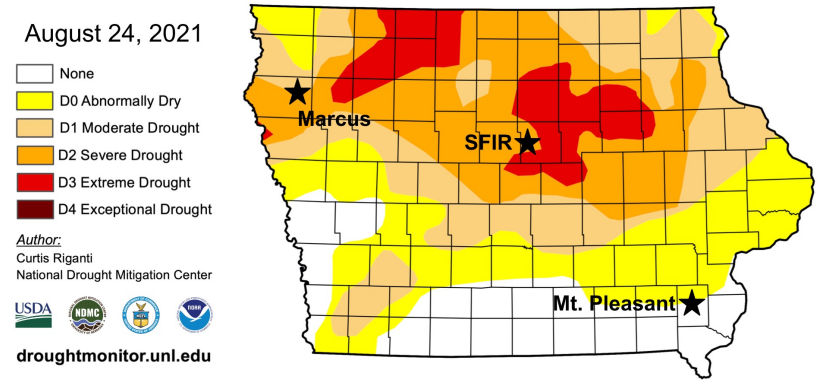
The Diurnal Variation of L-Band Polarization Index in the U.S. Corn Belt Is Related to Plant Water Stress

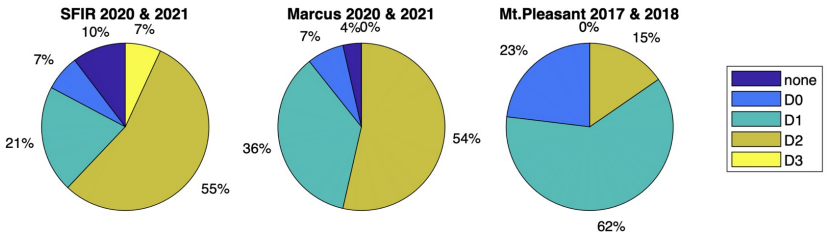
Richard Cirone (USDA ARS) and Brian K. Hornbuckle (Iowa State University), Remote Sensing, January 2025, doi:10.3390/rs17020180.

Problem: Infrared brightness temperature can be used to detect plant water stress. But because clouds are opaque, the temporal resolution in the U.S. Corn Belt is poor (weeks).

Finding: SMAP, which is unaffected by clouds, can detect plant water stress. When plants have adequate soil water they dry out during the day as transpiration outpaces root water uptake. SMAP's polarization index (PI, which quantifies the difference between V- and H-pol brightness temperature) is significantly higher at 6 p.m. (less plant tissue water) than at 6 a.m. When the Evaporative Stress Index indicates plant water stress (ESI < 0), there is less transpiration, a smaller decrease in plant tissue water, and the PI is not significantly different at 6 p.m. from 6 a.m.

Impact: Perhaps IR and microwave brightness temperatures could be used together to create a plant water stress product with high spatial resolution (< 1 km) and temporal resolution (days), and this product could aid in estimating crop yield.





	ESI	overpass	mean PI	significant difference?
SFIR	≥0	6 a.m.	0.0596	yes
	≥0	6 p.m.	0.0650	$p = 0.0135$
most droughty	<0	6 a.m.	0.0670	no
	<0	6 p.m.	0.0698	$p = 0.4204$
Marcus	≥0	6 a.m.	0.0642	yes
	≥0	6 p.m.	0.0700	$p = 0.0036$
	<0	6 a.m.	0.0573	no
	<0	6 p.m.	0.0610	$p = 0.2558$
Mt. Pleasant	≥0	6 a.m.	0.0734	yes
	≥0	6 p.m.	0.0813	$p < 0.0001$
least droughty	<0	6 a.m.	0.0743	no
	<0	6 p.m.	0.0795	$p = 0.0667$