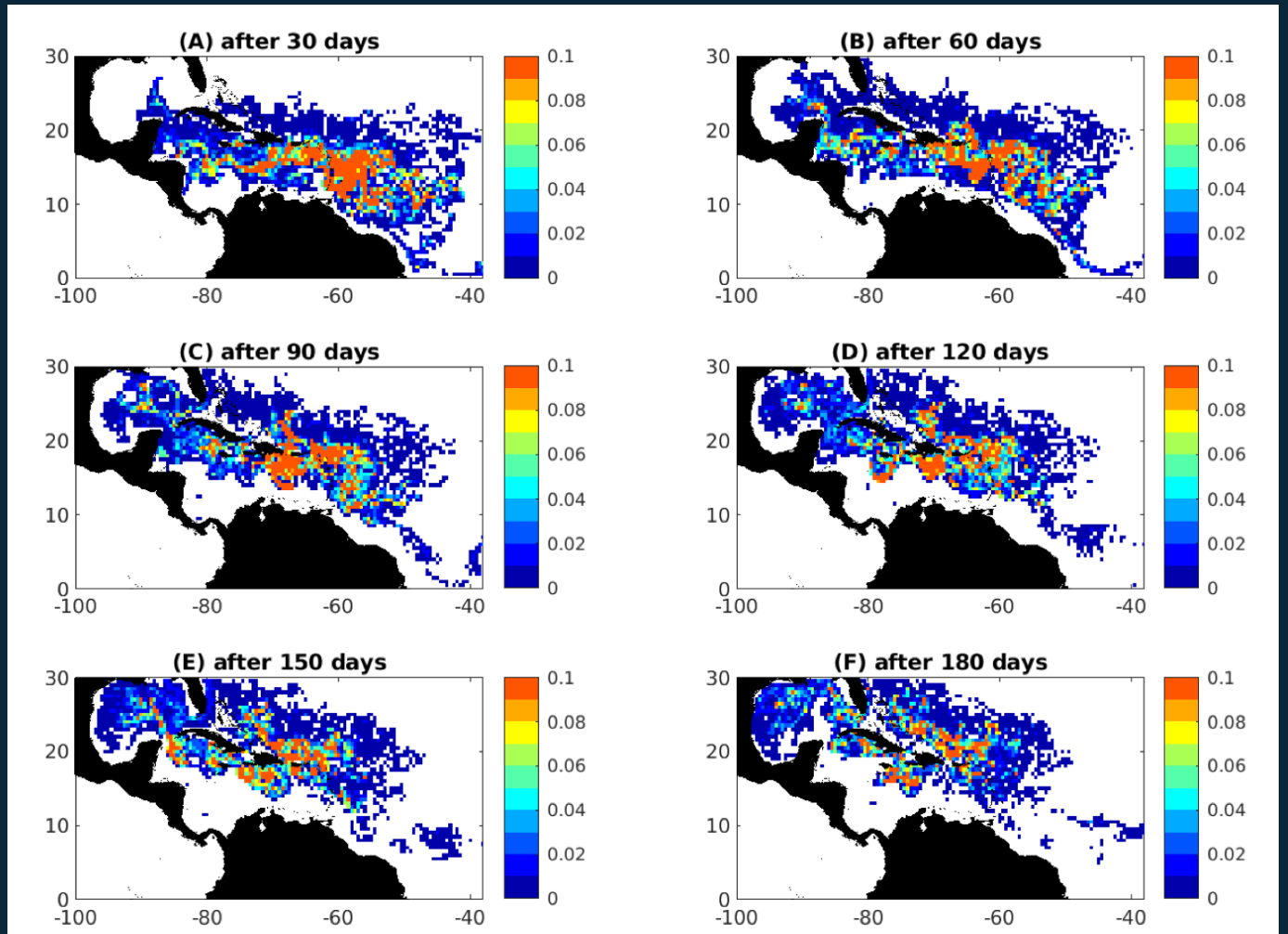


Particle tracking with ‘hindcast’ surface currents and winds to compute offline particle trajectories

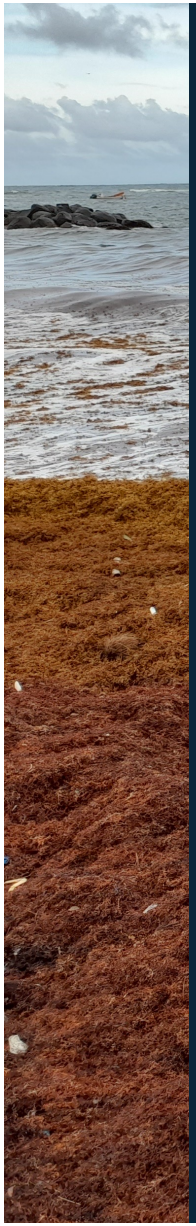
- e.g., 21 March 2020 distribution tracked with ocean currents for 95 days (1996 hindcast)
- using 1,139,428 particles



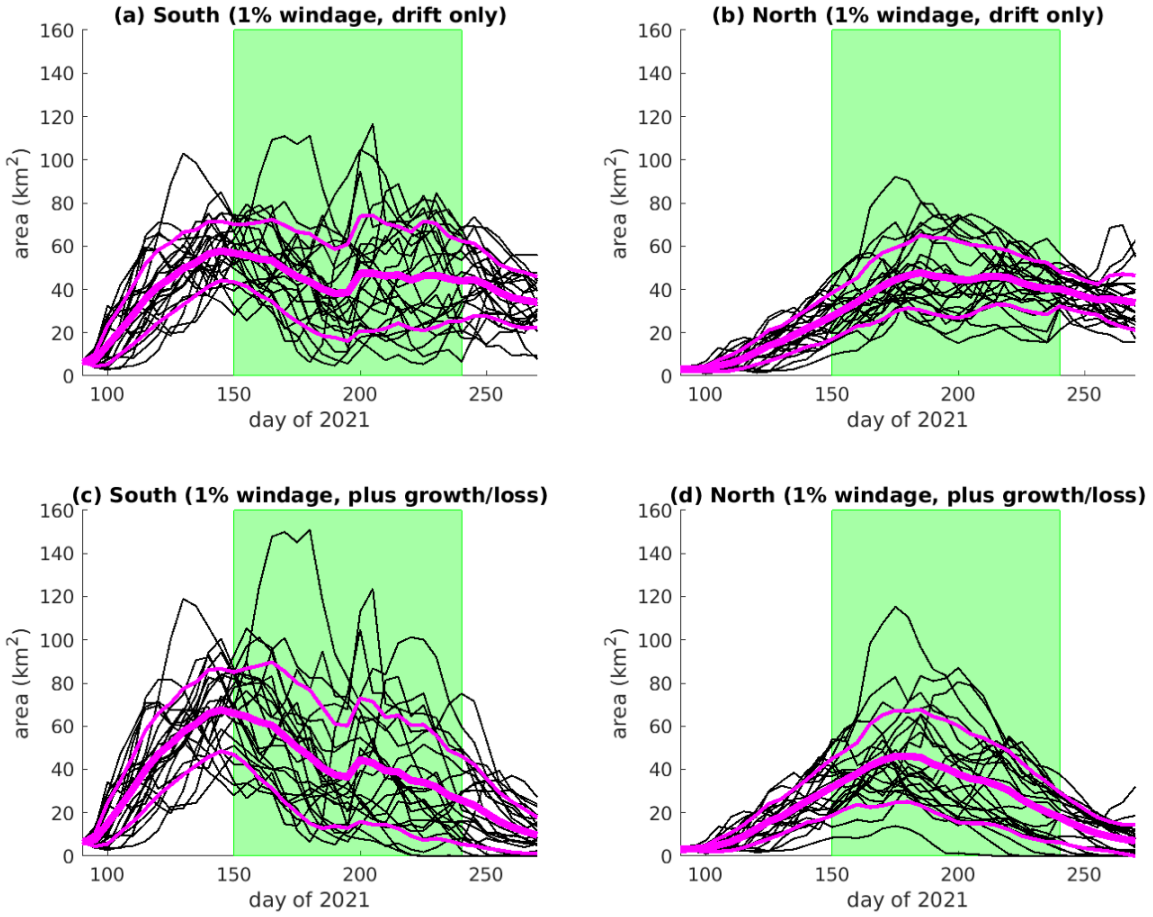
(4) Grid particle trajectory data



Post-process particle data to obtain fractional coverage (%) on 50-km grid

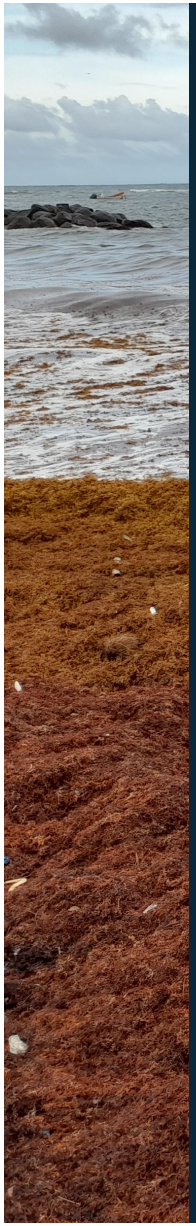


(5) Prepare forecasts – e.g., Jamaica, 2021



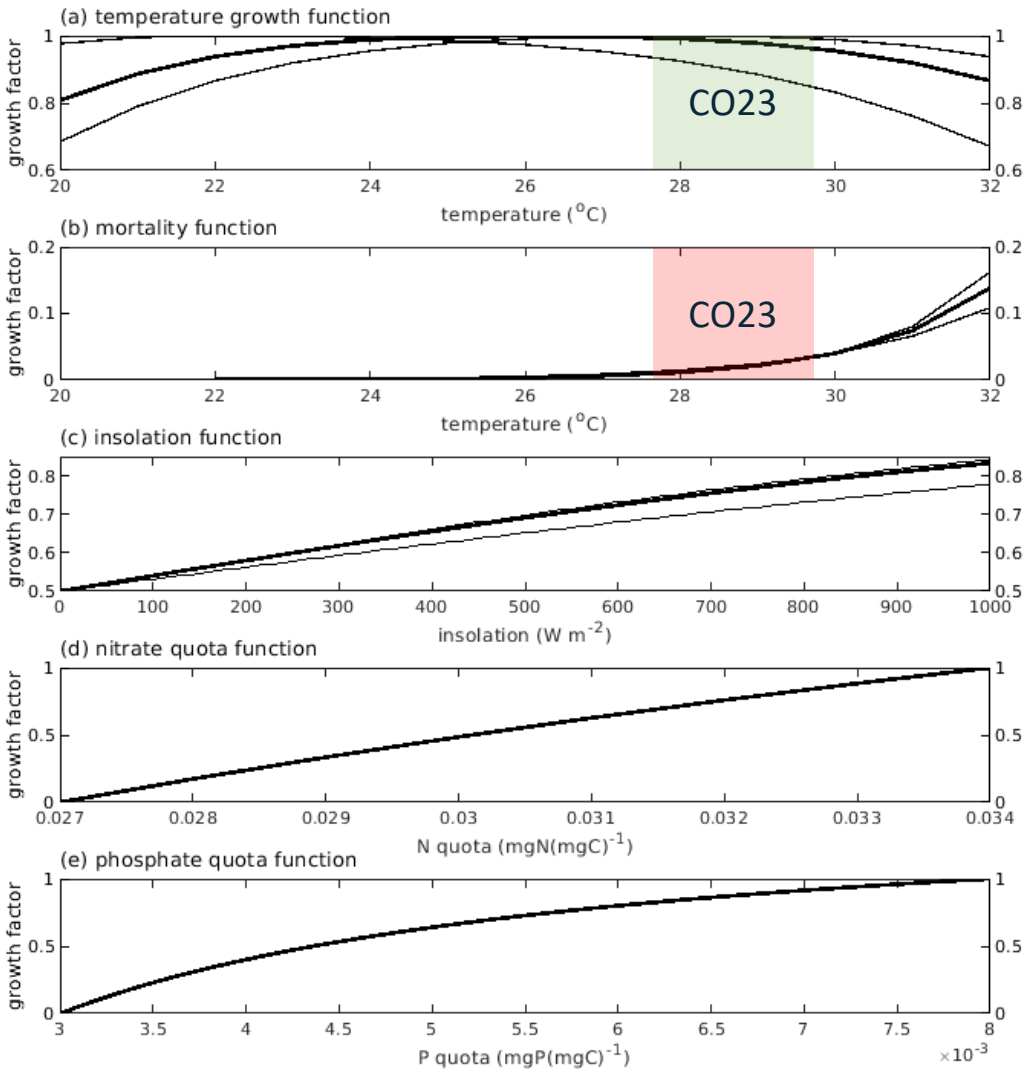
Forecast total area of sargassum in selected locations

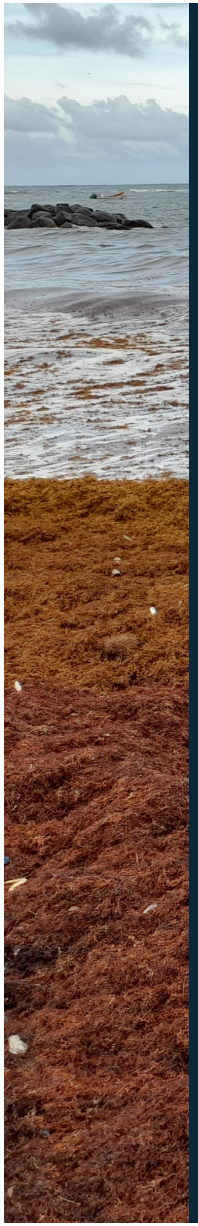
e.g., South (a,c) and North (b,d) of Jamaica for April-September 2021, assuming 1% 'windage' and drift only (a,b), including growth & loss factors (c,d)



Existing biological functions

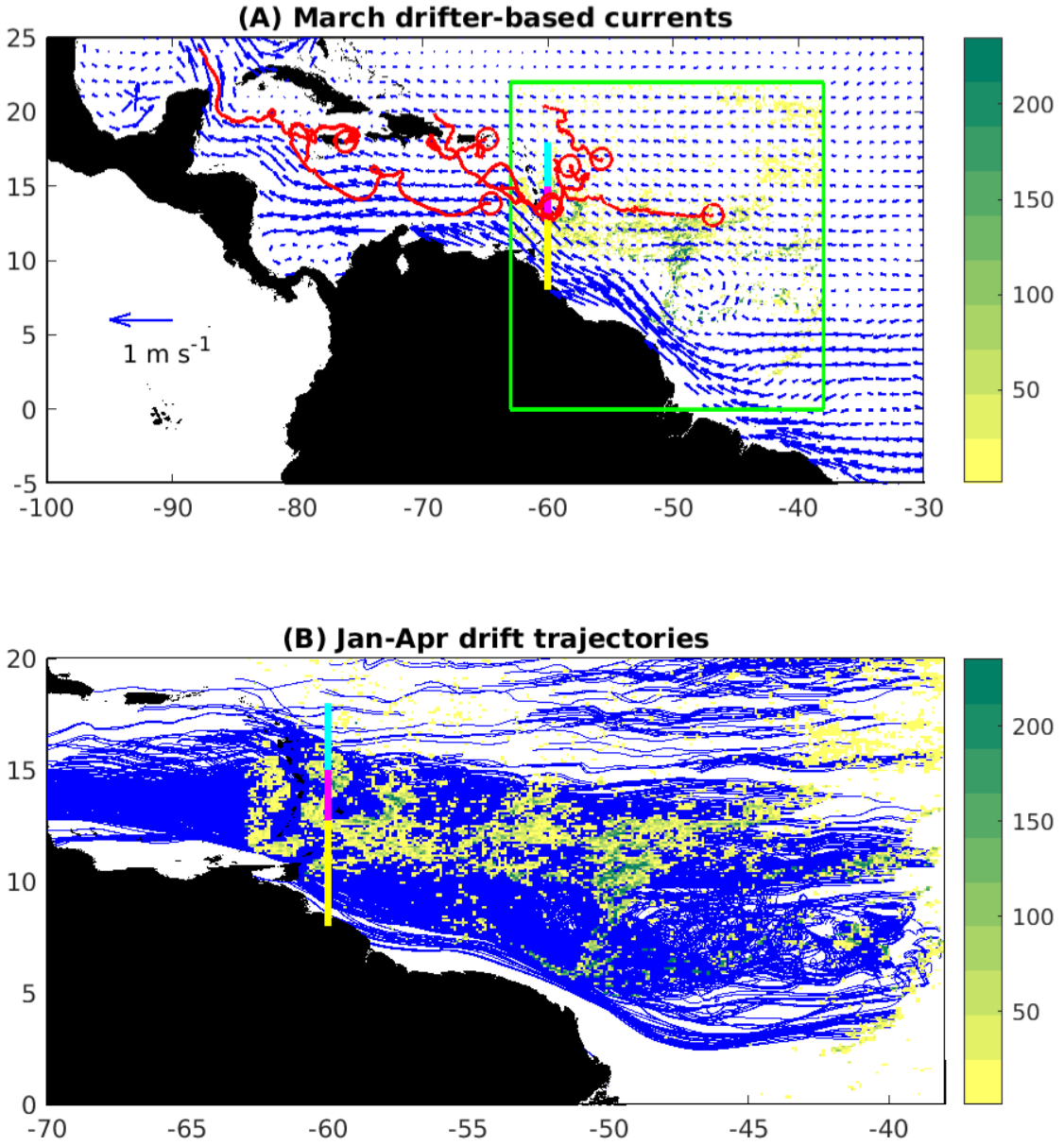
- Temperature dependence of growth and mortality
- Growth also depends on availability of light, nitrate and phosphate
- These functions, used in some forecasts (only temperature dependence in SARTRAC-EFS)
- Probably (very) incorrect for ‘new’ sargassum! (see Corbin & Oxenford, 2023)

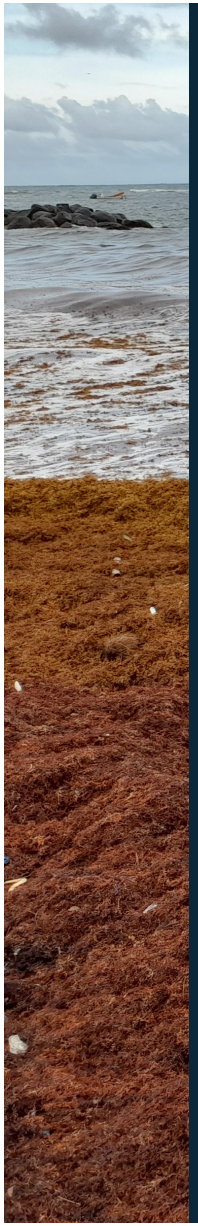




Alternative drifter-based forecasts

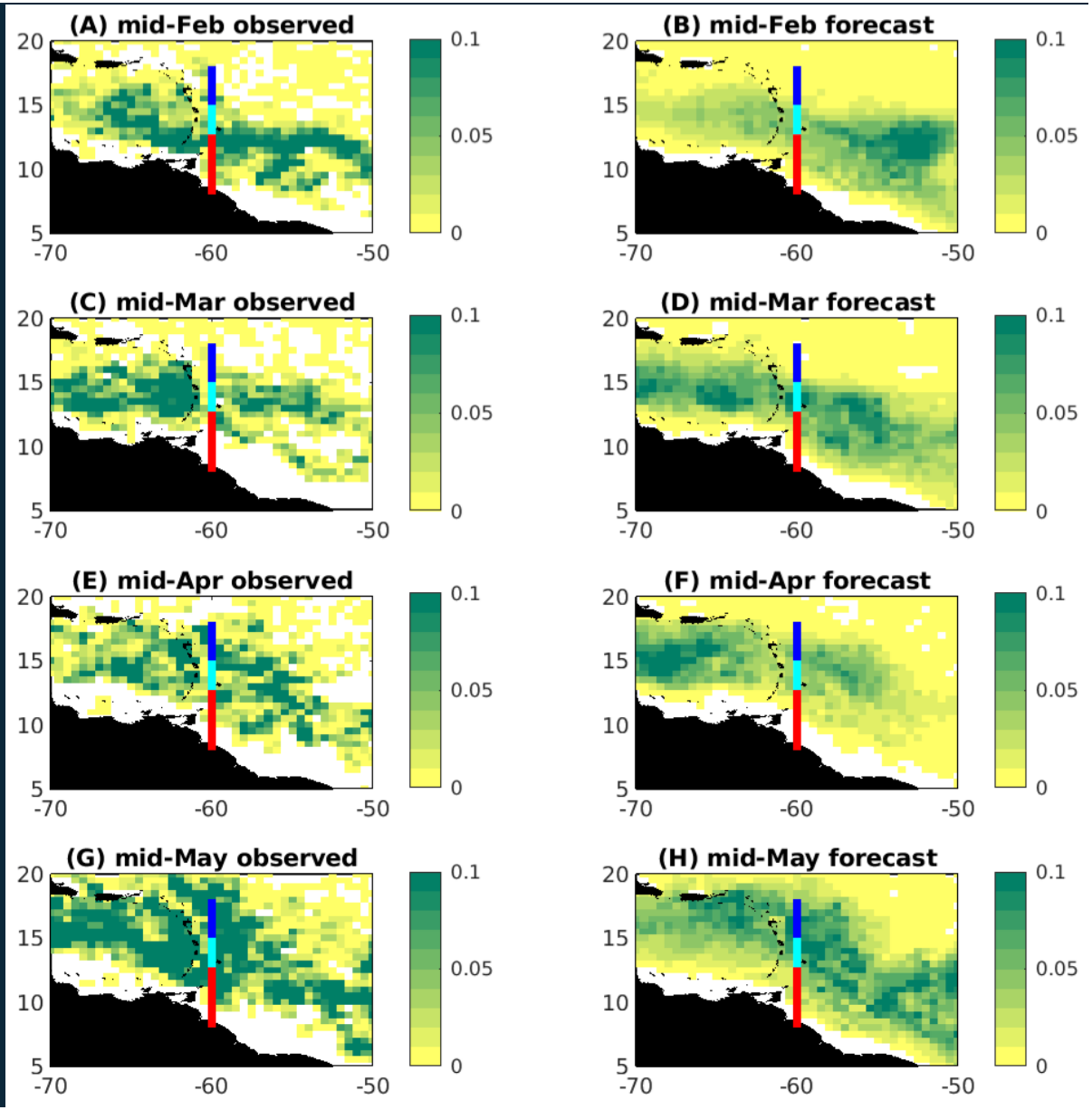
- Gridded currents based on Global Drifter Program data (upper panel)
- Used to track sargassum identified in satellite images (lower panel)
- Providing quarterly seasonal forecasts
- As issued in *Sargassum Sub-Regional Outlook Bulletin* (CERMES, UWI)

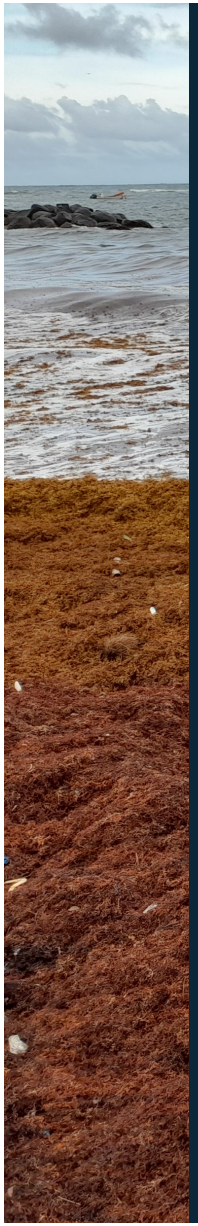




Challenging SARTRAC-EFS

- Adopt sub-regional focus of *Outlook Bulletin*
- SARTRAC-EFS forecasts (right panels)
- Evaluated with USF Floating Algae Index data (left panels)
- Forecasts ‘smooth out’ observations
- Much scope for forecast refinement!
- Marsh et al. (2022) Front. Mar. Sci.

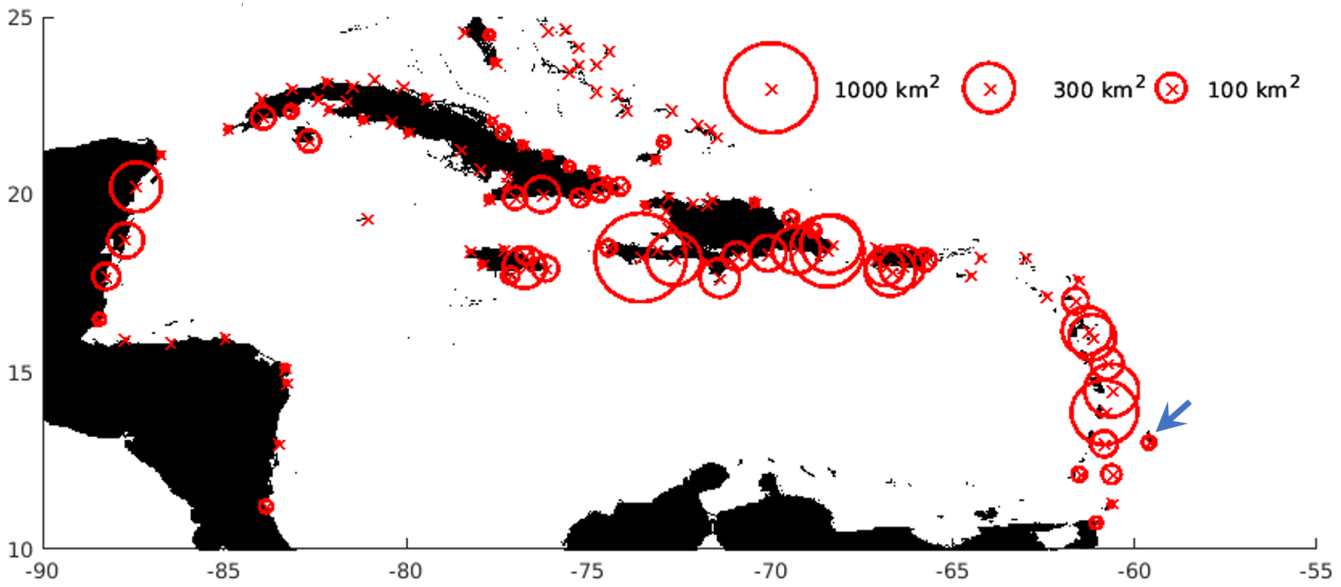




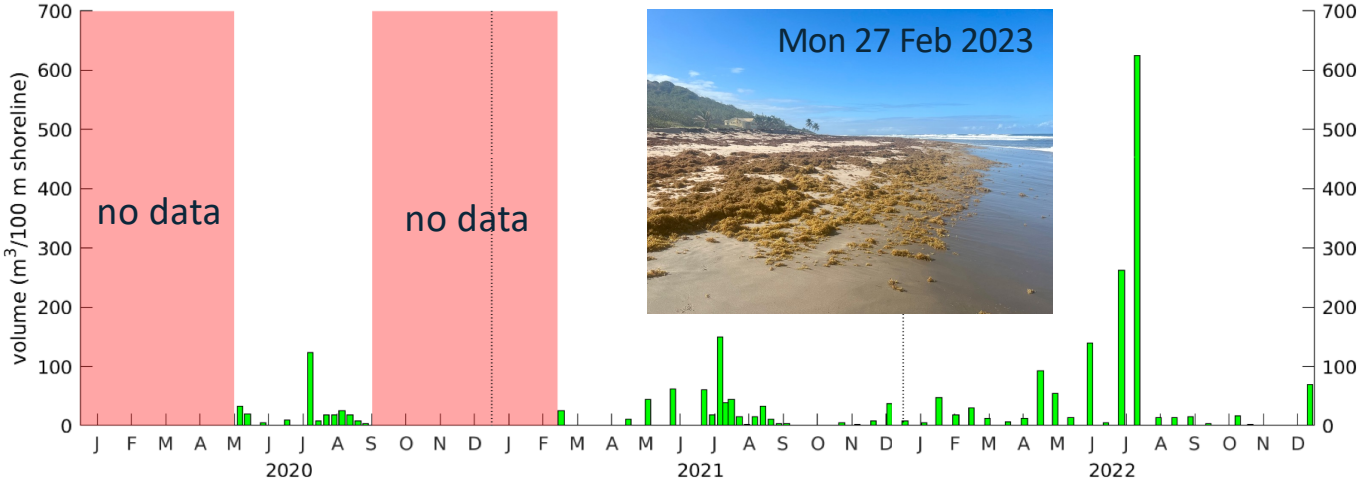
Variable beaching

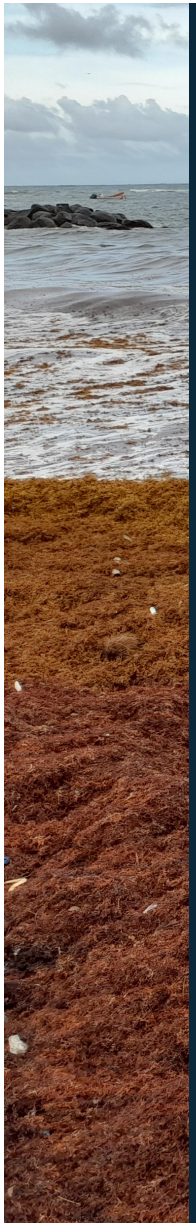
- Across region: variations between locations
- Depending on exposure to prevailing winds and currents
- Locally: variations week to week, year to year
- Depending on variable winds, currents, etc.

(a) annual beached area of sargassum, for 127 selected locations



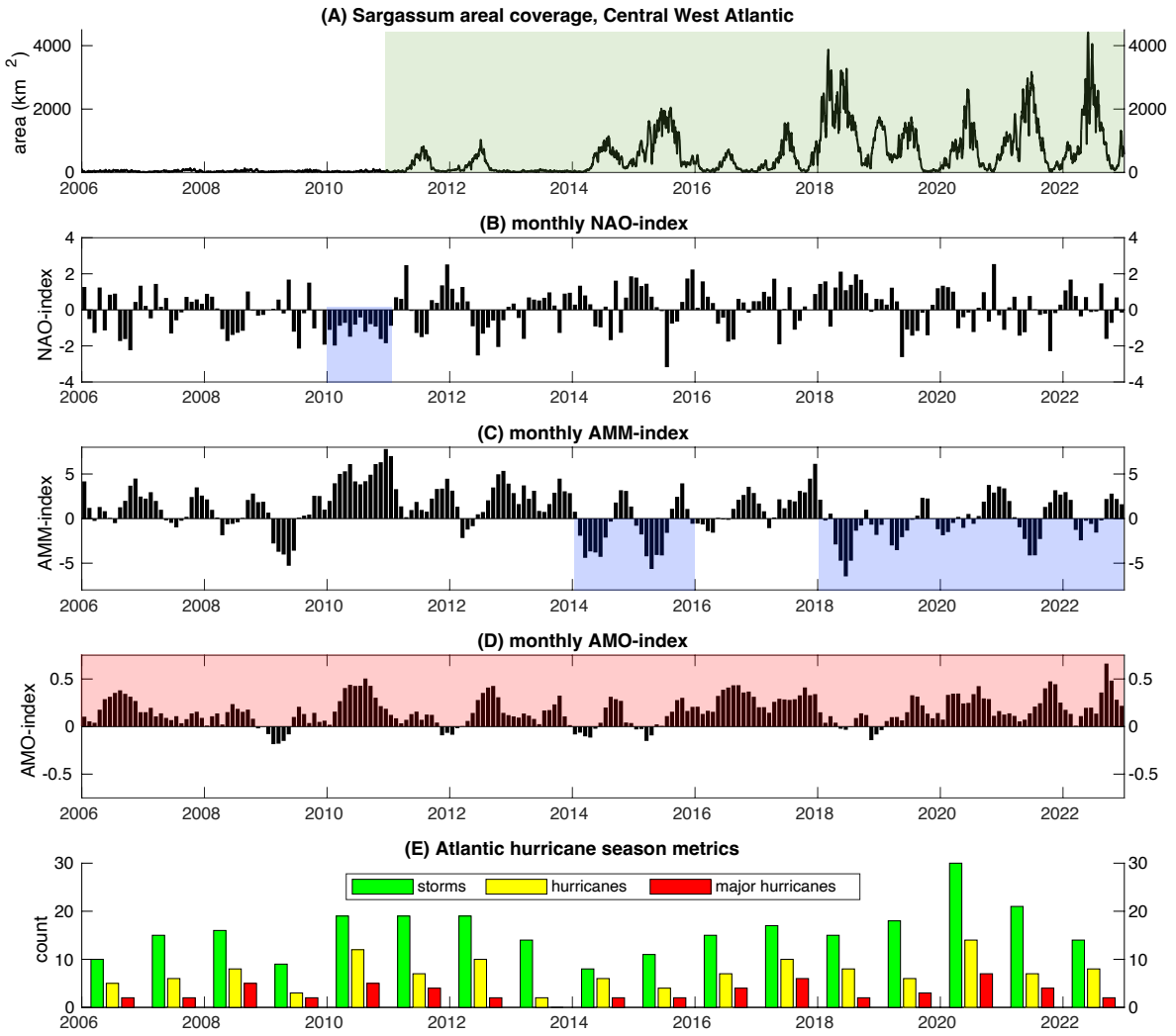
(b) Walker's Beach surveys, 2020-2022

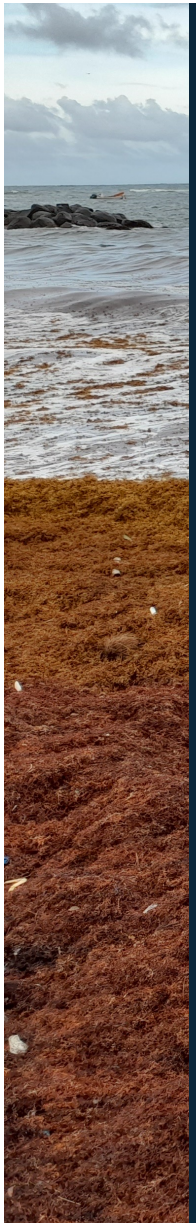




Physical drivers (1)

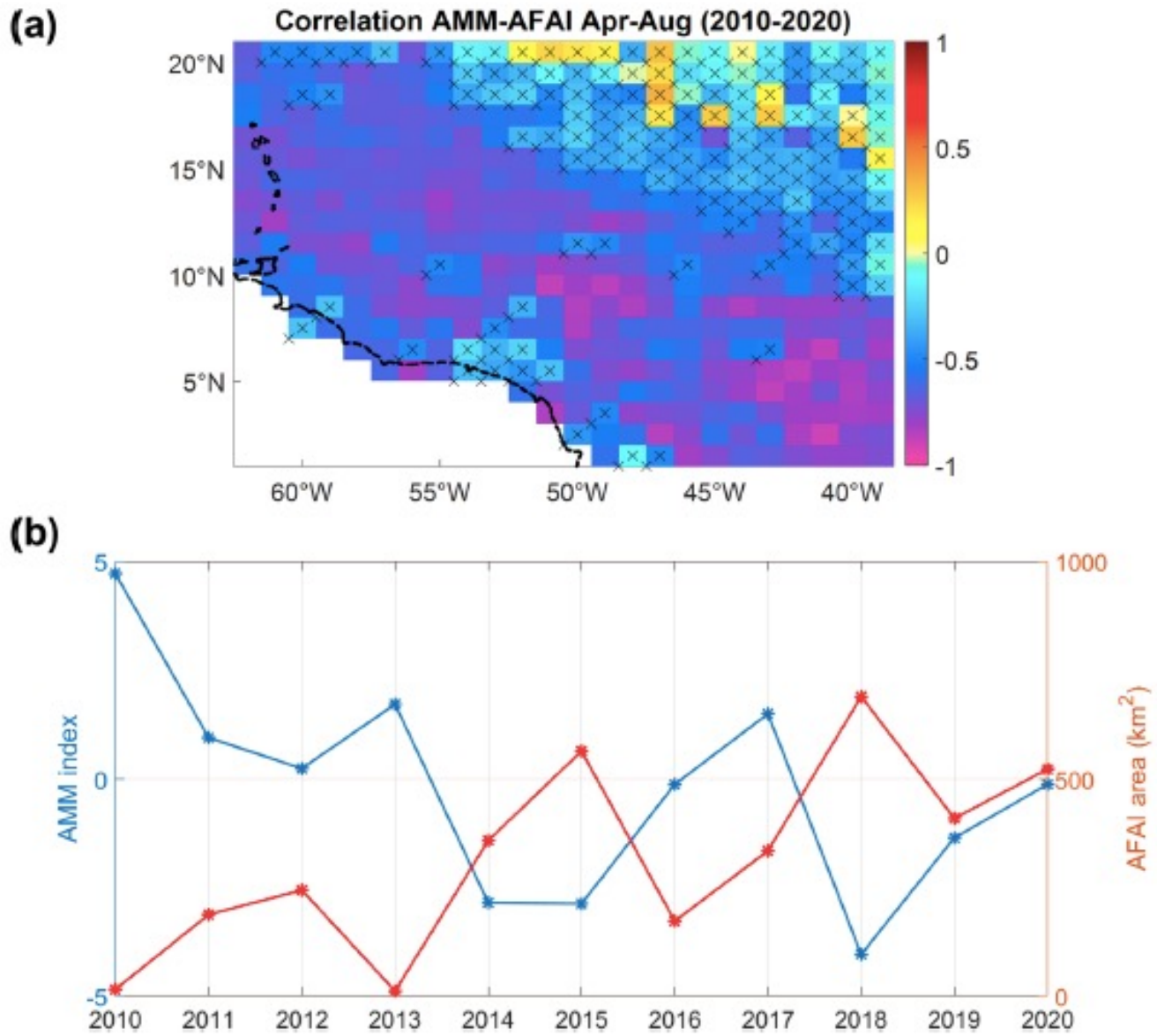
- NAO: negative phase triggered 2011 bloom
- AMM: negative phases enhance sargassum
- AMO: positive phase (warmth) may also favour growth
- Hurricanes: active season may enhance sargassum in the subsequent season

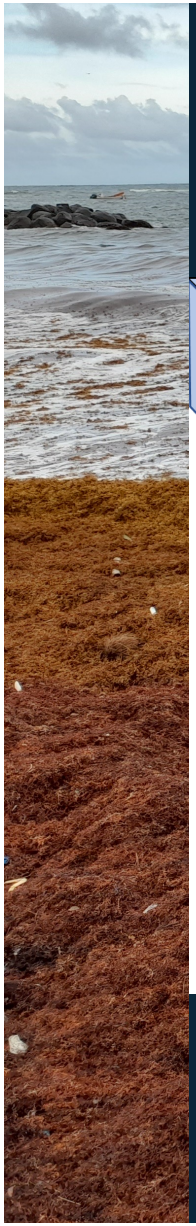




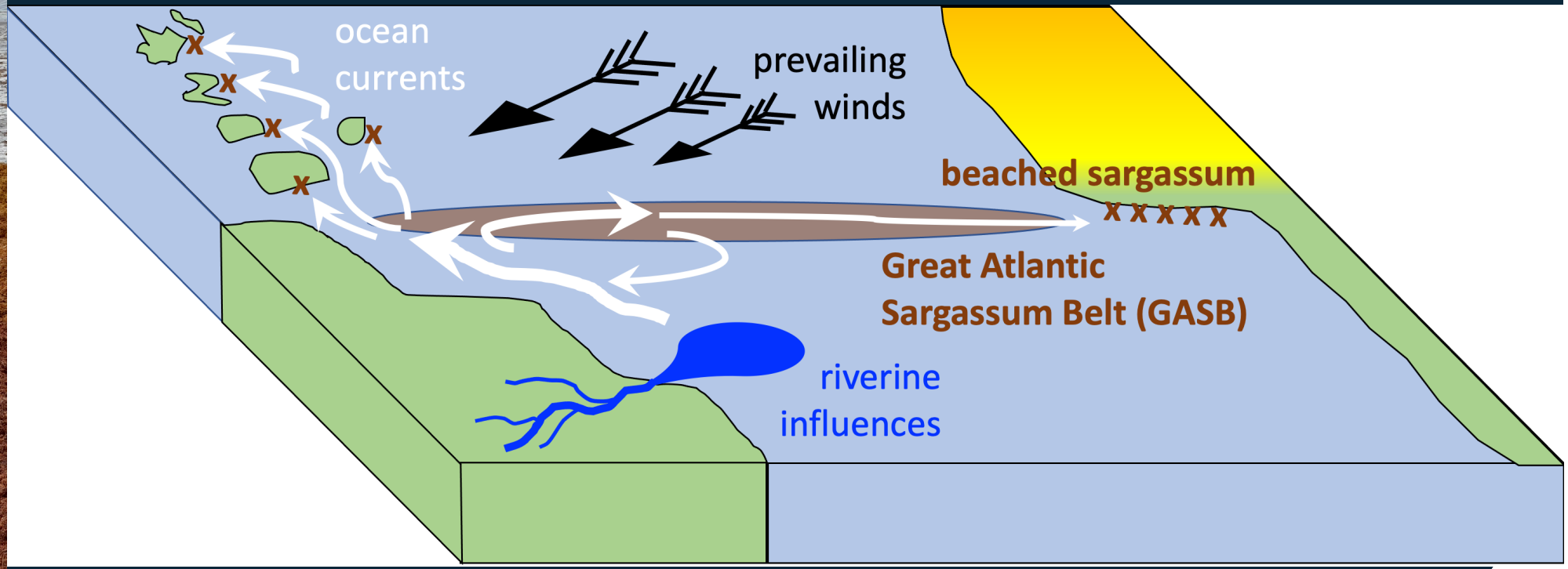
Physical drivers (2)

- Dominant influence of Atlantic Meridional Mode (AMM)
- Sargassum more extensive in negative phases of AMM (cooler sea surface, stronger trades)
- Less influence of Atlantic Niño
- Skliris et al. (2022) Ocean Dynamics

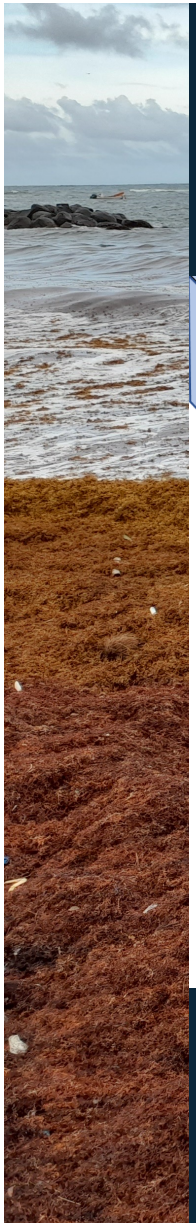




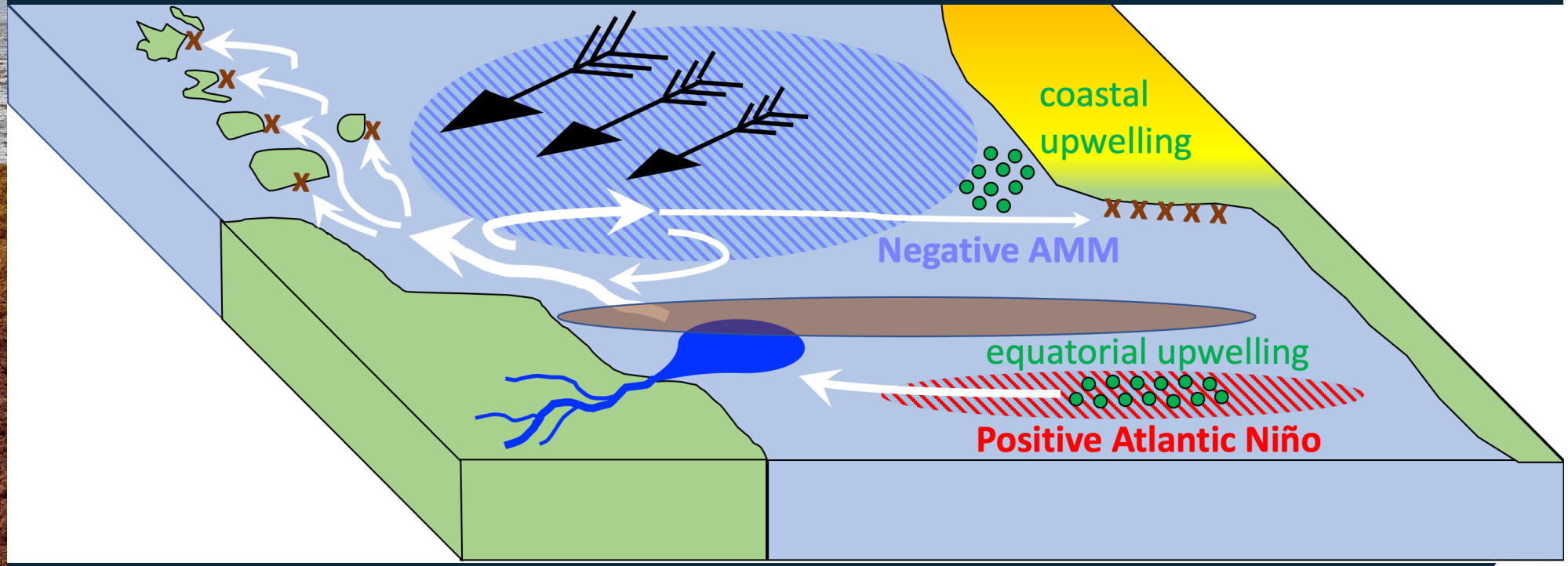
Dynamical and riverine drivers



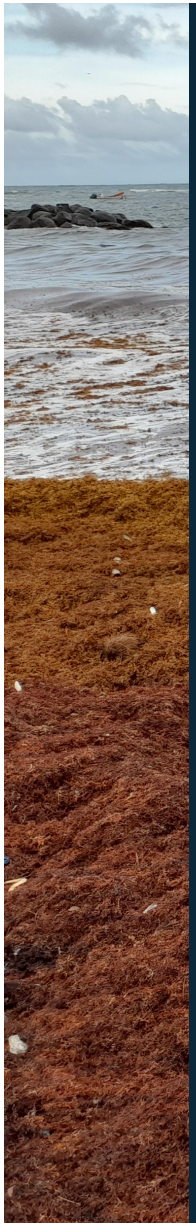
Based on early papers (Putman et al. 2018; Wang et al. 2019)



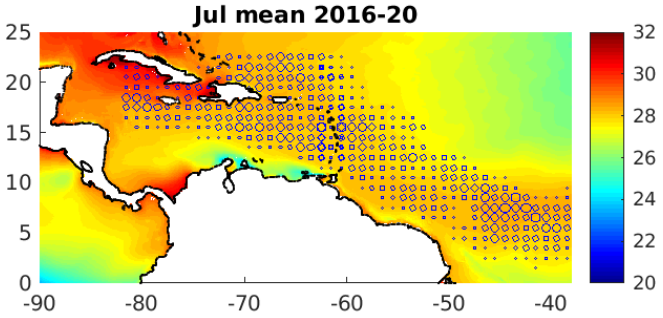
Modes of tropical variability

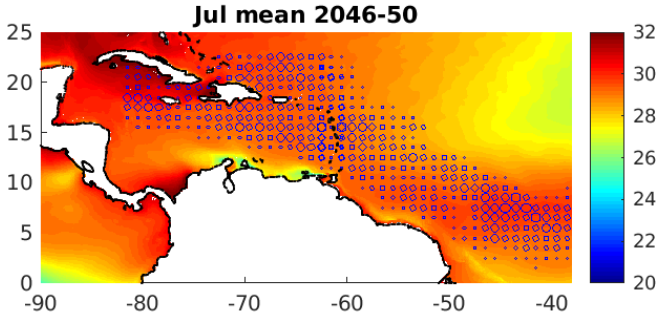


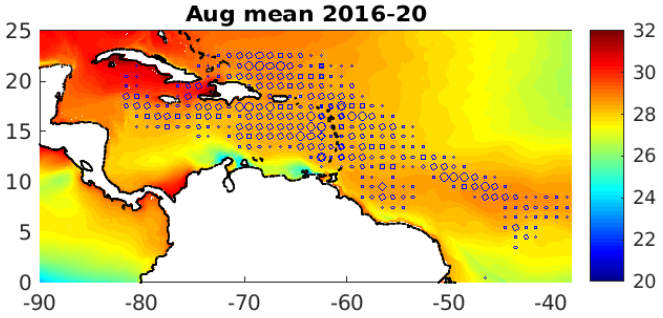
Based on our recent work (Skliris et al. 2022)

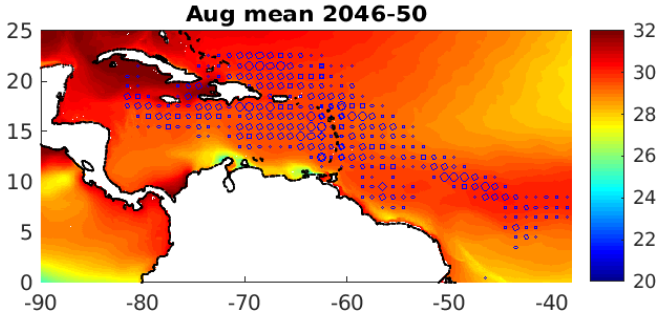


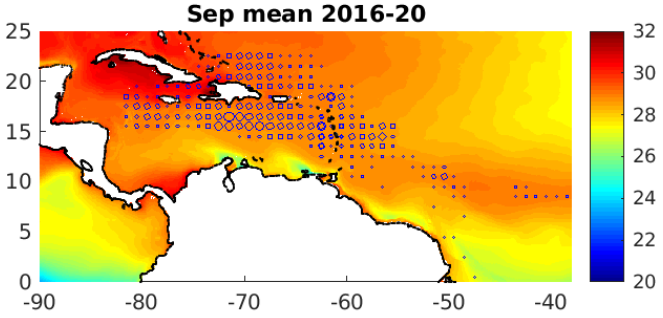
Tropical warming & sargassum – to 2050

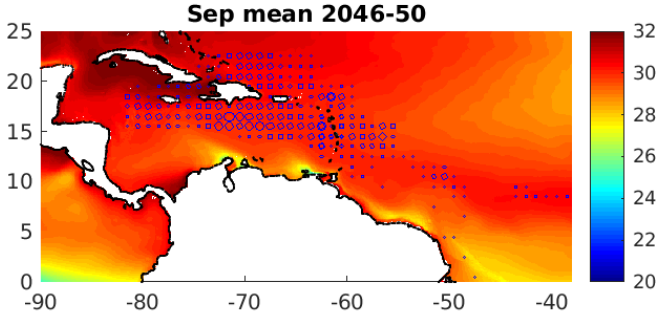




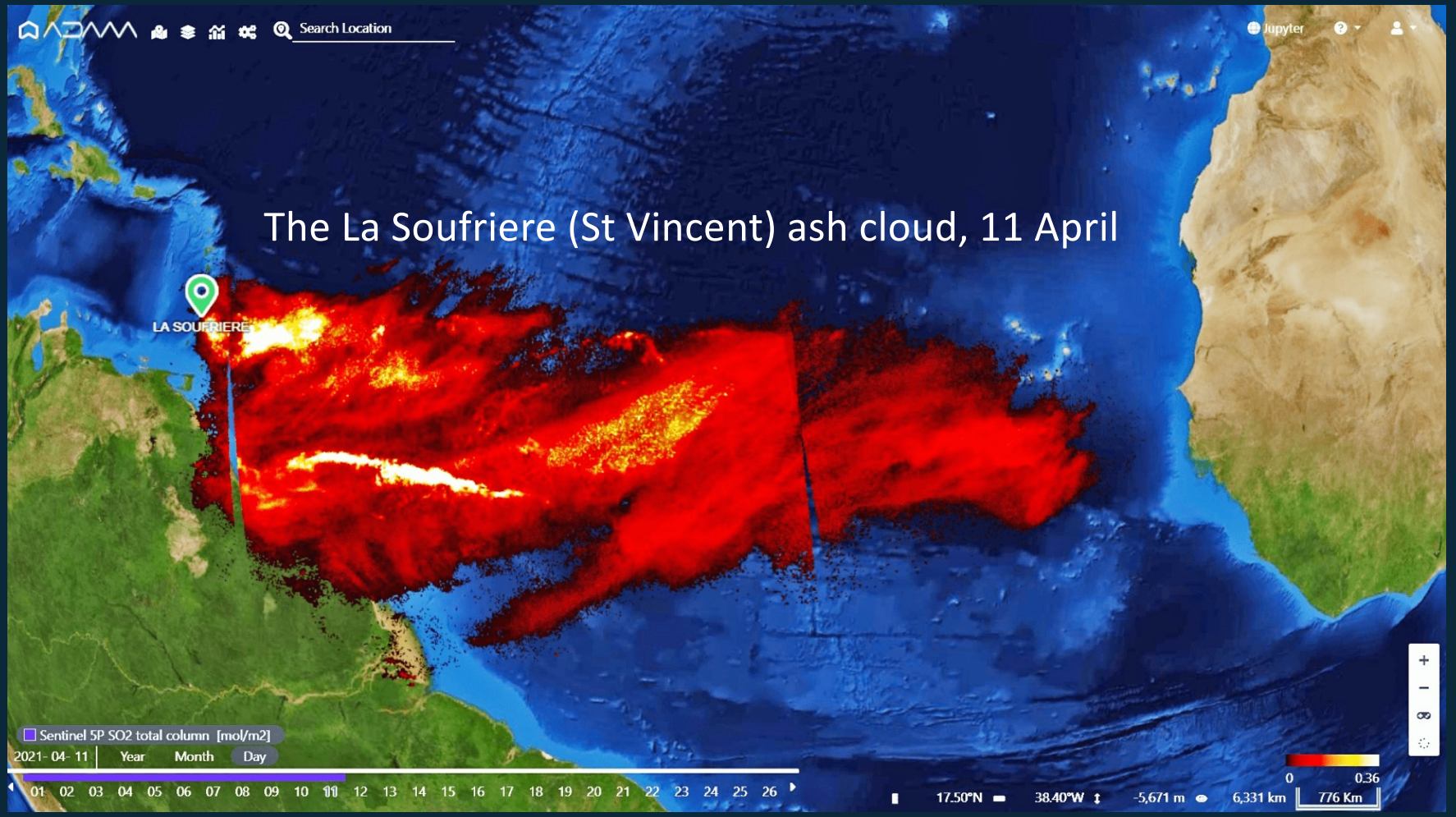




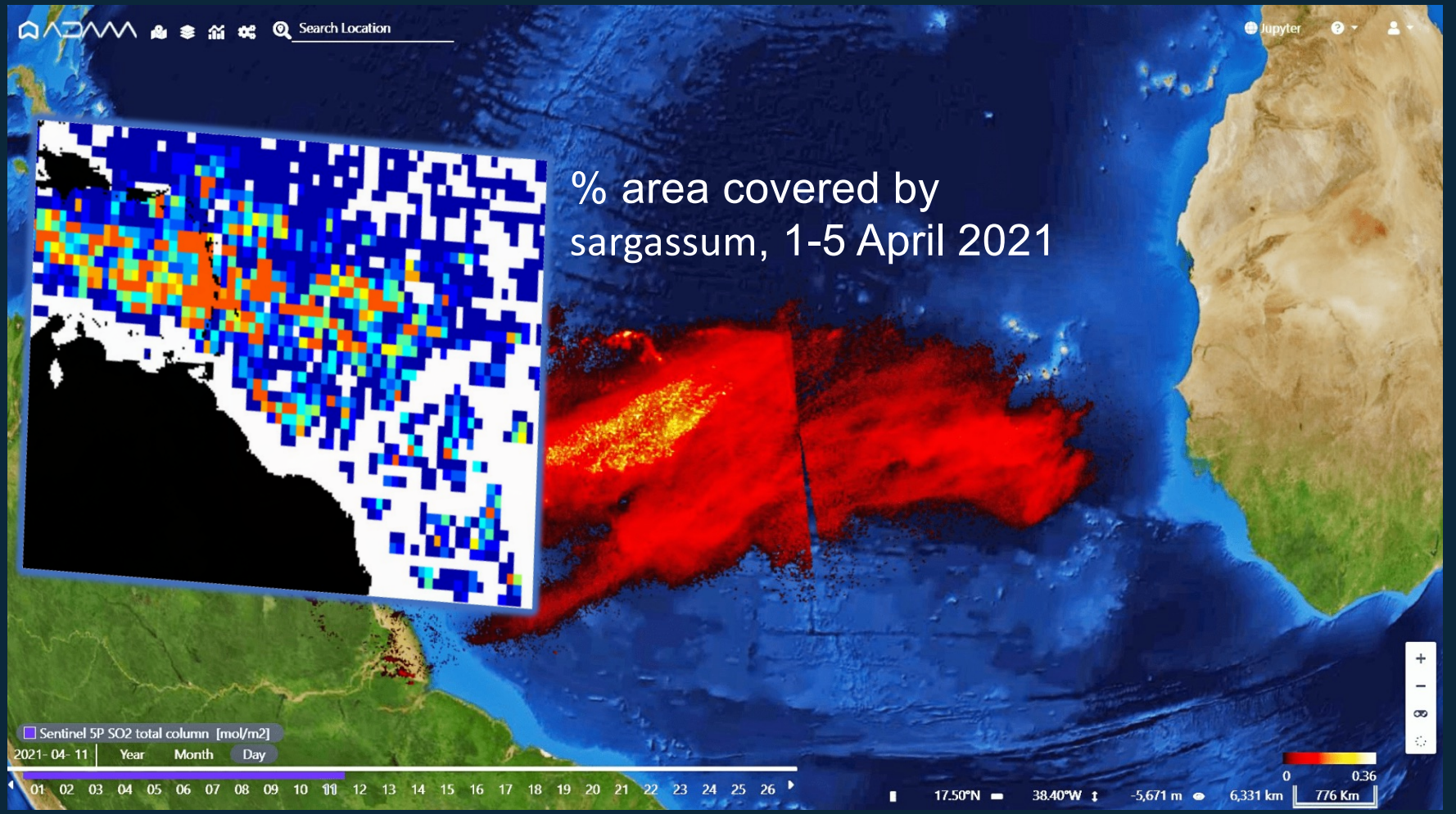




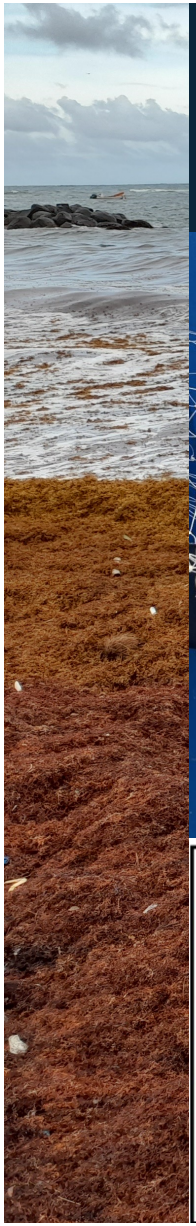
The 2021 season – La Soufriere erupts

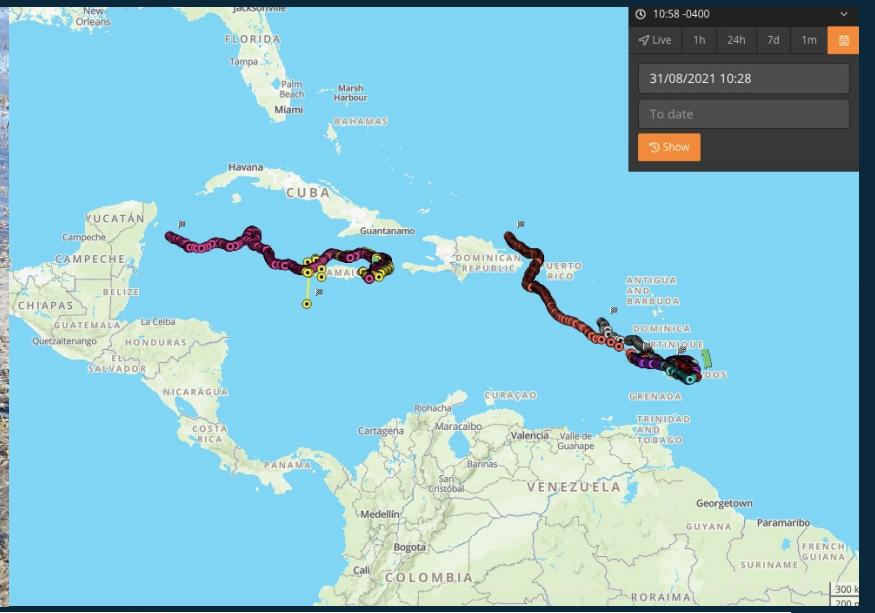


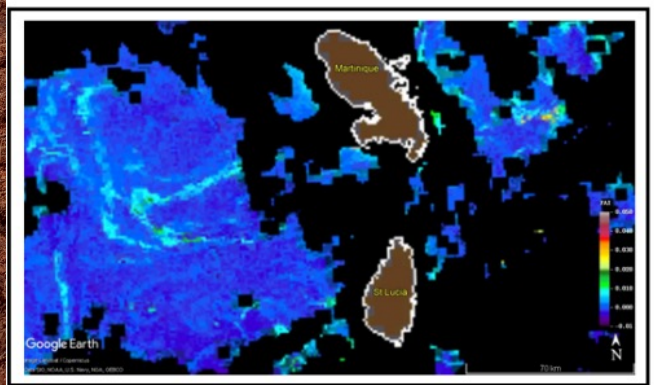
Ash fallout over sargassum

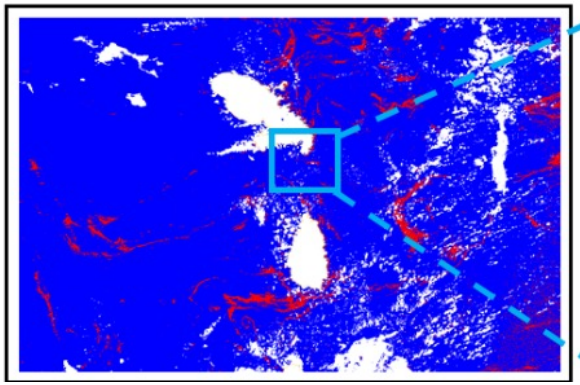


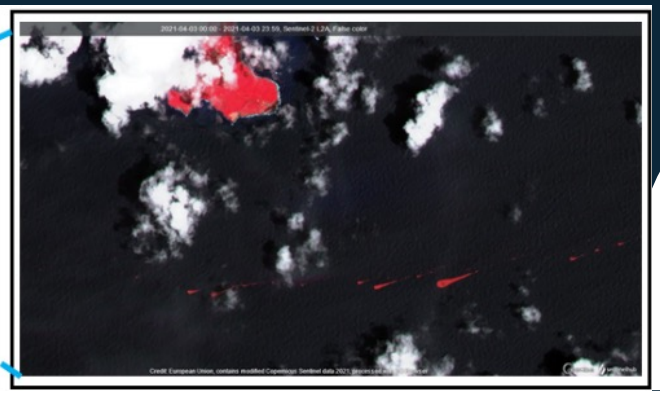
Monitoring a large sargassum bloom subject to a major volcanic eruption (MONISARG) – UK NERC project (2021)

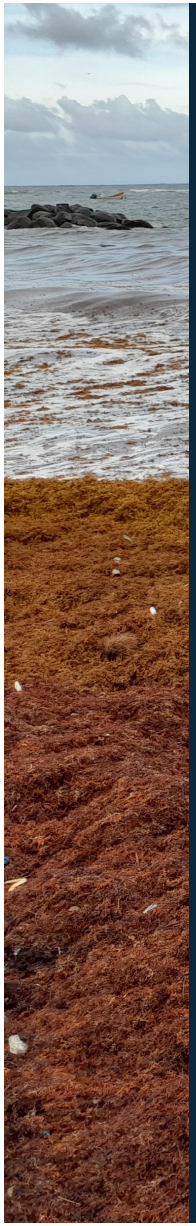






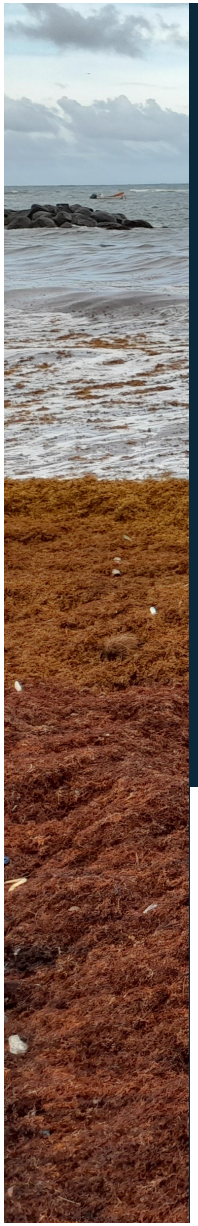






SARCAP (2022)

Capacity Building with communities & schools in Western Region, Ghana



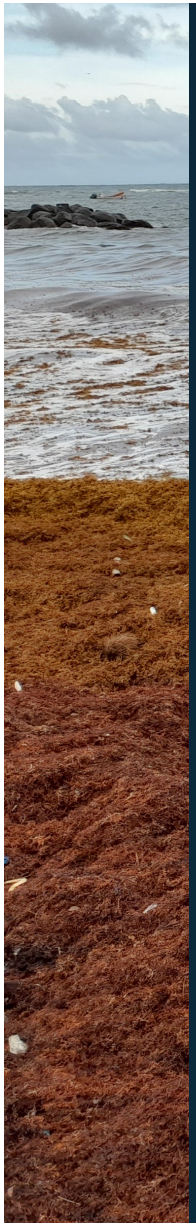
SargSNAP! (2022-23)

CoastSnap:

- photo snap points
- in Beyin, Sanzule and Esiama, Western Region, Ghana

[courtesy Sien van der Plank]

SARGSNAP!



SARTRAC – some takeaways (per publication)

WP1:

- Developed / converging seasonal predictions
- More understanding of drivers and processes

WP2:

- More systematic monitoring in Barbados & Jamaica (more from Romario)

WP3:

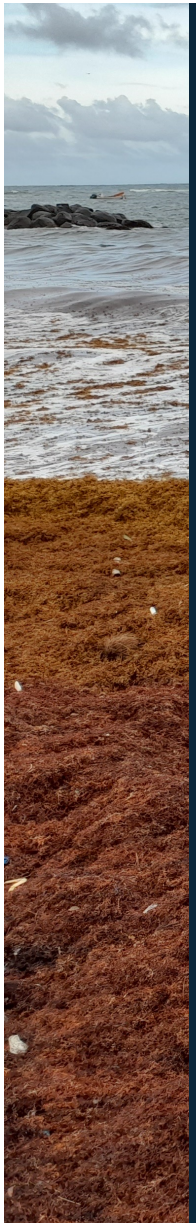
- Deeper knowledge of provenance by morphotype
- Experimental use of sargassum in composts

WP4:

- Polycentric governance, coordination and capacity

Overarching:

- The roles of regional climate and environmental change
- Synthesised science and policy lessons from last decade of adaptation



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Beach at Coconut Court, Hastings
0800, 11 March 2023