ATS/CIRA Colloquium

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Gravity currents in a deep anelastic atmosphere

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ATS room 101; Discussion will begin at 3:30pm
Refreshments will be served at 3:00pm in the coffee lounge

The region of relatively cold air that develops near the ground below deep moist convection is usually referred to as a "cold pool." Cold pools play a fundamental role in the organization and propagation of mesoscale convective systems (MCSs). Using special observations collected during BAMEX, analysis has revealed that cold pools are often 4 km deep in intense, midlatitude MCSs. Such large cold pool depths have raised concerns about the applicability of certain theoretical formulas that are used to study cold pools, such as Benjamin's famous formula for the propagation speed of cold pools. These formulas are derived from studies of gravity currents -- i.e., the flows that develop as cold air spreads along a flat surface -- and the formulas were developed using the incompressible equations, which are valid only for shallow flows (< 1 km). To gain new insight, an analytic study was undertaken using the anelastic equations, which are appropriate for deep (~10 km) flows. Two key results emerged from this study. First, the maximum propagation speed of atmospheric cold pools is about 25% less than is indicated by Benjamin's formula. Second, it is impossible to have a steady cold pool greater than 4 km deep in the Earth's troposphere (under the assumptions used in this study). These results will be explained in this talk, partly by drawing an analogy to flow over an airfoil.