Storm Signals

Houston/Galveston National Weather Service Office Volume 84 Fall/Winter 2010

Summer of 2010 was the Fourth Warmest on Record

The summer of 2010, defined as the months of June, July and August, was the fourth warmest in recorded history for the city of Houston. Neither Houston Intercontinental Airport nor Hobby Airport recorded a daily high temperature record this summer. High temperatures were warm but not record breaking like the summer of 2009. Yet, the average temperature for the summer was one of the warmest on record for each of the primary climate sites. The data suggests that the warm anomaly was driven by warm overnight low temperatures and not by daytime high temperatures. Despite slightly cooler high temperatures as compared to the past few years, higher humidity levels coupled with the warm afternoon temperatures created unusually high heat index values. There were several instances this summer where heat index values exceeded 112 degrees. Heat advisories were in effect for much of August.

Below is a series of tables with average temperature data for the summer months defined as June 1st through August 31st for each of the primary climate sites.

City of Houston data (1892 – 2010)
June 1 through August 31

Average High		Average Low		Average	
97.6	1980	77.0	1964	86.4	2009
96.6	2009	77.0	1963	86.4	1980
96.5	1998	77.0	1962	85.6	1998
96.1	1902	**76.8**	**2010**	**85.5**	**2010**
95.2	2000	76.8	1958	85.3	1962
94.2	**2010 (13th warmest)**				

Houston Hobby data (1931 – 2010)
June 1 through August 31

Average High		Average Low		Average	
95.4	2009	77.3	2010	86.1	1998
95.2	1998	76.9	1998	85.9	2009
94.4	1980	76.4	2009	85.0	2010
93.9	2000	76.3	2007	84.7	1980
95.2	2000	76.0	2008	84.3	2008
92.7	**2010 (18th warmest)**				

College Station data (1902 – 2010)
June 1 through August 31

Average High		Average Low		Average	
99.1	2009	76.7	2010	87.6	2009
97.5	1980	76.0	2009	86.1	2010
97.3	1958	74.6	2008	85.8	1980
97.2	2000	74.6	2007	85.6	1996
97.1	1954	74.2	1996	85.3	2008
95.6	**2010 (14th warmest)**				

Galveston data (1875 – 2010)
June 1 through August 31

Average High		Average Low		Average	
92.4	1875	80.7	1993	85.8	2005
91.8	1999	80.5	2010	85.7	2009
91.3	2009	80.5	2005	85.4	1875
91.2	2005	80.5	1994	85.3	2010
91.1	1995	80.2	1990	84.8	188
90.1	**2010 (10th warmest)**				

In this Issue:

Summer of 2010 was the Fourth Warmest on Record continued

So what is driving the increase in overnight temperatures? There are probably a number of factors that are playing a role. Evidence is becoming more compelling that the two primary factors for warmer overnight low temperatures are an abundance of water vapor and increasing levels of CO2. Water vapor and CO2 are considered greenhouse gases. Greenhouse gases generally trap heat from the surface, blocking the heat from radiating into space and reradiating the heat back toward the Earth's surface, thus warming the surface. The Greenhouse effect is more pronounced at night and warmer overnight low temperatures are the result. There are other factors which have likely contributed to warmer temperatures such as an increase in urbanization, changes in instrumentation, changes in documentation, site location and site relocation. Galveston and Houston both contain weather records to the 1890's (or earlier) and both observation sites have endured a change in location. The automated surface observation system, or ASOS, was commissioned in 1998, and temperatures have been warmer since ASOS stations were implemented. Temperature data in rural areas have not shown the same increase that urban areas have endured. Long term volunteer co-op stations such as Danevang and Bay City show some warming but nothing as extreme as the two Houston climate sites. The other two primary climate sites, Galveston and College Station, are also showing a substantial increase in overnight temperatures with numerous new record high minimum temperatures established in the summers of 2009 and 2010. Urbanization or a "heat island" effect may be playing a larger role in the temperature increase than previously acknowledged.

The new 30 year climate normals (1981 – 2010) will be issued next year so, we decided to take a look back at the last 30 years and compare the number and type of temperature records tied or established since 1981.

Intercontinental Airport (IAH)												
Record High Temperatures (1981 – 2010)												
Record High Temperatures (2000 – 2010)												
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
14	11	5	19	13	12	12	10	20	19	11	15	161
10	2	3	4	7	8	8	4	11	10	5	4	76

A whopping 161 high temperature records have been tied or established since 1981. That is 161 days out of 366 days (including leap year), or roughly 44% of the new high temperature records have occurred in the last 30 years. 76 of these new high temperature records or, roughly 21%, have occurred since 2000.

Intercontinental Airport (IAH)												
Record Low Temperatures (1981 – 2010)												
Record Low Temperatures (2000 – 2010)												
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
5	7	11	11	5	5	7	16	12	7	11	13	110
0	2	2	1	0	0	0	5	3	0	0	1	14

Roughly 30% of our low temperature records have occurred since 1981, but only 14 low temperature records have been established since 2000 (around 4%). Note that there were zero new low temperature records in six of the 12 months, and no new low temperature records in the warm months of May, June and July.

Intercontinental Airport (IAH)												
Record Low "High" Temperatures (1981 – 2010)												
Record Low "High" Temperatures (2000 – 2010)												
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
5	7	5	5	2	0	6	7	7	15	4	11	74
3	1	3	0	0	0	0	3	1	7	1	3	22

Intercontinental Airport (IAH)												
Record High "Low" Temperatures (1981 – 2010)												
Record High "Low" Temperatures (2000 – 2010)												
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
12	14	13	15	25	20	24	12	10	16	15	14	190
6	5	6	6	16	10	12	11	4	9	2	4	91

These values are probably the most troubling of all the data presented. Over half, or roughly 52%, of the Houston high minimum temperatures have occurred in the last 30 years. 25% of the warmest overnight low temperatures have occurred in just the last ten years. We have already touched on a few of the reasons at the beginning of this article, but let's review again. An increase in urbanization around the observation site coupled with more pollution and additional water vapor will yield warmer overnight low temperatures. Changes in instrumentation may also play a role in temperature variability.

Let's compare the data compiled at Intercontinental Airport to Hobby Airport. Urbanization around Hobby Airport has not changed much over the last 40 years, and the observation site has been relatively static since 1930.

Houston Hobby Airport (HOU)												
RecordHighTemperatures(1981–2010)												
RecordHighTemperatures(2000–2010)												
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
9	13	6	13	18	16	13	14	20	10	10	14	156
8	1	4	4	10	8	9	5	15	7	8	8	87

Houston Hobby Airport (HOU)												
RecordLowTemperatures(1981–2010)												
RecordLowTemperatures(2000–2010)												
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
3	7	9	5	11	6	6	7	7	8	1	14	84
1	1	3	1	2	0	0	1	1	0	0	2	12

Hobby Airport (HOU)												
Record Low "High" Temperatures (1981–2010)												
Record Low "High" Temperatures (2000–2010)												
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
6	11	5	14	13	13	13	13	9	15	9	14	135
2	3	3	2	4	4	5	6	2	7	1	3	42

Hobby Airport (HOU)												
Record High "Low" Temperatures (1981–2010)												
Record High "Low" Temperatures (2000–2010)												
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
11	16	11	17	26	21	27	27	25	21	21	19	242
6	7	7	12	18	9	19	24	16	18	6	6	148

Let's compare the data from the two airports and check for similarity and differences. Looking at record high temperatures, IAH recorded 161 new/tied high records and HOU reported 156 new/tied records. The records remain close even if we narrow the focus to high temperature records since 2000 with IAH recording 76 new/tied records and HOU recording 87 new/tied records.

A quick check of record low high temperatures reveals that IAH recorded 74 new/tied record low maximums since 1980 while HOU recorded 135 new/tied records. IAH reported 22 new/tied records since 2000 while HOU reported 42 new records since 2000. This is a significant difference particularly in the short term and is probably related to the shorter period of record for Hobby Airport.

IAH recorded 110 new/tied record low temperatures since 1981 while HOU recorded 84 new or tied record low temperatures. These values are rather close if you consider the amount of urbanization around Hobby Airport in the 1980's and the lack of widespread urbanization around IAH. IAH has had 14 record low temperatures since 2000 and HOU has had 12 record low temperatures since 2000. Again, these values are surprisingly close.

Let's turn our attention to record high minimum temperatures. It is these values that helped fuel our record heat this summer and actually for the past several summers. The numbers are brutal, and there is no way to circumvent the obvious, but we are, as a community, much warmer at night. A quick check of rural temperature data at several co-op volunteer sites do not show as much warming at night as Hobby and Intercontinental Airport show. More research is required to explore this area and examine temperature changes. IAH recorded 190 new/tied record high minimum temperatures since 1981. HOU has recorded 242 days with new/tied record high minimum temperatures since 1981. IAH recorded 91 new/tied record high minimums since 2000 while HOU has recorded a staggering 148 new or tied record high minimums since 2000.

Southeast Texas Weather and Fire

The last year has seen a noticeable lack of rainfall that has gotten worse since the wet months we had back in July and August across much of Southeast Texas. The lack of rainfall September through mid-November has accelerated the drying of the grasses, shrubs, and trees around the area. This drought has decreased the amount of moisture in the soil which has fed back to the grasses and shrubs across much of the region having become drier than normal for this time of year. The combination of typical fall weather and drier than normal fuels, such as grasses and shrubs, poses a threat of more erratic and difficult to manage wildfires. Typical fall weather brings warm and dry south and southwesterly winds that prevail for a few days that slowly moisten up as Gulf moisture eventually increases, followed by a cold frontal passage that ushers in breezy cool but dry conditions. If the area is fortunate the cold fronts typically bring showers and thunderstorms, but this year the last few have been accompanied by only light rainfall accumulations.

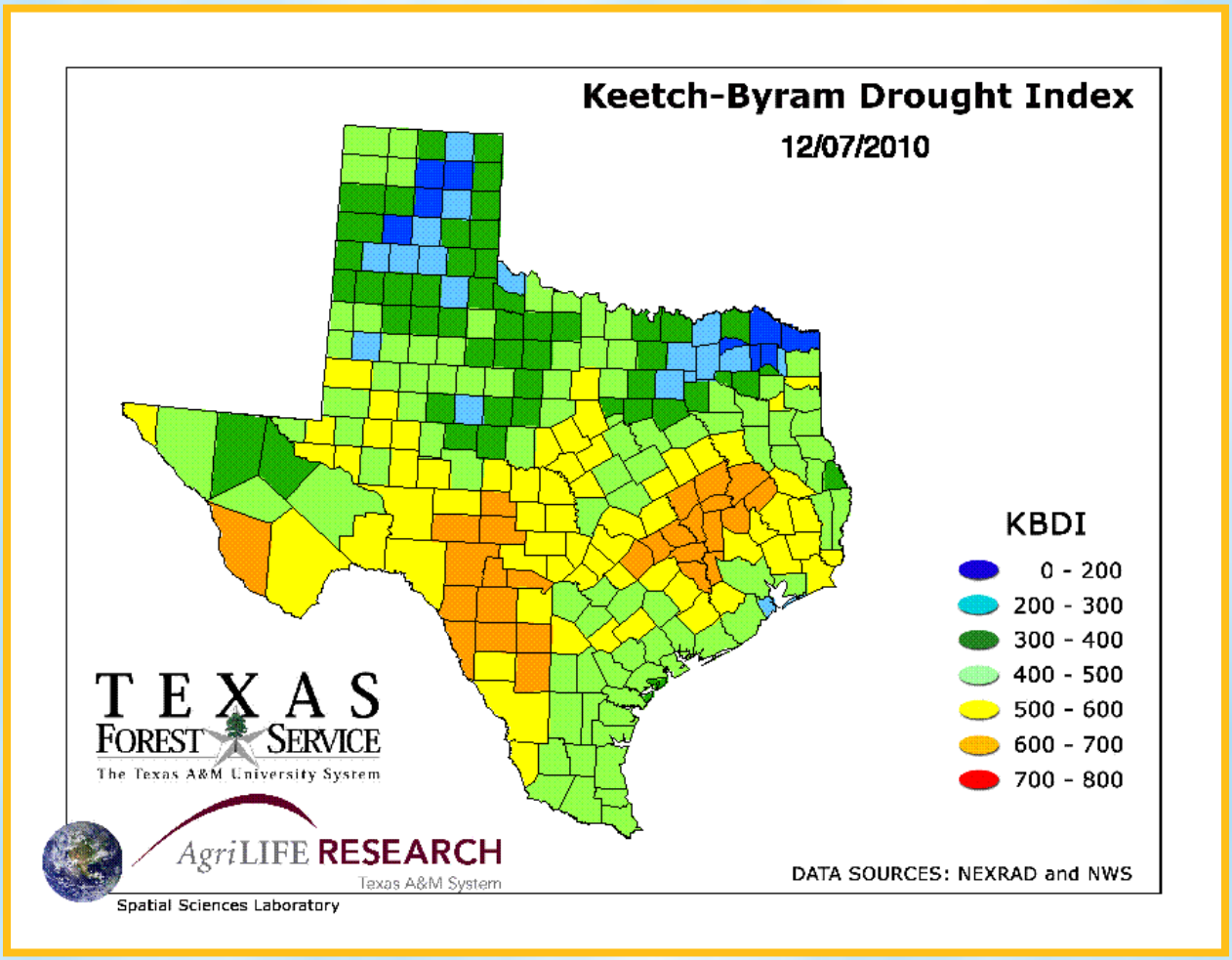


Figure 1. – Keetch-Byram Drought Index is used in estimating the magnitude of the dryness of the soil. Values near 0 indicate saturated soil and near 800 very dry soils.

One of the weather systems that modulates the long term rainfall and temperatures across much of Texas is the El Niño/La Niña phenomena. La Niña is characterized by unusually cold ocean temperatures in the Equatorial Pacific, compared to El Niño, which is characterized by unusually warm ocean temperatures in the Equatorial Pacific. During moderate to strong La Niña events it is customary for Southeast Texas to experience lower rainfall and warmer conditions during the fall and winter months. So far that has been the case in spades. The current seasonal outlooks for the region focus on this drought pattern of lower rainfall and warmer conditions to persist through the winter months.

Southeast Texas Weather and Fire continued

In the above, figure 1 the Keetch-Byram Drought Index indicates very dry soils over a large portion of Southeast Texas and in figure 2 the U.S. Drought Monitor indicates the area of moderate drought expanding across nearly all of Southeast Texas. For land owners and land management agencies the ongoing drought and forecast of extended drought during the winter months has made the option of using prescribed fires difficult to utilize as a means to manage the vegetation across the region. It is common for prescribed burning to be used during the fall and winter months to control unwanted plant species and to revitalize vegetation thereby providing cover and food for wildlife and livestock. Late winter burning is typically used to prepare fields before planting for areas west of the Interstate 45 corridor.

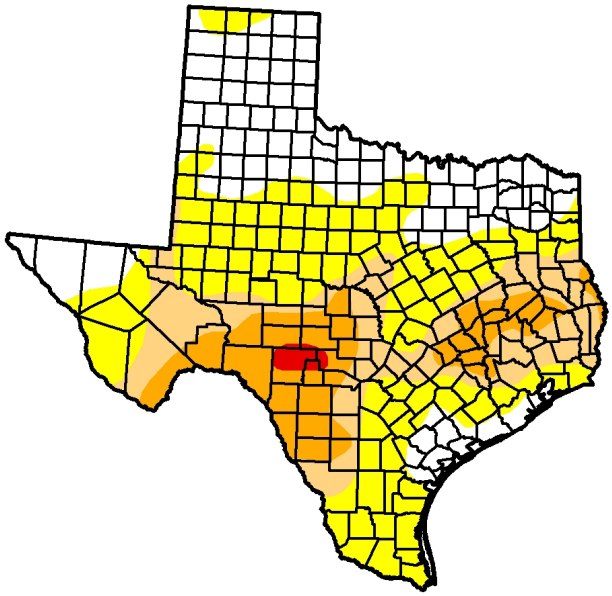
U.S. Drought Monitor

November 30, 2010
Valid 7 a.m. EST

Texas

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	29.5	70.5	32.5	14.3	0.8	0.0
Last Week (11/23/2010 map)	43.8	56.2	25.1	5.5	0.0	0.0
3 Months Ago (09/07/2010 map)	69.6	30.4	5.2	1.5	0.0	0.0
Start of Calendar Year (01/05/2010 map)	72.9	27.1	7.0	2.3	0.0	0.0
Start of Water Year (10/05/2010 map)	75.6	24.4	2.4	1.0	0.0	0.0
One Year Ago (12/01/2009 map)	66.0	34.0	12.1	5.9	2.9	0.0



Intensity:

- D0 Abnormally Dry
- D1 Drought - Moderate
- D2 Drought - Severe
- D3 Drought - Extreme
- D4 Drought - Exceptional

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

http://drought.unl.edu/dm

USDA National Drought Mitigation Center

Released Thursday, December 2, 2010
Author: R. Tinker, CPC/NOAA

Figure 2. – U.S. Drought Monitor. The drought monitor is used to classify the drought intensity D0 is dry ranging to exceptional drought at D4.

The U.S. Seasonal Drought Outlook is favoring a dry pattern with the drought to continue or worsen across the area. Prescribed fire use across the region could easily be hampered by the drought making fuels readily available and more subject to wildfires caused by man and nature. As the winter gets underway the winds typically increase behind the cold fronts and with the expected La Nina pattern the possibility of stronger high pressure spreading through the Plains this could support the possibility of stronger winds than normal in the wake of the cold fronts. Figure 3, the U.S. Seasonal Drought Outlook shows that the drought should continue to worsen throughout the winter. Burn bans could become more commonplace and only licensed prescribed fire officials may be allowed to burn if this pattern materializes. Landowners may want to pursue joining a prescribed burn association as a means of accessing the expertise and resources needed to perform burns safely.

You can stay up to date check out the latest fire weather forecasts on our new NWS webpage at: http://www.srh.noaa.gov/hgx/?n=fire.

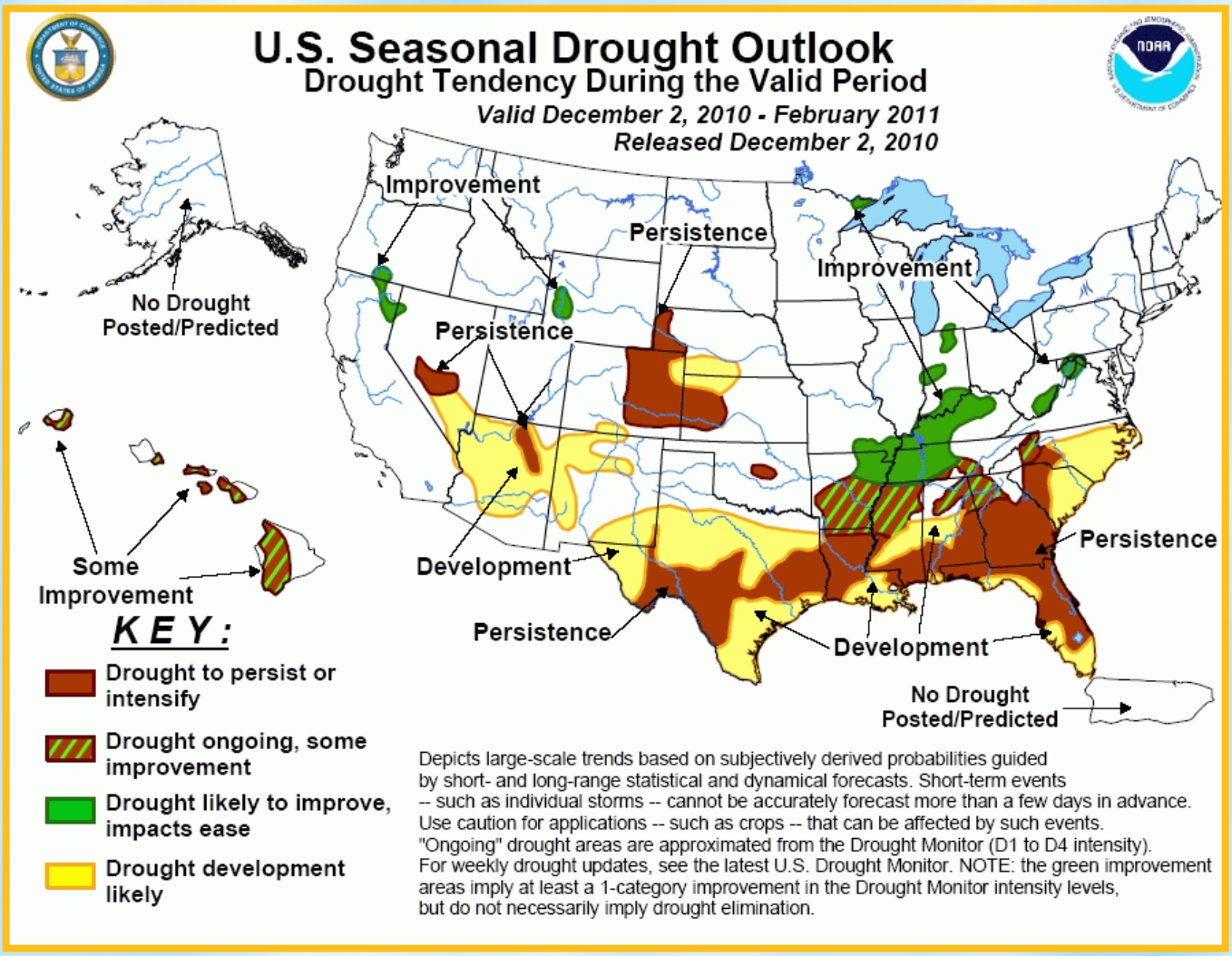


Figure 3 - The U.S. Seasonal Drought Outlook spans a 3 month period and is a forecast of changing drought conditions the for upcoming 3 months.

Winter Safety Rules

Although rare in southeast Texas, winter weather does occasionally occur. January is the month when snow, sleet, or freezing rain is most likely to be observed; yet, winter weather conditions can occur at anytime during the winter and early spring months. Also, people traveling into other parts of the country will likely encounter winter weather harsher than what occurs along the upper Texas Gulf coast. The leading cause of death during winter storms is transportation accidents. Hypothermia and frostbite are other dangers from very cold winter temperatures. The Houston/ Galveston National Weather Service Office would like to review some important safety information to help you and your family to prepare for winter weather.

- Limit travel during periods of winter weather. Bridges, overpasses, and elevated roadways are especially vulnerable to ice and snow conditions given the lack of ground insulation under these structures.
- Before the onset of winter precipitation, check your supplies and, if necessary, stock up on groceries, gasoline, and other necessities.
- Have flash lights and extra batteries on-hand in case of possible power outages.
- Wear layers of protective clothing if you are venturing outside—wind makes the air feel much colder.
- Be alert to the signs of hypothermia. These include uncontrollable shivering, memory loss, disorientation, incoherence, slurred speech, drowsiness, and apparent exhaustion.
- If hypothermia signs occur, seek immediate medical attention. If medical attention is not available, slowly warm the person's body core first by getting them into dry clothing and wrapping them in a warm blanket covering the head and neck.
- Giving warm broth and warm food is better than giving beverages or food that is hot. Alcohol should not be taken.
- Be alert to the signs of frostbite. The most susceptible parts of the body are the extremities such as fingers, toes, ear lobes, or the tip of the nose. If frostbite occurs, seek immediate medical attention. If it is not available, the affected areas should be warmed slowly.

Concerning travel, make sure your vehicle is prepared for the onset of winter weather. Have a mechanic check the coolant system and fluid levels, the electrical system and lights, and the heater and defroster. Also, ensure good winter tires are installed. Keep a windshield scraper and small broom available for ice and snow removal. During periods of winter weather it is a good idea to maintain at least a half tank of gas. If you must travel, allow extra time to reach your destination and leave plenty of space between you and other vehicles. Ice- or snow-covered roadways are especially treacherous and stopping distances are greatly increased. In the event of a winter storm, it is a good idea to carry a winter storm survival kit in your vehicle. Suggested items for the kit for southeast Texas residents include:

- Flashlights with extra batteries
- A first aid kit with a pocket knife
- Necessary medications
- Blankets and an extra set of winter clothes and rain gear
- Matches and a candle for heat
- A brightly colored cloth to use as a flag
- A supply of food and water
- A shovel and a small bag of sand for generating traction under wheels
- Small tools and booster cables

Remember, even though harsh winter weather is rare in southeast Texas, it still occasionally occurs. It is very important to stay informed about the possibility of winter weather in your area. This can be done by tuning into NOAA weather radio, commercial radio, or your local television station. If you would like more winter weather information, you can contact the Houston/Galveston National Weather Service Office.

Wind Chill Terms and Definitions

1. What is wind chill temperature?

The wind chill temperature is how cold people and animals feel when outside. Wind chill is based on the rate of heat loss from exposed skin caused by wind and cold. As the wind increases, it draws heat from the body, driving down skin temperature and eventually the internal body temperature. Therefore, the wind makes it FEEL much colder. If the temperature is 0 degrees F and the wind is blowing at 15 mph, the wind chill is -19 degrees F. At this wind chill temperature, exposed skin can freeze in 30 minutes.

2. Can wind chill impact my car's radiator or exposed water pipe?

The only effect wind chill has on inanimate objects, such as car radiators and water pipes, is to shorten the amount of time for the object to cool. The inanimate object will not cool below the actual air temperature. For example, if the temperature outside is -5 degrees F and the wind chill temperature is -31 degrees F, then your car's radiator will not drop lower than -5 degrees F.

3. What is FROSTBITE?

You have frostbite when your body tissue freezes. The most susceptible parts of the body are fingers, toes, ear lobes, or the tip of the nose. Symptoms include a loss of feeling in the extremity and a white or pale appearance. Get medical attention immediately for frostbite. The area should be SLOWLY re-warmed.

4. What is HYPOTHERMIA?

Hypothermia occurs when body temperature falls below 95 degrees F. Determine this by taking your temperature. Warning signs include uncontrollable shivering, memory loss, disorientation, incoherence, slurred speech, drowsiness, and exhaustion. **Get medical attention immediately.** If you can't get help quickly, begin warming the body **SLOWLY**. Warm the body core first, **NOT** the extremities. Warming extremities first drives the cold blood to the heart and can cause the body temperature to drop further--which may lead to heart failure. Get the person into dry clothing and wrap in a warm blanket covering the head and neck. Do not give the person alcohol, drugs, coffee, or any HOT beverage or food. WARM broth and food is better. About 20% of cold related deaths occur in the home. Young children under the age of two and the elderly, those more than 60 years of age, are most susceptible to hypothermia. Hypothermia can set in over a period of time. Keep the thermostat above 69 degrees F, wear warm clothing, eat food for warmth, and drink plenty of water (or fluids other than alcohol) to keep hydrated. NOTE: Alcohol will lower your body temperature.

Wind Chill Chart

Wind (mph) \ Temperature (°F)	Calm	40	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45
5		36	31	25	19	13	7	1	-5	-11	-16	-22	-28	-34	-40	-46	-52	-57	-63
10		34	27	21	15	9	3	-4	-10	-16	-22	-28	-35	-41	-47	-53	-59	-66	-72
15		32	25	19	13	6	0	-7	-13	-19	-26	-32	-39	-45	-51	-58	-64	-71	-77
20		30	24	17	11	4	-2	-9	-15	-22	-29	-35	-42	-48	-55	-61	-68	-74	-81
25		29	23	16	9	3	-4	-11	-17	-24	-31	-37	-44	-51	-58	-64	-71	-78	-84
30		28	22	15	8	1	-5	-12	-19	-26	-33	-39	-46	-53	-60	-67	-73	-80	-87
35		28	21	14	7	0	-7	-14	-21	-27	-34	-41	-48	-55	-62	-69	-76	-82	-89
40		27	20	13	6	-1	-8	-15	-22	-29	-36	-43	-50	-57	-64	-71	-78	-84	-91
45		26	19	12	5	-2	-9	-16	-23	-30	-37	-44	-51	-58	-65	-72	-79	-86	-93
50		26	19	12	4	-3	-10	-17	-24	-31	-38	-45	-52	-60	-67	-74	-81	-88	-95
55		25	18	11	4	-3	-11	-18	-25	-32	-39	-46	-54	-61	-68	-75	-82	-89	-97
60		25	17	10	3	-4	-11	-19	-26	-33	-40	-48	-55	-62	-69	-76	-84	-91	-98

Frostbite Times: 30 minutes | 10 minutes | 5 minutes

$$\text{Wind Chill (°F)} = 35.74 + 0.6215T - 35.75(V^{0.16}) + 0.4275T(V^{0.16})$$

Where, T= Air Temperature (°F) V= Wind Speed (mph)

Effective 11/01/01

Wind Chill Terms and Definitions continued

5. Tips on How to Dress during cold weather

The best way to avoid hypothermia and frostbite is to stay warm and dry indoors. When you must go outside, dress appropriately. Wear several layers of loose-fitting, lightweight, warm clothing. Trapped air between the layers will insulate you. Remove layers to avoid sweating and subsequent chill. Outer garments should be tightly woven, water repellent, and hooded. Wear a hat, because half of your body heat can be lost from your head. Cover your mouth to protect your lungs from extreme cold. Mittens, snug at the wrist, are better than gloves. Try to stay dry and out of the wind.

6. Avoid Overexertion

Your heart is already working overtime in cold weather. The strain from the cold and the hard labor of shoveling heavy snow, walking through drifts or pushing a car may cause a heart attack. Sweating from overexertion could lead to a chill and hypothermia.

7. Is there a Celsius version of the chart?

Go to: http://www.wrh.noaa.gov/slc/projects/wxcalc/windChill.php

8. Wind chill factor vs. wind chill temperature.

These terms are almost the same. The wind chill factor describes what happens to a body when it is cold and windy outside. As wind increases, heat is carried away from the body at a faster rate, driving down both skin temperature (which can cause frostbite) and eventually the internal body temperature (which can kill). Wind chill temperature is a unit of measurement to describe the wind chill factor. Wind chill temperature is a measure of the combined cooling effect of wind and temperature. On the bottom of the wind chill chart is the updated wind chill temperature formula.

9. Is it possible to get frostbite if the temperature is above freezing but the windchill is below freezing?

The air temperature has to be BELOW freezing in order for frostbite to develop on exposed skin.

10. How is the Wind Chill calculated?

The wind chill temperature is calculated using the following formula:
Wind Chill (°F) = 35.74 + 0.6215T - 35.75(V^0.16) + 0.4275T(V^0.16)
Where: T = Air Temperature (F) V = Wind Speed (mph) ^ = raised to a power (exponential)

11. When does the Houston/Galveston National Weather Service issue a Wind Chill Warning or Advisory?

Wind Chill Warnings are issued when the Wind Chill Temperature is expected to fall at or below -18 degrees F. Wind Chill Advisories are issued when the Wind Chill Temperature is expected to fall between 0 degrees F.

12. Does wind chill only apply to people and animals?

Yes. The only effect wind chill has on inanimate objects, such as car radiators and water pipes, is to more quickly cool the object to cool to the current air temperature. Objects will NOT cool below the actual air temperature. For example, if the temperature outside is -5 degrees F and the wind chill temperature is -31 degrees F, then your car's radiator will not drop lower than -5 degrees F.

13. Does humidity or being near a large water body affect wind chill?

When we tested the new Wind Chill Temperature Index (WCTI), our researchers applied the new index to 12 test subjects. The results of the tests showed that relative humidity was an insignificant weather parameter, less than one degree at worst. To simplify the calculation, relative humidity was left out of the formula.

14. How does this chart apply to children?

The tests that were done on Wind Chill were conducted on adult subjects. For legal and safety reasons, NWS could not ask for child volunteers. Use the existing chart as a starting point and be even more cautious with children, seniors and persons with compromised health.

Storm Signals is a publication of the
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