Tracey: [00:00](https://www.rev.com/transcript-editor/Edit?token=tWv4jUHIQlXeZj-k92hfgMP0L_sec2qbFggvDpTtheKswwOQqrg8gBL_3pKBTfGDsAE7i0RfixLsUYIcXSQMCKpjiyQ&loadFrom=DocumentDeeplink&ts=0.2) Hello and welcome to NC State's Audio Abstract. I'm your host, Tracey Peake. The months of March through June mark tornado season, the time of year when tornadoes are most likely to form and even though North Carolina isn't in tornado alley, we do get our fair share of these storms. Brice Coffer is a senior research scholar here at NC State who studies tornadoes. He's here today to talk about the latest findings on how exactly these storms can form. Welcome, Bryce.

Brice: [00:27](https://www.rev.com/transcript-editor/Edit?token=TV-ql8Bn1XOszUL6aAFf8zQbLKLzNexFGra0fPYX_SGTOiVng7jXydNOhBQgaYEJJfuozu9s1W6giuzBnPFTL9ywlEI&loadFrom=DocumentDeeplink&ts=27.19) Thanks, Tracy. I'm happy to be here.

Tracey: [00:28](https://www.rev.com/transcript-editor/Edit?token=IGpD9J6ZGWj6FzSfZjln_VJYPxxPPaSOgI6PBiv2Oj59dWjiYP41cecTG7I9c1z40yRrz2Jw4oJJLSwtXHQVJ_N5UjI&loadFrom=DocumentDeeplink&ts=28.9) Let's get right into it. So what do we know basically about tornado formation? How do these giant thunderstorms generate tornadoes?

Brice: [00:37](https://www.rev.com/transcript-editor/Edit?token=MnvPcoy7Z1rYa7bNXCM8_70UNA1Yz4a_fZRHqsj7l5thcBwiFQXDpyPSJyTykwMiuMNGZjEG3q1QpmO_XPL031It8JI&loadFrom=DocumentDeeplink&ts=37.46) Although some of the details of tornado formation are still being investigated by scientists, we kind of know the basics of why certain types of thunderstorms produce tornadoes and others don't. In general, we know that thunderstorms form when warm humid air at the surface is kind of overlayed on top of relatively cold air aloft. And this creates instability that the thunderstorms can feed off of to create all the precipitation and stuff that you see when you look out at thunderstorms.

Brice: [01:11](https://www.rev.com/transcript-editor/Edit?token=ocn5u-Qnx9wIXcamkQyTUwRTiiWX-cX9BBnzNsGnbK2jtYz69rwo2M9sOMDCZzBbvX-jFtWf3Ilwwv9ZiMogUt13ndQ&loadFrom=DocumentDeeplink&ts=71.32) And then another type of ingredient that is kind of special to the storms that produce tornadoes is wind shear, and that's when the wind changes speed and direction with height rapidly. And so those two things kind of combine to give you these special types of thunderstorms that produce tornadoes. And so for a tornado to form, there needs to be air spinning at the surface in addition to these storms, aloft. And so that happens when air sinks to the ground and starts to acquire rotation. But to get the tornado that you see, you need to contract that kind of broad rotation at the surface into a tornado. And that's similar to if a figure skater brings in his or her arms to spin faster. You kind of need that same process to happen in a storm in order to get something that's more of a tornado versus this broad rotation.

Tracey: [02:09](https://www.rev.com/transcript-editor/Edit?token=fY9KlLrhDcHYR0rF7ci37aAxtS9YpRvRIniXPgHYbUwjoTs-jLNFvJ_RfYW2b0dqPTId9m8_FBbA8h7Y5IpR7jlw1SU&loadFrom=DocumentDeeplink&ts=129.89) Well, that brings me to sort of a follow-up question. You know, most people think of, oh a tornado, they think of it coming down from the giant thunderstorm or the cloud, and your work focuses more on these ground level winds. And how did those winds get, are they pushed down by the thunderstorm to start with? Is that what's happening here? And then how do they get kind of compacted into, what we consider to be that funnel shape?

Brice: [02:39](https://www.rev.com/transcript-editor/Edit?token=A6aq0CqGc1OLlvM43u28aOKs0pUIAkUaOnsjiuzUBQUVsSl2inUBTPXyXXSWG23oj2YRWyfEHPZ6Mj-VAnxoEiOFy44&loadFrom=DocumentDeeplink&ts=159.87) What we're kind of been focusing on lately is the winds near the surface that are kind of going up and into the storm, into the updraft, but there is this kind of illusion that a tornado forms above the surface and then descends down. And that's actually not true, as you mentioned. It's kind of a visual illusion. You just see the clouds start to descend towards the surface, but actually the tornado forms near the ground and as the rotation increases at the ground, the pressure drops, which causes the cloud to move from say, maybe a kilometer above the surface to start descending down towards the surface. And that's actually what you see when you see a tornado come to the ground. But the actual tornado itself starts from the ground up. And so our work has been focusing on how you get that rotation at the surface to contract.

Brice: [03:39](https://www.rev.com/transcript-editor/Edit?token=8FAbblxVEOqikGVpO6Sy-LhyFcvTFZ7TI92uf8qUMAEAoMVtUDf_LC9X_RUTvbdX6L-zd2vgjyEDgSg68Vcx0oeW2Qk&loadFrom=DocumentDeeplink&ts=219.38) And what you really need is a strong updraft aloft. And so that updraft is air rising into the storm. And then when it's really strong, it stretches the air at the surface like that figure skater bringing her arm, his or her arms in. And so, our work has kind of looked at these near ground winds and the inflow of the storm, and so we looked at two different types of storms, non-tornadic and tornadic storms, and they seem to have slightly different winds in the lowest few hundred meters of the atmosphere. For example, the tornadic storms, they were rotating as the air goes into the storm, it's rotating, but it's rotating more like a tightly thrown spiral of a football. But in a non-tornadic ones, the air is rotating in a different sense. It's more like if you kick off or punt a football and the ball's rotating end over end instead.

Brice: [04:42](https://www.rev.com/transcript-editor/Edit?token=RS2UMN1R-N9ZOrdmIJckrZ43Kbx33CJ2iQZmLh7wHn6IXWIXGXcMR9uXE1KI-levRuSyWMDTdZ6GHxEv8bJZKcWnHiA&loadFrom=DocumentDeeplink&ts=282.21) And this leads to differences in the storm right above the surface. And that's really what kind of leads to the transition between that broad rotation into something that's more of a tornado.

Tracey: [04:55](https://www.rev.com/transcript-editor/Edit?token=mducKEAwtsHP-bHhcRb2t7LHUTdQIlTSA9Gex4Z5Y5ZBlP4zB31fzs19RQYrHYJ-hszQazUM2BGE52OOhOzfsphMTn0&loadFrom=DocumentDeeplink&ts=295.6) Okay. So you guys can presumably look at or measure the way that the air at the surface is rotating and be able to say, okay, this storm is likely to form a tornado?

Brice: [05:16](https://www.rev.com/transcript-editor/Edit?token=GE5YQNOmakc-I72GYbesReJSgJvXlsZvDTYAYcQIrdBjXkwz1JI5dgu-VPC83GsrvyeOt0ve_oW90ELCYLBrWhm2yBw&loadFrom=DocumentDeeplink&ts=316.74) Yes. So we have been working with some of the best forecasters for super cells and tornadoes at the storm prediction center in Norman, Oklahoma to look at maybe over 20,000 different super cells. And we know that super cells are a very special type of thunderstorm and they produce almost all tornadoes, but maybe only like 15% of super cells actually produce a tornado.

Brice: [05:41](https://www.rev.com/transcript-editor/Edit?token=T0jWQKec22X4zrB1x1R3kOuz2MAAhqMMjj7EBJxsKeFkIuiDTsFNxnSSf-r_omkOZ63v2OECox7E391ewpO7QXS4DiY&loadFrom=DocumentDeeplink&ts=341.86) And so with these forecasters, we've compiled all these different super cell cases over 20,000 as I mentioned, and separated them into non-tornadic, weakly tornadic and significantly tornadic storms. And so we were able to kind of confirm some of our earlier work, which was just a subset of storms from when we were out chasing, with a much broader data set to kind of confirm that these winds in the lowest few hundred meters when it's more like a football or a tight spiral rotating into the storm. Those storms have a much higher likelihood for tornadoes than-

Tracey: [06:30](https://www.rev.com/transcript-editor/Edit?token=FQBp0O_ypw8qOHEHfb9mFmSXJDjmtYbe1hP4xBDwexEQNNzkWUuoc_gBeiJ9FBgmcQX4D91RqJBkyCBpEWBO_7Vgz1s&loadFrom=DocumentDeeplink&ts=390.44) How would that maybe work into forecasting, like realtime forecasting? Would this be something that you could use in the future to say, okay, this thunderstorm is probably going to generate a tornado and you need to take cover?

Brice: [06:57](https://www.rev.com/transcript-editor/Edit?token=yGLQe5Zs-iu7U2hTypJs2zYdsT1rdGWIp5q_O3sZ3zn7PtVhxMe5Ud3W8DmXe-ItThMygJXV50p3JzsXQN7mxGw3WBk&loadFrom=DocumentDeeplink&ts=417.73) We were able to help them improve that by maybe about 25% and so it increases their awareness and understanding of which storms are probably the most likely to produce tornadoes. We'll maybe never be able to say exactly which storm is going to produce the tornado or not. But we're continually increasing our understanding of the environmental ingredients that control tornado formation in storms.

Brice: [07:42](https://www.rev.com/transcript-editor/Edit?token=IcCsoAbmV8mL7f7E4TXPo9Y6cVGBMN05Aor6Qo_f1mNzKVC43hH_uyi18FpCY_faMS7w64GWyhwR0SKqkrd8xziOl88&loadFrom=DocumentDeeplink&ts=462.04) And so by increasing our understanding of this and thus increasing the skill of the forecasting parameter, forecasters are already starting to use this to improve their weather forecast for tornadoes.

Tracey: [08:07](https://www.rev.com/transcript-editor/Edit?token=Ei8Oks_AUF0oEDE18kpgz9dUenJMTKryE9TddO9lYoKL8slfoY3xrdKy25RhwalCogC_8NkczfHrTP93nkvOMGBvJCY&loadFrom=DocumentDeeplink&ts=487.09) If you had sort of the perfect recipe for a storm that's going to produce a tornado, what would that look like? What's happening in a storm to make it the perfect storm to produce a tornado?

Brice: [08:24](https://www.rev.com/transcript-editor/Edit?token=eLRXCqagK71C8TcAobnwu1s5HyS-UMT8KY2QtncDVcG52vtSLlzev4bhFsxjG9QoXeFwU0d_BiSywo6uVhYDdWbV7ks&loadFrom=DocumentDeeplink&ts=504.3) Yeah, so things that you'd kind of look for are, I talked about the instability, aloft that kind of fuels the thunderstorm when you have really warm humid air at the surface and really cold air aloft, and this cold air, the faster that the temperature decreases with height leads to more instability. So, sometimes that can be over 30 degrees over a few miles. And so when that's really high, there's a lot more instability for the storms to work with. So that would be one ingredient.

Brice: [08:55](https://www.rev.com/transcript-editor/Edit?token=CN-Jgq2KPd8dGc7415YQtb-FsSb2v3dyy90c35_fUpqkqCPfWcfSpo2H4sc9ciTMme5_B_Z_ylnFvzxuXmLF08S5jTo&loadFrom=DocumentDeeplink&ts=535.54) And then also we know that when the bottom of the cloud is really low, that's actually more favorable for tornadoes as well because it has to do with how much evaporation occurs from the rain that falls. Evaporation leads to colder air. And so a lot of cold air is hard to stretch into a tornado. It's like a big cold dense block that's harder to move upwards. And so lower cloud bases, more instability, and then this winds in the lowest few hundred meters that feeds the low level updraft when that's more like a football. That's when some of the most common tornado outbreaks have those ingredients, but in very extreme quantities.

Tracey: [09:49](https://www.rev.com/transcript-editor/Edit?token=iSJDOeAqdNKVg19t8oVp1p1mMXTExD-fwr2L_JgnP9p0B1HRgREgGZDCxJL1XPlsmDpGS2urdO3PCWRoVQ1WIdm8aCw&loadFrom=DocumentDeeplink&ts=589.91) So you mentioned that you had done some tornado chasing, I guess as a way to get information for this research. So you know, how close have you been personally to a tornado? What was that like?

Brice: [10:02](https://www.rev.com/transcript-editor/Edit?token=fVL60kBhqxPx25S5dzsN-Vlu_muzTu-iaYJG4OwzFGRUnSqLYqVIn82SZ2E1xsc6We7FRZJT7dJnG6sMR5IiNrKLvxQ&loadFrom=DocumentDeeplink&ts=602.66) So normally we stay, when you're doing kind of the research aspect, you stay a bit farther away to kind of launch balloons and other instruments. You don't want them going directly in to the storm because then they often get destroyed a little bit. But when you're kind of chasing, maybe just personally, sometimes you stay about maybe a mile or two away, and storms don't move as unpredictably as they kind of show in television or especially on Twister. And so, you kind of know a general direction that a storm is going and so you can stay within about a mile or a mile and a half of it. And so, sometimes you get a bit closer, maybe not on purpose, but you try to stay just a bit away because that increases also your view of the storm. If you get too close to it then you can't see very well.

Tracey: [10:57](https://www.rev.com/transcript-editor/Edit?token=U5rd-Qov9c-TXKyfHuYRb_IOmMciDY2WWifXm8k9kuJYjZ1KKaCN1a5kFen2Cxsn2SVRStRvQiE0NRPL9gNCwglIygI&loadFrom=DocumentDeeplink&ts=657.03) What is the most exciting or surprising part of doing tornado research? Most people just think, oh yeah, you're driving around in a van chasing tornadoes. Woo. But what is really the most exciting or surprising thing that you've found?

Brice: [11:17](https://www.rev.com/transcript-editor/Edit?token=UrnuGgEgfSJggltN9UunbeKfTLZBZbscnG5XlkfqfUWG6b6Ttvl2H7r3piZGlTYsKiT-DBvSMEs_cKhAlp9ofA8tetI&loadFrom=DocumentDeeplink&ts=677.59) The most exciting thing is probably the driving around, and then one of the things that I really like about it is that, storms are unique in that they happen in a very small window of time. Like nobody will ever see what I saw at that moment again. It won't happen again in that same sense. Like storms and tornadoes form again, but the specific kind of formations that I saw nobody has ever seen and will ever see again, which is kind of a cool thing to think about.

Brice: [12:18](https://www.rev.com/transcript-editor/Edit?token=iG7dg-zcwrI1QX5X3xN5NQdN8rpfbg63_zovQ6aPMjF_9VSU7eLCSgmNLJNriZRxlxJIP2h0_d5tTJrleBBSmpsCdyk&loadFrom=DocumentDeeplink&ts=738.42) And then kind of the most surprising thing that people learn when I tell them what I do is that a lot of my time isn't doing that, going out and chasing. A lot of my time is behind a computer and some of the also exciting things in the future is just how much our computer processing is increasing and so we're able to recreate thunderstorms using computer models that, resolutions that we have never been able to before and seeing new details and new things that are going to lead to increase understanding of the controls on tornadoes in the near future because of how fast computing has been increasing.

Tracey: [12:59](https://www.rev.com/transcript-editor/Edit?token=Z8yf_iVyBdvG_Mg0BulFJ_647AjUVVeIkLdCVr0IPTbSiUirZL56V8ilMLNJMvVT_7m13P-p5FdfDZ6xB83GBQizzRg&loadFrom=DocumentDeeplink&ts=779.91) Is there anything that you wanted to add that I've missed?

Brice: [13:11](https://www.rev.com/transcript-editor/Edit?token=juyo10OAbPM_oMLTDNQEIzs4O500j1y0lYI4YPTU_xvPxjXOcszwrgt-0Vyu-UKzz-YUGADftZJ0of-SqT1NNx7UEM4&loadFrom=DocumentDeeplink&ts=791.49) In the last couple decades, it's amazing how far we've come forecasting tornadoes. As I said, we still can't mention exactly which one will produce a tornado, but we can identify areas that are, say like central North Carolina might be favorable for tornadoes in a couple of days and sometimes we even get good forecasts out to seven days. And this is pretty remarkable and this comes from a couple different things. One, we've now in the last like 20 or so years, we have weather radar that continuously scans for precipitation and rotation, which we didn't use to have. And so forecasters are always aware, but also we've just increased our understanding of which storms are most likely to produce tornadoes.

Brice: [14:01](https://www.rev.com/transcript-editor/Edit?token=vSsUOU05FrE-wqOEijqlepXnu6aVgU19ytHtWJSVWg4sB6CpWj64cDApbAOSom1LwTiLny3fgdG2vD7KSOIKQ_sxi10&loadFrom=DocumentDeeplink&ts=841.41) And so we've come a long way from, especially in this kind of the earliest 20th century when people the air force just started doing tornado forecast and then tornadoes, forecasts were actually banned by the U.S. Weather Service at the time, the version of it, because thought was it might induce mass hysteria or something. And so we've gone from a point where we weren't even allowed to talk about tornado forecast and now we can do it up to almost seven days on the really big outbreak days.

Tracey: [15:14](https://www.rev.com/transcript-editor/Edit?token=PTsyjY8F62iP3oPF57wpaVuRBIRNmSrgUizpTt8qX5bgiuThVUF9IQ30OTgymB3Kr4J0JGHvFbMj2nfmi8GELRHeyXg&loadFrom=DocumentDeeplink&ts=914.09) Well, that's amazing. Well, thank you so much for being here today, Brice.

Brice: [15:18](https://www.rev.com/transcript-editor/Edit?token=EYnEafVFjZmrpB1uJrJznLstzBPbyqFode_531zyEF_5MBeBd3LNnnpk0w8lcNNJRoHY_Q2hrlUy3TQP2BdzOCxeupY&loadFrom=DocumentDeeplink&ts=918) Thanks for having me.

Tracey: [15:19](https://www.rev.com/transcript-editor/Edit?token=84fkHsL58ill-A2n7fML4lpWucdoHLOlMS7jsVAiyiBpxlJALO_obsS8x3Dlk44hxPmARK_-NcKQwckAJPQ1vaa0YQM&loadFrom=DocumentDeeplink&ts=919.79) We have been speaking with Brice Coffer, a senior research scholar here at NC State. This has been an Audio Abstract. I'm your host, Tracy Peak. Thank you so much for listening.