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IFR

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TOMORROW'S NEXRAD

The forecaster's crystal ball is getting better and better. Soon that loop of pretty NEXRAD images will show rain that hasn't fallen yet.

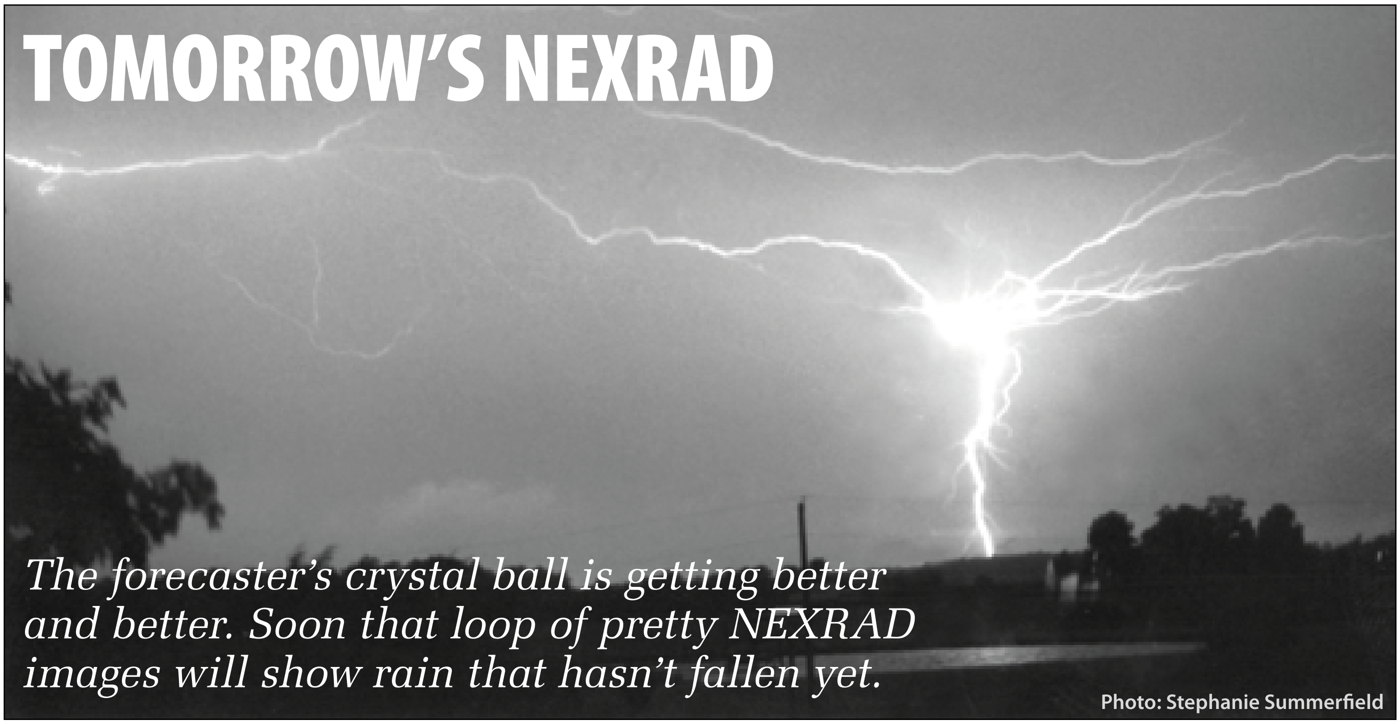


Photo: Stephanie Summerfield

by Scott C. Dennstaedt

Instrument pilots aren't terribly concerned about getting wet, except during preflight or when pushing the aircraft into the hangar. We can tolerate heavy rainfall in flight as long as we're not also getting our organs rearranged. But how do you know before flight if the precipitation will just clean off the bugs or remove the leading-edge paint?

Even without thunderstorms, precipitation still has an effect. Flying through rain or snow can be disorienting, especially at night. Precipitation cuts visibility even when below or between cloud layers.

Instrument approaches end with a visual segment — or missed approach. Precipitation can reduce our chances of seeing the runway environment even though the official report for ground visibility is above minimums, especially when circling to land.

Simulated NEXRAD

NEXRAD images from a NWS WSR-88D Doppler radar have an extremely high glance value. In an active environment, it doesn't take the pilot long to determine where the adverse weather is and where it might be heading using the radar loop.

While pilots are learning to interpret NEXRAD images in near-real-time, they say little about what may happen in the future — especially if convection hasn't yet materialized. That might all be changing with an experimental, high-resolution, simulated-reflectivity forecast, which will show you what the NEXRAD image may look like six to 36 hours in the future.

Since it looks like, tastes like, and smells like a NEXRAD image, it's easy to interpret.

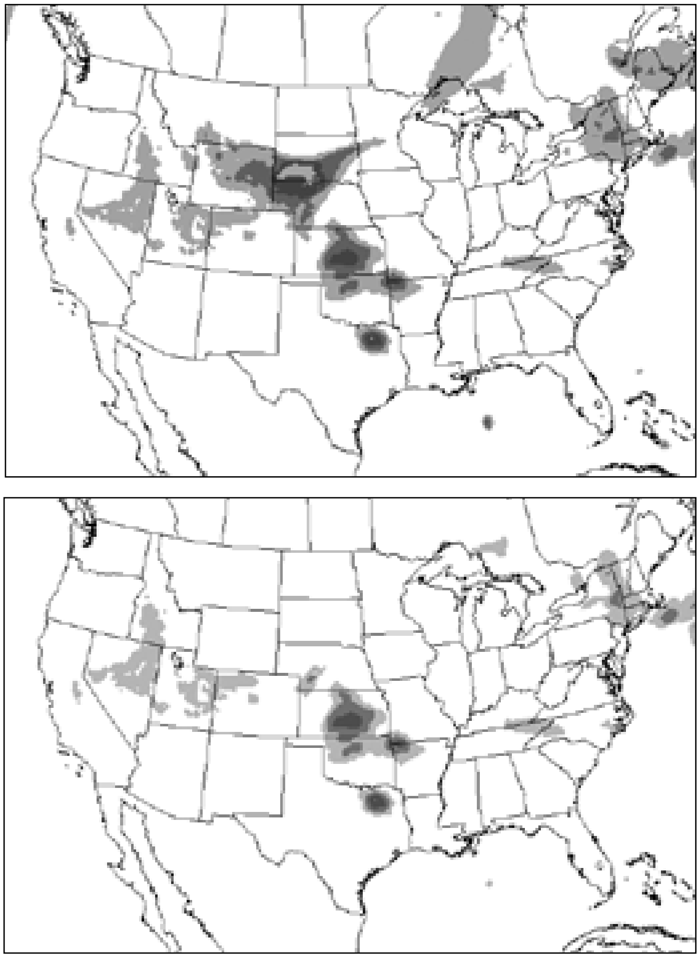
Until recently, numerical weather prediction models haven't been run at a high enough spatial resolution to accurately model individual thunderstorm cells or mesoscale convective complexes. The newer models such as the Weather Research and Forecasting (WRF) model — called "warf" by forecasters — can run with a resolution as small as two kilometers.

As a result, forecasts can be generated that model mesoscale features such as thunderstorms quite nicely. This precipitation product is not an accumulated precipitation field. Instead, it's a simulated reflectivity product similar to what you might see when looking at an image from a NEXRAD Doppler radar. The simulated reflectivity product (http://www.emc.ncep.noaa.gov/mmb/mmbpll/cent4km/v2/) offers pilots exciting advantages over traditional, accumulated-precipitation forecasts.

The most important benefit is visualizing the mesoscale features that will evolve. In other words, it allows the pilot to easily see detailed storm-scale structures and thunderstorm organization that is forecast to develop. Will the convection form as a line or multiple lines with little or no breaks in the line? Is this a thin line of thunderstorms moving quickly in advance of a cold front? Will there be numerous, large, supercell storms that exhibit a severe-looking signature? Is there a potential for embedded thunderstorms in a warm front? All of these questions can usually be answered by using the simulated reflectivity product.

The onset and location of thunderstorm initiation is a welcome

Right: *The precipitation in South Dakota shows up on the Total Precipitation forecast (upper), but does not show up on the Convective Precipitation image (lower). Both show accumulated precipitation over three hours. It's clear that the precipitation in South Dakota is not convective, whereas the precipitation in central Kansas is convective. Staying out of the convective stuff tends to keep our organs in their proper places.*



aspect. Knowing the approximate time and place where convection will likely erupt (or dissipate) is a dimension that has not been available in traditional convective forecasts.

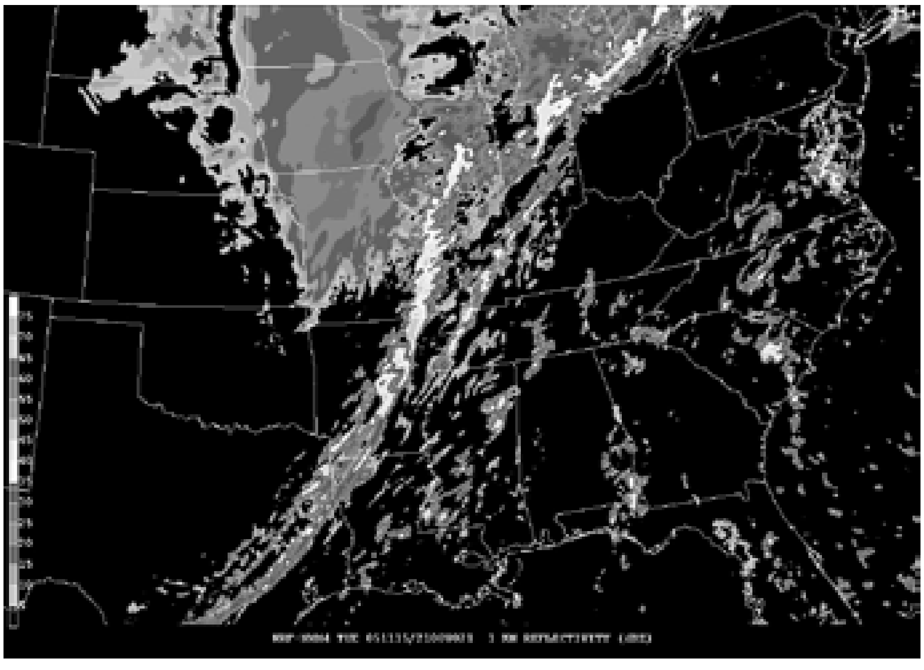
Finally, it makes understanding other forecast products easier with a visual for comparison. An accumulated precipitation forecast won't give you that instantaneous feedback that suggests the forecast has really captured the convective event.

The high-resolution, simulated-reflectivity product has a time resolution of one hour at the moment. The model takes a few forecast hours to ramp up before a useful image is developed, as well.

Currently, the high-resolution product is only run once a day beginning at 0000 UTC with an hourly forecast out to 36 hours. It's posted to the internet several hours later. As a result, you'll have a great opportunity in the morning to evaluate the convective potential for the remainder of the day. It only covers the area east of the Front Range of the Rockies and doesn't include most of Maine. You're also looking at the entire forecast area in one image — no zooming in on individual cities or towns — for now, anyway.

The simulated-reflectivity product doesn't include all the elements of WSR-88D NEXRAD Doppler radar. Ground clutter, anomalous propagation, effects of the earth's curvature, obstructions, and others are missing. From a pilot's perspective, this doesn't matter since most of these effects are undesirable anyway.

The part that I find the most satisfying with simulated reflectivity is the advantage it gives you over other thunderstorm forecasts. Since it looks like, tastes like, and smells like a NEXRAD image, it is easy to interpret. It doesn't just present the "symptoms" of a convective outbreak; instead it shows you the end results of the combination of instability, moisture, and a lifting source. You can almost begin to rope off an area that is likely



Right: *Most thunderstorm forecasts smear the storm in time and space. Simulated reflectivity, like this image, forecast exactly what should happen exactly where. Knowing the approximate time storms will form or dissipate takes some mystery out of flight planning. Zoom-in images like this should be available soon.*

to be problematic, which takes the mystery out of your planned route of flight before the first towering cumulus appears.

Other Rainy Pictures

Most other precipitation forecasts either show general areas of precipitation or forecast accumulated precipitation. Accumulated precipitation captures how much liquid precipitation (or melted equivalent) is forecast to fall over some period, from one hour to several days.

Precipitation forecasts can be difficult to utilize and will often mask the details pilots want to uncover. The fact that it will be raining cats and dogs in a particular area over a six-hour period isn't that helpful in evaluating the potential flight risk. Still, they are updated three or four times throughout the day and can provide useful information.

The Hydrometeorological Prediction Center (HPC) offers two precipitation forecast products. The first product is included on a pressure and weather prognostic chart (http://www.hpc.ncep.noaa.gov/cgi-bin/get_basicwx.cgi) and the second is a Quantitative Precipitation Forecast or QPF (http://www.hpc.ncep.noaa.gov/qpf/qpfloop.html). Graphical pressure and weather charts highlight general areas of precipitation and the QPF shows areas of accumulated precipitation.

Along with a graphical depiction, a textual discussion is available for both of these HPC products (http://www.hpc.ncep.noaa.gov/discussions/pmdspd.html and http://www.hpc.ncep.noaa.gov/discussions/qpfpfd.html).

The precipitation areas depicted on the pressure and weather progs can be a challenge to decipher given all the lines on the map. The HPC also issues a QPF that focuses strictly on precipitation quantity and coverage within a six-hour period. While these forecasts may be easier to decipher, a six-hour window is a large time period. All of the precipitation could fall within the first hour or last hour of the period. Most importantly, precipitation type and convective precipitation from thunderstorms is not distinguished.

Remember that convective areas of precipitation may or may not be protected by a Convective SIGMET (see Convective SIGMETs, *IFR* April 2005). Convective SIGMETs are issued for embedded thunderstorms currently in progress, but you may already be in the air before a bulletin is issued.

The Fine Print

I have been using simulated NEXRAD for the last seven or eight months and I can say that the technology is not perfect. While I have seen the model produce a forecast that is remarkably close to the actual NEXRAD image even as far in the future as 24 hours, I have also witnessed some real busts — missed convective outbreaks or forecast convection that never emerged.

If you're using the simulated NEXRAD product, don't ignore other parameters such as the lifted index, K-index, convective available potential energy (CAPE), or the official forecast from the Storm Prediction Center (SPC). Severe storm researcher Dr. Charles Doswell, III, said it the best: "You are not likely to recognize an impending event for which you are not looking." Simulated reflectivity shows you where to start looking.

Remember, too, that the lack of precipitation doesn't mean the absence of adverse weather, either. Don't become complacent. Turbulence and icing can still exist in the regions that are precipitation-free. But, when it comes to keeping your distance from the ugly stuff, simulated reflectivity will be a product that will become as ubiquitous as NEXRAD itself and will revolutionize precipitation forecasting.

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PRACTICE YOUR NEXRAD DAILY

For many of us, reading weather charts is usually a best-guess affair: "Lessee, that blue line with all the blue triangles on it doesn't look friendly. Guess I'll try not to fly there."

With the ubiquitous nature of NEXRAD in FBOs and, for the fortunate among us, in cockpits, extracting meaning from these images is now a core pilot skill. One problem, though, is that many of us approach it with the same depth of thought with which we did the weather charts. "Lessee, all that red on the NEXRAD. Guess I'll try not to fly there."

That's not bad *per se* — it beats the hell out of taking off blindly — but we can do better. The average pilot can learn to read direction, speed, and areas of growth or diminishment. It just takes some practice.

When I can't practice by flying, I practice on desktop computer or PDA / cell phone. By comparing the radar images and the real world out my window throughout the day, my understanding of NEXRAD images has gotten better. My favorite site for the cell phone is mobile.wunderground.com. It's free and the images are no more than 10 minutes old. Sure, I still stay away from all that red when I fly, but my gut sense of where the green will appear and disappear has improved immensely.

— Jeff Van West