SATELLITE SNOWCOVER PERSPECTIVE ON THE DROUGHT: COLORADO AND RIO GRANDE BASINS

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EXTENDED ABSTRACT

Estimating snowcover properties at a basin scale, particularly snow water equivalent (SWE), remains a challenge. We have used a combination of remote sensing and ground-based data to estimate snow covered area (SCA) and SWE for portions of the Southwestern U.S. for an eight-year period, 1995-2002. Two immediate applications for this product were to: i) evaluate the seasonal and interannual variability in snowcover patterns, and ii) provide snowpack information for evaluating hydrologic models of snowmelt runoff and other components of the water balance. Fractional snow covered area (SCA) maps with a 1-km^2 grid were developed from AVHRR scenes using a three-part cloud masking procedure and spectral unmixing algorithm (Figure 1 & 2). A 1-km^2 SWE product was developed for the same area using interpolation of ground-based SNOTEL data, followed by masking with the SCA scenes (Figure 1). The fractional SCA product showed areas with persistent snowcover to be relatively reproducible from year to year, corresponding to higher elevations (Figure 3). However, there were different January through June patterns of snowcover persistence during recent drought years as compared to previous years (Figure 3-4). The annual maximum snow extent, or area with any snowcover during the year, exhibited significant interannual variability, and was not well correlated with maximum SWE (Figure 5). The current products are available on a set of CD's (see http://resac.hwr.arizona.edu).

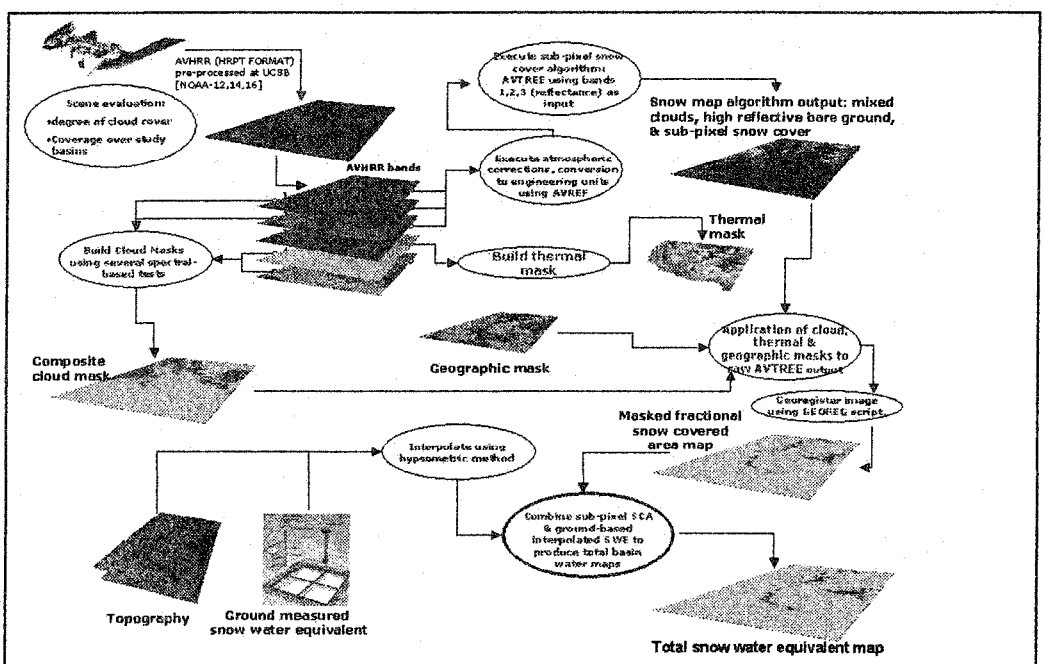

Figure 1. Snowcover mapping procedure. AVHRR satellite images were processed to estimate fraction SCA per pixel, based on snow versus no-snow end members. Images were then masked to remove cloud-covered areas, as well as lower-elevation areas mapped as snow. Bottom part illustrates addition of SWE product, which is an interpolation of ground-based SNOTEL data, masked with the SCA product.

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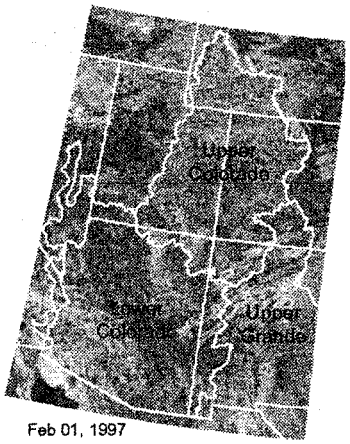

Figure 2. Area mapped includes all of the Colorado River basin, and the Upper Rio Grande basin. Image is gray scale of AAVHRR false-color composite.

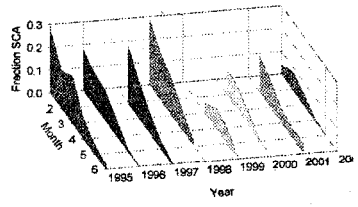

Figure 4. Basin-average SCA for Upper Rio Grande. Note lower SCA in 1999-2002 versus 1995-1998.

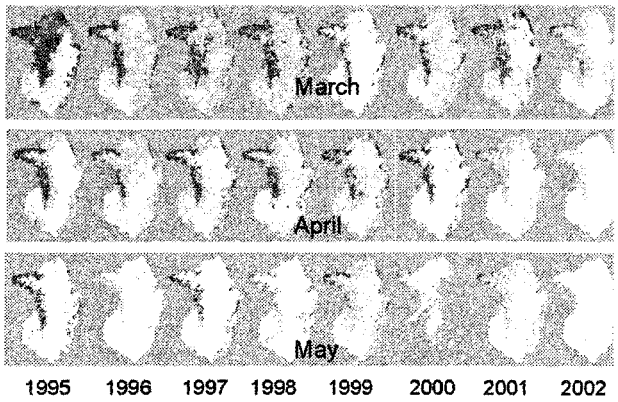

Figure 3. March-May snow-covered area for Upper Rio Grande. Dark shades indicate greater SCA.

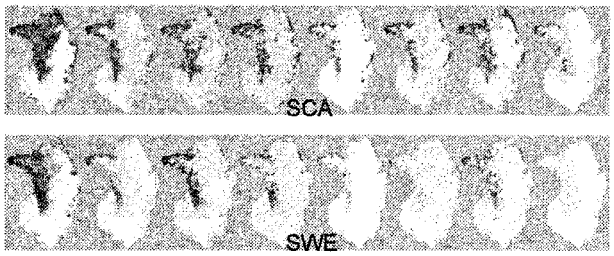

Figure 5. Comparison of snow covered area versus snow water equivalent for Upper Rio Grande. SCA peaks earlier in the season than SWE.