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

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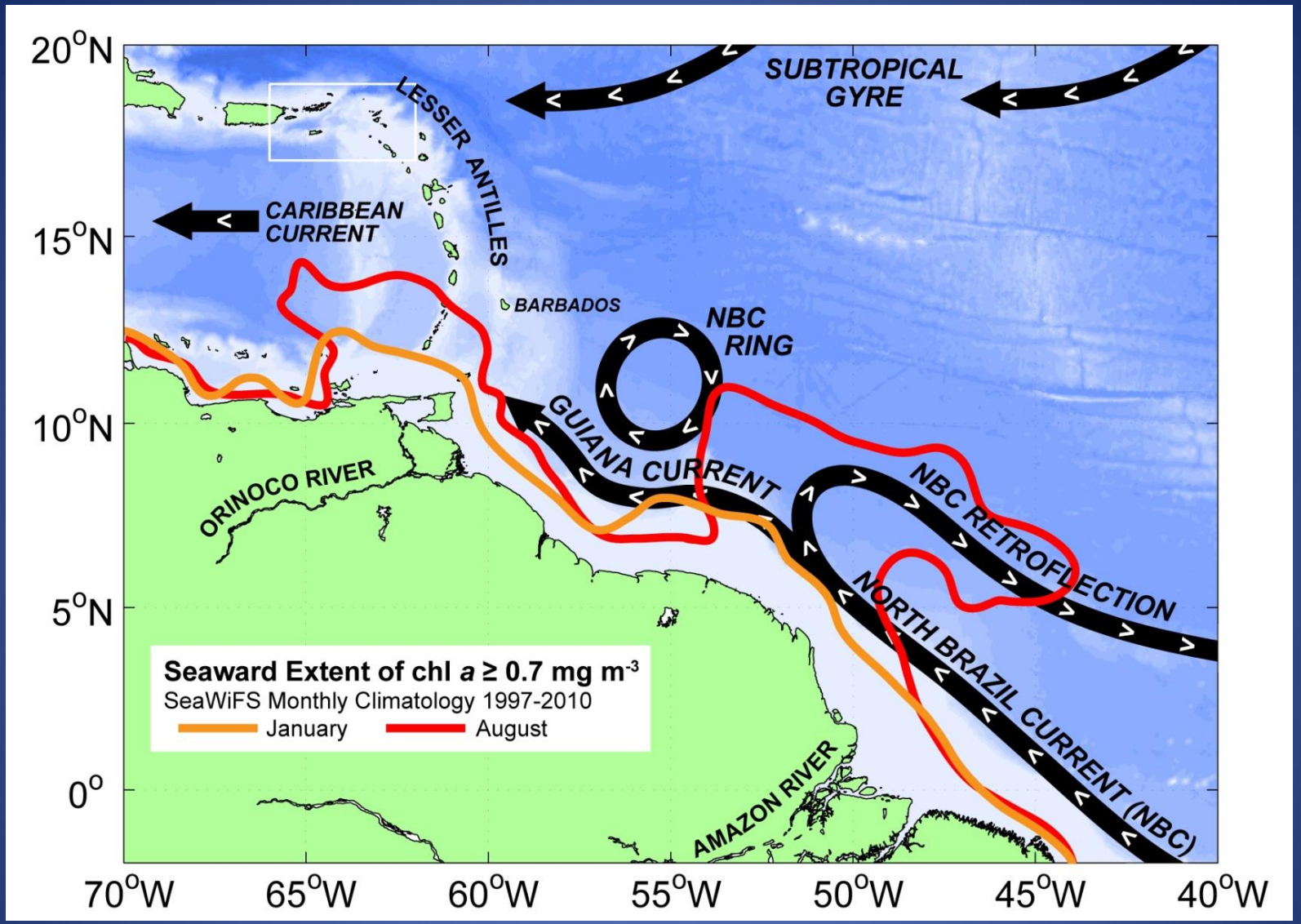
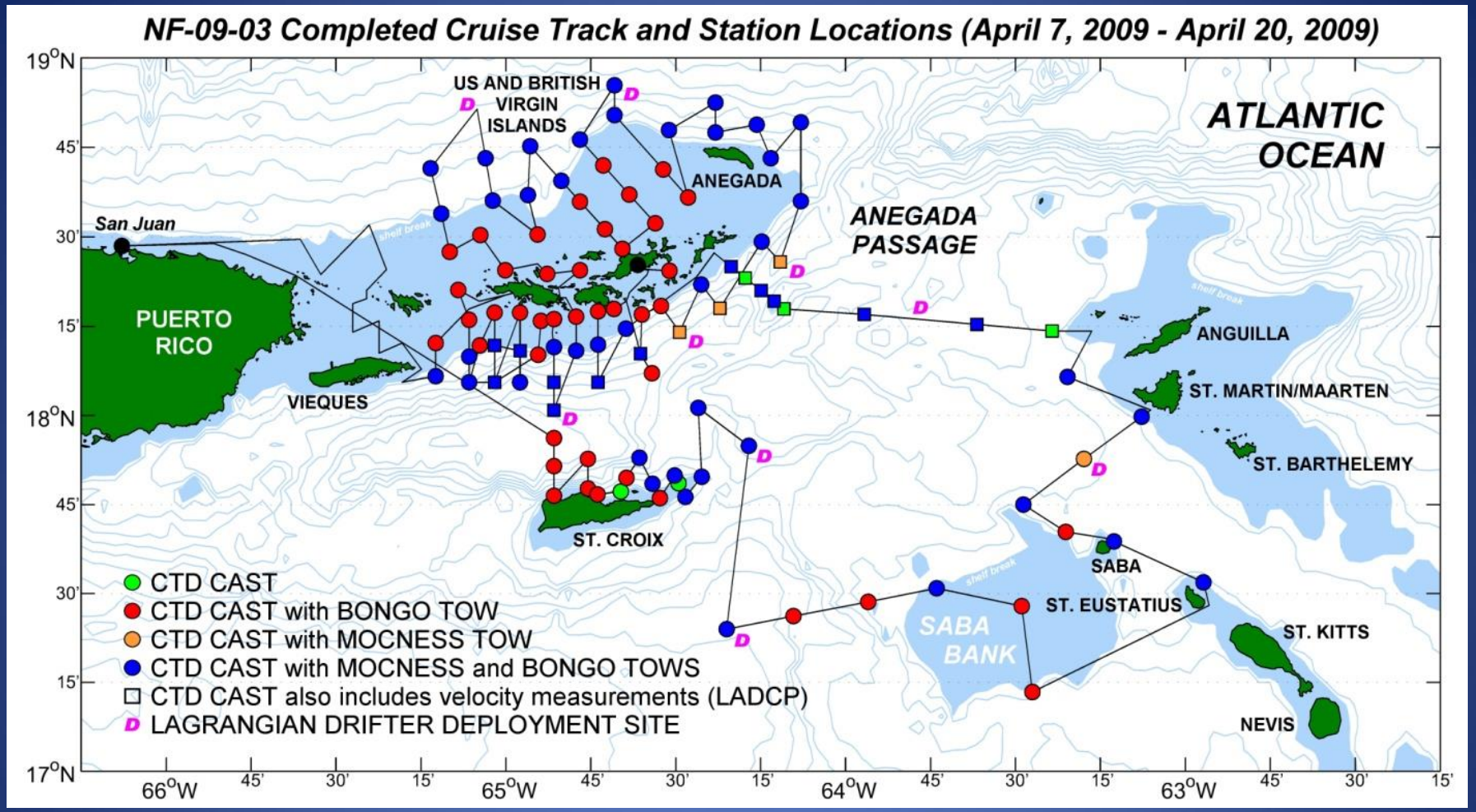
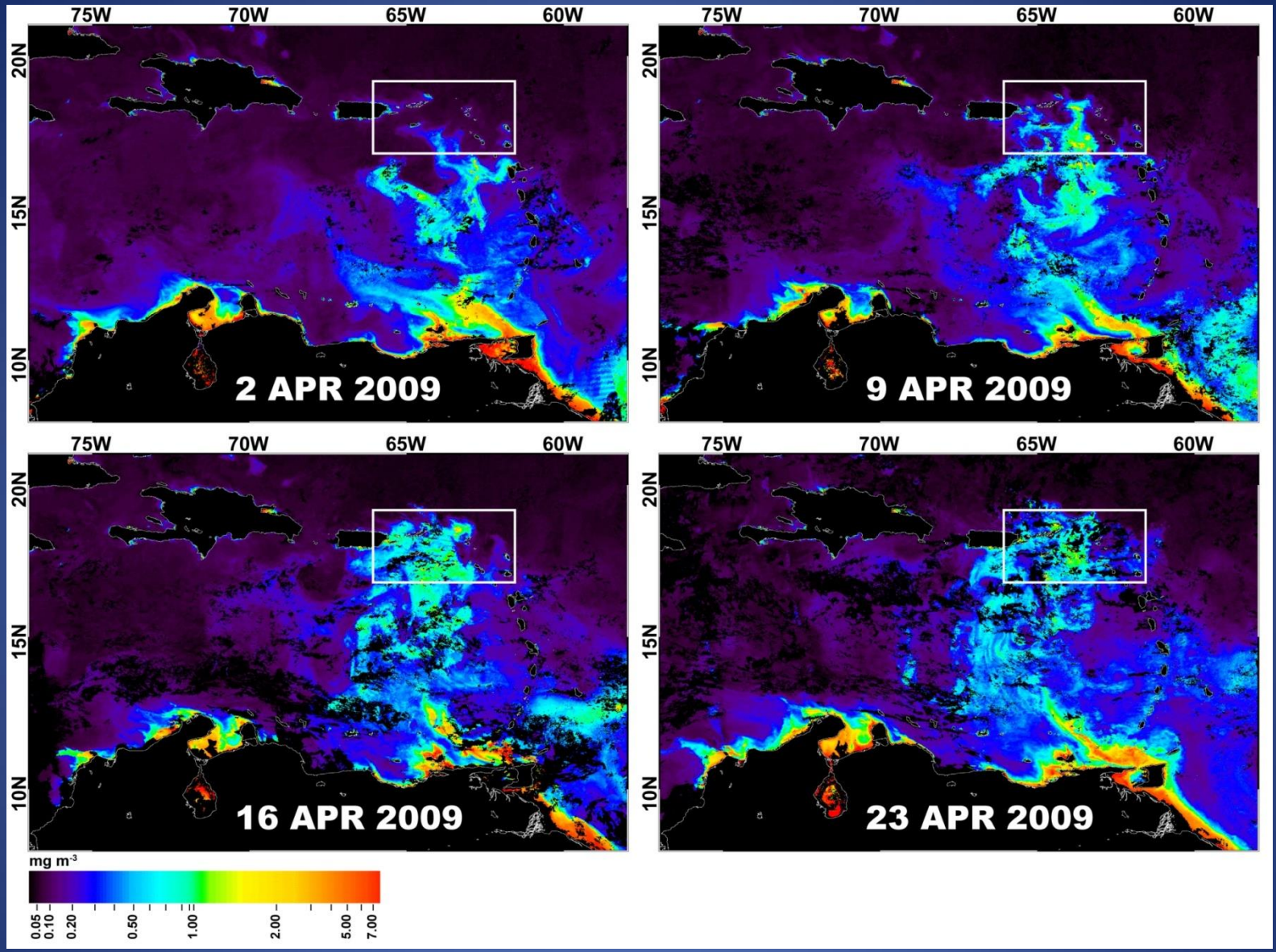


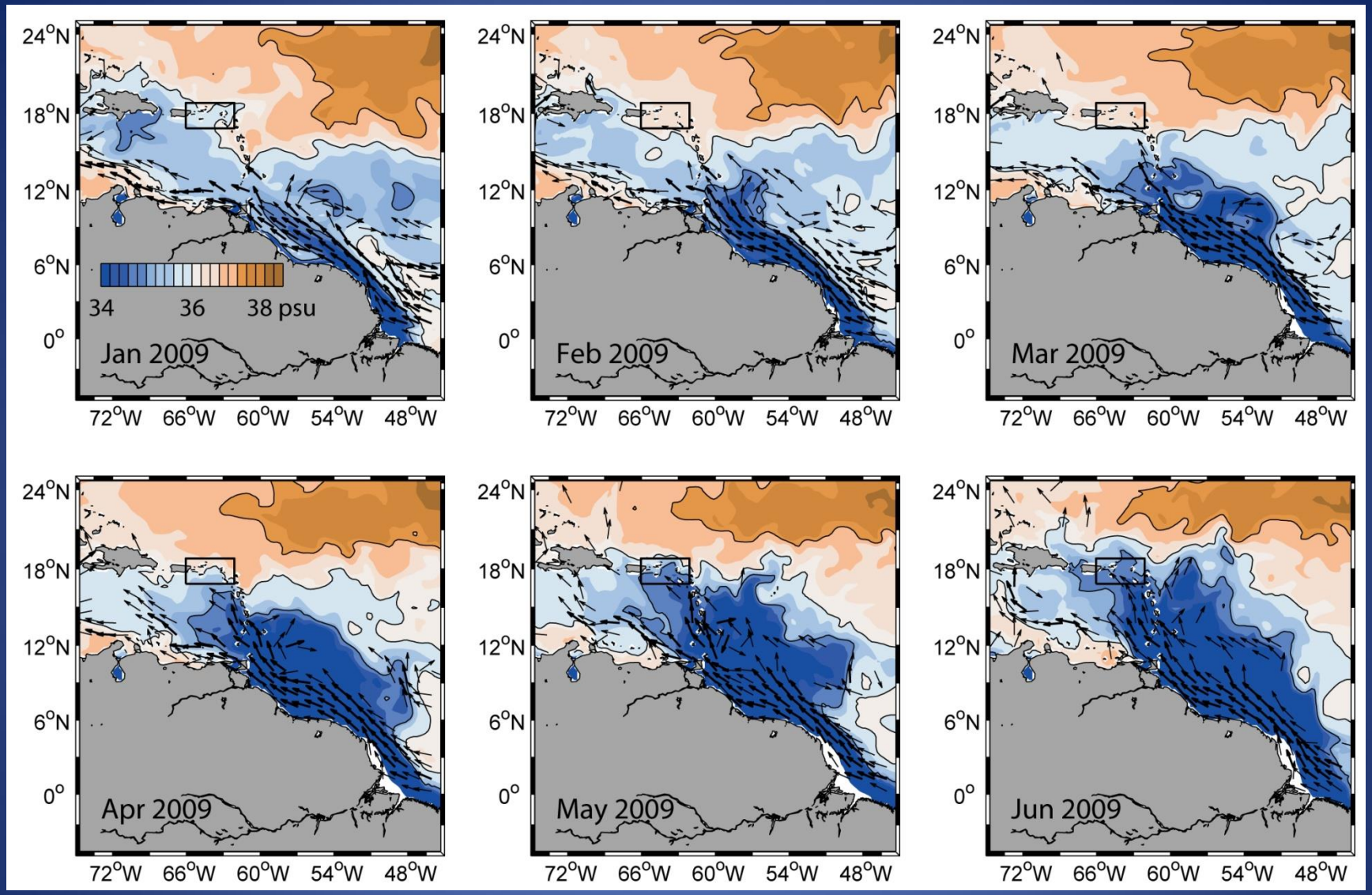
Schematic showing the Amazon and Orinoco river mouths, the seasonal variation of the North Brazil Current retroflection, other large-scale circulation features, and the location of the cruise study area in the northeastern Caribbean Sea.



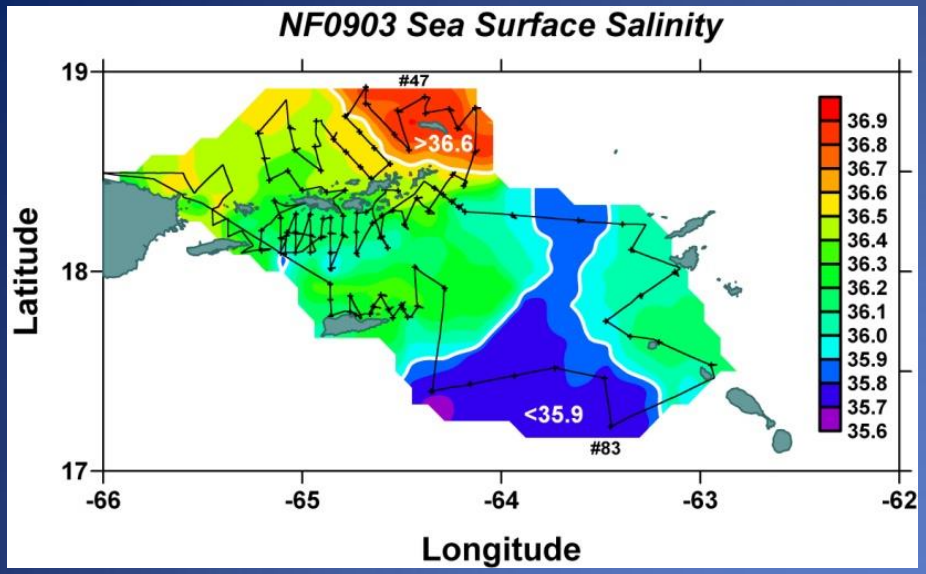
April 2009 cruise track showing station locations and activities including net tows and drifter deployments.

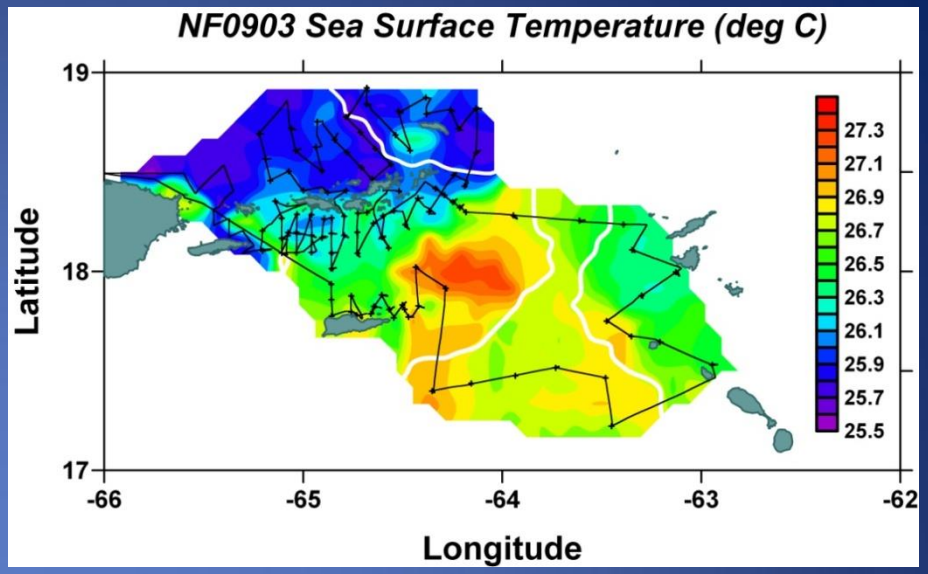


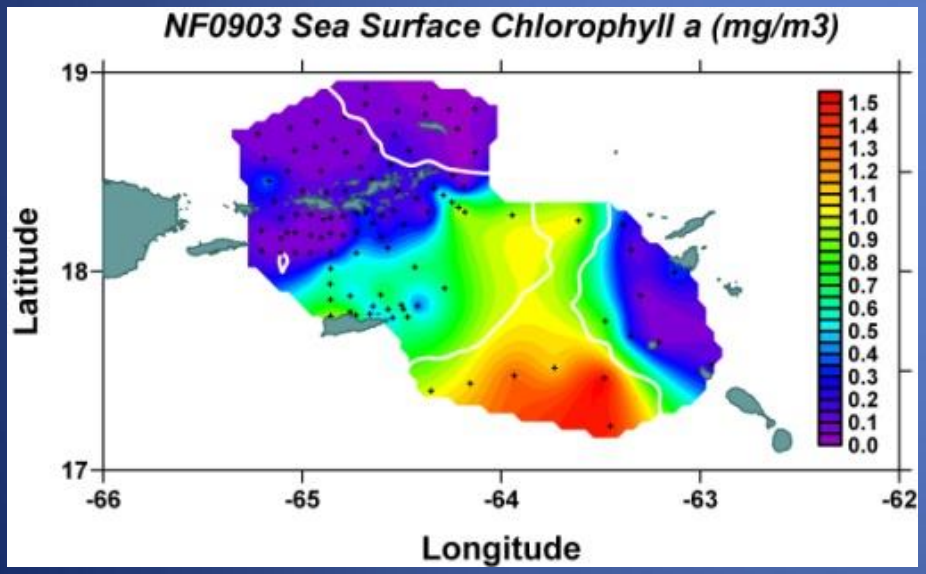
A weekly look at the Amazon River plume in the northeastern Caribbean during April 2009. The cruise area is shown as the white rectangle surrounding Puerto Rico, and the US and British Virgin Islands.

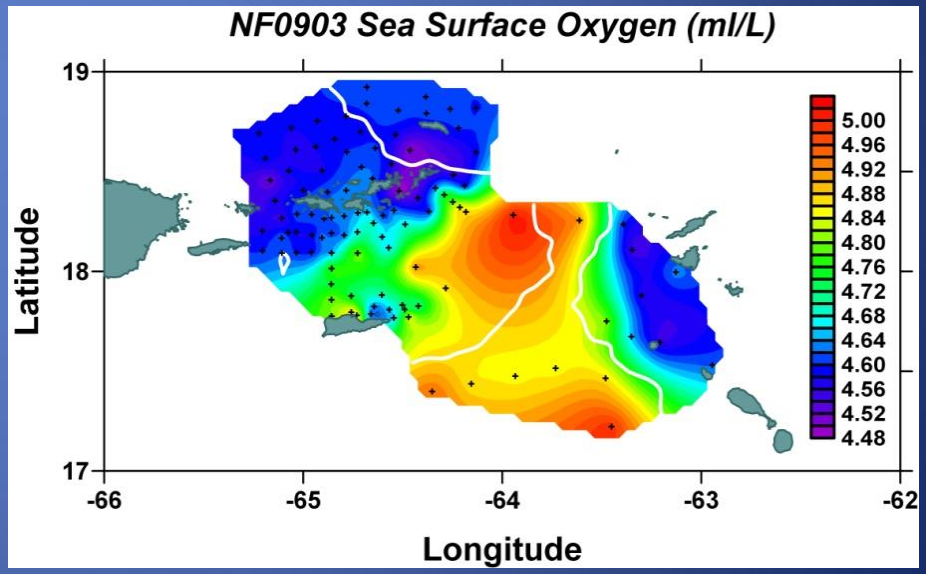


Monthly sea surface salinity fields from the data-assimilating MERCATOR Ocean numerical model. Surface velocity vectors are superimposed. The cruise study area is shown as a black rectangle.

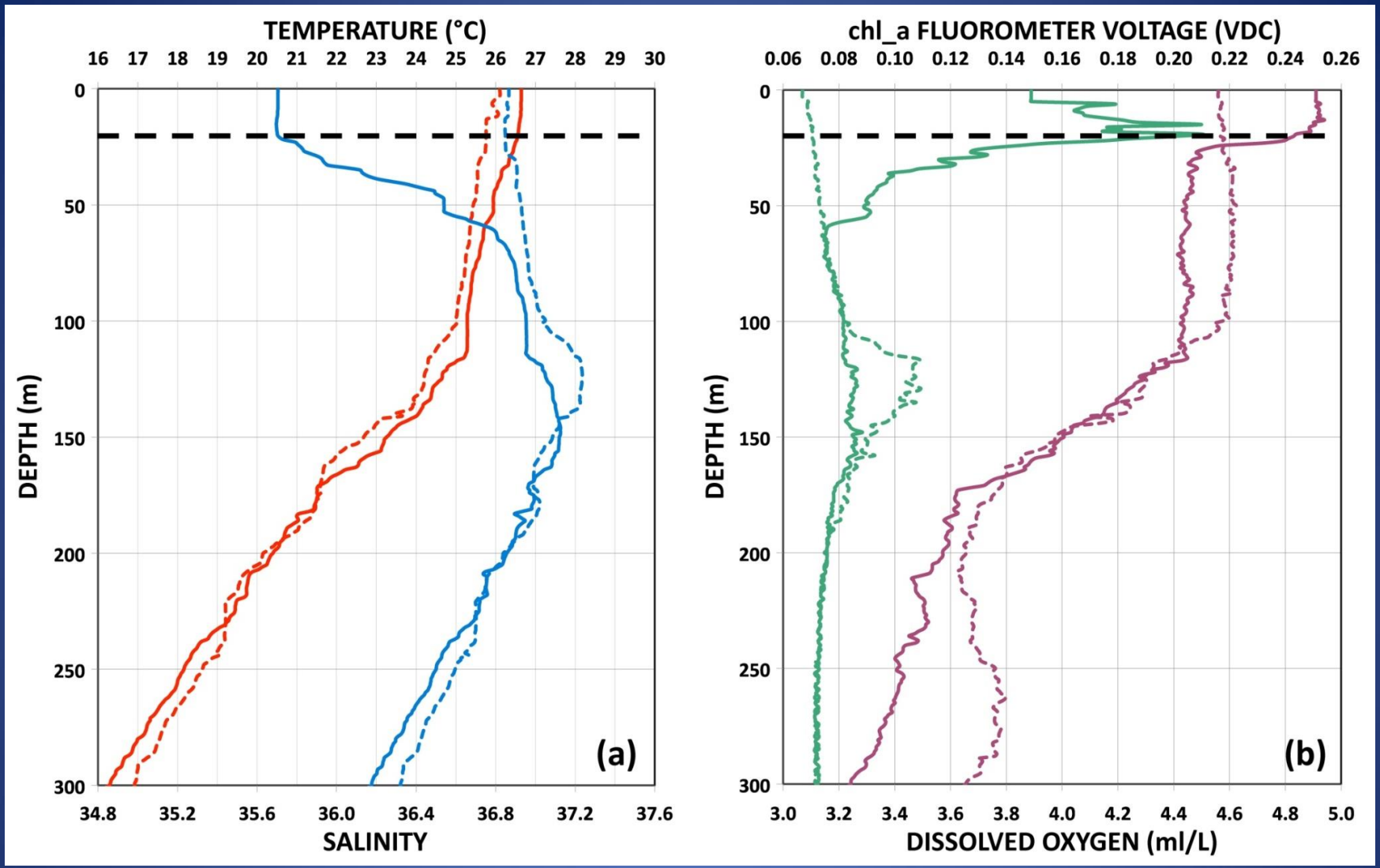




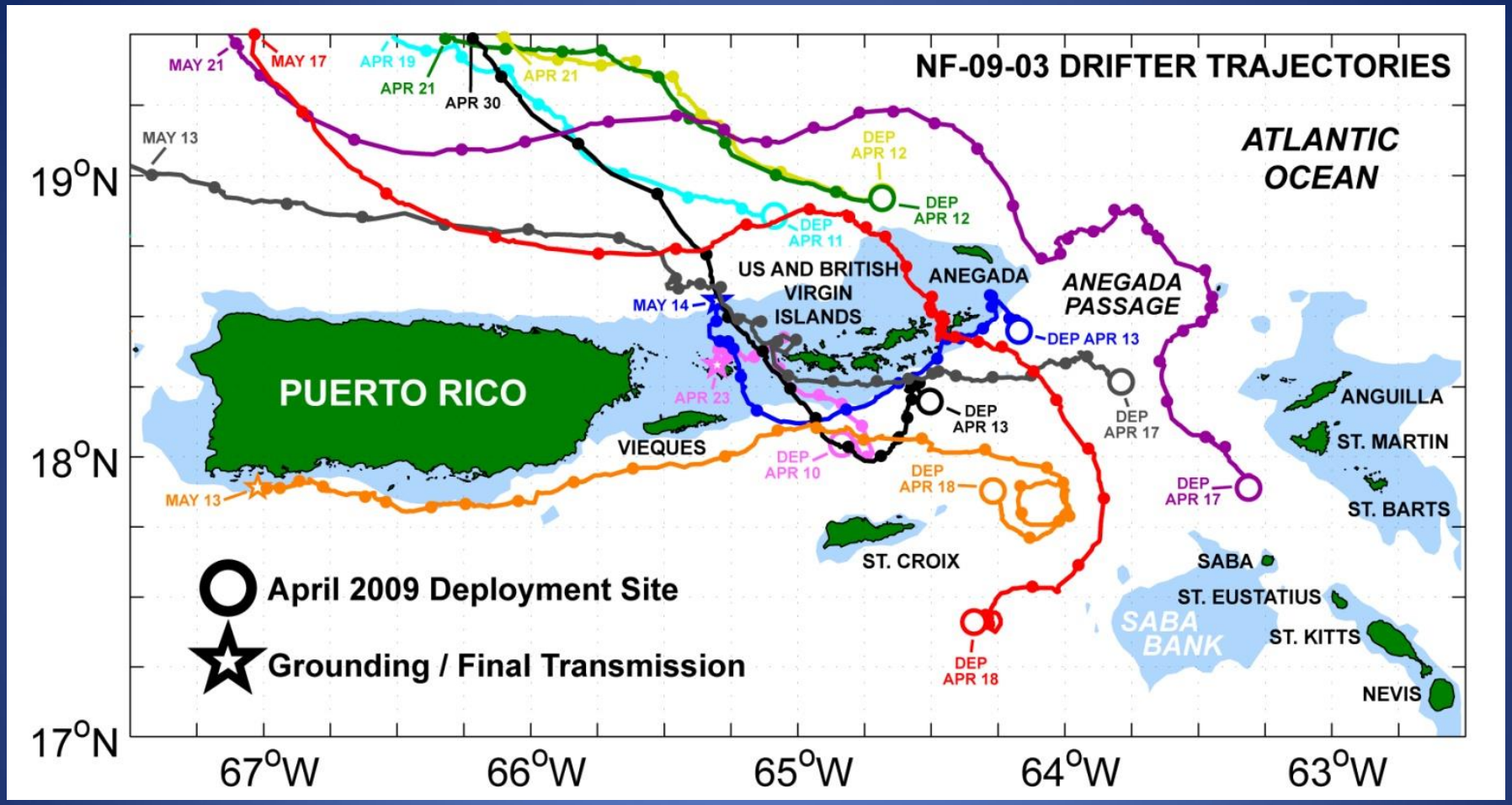




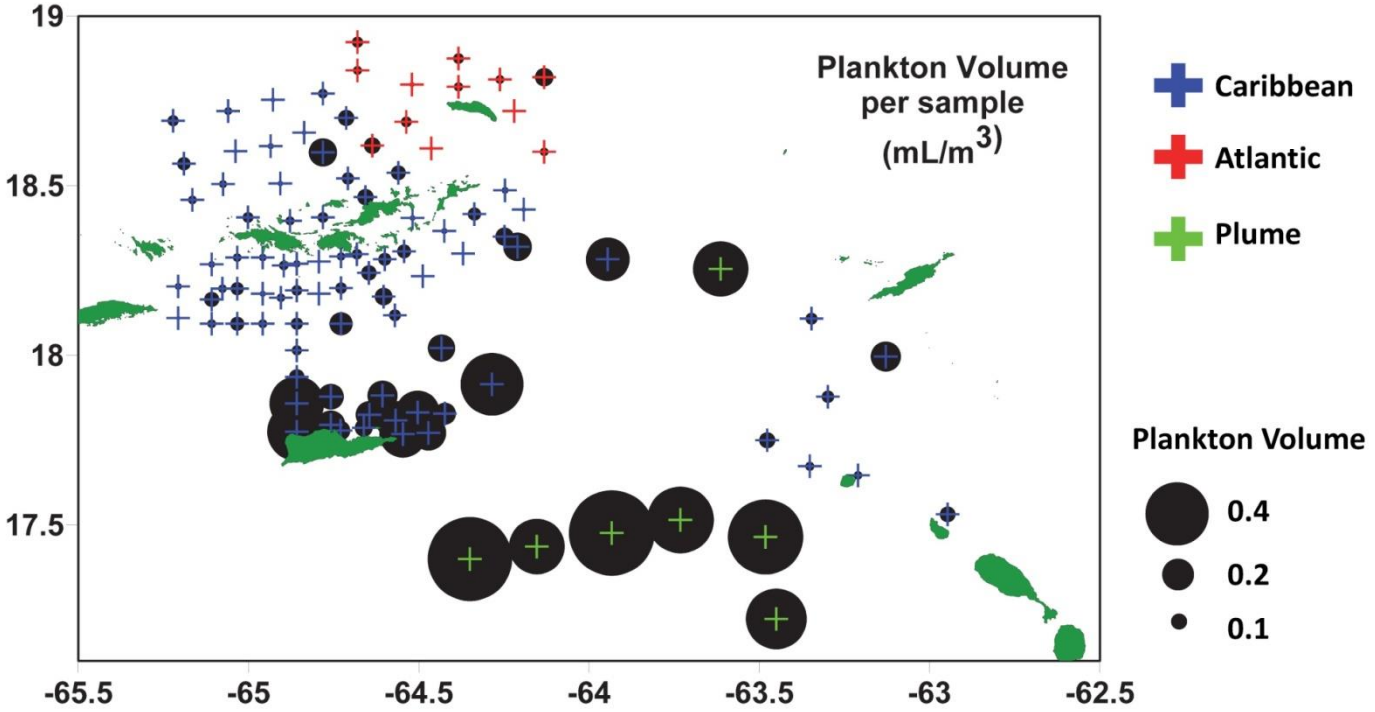
Maps of in situ sea surface salinity, temperature, chl *a*, and dissolved oxygen from the April 2009 cruise. The white lines delineate the 36.6 and 35.9 salinity contours.



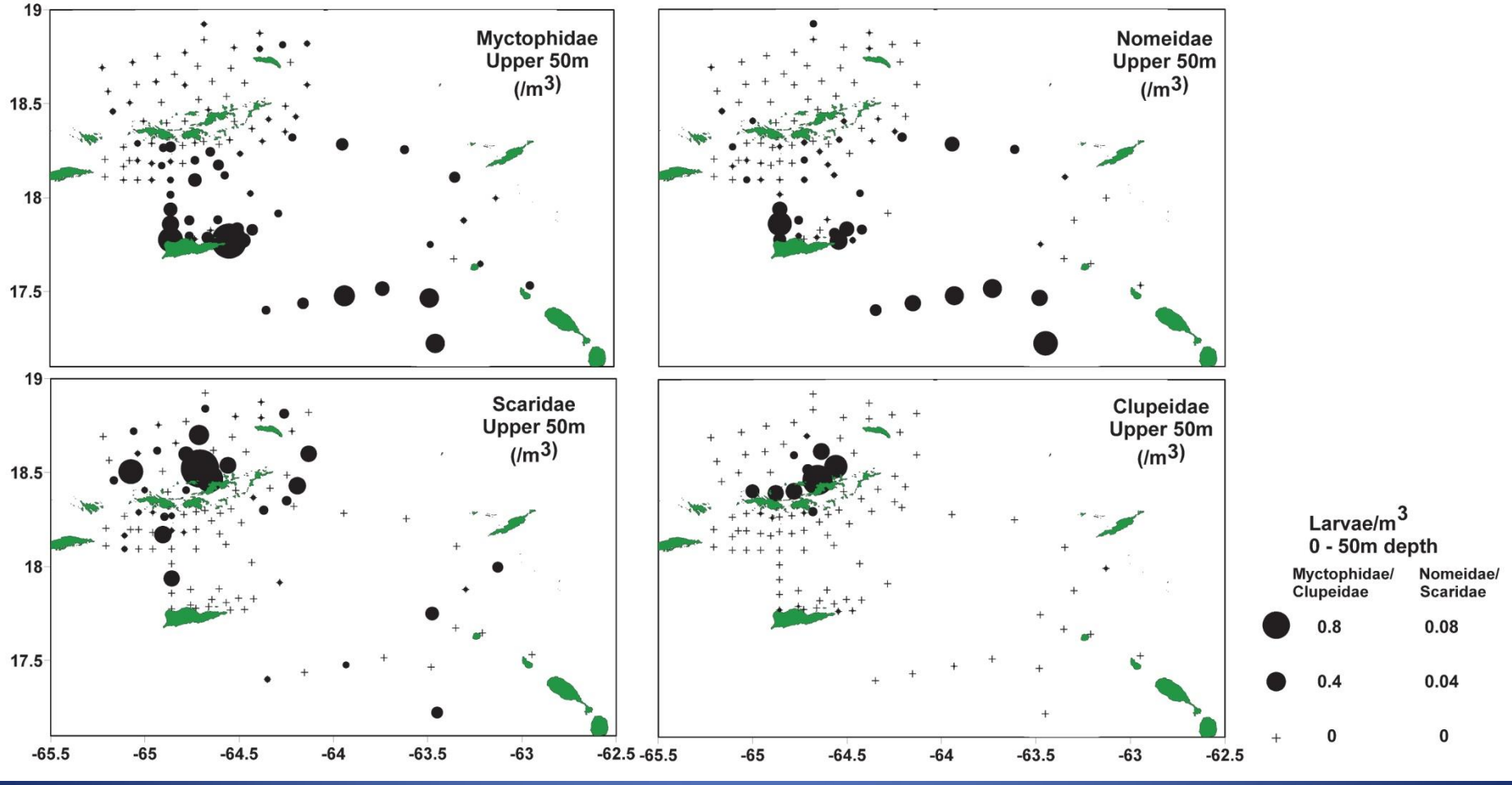
Vertical profiles of temperature (red), salinity (blue), chl *a* fluorometer voltage (green), and dissolved oxygen (purple). The solid profiles are from a plume station, and the dashed profiles are from an Atlantic station. The bold dashed line indicates 20 m depth, the approximate thickness of the plume.



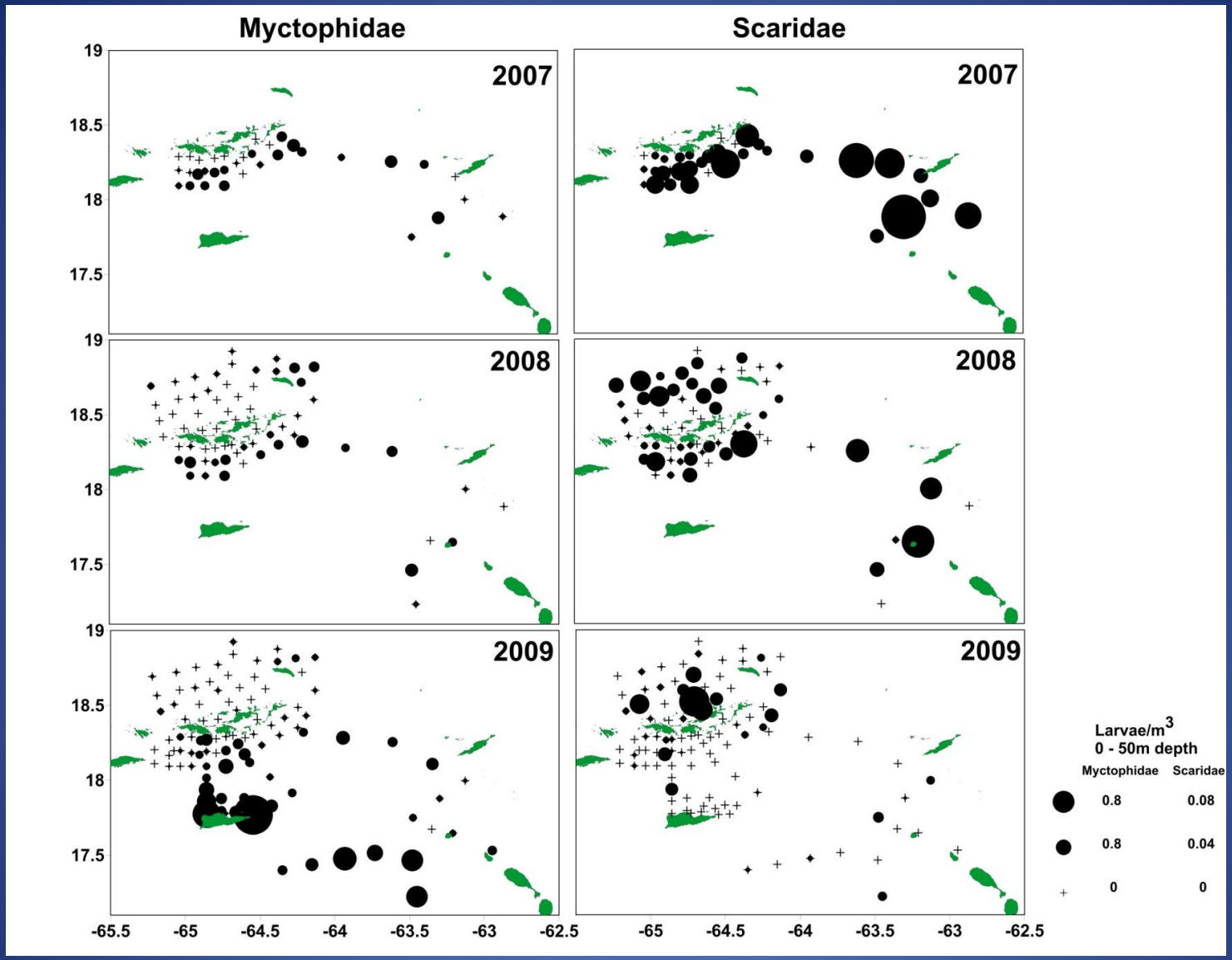
Trajectories of the nine drifters deployed during the April 2009 cruise. Note in particular the northward trajectories of the "purple" drifter through Anegada Passage, which is consistent with the spread of the plume water in the northeastern Caribbean.



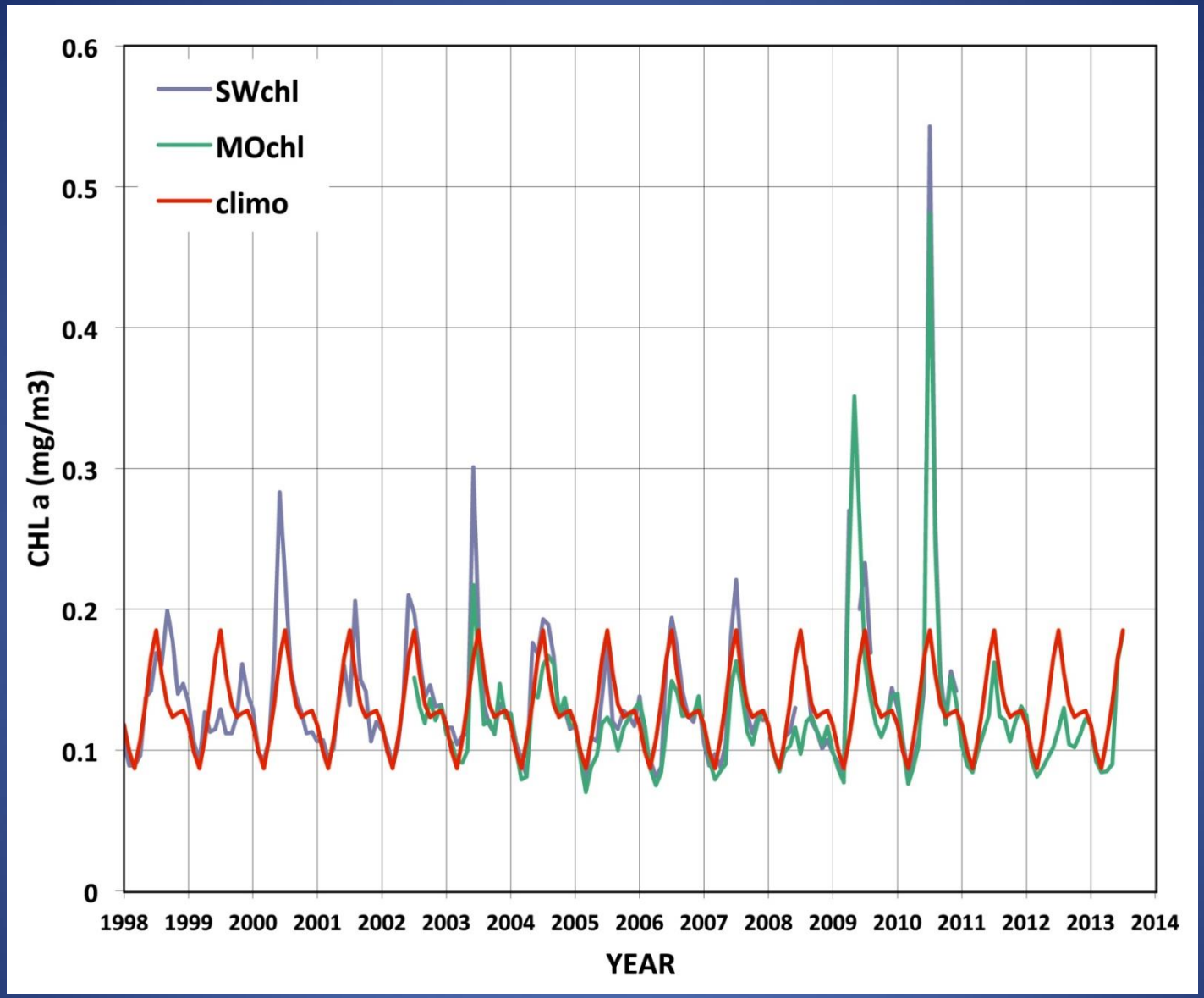
Total plankton volume sampled in the upper 50 m during the April 2009 cruise in Atlantic (red), Caribbean (blue), and plume (green) stations. There is a strong linear correlation (R^2 = .75) with surface chl *a*.



Upper 50 m distributions of lanternfish (Myctophidae), driftfish (Nomeidae), parrotfish (Scaridae), and herring (Clupeidae) larvae in # larvae/m^3. The plume waters were distinguished from the Caribbean and Atlantic water masses by having more pelagic and mesopelagic larval types (upper two maps) and fewer reef types.



Comparison of the distributions of a mesopelagic fish (left panel) and a reef fish (right panel) during the three sampling years 2007, 2008, and 2009. The reef fish types seen in the plume area during 2007 and 2008 were displaced by mesopelagics during 2009.



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

Summary

- 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 much of the northeastern Caribbean. The plume of turbid "green water" was unusual for this region and time of year, and received much attention.
- A research cruise in the area surveyed the plume with a variety of sampling techniques, including larval fish net tows. Three surface water types were identified based on surface salinity: Atlantic, Caribbean, and plume.
- The larval fish assemblages were statistically distinct between the three water masses identified. The plume water contained mesopelagic and pelagic species not usually found there, and the non-plume water contained the expected reef-associated, shallow water species.

General Conclusions

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

Strong currents can rapidly disperse larvae to remote regions, whereas quasi-stationary eddies and gyres can act to retain larvae near their original spawning areas as has been shown for the Mesoamerican Barrier Reef System.

On the other hand, “traveling” eddies such as the North Brazil Current Ring that delivered a plume of Amazon River water to the eastern Caribbean during spring 2009 can also 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.

Thank you!