



Possible uses of a Vegetation Water Content Data Product

- Incipient stages of drought stress
- Fuel dryness for potential wildfire
- Input into Tau-Omega model for soil moisture content

Alternatives for a Vegetation Water Content Data Product:

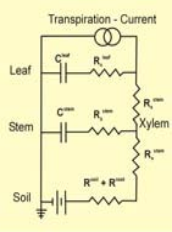
NDII: Normalized Difference Infrared Index (Hardisky et al., 1983)

$$NDII = (R_{850} - R_{1650}) / (R_{850} + R_{1650}) = (Band\ 2 - Band\ 6) / (Band\ 2 + Band\ 6)$$

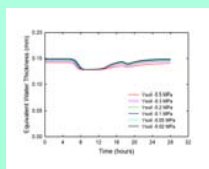
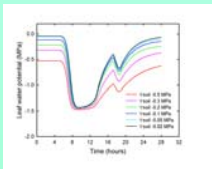
NDWI: Normalized Difference Water Index (Gao, 1996)

$$NDWI = (R_{850} - R_{1240}) / (R_{850} + R_{1240}) = (Band\ 2 - Band\ 5) / (Band\ 2 + Band\ 5)$$

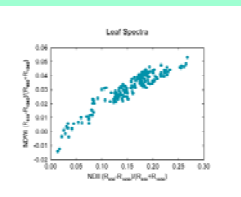
What Accuracy is Required for Monitoring Water Stress ?



Hunt et al. (1991) model for dynamic prediction of leaf water potential based on transpiration rate and soil water potential. Relationship between leaf water potential and leaf water volume is determined from pressure-volume curves; leaf water volume per leaf area is the **equivalent water thickness** (EWT, mm). Model simulates various types of vegetation (grass, shrub, conifer and deciduous broadleaf).



Leaf water potential reaches about the same low point in the morning, for both combinations of either high soil water potential and high transpiration rate or low soil water potential and low transpiration rate. *Translated to equivalent water thickness, the accuracy required is less than 0.01 mm for detection of water stress.* Continued stress leads to breaks in the xylem water columns, which increases the resistances to water flow, and increases potential for wildfire fuel potential.

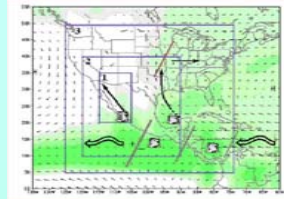


NDII and NDWI are linearly related over a large range of equivalent water thickness, however the range of NDII is much larger than NDWI.

Therefore, NDII has the potential to be more accurate as a backup algorithm for the MODIS vegetation water content data product



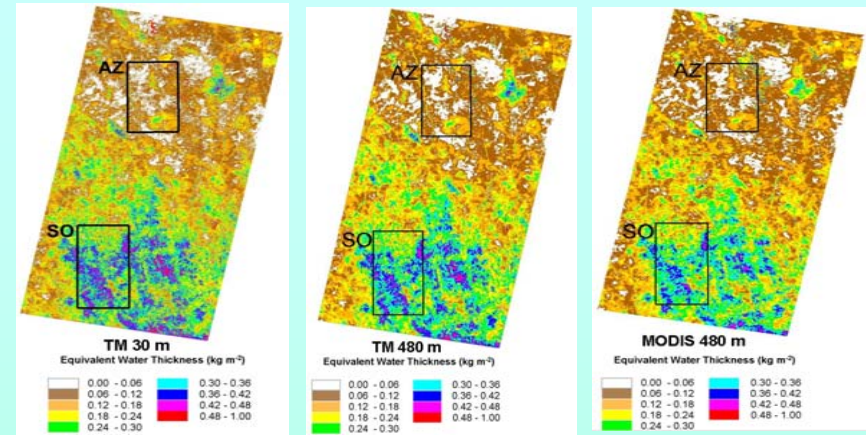
NAME and SMEX04 Study areas in Arizona, USA and Sonora, Mexico



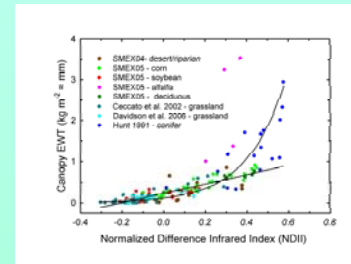
In SMEX04, the range of canopy EWT was from sampling different ecosystems



In SMEX05, the range of canopy EWT was from the growth of crops over time



Equivalent water thickness (EWT) is a linear biophysical variable that scales linearly from field data to intermediate sensor data (TM, Aster, AWIFS) to MODIS using NDII.



From the SMEX05, SMEX04, and published studies, canopy equivalent water thickness is a linear function of NDII, when NDII < 0.4. The standard error is 0.07 mm, which is about half the equivalent water thickness for one leaf, or a leaf area index of 0.5 m²/m², which indicates that the initial stages of water stress can not be detected.

Soil Moisture Experiment 2005 and Polarimetry Land Experiment (SMEX05/POLEX)



The linear regression was compared to the MODIS LAI data product by calculating expected leaf equivalent water thickness, which should be about 0.15 mm. Croplands, grasslands and shrublands have the largest differences between expected and actual leaf equivalent water thickness.

