The Dryline

The Official Newsletter of the National Weather Service in Amarillo

The Dryline - Summer 2014

Inside this issue:

Our Radar is Going *SAIL*ing

A new upgrade was recently completed on the WSR-88D Radar at the National Weather Service in Amarillo. This new upgrade will enable the radar to obtain more frequent low-level scans, which will aid in identifying areas of strong winds and/or tornadoes associated with severe thunderstorms.

Previously, the WSR-88D Radar would scan the horizon first at a 0.5° tilt, then progressively increase the tilt all the way up to a maximum angle of 19.5°. With this new software, titled *Supplemental Adaptive Intra-Volume Low-Level Scan* (SAILS), the radar will now perform a low-level 0.5° scan in the middle of its progression up to the 19.5° tilt. The pictures on page 2 show how the new scanning strategy works.

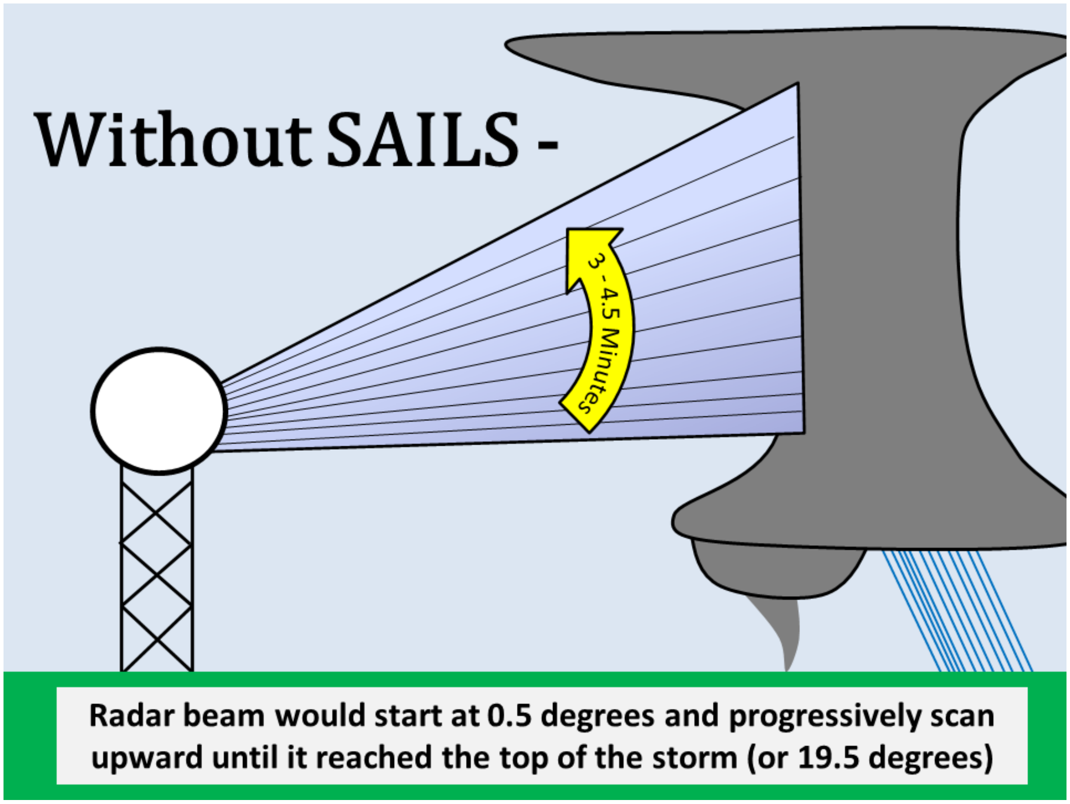
Landspout Tornadoes

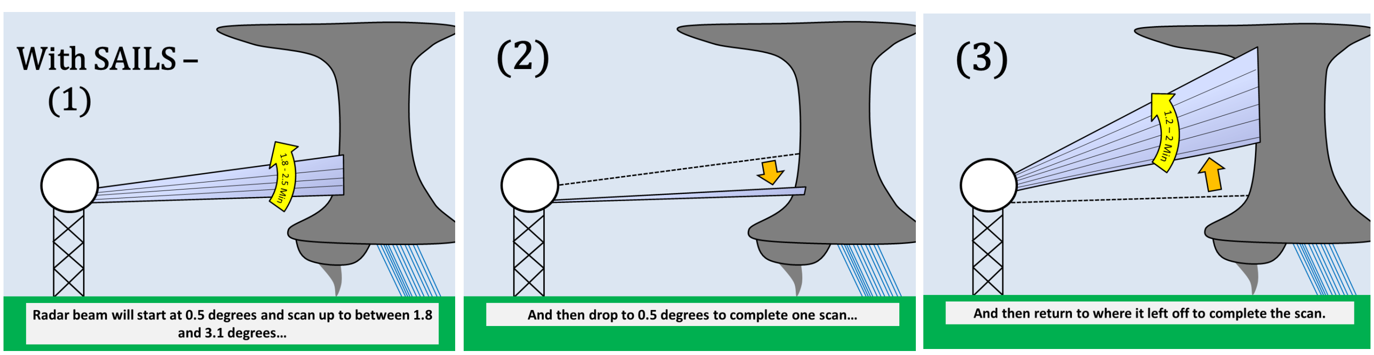
A look at the science behind landspout tornadoes and some commonly held misconceptions.

Landspout tornado NW of Spearman on 21 June 2006.

Landspout tornado outbreaks are a common occurrence in the Eastern Plains of Colorado, but seem much less frequent in the Texas and Oklahoma Panhandles. This article will discuss how landspouts form and address common misconceptions about landspouts.

Our Radar is Going *SAIL*ing





How will this help?

When severe weather threatens, it is crucial to observe what is going on in the lowest level of the storm. Having this lowest radar scan more frequently will help forecasters better determine wind and/or tornado potential within thunderstorms, which can occur in a matter of seconds. With SAILS, the NWS will be able to observe rapidly changing weather phenomena with a greater degree of precision and issue more timely severe weather warnings. Currently, the WSR-88D Radar completes its lowest scan in 3-4.5 minutes during severe weather. Now with SAILS, the radar will perform this low-level scan every 1.5 -2.5 minutes, giving us this valuable data twice as fast as before.

Landspout Tornadoes continued…

Formation: There are two methods by which tornadoes are thought to form: the Top-Down process and the Bottom-Up process. Most tornadoes (which themselves are a relatively rare occurrence) associated with supercell thunderstorms form by the former process, where rotation in the middle levels of the storm (giving rise to the storm's mesocyclone) is concentrated and descends to the lower levels of the storm. Landspout tornadoes, however, form by the Bottom-Up process. Typically, this process occurs under a developing or rapidly intensifying thunderstorm or towering cumulus cloud. Small low-level vortices (areas of concentrated rotation) exist in abundance along certain surface boundaries, particularly nearly stationary fronts exhibiting strong wind convergence. As the strengthening updraft of the storm moves over these vortices, the upward motion acts like a vacuum, stretching the low-level vortex and tightening it into a landspout tornado. This process may be compared to a rotating figure skater: when the skater's arms are extended, he/she spins slower; when the skater's arms are pulled in, the rotational velocity increases. Once the storm moves away from the boundary (and the source of the low-level rotation), the landspout weakens and dissipates.

Misconceptions: A few perhaps dangerous myths about landspout tornadoes continue to circulate (no pun intended) and should be dispelled:

Myth 1: Landspouts are not tornadoes.

Response: A tornado is defined as a violently rotating column of air in contact with the ground, and beneath or attached to a cumuliform cloud. While the formation process is different for landspout and mesocyclone tornadoes, both are tornadoes by definition.

Myth 2: Landspouts are weak and not dangerous.

Response: While there is no documented landspout tornado as strong as the strongest mesocyclone tornadoes, and most are usually on the weaker side, landspout tornadoes can reach EF2 to EF3 intensity (winds up to 165 mph) and can last for twenty minutes or more. In fact, they can do as much damage as a moderate tornado, and should be regarded as equally dangerous. This was unfortunately realized in Colorado, where F2- and F3-rated landspouts hit the Denver area on June 15, 1988.

Myth 3: No wall cloud or funnel cloud means no landspout.

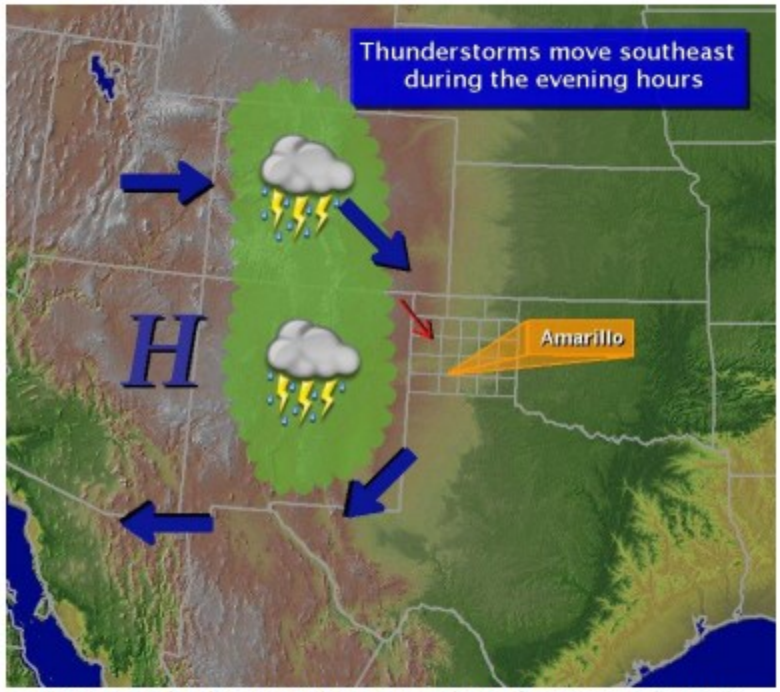
Response: Since landspouts do not form from a mesocyclone, and often form beneath developing storm updrafts (although they can just as easily form beneath a well-defined storm), a wall cloud is unlikely to be present when a landspout is developing or occurring, nor does the lack of a funnel cloud mean that a tornado is not occurring. As with mesocyclone tornadoes, funnel clouds do not always come into contact with the ground. The best indicator of contact with the ground is a sustained and well-organized dust whirl beneath the funnel, but even this indicator is not conclusive.

While landspouts are relatively unusual in the Texas and Oklahoma Panhandles, it is exactly their rarity that makes them potentially more hazardous. Landspout tornadoes are just as dangerous and capable of damage as their mesocyclonic counterparts and must be regarded with equal concern.

What is Northwest Flow?

If you have been in the Southern High Plains long enough, you have probably heard of the dryline and are familiar with its association with thunderstorm activity in the spring and early summer. However, the dryline is almost non-existent during most of the summer months, yet we continue to experience episodes of showers and thunderstorms, typically in the late afternoon and evening hours. Most of the time there are no frontal boundaries around the area in the summer months, so where do all of these thunderstorms come from?

Thunderstorms are a normal occurrence across many areas of the United States during the summer months. However, due to orographic (or terrain) effects, thunderstorms are more common in mountainous areas. One of these areas is the southern Rocky Mountains of Colorado and New Mexico. These thunderstorms typically form in the mid afternoon hours when heating is approaching its maximum but can dissipate quickly by sunset as the air begins to descend down the mountain slopes. So how does this have anything to do with the relatively flat Texas and Oklahoma Panhandles? The answer is what meteorologists refer to as “northwest flow”.



“Northwest flow” around high pressure in the Southwest U.S. allows thunderstorms which form over the Rocky Mountains to move southeast into the Panhandles.

During the summer months, the subtropical ridge (upper level high pressure) typically sets up over the southwest portion of the United States. Air moves in a clockwise direction around areas of high pressure. With the high located several hundred miles to our west, the winds around this high come from the northwest over the Panhandle region. Since thunderstorms tend to move along with the mean flow, the mountain thunderstorms drift southeast toward the Panhandles.

Thunderstorms associated with northwest flow patterns can produce severe weather and are quite common from June through August but can last well into September. Episodes of northwest flow typically lead to several days of unsettled weather. While tornadoes are not as common with this setup as during the spring months, they may occasionally develop since wind shear can be quite strong. The primary impacts with northwest flow thunderstorms are large hail and damaging straight line winds. The other concern with any thunderstorms during the summer months is locally heavy rainfall.

To sum it all up, northwest flow really doesn’t cause thunderstorms. It simply brings thunderstorms originating in New Mexico and Colorado to the Texas and Oklahoma Panhandles. So when you hear a meteorologist talk about a northwest flow pattern developing, you can expect several evenings with thunderstorms in the forecast.

NWS Amarillo Hosts Workshop

The National Weather Service in Amarillo, TX in conjunction with emergency management and local media held an Integrated Weather Team (IWT) workshop on July 31st. Nearly 125 key decision makers from across the Texas and Oklahoma Panhandles turned out to discuss how to effectively communicate a consistent message as an IWT through interactive scenarios, presentations, and panels.

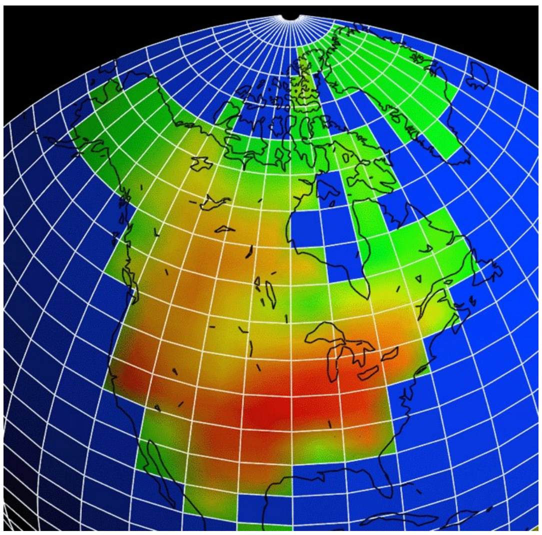
The day's events kicked off with two presentations discussing the IWT concept and what tools are available to ensure access to accurate information during hazardous weather. Following these presentations were multiple interactive panel discussions covering topics from how broadcast meteorologists respond to the public and operations during severe weather, to a panel of school officials dispelling the misconception that school hallways are always the safest area to take shelter for tornadoes. Prior to the keynote address, a series of decision point scenarios allowed attendees to apply the IWT concepts through interactive discussions.

The keynote address included four key leaders from the Moore, Oklahoma EF5 tornado tragedy from May 20, 2013. These leaders from the emergency management community, National Weather Service in Norman, broadcast media, and hospital services shared best practices to ensure a consistent message before, during, and after a major weather event. These thoughts were echoed by the Pampa, TX Emergency Manager Wes Schaffer, *"As an Emergency Manager in this region, I know that I am not totally alone when making tough weather decisions for my community. NWS events like this workshop help reinforce that collaboration, by providing candid insight into the perspectives of both our NWS Partners and our local broadcast meteorologists. Additionally, hearing the lessons learned from our neighboring jurisdictions' disaster will be very valuable, when examining my own jurisdiction's preparedness."*

The reception of the workshop was very positive. Beaver County OK Emergency Manager Keith Shadden raved, *"The 2014 DSS/IWT Workshop was one of the more enjoyable workshops that I've attended. The diversity of speakers and presentations were well presented and pertinent to all of the attendees regardless of agency or discipline. Well done NWS."* The success of the Amarillo IWT/DSS workshop benefited not only the attendees, but the presenters as well. Shane Cohea, Director of Safety and Security, Norman Regional Health System commented "*I feel like I learned more than I shared!"*

Understanding Climate through Modeling

Climate models are critical tools for improving our understanding and predictions of the behavior of the atmosphere, the oceans, and the climate system. Since we can not recreate the Earth's atmosphere in a test tube in order to run experiments, scientists use computer-based simulations known as "general-circulation models" to study the chemical, biological, and physical processes that drive climate. These models rely on mathematical formulas to simulate the complexities of the atmosphere, oceans, and land. These complexities include things such as exchanges of heat and moisture, the effect of volcanic eruptions on temperature patterns, the effect of melting land ice on the ocean, and the reflection of sunlight off the Earth's surface (known as albedo).



Prior to development of climate models, our knowledge of oceanic and atmospheric circulations and how these circulations affect each other was based purely on theory and observation. Climate models provide the best available answers to important questions about whether the Earth's climate is changing and what may be causing the change. Models help us gain insight into climate patterns, changes, and events that occur as a result of natural variability or changes brought on by human activities, and the interplay of both. Models are also used for seasonal and long-term forecasting and for projecting high-impact features of climate such as seasonal hurricane activity and drought.

Observational climate data alone does not reveal much about cause and effect of climate change, but models allow us to determine the distinct influence of different climate features. Changes can be made to one feature in a climate model, such as warming or cooling ocean surface temperatures, to see how those changes impact climate. Today's complex climate models are used to investigate the extent to which observed climate changes may be due to natural causes or may be attributable to human activities. Models are an essential tool for estimating the effects of increasing greenhouse gases on future climate, on spatial scales from global to regional. For example, using various computer models, scientists estimate that the average global temperature will increase 2° to 6° F over the next century. For comparison, at the peak of the last ice age, the temperature was only 7° F cooler than it is today.

The founding director of NOAA's Geophysical Fluid Dynamics Laboratory (GFDL), Dr. Joseph Smagorinsky, was a pioneer in combining computers and mathematical models to make extended predictions of the weather and, ultimately, of trends in the global climate. Dr. Smagorinsky was among the earliest researchers who sought to exploit new methods of numerical weather prediction to extend forecasting past one, or at most, two days. He published a seminal paper in 1962 that fundamentally changed the approach to studying physical processes that drive climate. Dr. Smagorinsky's paper was based on his research using primitive equations of atmospheric dynamics to simulate the atmosphere's circulation. Dr. Smagorinsky's work led to the extension of early weather models to include variables such as cloud cover, precipitation, turbulence, and radiation emanating from the Earth and sun.

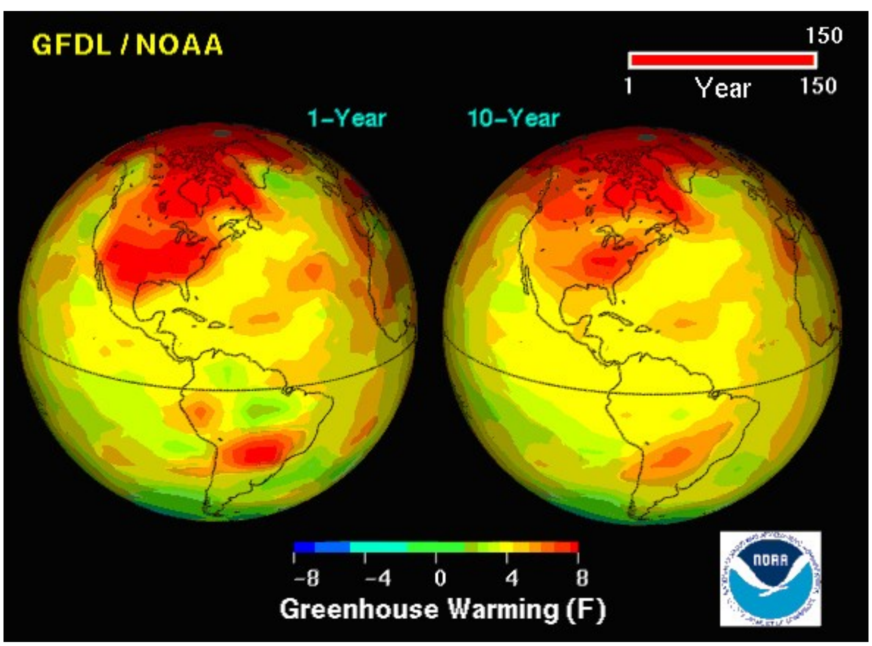
Understanding Climate Through Modeling Continued…

GFDL was founded in 1955, and in 1969, the results of the first-ever coupled ocean-atmosphere general circulation model were published by two GFDL scientists, Syukuro Manabe and Kirk Bryan. NOAA was formally organized in 1970 and later in that decade, general circulation models emerged as a central tool in climate research.

GFDL's original coupled ocean-atmosphere general circulation model was the first of its kind. It included all the basic physical components of a climate model (atmosphere, ocean, land, and sea ice), but covered only one-sixth of the Earth's surface, from the pole to the equator and 120° in longitude. Its development was based on a completely new approach to scientific endeavor, departing from the independent, individual mode of enquiry. Only large-scale numerical modeling, with teams of scientists using commonly shared high-speed computers for experiments could produce answers to such extraordinarily complex problems.

The computer used to develop and run that first model was a Univac 1108 with half a megabyte of memory - not enough to store a song or a high-resolution picture today. Most watches, cell phones, MP3 players, and other electronic gadgets now have chips that process faster than the Univac 1108. It took 20 minutes to simulate one day for just the atmosphere. GFDL's supercomputer currently provides more than 100,000 times the computing power of that early computer. Pushing the limits of increasingly powerful supercomputers, efforts are underway at NOAA to use climate models with high enough resolution to produce regional or local predictions, on timescales spanning hours to centuries.

NOAA is now poised to move beyond modeling just the physical climate system. Elements which are the building blocks of life, such as oxygen, carbon, and nitrogen, continually cycle through Earth's systems. Climate—temperature, precipitation and solar radiation—affects and, at the same time, is affected by, these cycles. The next generation of models - Earth system models - simulate the biological, geological, and chemical processes in which these elements are transported and stored. Earth system models will simulate global ecosystem dynamics and exchanges of water, energy, and carbon between plants, soil, and the atmosphere.



The ongoing development of Earth system models is just the latest chapter in the story of climate modeling that began a few decades ago. Continually fueled by increasing scientific knowledge, innovation, and computer power, each successive generation of climate models has evolved to be more comprehensive, more complex, and ultimately more capable of being applied to questions that are of great importance to society.

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