# Lifecycle and Impacts of MCS Convectively-Generated Low-Frequency Gravity Waves

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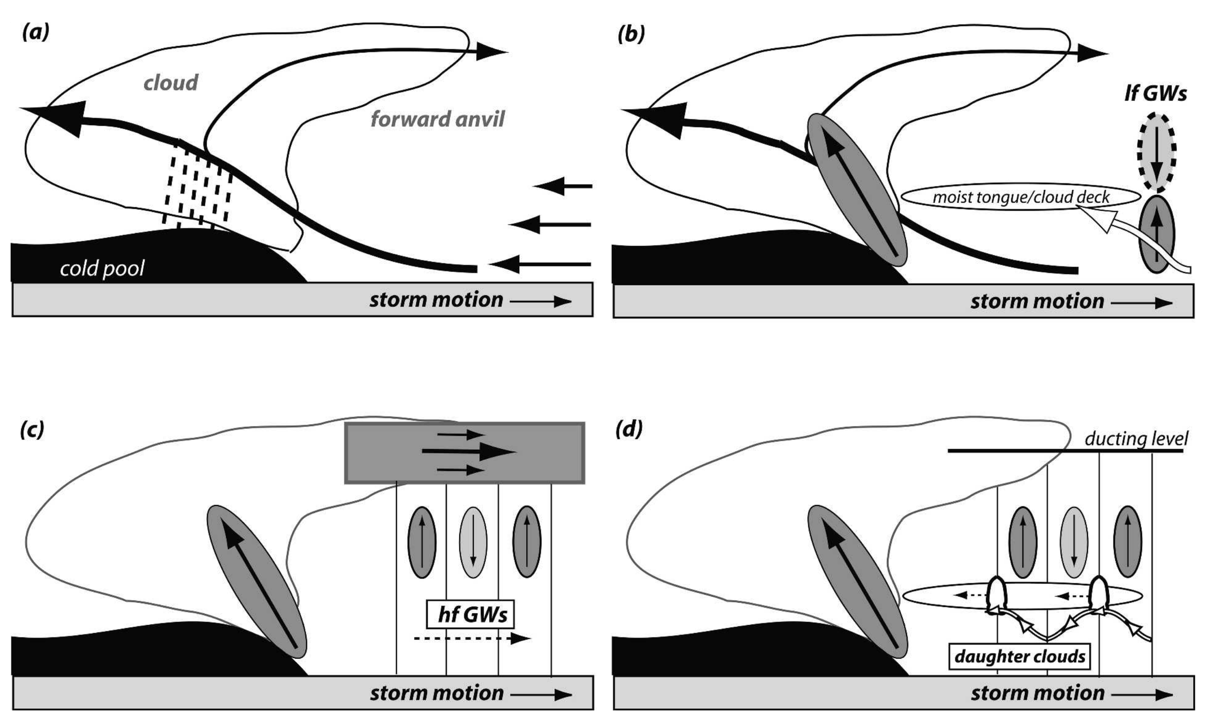
## PURPOSE

- What type of low-frequency waves are associated with discrete propagation events?
- What type of latent cooling profile is associated with these waves? What event in an MCS lifecycle creates this cooling profile?
- Can modifications to the latent cooling profile made via microphysics parameterization impact or even suppress the gravity wave, and hence, discrete propagation events?




Fovell et al. 2006, *J. Atmos. Sci.*

## EXPERIMENT DESIGN

- CM1 idealized simulation
- modified WK84 sounding
- 15 m s$^{-1}$ 0-5 km shear, 3500 J kg$^{-1}$ CAPE
- 350 x 300 km domain
- 250-m horizontal, 100-m vertical grid-spacing
- Morrison microphysics with hail, graupel options

## ACKNOWLEDGMENTS

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## HAIL GRAUPEL

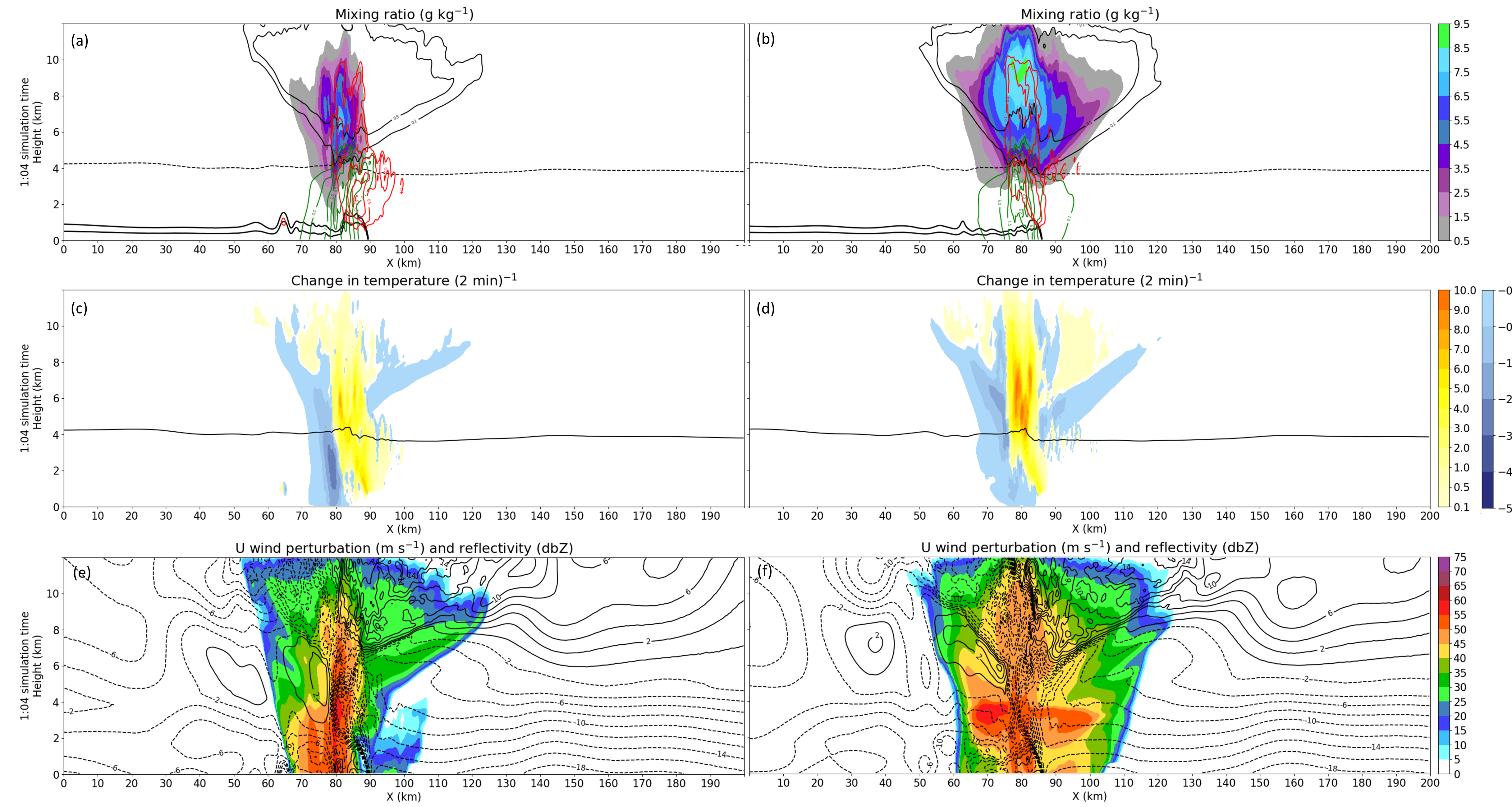


Fig. 1: Vertical cross-sections at X=125 km through the MCS at 1:04 simulation time. (a,b) Mixing ratio (g kg$^{-1}$) of snow (black), rain (green), cloud water and ice (red), and graupel (color fill). Thick black contours are -2 and -4K potential temperature contours. (c,d) Change in temperature due to all latent heating processes summed over 2 min. (e,f) Simulated reflectivity (dBZ) and u wind perturbation (2 m s$^{-1}$, black, negative dashed).

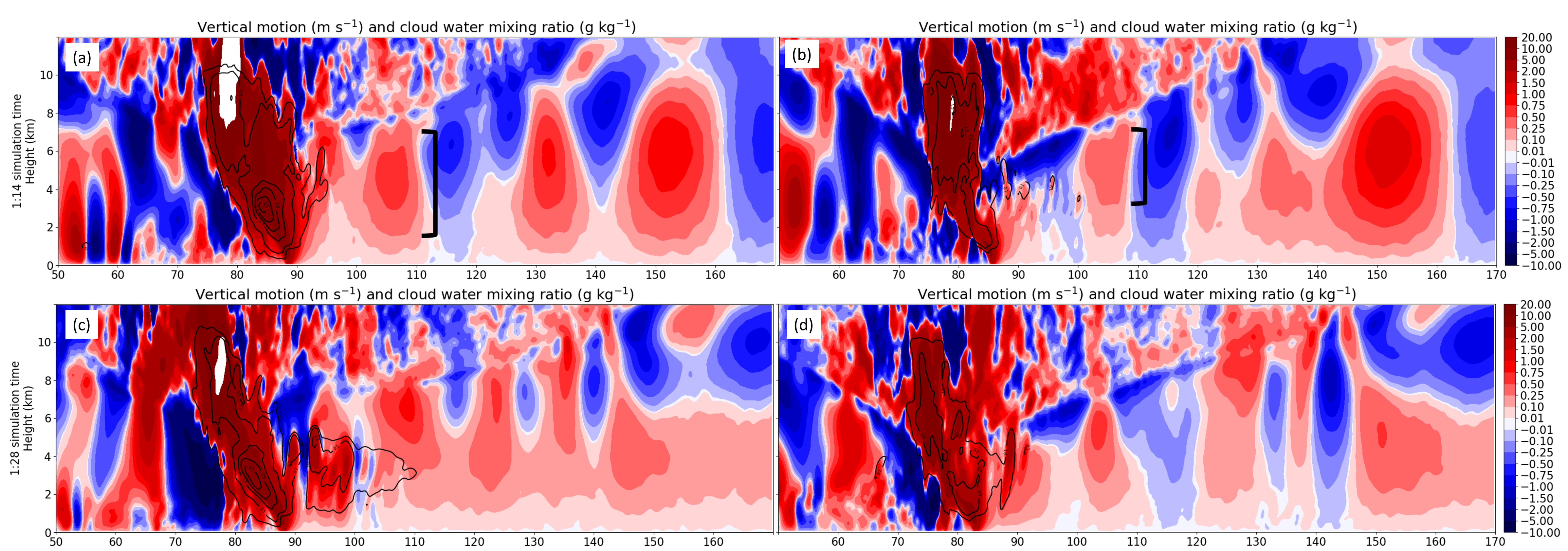


Fig. 2: Vertical motion (m s$^{-1}$, color fill) and cloud water mixing ratio (0.5 g kg$^{-1}$, black). Vertical cross-sections displayed as in Fig. 1, but for 1:14 simulation time (a,b) and 1:28 simulation time (c,d).

- Larger, faster-falling hail melts more slowly; graupel more quickly
- Hail simulation latent cooling rates extend to the surface; graupel simulation cooling rates stay more concentrated near melting level
- Rear inflow maxima in graupel simulation is also farther aloft
- Low-frequency wave in hail simulation extends over a deeper layer, with stronger lifting near the surface
- Low-level lifting associated with wave decreases the LFC; hail simulation wave decreases LFC by about 50 m more than graupel simulation wave
- No discrete propagation event in graupel simulation

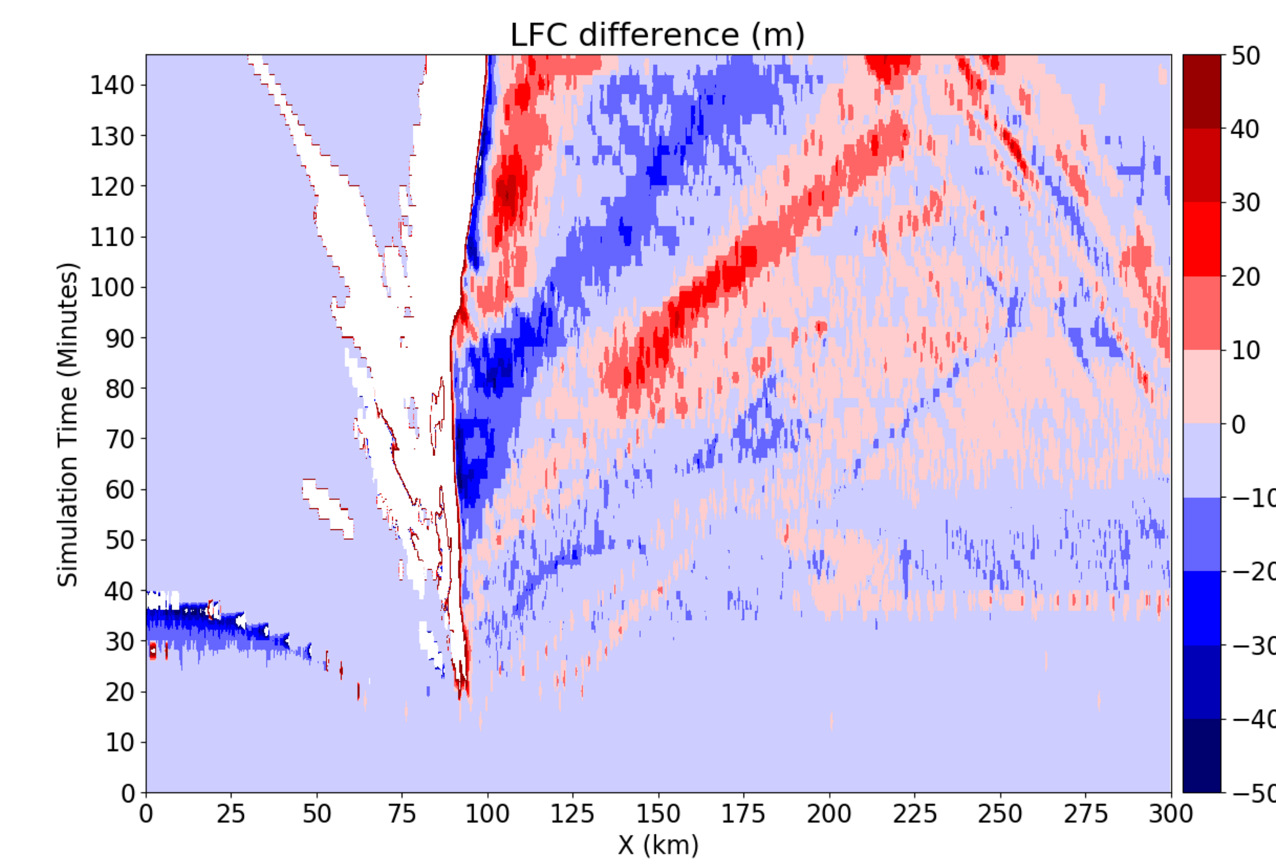


Fig. 3: Hovmöller diagram of the difference in LFC in the hail simulation minus the graupel simulation. Negative values indicate the hail simulation LFC was smaller than the graupel simulation LFC.

## CONCLUSIONS

Idealized CM1 simulations were analyzed to determine that a discrete propagation event and associated low-frequency gravity wave were generated by an increased latent cooling profile extending from the melting level to the surface resulting from intensification of rear inflow into the system. When the vertical distribution of the latent cooling was changed through microphysics scheme perturbations, the wave structure similarly changed, shifting the more intense lifting aloft. With less lifting concentrated in the lower levels, the LFC remained higher, and the discrete propagation event was suppressed. **In sum, discrete convective initiation can be controlled by the in-storm latent cooling profile.**