Get Ready to Measure Snow! By: Megan Taylor

### TOOLS you need:

- Ruler or yardstick (measuring tenths of an inch)
- A snowboard or flat surface (not subject to snow drifting)

### WHAT to measure:

| Storm Total Snowfall after snow has ended (multi-day accumulation) |
| New Snow since snow began |

### HOW to measure:

1. Place snow board on a flat, un-obstructed surface to measure.
2. Slide yardstick into snow until it reaches snowboard.
3. Read the value on the yardstick to the nearest $\frac{1}{10}$th of an inch (i.e. 2.6”).
4. Wipe the board clean so it’s ready for the next snow.

### REPORTING to NWS Flagstaff:

- **Online**: [Online Link](#) (bookmark)
- **Phone**: 1-888-745-1637
- **Facebook**: [facebook.com/NWSFlagstaff](http://facebook.com/NWSFlagstaff) (photos encouraged!)
- **Twitter**: @NWSFlagstaff
- **mPING App**: For both Android and iPhone devices

### A few more TIPS:

- Measure as soon as possible after the snow stops.
- Don’t measure under trees.
- If snow is wind blown - take several measurements and average (but don’t measure drifts!).
- Don’t measure more than once every 6 hours.
Monsoon 2016 Summary  
By: Megan Taylor

Much of Coconino and Yavapai Counties saw above average rainfall this past monsoon season, with the rest of northern Arizona seeing closer to average values. The graphic to the right indicates the % of normal rainfall with green/blue showing above average and brown indicating below average. Seasonal rainfall in some of our more populated cities saw precipitation totals ranking among some of the highest on record. Flagstaff (Airport) ranked as the 12th wettest monsoon season with 11.41". Both of our weather stations in Prescott ranked as the 8th wettest monsoon season on record at 9.27" (Airport) and 13.34" (Sundog Water Plant). A couple other notable rankings were the four corners (Teec Nos Pos) and Wupatki National Monument at 4th wettest. We saw plenty of exciting weather throughout the season and sincerely appreciate your timely spotter reports!

Winter Outlook  
By: Brian Klimowski

It’s that time of year we’re all talking about the upcoming winter. Will it be snowy? Will it be warm? Cold? Will we get enough rain to fill the reservoirs? Last year we had a very strong El Niño signal, and we were all forecasting the likelihood of a wet, snowy winter. Well, that didn’t quite happen, and we learned quite a bit about the variability of our seasonal weather and forecasts. So what’s in store for this upcoming winter?

Unlike last year, there aren’t any strong forcing mechanisms that would indicate much of a deviation from near normal conditions and variability. There are weak La Niña conditions present (cooler than normal temperatures over the equatorial Pacific) which should extend through much of the winter. The official Climate Prediction Center forecasts for this winter (which are largely based on the weak La Niña conditions) indicate an enhanced chance for warmer than normal conditions, and a very slight chance for drier than normal conditions for Arizona. So what should we expect here in northern Arizona? Perhaps a winter which is somewhat warmer than normal, with precipitation largely within the variability of a normal year. Outside of this, there’s not much we can really say much about the outlook this year!

Photo: Mark Gullo
Anyone that’s lived in northern Arizona a while knows that each winter season can vary dramatically from one to the next. The mountainous terrain locations are no stranger to heavy snowfall during the winter months. It is not uncommon for higher elevations to see multiple feet of snow in one storm. In fact, Flagstaff’s largest snow storm totaled 4 and a half feet! 54 inches accumulated between December 29th-31st, 1915. You can imagine the impact that had on the city in the early 20th century! The photo to the right shows heavy snow in downtown Flagstaff on Aspen Street in the early 20th century - perhaps after that record snow storm (exact date is unknown).

What causes heavy snowfall events like this? If you have ever been curious about forecasting winter snowfall here in Arizona, check out the details below.

One of the first things taught in meteorology are the ingredients needed to generate precipitation. Though the processes vary between summer and winter weather (and everything in between), the ingredients remain the same. The three ingredients needed for precipitation formation are (1) Moisture, (2) Instability, and (3) Lift.

**Moisture:** Our greatest source of moisture for winter precipitation comes from the Pacific Ocean. Large low pressure systems that have a long fetch over the Pacific waters can transport significant amounts of moisture into Arizona. It usually takes a deep layer of moisture to make it all the way into Arizona, so moisture depth is quite important. In order to forecast accurate snowfall amounts, we have to consider the density of the snow. In other words, the water content of the snow. Snow density is dependent on temperature and relative humidity. Generally, warmer temperatures produce more dense snow (heavy cement like snow), while colder temperatures produce lighter, fluffier snow (powder like snow). The most efficient snow production occurs when the atmosphere is saturated within the “Dendritic Growth Zone” (-4°F to -14°F).

**Lift:** When air is lifted, it cools, and eventually reaches the point of condensation (water) or deposition (ice), when precipitation particles form. A lifting mechanism is needed for air to cool and form precipitation (water droplets or ice crystals). During the winter season, the most common lifting mechanisms are frontal systems (warm or cold) and orographic lifting, which is when air is forced upward over mountainous terrain. Sometimes, sunshine can act as a lifting mechanism as it warms parcels of air on the ground that rise and eventually form convective showers.

**Instability:** Instability is essentially the ability of an air parcel to be lifted. Under stable conditions, it is much harder for air parcels to be lifted to the point of forming precipitation. On the other hand, when the atmosphere is unstable, air is lifted more freely allowing for the production of precipitation.

All three ingredients are essential in winter storm forecasting. The biggest snow storms we see here in northern Arizona are when all three factors are maximized. A strong fetch of Pacific moisture combines with a strong lifting mechanism (like a cold front), and ample instability. As mentioned above, the moisture profile is very important and plays a large part in how efficient snow production is. Strong upward motion (lift) and saturation in the “Dendritic Growth Zone” lead to high snow ratios and can lead to very heavy snowfall accumulations.
New GOES-R Satellite Series!
By: Robert Bohlin

**NOAA’s next generation of geostationary weather satellites is almost here!**

A new series of Geostationary Weather Satellites (GOES-R) is scheduled to launch from Cape Canaveral, Florida in the coming weeks. This new earth observing satellite will orbit the Earth in a Geosynchronous Orbit over the equator at an altitude of ~22,000 miles above the ground. New imagery on the GOES-R satellite will provide 16 spectral imagery channels compared to 5 on the current GOES satellite constellation. Image resolution will be four times clearer and image production cycle will be five times faster as compared to the current satellites. A Geostationary Lightning Mapper (GLM) will be the first operational lightning mapper flown from geostationary orbit. This new sensor will provide in-cloud, cloud to cloud and cloud to ground lightning activity day and night across North and South America including the adjacent Pacific and Atlantic ocean regions. All in all, this new satellite series will provide much higher resolution imagery at faster updating times. The additional channels will help detect things like dust plumes which have historically been a challenge to detect.

“The GOES-R series will significantly improve the detection and observation of weather that directly affects public safety, protection of property and our nation’s economic health and prosperity.”

To find out more information, please visit


Photo: Mark Gullo
Winter Weather Safety

By: Tony Merriman

Winter storms can bring snow, sleet and freezing rain across the entire United States and its territories. Even Hawaii gets snow on its Big Island! Thousands of people are injured or killed every year in traffic accidents related to slippery roads from winter storms.

Prepare! Don’t Let a Winter Storm Take You by Surprise!

Before the storm strikes, make sure your home, office, and vehicles are stocked with the supplies you might need. Make sure pets also have the essentials they will need during a winter storm.

Each year, on average, more than 6,000 people are killed and more than 480,000 are injured due to weather-related vehicle crashes. If you need to drive in snow or cold conditions, TAKE IT SLOW IN THE SNOW. Black ice can be difficult to see. If the temperature is near freezing, drive like you’re on ice - you may be!

Make sure your vehicle is stocked with a winter emergency supply kit. Please see the graphic below for items you’ll need in your kit.

Know Your Watch vs. Warning

<table>
<thead>
<tr>
<th>Watch - Be Prepared</th>
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<tbody>
<tr>
<td>Conditions are favorable.</td>
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<td>Time to prepare.</td>
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<tr>
<th>Advisory - Be Aware</th>
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<tr>
<td>Weather likely to cause inconvenience or nuisance is imminent or occurring.</td>
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<table>
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<tr>
<th>Warning - Take Action!</th>
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<tr>
<td>Hazardous weather is imminent or occurring. Take protective action now!</td>
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For more winter safety tips, please visit http://www.nws.noaa.gov/os/winter/index.shtml