How Does A Funnel Cloud Form?

One of the funnel cloud photos sent to us by Martin O'Brien

One of our Twitter followers, Martin O'Brien, tagged us in a series of 4 photos which clearly show a well-formed funnel cloud. He took these while passing through the scenic Blueway region in Carrick-on-Suir, Tipperary on Saturday afternoon 9th May, during this period of convection.

Paul Downes, Forecast Meteorologist, Central Forecasts and Applications Office, Met Éireann, provided the following explanation.

This funnel, while not reaching the ground is a great example of the conservation of angular momentum. There are three main ingredients needed to get this.

1. **Moisture.** While you might not see it until it transforms into a cloud, moisture is all around us. The more humid the air the more moisture that is being suspended in the air. Saturday was a warm humid day.
2. **Instability.** Like a hot air balloon, the air inside a cloud has to be warmer than the air outside it, so when the sun heats the earth, 'bubbles' of warm air rises.

The air in the bubble cools as you go up in the atmosphere, e.g. when you see ice crystals grow on the outside of an air plane window- its very cold out there! But the rate at which it cools is always changing. The air in the 'bubble' will cool too at a constant rate as it rises, the key here is if it cools slower than then atmosphere, we call this instability. The atmosphere is unstable and the bubble can continue to rise.

At a point called the Tropopause, approximately 10km above our heads, the atmospheric temperature begins to rise again and the air becomes stable once more. So If you have (1) moisture then as the invisible bubble rises and cools it will eventually condense into a cloud. If it is still unstable the cloud will continue to rise into a cumulonimbus (cumulus- a towering cloud, nimbus - with rain).

So that is what starts the process. The final ingredient is:

3. **Shear**. This can have several forms but for now we will just look at directional shear. If winds change direction along a front, such as a sea or lake, breeze shear can exist along the front, this can cause the air to turn. Alone it will do very little and is quite common. However if you place it under an updraft (a cloud going upwards) it acts like an ice skater in a spin. When an ice skater spins and their arms are out they rotate slowly, if they want to spin faster they pull their arms in - this is called the conservation of momentum and it works in nature just the same. If a large eddy of rotation exists along a boundary and a shower accelerated the air upward, it will tighten the rotation below it. This causes pressure to decrease and to condense, thus forming the funnel cloud we see in the photo above. In extreme cases it can produce powerful tornadoes. However more of every ingredient would be needed- which is something we rarely ever see here- as well as a lot of help from the jet stream which didn't really play a major role that day.