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Potential effects of deep convection observed during HIBISCUS 2004 on the water vapour content of the TTL as simulated by a Cloud Resolving Model.

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It has been demonstrated that overshooting cumulus clouds may play an important role in regulating the water vapour content of the stratosphere through both dehydration and/or moistening roles.

The potential significance of these effects is explored using the UK Met Office LEM Cloud Resolving Model by simulating overshooting, deep convective clouds that represent the upper end of the spectrum of convective strength occurring in reality, as observed during the HIBISCUS project. In 2-D simulations the overshooting cloud produced a 0.75 km thick layer of dehydrated air in the TTL above the convective anvil through vapour deposition and subsequent ice fall out. Here the total water content of the air was reduced by 1 ppmv or more over a distance of 200 km thus representing a reasonably significant dehydration, which could have a global impact given the frequency of very deep convective events observed in the Bauru area by the IPMET radar. However, moistening due to remaining ice occurred below this height such that the overall effect on the TTL might be to moisten depending on the level of net zero radiative heating and if the remaining ice did not fall out before evaporating. Accurate determination of this height is likely to be vital in order to gauge the effect of convection on stratospheric water content. However, the results are found to be sensitive to model parameters such as resolution and dimensionality. Reasons for these sensitivities are explored.

The vast majority of the ice reaching the TTL was formed much lower down in the cloud and then transported upwards, which indicates the importance of the microphysical processes occurring throughout the cloud in determining the fall speeds of ice and hence the amount of dehydration. This has been demonstrated by examining

the sensitivity to the number density of droplets in the cloud. When this number was increased the mode mass of ice particles reaching the TTL was found to be significantly smaller. Therefore, the ice particles had lower fall speeds and as a consequence there was significant ice present below 16 km allowing the possibility of net moistening of a magnitude significantly greater than in the control run. This points towards a possible anthropogenic aerosol impact on the effects of overshooting convection on the TTL water vapour budget.