COMPARISON OF THE SNTHERM MODEL WITH EXPERIMENTAL MEASUREMENTS

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1. INTRODUCTION

Snow is a key element in the meteorological and hydrological studies, as the amount of snow can affect the climate change and runoff and flood. The snow could be well understood by assimilating snow process model with remote sensing model. So it makes great importance to do sensitive analysis for the snow process model which predicts snow water equivalent and the snow properties, and compare the snow model with the experimental measurements before it's assimilated with the parameterized snow microwave emission model. The objective of this paper was to conduct sensitive analysis of snow properties to meteorological forcing data and evaluate the predicting ability of the SNTHERM model using the field measurements at the Local Scale Observation Site (LSOS) of the Cold Land Process Field Experiment (CLPX) in Colorado, USA and Binggou basin in Gansu province, China.

2. MODEL

SNTHERM is a multi-layered, one-dimensional energy and water balance point model designed to predict temperature profiles within strata of snow and frozen soil at non-forested sites. It is intended for seasonal snow covers and addresses conditions found throughout the winter, from initial ground freezing in the fall to snow ablation in the spring [1]. Many studies have tested the capacity of the SNTHERM model to simulates snow depth and other snow properties at diverse locations and under varying conditions, including using the CLPX data [2] [3][4].

3. FIELD DATA

The forcing micrometeorological time series data from December 13th, 2002 to March 11th, 2003 selected from the GBMR dataset at the Local Scale Observation Site (LSOS) of the Cold Land Process Field Experiment (CLPX) in Colorado, USA, are used to compare the predictions of SNTHERM with the observed data selected from snow pit data [5][6]. The missing data are replaced by the mean data in the former and latter one. The consecutive missing data are estimated according to the time and data around them through arithmetic progression method. Another data set is acquired from the Binggou basin, which is a 30km2 watershed in Gansu province, China. The forcing data for Binggou range from December 6th, 2007 to March 31th, 2008. The density and water content in the snow were measured using the Snow Fork instrument.

4. RESULT

Firstly, sensitive analysis of density, grain size, snow depth and surface temperature and average temperature of the snow to the meteorological data and albedo were carried out by changing the forcing data with its range of ±10%. It is indicated that snow depth and snow density are more sensitive to air temperature, albedo and the incident long wave radiation. Grain size is sensitive to air temperature and albedo. Snow surface temperature is sensitive to the incident long radiation. When the albedo decreased from 0.78 to 0.65, the snow depth is also decreased by 26.77%. The snow depth decreased as the incident long radiation and temperature increased. The density is very sensitive to the temperature, as even a 5% increase in temperature can cause a 65.49% increase in snow density. An alteration of incident long radiation by 10% increased a 22.61% increase in estimated snow density. The density increases by 28.26% if the albedo of 0.65 is substitute for 0.78. By comparison, the snow depth and density are less sensitive to the solar radiation. When the varying range of the incident solar radiation is up to 20%, the snow depth and density change only by 6.82 % and 3.07% respectively.

The test of SNTHERM using the snow pits data over LSOS shows that the modeled surface temperature and average temperature of the snow matched the measurements well, while there was discrepancy in comparison of the measurements of grain size, snow depth and density. The model underestimated the density and snow depth during the accumulation period, while overestimated the density and snow depth during melt period. Meanwhile, the validation of SNTHERM using Binggou field data indicated that the melt time in the model was earlier, and the melt rate seemed high over the Binggou basin. Therefore, it underestimated the snow depth in Binggou basin, China.

5. CONCLUSION

Snow depth and snow density are most sensitive to air temperature, albedo and incident long radiation. Grain size is sensitive to air temperature and albedo. Snow surface temperature is sensitive to the incident long radiation .The SNTHERM simulates temperature of the snow well, but not very well when it comes to snow depth and density.

6. REFERENCES

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