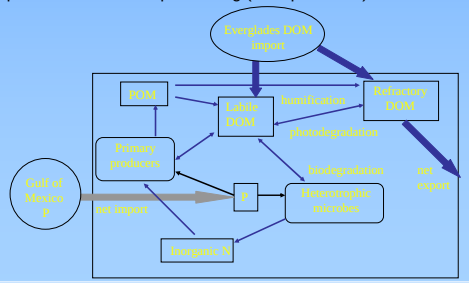
FATE AND EFFECTS OF EVERGLADES DISSOLVED ORGANIC MATTER IN FLORIDA BAY

Stephen Kelly, David Rudnick, Christopher Madden, Chelsea Donovan and Joshua Creasser (2003)

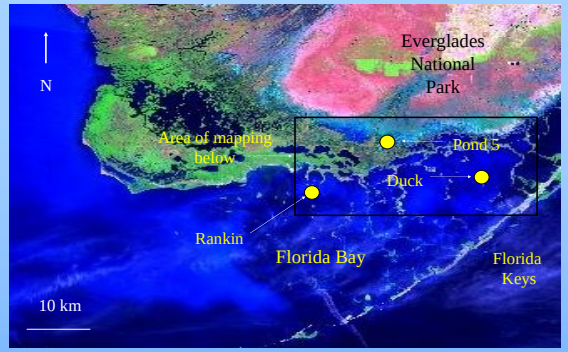
Introduction

Hydrologic restoration of the Everglades system will result in increased fresh water flow to Florida Bay. Nutrients, especially dissolved organic nitrogen associated with this increased flow, may impact the Florida Bay ecosystem. Little is known of the fate and effects of Everglades dissolved organic matter (DOM) in Florida Bay. This is a key uncertainty regarding the effect of Comprehensive Everglades Restoration Plan (CERP) implementation on the Florida Bay system.

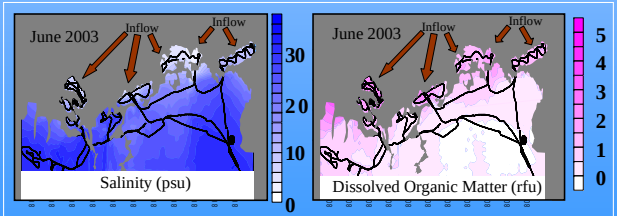
Conceptual Model of DOM processing (N steps in blue):



Study Area



Shipboard Mapping of Everglades Outflows

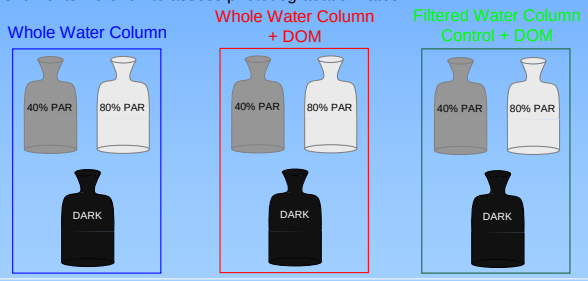


Map above shows coverage area with boat tracts

- Areas with high fresh water flow have low salinity and high concentrations of colored DOM (CDOM, measured by fluorescence)
- Fate and effect of this CDOM in the Bay is unknown
- DOM may be degraded via microbial and photochemical processes

Short Term Experiments on Everglades DOM in Florida Bay

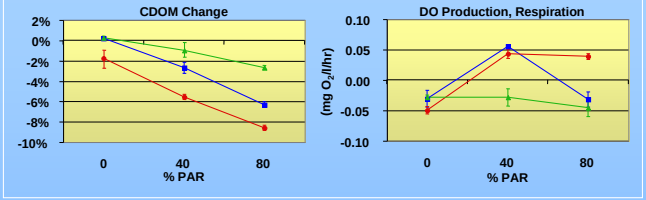
Experiments were run for 3-5 hours with Florida Bay water collected at Rankin (11 mg/l DOC), with and without amendments (10 ml) of 0.2 µm filtered DOM-rich water from Pond 5 (13-16 mg/l DOC). Controls (0.2 µm filtered Rankin water) with DOM amendments were run to assess photodegradation rates.



Rankin Whole Water Column Incubations, March 2002

CDOM fluorescence decreased with increasing light in all treatments. Decreases in 0.2 µm filtered controls (green) indicate maximum photodegradation rates. CDOM loss with biota (blue) was more rapid than with filtered controls and most rapid with Pond 5 DOM additions (red). CDOM loss occurred in the dark only with Pond 5 DOM additions. Dissolved oxygen (DO) production was stimulated by DOM additions under high light conditions.

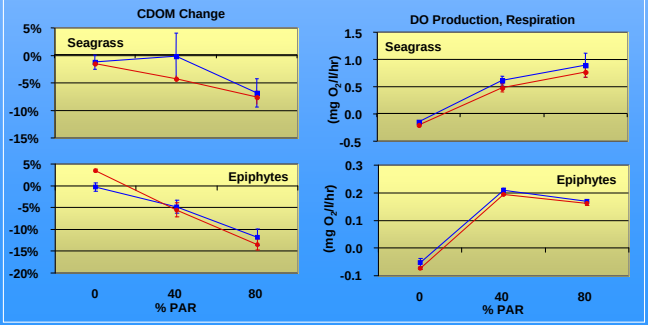
No DOM Addition **DOM Addition** **Filtered Control + DOM Addition**



Rankin Seagrass and Epiphyte Incubations, June 2003

In contrast to the water column experiments (above), seagrass and epiphyte experiments resulted in no clear treatment effect (with and without wetland DOM amendments) for either CDOM or DO changes.

No DOM Addition **DOM Addition**

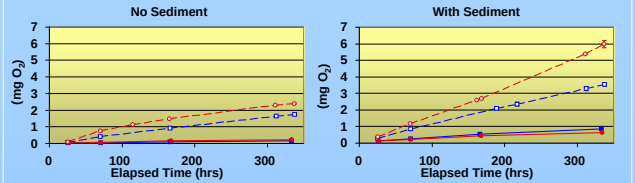


Long Term Experiments on Everglades DOM in Florida Bay

Experiments were run for 14 days in duplicate 300 ml BOD bottles in the dark. Source waters were Duck Key (8 mg/l DOC) and Pond 5 (10 mg/l DOC). Water was filtered (0.2 µm) to exclude ambient microbes. Salinity in Pond 5 water was increased to that of Duck water, using NaCl. An inoculum of Duck Key bacterioplankton (1.5 mls of GF/F filtrate) or benthic microbes (0.6 g of Duck Key sediment slurry) was added to each bottle. Experiments were run with or without nutrient amendments (phosphate plus glucose) that were intended to ensure N limitation. Results are presented as the cumulative DO uptake per bottle in mg O_2.

Cumulative Oxygen Uptake, August 2003

Duck:No Nutrient Addition **Pond 5: No Nutrient Addition**
Duck:Nutrient Addition **Pond 5:Nutrient Addition**



Results show strong nutrient effects - DO consumption was stimulated by nutrient additions. This effect was relatively greater in water column experiments than sediment experiments (12 fold increase in DO consumption vs. 4 -10 fold increase). DO consumption was higher with microbial decomposition of Pond 5 DOM than Duck Key DOM when nutrients were added. This difference was most pronounced in bottles with sediments, with DO demand with Pond 5 water nearly 2 fold that with Duck Key water.

Conclusions

- DOM is transported from the Everglades to Florida Bay with fresh water.
- CDOM fluorescence is a sensitive indicator of Everglades DOM.
- CDOM in Florida Bay decreases rapidly with distance from the shore line.
- In 5 hr experiments, CDOM loss increased as a function of light intensity.
- This CDOM loss appears to be mostly via the activity by pelagic microbes.
- Photodegradation accounted for about 25% of observed total CDOM loss.
- Everglades DOM additions stimulated pelagic primary production at high light levels during 5 hr incubations.
- Seagrass leaves and epiphytic microbes did not appear to process Everglades CDOM.
- In two week experiments, microbial respiration was increased with Everglades DOM additions when P and C are readily available.
- Preliminary results indicate that Everglades DOM is readily transformed in Florida Bay via abiotic and biotic processes. In regions that are rich in P and labile C, microbial activity (including nutrient cycling and algal production) may be stimulated by nitrogen in Everglades DOM. The magnitude of this stimulation remains to be determined.