Amazon River water in the northeastern Caribbean Sea and its effect on larval reef fish assemblages during April 2009

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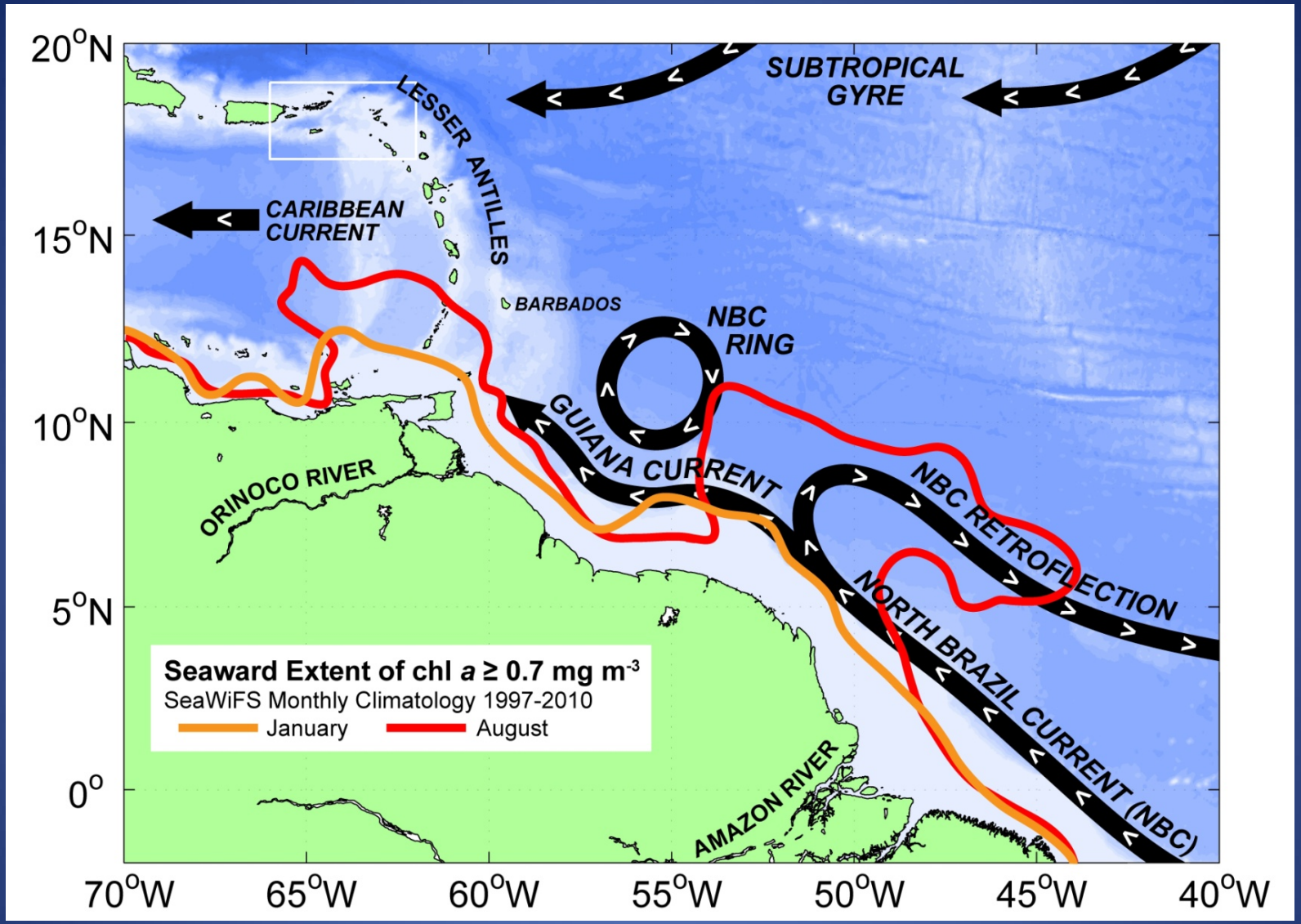
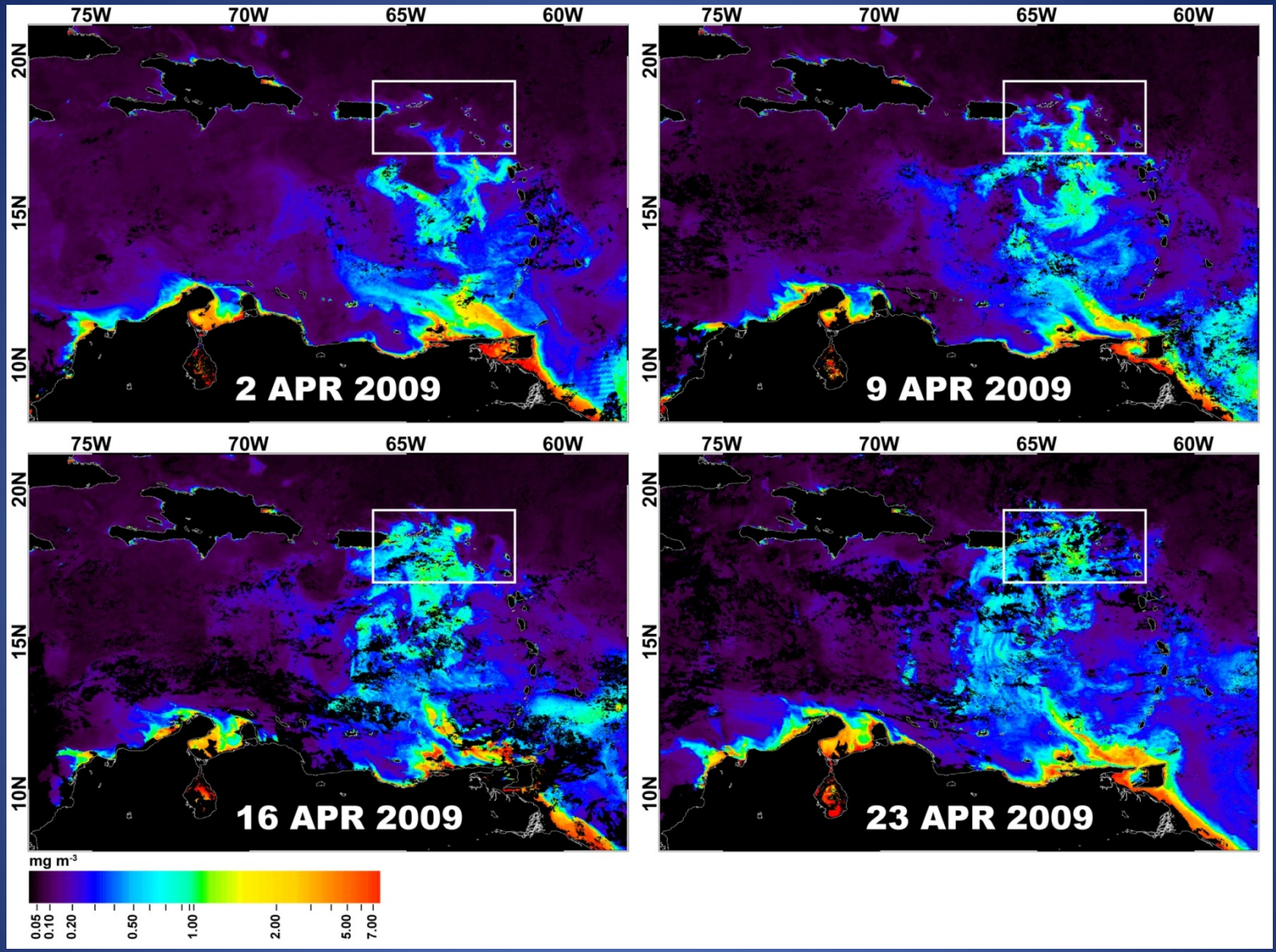
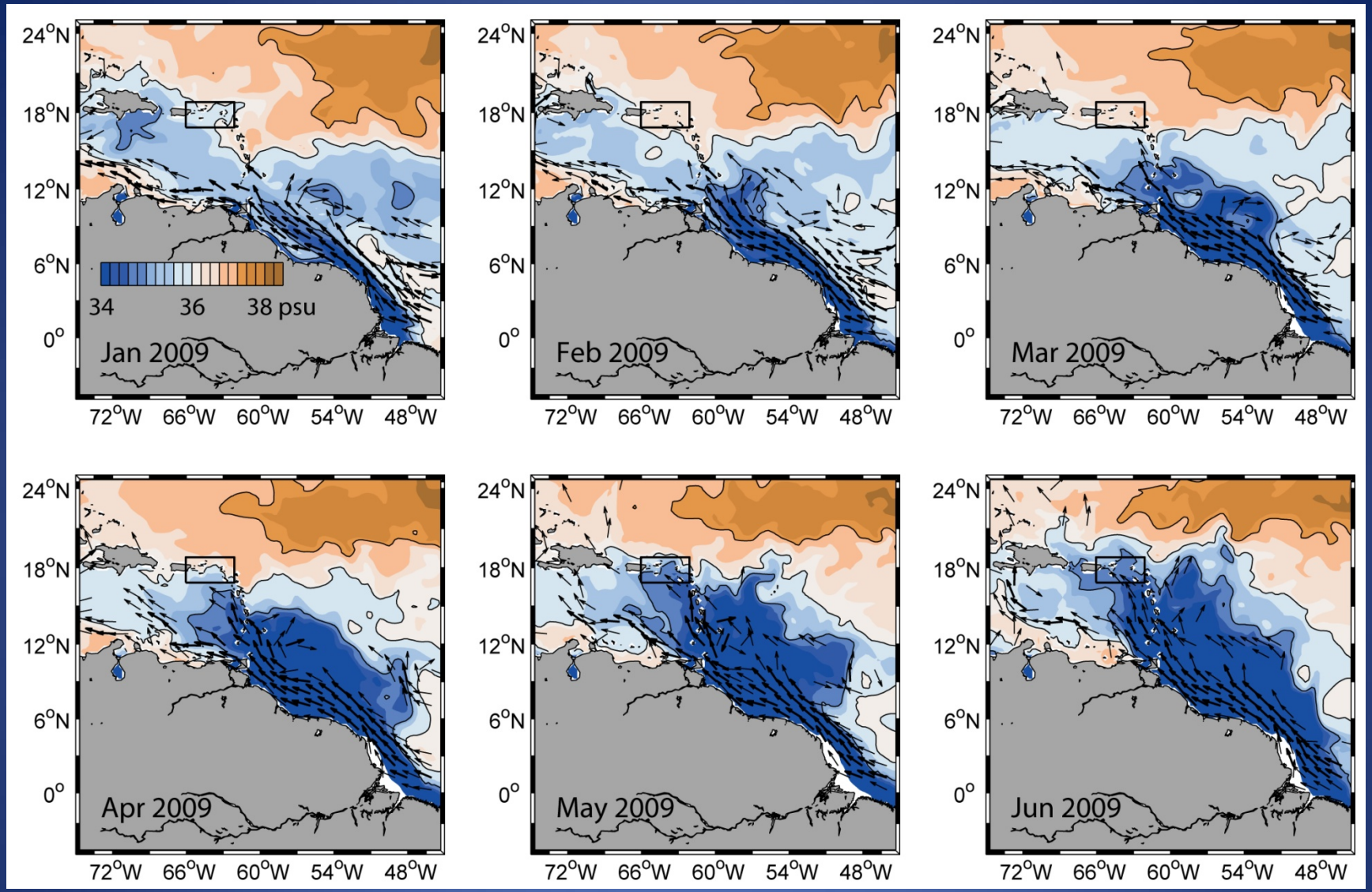


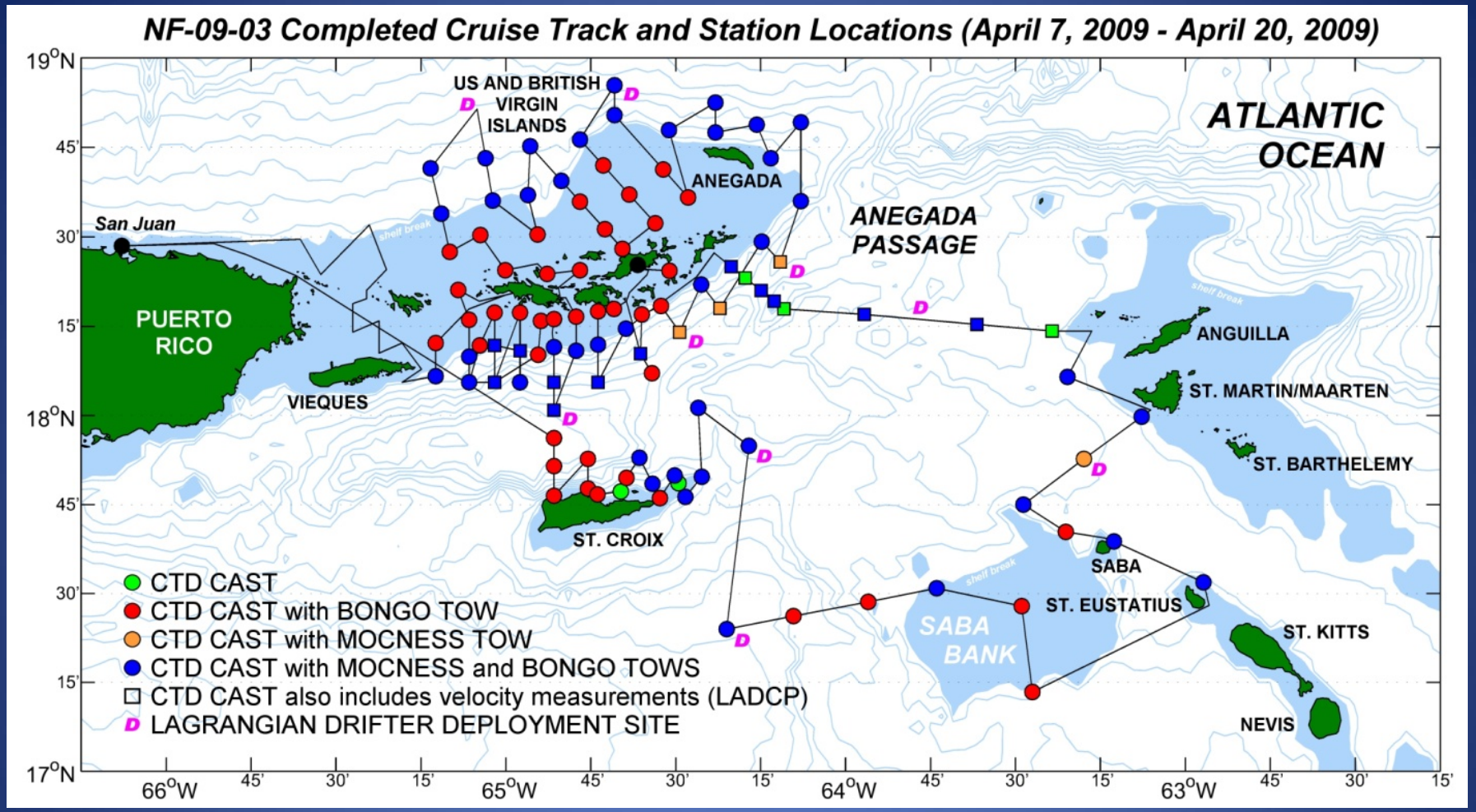
Circulation schematic showing the Amazon and Orinoco River mouths, the seasonally varying location of the North Brazil Current retroflection based on a SeaWiFS chl *a* climatology, other large-scale circulation features, and the location of the cruise study area in the northeastern Caribbean Sea.



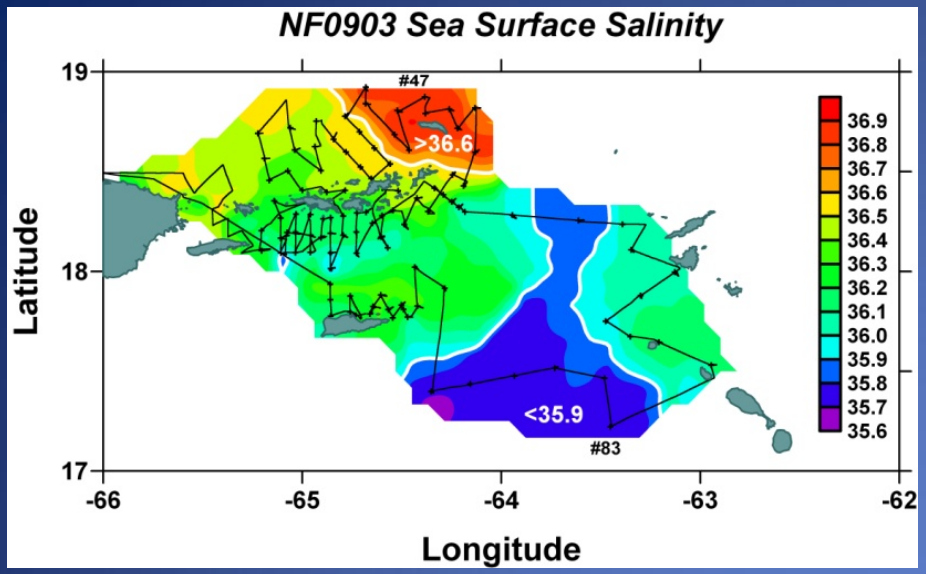
A weekly look at the Amazon River plume in the northeastern Caribbean Sea during April 2009, from MODIS ocean color imagery of chl *a*. The cruise area is shown as the white rectangle surrounding Puerto Rico and the US and British Virgin Islands.

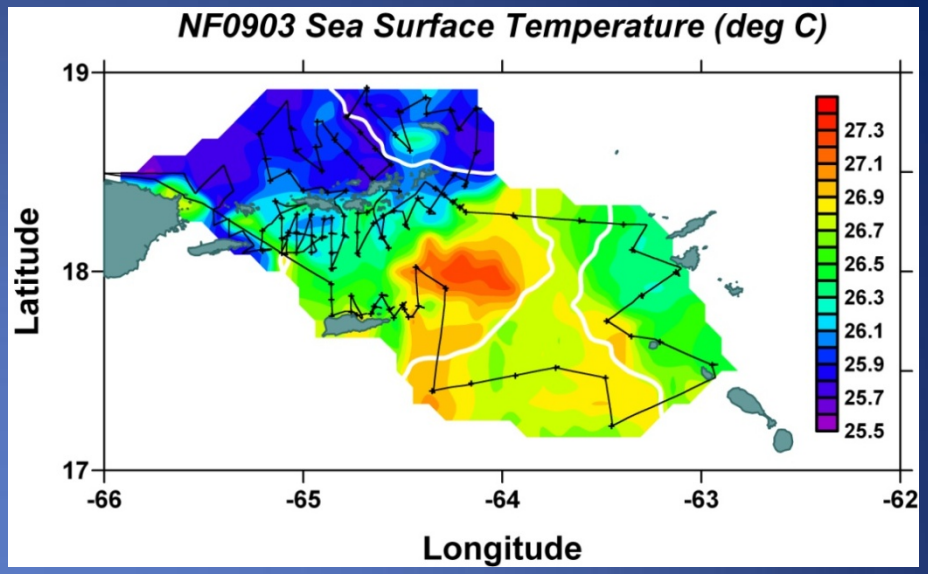


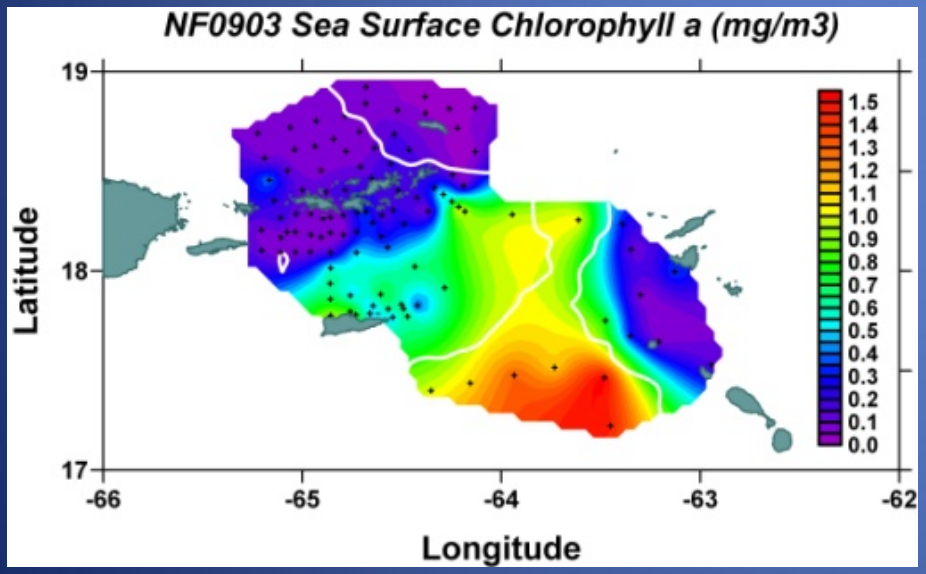
Monthly sea surface salinity fields (January – June 2009) from the data-assimilating MERCATOR Ocean numerical model. Surface velocity vectors are superimposed. Thicker arrows denote velocities >50 cm/s. The cruise study area is shown as a black rectangle.

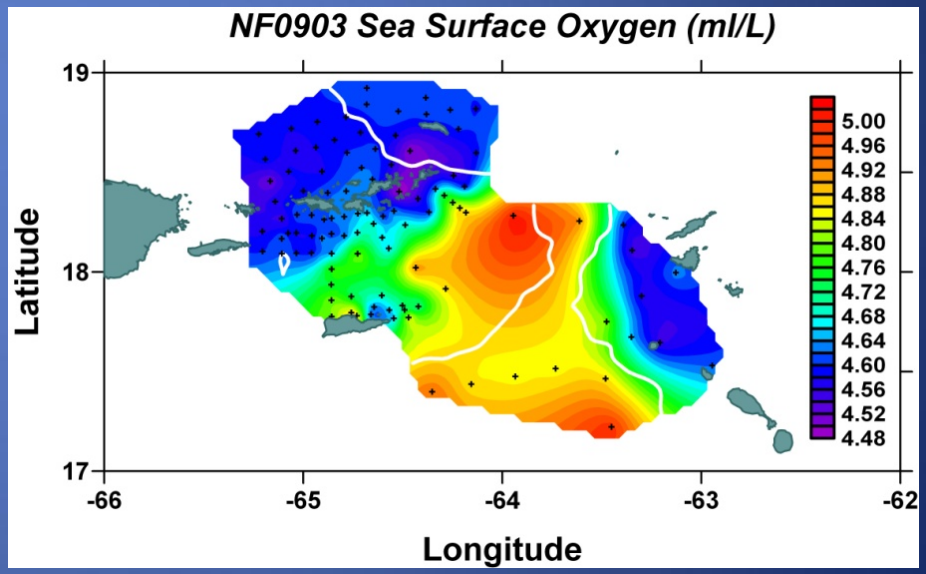


April 2009 NOAA Ship *Nancy Foster* cruise track showing station locations and operational activities including net tows and drifter deployments.

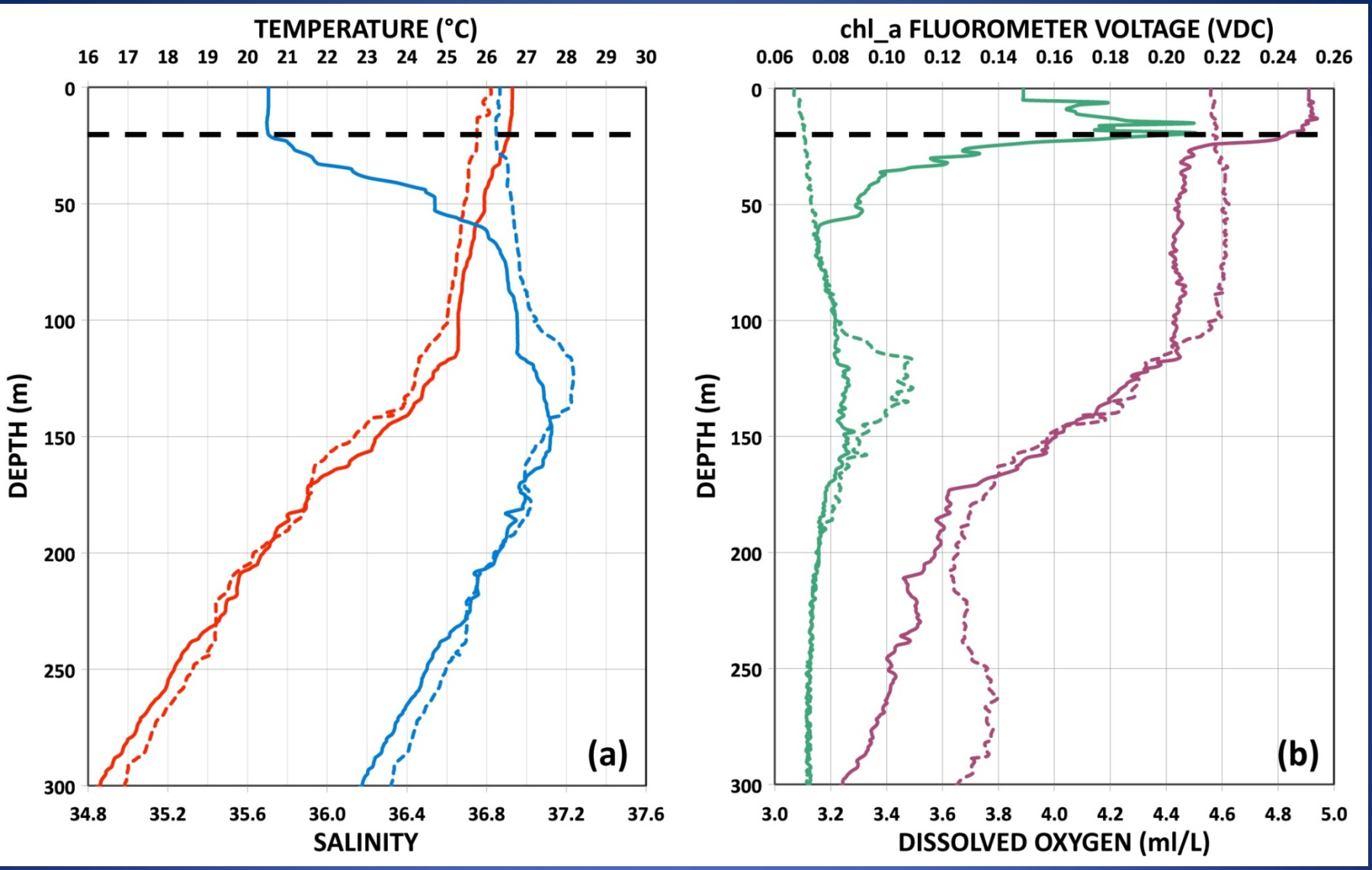




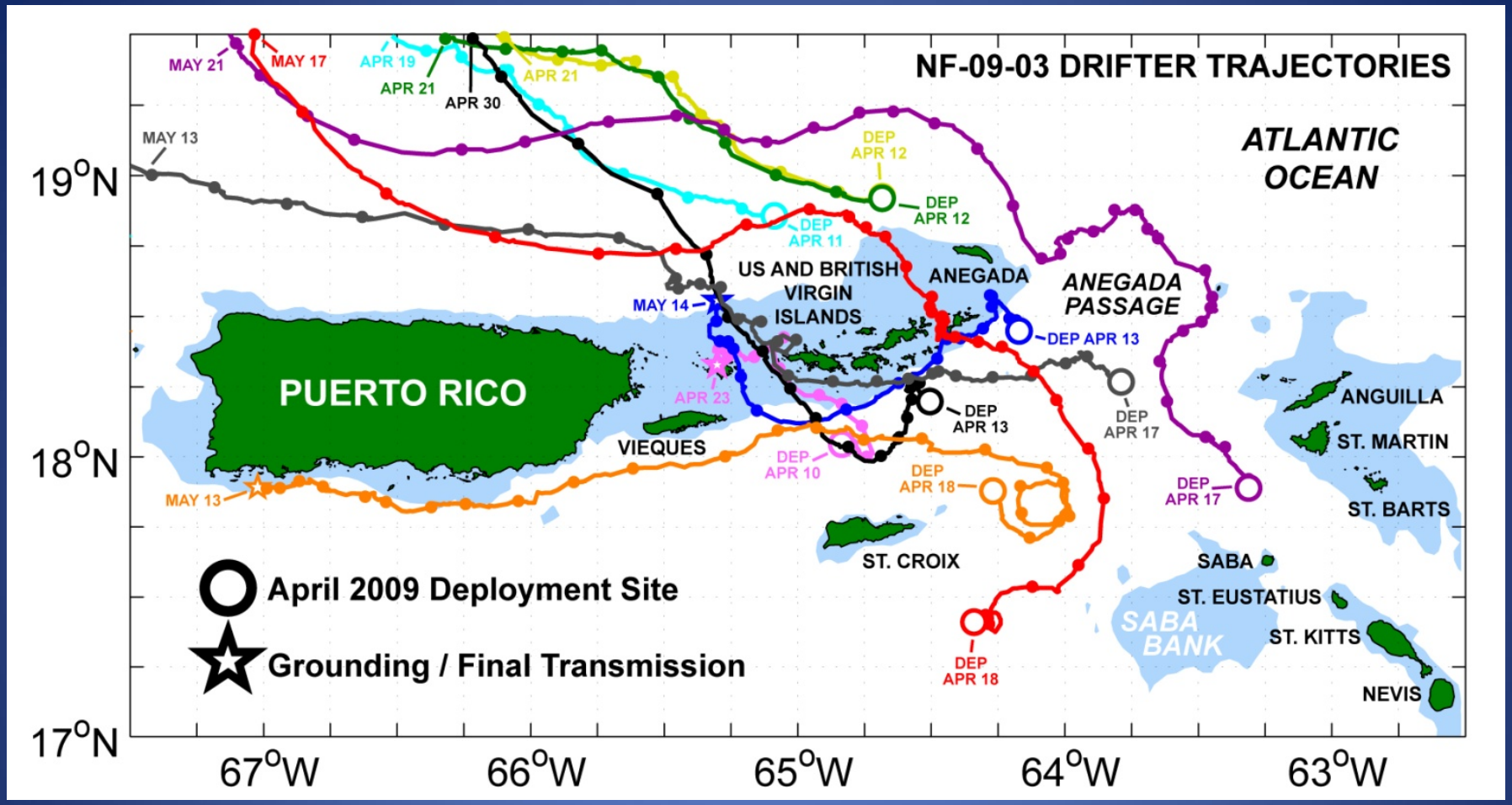




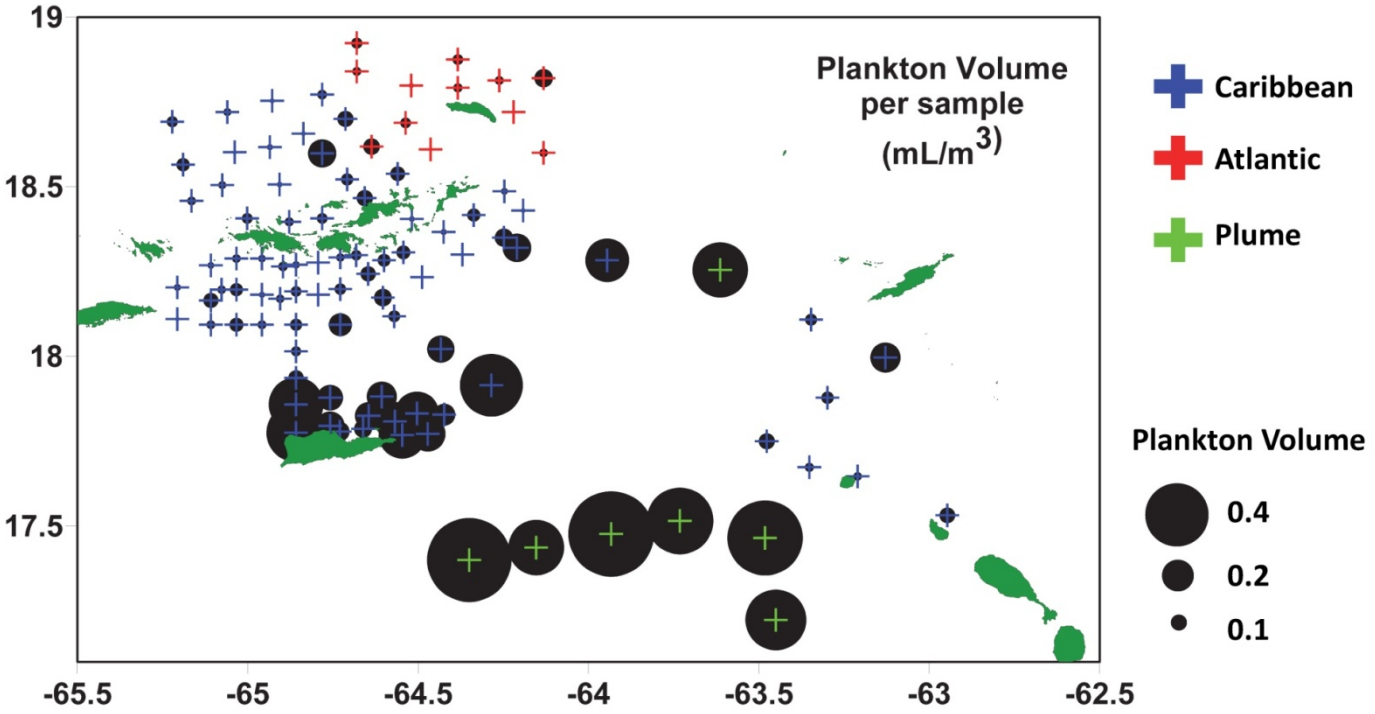
Maps of *in situ* sea surface salinity, temperature, chl *a*, and dissolved oxygen from the April 2009 cruise. The white lines show the 36.6 and 35.9 salinity contours, used to define Atlantic, Caribbean, and plume waters.



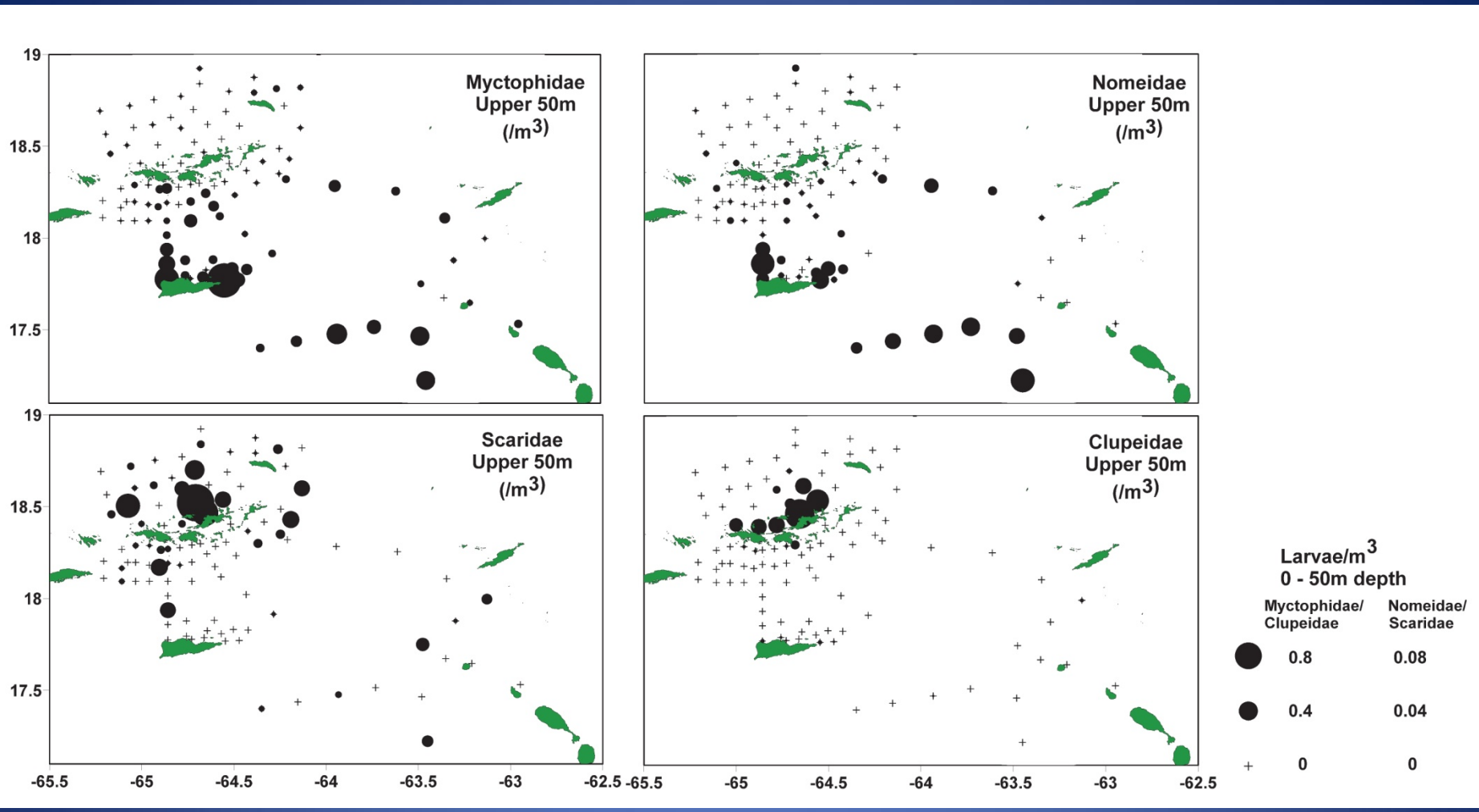
Vertical profiles of temperature (red), salinity (blue), chl *a* fluorometer voltage (green), and dissolved oxygen (purple) from selected CTD stations. The solid lines are in Atlantic water, and the dashed lines are in the plume water. The thick dashed line indicates a depth of 20 m, the approximate thickness of the plume.



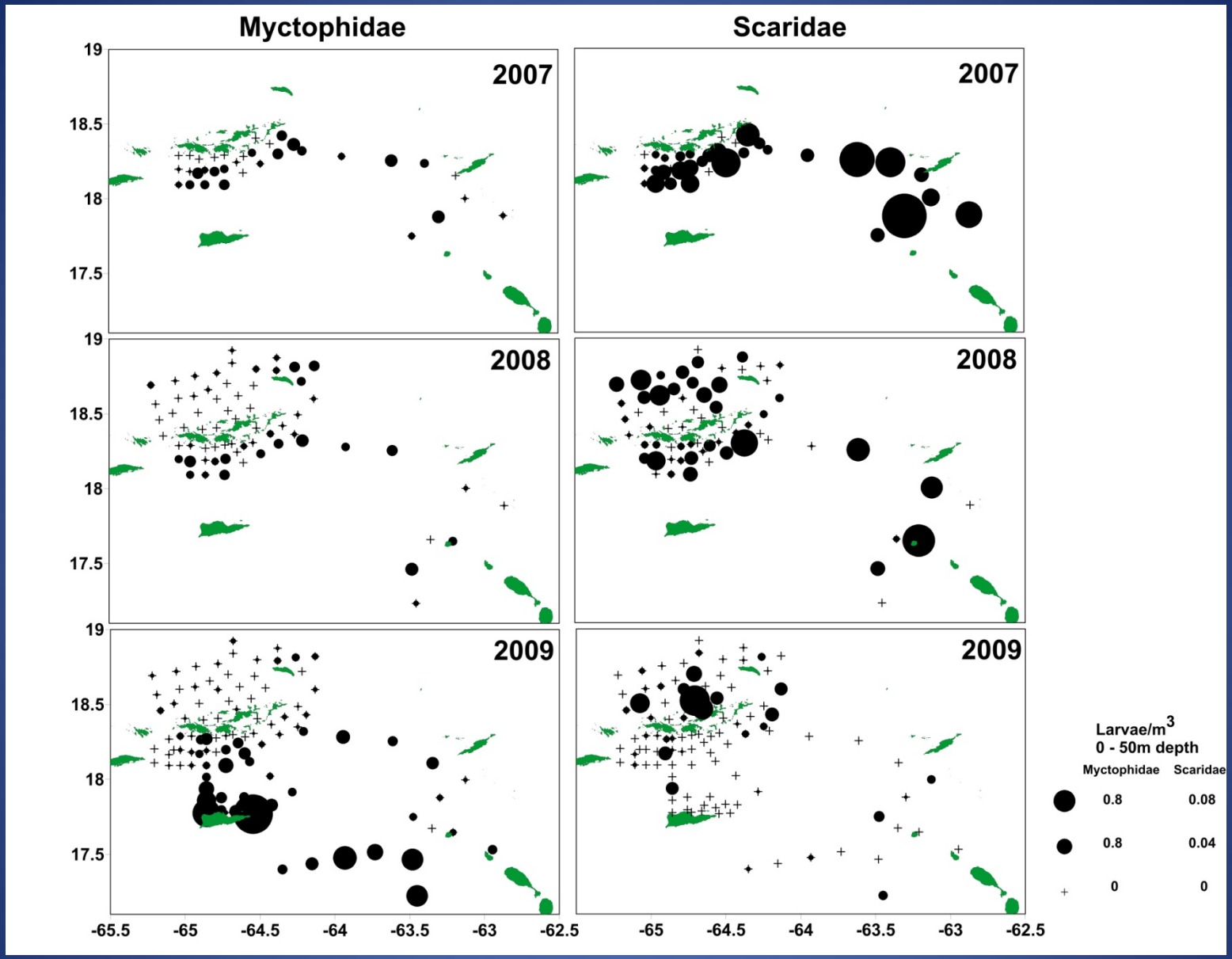
Trajectories of the nine drifters deployed during the April 2009 cruise. Note in particular the northward trajectories of the "purple" and "red" drifters through and just west of Anegada Passage, which are consistent with the direction and speed spread of the plume water in the northeastern Caribbean.



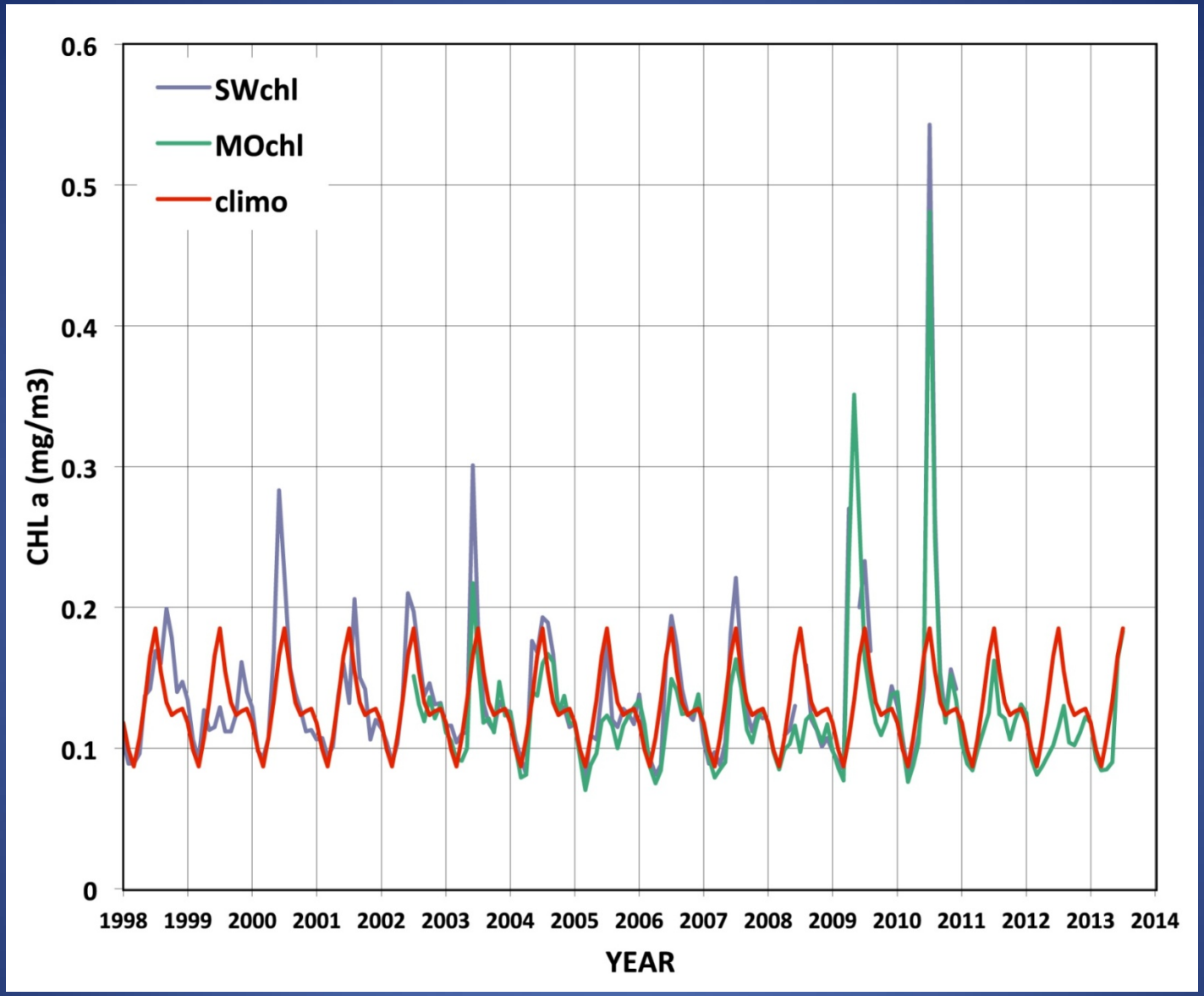
Total plankton volume sampled in the upper 50 m during the April 2009 cruise in mL/m³ in Atlantic (red), Caribbean (blue), and plume (green) stations. There is a strong linear correlation (R^2 = .75) with surface chl *a*.



Upper 50 m distributions of lanternfish (Myctophidae), driftfish (Nomeidae), parrotfish (Scaridae), and herring (Clupeidae) larvae in # larvae/m^3 during April 2009. The plume waters were distinguished from the non-plume waters by having more pelagic and mesopelagic larval types (upper two maps).



Inter-year comparison of the distributions of a mesopelagic fish (lanternfish, left panel) and a reef fish (parrotfish, right panel) during the years 2007, 2008, and 2009.



Chl *a* from satellite ocean color observations for the period 1998 to 2013, averaged over the cruise domain (17 – 19°N, 66 – 62°W). Data from the SeaWiFS (blue), MODIS (green), and the SeaWiFS climatology (red) are shown.

Summary of the observations

- A North Brazil Current Ring separated from the North Brazil Current retroflection and, carrying a plume of Amazon River water, impinged upon the Caribbean Sea in early spring 2009.

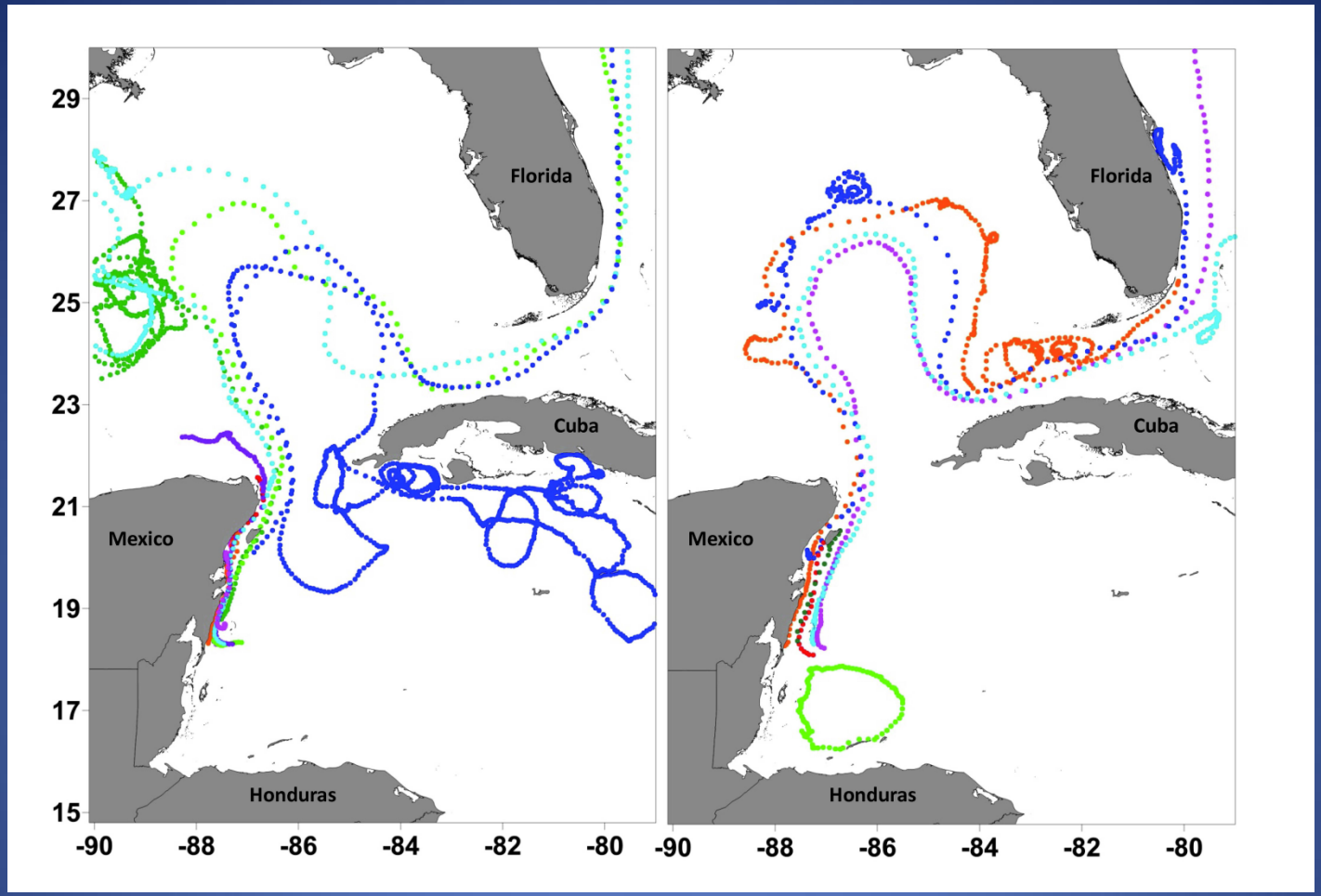
- A plankton bloom subsequently intensified and dispersed to the north and west, eventually covering the northeastern Caribbean. The plume of turbid "green water" was unusual for this area.

- A research cruise surveyed the plume with a variety of sampling techniques. Three surface water types were identified based on surface salinity: Atlantic, Caribbean, and plume. The plume water had the lowest surface salinity and the highest SST, oxygen, and chl *a* levels of the three water types.

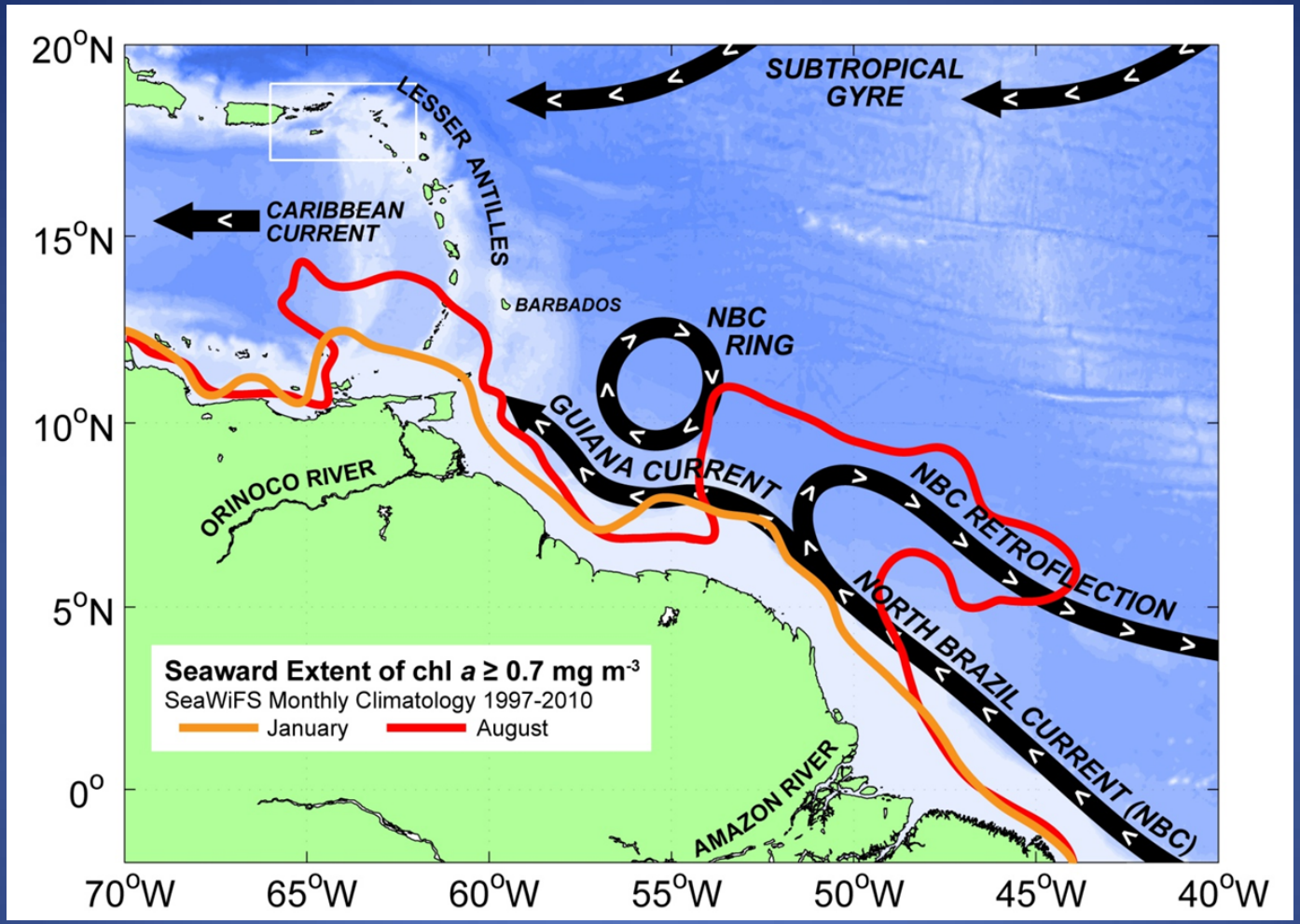
- The larval fish assemblages were statistically distinct between the three water types. The plume water contained mesopelagic and pelagic species not usually found in the area, and the non-plume water contained reef-associated, shallow water species.

General Conclusion

Ocean circulation plays an important role in controlling the distribution and abundance of larval fish. Two examples follow.



Strong currents (as illustrated by these drifter trajectories) can rapidly disperse larvae to remote regions, whereas quasi-stationary eddies and gyres can act to retain larvae near their original spawning areas as we have previously shown for the Mesoamerican Barrier Reef System (Barbara A. Muhling et al., *Fisheries Oceanography*, 409-428, September 2013).

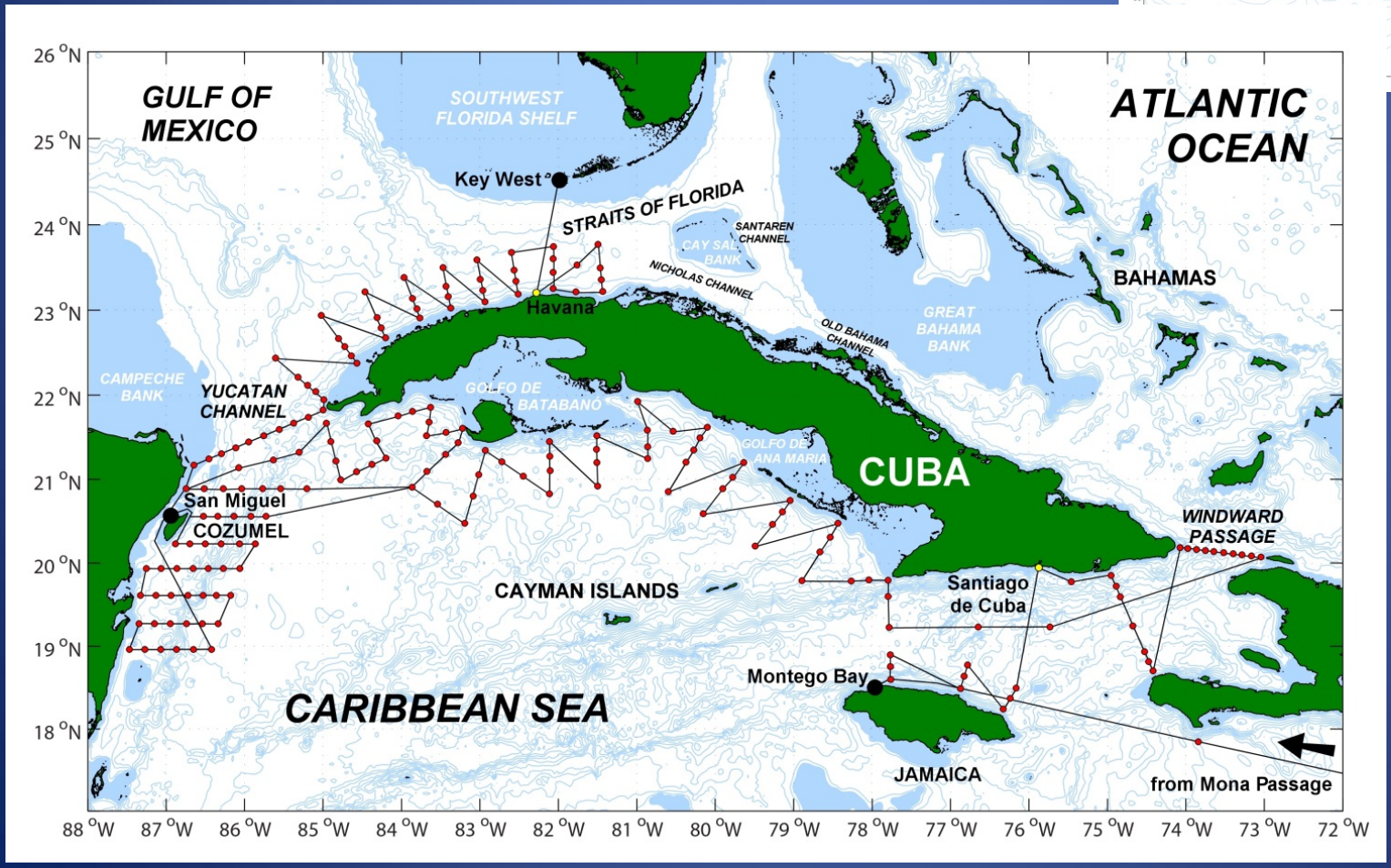


On the other hand, "traveling" eddies such as North Brazil Current Rings can have far-reaching effects on the regional larval fish assemblages due both to retention in the ring and the ring's transit over long distances (Elizabeth M. Johns et al., *Fisheries Oceanography*, 23(6), 472-494, November 2014).

Future work

Draft cruise track for the upcoming April-June 2015 fisheries oceanography cruise aboard the NOAA Ship *Nancy Foster*.

Leg 1



Legs 2, 3, and 4

Thank you!