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Democracy Dies in Darkness

CAPITAL WEATHER GANG

How understanding sun angles clarifies the character of the seasons and their weather

By David Policansky
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It is late September, and the autumnal equinox has arrived. That gets me to thinking even more than usual about sun angle. Noticing differences in sun angle during different times of year and locations helps our knowledge of weather, climate and the natural world.

We have seasons because the sun angle varies over the course of the year, and it varies because the Earth's plane of rotation is tilted by about 23.5 degrees from the plane of its orbit around the sun. As a result of this tilt, the sun is high in the northern hemisphere in May, June and July and low in November, December and January.

Low sun angle goes with shorter days and cooler temperatures. The closer a place is to the equator, the higher the average sun angle is. That is why the tropics are, well, tropical. Similarly, the low average sun angle at high latitudes gives those places an Arctic climate.

The changes in the daily cycle of light also affect how plants and animals, including humans, live their lives. For example, most owls are nocturnal hunters. They see and hear well in the quiet darkness of nighttime, and they hunt at night. But the snowy owls of the Arctic would starve to death in summer if they hunted only in the dark, because it never gets dark up there in summer. So, unlike most other owls, snowy owls often are active during the day, even when they visit mid-latitudes.

The autumnal and spring equinoxes are two days when sun angle makes the most sense, because on those days, it is easiest to know how high the sun gets at *solar noon. That angle is found by subtracting your latitude from 90 degrees. At the equator, 0 degrees latitude, the sun angle at noon at the equinox is 90 -- 0 = 90 degrees, or directly overhead. Washington is at about 39 degrees north latitude, so at the autumnal equinox, which falls on Monday, the noon sun angle was 51 degrees. The same is true of the spring equinox. Every place closer to the equator than Washington will see a higher sun angle at noon at the equinoxes, and every place farther from the equator will have a lower sun angle.

At other times, this simple calculation for calculating the noon sun angle will not work. For example, at the summer (June) solstice, the sun is directly overhead at the Tropic of Cancer (northern tropic). In Washington, which is 15.5 degrees north of the tropic, the noon sun angle is 74.5 degrees above the horizon. In Rio de Janeiro, which lies within the tropics at about 23 degrees south latitude — much closer to the equator than Washington — the sun angle on that day is only 43.5 degrees. Even places on the equator have a lower noon sun angle, 66.5 degrees, than Washington and even places as far north as Montreal at the June solstice.

Although the sun never gets directly overhead in Washington, it feels as if it is in June and July. By mid-September, it has become obvious that the shadows at noon are much longer, the sun isn't nearly as high in the sky, and despite the occasional sweltering day — the temperature at Reagan National Airport reached 98 degrees on Sept. 12 this year — the sun just doesn't beat down on you the way it did in July.

In three more months, the sun in Washington will be only a bit more than 27 degrees above the horizon at noon. And, as a result, it will be much colder than it is now.

Washington, with a mid-latitude location, has a greater seasonal variation in day length and sun angle than tropical locations do, and a smaller variation than places at higher latitudes. Changes in seasonal weather follow the same pattern. It doesn't get cold in the tropics except at high altitudes, while high latitudes can experience many consecutive months of bitter cold even at sea level.

At the South Pole, where the altitude of more than 9,000 feet above sea level adds to the climatic effect of high latitude, the temperature is almost always below 0 degrees, and the highest temperature ever recorded was just shy of 10 degrees. And that's largely because of the variation in sun angle.

Sun angle has other effects, as well. January snows in Washington tend to stick around longer than snows in late February or March, when the higher sun is more effective at melting the snow and raising the temperature above freezing.

Appreciating sun angles not only will improve your understanding of weather and the world but also add a dimension to your travels. While the effects of human activities have caused the global climate to get warmer, I remain confident that we humans won't be able to do anything about the sun angle, at least not anytime soon.

**Solar noon is the time of day when the sun reaches its highest angle above the horizon. In Washington, solar noon is only a few minutes different from noon Eastern standard time, but at the edges of a time zone it can be up to 30 minutes different, and in some places the difference can be much greater.*

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