VPD as a Replacement for NDVI

## The Problem

Although NDVI is considered a standard in remote sensed vegetation health, we have been having issues with reliability of coverage and production consistency. Because the daily satellite passes for NDVI are not complete across the globe (or even CONUS), NDVI is “completed” by taking the maximum value from 8-day timeframes. For our global use, we must process the daily values into a monthly by finding the maximum value per cell for the entire month.

This process of using maximum values to create complete coverage can skew the results, especially when dealing with monthly values. NDVI is intended to be an instantaneous snapshot of conditions, not a representation of longer periods as can be done with SPI, SPEI, etc.

## The Possible Solution

Vapor Pressure Deficit is a crucial component of Penman-Monteith PET, and the subject of greenhouse growth optimization (over relative humidity). Various greenhouse studies point to VPD as a more accurate measurement of optimal humidity for plant transpiration. In general, it has been noted that a deviation from the optimal VPD (absolute delta) creates stress on the plants. One such study can be found at: <https://www.canr.msu.edu/uploads/resources/pdfs/vpd-vs-rh.pdf>.

## The Questions to Answer

1. Is there a VPD that highly correlates to an NDVI of 1.0? If so, is there an absolute delta from that value which correlates to an NDVI of 0.0?
2. Do we need to use the “delta from optimal VPD” as a replacement for NDVI, or can we simply use VPD anomalies to replace NDVI anomalies?

While we use standardized gamma distributions to measure the NDVI anomalies in production, comparing Z-scores of NDVI to VPD will be effective enough for measuring replacement potential.

## The Data

I have included 1-month NDVI values (5km grid) for 1981 to present, and 1-month mean VPD values (10km grid) for the same period.