

# Tropical Storm Impacts on Arizona and New Mexico

By Rebecca Carter

Once the drama that monsoon storms can bring to Arizona and New Mexico subsides toward the end of August, it may seem like time to breathe a sigh of relief and look forward to calmer autumn weather. However, fall can also be a time of dramatic and sometimes dangerous weather, due largely to tropical storms. Actually, tropical storms can feed into monsoonal moisture flows and contribute to copious rainfall totals.

Some of the most severe weather-related events recorded in Arizona have been caused by tropical storms, more than can be attributed to either the monsoon or drought. When the National Weather Service's Phoenix office put together a listing of Arizona's top ten weather/water/climate events for the 20th century, flooding due to tropical storms caused three of the ten most costly weather events in terms of impacts on people, property, and the economy and also was cited in four of the eleven honorable mentions.

The deadliest natural disaster in Arizona's history was a tropical storm that resulted in 23 deaths. According to National Weather Service offices in Arizona, heavy rains were spawned by an influx of moisture from a dying Pacific tropical storm named Norma over Labor Day weekend of 1970. During the 24-hour period from 10 p.m. September 4th to 10 p.m. September 5th, 11.4 inches of rain were measured in the official recording rain gauge at Workman Creek, about 60 miles east-northeast of Phoenix at an elevation of 7,000 feet. Of the 23 lives lost in the flooding, 14 were in campground

areas at the headwaters of the Tonto Creek drainage. Most of the deaths occurred as people attempted to leave the campgrounds for home. Some rivers rose 5 to 10 feet per hour, with Sycamore Creek, near Sunflower, experiencing floodwaters that reached 36 feet above the creek bed.

The tropical storms that affect Arizona are often the remains of hurricanes that form in the eastern Pacific Ocean. Although the official hurricane season begins May 15 in the eastern and central Pacific basins, June through October are the most active months for tropical storm formation. Data from 1961-2000 show that the storms peak in frequency in August, with an average of 3.8 storms, while July and September each average 3.7 storms. During a typical hurricane season, 16 named storms form in the eastern Pacific, 9 of which become hurricanes, and 5 of those become major hurricanes.

While most tropical storms fall apart as they make landfall, some do possess enough power to make it into Arizona and eastern New Mexico. In fact, Erik Pytlak of the Tucson National Weather Service Office calculated that Arizona can expect a direct hit from a named tropical storm, including heavy rainfall, every 4.5 years and that a storm will affect the state indirectly every two years. That means that Arizona is more frequently affected by tropical storms than some coastal states such as New Jersey!

Tropical storms that are likely to affect Arizona are those that make landfall along the Pacific coast of Baja California and travel north-easterly into the state, often com-

ing across the border with southern California and most strongly impacting the western portions of Arizona.

New Mexico is less likely to be affected by tropical storms, but may still experience some minor impacts. On rare occasions, tropical storms moving inland from the Gulf of California will cause heavy rains in the southwestern part of the state, according to the Western Regional Climate Center. Interestingly, the eastern and central parts of the state also may be affected by tropical storms, but by those spawned in the Atlantic, rather than in the eastern North Pacific.

Flooding is by far the greatest threat that tropical storms pose to Arizona and New Mexico. However, high winds also can be a danger, although this aspect of tropical storms has been much less studied. Although the lower elevation winds that accompany such storms may dissipate by the time the storm reaches Arizona or New Mexico, these gusts can still be quite well organized at higher altitudes, particularly those over 7,000 feet. Tropical storms in general are likely to cause greater amounts of property damage and other losses as populations grow in the Southwest.

ENSO conditions such as El Niño or La Niña can affect the year-to-year levels of vertical wind shear over both the North Atlantic and eastern North Pacific. During an El Niño, vertical wind shear increases, which suppresses the ability of hurricanes to form. This effect is particularly pronounced in the North Atlantic, where research indicates that during El Niño years the likelihood of hurricanes is de-

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creased and during La Niña years the likelihood of Atlantic hurricanes is increased. For example, El Niño-like conditions from 1991 to early 1995 were accompanied by very little Atlantic tropical storm and hurricane activity. However, the La Niña years of 1995 and 1996 showed increased tropical storm activity in the North Atlantic, but reduced the number of storms over the eastern North Pacific.

During strong El Niños, such as 1997-98, the eastern North Pacific recorded close to an average number of storms at 17, but the storms were more intense than usual. Hurricane Linda reached unprecedented sustained winds of 185 mph, and Hurricane Guillermo followed close behind at 162 mph. This was also the year that Hurricane Pauline devastated Acapulco, leaving 232 dead and hundreds of thousands homeless.

El Niño also may affect the usual track of tropical storms: in 1997, Hurricane Nora was one of two storms that tracked well north of their normal area. Although the storm did not follow its expected path and weakened considerably upon landfall, rainfall amounts of three to five inches were recorded in western Arizona. Nora caused a loss to agriculture estimated at several hundred million dollars and left about 12,000 people without electricity in Yuma, according to the NWS Tropical Prediction Center.

The North Atlantic, on the other hand, experienced only seven storms in 1997, compared to its average of 10; of those, three became hurricanes, as opposed to an average of six. This year, NOAA's Climate Prediction Center does not expect the current weak El Niño to

have much of an effect on tropical storm activity in the North Atlantic. Similar comprehensive forecasts for the eastern North Pacific are not available, which reflects a long-standing lack of attention to tropical storms in this area.

Gregg Garfin of the END Initiative has attempted to provide some answers to what this tropical storm season may bring to Arizona and New Mexico. Garfin examined climatological records from 1961-2000 and found that the overall number of tropical storms is not any greater during El Niño years than during other years.

The National Weather Service Tucson office also found no clear link between El Niño and tropical storm impacts in Arizona. Forecasters reviewed tropical storm records from 1965 to the present and found that of the nine direct hits that Arizona has received, three occurred during El Niño events, three happened during La Niña conditions, and three took place during neutral years.

However, Garfin found that the duration of tropical storms during El Niño years is greater than the duration of storms during La Niña years. He also found that the number of *fall* storms (September-November) is greater during El Niño years.

Garfin identified four strong El Niño events, and four weak ones, based on their intensity during the start of the tropical storm season. He found that during strong El

El Niño and La Niña Impacts on Tropical Storm Activity

|                   | La Niña     | Neither     | El Niño     |
|-------------------|-------------|-------------|-------------|
| Duration (# days) | 6.1 / 5.0   | 6.5 / 6.0   | 7.1 / 6.0   |
| # Storms          | 15.1 / 17.0 | 15.2 / 16.0 | 15.6 / 15.0 |
| # Fall Storms     | 4.5 / 4.0   | 5.4 / 5.0   | 6.2 / 6.0   |

Note: # of years – La Niña = 9; Neither = 18; and El Niño = 13, for 1961-1990. Average values are to the left of the slash and median values are to the right of the slash.

Niño events, tropical storms tend to be longer (7.6 days) and stronger, with a slight tendency toward greater than average frequency (16.5). In contrast, during weak El Niños, such as the one currently occurring, Garfin found that tropical storms tend to be shorter than average length (5.6 days), fewer in frequency (10.2), and weaker.

Regardless of whether or not there is a clear El Niño influence on tropical storms, there is no doubt that these weather systems can have major impacts on drought. For example, the remnants of Tropical Storm Olivia brought 3 to 5 inches of rain to southeastern Arizona and southwestern New Mexico around October 11 and 12, 2000, according to the U.S. Drought Monitor archives. This ended abnormally dry conditions in the area that had begun the previous December in parts of the states and provided these areas with a buffer in terms of soil moisture and water supply that some climatologists say protected the area for over a year from widespread drought conditions.

Thus, using the past as a guide to the future, we might reasonably expect that Arizona will see a fairly quiet tropical storm season, despite the presence of an El Niño. However, as you've heard before, no two El Niños are alike—so stay tuned!