Hurricanes Accelerate Dissolved Organic Carbon Cycling in Coastal Ecosystems

Ge Yan¹,²*, Jessica M. Labonté³, Antonietta Quigg³,⁴, Karl Kaiser²,⁴

¹Institute of Deep-Sea Science and Engineering, Chinese Academy of Sciences, China
²Department of Marine and Coastal Environmental Science, Texas A&M University at Galveston, United States
³Department of Marine Biology, Texas A&M University at Galveston, United States
⁴Department of Oceanography, Texas A&M University, United States
*correspondence: yange@idsse.ac.cn
Hurricane Harvey

- August 26-30, 2017
- Category 4 (>130 mph)
- 93 km³ of rainwater over 5 days

R/V Trident

- five trips (T1-T5), 10 stations (S1-S10)
- surface water
- 0.2 μm filtration
Methods and approach

- dissolved organic carbon (DOC)
- dissolved lignin phenols (TDLP<sub>9</sub>)
- dissolved enantiomeric amino acids (THAA)
- UV-VIS absorbance properties
- bacterial community composition and function

L-amino acids (LAA)
- phytoplankton production

THAA=LAA+DAA

D-amino acids (DAA)
- bacterial production
Evolution of DOC distribution and sources

upper bay      lower bay

Salinity (psu)

DOC (nmol L$^{-1}$)

Terrigenous input

Phytoplankton production

Bacterial production

LAA - C (nmol mgC$^{-1}$)

DAA - C (nmol mgC$^{-1}$)
tDOC flux = freshwater DOC × freshwater export flux

Determination of freshwater endmember DOC
Method 1: measured river DOC concentrations during the first sampling cruise
Method 2: extrapolated DOC at salinity 0 using DOC/salinity relationship

The input of tDOC to Galveston Bay for the entire storm event was 87 ± 18 Gg (95% was delivered within the first week), which is equivalent to the average annual tDOC load to Galveston Bay.
tDOC source and degradation mechanism

Major source — leachates from nonwoody tissues (e.g., leaves and grasses) of angiosperm vegetation

Citation: Lu C-J, Benner R, Fichot CG, Fukuda H, Yamashita Y and Ogawa H (2016) Sources and Transformations of Dissolved Lignin Phenols and Chromophoric Dissolved Organic Matter in Otsuchi Bay, Japan.
**tDOC removal**

\[ \text{TDLP}_9 - C \ [\text{nmol mg C}^{-1}] = \frac{\alpha \times f_R}{f_R + \beta} \]

- \( f_R \) – fraction of river water
- \( \alpha, \beta \) – model parameters

**Freshwater endmember**
- measured values in river water during first cruise

**Seawater endmember**
- DOC assumed to be 80 \( \mu \)M
- lignin = 0

High decay constant (~3 times) → highly labile tDOC and/or efficient removal process
Linking mineralization of tDOC to microbial community structure

relative composition of major bacterial classes

bacterial community change → change in decay rate

freshwater/soil/sedimentary microorganisms (e.g., Betaproteobacteria) → estuary/marine microorganisms (e.g., Cyanobacteria)

heat map showing scores of gene expressions

heterotrophy/tDOC metabolism → autotrophy/planktonic DOC metabolism
During and immediately after Harvey

87±18 Gg angiosperm nonwoody

Following Harvey

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