Size matters: another reason why the Atlantic is saltier than the Pacific

C S Jones and Paola Cessi

Idealized numerical experiments are performed with an ocean-only circulation forced by wind-stress, surface temperature and freshwater flux, all independent of longitude, in a domain consisting of two basins, differing only in their widths, which are connected by a circumpolar channel at the south and. These experiments show that a spontaneous asymmetry in the latitudinal distribution of surface salinity develops, which favors salinification of the narrow basin over the wide basin. This salinification induces a stable pole-to-pole overturning in the narrow basin, maintained by the salt-advection feedback. Pole-to-pole overturning in the wide basin does not occur for zonally-symmetric forcing, but can be induced by reducing the precipitation over the northern end of the wide basin. The preference for sinking at the northern end of the narrow basin over sinking in the wide basin is due to two compounding processes: a larger overturning velocity associated with narrow-basin sinking, and a smaller gyral velocity, which is always found in the narrow basin compared to the wide basin. Together, these differences in salt advection favor sinking in the narrow basin.