Exchange processes at the shelf edge

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Big picture

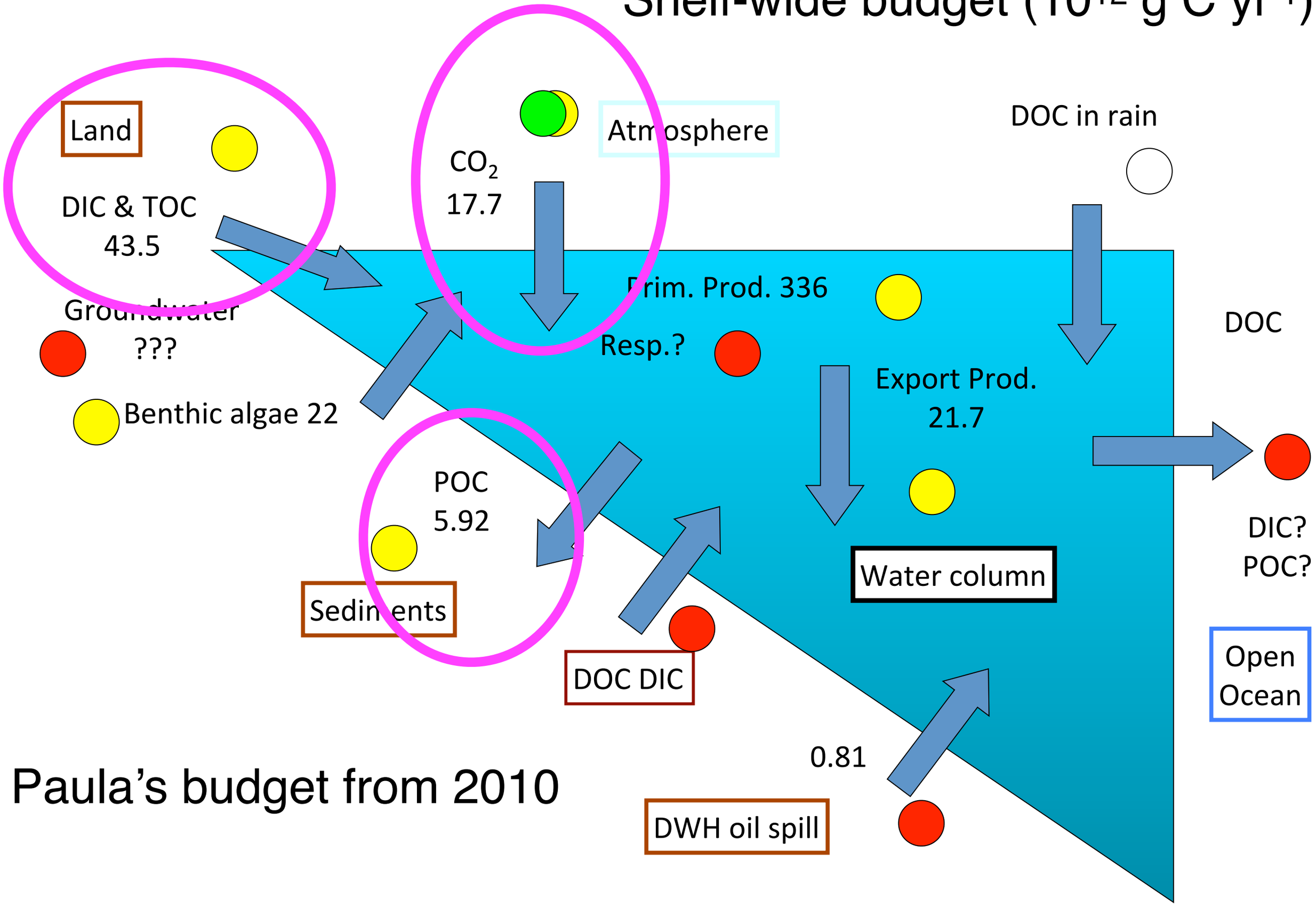
Shelves are thought of as barriers that filter terrestrial inputs before they reach the open ocean.

E.g., shelves remove much more N (DNF) than enters from rivers, estuaries & atmosphere, hence significant onwelling of inorg. N from open ocean (Seitzinger et al. 2006).

C is more complicated (actively exchanged with atmosphere; rich inorg. chemistry). Globally shelves are thought to export inorg. & org. C to the open ocean (Borges 2011, Gattuso et al. 1998); however, uncertainties and regional differences are large.

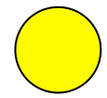
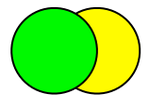
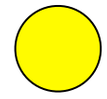
<u>Questions for GoMx:</u> Is there cross-shelf import of inorg. N? Is there cross-shelf export of inorg. & org. C? How large?

Shelf-wide budget (10^{12} g C yr^{-1})



Paula's budget from 2010

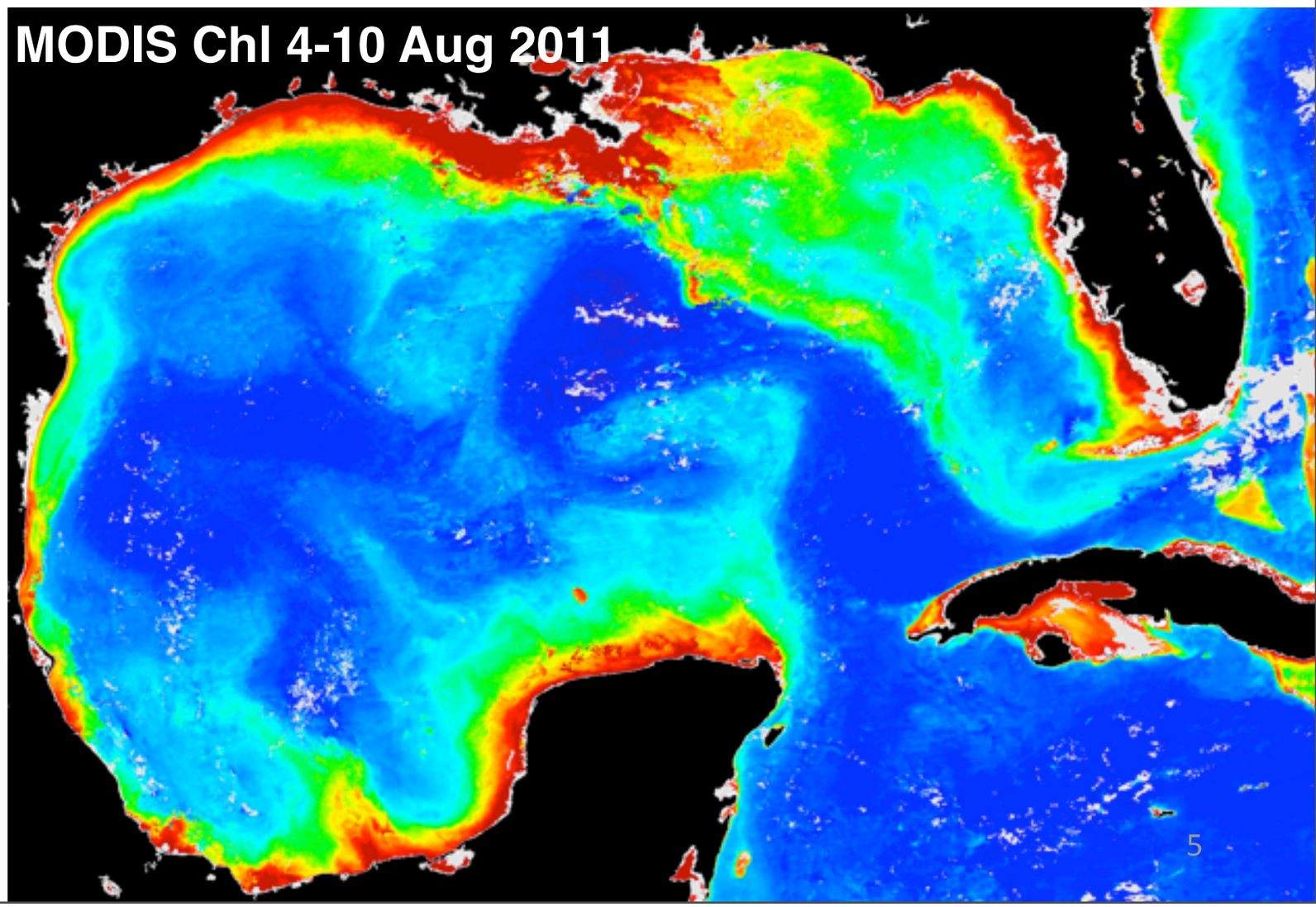
Back-of-the-envelope calculation for cross-shelf C flux:

land input of DIC & TOC:	43.5		(10^{12} g C yr^{-1})
air-sea flux:	17.7		
POC burial:	-5.9		

Inferred total C export: -55.3

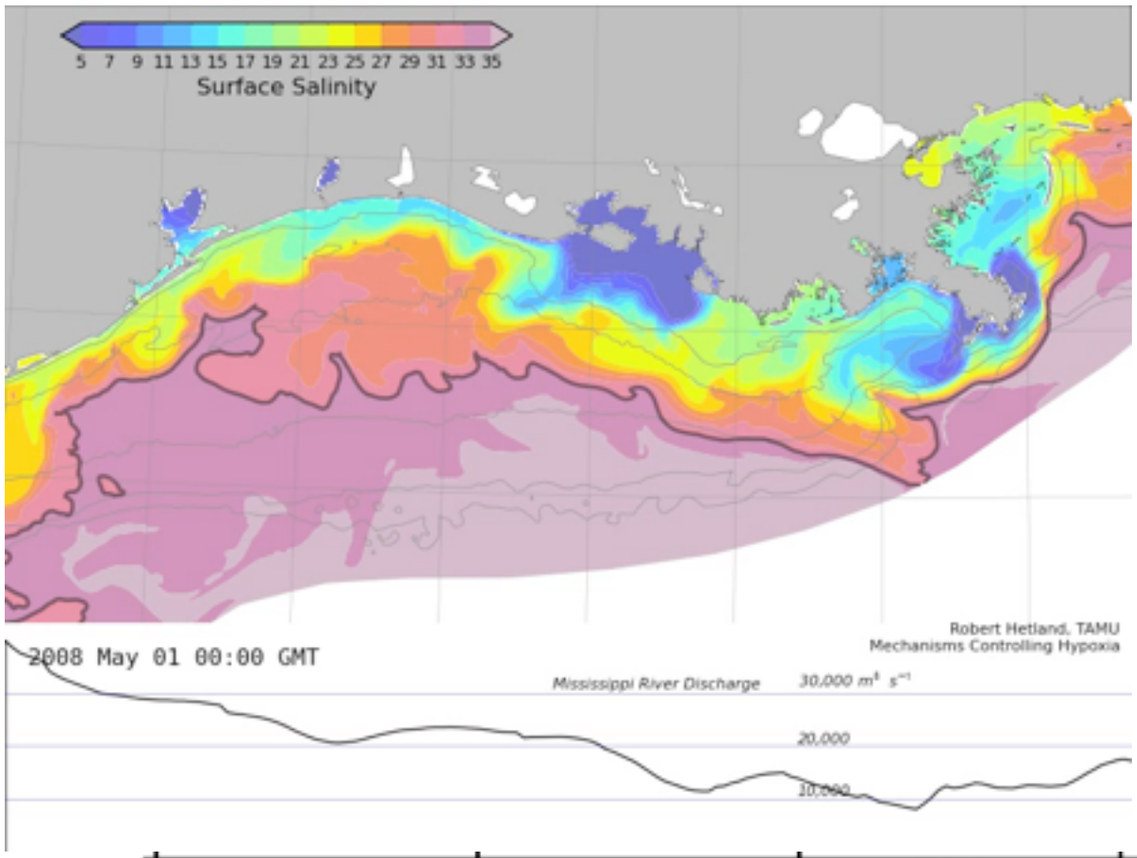
Observational estimates of cross-shelf C flux

Cross-shelf transport effective where eddies interact with shelf circulation (Mueller-Karger et al., 1991; Toner et al., 2003; Zavala-Hidalgo et al., 2003)



MCH model

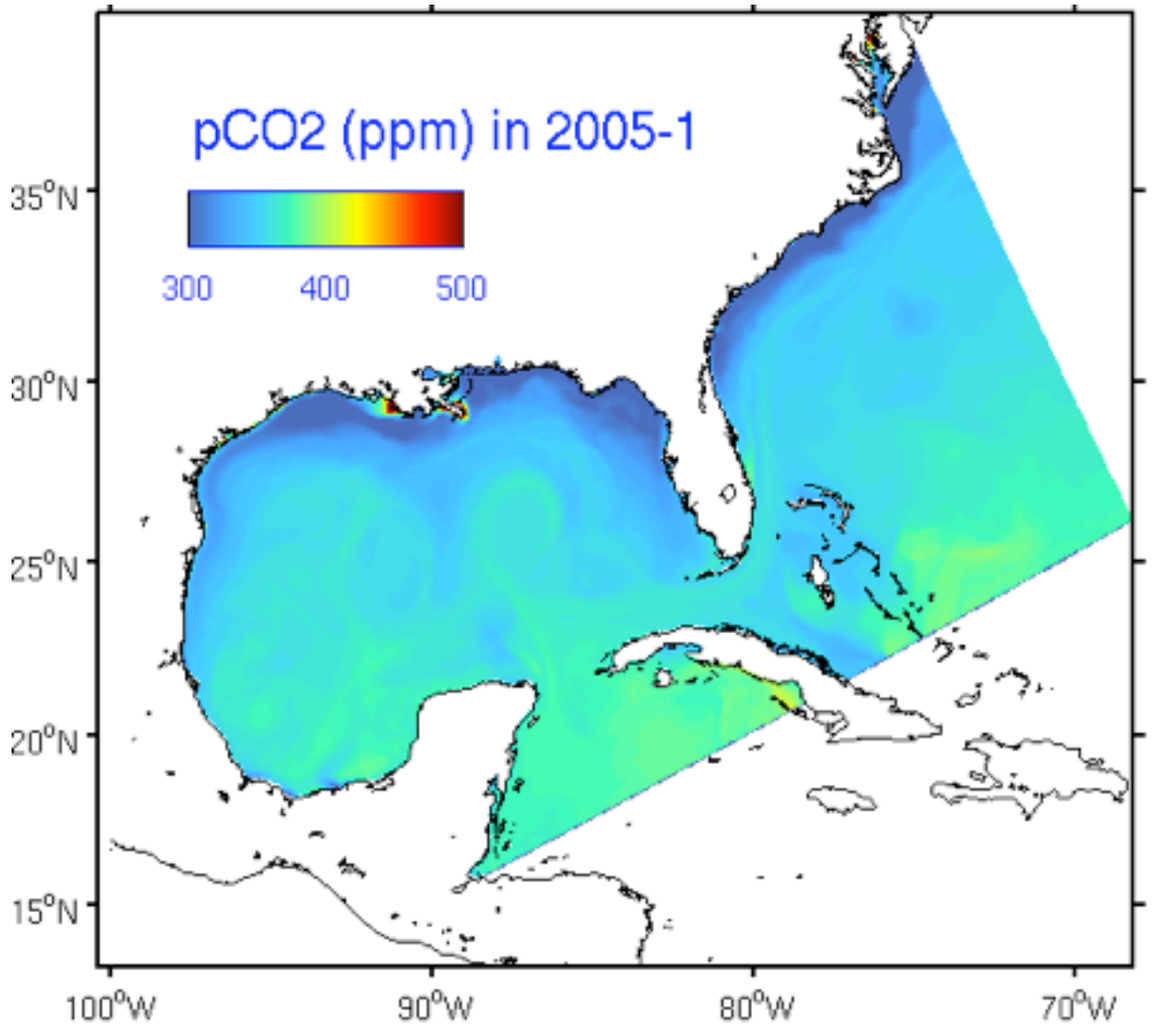
2008 surface salinity

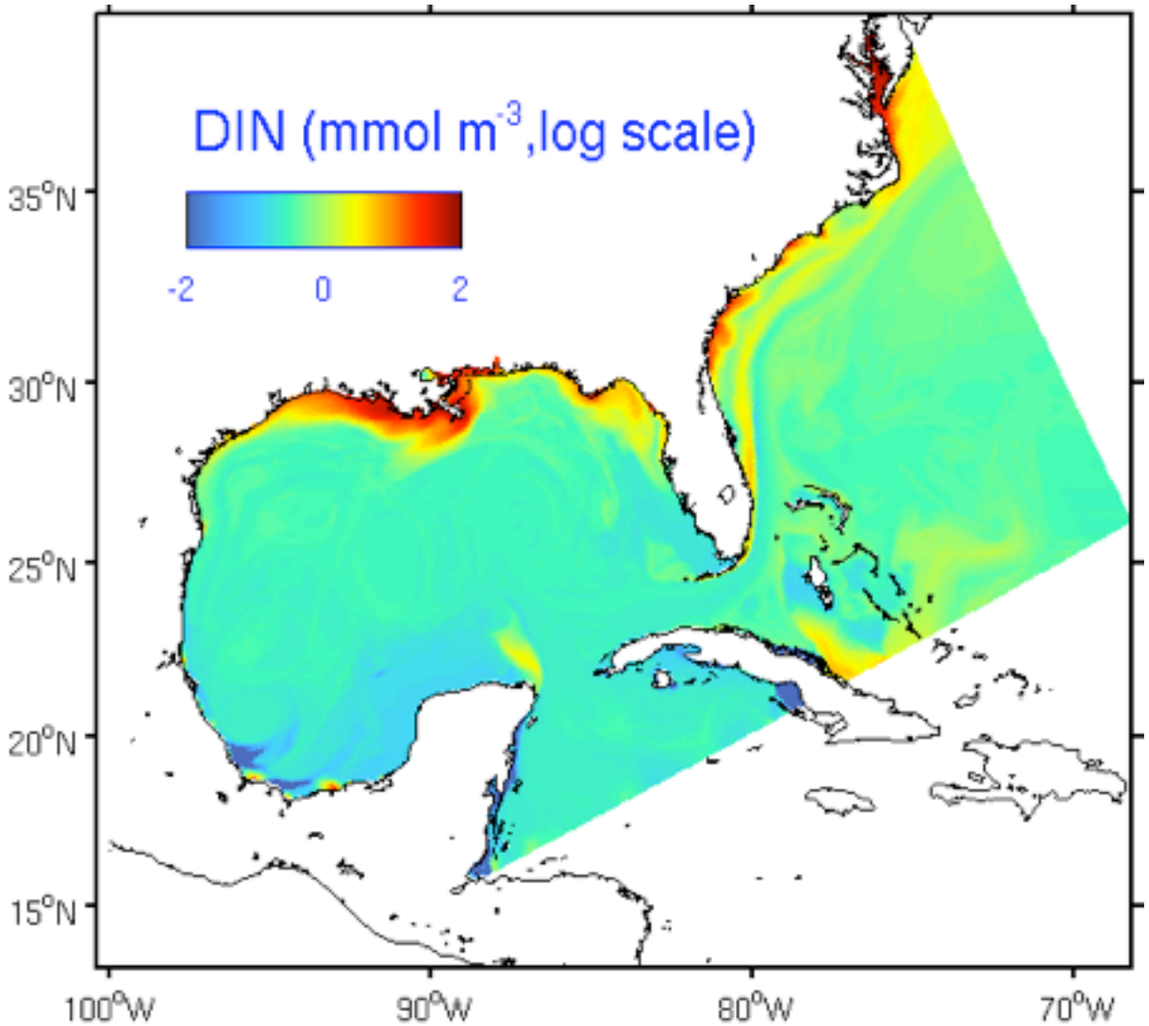


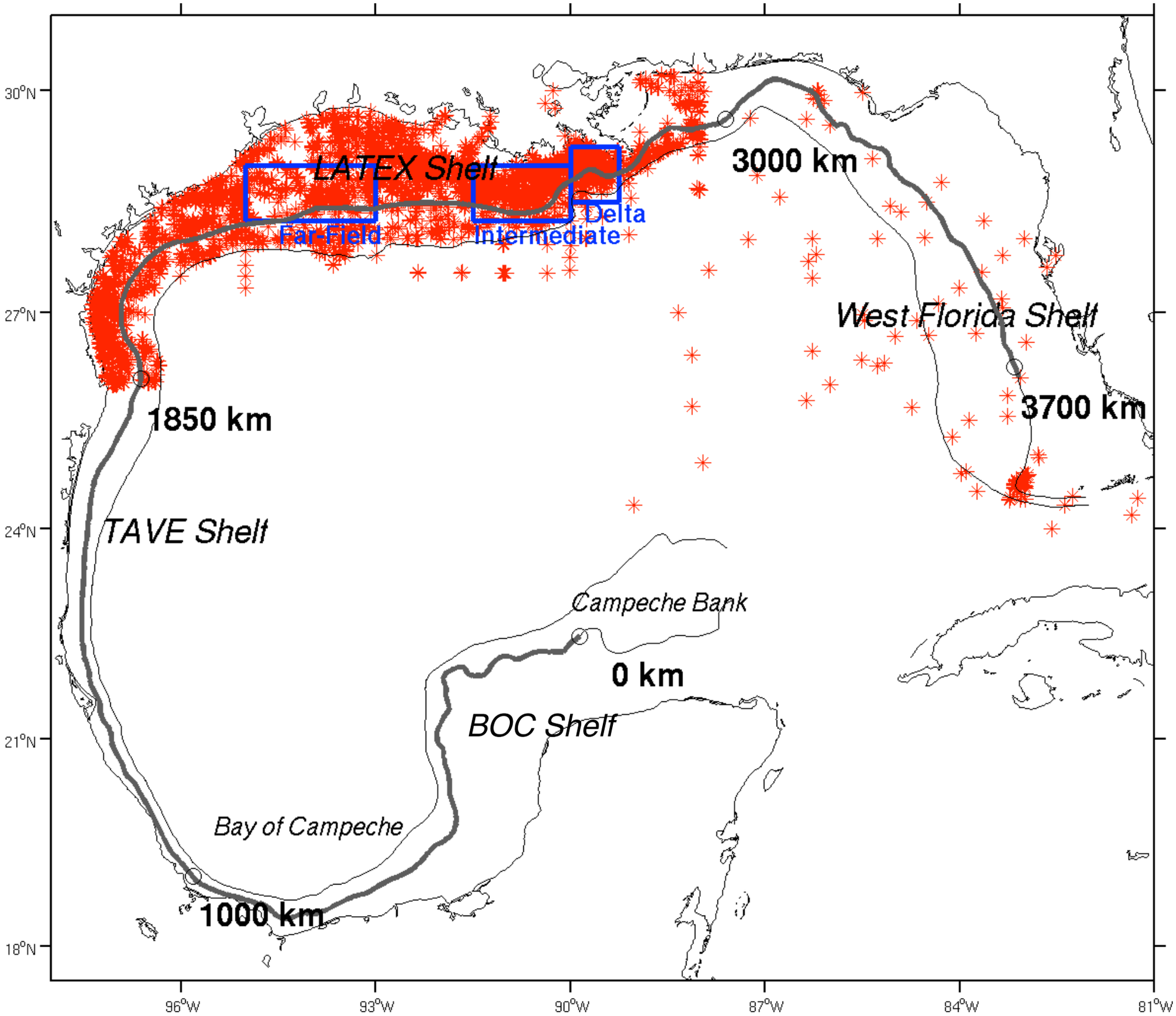
SABGOM model

2005 - 2010

surface pCO_2 & DIN

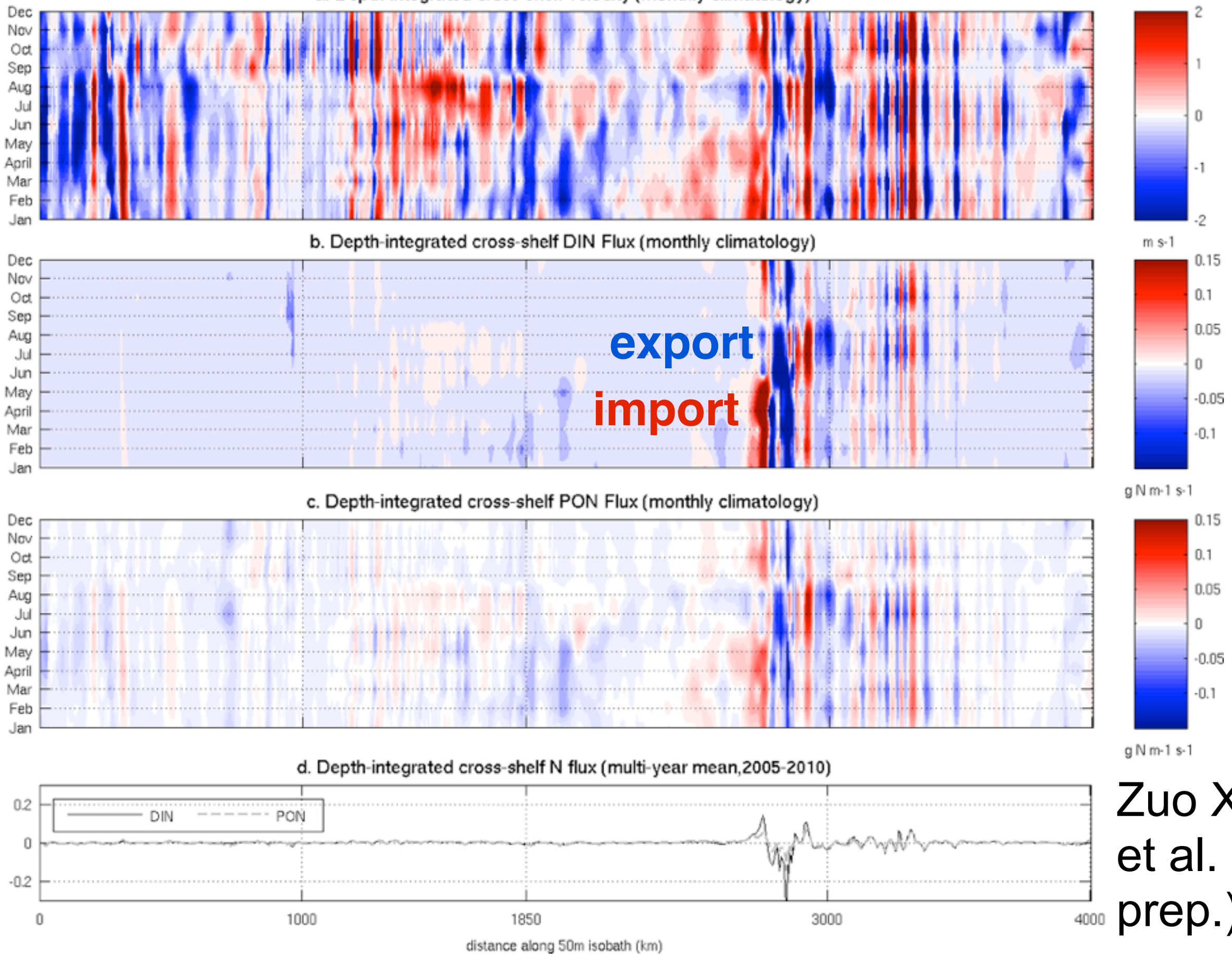






Zuo Xue et al. (in prep.)

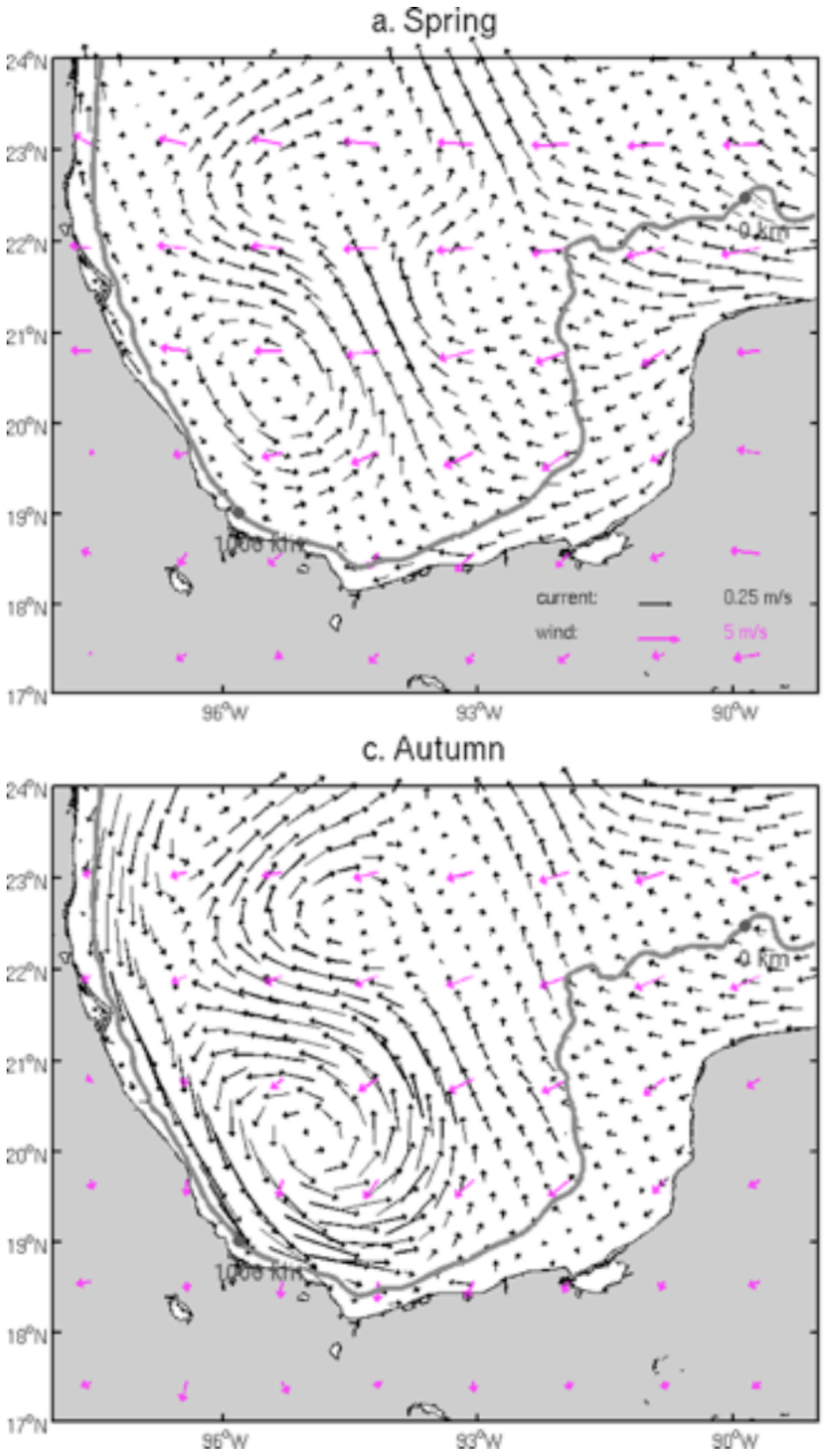
BOC: Bay of Campeche, TAVE: Tamaulipas-Veracruz shelf,
LATEX: Louisiana-Texas shelf; WFS: West Florida Shelf



Zuo Xue et al. (in prep.)

-0.14 POC; 0.002 DIN (cross-shelf)
0.24 POC; 0.005 DIN (along-shelf)

-0.18 POC; -0.005 DIN (cross-shelf)
0.20 POC; 0.003 DIN (along-shelf)



POC fluxes
10^{12} g C yr^{-1}

DIN fluxes
10^{12} g N yr^{-1}

River:
DIN 0.174

DNF -0.174

Zuo Xue et al.
(in prep.)

-0.10 POC; -0.014 DIN (cross-shelf)
0.05 POC; 0.003 DIN (along-shelf)

-0.10 POC; -0.003 DIN (cross-shelf)
0.06 POC; 0.003 DIN (along-shelf)

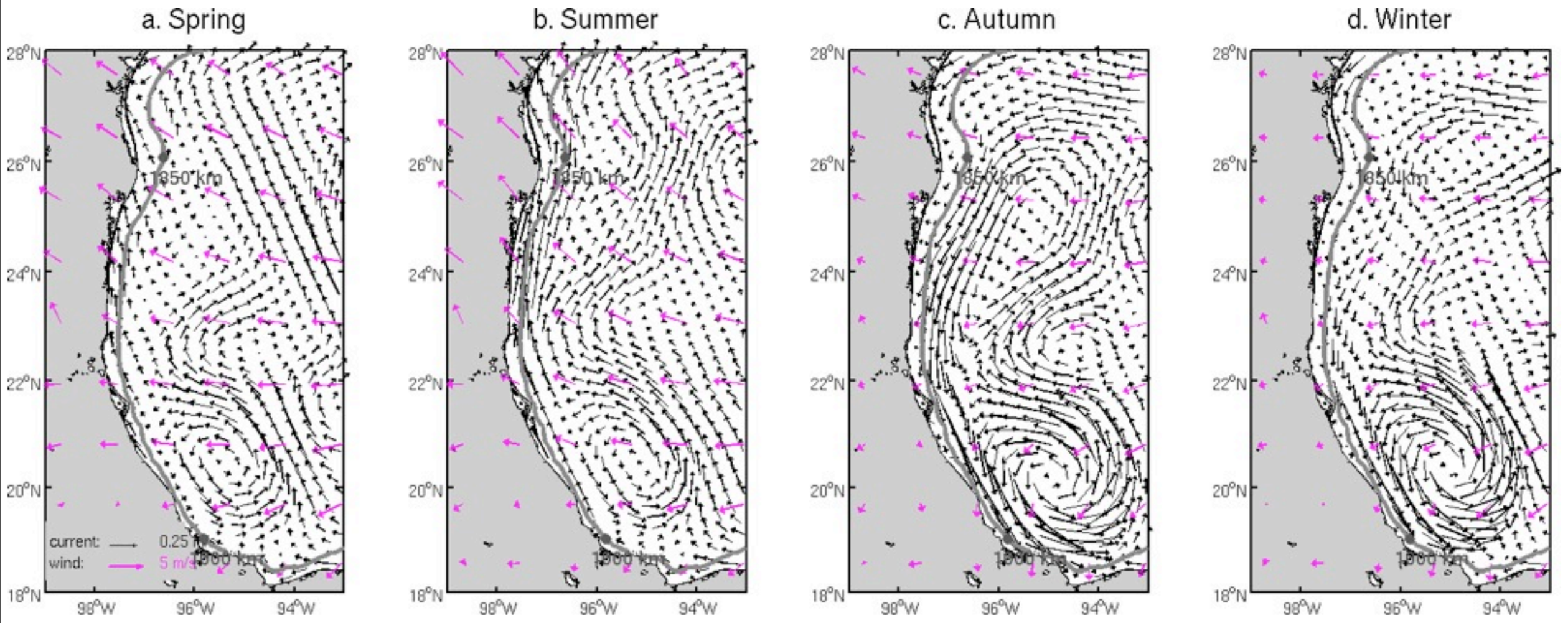
-0.085 POC; 0.018 DIN (cross-shelf)

0.091 POC; 0.035 DIN (along-shelf)

River:

DIN 0.007

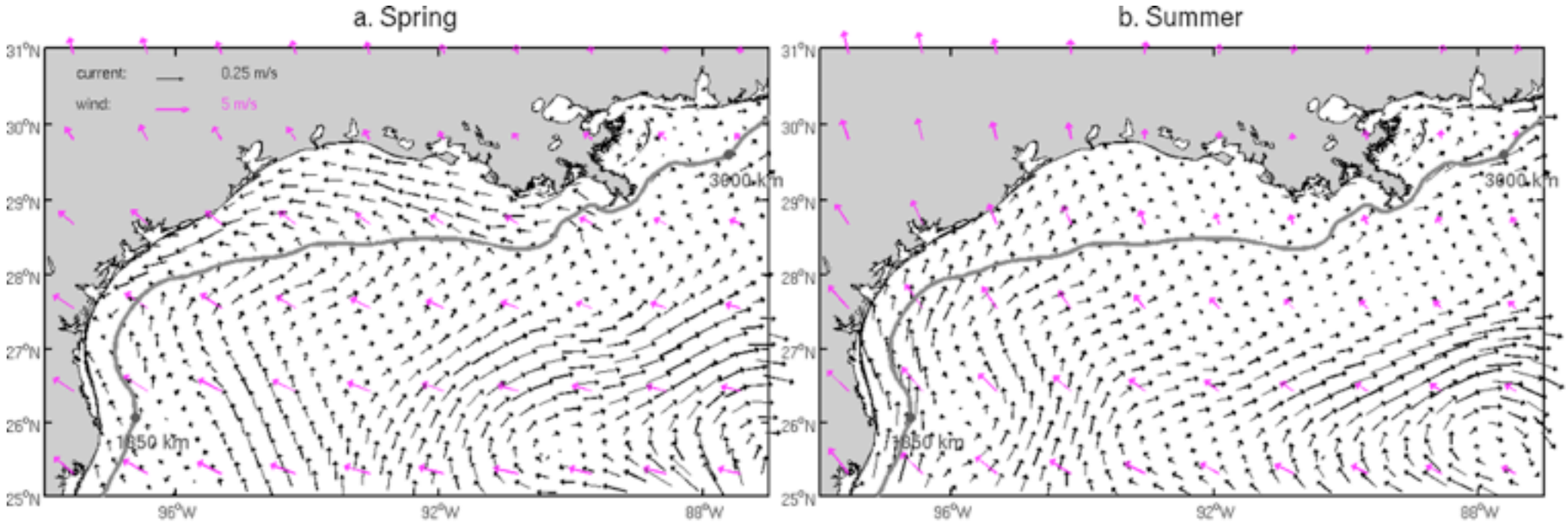
DNF -0.080



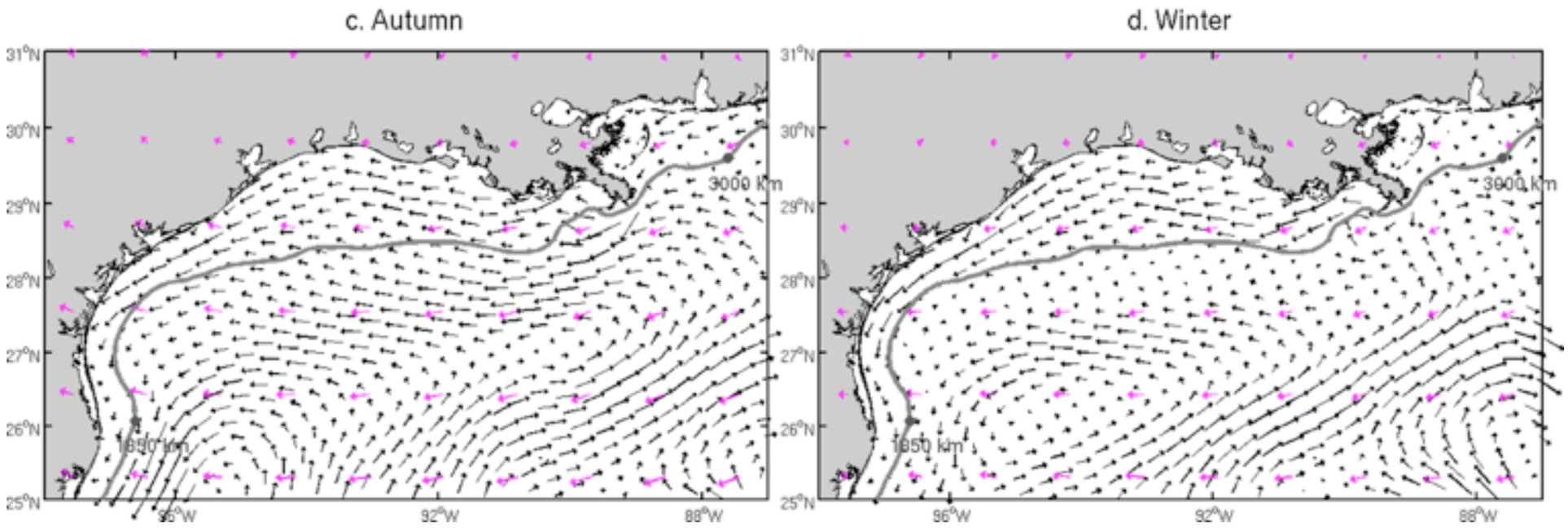
Zuo Xue et al. (in prep.)

-0.08 POC; -0.032 DIN (cross-shelf)
-0.21 POC; -0.030 DIN (along-shelf)

-0.14 POC; -0.060 DIN (cross-shelf)
-0.22 POC; -0.063 DIN (along-shelf)



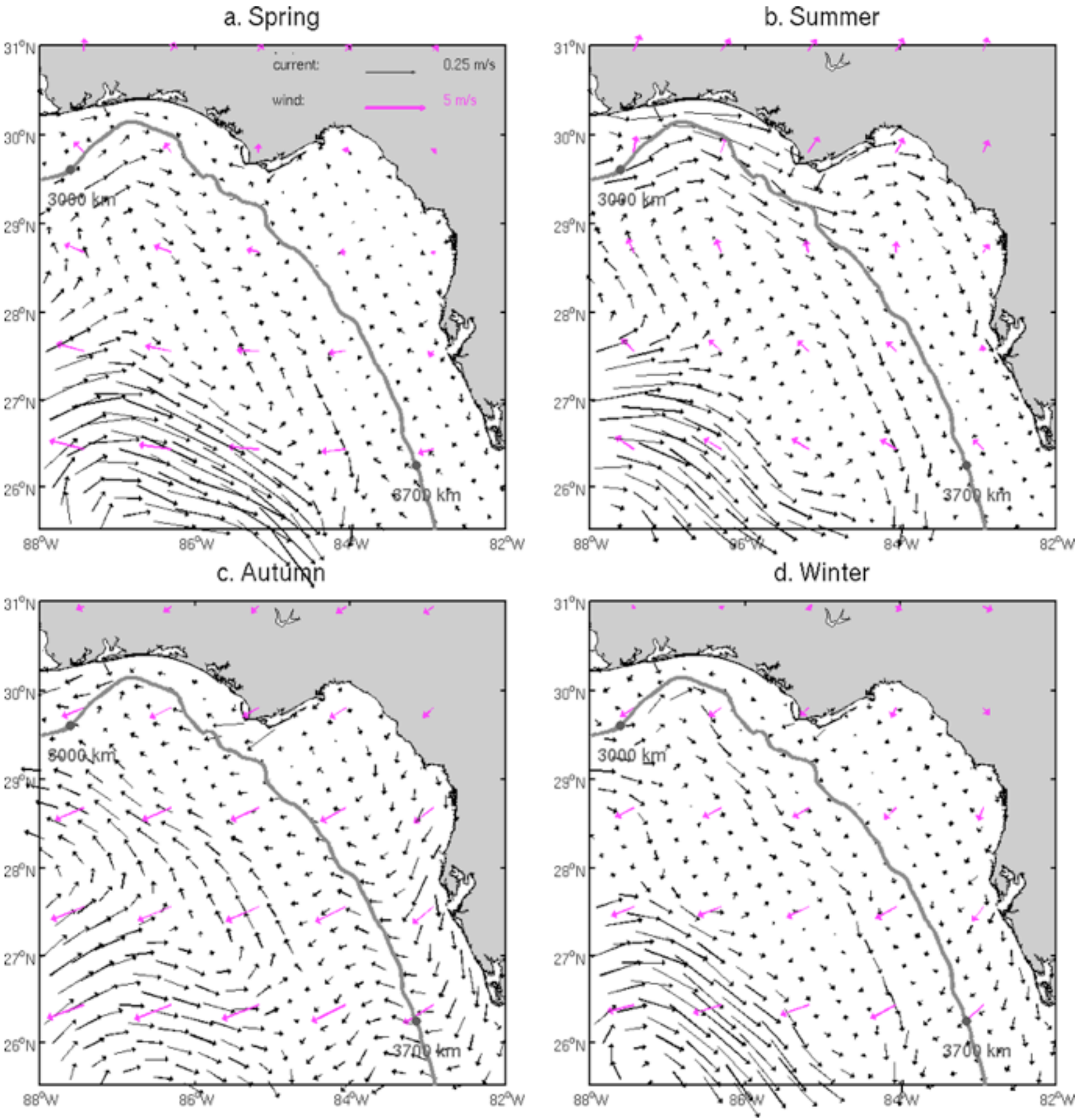
River:
DIN 1.52
DNF -1.01



Zuo Xue et al. (in prep.)

0.03 POC; -0.020 DIN (cross-shelf)
-0.15 POC; -0.030 DIN (along-shelf)

-0.04 POC; -0.031 DIN (cross-shelf)
-0.27 POC; -0.060 DIN (along-shelf)



-0.32 POC

-0.002 DIN

(cross-shelf)

0.72 POC

0.14 DIN

(along-shelf)

River:

DIN 0.18

DNF -0.38

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(in prep.)

Annually integrated cross- and along-shelf POC fluxes:

	BOC	TAVE	LATEX	WFS	**shelf-wide**
cross-shelf POC	-0.51	-0.08	-0.27	-0.32	**-1.15**
along-shelf POC	0.56	0.09	-1.01	0.72	**0.51**

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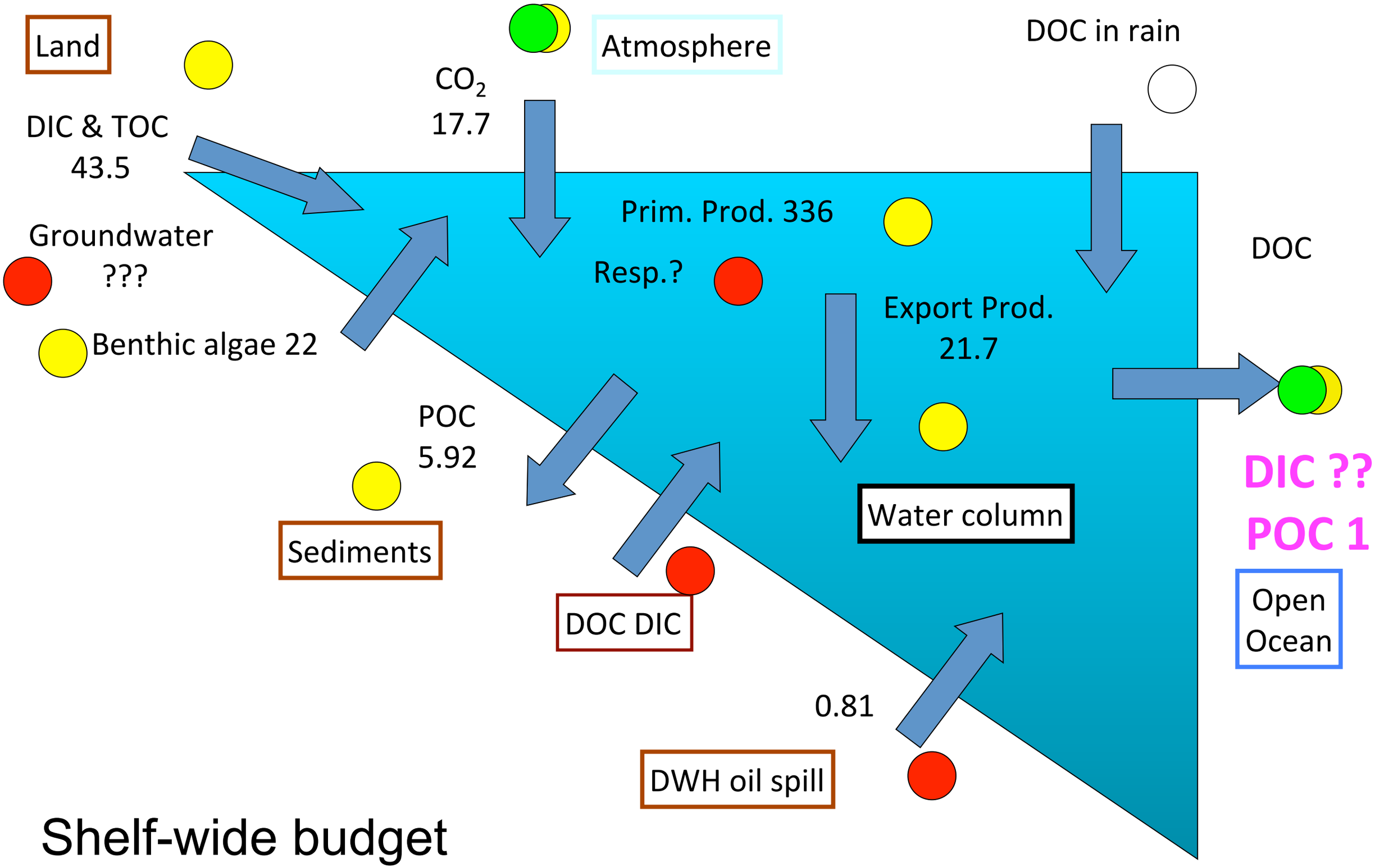
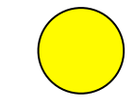
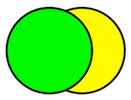
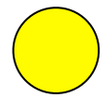
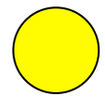
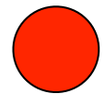
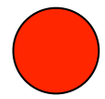
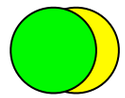
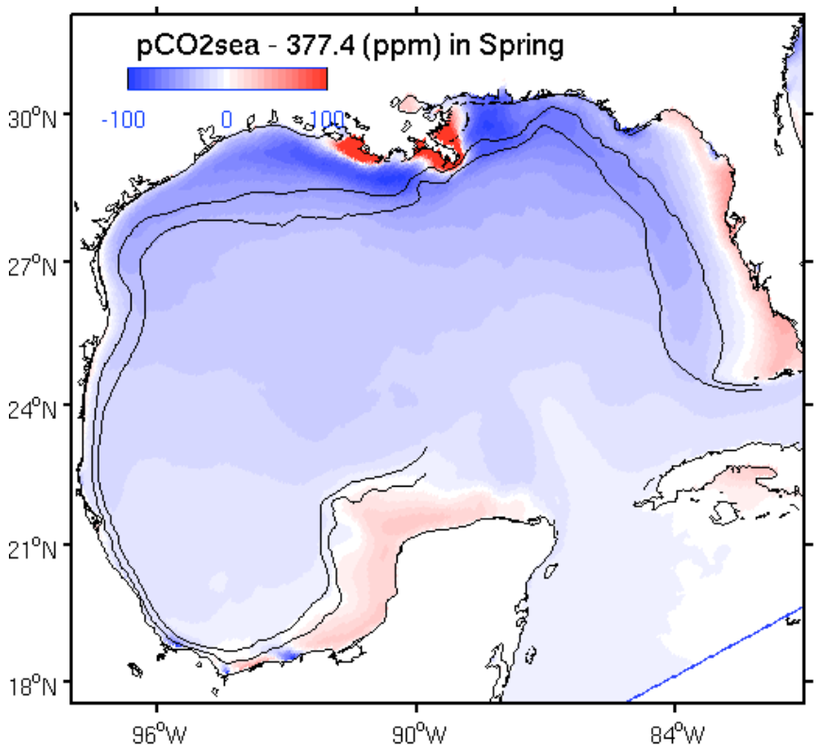
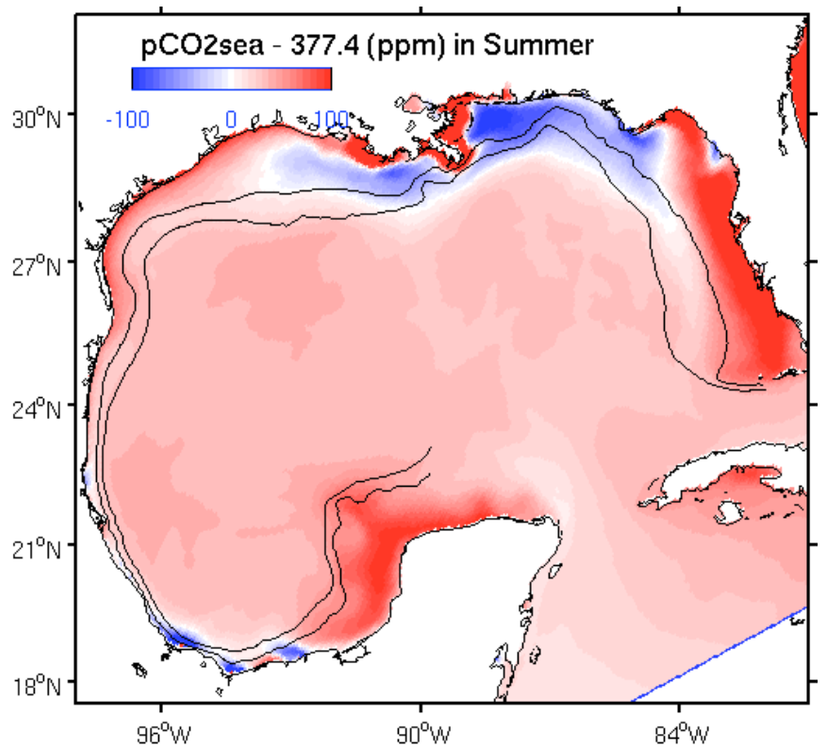


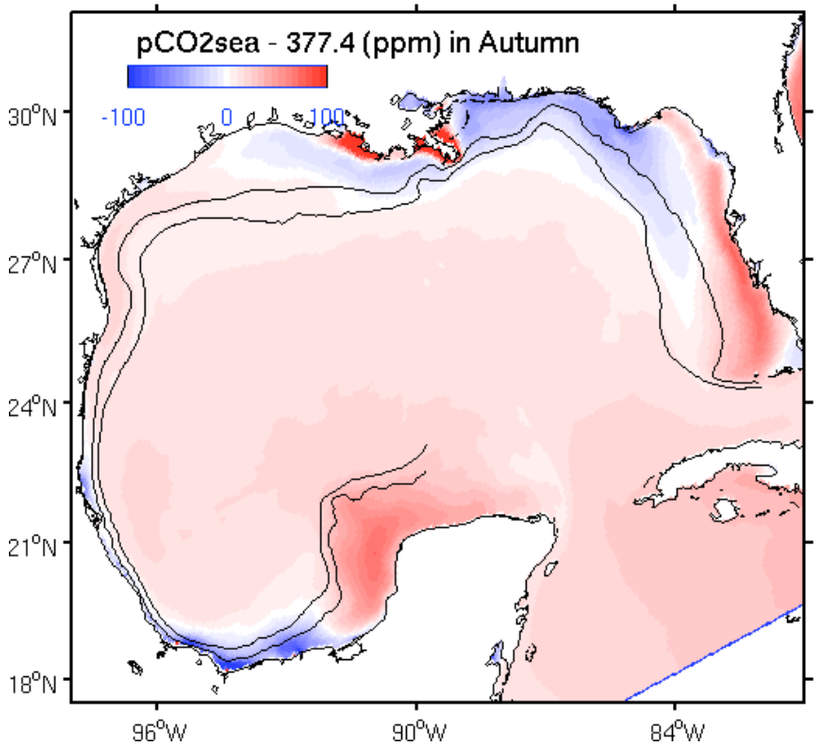
Shelf-wide budget
(10^{12} g C yr^{-1})

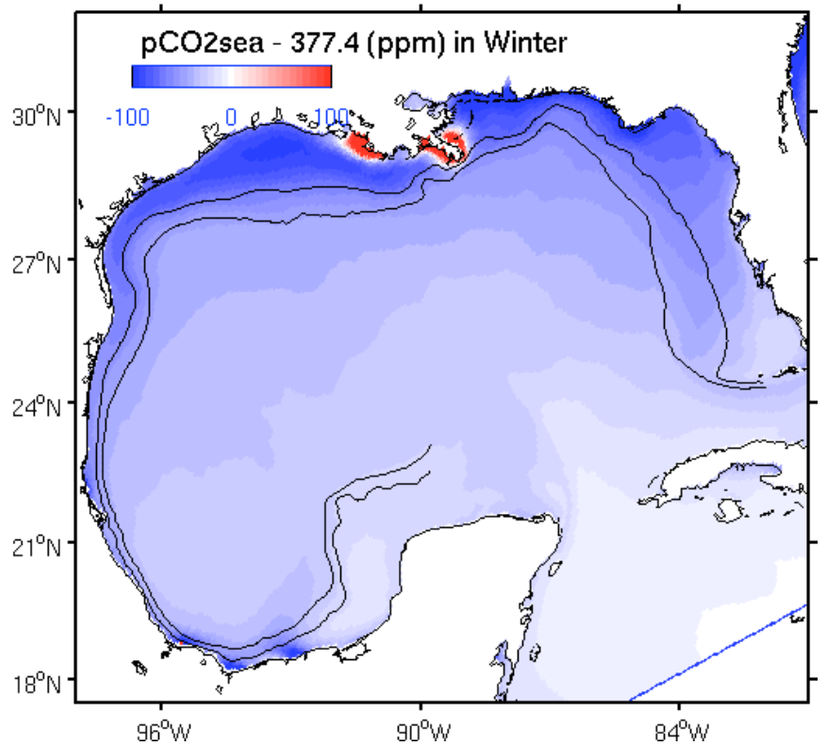
C budget:

	(10^{12} g C yr^{-1})		model
land input of DIC & TOC:	43.5		17.7
air-sea flux:	17.7		-1.07
POC burial:	-5.9		0
Primary production:	336.		472.
Respiration:	??		??
Inferred total C export:	-55.3		
Cross-shelf flux of POC:	-1.		
Cross-shelf flux of DIC:	??		









Simulated Delta pCO_2 (sw-air)

oversaturation

undersaturation

Zuo Xue et al. (in prep.)

Conclusions:

Model provides consistent estimates for PP, R, air-sea flux, and cross-shelf exchange. We should compare all empirical and simulated fluxes.

There is cross-shelf export of DIN and POM, but it's small compared to river inputs (~1/10th). Majority of river DIN is denitrified on the shelf.

Obtaining cross-shelf DIC fluxes will take more work (air-sea fluxes CO_2 are available).