Following up on this since someone asked (looking at you Kyle G!) what about flat spots?

These might be considered as spots with northness and eastness both zero and then we are in trouble, because they violate the "sum of their squares equals zero" trig identity.

What my students and I have done in the past is to take the slope, convert that to radians, find its sine, then make new variables:

Northness\_exposure = sin(slope)\*northness,

Eastness\_exposure = sin(slope)\*eastness,

where as before

northness= cos(geographic aspect in radians) and

eastness= singeographic aspect in radians)

So if a place is flat, then slope = zero and both northness.exposure and the equivalent eastness.exposure will now be zero.

In contrast, an icy, vertical north face in the Brooks Range of Alaska will have the maximum value of northness.exposure = 1

From here we devolve into a lot more issues like solar angle relative to the slope and aspect---I think that Paul Rich solved these issues and sold (?) the code to ESRI in the 1990s as the "Solar tool" to get some measure of a "solar value" or exposure at a given time or across times.

Sometimes I have used the solar tool for a given study area, then regressed the solar value from ESRI's "Solar tool" against Northness\_exposure and Eastness\_exposure finding high R^2 and so using the faster and simpler variables