Staying Cool(er) in Hot, Humid Weather

by Mark Florian

The last article I wrote about dealing with our weather was the short season: January. This article will address our second, longer season: Summer.

Due to our near 30° latitude, low elevation and close proximity to the warm waters of the Gulf of Mexico, our climate is officially described as "humid, sub-tropical." If you look on a globe and follow the 30° latitude line around, you'll notice it also runs through Shanghai China, New Delhi India, mid-Pakistan, South Afghanistan, Basra Iraq, Cairo Egypt, Sakakah Saudi Arabia, North Libya, Tallahassee Florida and Southern Lousiana. All definitely hot climates and some very humid. Additionally, the Austin metro area is rated #9 in the entire US for the sweaty combination of high heat (107 days above 90° F.) and high humidity (average 70% rh)!

There are a couple of ways to deal with the heat & humidity of Central Texas. First lets talk about temperature, dew point, the standard heat index and a more comprehensive heat index. Second, I'll discuss some typical weather patterns that regularly occur in our area. Third, I'll discuss different clothing, shade & radiant barriers. Finally, for clarity's sake, dressing for hot, dry weather in a desert environment is a bit different than discussed here. Some tips will carry over, however some won't.

First, some definitions. Air temperature is also known as the dry-bulb temperature. Shielded from solar radiation, it simply measures the ambient air temperature without taking humidity into account. This is the figure reported by TV and radio stations. Wet-bulb temperature varies depending upon the amount of water vapor or humidity in the air. When the air is saturated, or the humidity is 100%, no evaporation occurs to cool the wet bulb so the wet-bulb temp and the dry-bulb temp will be the same. As the humidity drops, water will evaporate from the wet-bulb and cool it just as sweat evaporating off of your skin cools you. The lower the humidity, the greater the difference between the dry-bulb & wet-bulb temps.

Relative humidity is defined as the amount of water vapor in a sample of air compared to the total amount of vapor that sample of air is capable of holding at the same temp & pressure. Rh is expressed as a percentage and is reported during the weather briefings. Two additional points to understand about humidity are (1) As the air temp increases, the amount of moisture it will absorb also increases and (2) as the barometric or air pressure drops, the air can absorb more moisture. So our hot Summer air temps are capable of holding a lot of moisture and when a low-pressure area moves in, such as a hurricane, the air can hold even more moisture. The higher the relative humidity is in a hot climate, the more uncomfortable it feels and the harder it is for your body to cool itself off.

The dew point is the air temp below which water vapor in the air will start to condense. It's also the same point at which 100% relative humidity occurs. Because our dew points are quite high, in the mid-70's during the evenings at times, the air temp doesn't have to fall much before dew occurs on Tel-Rads, corrector plates, secondary's, paper star charts, etc. An interesting note here is that a metal surface, such as your car or a metal roof, can quickly cool during the night to a temp slightly below that of the ambient air temp because of radiation to the night sky. If this point happens to cross the dew point, then moisture will form on the roof of your car. If your cars engine has been on, the hood will show dew later because the residual engine heat is keeping the hood above the dew point.

Next let's talk about the heat index. A standard heat index only takes air temperature & humidity into account, which is fine if you stay in the shade, don't move and there's no breeze. A heat index doesn't take into account whether it's day or night.

It also doesn't factor in wind speed. However, you can sure feel a difference between a bright sunny day, cloudy skies & night time. You can also feel a difference is there is a breeze blowing. Often it means the difference between being pleasant and completely soaked. A more complete, and accurate, heat index takes into account air temp., humidity, level of solar radiation and wind speed. This is closer to what you would actually feel when standing out in a field, like at COE. The weather station in the observatory is capable of calculating this combined heat index. I have the same system at my house.

As I type this at 4:15 in the afternoon in July, my Davis Weather Vantage Pro weather station reports the following: Outdoor temp: 89° F, outdoor humidity: 75%, wind speed: 2 mph ENE, solar intensity: 479 Watts/square-meter (mostly cloudy), extended heat index (temp., humidity, wind speed, solar intensity): 113° F; standard heat index (temp., & humidity): 104° F. The extended heat index is close to what it would feel like on your body if you were standing out in the sun. The standard heat index would be in the shade. Note the difference between the two: 9° F. If the skies cleared, the solar intensity would be up around 900 W/square-meter. The standard heat index wouldn't change, but the extended one would and so would your comfort level. Remember that the heat indexes reported by the local weather stations are the standard type. It will always feel hotter if you're in the sun and even more so if you're exercising.

Next let's talk a bit about our weather patterns. When a bubble of high pressure forms in our area, it puts a 'lid' on our atmosphere so to speak, preventing clouds from forming, causing air stagnation, low humidity, high temps, and low wind speeds. At times, this will result in a thermal inversion where cooler air on top is trying to sink and warmer air below is trying to rise. This is the same weather pattern that causes ozone action days. You'll see no clouds and the sky will look sort of hazy after a couple of days. As long as this bubble of high pressure is in place, no clouds can form and the atmosphere remains quite stable. When you see big, puffy cotton ball clouds in the sky, such as cumulonimbus, low pressure is in place and the atmosphere is more unstable. The humidity is also higher and so it feels muggy.

As the Sun sets, the rate at which the air temp will drop is determined by the humidity. The higher the humidity, the slower the temp. drop; the lower the humidity, the faster the temp drop. During our Summers it's not at all uncommon for the air temp to still be above 85° F at 10 o'clock in the evening around town. Out at COE, it will drop faster. If you were in a very dry climate and at the same elevation, the temp could drop 20° F or more within a few hours of the Sun setting. Unfortunately, that'll never happen here because of our high dew points. As the night progresses from dusk to dawn in our area, the humidity will rise to 100%. So as astronomers, we're faced with setting up our equipment in the late afternoon or early evening, when the Sun is still out and it's very hot. As it gets later, the air temperature will begin to fall and the humidity will begin to rise.

Before we move on to clothing, we need to talk about two ways your body cools itself. The first we are all familiar with, sweating, or for women, 'glistening'. Whatever. Your body moves moisture from your insides to your outsides in hopes that it will evaporate and cool you off. The hotter it is, the more you sweat. As the humidity increases, this cooling mechanism isn't as effective so you sweat more and soon become soaked. Naturally, as you sweat your body loses water that needs to be replaced or you'll become dehydrated. If you lose too much water due to sweating, your body will also lose its ability to cool itself and your core temp. will rapidly increase. This is called sunstroke and is covered below. Drinking plenty of ice water keeps you hydrated, absorbs heat from your body and keeps the sweat pump supplied. Ice water is around 32° F and your skin temp is around 90° F. Water has a high specific heat, which means it is capable of absorbing a lot of heat, which makes it a great coolant. Your body takes in ice water at 32° F and heats it to near your core temp, 98.6° F, then eliminates it through urination and sweating. An important point here is that since our climate is quite humid, sweating is less effective at cooling us off due to reduced evaporation. So our body sweats more & more as we exercise trying to cool us off and we soon become soaked. Drink-

ing water isn't an option, it's mandatory. However, if you drink ice water, it's capable of absorbing much more heat than tepid water and you'll sweat less. Get it? So one of the keys to staying comfortable in hot humid weather is to drink lots of ice water. You'll sweat less and you'll stay cooler. A handy guide is to pee frequently! If you're not, drink more ice water. This also means you'll have to bring more ice water when going out to COE. The second less well known way your body cools itself is through respiration or breathing. The air you exhale is saturated with water vapor and very warm because the path from your mouth to your lungs and back out is very warm & humid. Warm air holds more water vapor and water (vapor) is capable of absorbing a lot of heat, right? So you also cool yourself as you breathe. Which is why breathing hot, muggy air is no fun.

OK, let's talk about what to wear. Or maybe what not to wear. Cotton T-shirts in a regular weave are quite comfortable until you soak one with sweat, then they cling on you like a wet blanket. Cotton underwear will do the same thing and have you reaching for the baby powder. When your skin sweats, the moisture moves into your clothes because initially it's drier than your skin and moisture has a habit of moving from wet to dry. This is called capillary action. As long as the fabric is drier than your skin, it'll continue to lure sweat off of your body. Once it becomes saturated however, it'll stop and you'll be soaked. Remember, cotton fibers absorb moisture and take a long time to release it. In hot, humid weather, sweat-logged clothing of any type is no fun to wear. So take an additional dry cotton shirt or two along with you. When you soak one, change. It feels really good to change into a dry shirt at the end of an observing session when you're sweaty from loading your car. If your shirt is soaked when you turn on the a/c full blast inside your car on the way home, you'll soon freeze: As the a/c cools down & dehumidifies the air inside your car, the sweat from your soaked shirt will also rapidly evaporate and you'll get a chill. Remember, moisture moves from wet to dry. Wet shirt to dry air equals evaporative cooling. Weave is also important in addition to the material. I've learned to avoid woven mesh fabric of any type, including cotton, in hot humid weather such as 'polo' shirts. I feel hotter in these cotton mesh shirts than in a regular cotton T-shirt or a cotton button down shirt. Evidently, the mesh weave is better at trapping air in it and air is a poor conductor of heat, which is why it will keep you warmer in cooler weather. See if you notice a difference.

Synthetic fabrics, such as polyester or nylon, will not absorb moisture. Other fabrics are popular with bicycle riders and work well. However, remember that bicycle riders are always on the move and the movement of air helps to evaporate sweat. So these types of fabrics won't necessarily help you in hot, humid weather with no breeze blowing.

Personally, I wear either a cotton T-shirt with a pocket, a cotton button-down madras shirt with a pocket or a fly-fishing shirt made either of nylon or cotton. I also bring along a dry spare or two when wearing cotton. Note all shirts have pockets. The fly-fishing shirts are a favorite because: They have a mesh vent across the back and up each arm seam, they have several large pockets, to corral astro-dropables, the nylon fibers won't absorb sweat, and the shirt will dry quickly if you stand in front of a fan or when you turn the a/c on in the car. They are designed for use in humid, sunny, wet climates while fly-fishing to keep fishermen more comfortable. You can also get these in a long-sleeve version which is handy for protecting against sunburn & insects. Plus they're available in light, tropical colors. Though black seems to be in vogue among the younger set, wearing it on a sunny, hot, humid day will definitely make you sweat. So will dark green, blue, gray, and red. You'll be more comfortable wearing white or light-colored pastel colors. They also make shorts with large pockets out of the same stuff. Another advantage with this type of material is that you can wash it in a sink with some shampoo, body wash or dishwashing detergent, rinse and hang it up to dry. If there's no room to hang, then roll it up tightly in a dry towel. These are great for extended trips or astro-camping. Beats having a large plastic bag of smelly, sweat-logged cotton!

For shorts, I prefer nylon with a pocket on each side and a draw-string at the waist. They're light, won't absorb sweat so they dry quickly, pack eas-

ily and can be washed in the sink like the tops for camping trips. An alternative is to wear polyester briefs (underwear) and cotton shorts with large pockets. The poly briefs will move sweat away from your skin towards the cotton shorts. However, if the humidity is high, and you're sweating and your cotton shorts (or jeans) get soaked, their is no 'dry' for the moisture to move to and even your poly briefs won't help much. You can wash the poly briefs though and hang them up to dry. You can also wear nylon shorts or swim suits instead of cotton or poly underwear under shorts. Women can wear their bathing suit under shorts and cover with a shirt. If a water hose is available, you can strip and douse yourself to cool off. If a pool or lake is handy, you can easily strip and jump in to cool off without having to deal with underwear of any type. This is great for kids & camping. Finally, baby powder applied to your privates and on your feet can really help make you feel more comfortable. Note that baby powder made of cornstarch, instead of talc, is more effective at absorbing moisture.

Next are your feet & head. Your feet have an incredible number of sweat glands so they perspire a lot. Furthermore, if you encase them in leather tennis shoes, they'll have a hard time breathing . . . your puppies will be hot & damp. Since astronomers are known to wander around in the dark, we also need to protect our toes from objects and at times, stickers. So while wearing open-toe sandals are comfortable, they don't provide any protection to your toes. I've found cotton (canvas) boat shoes, mesh tennis shoes, and water shoes or slip-on's to be good. The topsides of the water shoes are mesh, so they breathe. You also don't need socks, which can trap moisture. They are easy to slip on & off, and when they begin to stink, you can toss them in the washing machine with a bit of bleach. They're not much good for hiking though. When I do wear tennis shoes, I use a running-sock with baby powder to prevent blisters and keep my feet dry. It's important that your shoes are roomy enough with your socks on to allow your feet to feel comfortable: Give them room to spread out.

For your head, a hat can help shade your face, eyes & scalp from the Sun. For me though, I don't like hats in hot weather . . I feel hotter. Many don't have adequate ventilation and your body radiates a lot of heat from your neck & head. Though a mesh-top baseball cap will allow heat & moisture to escape, it won't ventilate around the rim where it touches your head, so air is cut off from flowing up. I compromise by using a visor to keep the Sun out of my eyes, keep me from squinting, but allow the heat & sweat to escape because there's no 'top'. I have a friend who has a wide-brimmed hat, made out of a rigid light-colored mesh, where there is an inner band of sweat-absorbing material that allows it to stand off from your head. So you have an air gap of half-an-inch or so all around your head where the hat touches. This way air can flow in from the bottom and leave the top. I think even I would wear one of these. I also believe the hats the walking postmen used to wear were like this. Once the Sun goes down, you really don't need a hat. Another useful head-accessory is a thick cotton terrycloth headband. It's main purpose is to collect sweat off of your head and keep it from getting in your eyes, and dripping on your glasses and eyepieces. When you really need to cool off, you can soak it with ice water and put it back on. It'll absorb a surprising amount of heat. Also, you can use sweat bands on your wrists to wipe your face & eyes. These are handy if you have insect repellent or sunscreen on your hands and don't want to get it in your eyes. Ouch.

We've covered fabric types, colors and clothing for our weather what else can we use to stay cool and comfortable while observing in humid Texas? How about a fan? Ever remember saying, "At least there's a breeze blowing?" With a fan, you can bring a breeze with you. A good fan needs to be able to move enough air in cfm (cubic feet per minute), while being portable, not making too much noise and not drawing too much current, especially if we want to use it with a device called an AC inverter, which will allow us to power it with a marine, car, gel cell or rechargeable DC battery. For example, I have a Vornado AC powered fan, with steep-pitched blades 9" in diameter. It draws about 1 Amp on high or about 100 Watts, an easy load for my 300W AC inverter. A fan can go along way toward making observing much more comfortable. If AC power is easily available, a white

extension cord will be easier to see on the ground. If you put down a ground tarp before setting your scope down, you can point the fan to your Dob. primary and cool it down faster. The tarp will prevent dirt from being picked up by the fan. It'll also act as a bit of insulation from the radiant heat of the ground. More on this later. Finally, the water atomizer systems seen around outdoor decks at restaurants & bars don't help much in our climate because high humidity levels decrease evaporative cooling. They just increase the local humidity level to near 100% and make you feel muggier faster. However, they do work well when coupled with a large fan capable of moving a lot of air. My mechanic has one that rolls around on a large cart in his shop, but it requires a constant water source and a lot of Watts so it's not very portable.

As mentioned earlier, ice water is a very useful item to keep you cool in hot, humid weather. An insulated jug of ice water will not only give you something to drink, but also a means to remove heat. I already mentioned soaking a headband in it. Since your body radiates most of its heat from your neck and head, you can soak a small cotton towel or bandana in ice water and wrap it around your neck. Or pour some over your head. If it's too cold for you, let it sit out for a minute to warm up a bit, then pour it over your head. Think of it as portable refrigeration.

To make the ice last longer, bring your ice chest & water jug indoors the night before if they're kept in the garage. Open the tops to allow cool, dry air to circulate inside. This will allow your home air conditioning system to remove the stored heat instead of your ice. Another option is to add a fan to blow air on it while indoors. The goal is to remove as much heat as possible from your ice chest, and insulated water jug before you put in ice. The reason is this fact: It takes the same amount of energy to melt a block of ice as it does to raise the equivalent amount of water from 32° F to 176° F! Pretty amazing. And when that block of ice has melted, the water will still only be at 32° F! So preserve your ice. Likewise, be sure your drinks, food, etc. and drinking water are as cold as possible before putting them in the cooler. Fill a gallon jug of drinking water and put it in the fridge overnight. For long-term ice, take a one, two or three liter plastic jug like soft drinks come in, fill it with cool tap water to about 75% full and lay it down in the freezer and freeze it solid. Remember, water expands when it freezes. If you fill it full and freeze it, the bottle will split. You can put this in your cooler the next day and it'll keep everything cold for a very long time. As it melts, you can drink the water or pour it on your towel and put it around your neck.

Of course, no astro-outing should be considered, much less attempted, without weather appropriate astro-snacks. Forget animal protein, your body generates too much heat to digest it. Instead chill down foods with a high water content that you can eat when you get hot. For example, celery, carrots, grapes, oranges, apples, etc. Ever eaten a really cold juicy orange when you're hot? How about really cold celery & carrot sticks with a chilled dip? They taste pretty good when the air temp. is above 80° F, it's past 11 pm and the humidity is still rising. Another favorite is to take your favorite candy bar, mine's Snickers, and freeze it. Put a few in a Ziploc bag and drop them in your cooler. It'll taste really good, help you cool off and won't melt all over you like ice cream will. Though I've never met a chip, cracker or cookie that I didn't like, high humidity will turn them soggy in no time and they'll lose much of their appeal.

I hope you find the above helpful for staying more comfortable when it really gets hot & muggy. Below are some more ideas:

* Watch for signs of heat exhaustion (Pale, moist, clammy skin, excessive sweating, dizziness, mental confusion and cramps) in yourself and others, particularly in children. Their little cooling systems can easily be overwhelmed on a hot day, especially if they become the least bit dehydrated. Sun stroke occurs when the body has lost too much water and electrolytes and can no longer cool itself. Signs are: Hot, dry skin, no sweating, dizziness, mental confusion, and nausea. If you ever see a child or adult with a dry, fire-red face, they're in trouble and need immediate attention. Take them indoors to air conditioning, if possible, and have them lie down. Otherwise get them in the shade, have them lie down on a cot or several

chairs placed side-by-side next to each other to allow air flow underneath, place a fan or two on them, remove their shoes, socks and hat. Give them sips of cold water (best) or juice, but nothing carbonated. Put some cold water and ice cubes into a small Ziploc plastic bag and put one under each armpit. You can also place one between their legs near the crotch. This will cool down the blood flowing to and from their core. You can pour cold water (but not ice water) over their hair and throat or place a towel soaked in cold water under their neck and up the sides. You can also place towels soaked in cold water over each leg and direct the fan there. Or if appropriate, remove their shirt, cover them with a towel or sheet or dry shirt and pour cold water over it. Be mindful of brain freeze and thermal shock: Don't do all of these or they'll freeze! Use common sense. The point is to lower their core temperature and thoroughly cool them off. Don't let them go back outside in the Sun the rest of the day, they need to rest. Give them enough water so that their urine is clear, they need to be peeing on a regular basis. The same goes for adults, except they take longer to cool down. Be prepared for a banging headache.

* If you like sports drinks, such as Gatorade, make a slush, put it in a container and store it in the bottom of your cooler covered in ice. It'll taste great when you're hot and sweaty after unloading the car and setting up. To make, mix the powered stuff 50 to 75% stronger with water. Fill a blender with ice and pour in the mixture. Blend until it's a slush.

* A radiant barrier is a material that is classified as a low emitter of radiation or has a low emmisivity or a low-e rating. Aluminum foil, aluminum coated Mylar, aluminum coated bubble wrap and metallized window film are examples of radiant barriers. Aluminum foil will get very, very hot but it will not emit much of this heat. You can put your face very close to a hot piece of aluminum foil and feel very little heat on your cheek. So it acts as a barrier to radiant heat. Once the radiation source is removed, it will cool down to ambient temp rather quickly. Steel and iron when very hot will re-radiate heat for a long period of time, thus they make poor radiant barriers. Don't confuse emitting with reflecting, they're not the same. A foil-based radiant barrier will stop long wave radiant heat (the type you feel when standing out in the Sun) from penetrating it to something on the other side. Rb's need an air space around them to work so that heat isn't transmitted by conduction. The emergency blankets or 'space blankets' are radiant barriers and are used in cold climates to wrap a person in to keep them warmer. You could wrap one of these loosely around your cooler to keep it's contents colder longer, but ideally it shouldn't touch your cooler at all. I use the shiny, collapsible, aluminum-coated-mylar types sold as dashboard protectors to shield coolers from radiant heat even when they're in the shade. For a test, place a couple of 2 x 4's on the ground that's had the Sun beating on it all day, put one of these radiant barriers on top of it, then stack two more 2 x 4's on top of those and put your cooler on top. Do the same with another cooler, but leave out the radiant barrier. Leave both for an hour. Put your hand on the bottom of the cooler with the radiant barrier in place and then on the other, note the difference. Which cooler would ice stay ice in longer? To make it more interesting, use a third cooler and put it right on the ground. You'll be amazed at how warm the bottom gets. To really amaze yourself, stick a instant reading thermometer into the ground and note the temp. This makes a great, simple science experiment to do with kids (and teach them to close the refrigerator door!)

* Remember that the ground will radiate heat long after the Sun has set. You can minimize the radiant heat by putting your large Dob. on top of a plastic ground tarp. Set up your fan on the tarp and aim it at the back end of your mirror box. The tarp will keep your fan from picking up dust, dead grass, etc. Otherwise the radiant heat from the ground will transfer itself to the back end of your Dob for hours on end and slow down the cooling of your mirror. To prove this, lay down on your tarp around 11 pm or pick up something that's been sitting on

your tarp for several hours and feel the bottom of it. The tarp will also protect you from stickers and make it easier to find something if you drop it. Likewise, don't set your cooler or water jug down on bare ground and never on concrete. Put it on a table, on a tarp, or on top of a couple of 2 x 4's to create an airspace. While it's true that a plastic tarp is not a radiant barrier, plastic is a lousy conductor of heat which is how we're using it in this case.

* Protect your telescope from the direct rays of the Sun, especially if it's a big Dob. It'll store lots of heat which later on you'll have to get rid of to get better images. Use a shiny foil-type dashboard protector to shield your mirror box from the Sun. Be sure to leave an airspace between the two. The goal is to minimize the amount of heat your large Dob. primary soaks up. A radiant barrier with an airspace is the best way to do that. This is particularly important during astro-fests where your scope is sitting out in the Sun all day. Shading it with a tarp is one thing, using a radiant barrier is better.

* When packing your car, remember to keep your cooler and scope (if possible) away from areas directly above heat sources such as the catalytic converter(s), muffler(s), engine compartment and automatic transmission. These will radiate heat up through the vehicle to whatever's above them. A cooler sitting on a floorboard for a couple of hours above a catalytic converter will be quite warm on the bottom.

* Metallized window film on your car's windows, particularly if your vehicle has a lot of glass, will cut down on radiant heat coming through the glass and heating up your cooler, scope, eyepieces, and family.

* It won't keep you cool, but it's a great way to degrease and disinfect your hands. Keep a bottle of 70% isopropyl alcohol and some paper towels handy. If you have sunscreen, insect repellent or oil from sweat on your hands and want to remove it, pour some alcohol on them and rub together, then wipe dry with a paper towel. It will also cool off and de-stink your feet quickly.

* Ever put a glass of ice water next to your face when you're really hot? Try this: load a Ziploc bag with some ice water & cubes and use that. You can sit it on top of your head, put it behind your neck, lay it on a shoulder, put it under an armpit or two or between your legs. That's the big chill.
