



MODIS Collection-5 Snow Products and Ongoing Projects

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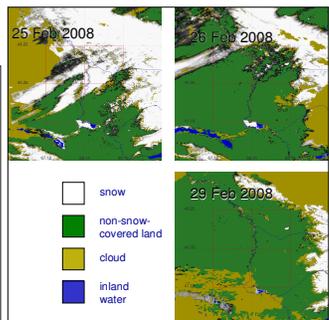
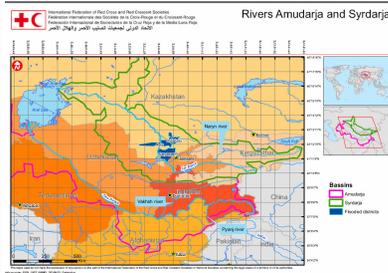
Introduction

Research and snow product enhancements are ongoing. Work-in-progress and some Collection-5 enhancements of the snow products are described in the various panels. Data-product enhancements include a monthly average snow-cover product, MOD10CM (Riggs et al., 2006), and fractional-snow cover in the daily snow products (Salomonson & Appel, 2006). A major effort has been the blending of the MODIS, AMSR-E and QuikSCAT snow products to provide a 5-km resolution product that is unaffected by cloudcover; this work is being done in collaboration with the Air Force Weather Agency. A MODIS cloud-free product is also under development. And research into the improved snow/cloud discrimination continues using an image segmentation approach. Additionally, preliminary attempts at using the MODIS snow products in data assimilation are presented.

Flood event in Uzbekistan and Tajikistan as seen with the blended MODIS-AMSR-E snow-cover product

D.K. Hall, N.E. DiGirolamo, G.A. Riggs & J.L. Foster

Using the combined snow-cover, snow-water equivalent (SWE) product developed by GSFC for the Air Force Weather Agency (AFWA) using MODIS and AMSR-E snow products (Hall et al., 2006; Foster et al., 2007), it is possible to monitor a flooding event that took place in Uzbekistan and Tajikistan in late February 2008. The AMSR-E data product shows ~30 cm SWE on 25 February, 2008 right before the rapid snowmelt and floods began. The images to the right show extensive snow cover on Feb. 25th, followed by rapid melting on the 26th, as evidenced by the fact that there was no snow cover on the next cloud-free day (February 29th).

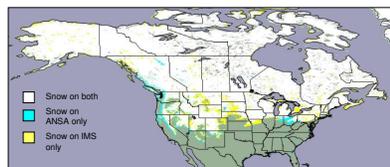


MOD10A1 daily snow-cover images showing the rapid melting of snow led to major local flooding events.

Cloud-Cleared MODIS Snow Product

D.K. Hall, G.A. Riggs & J.L. Foster

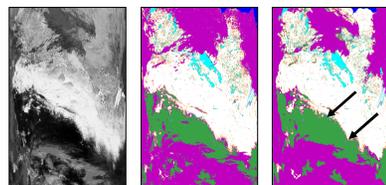
Work is ongoing to validate a MODIS cloud-cleared data product developed by the MODIS Snow and Ice Project. The images below represent difference maps of the MODIS-AMSR-E blended product (using the cloud-cleared MODIS product) and the NOAA IMS snow product for 2-18-08. Preliminary comparisons with the IMS product are providing promising results; work is continuing.



Reduction of the "Cloud Fringing" Effect utilizing Image Segmentation

J.C. Tilton, D.K. Hall & G.A. Riggs

The MOD35 cloud mask was modified by replacing it with the "majority vote" for each NDSI region (Cloud Obscured vs. Clear). The "cloud fringing" effect is largely eliminated in the center of the snow-cover map (see arrows). In addition, an apparently more appropriate "snow-cover labeling" is produced in the upper right portion of the modified snow cover map. Also see Tilton et al. (2006).



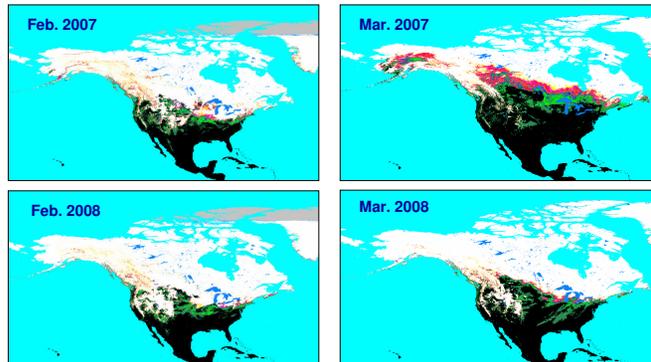
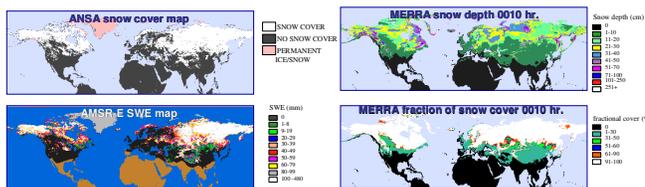
Left - NDSI image; Center - MOD10A1; Right - modified snow-cover map.

Initial Evaluation of Model Assimilated and Satellite Observed Snow Cover Data Products

G.A. Riggs, M. Bosilovich & D.K. Hall

The joint Air Force Weather Agency and NASA (ANSA) daily snow-cover product, generated by blending the MODIS daily global snow and the AMSR-E daily SWE products, is compared to NASA's Modern Era Retrospective-analysis for Research and Applications (MERRA). MERRA is a reanalysis for the satellite era using a new version of the Goddard Earth Observing System Data Assimilation System Version 5 (GEOS-5). MERRA/GEOS does not assimilate snow observations; model physics determine if snow is produced.

Preliminary comparison of the ANSA and MERRA maps of snow cover shows a general similarity in snow-cover extent in regions of deep, nearly-continuous snow cover. However, MERRA appears to overestimate snow extent and volume compared to the ANSA product when snow cover is sparse or shallow and at the lower snow-cover fractions. Further evaluation is ongoing.



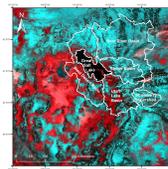
Monthly average snow cover, MOD10CM, is a new Collection-5 product. White represents 90-100% snow cover, and the various colors represent fractions of snow cover; inland water is blue. February and March 2007 (top row) and 2008 (bottom row) are shown. Note the increased amount of snow coverage in 2008 as compared to 2007. It is especially noticeable because of the lower snow-cover fractions in 2007 as compared to 2008; snow cover was much more extensive in the western United States in the winter and spring of 2008.

Examination of Snow Mapping Methods over the Weber River Basin, Utah using MODIS Observations

J.Y. Han & V.V. Salomonson

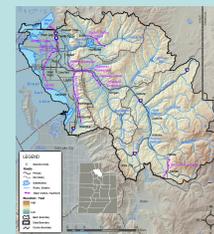
Various methods to derive fractional-snow cover (FSC) in the Weber River Basin (a sub-basin within the Great Salt Lake Basin drainage area) are compared: MOD10A1 & MOD10A2, and two FSC methods. The fractional snow cover methods examined are a linear regression approach (Salomonson and Appel, 2006) and a spectral unmixing approach using the ENVI package. Terra ASTER observations were used for ground-truth/validation. In addition, preliminary comparisons were made with MODSCAG results (Painter, et al., 2003). All the methods track the temporal variation of snow cover rather well, however, the MOD10A2 consistently shows the most snow cover and the spectral unmixing approach shows the least. Research is continuing to understand the basic reasons for the differences, and the utility of MODIS snow cover mapping for improving basin runoff predictions.

Great Salt Lake Basin



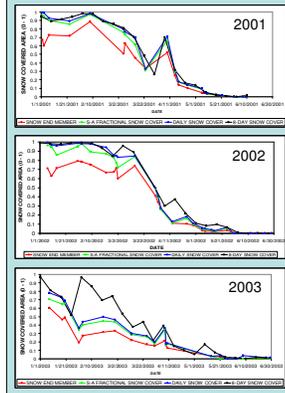
A Terra MODIS image using C5 MOD09GHK (R: band 6, G: band 4, and B: band 1, 01/23/2003) showing the sub-basin names. MOD09GHK = MODIS/Terra Surface Reflectance Daily L2G Global 500m SIN Grid <http://edodac.usgs.gov/modis/mod09ghk4.asp>

Weber Basin



http://www.water.utah.gov/planning/SWP/Weber_riv/Chp-01A.pdf

Snow Coverage



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