Wind stress for ocean circulation as given by the dissipation rate of surface waves

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Recent studies have shown that mesoscale eddies and recirculation around western boundary currents are better simulated with a moderate magnitude in high-resolution OGCMs when relative wind speed (difference between the speeds of wind and surface circulation) is used in the bulk formula for wind stress. However the drag coefficient for wind stress might be better parameterized using quantities associated with surface gravity waves, such as significant wave height, wave age, and the direction of waves. Many studies in the surface wave community suggest that the net momentum flux from air (i.e. wind) to water (i.e. ocean circulation and surface waves) is given by the sum of skin stress and wave stress, the latter of which is associated with the generation of surface waves. Meanwhile, the net momentum flux to ocean circulation is given by the sum of the skin stress and dissipation-induced stress, the latter of which is associated with the breaking of surface waves. In order to investigate the utility of this mechanism, we have developed a coupled atmosphere ocean surface-wave model and performed sensitivity experiments associated with three types of wind stress. The first type of wind stress is given by the traditional formula with absolute wind speed. The second type of wind stress is given by the traditional formula with relative wind speed. The third type of wind stress is given by the surface wave model based on the dissipation rate of surface waves. The sensitivity experiments have been performed to examine the strength of mesoscale eddies in the Kuroshio Extension region, the small Kuroshio meander south of Japan, and the interaction between the Kuroshio Current and coastal upwelling associated with the landing of tropical cyclones.
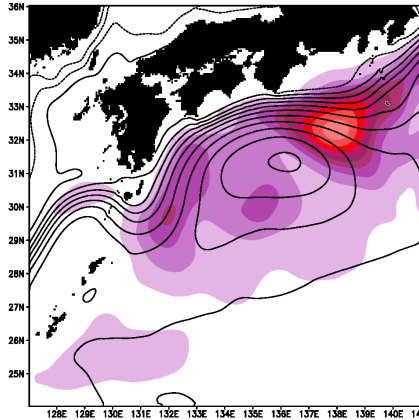
Keywords: Wind stress, Wind waves, Ocean circulation surface-wave coupled model

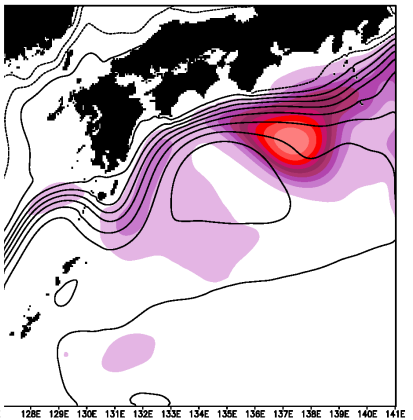# sensitivity of Kuroshio Small Meander to wind forcing

Color:
7-yr variance of SSH
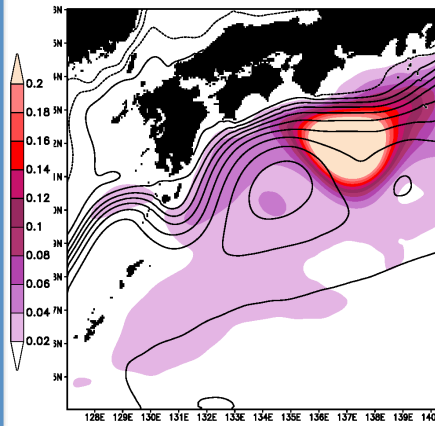
Contour:
7-yr mean of SSH

#1: Absolute Wind Velocity

#2: Relative Wind Velocity

#3: Wind Stress in JRA55

#4: Surface Wave Model

JCOPE2 reanalysis