

# Comparing Water Use in Semi-arid Montane Aspen, Conifer, Sage and Grass/Forb Ecosystem



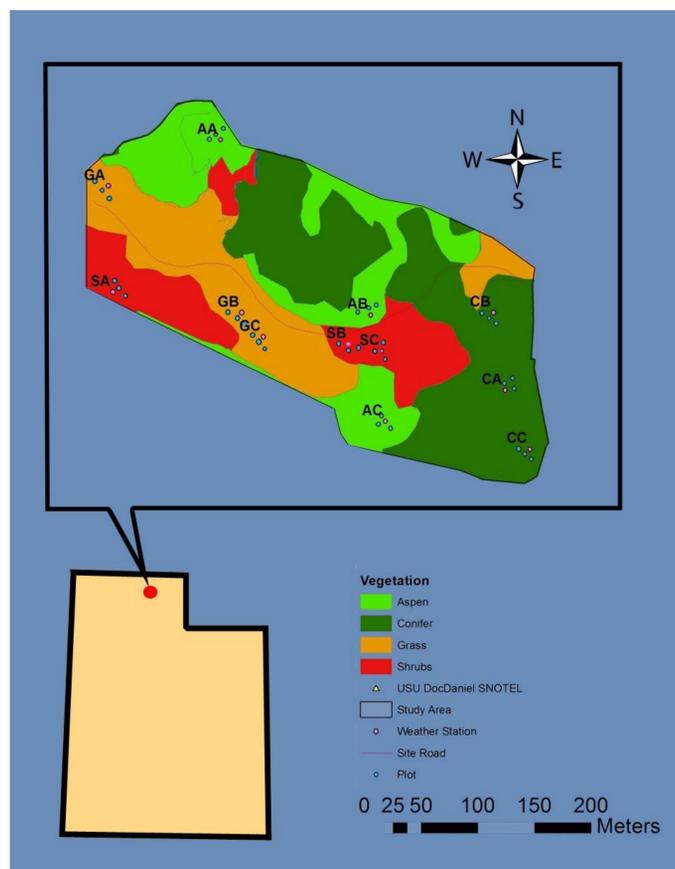
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## Introduction

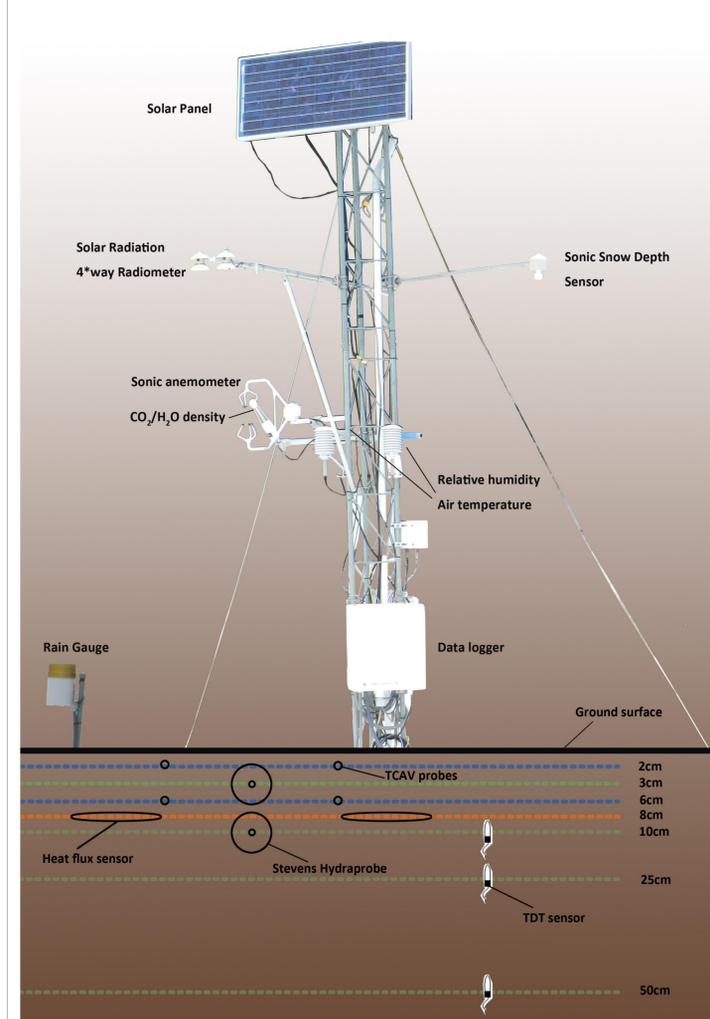
A portion of the T.W. Daniel Experimental Forest (TWDEF) has been instrumented for monitoring weather and environmental conditions. These data provide detailed climatic variables at 2600 m elevation. Soil water content measurements were used to model evaporation, transpiration and ET in four common semi-arid montane vegetation types (Aspen, Conifer, Grass/Forb and Sagebrush) during the 2010 growing season.

## Study area



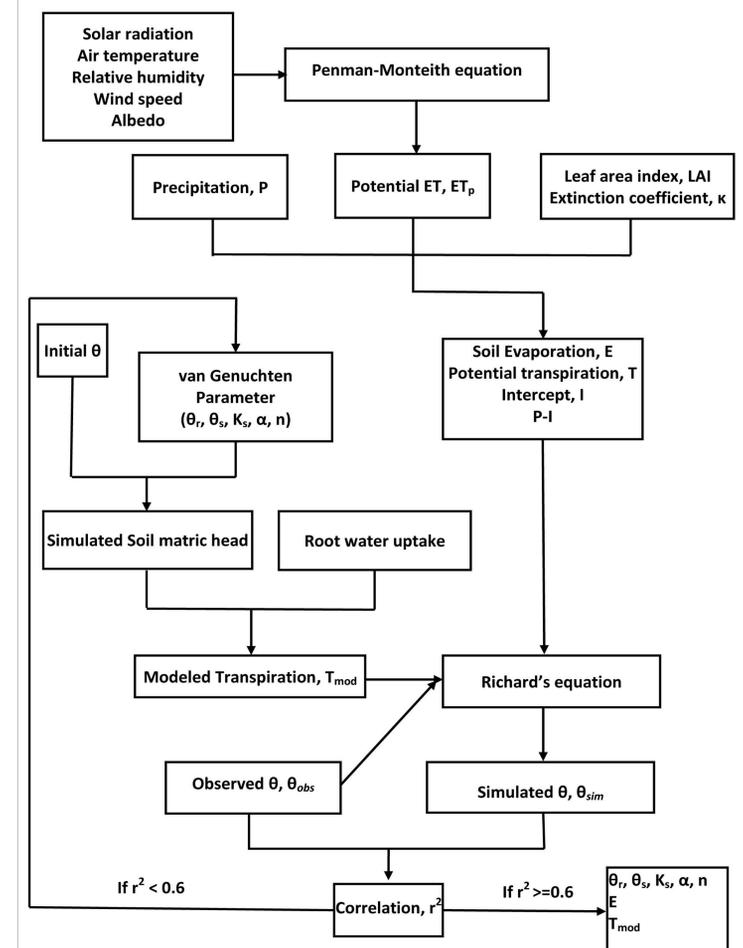
TWDEF experimental plot layout. TWDEF located at the Bear River Range of the Wasatch Cache National Forest in Northern Utah, USA (41.86° N, 111.50° W), with an area of 8 ha and an elevation more than 2600 m. Climate is typical of the montane semi-arid intermountain west with a mid-growing season mean temperature of 14.4 °C.

## Environmental variable measurements



The meteorological tower, soil heat flux and soil moisture measurements at the TWDEF. Three plots for each type of vegetation and 3 subplots (5m×5m) within each plot were established at TWDEF. The meteorological towers are installed in a plot of each vegetation type. Soil moisture is collected within each subplot. The data are collected with several types of data loggers (CR1000/CR10X data loggers, Campbell Scientific, Logan, UT).

## Method and Data analysis

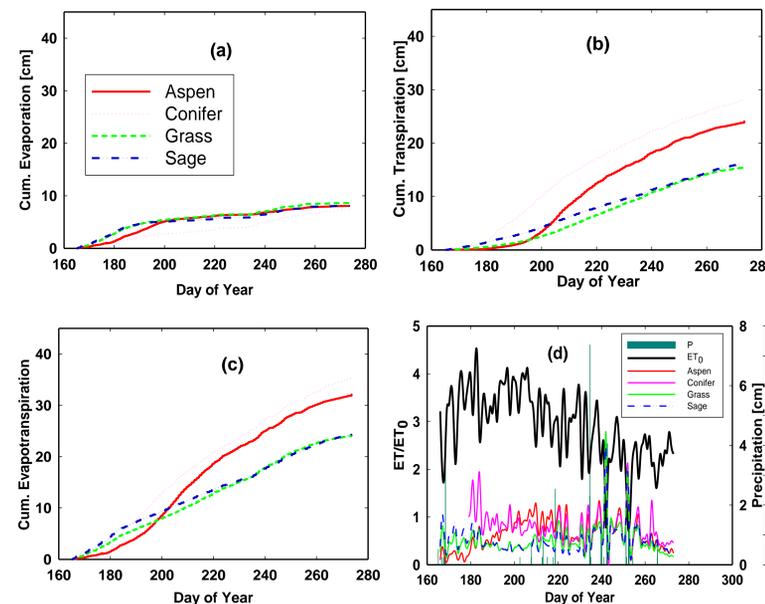


The illustration of the numerical model's (HYDRUS-1D) input, output and major processes. Parameters  $P$ ,  $ET_p$  and  $I$  were time-dependent upper boundary conditions (BC). The bottom BC (at 2 m soil depth) was free drainage. Initial  $\theta$  was from observation data. LAI of conifer is measured using a Line Quantum Meter (MQ-301, Apogee), other vegetation was modeled using a logistic growth function (Yu et al., 2010; Barr et al., 2004). The normalized root density distribution was interpreted from soil pedon surveys (Boettinger and Lawley, 2004). This study was arranged in a completely randomized design. The PROC MIX (Ver. 9.3, SAS Inc. Raleigh, NC, USA) was used to analyze the effect of vegetation and clay content on evaporation, transpiration and ET data.

## Results

Vegetation	Snow melt date	Growing days [d]	E [cm]	T [cm]	ET [cm]
Aspen	14Jun2010	108	7.96 a	24.02 a	31.93 a
Conifer	26Jun2010	96	7.23 a	28.36 a	35.42 a
Grass/forb	14Jun2010	108	8.63 a	13.98 b	22.73 b
Sage	14Jun2010	108	7.76 a	16.12 b	23.93 b

The mean evaporation (E), transpiration (T) and ET during the growing period of 2010 were compared among vegetation types. Evaporation and transpiration simulations began from the end of snow melt in the Spring of 2010. Conifer may transpire earlier in the spring (LaMalfa and Ryel, 2008) but rates are considerably lower than after snow melt due to reduced soil temperatures.



The figure (a), (b) and (c) showed the cumulative evaporation, transpiration and ET during the 2010 growing season.

The figure (d) plotted the vegetation stress coefficient (ET/ET<sub>0</sub>), precipitation (P), and reference ET (ET<sub>0</sub>) of the 2010 growing season.

## Summary and Conclusions

- The HYDRUS-1D model provides an advanced simulation approach for estimating ET referencing direct soil moisture measurements.
- Transpiration and ET revealed significant differences between trees and Grass/forb and sage ecosystems.
- Vegetation showed correlations with clay content where conifer and grass occurred in limited clay content range.
- Evaporation rates showed no significant difference

## References and Acknowledgement

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