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**Open-Ocean Energy Production:  
The Environmental Context**

**Howard P. Hanson**

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# Open-ocean Energy Production: The Environmental Context

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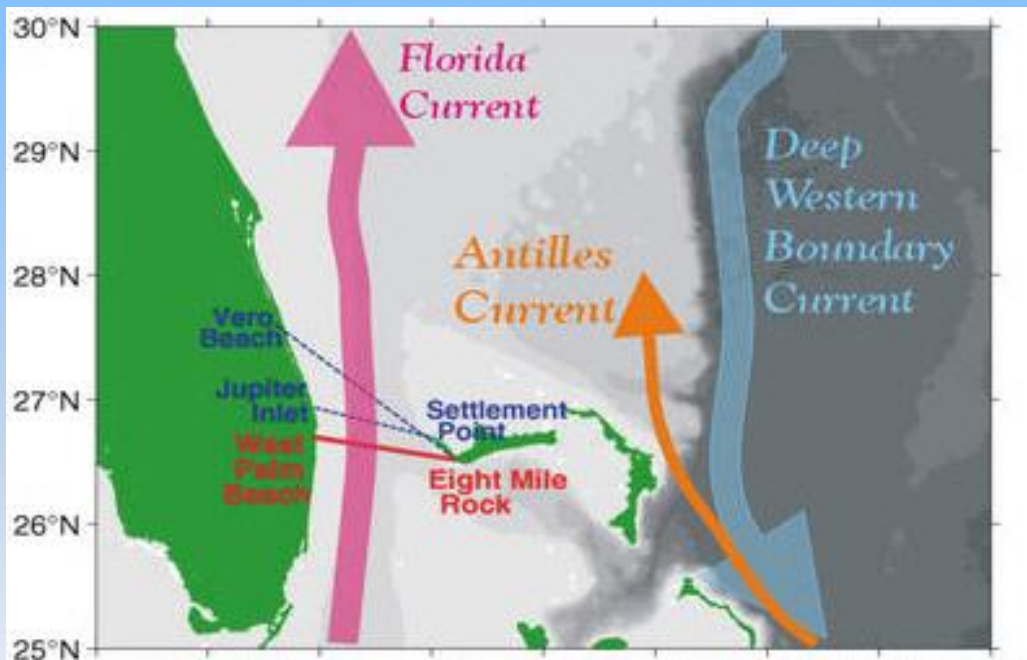
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***Précis:* Environmental issues present both challenges and opportunities for marine renewable energy development.**



# Ocean Energy: Focus on Florida

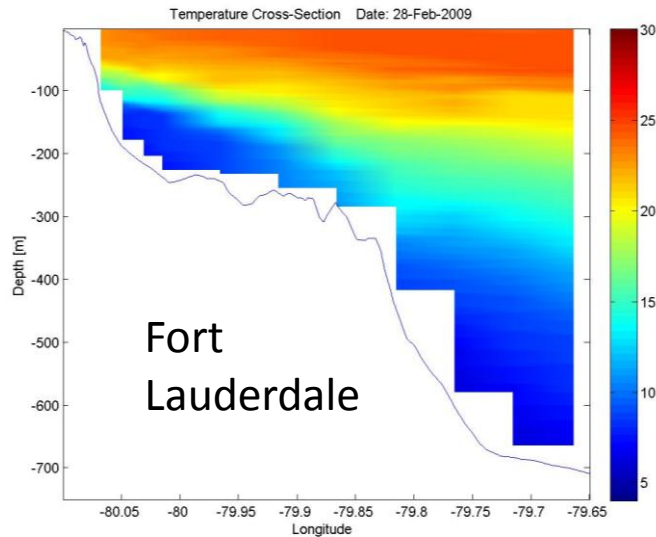
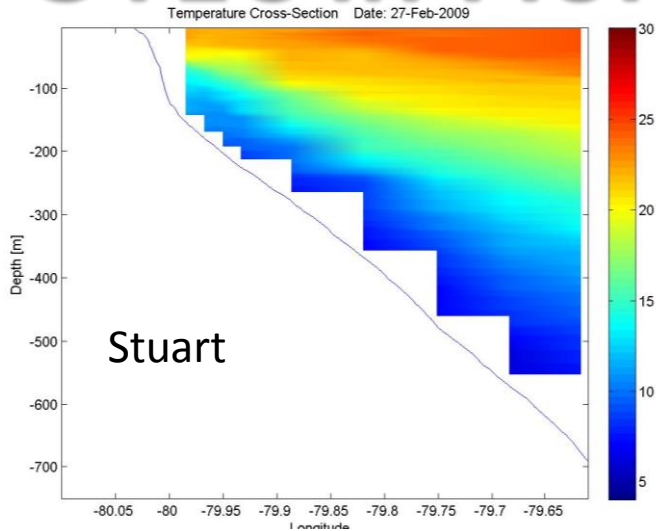
In Florida, generally speaking,  
the waves are weak and the tides are tame.



NOAA/AOML graphic

But we've got serious  
current, as well as a  
surprisingly robust  
thermal resource.

# OTEC in Florida?



Courtesy A. Leland, COET

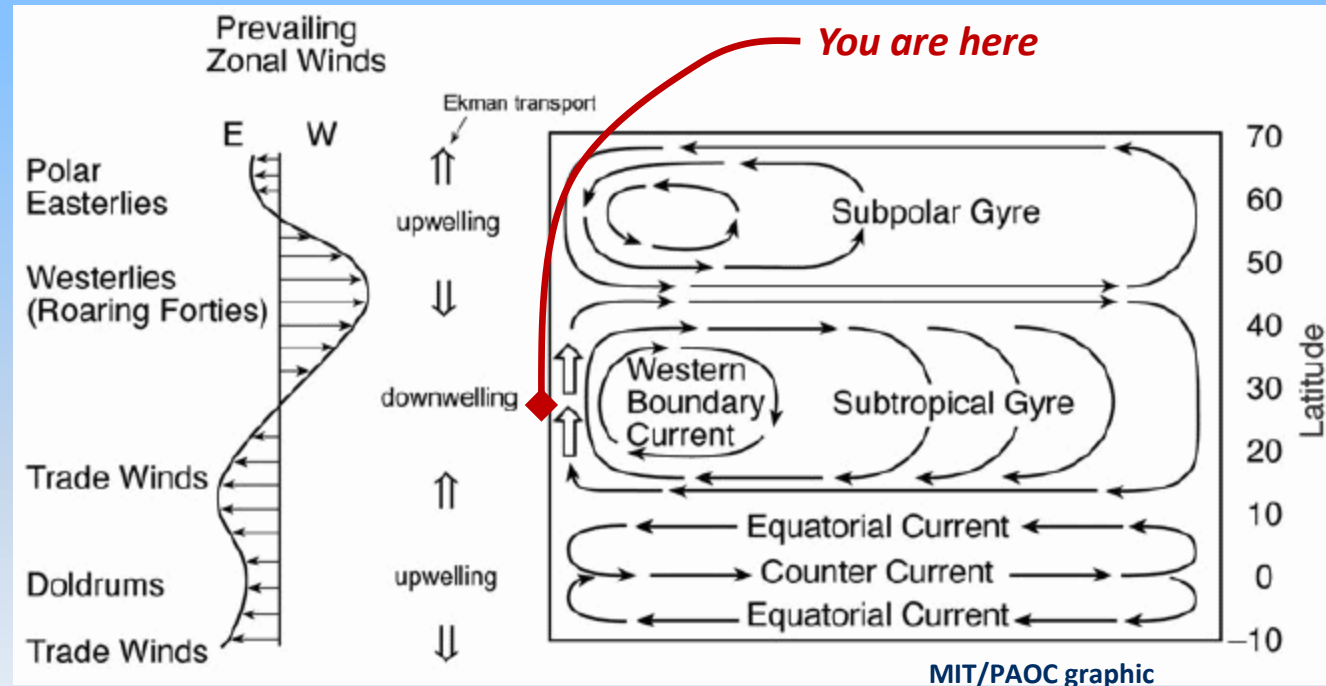
Even in the winter, there is a  $\Delta T$  of around  $20^{\circ}\text{C}$ ; in summer, it's larger.

Further, offshore of Miami/Ft. Lauderdale, the cold water is at  $\sim 200\text{-}300\text{m}$ . *And it's renewed continuously by the currents, our first priority.*

# The Florida Current...

...is part of the Gulf Stream System, the western boundary current of the North Atlantic wind-driven circulation.

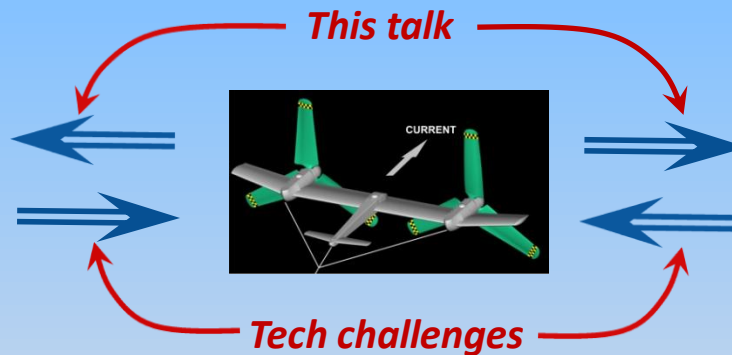
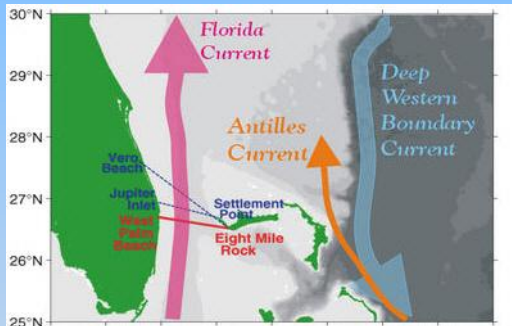
The amount of water carried northward is determined, to a large degree, by the winds.





# In turn...

...that water carries heat northward and provides a rich environment for a variety of migratory and resident marine species.

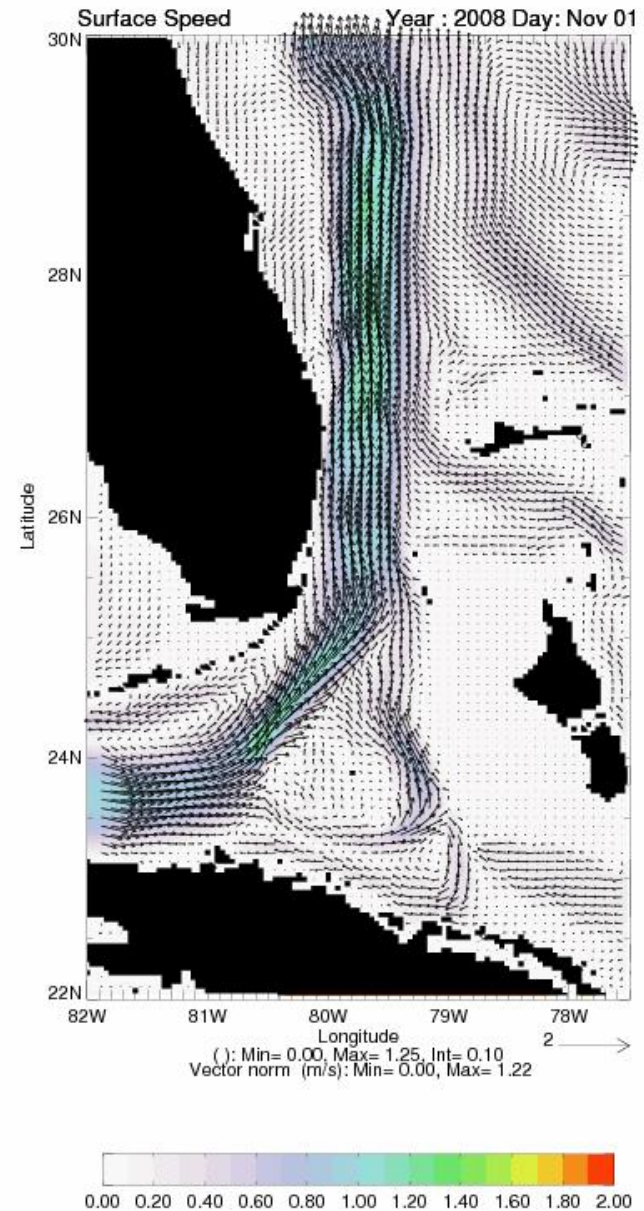


Thus, any energy development in the area will interact with both the physical and the biological environment.

# The Flow

Although the total transport northward is unlikely to change, nor will the temperature of that water, details of the flow may well be altered by large-scale deployments.

How and where (and why) is under investigation using the HYCOM.

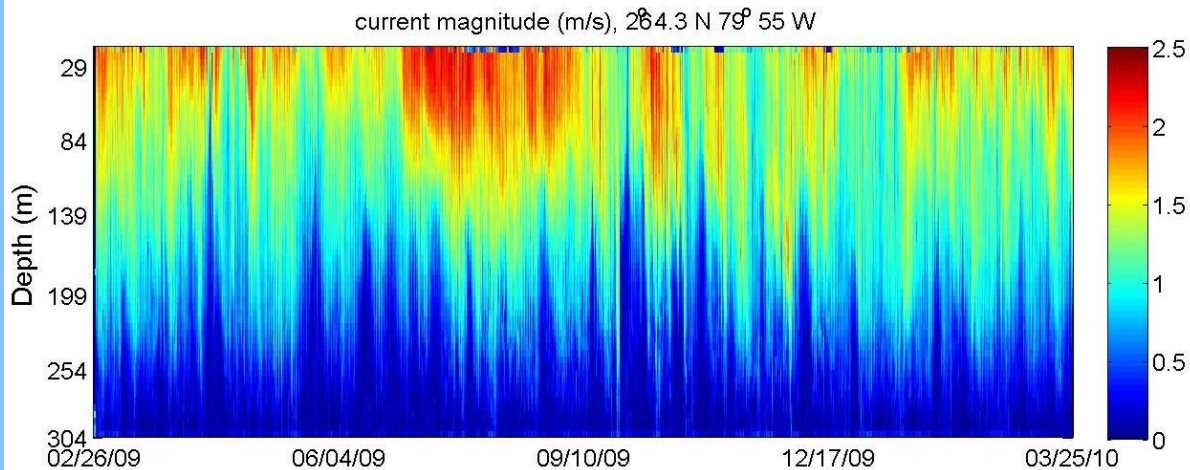


Courtesy A. Bozec, FSU

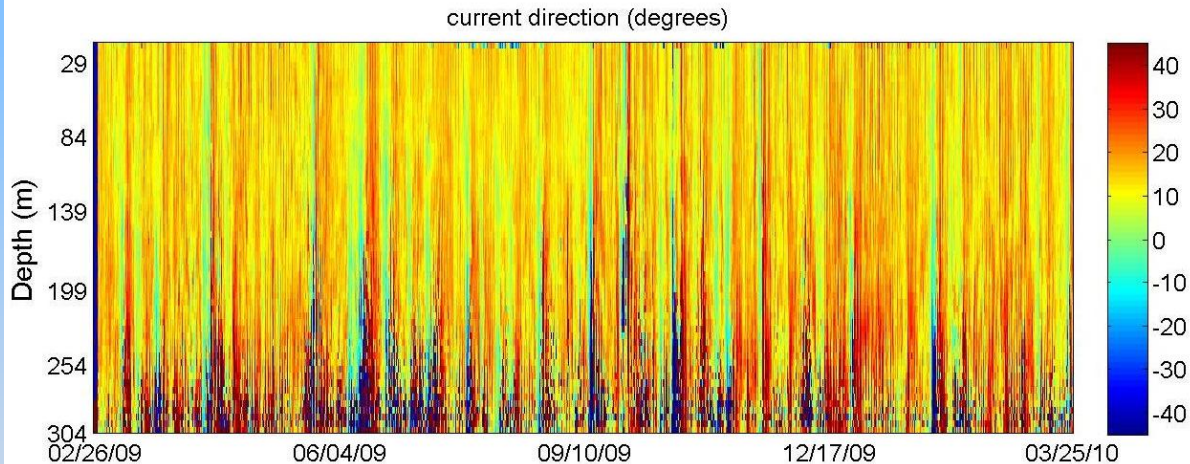
# Who Cares?

The shipping industry, for one. Generating system developers, for another.

The role these variations play in ecosystem dynamics is unknown and needs considerable study to develop the understanding needed to assure stewardship.



Courtesy J. van Zwieten, COET





# Marine Life

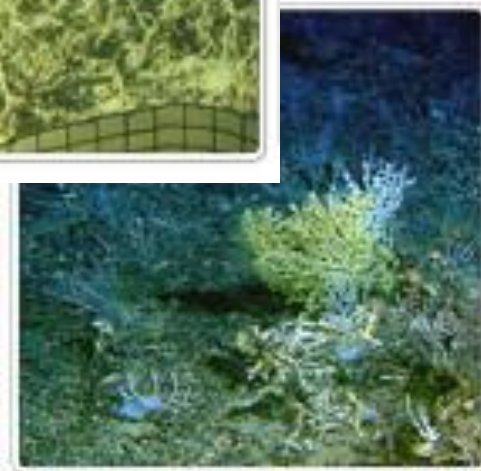
Of perhaps more concern is the effect of energy development on marine life, concern that extends from the bottom to the top of the water column.

It is a given that renewable energy development must take place within a framework of environmental stewardship.

This topic is broad and far too involved to cover here, so two brief examples will have to suffice.

# Lopheila

The existence of these cold/deep-water corals will provide challenges for ocean-bottom activities. The patchy nature of their distribution throughout the region of interest will require great care with emplacements of anchors and underwater cables.





# Sea Turtles

All species are endangered.

Like tourists, they *love* our beaches (but for different reasons).

Little is known about their at-sea behavior, and how they might react to energy-system deployments is a complete mystery. Research is needed.



# Outlook

Responsible environmental stewardship is a foundation principle for deployment of marine renewable energy systems. Challenges abound in all locations; South Florida's are representative of the difficulty.

Testing centers such as that planned at COET present opportunities to initiate new research efforts to increase understanding of critical issues and develop mitigation measures for the future.



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