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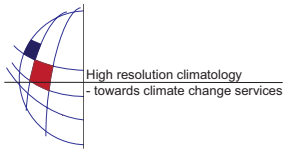

Does rain affect surface pressure?

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The process of hydrostatic adjustment in a vertical column is discussed in the context of rain formation and sedimentation with particular emphasis given on the evolution of the surface pressure. We assume an event of instantaneous condensation in a mid-atmospheric layer which removes mass from the gas phase and implies latent heating. It is shown that the rain formation leads to a change of the surface pressure after a short phase of acoustic wave activity. There is, however, no hydrostatic surface effect once the particles reach terminal velocity. It is not until the rain reaches the ground that the surface pressure decreases consistent with the mass removed by the phase change. Release of latent heat alone does not affect the hydrostatic surface pressure.

It is shown that the amplitude of the initial conditions and transient dynamics are dominated by the effects of latent heating, which dominate over the effects of mass removal by an order to magnitude. However, it is only the mass removal which can induce hydrostatic perturbations below the layer of rain formation, and thus at the surface, while heating solely yields perturbations within and above the layer. In a dynamical sense the net mass removal in the layer acts to stretch the levels below reducing hydrostatic pressure and temperature.

The energy distribution is found to be dominated by the effects of latent heating, however, it is shown that the mass removal significantly alters the amount of energy lost due to work done by the pressure perturbations. Mass removal reduces the amount of energy lost, thus enhancing the energy efficiency of the overall adjustment process.