Loop Current & Its Coupling with the Deep Flows

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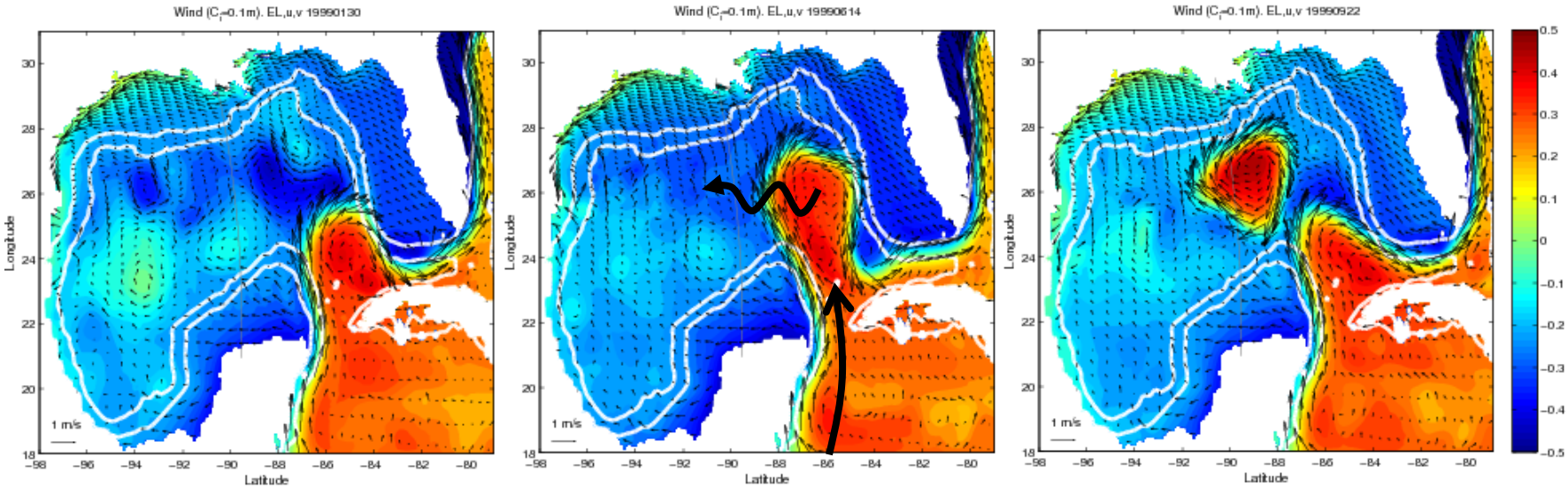
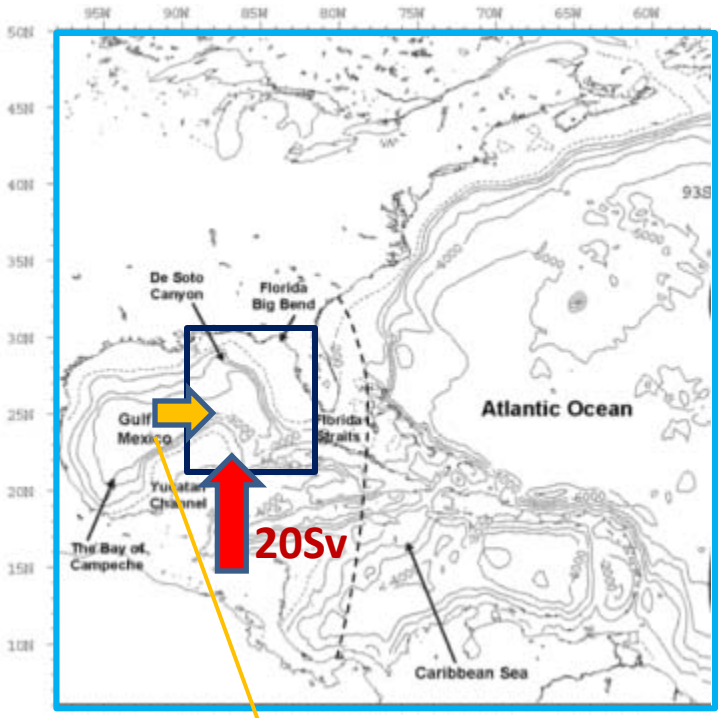


Period: 2 – 20 months

Westward speed (~ $-\beta R_d^2$) > growth rate



Integrate around circuit the steady state, inviscid, x-momentum equation (Pichevin & Nof 1997):

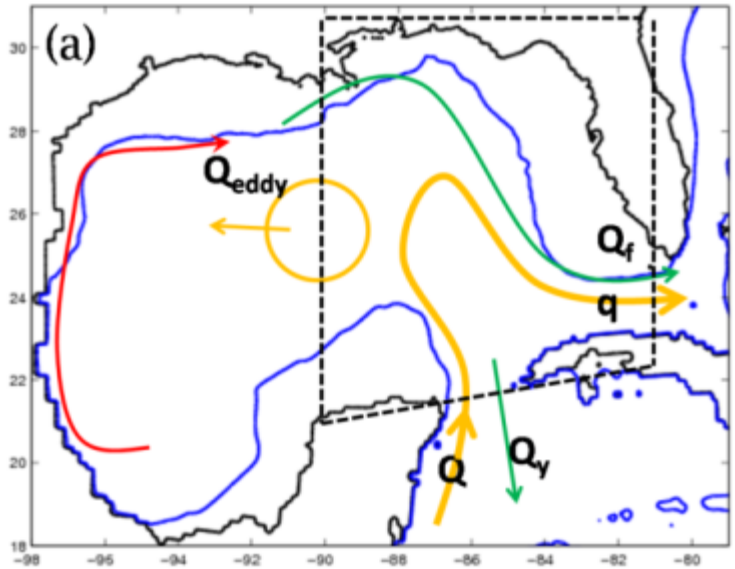
$$\int_{Florida} hu^2\, dy \approx 0$$

which cannot be true, i.e., this momentum outflux produces a westward force that needs to be balanced.

Add d/dt term:

$$\frac{\partial}{\partial t}(\ldots) = \int_{Florida} hu^2 dy$$

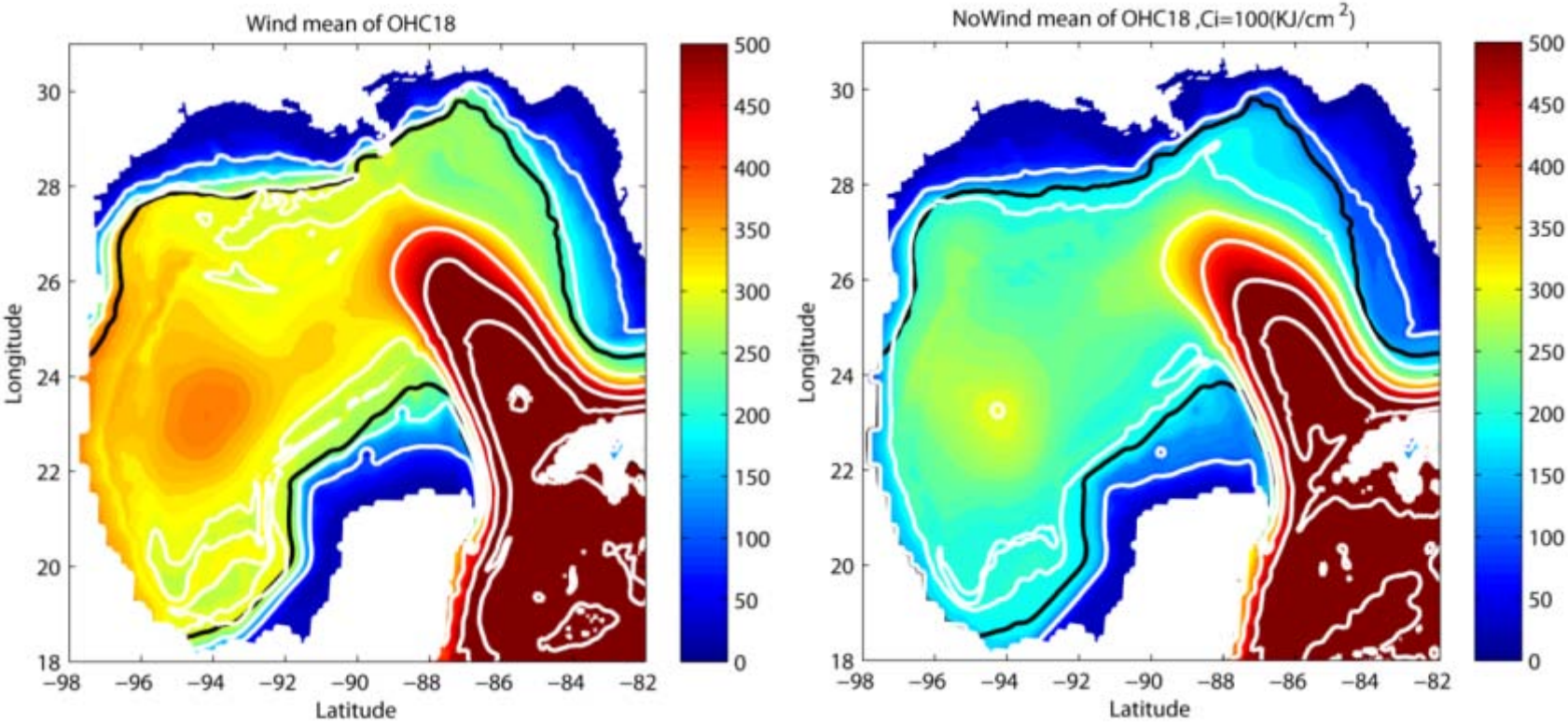
Add momentum influx (i.e. eastward force):

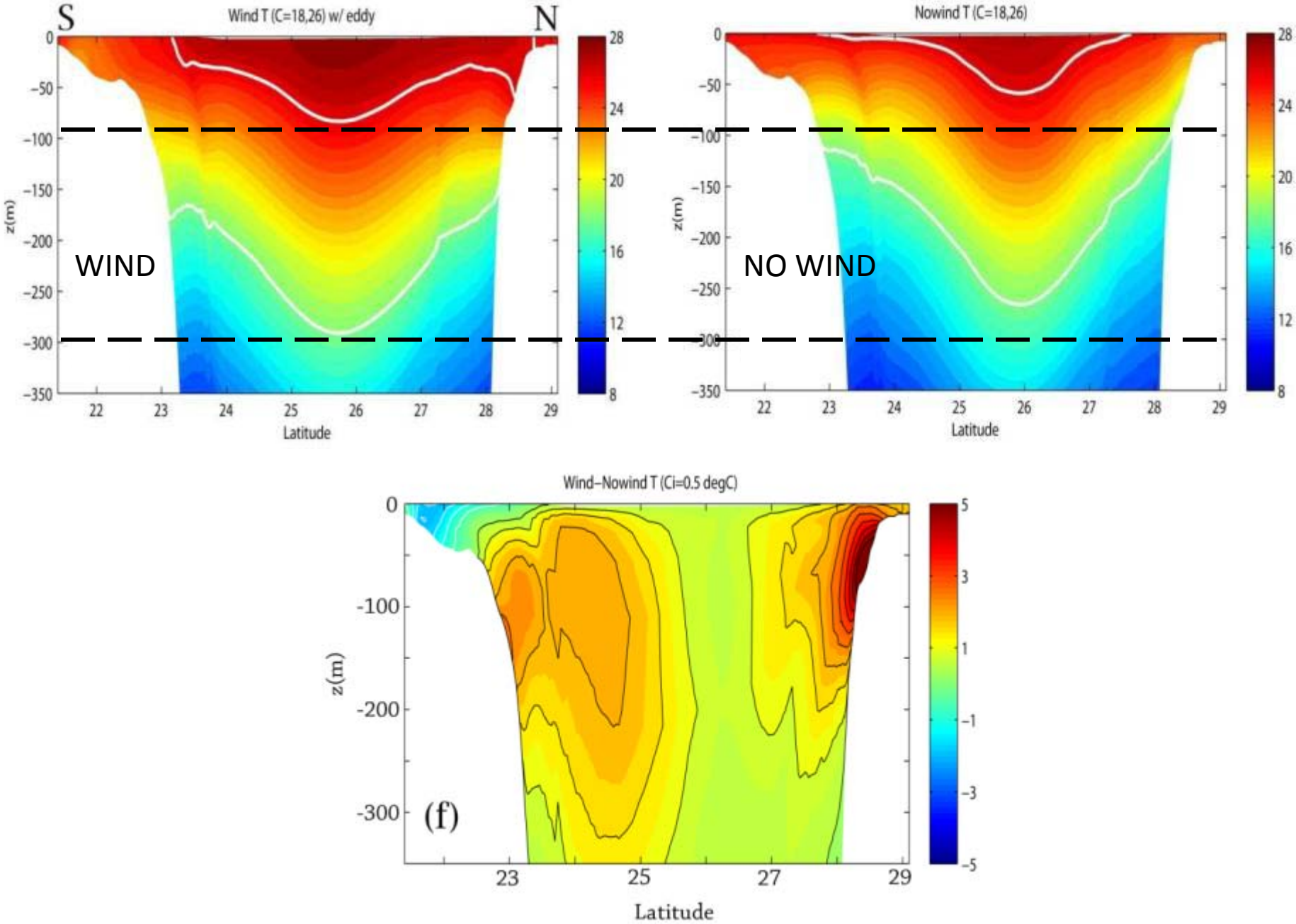


$$Q_{eddy} = Q - q$$
$$= Q_y + Q_f$$

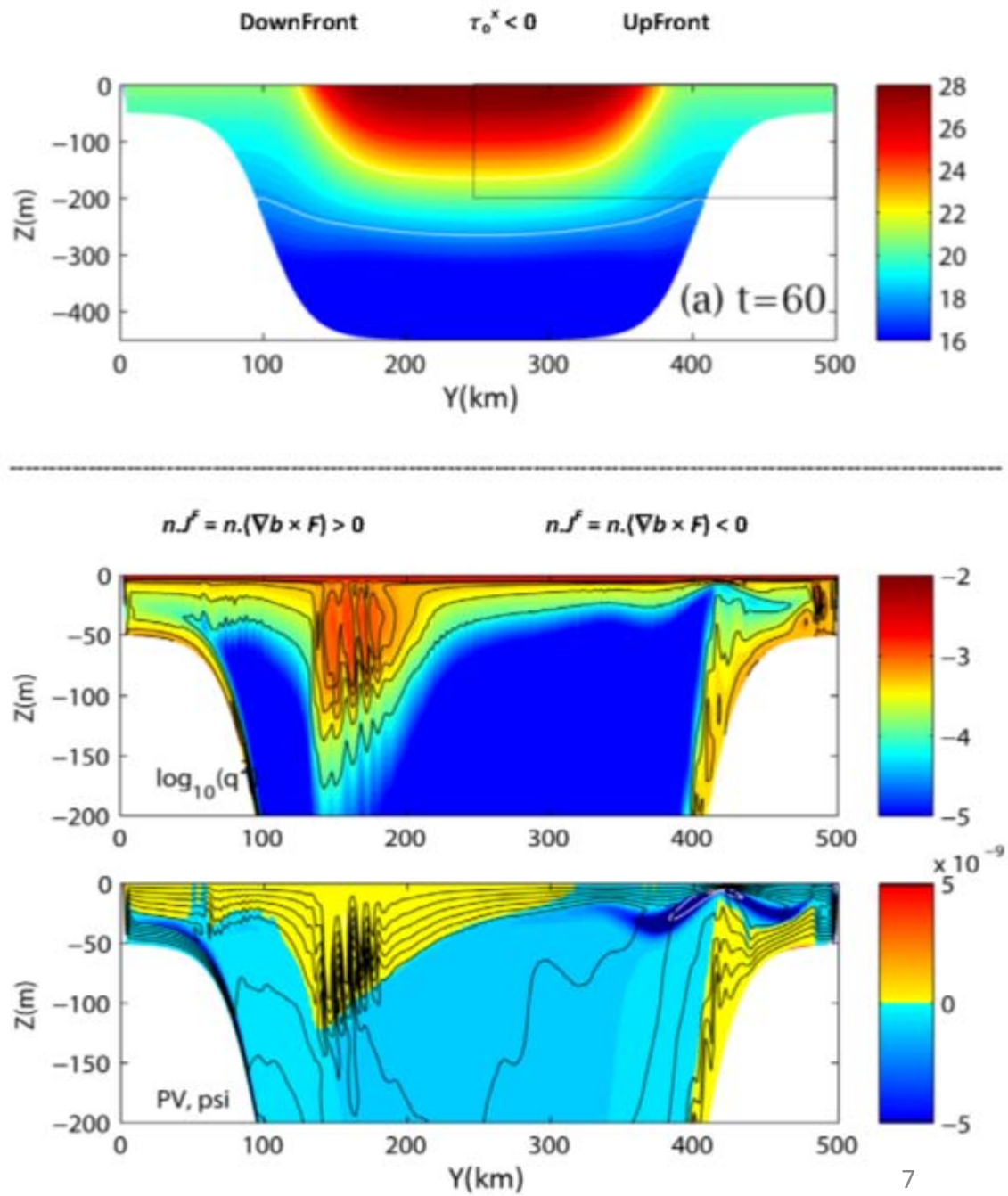
Transports (Sv)	No Wind
Yucatan Inflow Q	30.6
Yucatan Outflow Q_y	6.9
Westward Eddy Q_{eddy}	13.1
Florida Outflow $q = Q - Q_{eddy}$	17.5
Florida Eddy Outflow $Q_f = Q_{eddy} - Q_y$	6.2

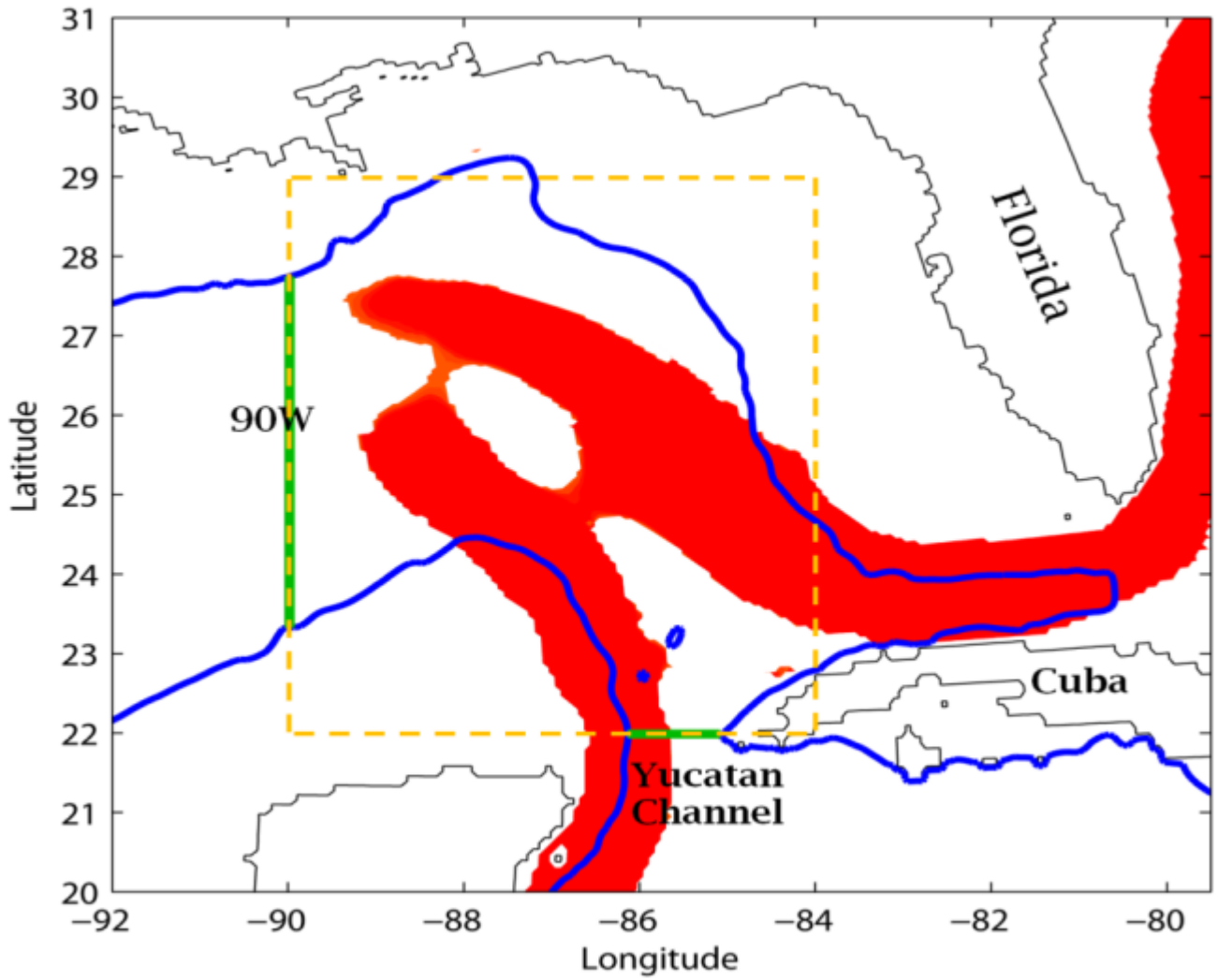
$$OHC = \rho_r c_p \int_{z18}^{\eta} (T - 18) dz$$




S
N
Wind T (C=18,26) w/ eddy
WIND
z(m)
Latitude
Nowind T (C=18,26)
NO WIND
z(m)
Latitude
Wind−Nowind T (Ci=0.5 degC)
(f)
z(m)
Latitude

Elliott's (1982) BV-frequency across the ring (his Figure 12) shows remarkable asymmetry with a deep low-stability water column to the left (i.e., southwest) of the ring's center and high stability to the right.



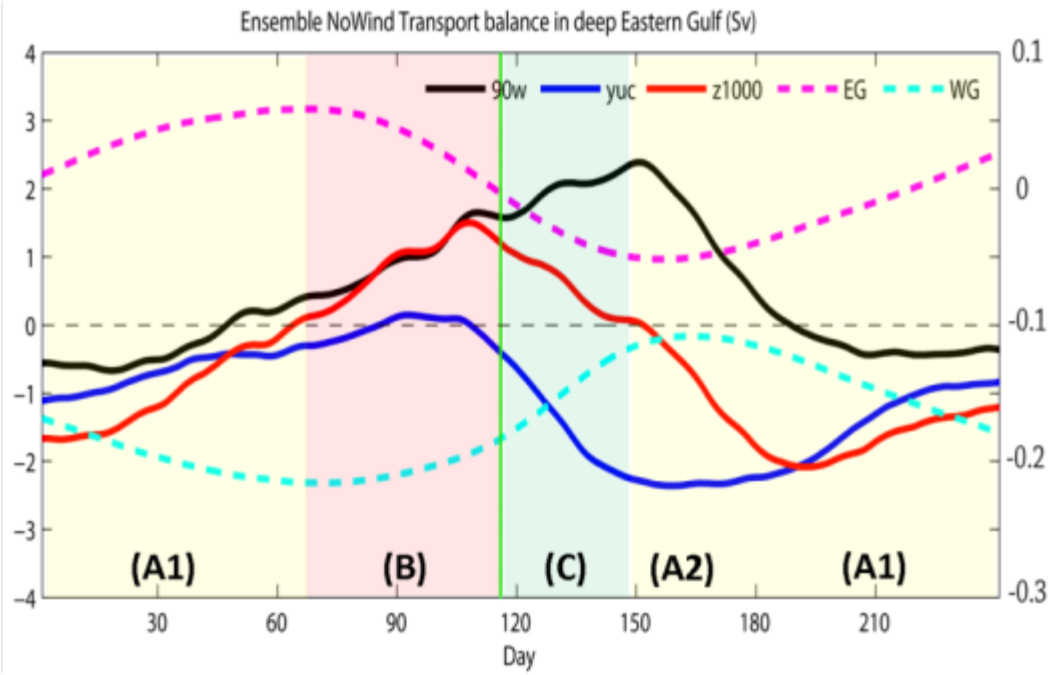

Florida
90W
Cuba
Yucatan
Channel
Latitude
Longitude
31
30
29
28
27
26
25
24
23
22
21
20
−92
−90
−88
−86
−84
−82
−80

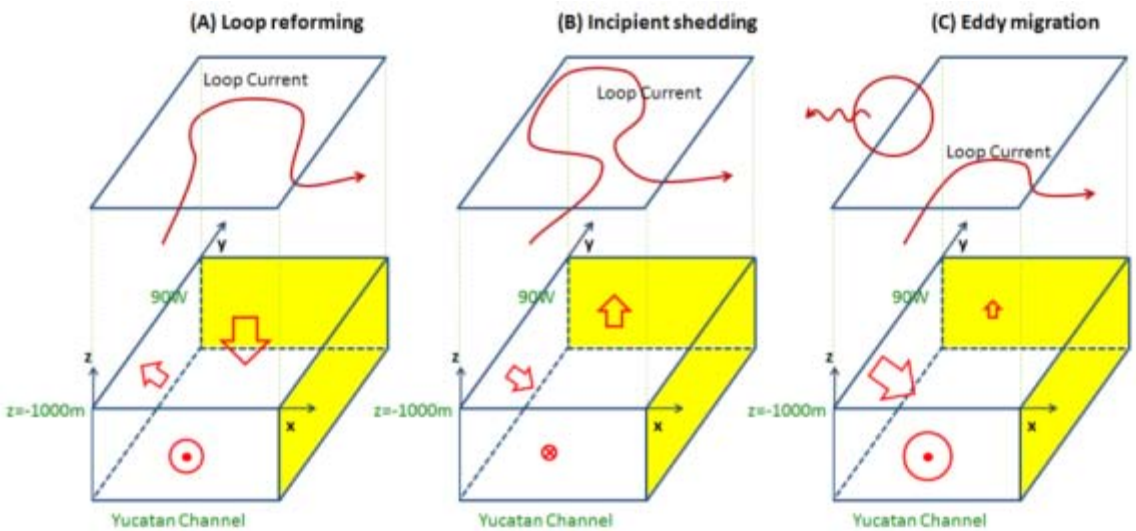
Loop expansion ←→ Yuc outflow only during A1; otherwise 90W is significant → see “C” & A2

Note strong Yuc outflow aft shedding

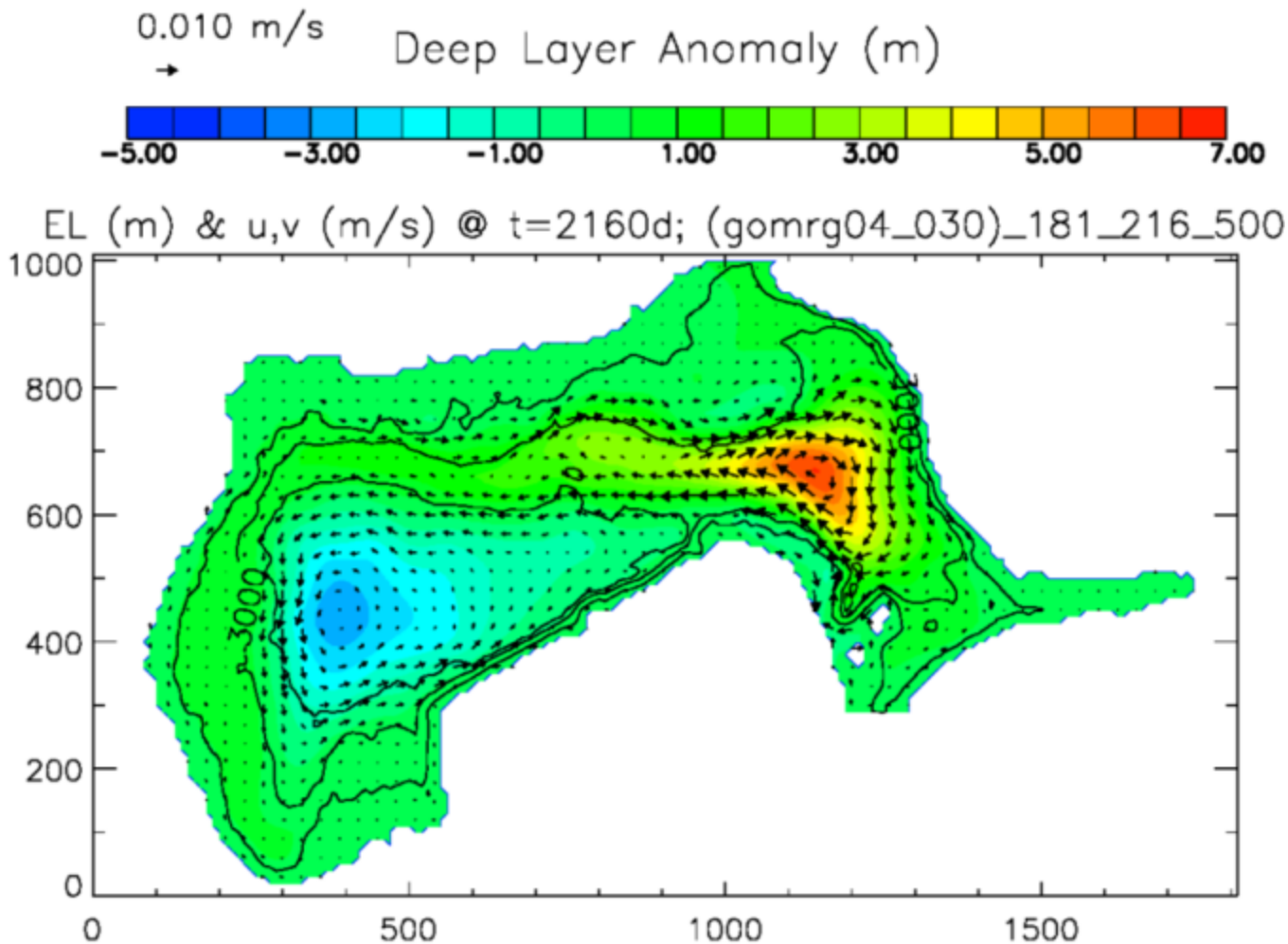
Deep EG cyclone is caused by shedding in “B,” not the other way around

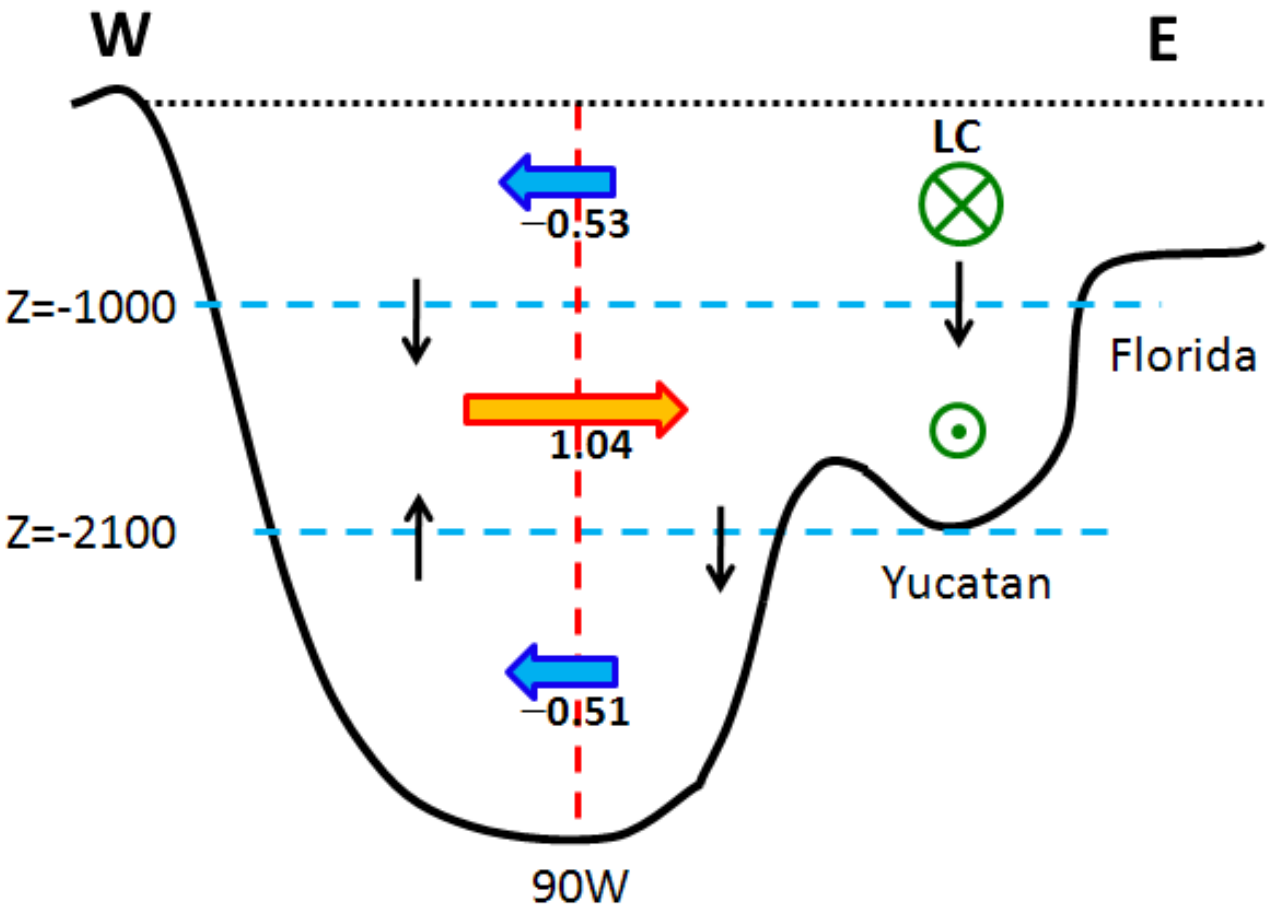
Except during A2, 90W & z1000 are of the same sign → GOM Oscillator





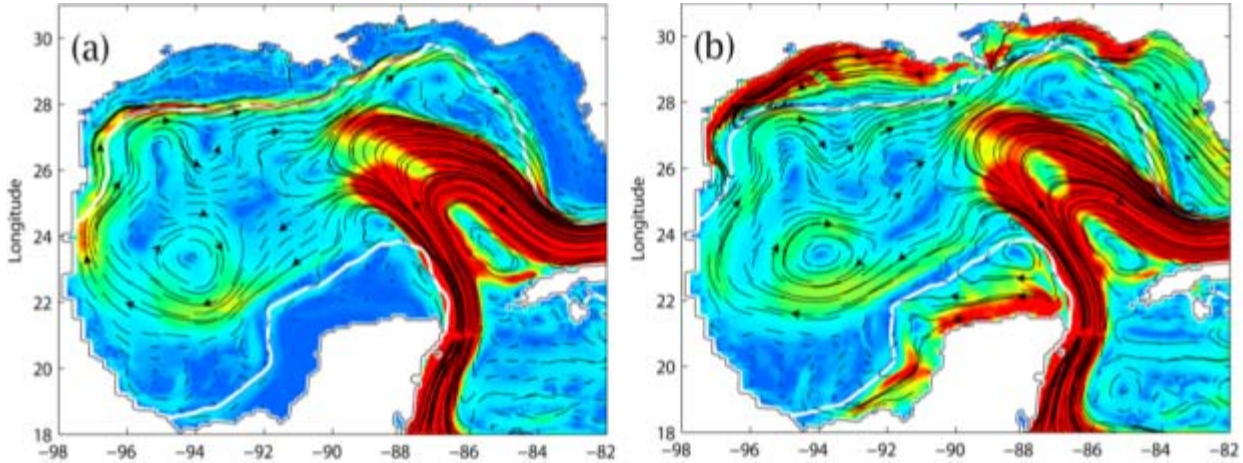
$$\oint \boldsymbol{U}_h . \boldsymbol{n} \left(\frac{f+\zeta}{H+\eta} \right) ds = -r \oint (\boldsymbol{u}_h . \boldsymbol{l}) ds$$

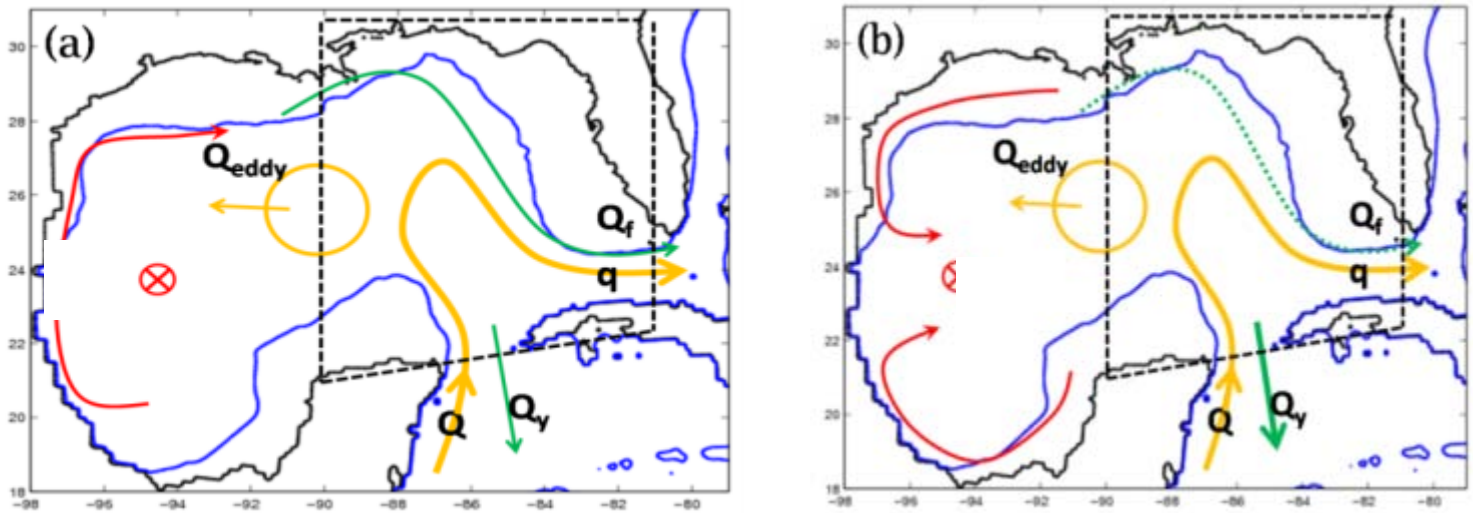



W
E
LC
−0.53
Z=-1000
Florida
1.04
Z=-2100
Yucatan
−0.51
90W

NO WIND

WIND





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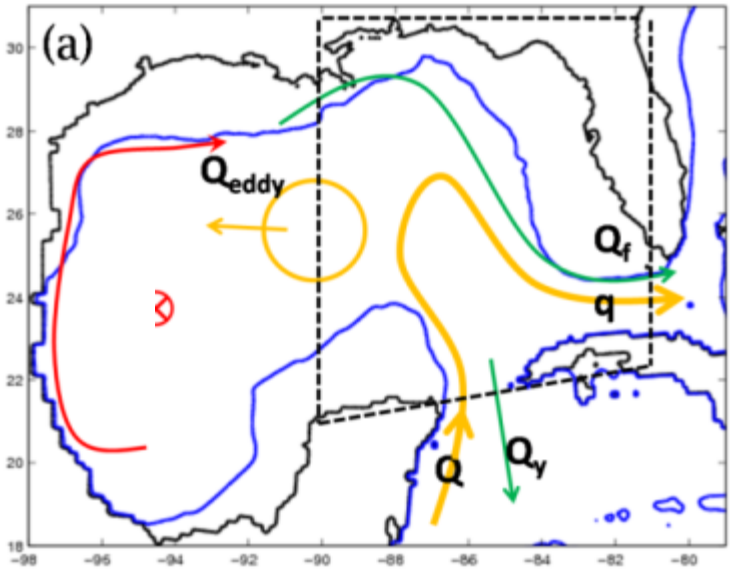
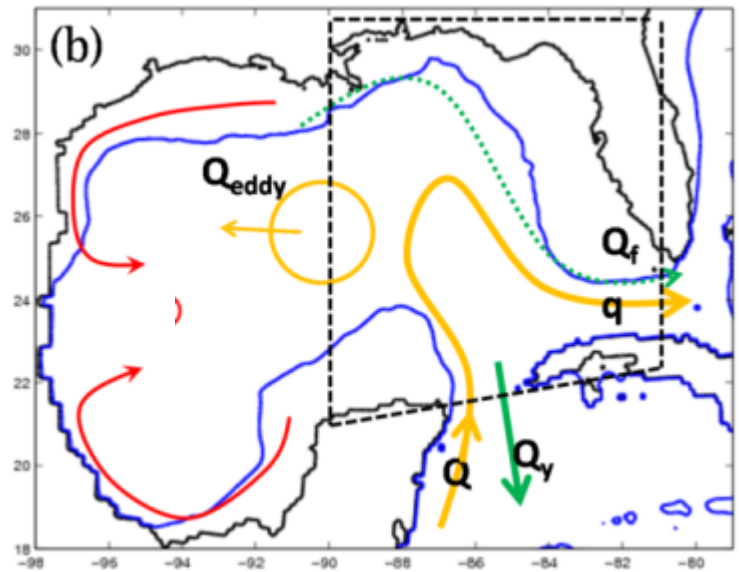
NO WIND



WIND



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References

Elliott, B. A. 1982. Anticyclonic rings in the Gulf of Mexico. Journal of Physical Oceanography 12:1292–1309.

Pichevin, T. and D. Nof. 1997. The momentum imbalance paradox. Tellus 49:298–319.