Assessing inorganic carbon export from intertidal salt marshes using direct, high-frequency measurements

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Measuring and modeling DIC in the salt marsh at Sage Lot Pond

Two methods to estimate DIC: CHANnelized Optical Sensor (CHANOS) (Wang et al. 2015) and Multiple Linear Regression (MLR) (Wang et al. 2016)
DIC directly measured by CHANOS vs DIC estimated by MLR

(a) CHANOS DIC vs Discrete bottle DIC vs MLR DIC

(b) Salinity, Temperature, Water level

Rain

DIC (μmol kg⁻¹)

Rain (mm)

Water level (m)

Temp. (°C) or Sal. (PSU)

Jul 10  Jul 15  Jul 20  Jul 25  Jul 30  Aug 04  Aug 09

Jul 10  Jul 15  Jul 20  Jul 25  Jul 30  Aug 04  Aug 09
Rain and groundwater influences on DIC concentrations

(c) DIC (μmol kg\(^{-1}\))

Rain

Chanos DIC
Discrete bottle DIC
MLR DIC

(d) Salinity
Water level
Temperature

Nov 30 Dec 02 Dec 04 Dec 06 Dec 08 Dec 10 Dec 12 Dec 14 Dec 16 Dec 18

Rain (mm)

0 20 40 60 80 100

DIC (μmol kg\(^{-1}\))

1100 1200 1300 1400 1500 1600 1700 1800 1900 2000 2100 2200 2300 2400 2500 2600

Salinity

30 25 20 15 10 5 0

Water level (m)

0.8 0.6 0.4 0.2 0 0.2 0.4

Temp. (°C) or Sal. (PSS)

-0.4 0 0.2 0.4 0.6 0.8

Nov 30 Dec 02 Dec 04 Dec 06 Dec 08 Dec 10 Dec 12 Dec 14 Dec 16 Dec 18
MLR is a robust method to measure DIC fluxes – good agreement with CHANOS DIC fluxes

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<th>July (N=2470)</th>
<th>December (N=1037)</th>
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<tbody>
<tr>
<td><strong>Mean DIC residual (umol kg⁻¹)</strong></td>
<td>-23 ± 150</td>
<td>-3 ± 170</td>
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<tr>
<td><strong>Mean DIC flux residual (mol s⁻¹)</strong></td>
<td>-0.03 ± 0.2</td>
<td>-0.008 ± 0.1</td>
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On average,

DIC concentration: MLR <1% different than CHANOS

DIC flux: MLR <20% different than CHANOS