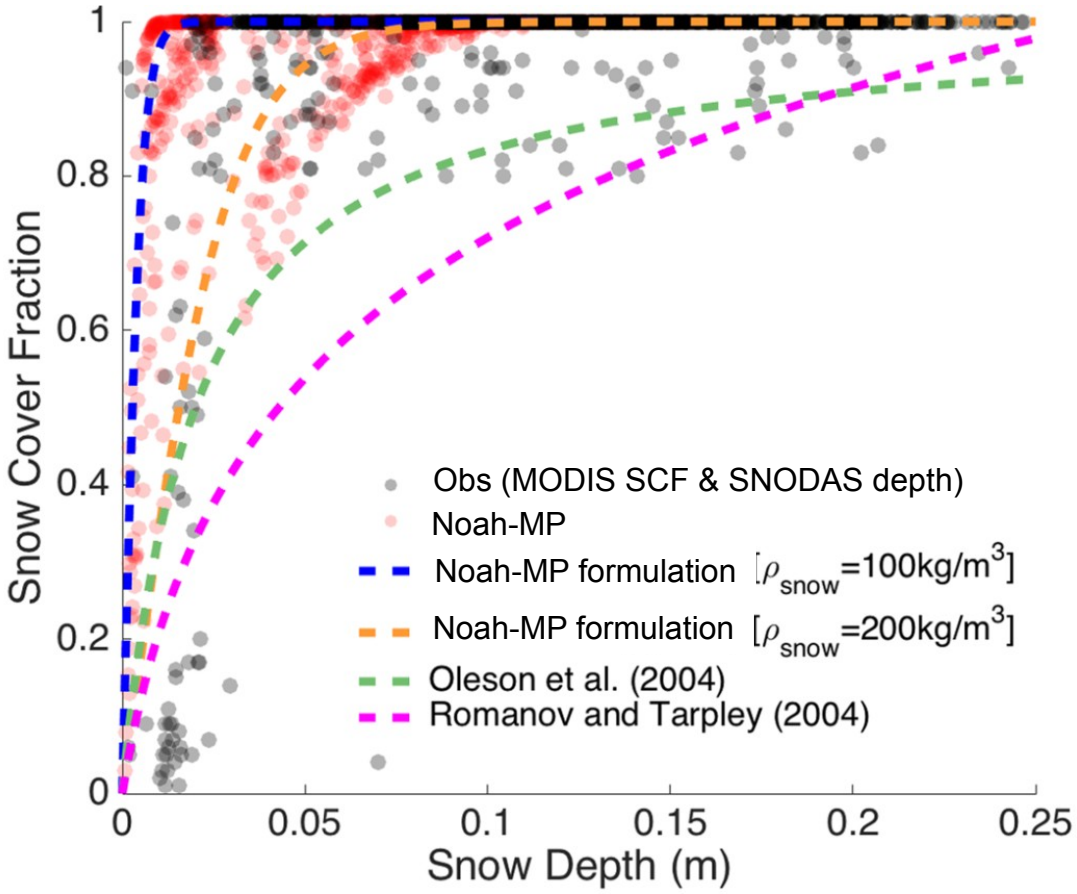
Improving snow cover modeling in UFS/Noah-MP land

Cenlin He (NCAR)

Ronnie Abolafia-Rosenzweig (NCAR), Fei Chen (NCAR), Michael Barlage (NOAA/EMC)

UIFCW 2023
A UFS Collaboration Powered by EPIC

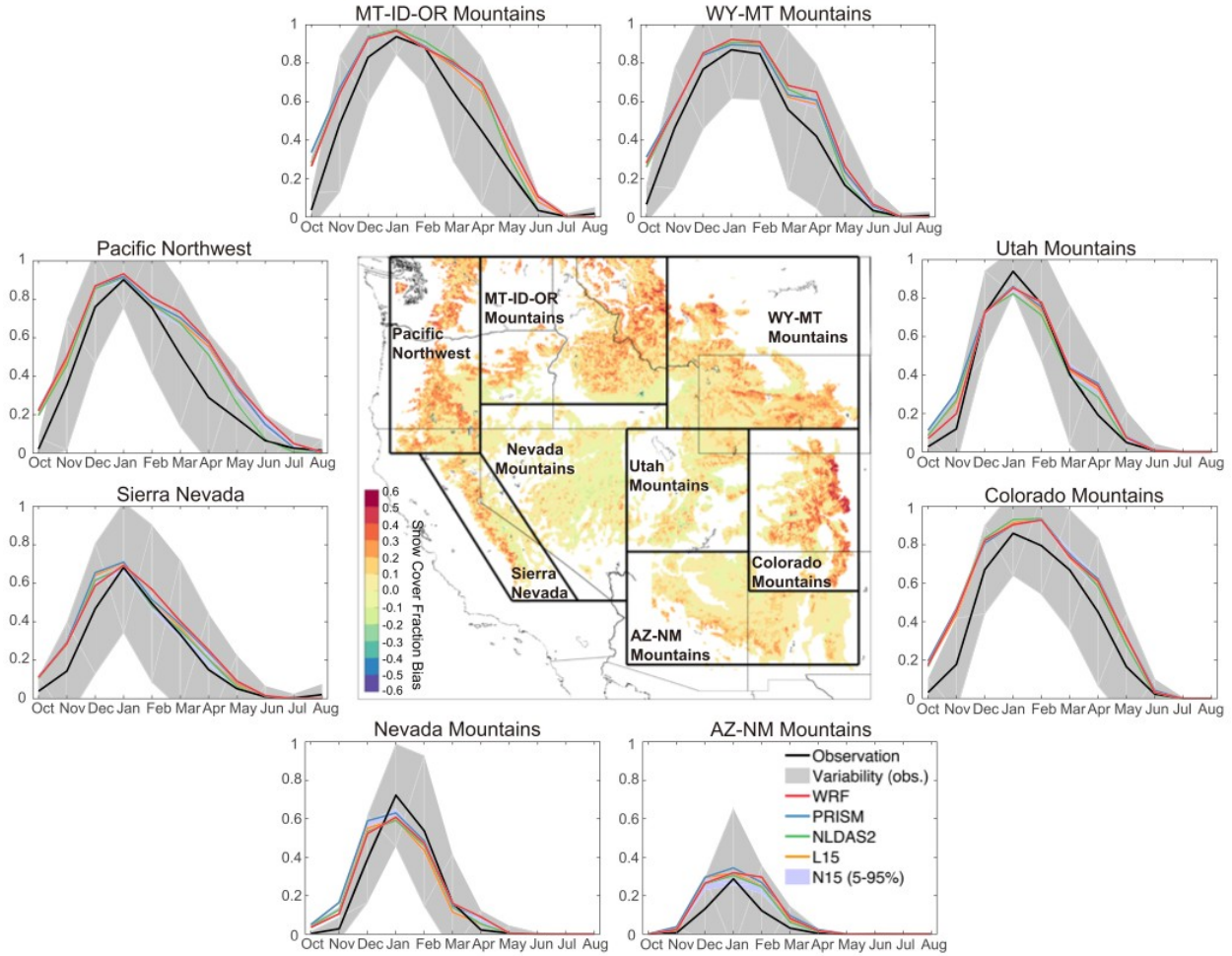
Snow cover bias in Noah-MP



Samples over bare ground (no vegetation)

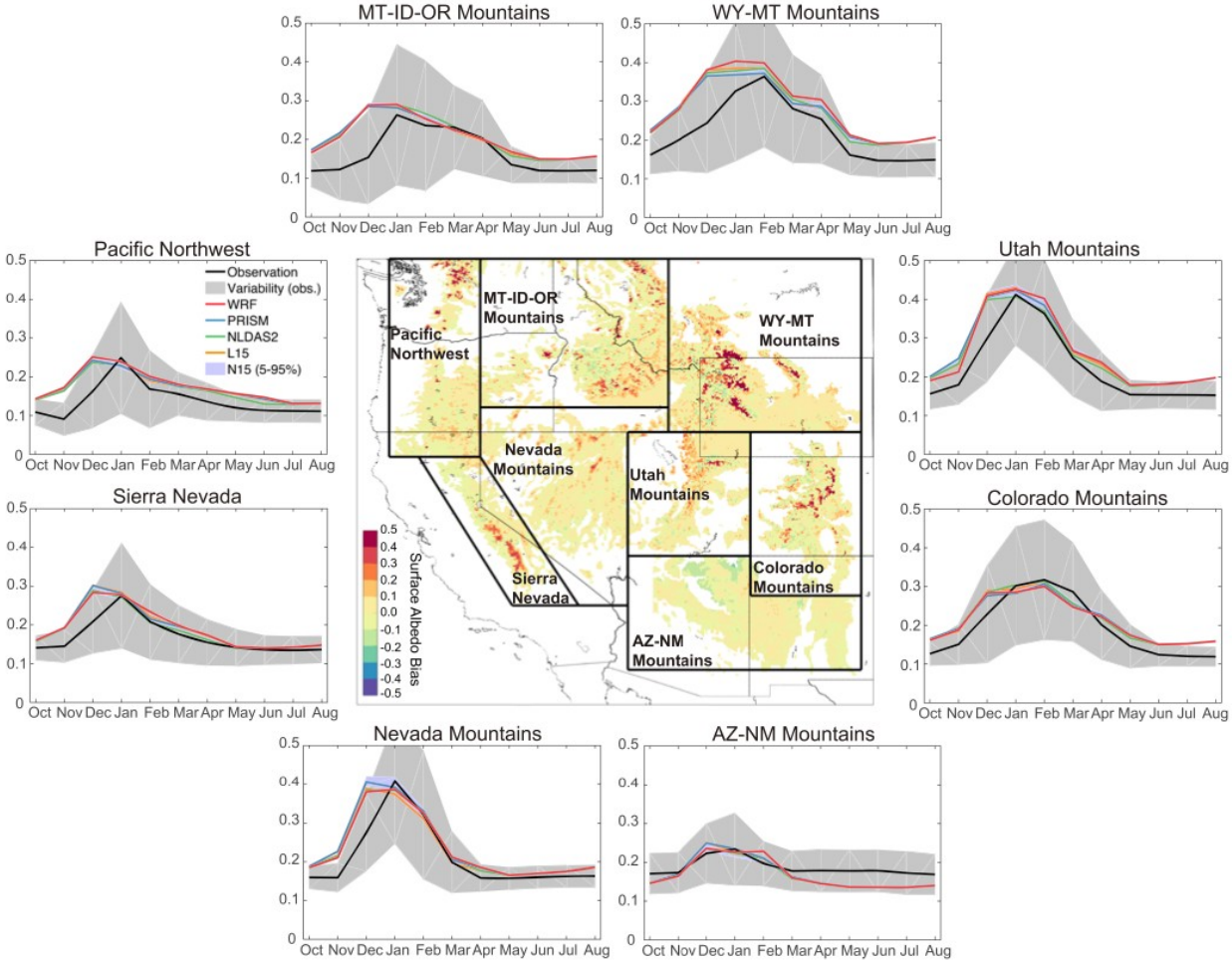
He et al., 2019

Snow cover bias in Noah-MP



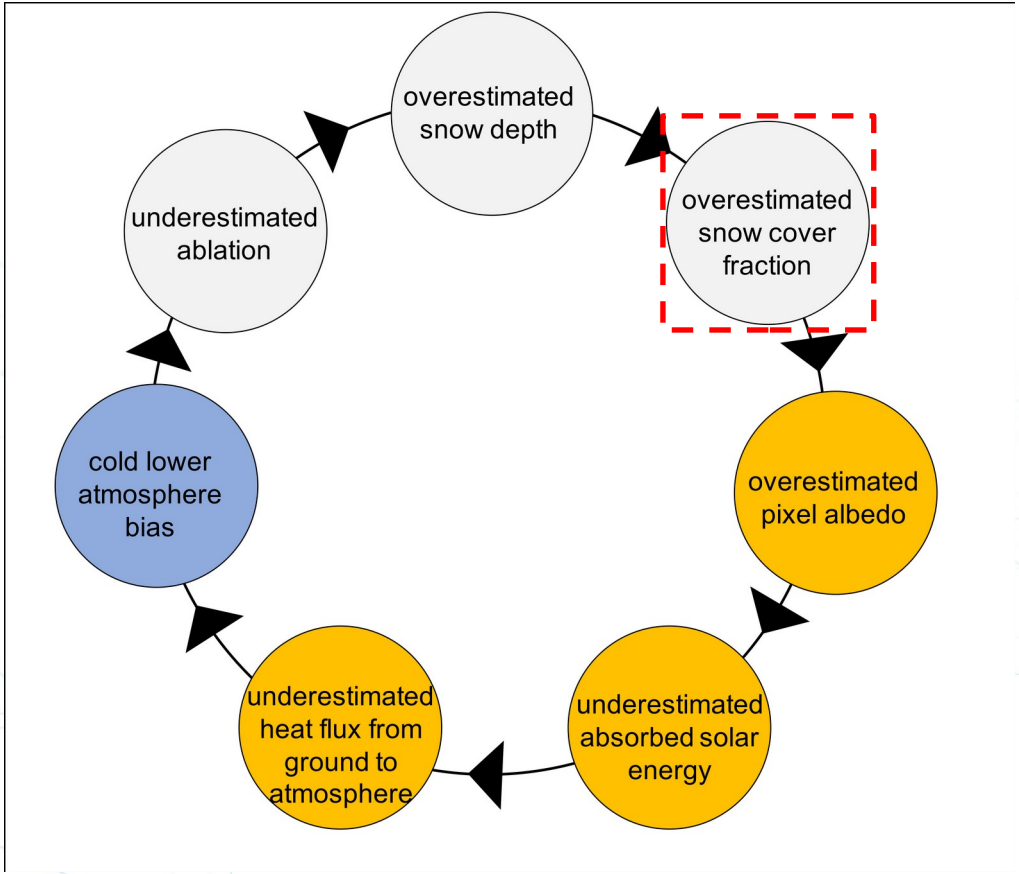
He et al., 2019

Surface albedo bias in Noah-MP



He et al., 2019

Snow albedo feedback connecting various model



Abolafia-Rosenzweig et al., 2023 in review

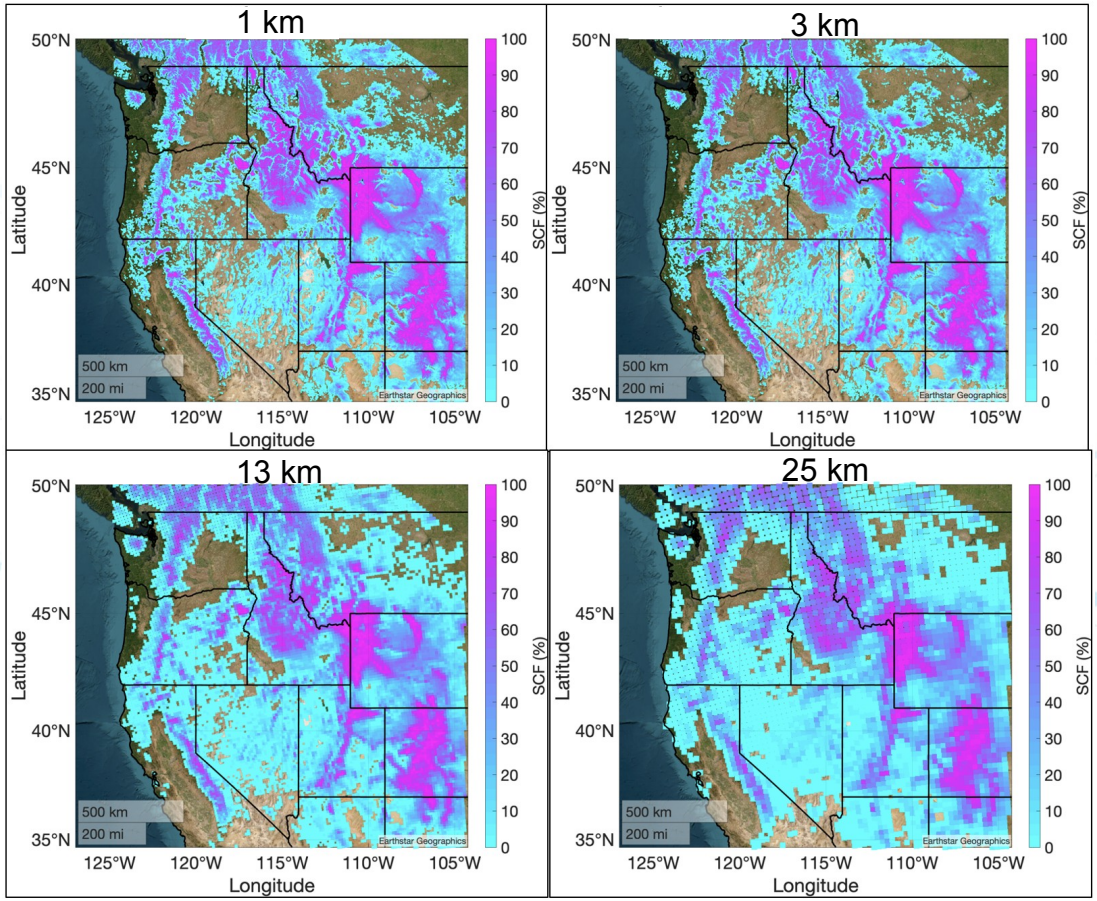
Enhancing snow cover parameterization across scales

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

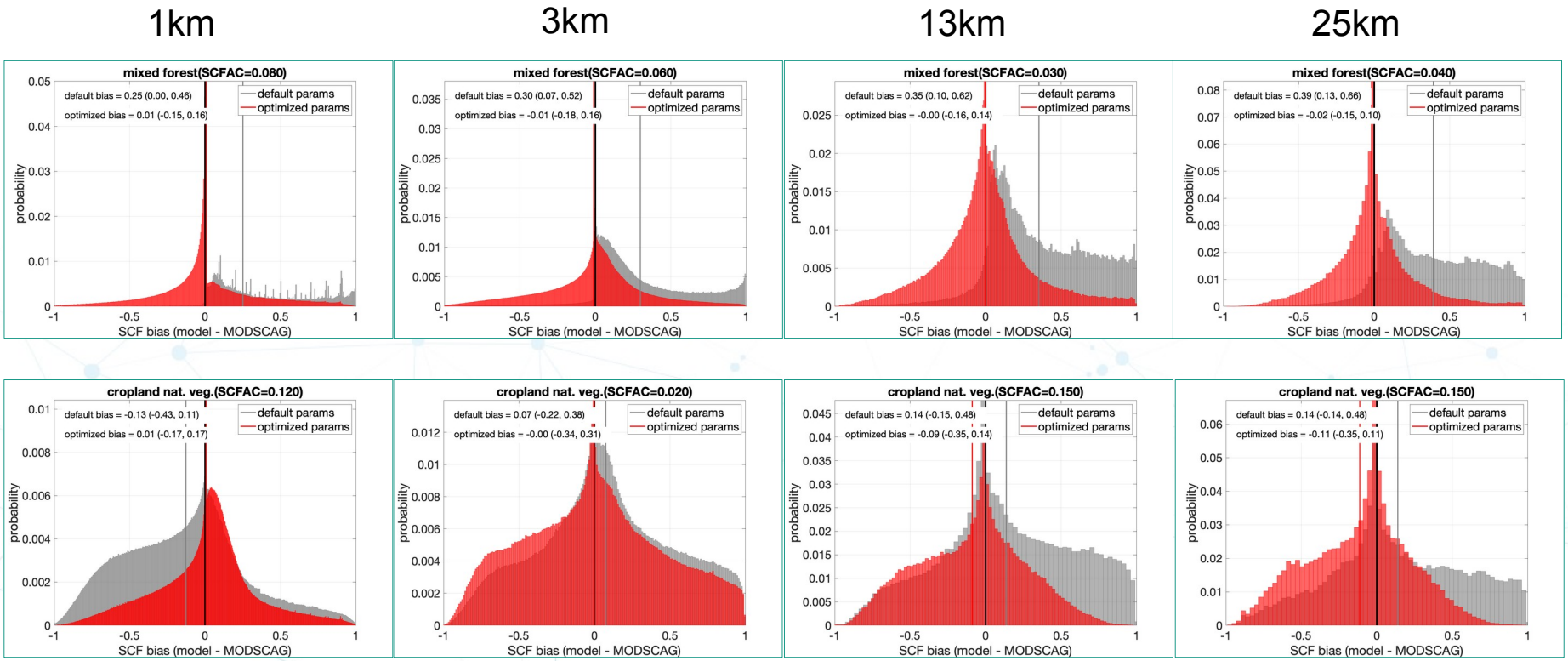
Use observations to constrain and optimize the snow cover formulation parameters:
Snow melting factor: "*m*"
Snow cover prefactor: "$2.5z_{0g}$" = SCFFAC

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

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



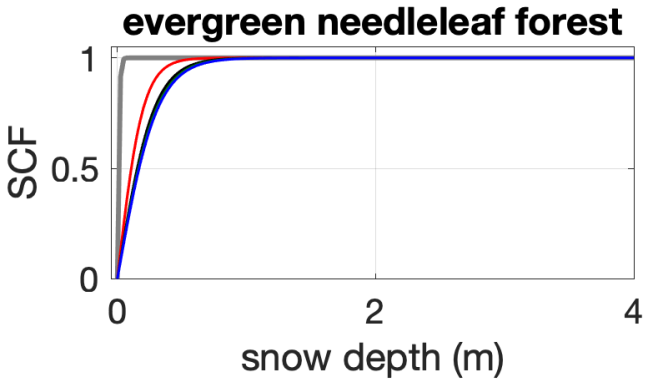
Reduced snow cover bias from optimized parameterization

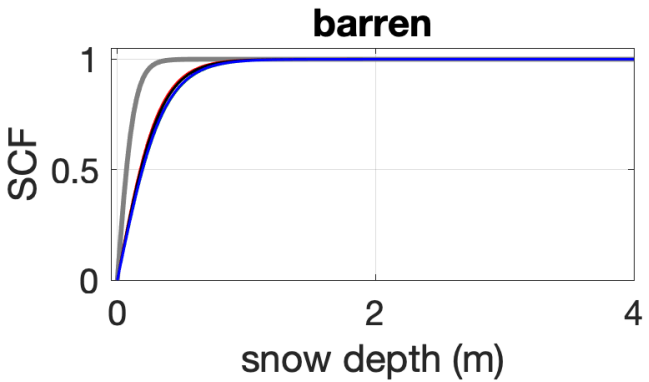


Scale dependence of snow cover parameterization

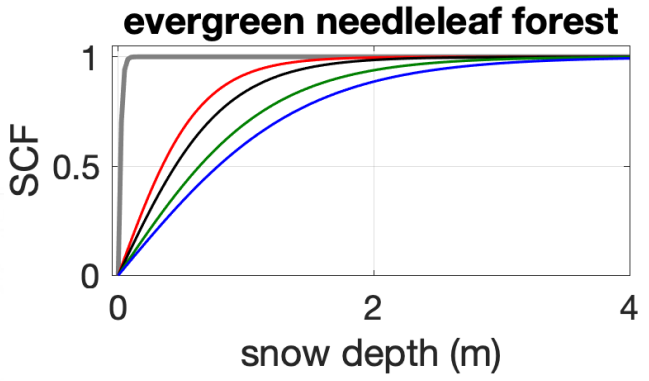
default params
1km opt
3km opt
13km opt
25km opt

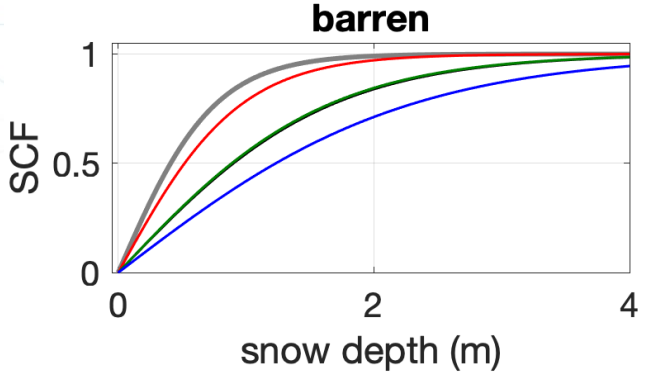
Low density example
(density = 200 kg/m3)





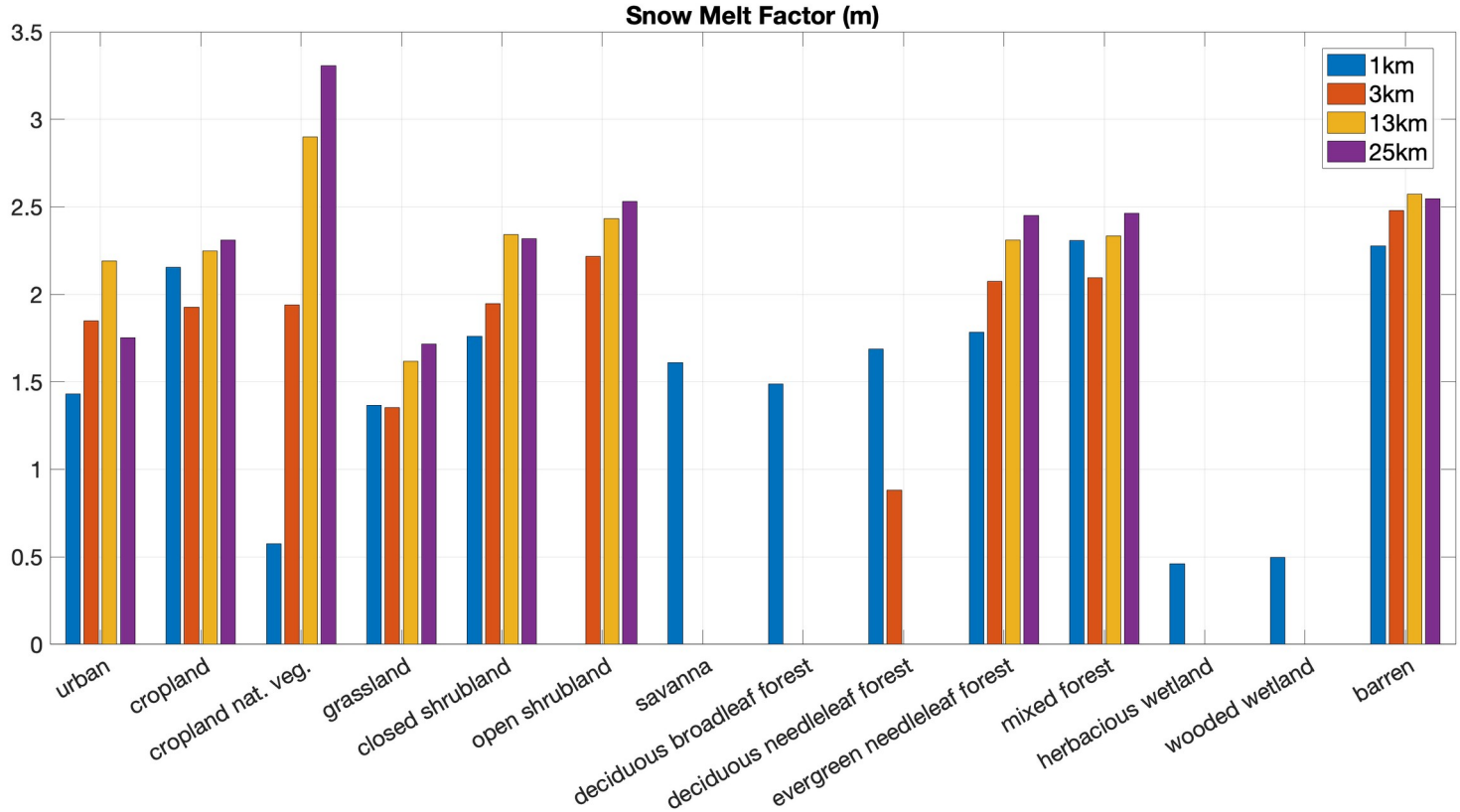
High density example
(density = 400 kg/m3)





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