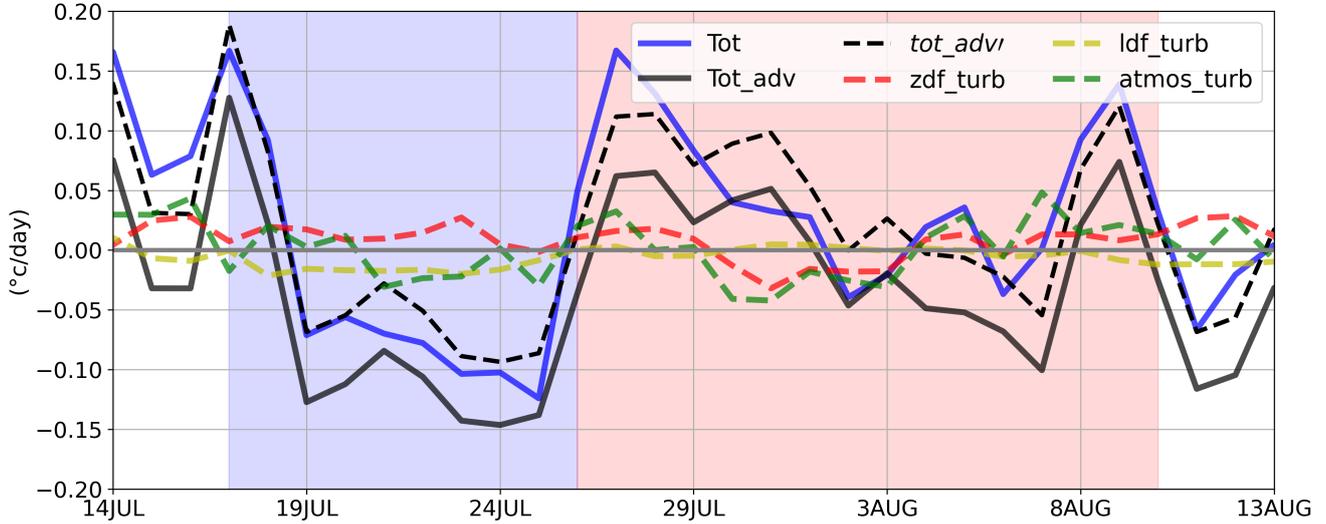


## Supplementary Material



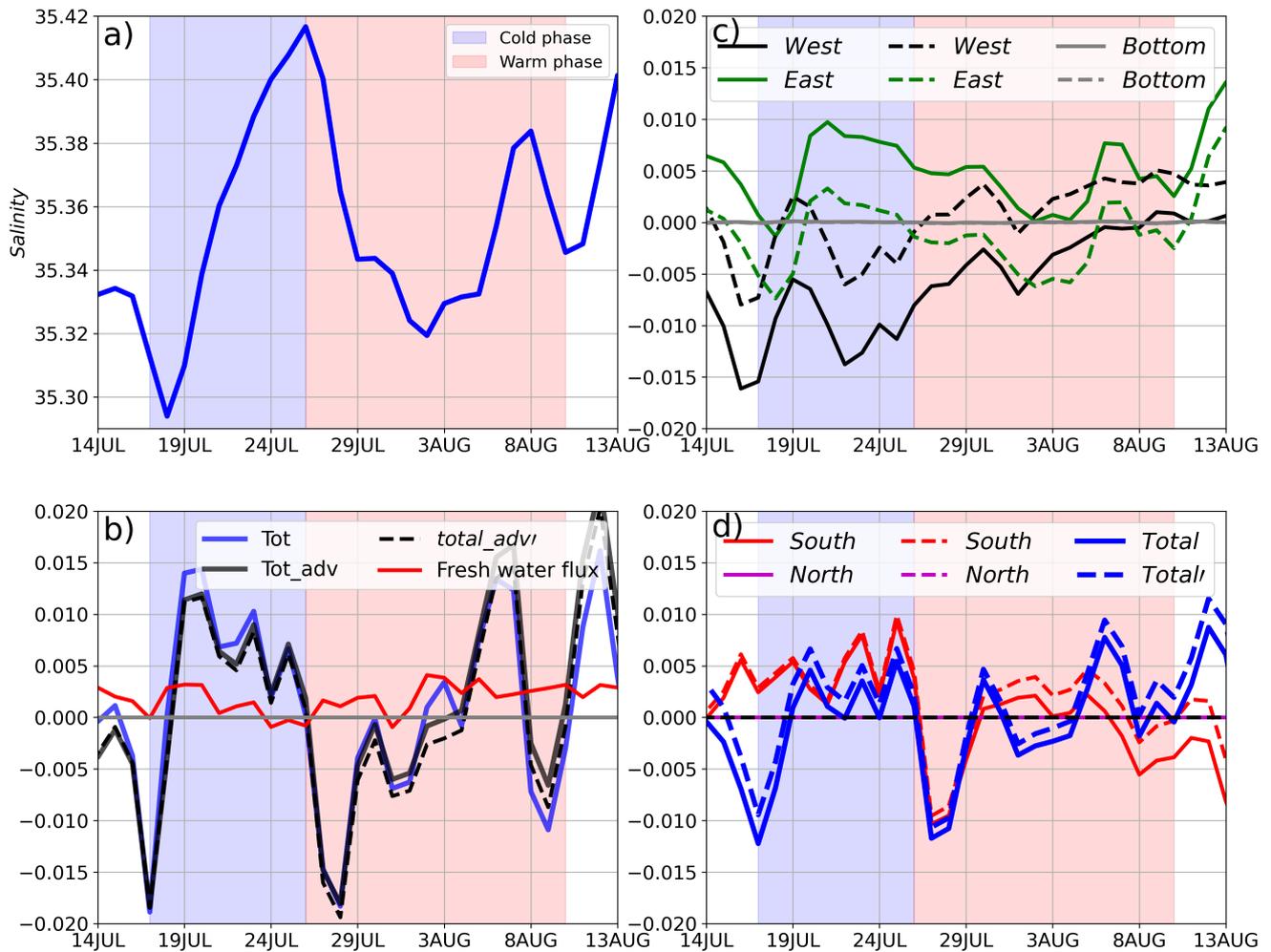
**Figure S1.** Heat budget in the mixed layer within the black box (in Figure 7b) during the cyclone life period : total temperature tendency (Tot), advective temperature tendency (Tot\_adv : zonal+meridional+vertical) encompassing both seasonal and mesoscale (or turbulent) processes, eddy (or turbulent) advection of temperature tendency (Tot\_adv); atmospheric turbulent heat tendency (atmos\_turb), lateral (ldf\_turb) and vertical (zdf\_turb) turbulent diffusion tendencies.

### SALINITY BUDGET:

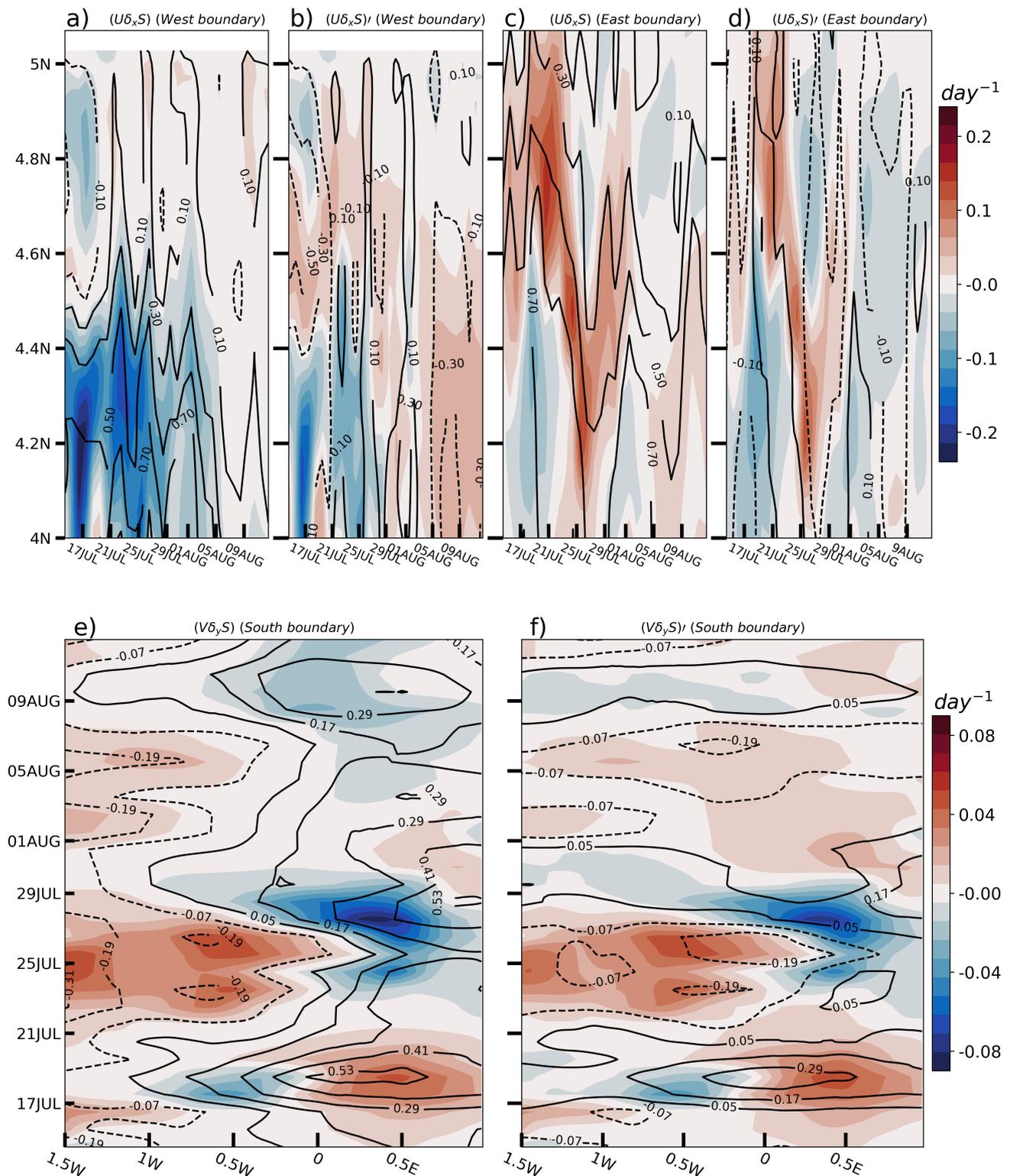
$$\begin{aligned}
 \underbrace{\frac{\delta \langle S \rangle}{\delta t}}_{\text{Total tendency}} &= \underbrace{-\langle u \delta_x S \rangle}_{\text{XAD}} - \underbrace{-\langle v \delta_y S \rangle}_{\text{YAD}} - \underbrace{-\langle w \delta_z S \rangle}_{\text{ZAD}} \\
 &\quad \underbrace{\text{Zonal + Meridional + Vertical Advection}} \\
 &+ \underbrace{\langle D_l(S) \rangle}_{\text{Lateral diffusion}} - \underbrace{\frac{1}{h} (K_z \delta_z S)_{z=-h}}_{\text{Vertical diffusion}} + \underbrace{\frac{(E - P - R) SSS}{h}}_{\text{Fresh water flux}} \\
 &\quad - \underbrace{\frac{1}{h} \frac{\delta h}{\delta t} (SSS - S_{z=-h})}_{\text{Entrainment}}
 \end{aligned} \tag{S1}$$

with  $\langle X \rangle = \frac{1}{h} \int_{-h}^0 X dz$  representing the vertical average of a quantity  $X$  from the surface to a depth  $-h$ . The mixed layer ( $h$ ) is defined as the depth of the isopycnal representing a  $0.03 \text{ kg.m}^{-3}$  increment from the density value at  $10 \text{ m}$ .

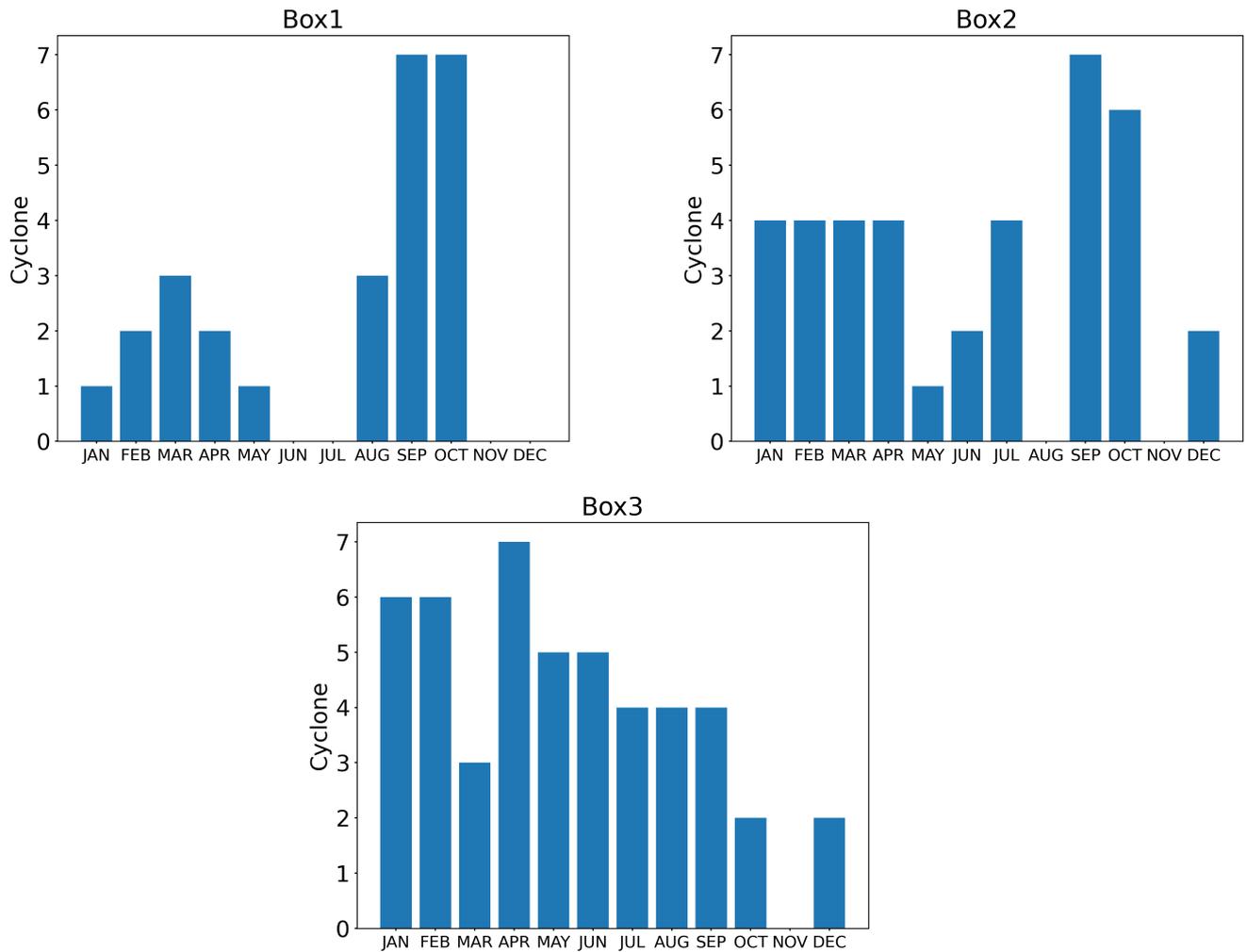
The mixed layer ( $h$ ) is defined as the depth of the isopycnal representing a  $0.03 \text{ kg.m}^{-3}$  increment from the density value at  $10 \text{ m}$ . The total sea salinity tendency equation(S1) is controlled by different terms in its RHS, namely, the 3-d advection terms, diffusion terms, the fresh water flux, and the entrainment term. For completion,  $E$ ,  $P$ ,  $R$ ,  $SSS$  variables are evaporation, precipitation, river runoff and sea surface salinity, respectively.



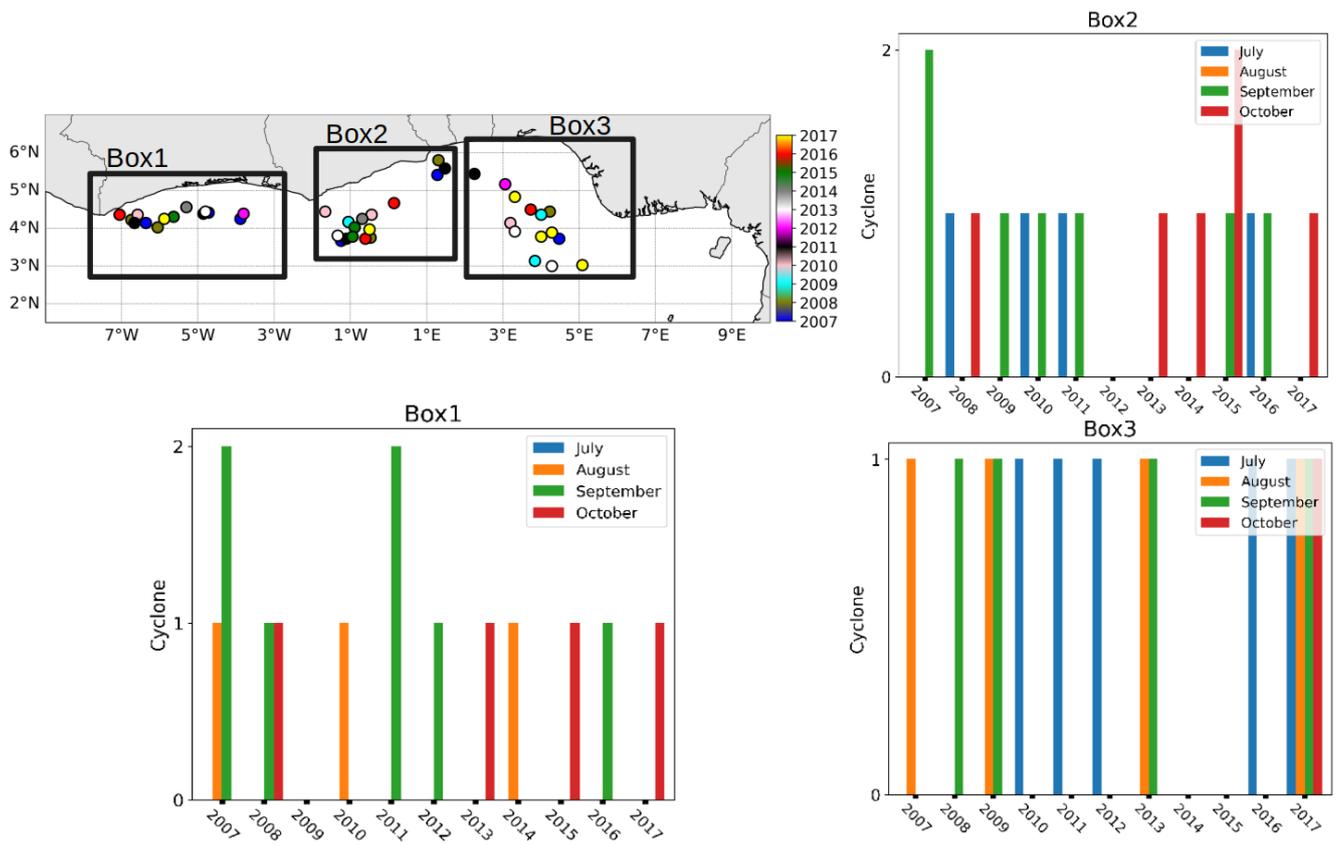
**Figure S2.** Salinity budget in the mixed layer within the black box (in Figure 6b) during the cyclone life period : (a) mean salinity within the box in the mixed layer ; (b) total salinity tendency (Tot), advective salinity tendency (Tot\_adv: zonal+meridional+vertical) encompassing both mean and turbulent contributions, turbulent advection of salinity tendency (Tot\_adv'), Fresh water flux; (c) and (d) are the advective salinity tendency at each boundary delineating the box (West, East, Bottom and South) and the sum of all boundary advective terms (Total), the solid lines are both mean and turbulent contributions, dashed lines are the turbulent (mesoscale) contribution alone.



**Figure S3.** Avection salinity tendency in the mixed layer at the western boundary for (a) mean and turbulent processes, (b) turbulent processes alone, (c) and (d), (e) and (f) similar to (a) and (b), but for eastern and southern boundaries, respectively. The isocontour lines represent zonal current : (a) and (c) the total zonal current encompassing both mean and turbulent components ; (b) and (d) the turbulent component alone ; (e) and (f) similar to (a) and (c), respectively but for the meridional current. The dashed and solid lines represent negative (westward, southward) and positive (eastward, coastward) currents, respectively. The isocontour intervals are 0.2 m/s and 0.16 m/s for the zonal and meridional current, respectively.



**Figure S4.** Seasonal variability of the detected cyclonic eddy in the northern Gulf of Guinea from the NEMO simulation, no interpolation onto the altimetry grid (25 km) is made, so that we take advantage of the high spatial resolution ( 3km) of the model to potentially find smaller eddies as well as nearest eddy structures to the coast that can be missed out when interpolating on the altimetry grid. Boxes 1-3 are specified in Figure S5.



**Figure S5.** Interannual variability of the seasonal (JASO) detected cyclones over 2007-2017. Colored dots are the cyclonic eddy centers when they are for the first time detected and filled colors refer to years. In box1-3, is represented the number of cyclonic eddies detected for each month over JASO of the 2007-2017 period.