

The horizontal distance of each cumulus and broadening distance of stratiform clouds determines shallow cloud cover

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Shallow cloud cover below sharp inversion is determined by the relationship between two scales. One is the horizontal distance of each cumulus and the other is the horizontal broadening distance of the stratiform clouds at the top of the boundary layer. We indicated it through the numerical experiments of a transition from cumulus under stratocumulus to the shallow cumulus off the west coast of California. The experiments were conducted with an extremely wide domain (i.e. 300 km × 28 km) using a large eddy simulation model with fine grid resolution (i.e. $dx = dy = 50\text{m}$, $dz = 5\text{m}$). The results show that cloud cover is high with large broadening distance of the stratiform clouds and a short distance between each cumulus. In contrast, low cloud cover occurs when the broadening distance is smaller than the distance of each cumulus. The contrast of the two distances is generated by the difference in aerosol the amount and the strength of surface heat flux. The small broadening distance of the stratiform clouds occurs when the surface heat flux (the aerosol amount) is strong (small), and vice versa. The effects of the surface heat flux are larger than that of aerosol amount.

The relationship between two distances can be applied for estimating the cloud cover below the sharp inversion. Hence, it is of help for improving the better expression of shallow clouds in global scale model.

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