High-resolution observations of velocity waves in Colorado snowstorms

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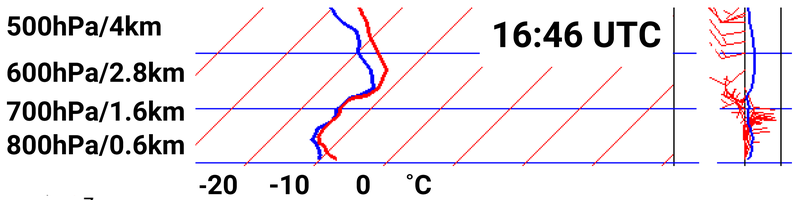
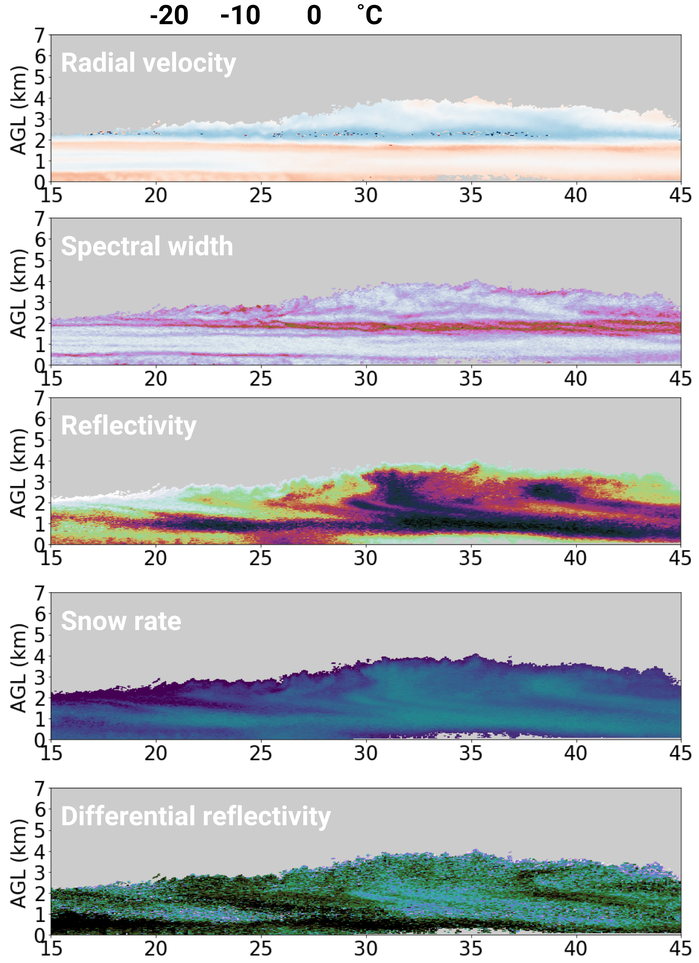
PREMISE | Waves visible in radar velocity and spectral width (turbulence) are a dramatic feature of some snowstorms. These waves often visibly affect reflectivity, differential reflectivity, and snow rate.

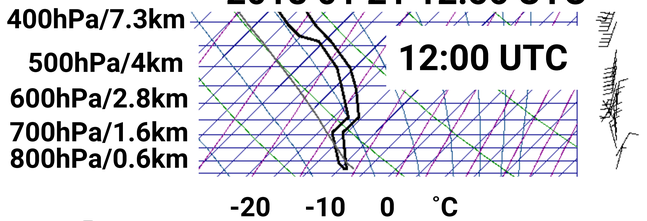
METHODS | We used the CSU-CHILL radar to take rapidly-updating X-band RHI observations through several slow-evolving snowstorms without strong surface fronts during winter 2017-2018. We identify stable layers and shear boundaries using vertical profiles from ACARS aircraft data and the NWS Denver sounding.

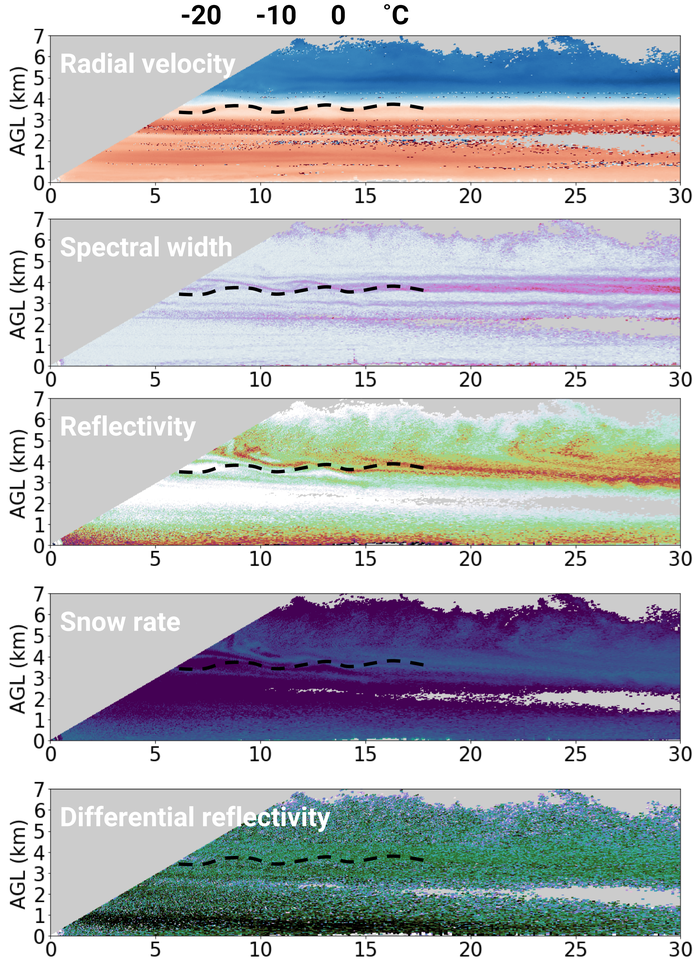
Generating cells and indistinct waves: 2017 12 21 17:26 UTC



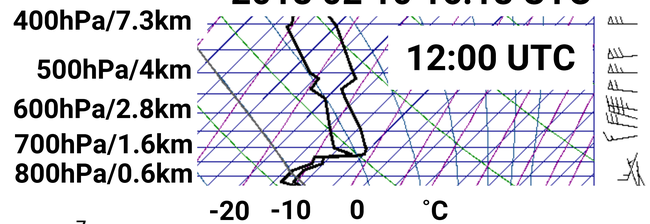


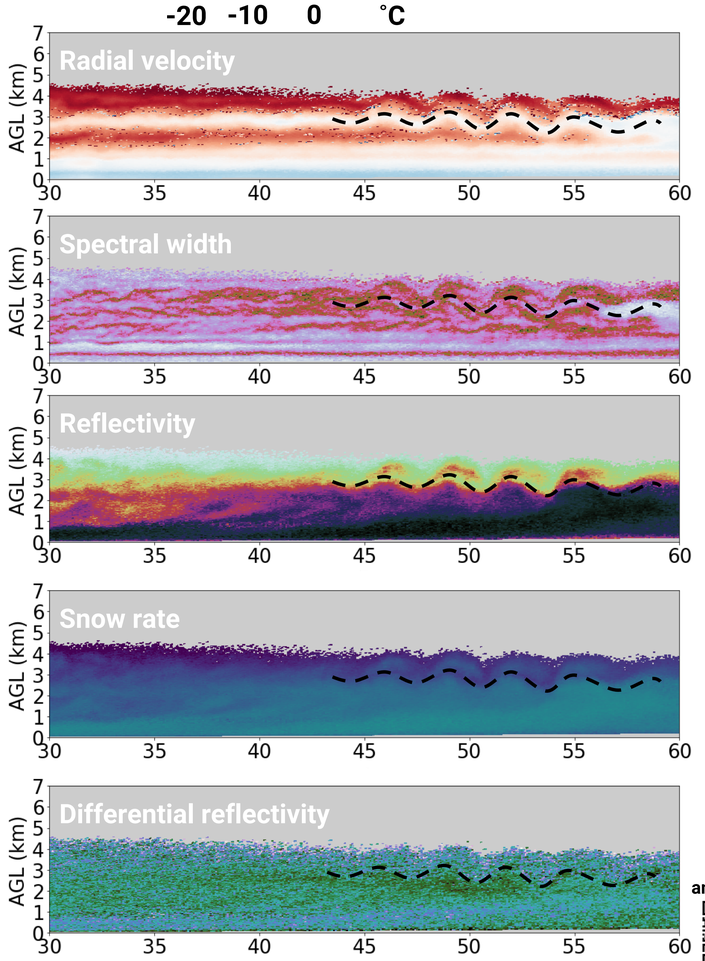
Generating cells and Kelvin-Helmholtz waves: 2018 01 21 12:56 UTC





Propagating gravity waves: 2018 02 10 16:18 UTC





Link to animations

-20	V (m/s)	20
0	Spectral width (m/s)	4
-5	Z (dBZ)	25
0	Snow rate (mm/hr)	1.25
-1	Z_{dr} (dB)	2

KEY POINTS

We document orographic (terrain-locked) and propagating gravity waves as well as Kelvin-Helmholtz waves.
Classic spectral width features of waves such as braiding and the “cat’s eye” are frequently observed.
Velocity waves are often associated with distinct wave-shaped structures in Z, Z_{dr}, and ρ_{hv}.

ACKNOWLEDGEMENTS

PyART: Helmus & Collis (2016) http://doi.org/10.5334/jors.119
Environment Analytics PyART toolkit originally written by Sara Berry.
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