

EDUCATING THE PUBLIC ON THE NORTH AMERICAN MONSOON SYSTEM

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1. INTRODUCTION

In Arizona the weather event of the year, every year, is the North American Monsoon. During May and June temperatures soar to well over 100°F throughout much of the state and conditions are extremely dry with relative humidity in the single digits. Vegetation becomes heat stressed as the landscape turns brown.

These conditions, along with blistering sunshine for days on end, cause people to long for clouds in the sky, the scent of rain in the air and the cool breeze from a thunderstorm outflow. The monsoon is also the time of year in which the most weather-related fatalities, injuries and damage occur across Arizona from flash floods, lightning, dust storms, straight line winds, and persistent heat outside of the active thunderstorm days (Shoemaker and Davis 2008). These are the reasons the monsoon is always the weather event of the year in Arizona.

This paper describes how the North American Monsoon was historically monitored in Arizona (Section 2), the shortcomings of these approaches (Section 2.1), how the National Weather Service helped educate the public on the North American Monsoon System (Section 3), specific examples of what was used in this education effort (Section 3.1) and a brief summary of this ongoing education effort (Section 4).

2. HISTORICAL PERSPECTIVE

Many names have been given to the summer thunderstorm season in Arizona, for example, the Arizona Monsoon, the Mexican Monsoon and the Southwest Monsoon. The current agreed upon name in journals is the North American Monsoon, since the summer thunderstorm outbreaks in Arizona are part of a large scale pattern affecting much of western North America.

As the name has changed describing this weather regime, so have the methods used to track it. One early method involved a precipitation index derived by counting the number of observation sites receiving precipitation. Once

most of the stations in Arizona received rain, the monsoon would be declared as “being here” (Tenhakel 1980).

Another method used to declare the monsoon was dew point temperatures. Three consecutive days of 55°F or higher at the Phoenix airport was used to indicate the monsoon had started. Likewise, monsoon days (days with an average dew point higher than 55°F) could be counted and an end to the monsoon could be declared (Skindlov 2007).

2.1 Faults of these historical methods

All of these historical methods were an after-the-fact analysis of what happened in Arizona associated with the monsoon system. All of them failed to accurately represent what was truly happening in the weather.

The most widely used method was the three consecutive days of high dew point values. The dew point method was simple to understand and directly reflected what people felt when outside. While dew point tracking did correctly indicate that low-level moisture was present, it gave no indication of whether severe weather would occur on any given day or even if the large scale pattern associated with the North American Monsoon had established itself.

Another major limitation of these historical methods is they lacked the modern sensing and modeling techniques widely available today. By their nature, they were mostly designed before satellite imagery was available and hence used surface based analysis techniques.

The most critical fault of the historical methods is that many people tended to focus on the dew point number or index rather than what was actually happening in the weather. This situation decreased the public’s situational awareness, because significant severe weather could occur prior the monsoon “beginning”.

3. EDUCATING THE PUBLIC

Significant advances in understanding the North American Monsoon System have taken place in the last ten years. Unfortunately much of this information was only available in journal articles and not easily understood by weather

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hobbyists or the media. This scientific gap in knowledge between operational meteorologists and the general public, combined with the lack of an accurate method to track monsoon activity, led the Arizona National Weather Service offices to clearly define the monsoon season in the summer of 2008.

After doing a climatological analysis of thunderstorm activity in Arizona and in collaboration with the Phoenix and Tucson media, the monsoon in Arizona was defined as being from June 15 through September 30. Using specific dates on a calendar as the definition followed other severe weather seasons' definitions, such as the hurricane season. Hence the National Weather Service (NWS) in Arizona was not establishing a scientific precedent. Using defined dates opened the door for more modern methods to track monsoon activity and helped establish June 15 as a day for the public to become aware that severe weather was coming soon.

Establishing a set season was the first step to increasing the public's knowledge of the North American Monsoon System (NAMS). Subsequent steps were: (1) documenting our increased understanding of the NAMS in a simple, easy-to-read format on the web, (2) linking these new methods for tracking the monsoon to real-time data on the web so everyone could track what was happening, and (3) working closely with the media to support these new ideas throughout the season.

Changing the definition of the monsoon in Arizona was by itself a news story. Therefore the NWS actively collaborated with local media prior to implementation. The media, in turn, was instrumental in getting this information out to the public. Rather than letting this story end at the change in definition, additional educational materials and real-time tracking methods were unveiled at the same time. Tying the Arizona weather event of the year to the story of a monsoon definition change set the stage for successfully increasing the public's understanding of the NAMS. The ultimate goal of these efforts was to improve the public's safety during the monsoon.

3.1 Monsoon Web Pages Description

The web provides an easy method to reach millions of people and was the primary technology used in this education effort. The web pages described in this section can be found at:

http://www.wrh.noaa.gov/tucson/monsoon/monsoon_tracker.php

Several categories of information were established on this web page for people to easily focus their interest on a particular aspect of the monsoon. Each of these categories was assigned a tab at the top of web page, and all the top level web pages had these same tabs:

- Tracking the monsoon – real-time data depicting what was currently happening.
- What is the monsoon? – the science associated with the North American Monsoon System.
- Monsoon rainfall – climatological rainfall data for southeast Arizona.
- Dewpoint data – historical dew point data for Phoenix and Tucson.
- Monsoon statistics – seasonal precipitation statistics for Phoenix, Tucson and Yuma.

This design allowed people to switch rapidly between the various sections and explore the entire web site without getting lost.

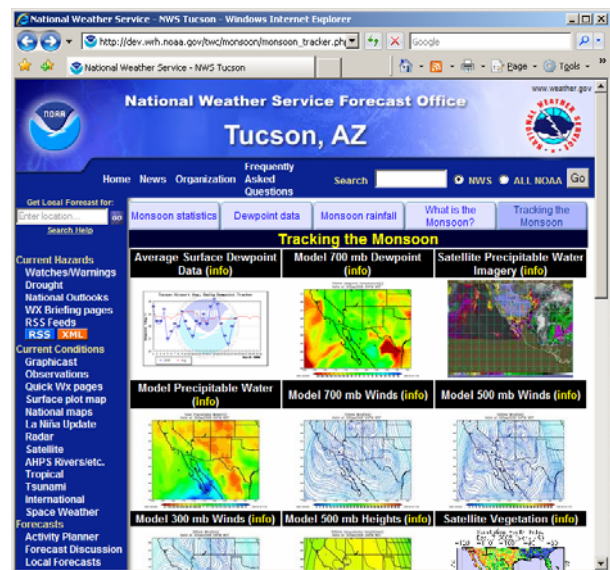


Figure 1 - Tracking the Monsoon web page

Once severe weather starts occurring, people want to check out what is happening. Hence the "Tracking the Monsoon" page was used as the entry point into this collection of pages. As seen in Figure 1, this page featured a collage of data and charts, each representing a different aspect of the NAMS. Each thumbnail could be expanded for easier viewing and was automatically updated as new data became available. The data sets available on the tracking page were:

- Dew point graphs.
- Winds for 700mb, 500mb and 300mb.

- Heights for 500mb.
- Satellite-derived vegetation index.
- Satellite water vapor imagery
- Radar precipitation estimates for 1 hour, 3, 6, 12 and 24 hours.
- Upper air plots
- Links to Maricopa and Pima county rainfall data.

The entire concept behind the “Tracking the Monsoon” page was to provide one location where all aspects of the NAMS could be viewed. Since some of these charts would be difficult for a lay person to interpret, an “info” link was available above each thumbnail which described the usefulness of the chart or data, and how it could be used in tracking the monsoon.

The next tab, “What is the Monsoon?” contained nine links:

- What is a monsoon?
- North American Monsoon
- Gulf Surges
- Monsoon Progression
- Monsoon Inter-annual variability
- Severe Thunderstorm and Flash Flood Patterns
- Upper Level Lows and the Monsoon
- Monsoon Safety
- For More Reading

The links in this list begin with general, easy to understand meteorology and increase in complexity as the reader descends to the next link. The first four modules were designed to be read by everyone; the next three modules bring a reader up to active NAMS research topics and were designed for those with an atmospheric science background.

All of these links contain graphics depicting specific instances of what occurs during the NAMS. For example Figure 2 is from the North American Monsoon link and shows moisture sources into the Southwest.

The Monsoon Safety link contains weather safety information useful throughout the summer. These safety tips are categorized by the specific weather being observed, such as lightning, straight-line winds or dust storms.

Over ninety articles were used in assembling the information found under the “What is the Monsoon?” tab. For readers desiring more technical details, these references are given under the “For more reading” link. These references were designed to serve as a complete listing of the research results available on NAMS.



Figure 2 – North American Monsoon low level moisture sources.

The remaining three tabs (Monsoon Rainfall, Dewpoint Data and Monsoon Statistics) contain historical data about precipitation and dew point values for various observation sites around Arizona. Figure 3 depicts the historical monsoon rainfall as seen under the Monsoon Statistics tab. The contents of these three tabs are all similar in nature, although each contains different data.

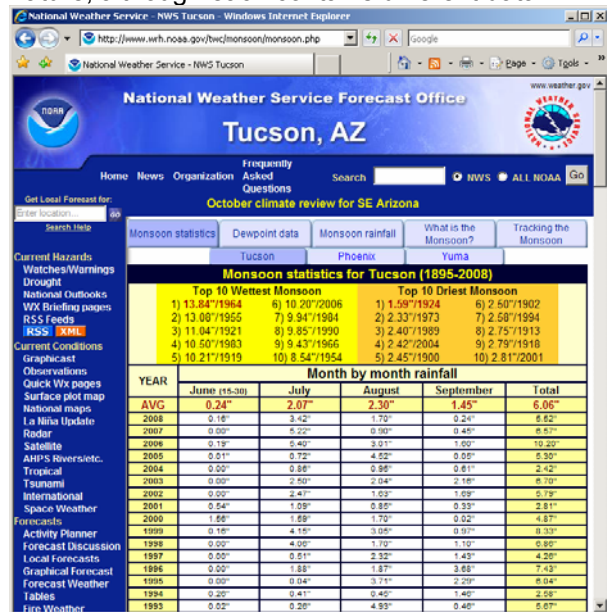


Figure 3 - Depiction of data under the Monsoon statistics tab.

Hence these tabs describe what has happened in the past from an observational standpoint. Collectively this information represents a comprehensive dataset on how the North American Monsoon System has affected Arizona.

4. ONGOING EDUCATION EFFORTS

This education effort on the North American Monsoon System started in March 2008. Significant accomplishments were made during the summer of 2008. Multiple stories appeared in local newspapers, TV meteorologists began using the web pages as a monsoon resource and millions of hits occurred from the general public. While major accomplishments were achieved in this education process, a change of this magnitude will take years to achieve its final objective. To continue moving forward, updates to the web pages will occur over the next several years. The results of current research projects will be added to the "What is the monsoon?" tab, new datasets will be added to the tracking page as they become available, and the climatological data will be updated on a yearly basis. Every year a week near June 15 is designated Thunderstorm Safety Awareness Week by the State of Arizona, county and local governments. All of these efforts will continue to educate the public on the NAMS and associated weather safety principles.

5. REFERENCES

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