Efforts at Quantitative Remote Sensing for Applications in the Intermountain West

Mark Seyfried, Pat Clark, Danny Marks, and Christopher Neale.,
Northwest Watershed Research Center, Boise, ID, and Utah State University, Logan, Utah

Introduction

Given that our currently changing climate, economy and society, it behooves us to include our understanding of ecological processes in future management decisions where possible.

There are many currently available models that can potentially serve that purpose for a number of different applications (e.g., plant growth, fire hazard, snow melt).

In order to properly test and parameterize these models in western landscapes, which tend to be very extensive, spatially extensive data describing those landscapes is required. This is an area that remote sensing would appear to be perfectly suited.

It is critical that the remote sensing data goes beyond the "pretty picture" stage and provide quantitative information. That is, making quantitative linkages between remote sensing data actual conditions on the ground.

We have been working at applications of remote sensing related to vegetation type, leaf are index, soil water content, frozen soil extent, snow cover, riparian vegetation and vegetation height and density.

Some of this work is described below.

Vegetation State—some intermountain plant communities

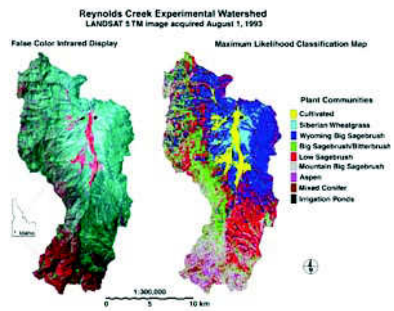
Knowledge of the plant community distribution and extent is critical for management in terms of prescribed fire and optimal grazing intensity. Ground surveys are time consuming and limited by access. Here we used landsat imagery to describe the distribution of critical intermountain plant communities.

Mixed sagebrsuh and Bitterbrush, found mostly on the western side of the RCEW on soils formed from granite.

Crested wheatgrass in the valley, planted after a recent fire.

Mounatin sagebrush in the foreground, mixed forest in the back. View is typical of higher elevations.

Wyoming Sagebrsuh found extensively in the Intermountain region and at lower elevarions in the RCEW

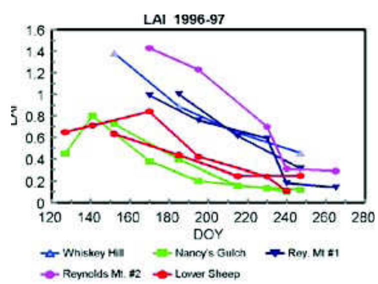


The overall accuracy of the vegetation type classification we achieved was 83.8% with a 95% confidence interval of +/- 4.85%.

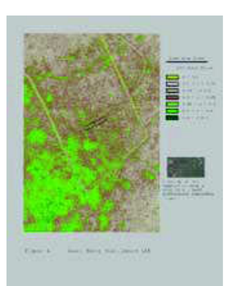
Leaf Area Index

Leaf area index (LAI) is often used in the simulation of plant growth, soil water utilization and overall energy and carbon balance. Actual ground measurements of LAI are small-scale and labor intensive. It's very difficult to relate directly measured data with remotely sensed data due to this scale mismatch. We used high resolution aerial data (0.3 m and 3.0 m) to relate remote sensing and ground data. The goal is to have more specific data to use for large scales, such as the landsat image shown below.

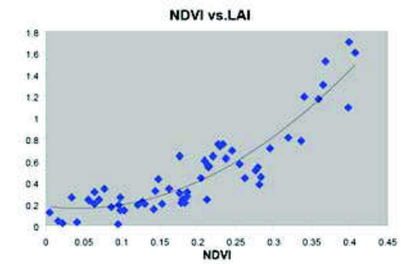
Measuring LAI by point frame at the RCEW



Seasnal variation in LAI measured at different sites in the RCEW



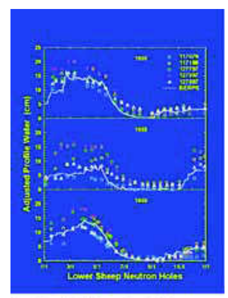
Distribution of LAI in the Lower Sheep Creek subwatershed derived from remotely sensed data. Pixel size is 3 m. Small rectangle indicates the ground vegetation monitoring plot.



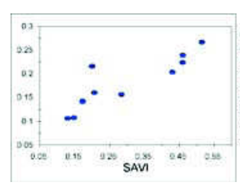
Relationship between NDVI and LAI based on 0.3 m resolution aerial data and ground measurements at four sites in the RCEW.

Simulation

Simulation of relative production, or T/PET, is based on soil water dynamics, indicates a high degree of consistency between the 30 m landsat scale and basic soil information used for model parameterization.



Simulation of soil water content at three nearby locations illustrates the spatial and temporal variability of soil water content and general agreement between simulated and modeled values.



Combined field measurements and simulations indicate that SAVI is reasonably well correlated with the average T/PET for a range of sites within the RCEW. The sites simulated do not include those that receive significant subsurface lateral flow, such as in riparian zones.

References

Clark, P., M.S. Seyfried, and R.Harris. Intermountain Plant Community Mapping Using Landsat TM and SPOT HRV Data. Journal of Range Management 54:152-160. 2001.

Crosby, G. S., Neale, C. M. U., Seyfried, M. S., and Tarboton, D., Remote sensing inputs and a GIS interface for distributed hydrologic modelling, In Remote Sensing and Hydrology 2000 Proceedings of a symposium held at Santa Fe, New Mexico, USA, April 2000
Edited by Manfried Owe, Kaye Brubaker, Jerry Ritchie, Albert Rango IAHS Publ. no. 267, p. 421 – 426 2001.

Seyfried, M.S. 2003. Incorporation of remote sensing data in an upscaled soil water model. Pachepsky, Y., Radcliffe, D.E., Selim, H.M. editors. CRC Press, New York, NY. Scaling Methods in Soil Physics. 2003. p. 309-346.

POSTER NUMBER 5