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From Mixing to the Large Scale Circulation: How the Inverse Cascade Is Involved in the Formation of the Subsurface Currents in the Gulf of Guinea.

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We analyse the results from a numerical model at high resolution. We focus on the formation and maintenance of subsurface equatorial currents in the Gulf of Guinea and we base our analysis on the evolution of potential vorticity (PV). We highlight the link between submesoscale processes (involving mixing, friction and filamentation), mesoscale vortices and the mean currents in the area. In the simulation, eastward currents, the South and North Equatorial Undercurrents (SEUC and NEUC respectively) and the Guinea Undercurrent (GUC), are shown to be linked to the westward currents located equatorward. We show that east of 20°W, both westward and eastward currents are associated with the spreading of PV tongues by mesoscale vortices. The Equatorial Undercurrent (EUC) brings salty waters into the Gulf of Guinea. Mixing diffuses the salty anomaly downward. Meridional advection, mixing and friction are involved in the formation of fluid parcel swith PV anomalies in the lower part and below the pycnocline, north and south of the EUC, in the Gulf of Guinea. These parcels gradually merge and vertically align, forming nonlinear anticyclonic vortices that propagate westward, spreading and horizontally mixing their PV content by stirring filamentation and diffusion, up to 20°W. When averaged over time, this creates regions of nearly homogeneous PV within zonal bands between 1.5° and 5°S or N. This mean PV field is associated with westward and eastward zonal jets flanking the EUC with the homogeneous PV tongues corresponding to the westward currents, and the strong PV gradient regions at their edges corresponding to the eastward currents. Mesoscale vortices strongly modulate the mean fields explaining the high spatial and temporal variability of the jets.