ESTIMATION OF SNOW COVER BY APPLICATION OF A TWO LAYERED MODEL OF ACCUMULATION AND SNOWMELT IN THE SIERRA NEVADA NATURAL PARK

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INTRODUCTION AND OBJECTIVES

Snow and melting in Sierra Nevada

Background:
Physically-based Snowmelt Model (Herrero et al., 2009)

Equations of mass and energy balance

Single layer with homogeneous characteristics

Point Snowmelt Model
(Refugio Poqueira)

Distributed Snowmelt Model
(Southern slope Sierra Nevada)

STUDY SITE DESCRIPTION

Sierra Nevada

- Located in South-Eastern Spain; with mean latitude of 37 N and stretching from 2000 km.
- The highest mountain peaks in the Iberian Peninsula (3480 m), at only 40 km from the coast.
- Semi-arid Mediterranean environment with an important variability (e.g. precipitation and temperature) in short periods of time.

METHODS

Inputs:
Topographic information
Meteorological variables
Surface Information

Interpolation meteorological variables

Point single layer Snowmelt Model

Distributed Snowmelt Model

Two-layered model

Point single-layer Snowmelt Model

Distributed Snowmelt Model

Measured Snow

Simulated Snow fields

RESULTS

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The evaluation of the simulation fit degree with respect to measured values (SWE) is confirmed by mean error e, absolute mean error e, and root mean square error R.e.

25/03/2009: the simulated snow water equivalent (SWE) over the whole NPSN was 5.08 hm3. As the evaporation simulated with the point single layer model was 4% higher than the obtained with the point two-layered, the simulation of the SWE for the whole study site with the two-layered model, was approximated to 5.28 hm3.

CONCLUSIONS

- The application of the model in the whole area of the Natural Park of Sierra Nevada allowed the estimation with a sufficient approximation of the surface occupied by accumulated snow, with 96%, 93.6% and 96.6% of cells with snow correctly simulated for the two simulation periods studied, and a certain overestimation in the total area simulated due to the imbalance between the passage of time of the calculation and the time at which the satellite image was taken, the advective transport associated with the wind, not included in the model, and the calculation error inherent to the calibration.
- At a point scale the two-layered model sufficiently reproduces the snow melting cycles, with a mean error of -1.08 mm and -3.94 mm, opposite to -13.63 mm mm -4.08 mm obtained by single layer model, for the period 2004-2005 y 2006-2007 respectively.
- Evaporation is estimated as a very significant fraction of the snowfall, with values reaching 39% for the period 2004-2005, 44.5% for the period 2005-2006 and 20.5% for the period 2006-2007. These values are very similar than the obtained values with the one layer model; 41.56%, 48.82% and 20.9% respectively.