The pelagic *Sargassum* population in the tropical Atlantic: establishment and predictability
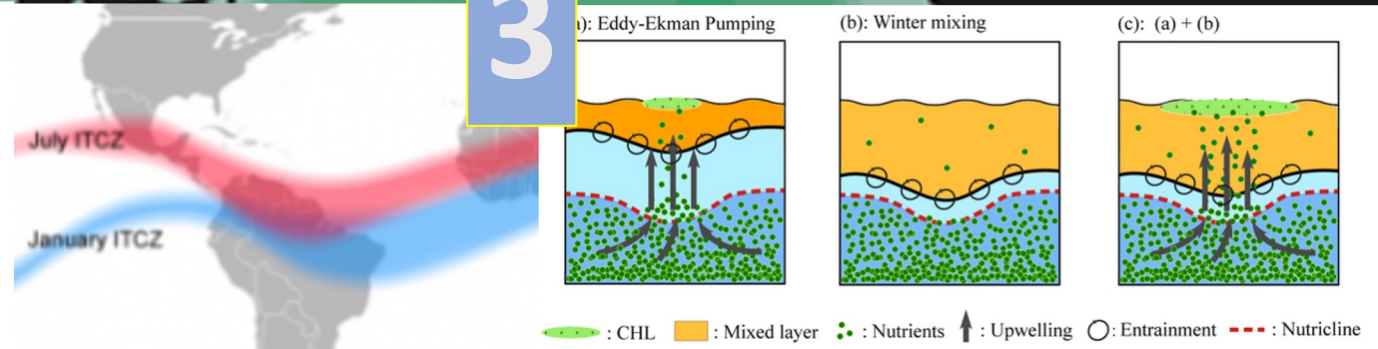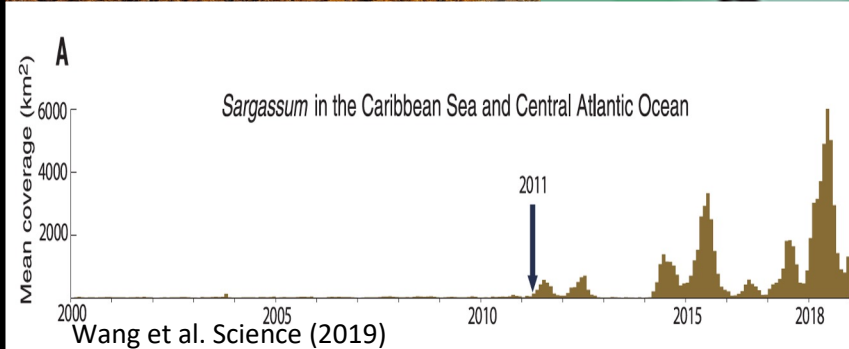
Cisco Werner, Chief Science Advisor, NOAA Fisheries

Frank Muller-Karger, Professor, University of South Florida

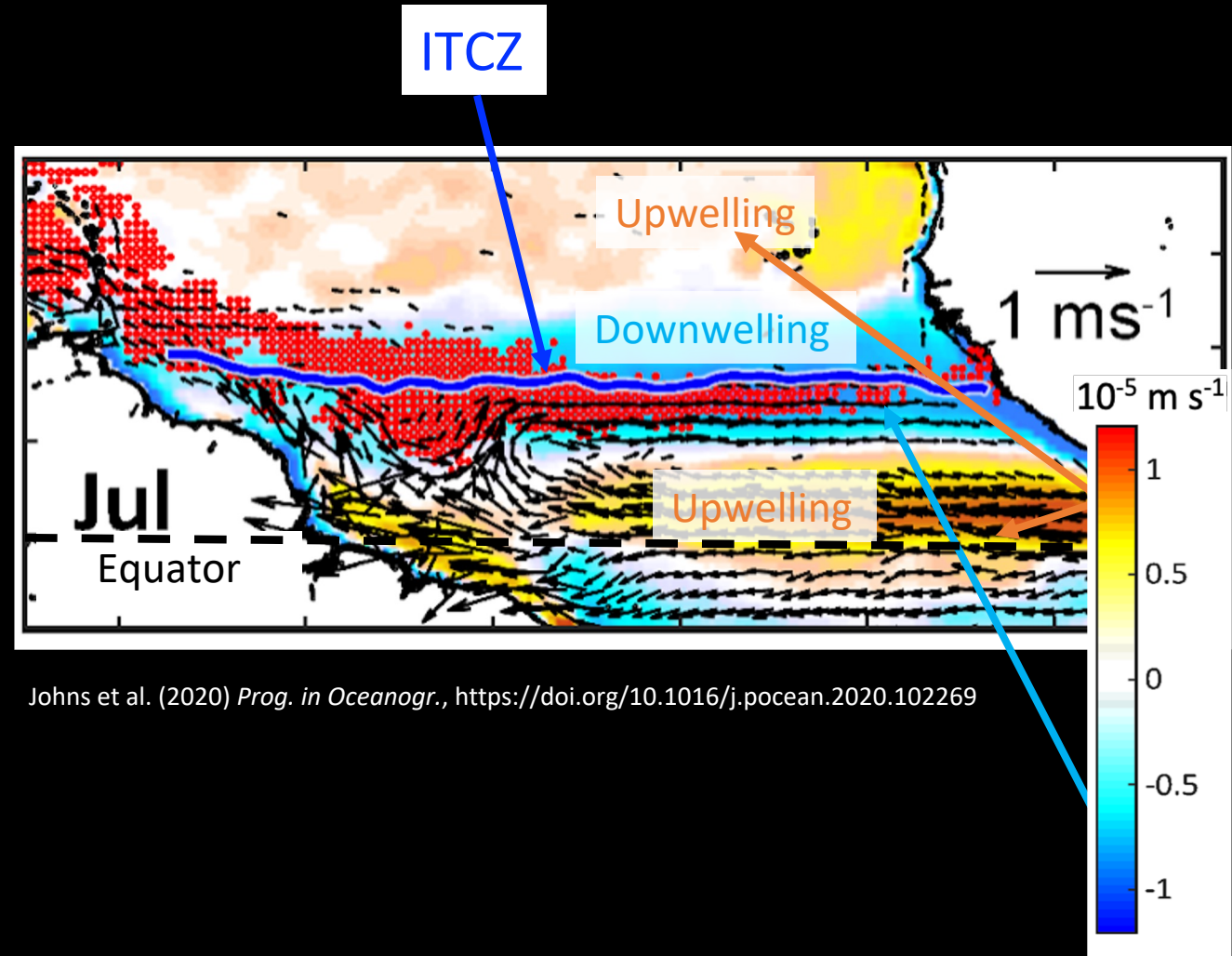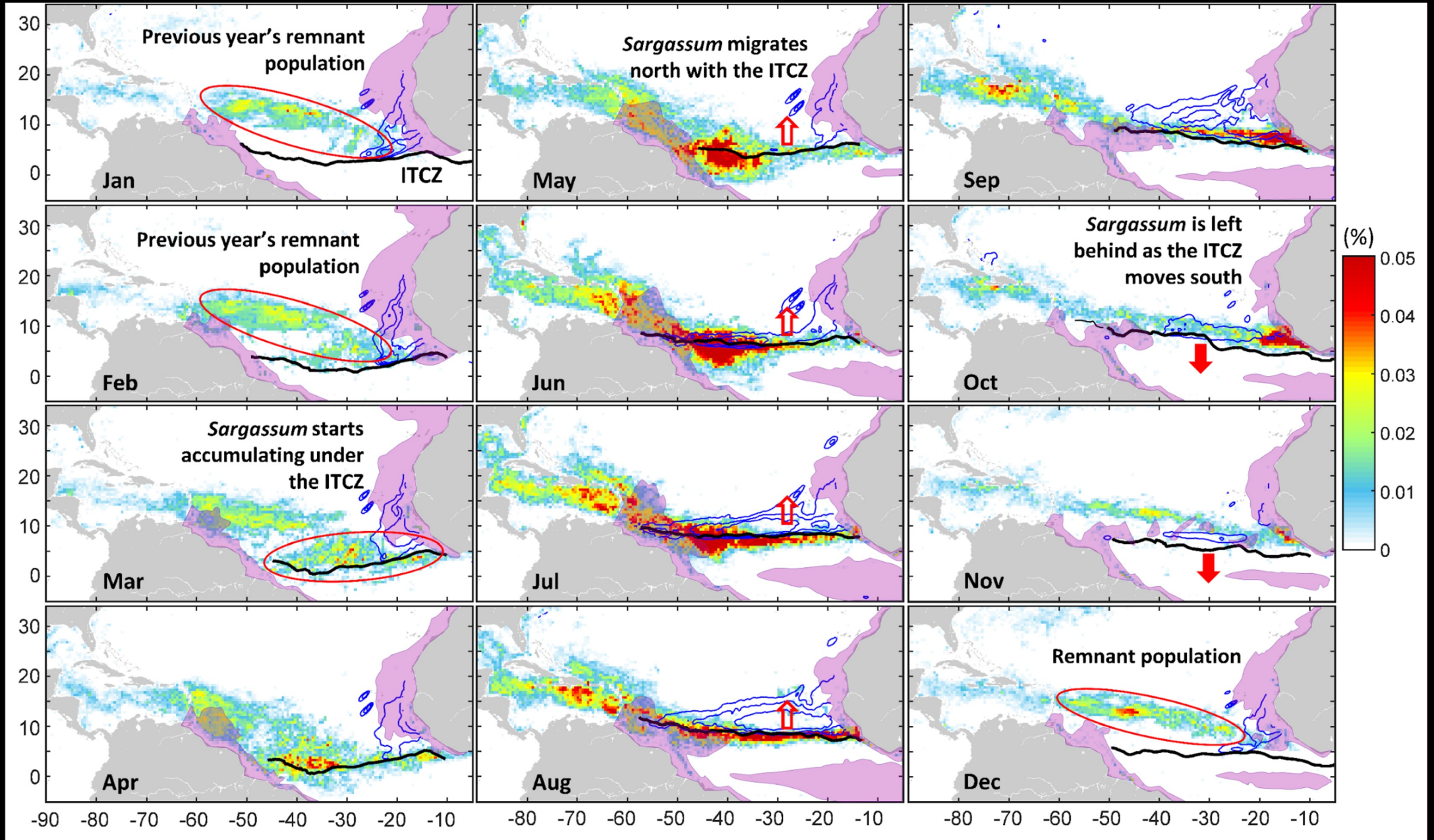St. Thomas, USVI, Dec 2023

In short...

Johns, L., F. Muller-Karger, R. Lumpkin, N. Putman, R. Smith, D. Rueda-Roa, C. Hu, M. Wang, M.T. Brooks, L.J. Gramer, F. Werner (2020)
Progress in Oceanography: https://doi.org/10.1016/j.pocean.2020.102269

What fuels the recurrence of the blooms and what determines their seasonality?

Sargassum patches aggregate in windrows along the ITCZ, and are exposed to high sunlight and upward flux of nutrients:

- **Northern spring and summer:** *Sargassum* **drifts north with the ITCZ,** and portions are advected into the eastern Caribbean Sea.

- **Strong wind mixing and deep mixed layer (~50–60m)** in the southern tropical Atlantic, can result in *Sargassum* blooms.


ITCZ

Upwelling

Downwelling

Upwelling

1 ms⁻¹

10^{-5} m s⁻¹

Jul

Equator

Johns et al. (2020) *Prog. in Oceanogr.*, https://doi.org/10.1016/j.pocean.2020.102269

Seasonal Dynamics (monthly averages 2010-2018)

Interannual variability

- Monthly mean *Sargassum* density for the month of July from 2011 to 2018.

- The GASB* is observed in all years except 2013.

*Great Atlantic *Sargassum* Belt

Wang et al. Science (2019)
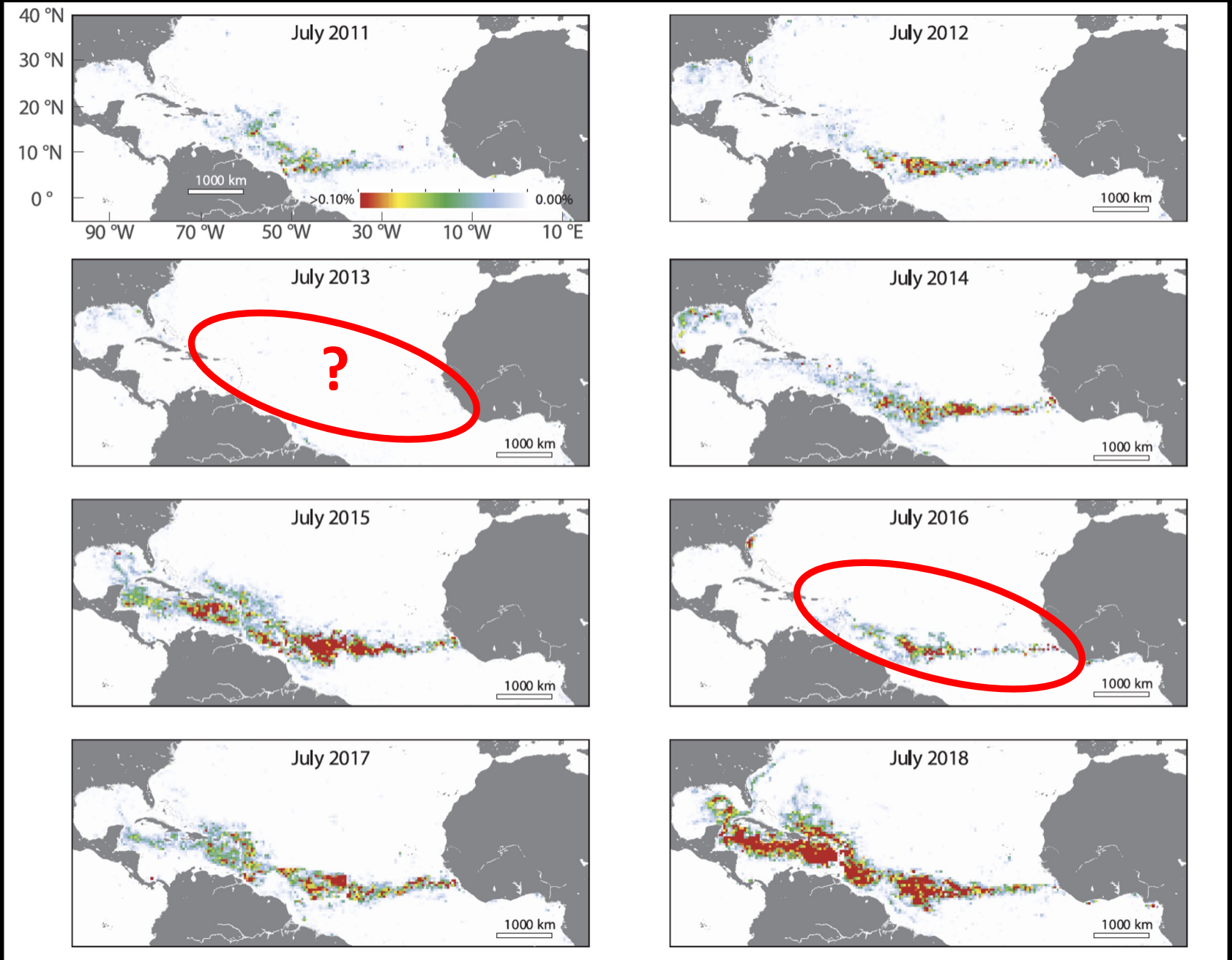
Mixed layer and nutrient dynamics

Deeper MLD results in most **intense Sargassum blooms** were observed when the (and strongest trade winds) were observed.

a) Time series anomaly of the *Sargassum* and MLD under the *Sargassum* belt

MLD deeper than climatology
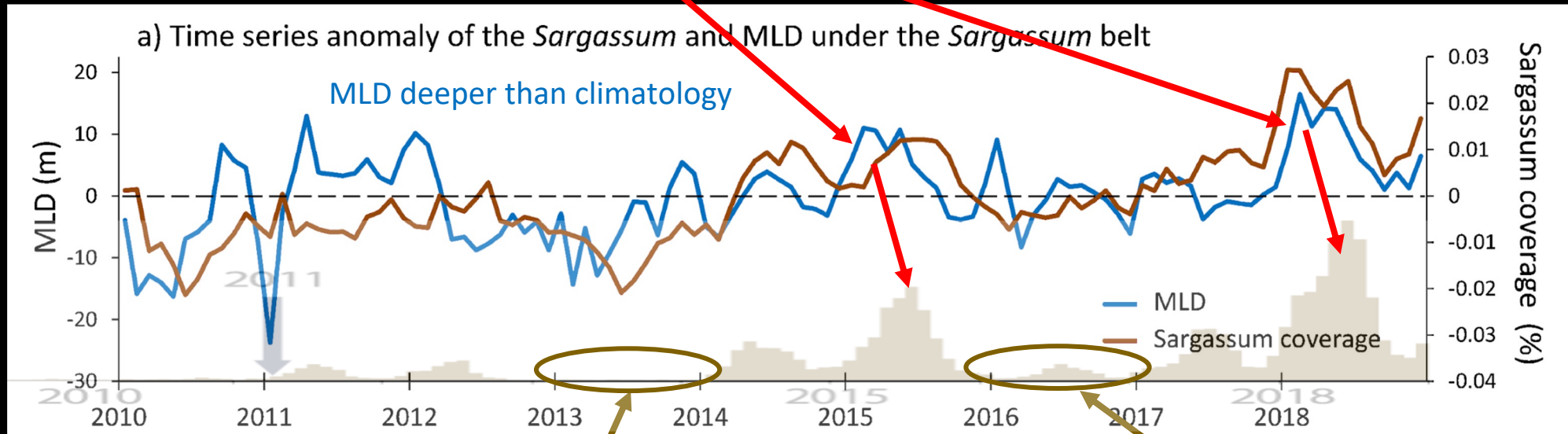
Shallow MLD (relative to Oct-Dec climatology, e.g., 2012 & 2015), results in **smaller or delayed blooms** the following year. The bloom was absent in 2013, and weaker/delayed in 2016.

Johns et al. (2020) *Prog. in Oceanogr.*; Wang et al. (2019) *Science*.

Predictability

Factors representing *Sargassum* growth are:

- surface ocean currents

- internal nutrient reserves of N and P

- dissolved inorganic nutrients

- solar radiation

- SST & SSS, and

- surface wind speed.

- Model skill ~7 mos across the GASB.

- The skill is high in the Lesser & Greater Antilles, and lower near West Africa.

Johns et al. (2020) *Prog. in Oceanogr.*, https://doi.org/10.1016/j.pocean.2020.102269
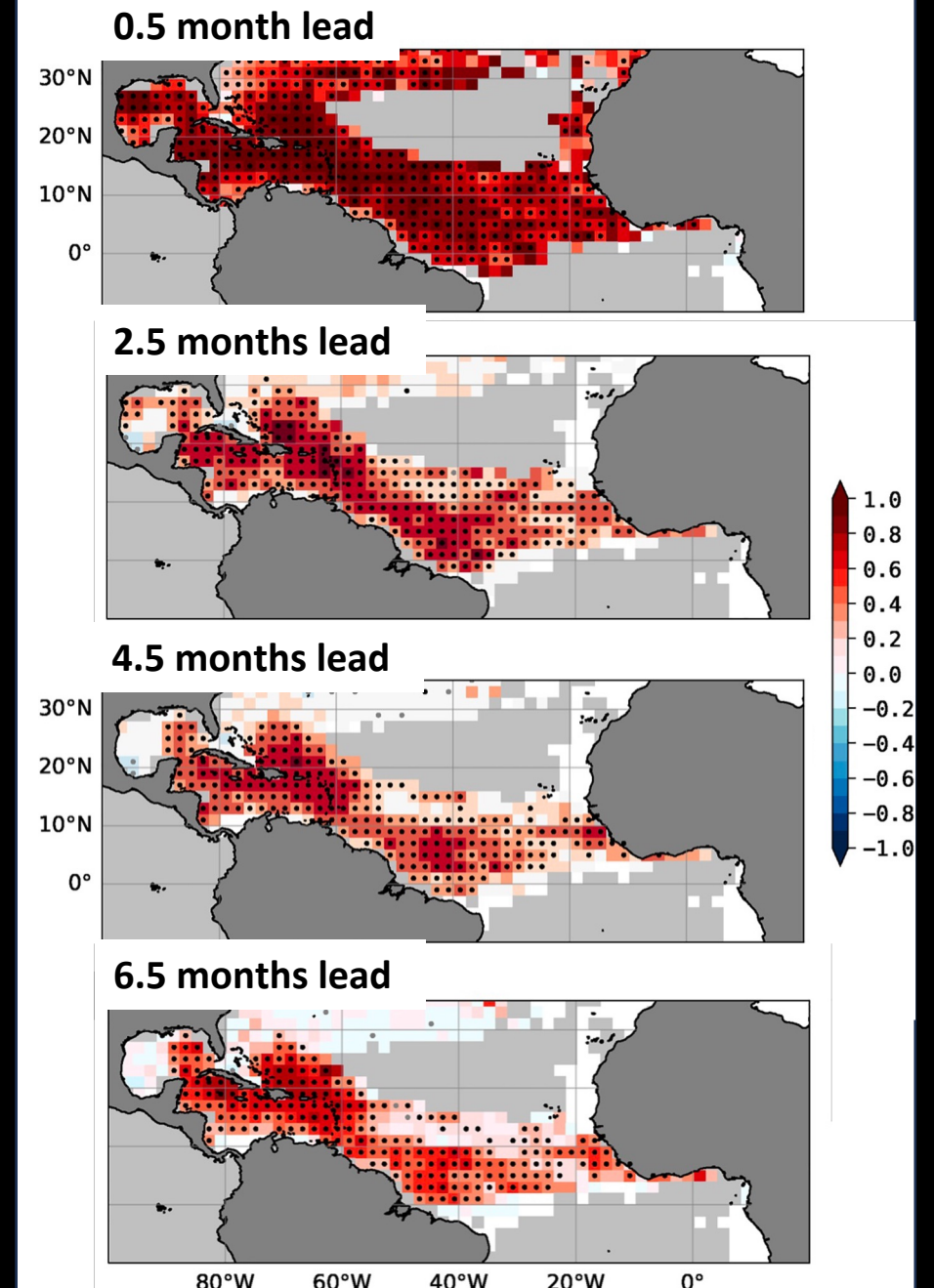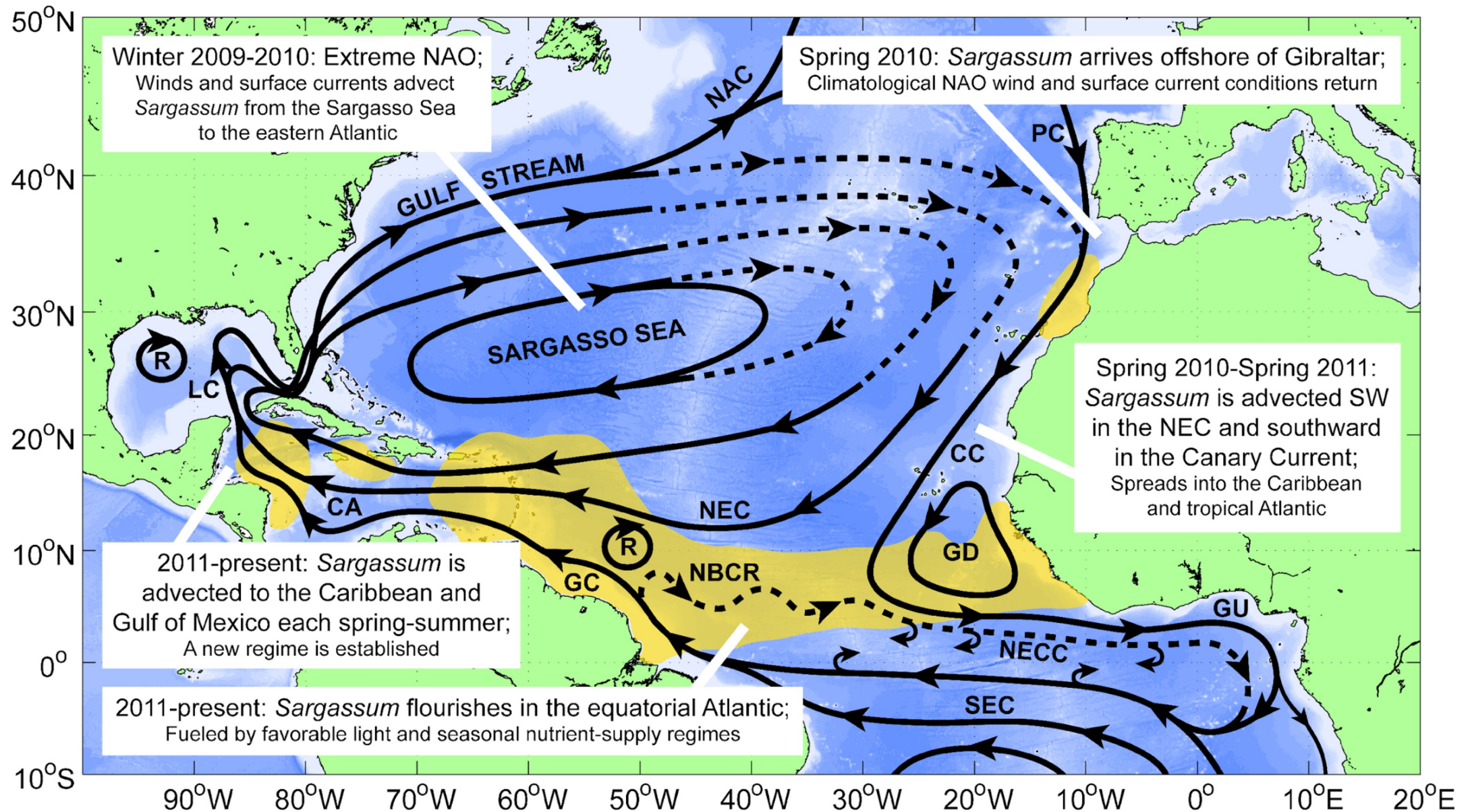
Concluding Remarks

- Long-distance dispersal (LDD) event in 2010-2011 offered as an explanation for the *Sargassum*'s initial spread and accumulation in the tropical Atlantic.

- The establishment of a *Sargassum* population results from winds, surface currents, ITCZ, and mixed layer & nutrient dynamics.

- Recent models suggest a ~7-month forecast skill, with additional attention needed to quantify biogeochemical signals including vertical mixing.

- **Outstanding question:** What are the key mechanisms leading to the blooms' initiation, intensity, and thus to improved predictability of potential ecological and socioeconomic impacts ?