INTEGRATION OF THE MODIS SNOW COVER PRODUCTS INTO SNOWMELT RUNOFF MODELING

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ABSTRACT

Use of recently developed satellite snow covered area (SCA) products as quantitative inputs to hydrologic models require resolution of temporal noise, introduced owing to varying satellite viewing angles. For MODIS , a NASA space-borne scanning radiometer, which receives the electromagnetic radiation reflected or emitted by the earth and atmosphere, requires a multiple endmember spectral mixture analysis model, inverting MODIS surface reflectance products (MOD09) for enhanced fractional snow cover, plus the grain size and albedo of the fractional snow cover. However, to accurately incorporate SCA into snowmelt runoff models requires the resolution of a temporal inconsistent fractional snowcover product. Inconsistencies in the MODIS fractional SCA product results from daily differences in the local sensor view angle which ranges between 0-65 degrees. These daily differences in the radiometer scan angle can result in a 30% occlusion of snowcover over forest covered areas, and a proportional variation in SCA estimates. Results are presented that resolve the temporal inconsistencies from the forest occlusion of snowcover by using empirical corrections based on forest canopy densities. The empirical corrections result in a temporal consistent fractional SCA product for development of a composite spatial map that blends the MODIS fractional SCA product with interpolated snow water equivalence (SWE). This tool, the MODIS Snow Covered Area and Grain Size/Albedo (MODSCAG) model, specifically provides an accurate estimate of snowcover and albedo for regional studies in mountainous areas.

PRESENTATION EXTRACTS

Slide 1: Title and outline:

- Overview of the MODIS snow product
- Analysis of Sierra Nevada snowcover by basin
- Development of SWE product by basin
- Ground-based instruments
- Conclusions and research directions

Slide 2: MODSCAG: MODIS Snow Covered Area and Grain size

- Based on MEMSCAG (Multiple Endmember Snow-Covered Area and Grain Size), Painter et al., 2003, RSE

Slide 4: Directional Effects

- MODIS has 55° scan angle
- Directional effects
  - –Pixel size (bowtie) at scan edge
  - –Forest occlusion of snow cover
  - –Directional reflectance

Slide 28: Estimating SWE (Range and Basin Volume Maps)

- Interpolation of ground based SWE:
  - Snow pillow (daily) and snow course (monthly)
- Hypsometric method with inverse weighted distance interpolation of the residuals (detrended inverse weighted distance technique) using a grid resolution of 500m
  - Search radius 50km and 100km
- Described by Fassnacht et al., 2003, Water Resources Research

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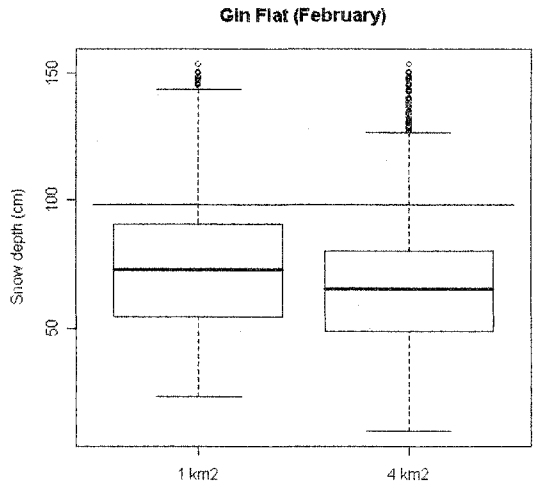
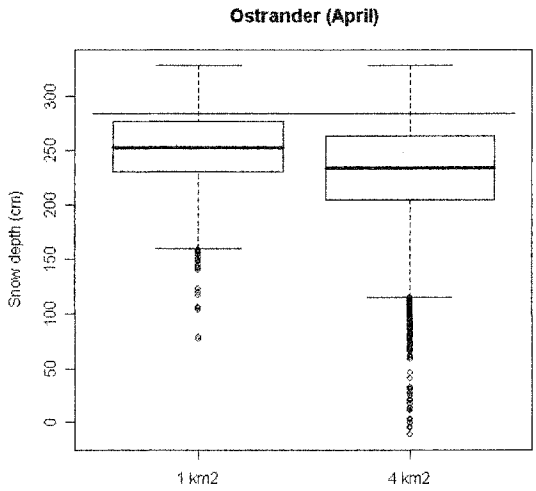
Slide 38: SWE measurement problem:

- Snow pillow & snow course measurements provide limited information on spatial distribution patterns.
- Sites are not representative of the terrain & thus fail to represent basin-wide snow depth or water equivalent. (Yosemite National Park Snow Survey, 2006)





Slide 40: Conclusions and Research Direction

- Accurate estimates of SCA requires: empirical corrections based on vegetation cover, elevation, aspect.....
- A quality blended SWE/SCA basin product requires improved knowledge of snow distribution patterns for scaling from the point to the basin.

Slide 41: Acknowledgements:

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