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Multi-sensor observations of an elevated mesoscale convective system with a low-level wave beneath its impacting rear-inflow jet

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Elevated convective storms, where the source air is located above the boundary layer, are often associated with severe weather and the forecasting of such storms remains particularly challenging. Elevated mesoscale convective systems (MCSs) are relatively rare in the UK compared with, for example, the Great Plains of the USA. However, during the UK "Convective Storm Initiation Project (CSIP)" an elevated MCS tracked directly across the CSIP observational network.

The elevated MCS was fed from source air located above an undercurrent of cool air flowing against the direction of travel of the storm. The upright convection was intense at first and was accompanied by alternating layers of slantwise ascent and descent within the storms precipitation area, with the lower layer of descent corresponding to a moderately intense rear-inflow jet. The rear-inflow jet did not penetrate the cool undercurrent and did not reach the surface; instead beneath the rear-inflow jet the undercurrent took on the structure of a gravity wave without stagnation. The wave propagated, with the MCS, across the 90 km extent of the observational network over a period of 1.5 hours. The overall wave in the undercurrent led to between 200 and 1000 m of ascent and 1500 m of descent. However, undulations were superimposed on the overall wave, with a wavelength of approximately 7 km and a crest to trough amplitude of approximately 1000 m. The lifting from the wave was sufficient to raise the source air to its level of free convection. No cold-pool outflow was observed and the observed surface pressure increase was consistent with the hydrostatic effect expected from the observed lifting in the wave.

The route of the MCS across the Chilbolton radar, which has an angular resolution of 0.28 degrees, as well as the other instruments deployed for CSIP, has generated what is probably the most complete dataset to date of such a wave coupled with an MCS. These observations and their implications will be discussed and briefly contrasted with other recent results from IHOP_2002 and other idealised modelling studies.