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风驱动下f-平面准地转三维海洋环流的形成及总质量守恒的应用

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摘要 将理想化的南中国海海盆在垂直方向上划分为Ekman层、惯性层和摩擦层. Ekman层中的运动由大气风应力驱动，其底部的扰动压力将作为其下惯性层中运动的上边界条件. 惯性层中的运动是由f 平面三维非线性方程在准地转近似下位势涡度守恒控制，由此得到控制惯性层中运动关于扰动压力的三维椭圆型方程. 在惯性层以下考虑到深层的海盆水平尺度很小，由此引进带有底部摩擦的线性控制方程，方程的边界条件为惯性层和摩擦层交界面上的扰动压力连续，沿海盆边界假定海水与相邻的固壁间无热量交换，由此设在海盆边界上扰动温度为零. 在此基础上分别利用惯性层和摩擦层中的椭圆型控制方程计算了相应层次上冬、夏季的扰动压力和准地转流. 结果表明冬季各层上以气旋式环流为主，且随深度的增加流速减小；夏季各层上以反气旋式环流为主，流速也随深度增加而减小. 这在一定程度上和观测事实相符.

关键词 南中国海 准地转环流 斜压惯性运动 海水总质量守恒

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Formation of the f-plane quasi-geostrophic three-dimensional ocean circulation under wind-driven and the application of mass conservation

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Abstract In this paper, we divide the idealized South China Sea basin into Ekman layer, inertial layer and friction layer in the vertical. Motion in the Ekman layer is driven by wind stress, and the perturbation pressure on the bottom will be the upper boundary condition of the inertial layer. Motion in the inertial layer is controlled by potential vorticity conservation derived from the f-plane three-dimensional nonlinear equation under quasi-geostrophic approximation, and then we can get the elliptic equation of the inertial layer. Considering that the horizontal-scale is small below the inertial layer, we introduce linear ontrol equation with bottom friction. The upper boundary condition of the equation is that the perturbation pressure on the interface of the inertial layer and the fric
tion layer is equal. Supposing that the sea water has no heat exchange with the wall, the temperature along the basin wall can be set to zero. From the aboving, we calculated every level's perturbation pressure and quasi geostrophic flow by using the ellipse equations in the inertial and friction layer. The results indicate that circulation in each level is cyclonic dominatingly, the velocity decreases with depth, however, there is anti-cyclonic circulation in summer. It's according with the observation in some degree.

Key words South China Sea Quasi-geostrophic circulation Baroclinic inertial motion Sea water mass conservation

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