Improving snow cover modeling in UFS/Noah-MP land



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Snow cover bias in Noah-MP



Snow cover bias in Noah-MP



UIFCW2

A UES Collaboration Powered by

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Surface albedo bias in Noah-MP



He et al., 2019

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Snow albedo feedback connecting various model



Enhancing snow cover parameterization across scales

$$f_{sno} = \tanh\left(\frac{h_{sno}}{2.5z_{0g}(\rho_{sno}/\rho_{new})^m}\right)$$

Use observations to constrain and optimize the snow cover formulation parameters: Snow melting factor: "m" Snow cover prefactor: " $2.5z_{oa}$ " = SCFFAC

Observations: 500-m MODSCAG snow cover data 1-km SNODAS snow depth and density data

1 km 3 km 100 50°N 100 50°N 90 90 80 70 45°N 45°N 60 SCF (%) 50 50 40 40 40°N 40°N 30 30 20 20 10 10 35°N 35°N 125°W 120°W 115°W 110°W 105°W 125°W 120°W 115°W 110°W 105°W Lonaitude Lonaitude 13 km 25 km 50°N 100 50°N 100 90 80 70 45°N 45°N 60 60 _atitude (%) 50 50 40 40°N 40°N 30 30 20 20 10 500 km 500 km 35°N 35°N 120°W 125°W 115°W 110°W 105°W 125°W 120°W 115°W 110°V 105°W Lonaitude Lonaitude

MODSCAG: Mean Winter SCF (Jan-March, 2015)

Reduced snow cover bias from optimized parameterization

mixed forest(SCFAC=0.040) 0.08 default bias = 0.39 (0.13, 0.66) default params optimized params optimized bias = -0.02 (-0.15, 0.10) 0.07 0.06 € 0.05 liqued 0.04 d 0.03 0.02 0.01 n -0.5 0 0.5 -1 SCF bias (model - MODSCAG)

25km



13km

3km

default bias = 0.30 (0.07, 0.52)

-0.5

0.03

0.02

0.01

-1

optimized bias = -0.01 (-0.18, 0.16)

mixed forest(SCFAC=0.060)

default params

0.5

optimized params

1km









0

SCF bias (model - MODSCAG)





Scale dependence of snow cover parameterization

Low density example (density = 200 kg/m3)





Remaining challenges

Discern a pattern between optimal parameters and spatial scale across vegetation classes



On-going work

- Find a solution to allow the optimized snow cover parameters to be applied across scales
- Assess the suitability of current SCF scheme is suitable for high-res modeling (the scheme was originally developed at a 1-degree resolution), and the need for a more complex parameterization to account for other land surface and met conditions (e.g., aspect, wind speed, radiation, topographic complexity).
- Assessing regional offline Noah-MP simulations with the enhanced snow cover parameters
- Testing coupled UFS/Noah-MP performance with the enhanced snow cover parameters



Thank you!

If you are interested in our work, please email me: cenlinhe@ucar.edu

