Optical properties of marine DOM in the NW Iberian coastal upwelling system

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International DOM Spectroscopy Workshop
21-23 May 2010, Granada, Spain
CDOM in the NW Iberian upwelling system

outline of this talk

► study site: the NW Iberian upwelling system in brief
► CDOM in rain water of the Ría de Vigo
► CDOM in marine waters of the Ría de Vigo
► *in vitro* net community production (NCP) of fluorescent CDOM
  ► daily incubations
  ► monthly incubations
the NW Iberian upwelling system in brief
the rías, large coastal embayments driven by remote winds

S. Groom, PML, UK (satellite images) & C. Souto, UVigo; Spain (animation)
the NW Iberian upwelling system in brief

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CDOM in rain water to the Ría de Vigo
absorbance, induced fluorescence and quantumn yield of CDOM

DOC = 174(±13) \cdot P^{-0.68(±0.05)}
R^2 = 0.47, p < 0.01
CDOM in rain water to the Ría de Vigo
absorbance, induced fluorescence and quantum yield of CDOM

\[ a(254) = 33.1 \text{ m}^2 \text{ mol C}^{-1} \]

\[ a^*(340) = 7.7 \text{ m}^2 \text{ mol C}^{-1} \]

\[ R^2 = 0.85, \ p < 0.001 \]
CDOM in rain water to the Ría de Vigo
absorbance, induced fluorescence and quantum yield of CDOM

R² = 0.37, p <0.001

R² = 0.21, p <0.001

R² = 0.25, p <0.002
CDOM in marine waters of the Ría de Vigo absorbance, induced fluorescence and quantum yield of CDOM

\[
\begin{align*}
\text{DOC (µmol L}^{-1}\text{)} & \quad R^2 = 0.63, \quad p < 0.001 \\
\log(a(340)) & \quad F(340/440) (QSU)
\end{align*}
\]

\[
\begin{align*}
49 \pm 1 \text{ µmol L}^{-1} & \quad a^*(340) = 14.4 \pm 0.8 \text{ m}^2 \text{ mol} C^{-1} \\
\Phi(340) & \quad 0.83 \pm 0.05 \%
\end{align*}
\]
CDOM in marine waters of the Ría de Vigo
absorbance, induced fluorescence and quantum yield of CDOM

\[ Y = \alpha_0 + \alpha_1 \times S \]
\[ \Delta Y = Y - \alpha_0 - \alpha_1 \times S \]

microbial: 86%
photochemical: 14%

microbial: 23%
photochemical: 77%

\[ \Phi(340) = 1.1 \pm 0.1 \% \]

\[ \Delta a^*(340) \text{ (m}^2 \text{ mol C}^{-1}) \]

\[ R^2 = 0.45, \ p < 0.001 \]
in vitro net (microbial) community production (NCP) of FDOM
daily production of marine humic-like substances

► sixteen visits through the seasonal cycle, five depths
► incubated 24 hours at in situ light and temperature conditions

Nieto-Cid et al., Limnol. Oceanogr. 51: 1391–1400, 2006
in vitro net (microbial) community production (NCP) of FDOM
daily production of marine humic-like substances

\[ \Delta \text{FDOMm}/\Delta R = 8.1 (\pm 0.9) \times 10^{-3} \mu \text{g eq QS} (\mu \text{mol O}_2)^{-1} \]

\[ R^2 = 0.54, \, n = 79, \, p < 0.001 \]

in situ net (microbial) community production (NCP) of FDOM separating water mass mixing from microbial production of FDOM

\[ FDOM_m = \alpha_0 + \alpha_1 \times S \]

\[ O_2 = \beta_0 + \beta_1 \times S \]

\[ \Delta FDOM_m = FDOM_m - \alpha_0 - \alpha_1 \times S \]

\[ \Delta O_2 = O_2 - \beta_0 - \beta_1 \times S \]
in situ net (microbial) community production (NCP) of FDOM separating water mass mixing from microbial production of FDOM

\[ \frac{\Delta \text{FDOMm}}{\Delta \text{O}_2} = -7.5 \pm 0.6 \times 10^{-3} \text{ g eq QS (\text{\textmu mol O}_2)}^{-1} \]

\[ R^2 = 0.50, \ n = 64, \ p < 0.001 \]

\[ \frac{\Delta \text{FDOMm}}{\Delta R} = 8.1 \pm 0.9 \times 10^{-3} \text{ g eq QS (\text{\textmu mol O}_2)}^{-1} \]

\[ R^2 = 0.54, \ n = 79, \ p < 0.001 \]

in vitro photo-degradation of FDOM
daily photo-bleaching of marine humic-like substances

Nieto-Cid et al., Limnol. Oceanogr. 51: 1391–1400, 2006
in vitro photo-degradation of FDOM
interactions microbial production-photodegradation

Nieto-Cid et al., Limnol. Oceanogr. 51: 1391–1400, 2006
in vitro net heterotrophic community production of FDOM
long-term net production of protein- and marine humic-like substances

- twelve visits through the seasonal cycle, one depth
- surface water filtered through 0.2 μm
- mixed with 10% the same water filtered 1.2 μm
- incubated in the dark at 15°C from 50 to 70 days

**in vitro** net heterotrophic community production of FDOM

kinetics of the net production of protein- and marine humic-like substances

\[
\text{DOC}(t) = B\text{DOC} \cdot \exp(-k_{\text{DOC}} \cdot t) + R\text{DOC}
\]

\[
\text{FDOM}_m(t) = P\text{DOM}_m \cdot \left[ 1 - \exp(-k_m \cdot t) \right] + \text{FDOM}_m(0)
\]

\[
\text{FDOM}_t(t) = B\text{DOM}_t \cdot \exp(-k_T \cdot t) + R\text{DOM}_t
\]

*in vitro* net heterotrophic community production of FDOM kinetics of the net production of protein- and marine humic-like substances

in vitro net heterotrophic community production of FDOM kinetics of the net production of protein- and marine humic-like substances

\[ k_{\text{DOC}} = 0.05(\pm 0.02) + 0.58(\pm 0.08) \cdot k_T \]

\( R^2 = 0.86, \ p < 0.001 \)

\[ 72 \pm 23\% \]

\[ 5 \pm 2\% \ \text{day}^{-1} \]

*in vitro* net heterotrophic community production of FDOM kinetics of the net production of protein- and marine humic-like substances

\[ k_M = 0.02(\pm 0.01) + 0.17(\pm 0.04) \cdot k_{\text{DOC}} \]

\[ R^2 = 0.64 , p < 0.01 \]

¡Gracias por vuestra atención!
Thank you for your attention!