

Global Estimation of Canopy Water Content

nra-03-oes-02

Equivalent Water Thickness (EWT):

$$EWT = \frac{(F_w - D_w) A}{A}$$

F_w = Fresh weight
 D_w = Dry weight
 A = Leaf area



I. Project Objectives

What methods can we use?

Can we perform a multiscale validation?

Can we estimate canopy water content from MODIS?

Can we provide an operational estimation of canopy water content from MODIS?

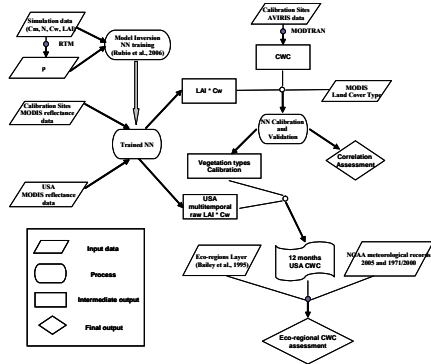
Can we spectrally estimate canopy water content?

MODIS (500 m)
AVIRIS- low high altitude (5 & 20 m)

Field sampling plots

Global
5 km x 8 km - low altitude
15 km x 50 km - high altitude
plots of 40m x 40 m

II. Overview of Methodological Process



- Inversion of radiative transfer model: PROSPECT-SAILH
- Artificial Neural Network trained dataset
- MODIS Surface Reflectance and Land Cover Type Product: forest, grassland, and shrubland
- Utilize vegetation indexes (VIs) for water content estimation

$$NDVI = \frac{\rho_2 - \rho_1}{\rho_2 + \rho_1} \quad EVI = 2.5 \frac{\rho_2 - \rho_1}{\rho_2 + 6\rho_1 - 7.5\rho_3 + 1}$$

$$NDWI = \frac{\rho_2 - \rho_3}{\rho_2 + \rho_3} \quad SIWSI = \frac{\rho_2 - \rho_6}{\rho_2 + \rho_6} \quad NDI7 = \frac{\rho_2 - \rho_7}{\rho_2 + \rho_7} \quad SWIRR = \frac{\rho_6}{\rho_7}$$

- Validated with retrievals from AVIRIS data: Green Ridge, MD; SMEX, AZ; Table Mountain, CO; Yosemite, CA

III. Canopy Water Content Estimation at Continental Level

Correlation between the retrieved CWC and the reference AVIRIS estimates, for the best five band-index combinations.

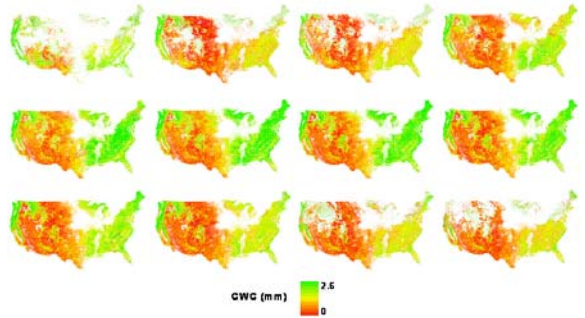
	m	b	r ²	RMSE
SIWSI - NDI7	0.19	-0.003	0.714	0.14
NDVI - SIWSI - NDI7	1.59	-0.15	0.708	0.10
NDVI - SWIRR	0.49	-0.04	0.689	0.13
NDVI - NDWI - NDI7	0.76	-0.14	0.611	0.19
NDI7	0.34	-0.05	0.568	0.16

m = slope, b = offset, RMSE = root mean square error

Correlation between the retrieved CWC and the reference AVIRIS estimations, for each of the vegetation types.

	Shrublands	Forest	Grassland	All
m	1.1796	1.6671	1.4696	1.4649
b	-0.1145	-0.1952	-0.1437	-0.1502
N	3614	5747	2886	12247
r ²	0.5915	0.6072	0.7538	0.7085
P-value	< 0.0001	< 0.0001	< 0.0001	< 0.0001
RMSE	0.028	0.080	0.0353	0.063

m = slope, b = offset, N = number of the MODIS-resolution pixels, RMSE = root mean square error.

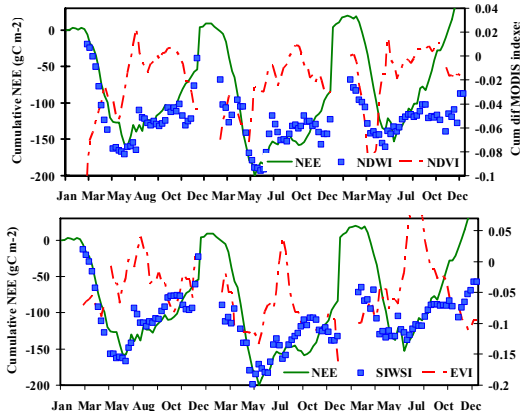
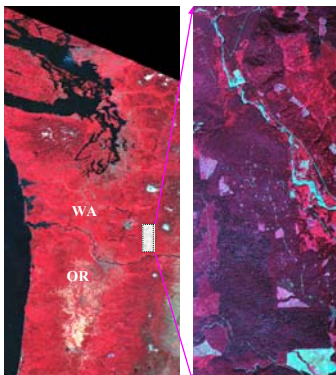
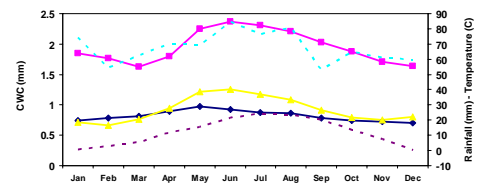


Monthly CWC of natural vegetation of the USA in 2005. Areas cover by snow and cloud were masked. The sequence of the months increases left to right and top to bottom.

IV. Temporal Change of MODIS VIs and Net Ecosystem Exchange

- Temperate conifer forest at Wind River, WA
- Three years (2001-2003) of MODIS Surface Reflectance Product and tower-based NEE
- Similar temporal trajectory between water indexes and NEE

Canopy Water Content - US - Year 2005



V. Future Work: Jasper Ridge

