

Paul Markowski

Penn State

How To Make A Tornado

I will examine the mechanisms of tornadogenesis within atmospheric convection with the aid of vortex lines. The three-dimensional perspective provided by vortex lines can expose dynamics that may not be as apparent in inspections of only one vorticity component at a time. Although the presence of horizontal buoyancy gradients and baroclinic vorticity generation can complicate vortex line analyses in phenomena like thunderstorms (horizontal buoyancy gradients accompany precipitation regions and vertical drafts), vortex line analyses still can be enlightening in that they can suggest plausible methods of vorticity generation and reorientation.

I will discuss the importance of downdrafts in tornadogenesis and present vortex line analyses in observed and simulated supercell thunderstorms. The vortex line configurations strongly suggest that the baroclinic generation of vorticity within downdrafts, rather than simply a barotropic redistribution of pre-existing vorticity by downdrafts, dominates the tornadogenesis process in supercell storms. I also will attempt to reconcile the fact that observed tornadic supercells actually tend to have weaker low-level baroclinity than nontornadic supercells. Lastly, I will briefly discuss some of the ideas emerging from the recently completed Second Verification of the Origin of Rotation in Tornadoes Experiment (VORTEX2).