Predicting Surface Density using Snow Models and Assimilation for Wildlife Applications

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ABSTRACT

Surface layer snow density is correlated with the depth that animals sink into snow, which in turn controls their mobility and ultimately impacts predator-prey dynamics. Snow model density parameterizations have a long history, and thus are a promising tool to predict wildlife dynamics. However, surface snow density is challenging to predict in areas that experience melt-refreeze metamorphism in part because it is challenging to accurately predict brief periods of snowmelt. This suggests the use of spaceborne land surface temperature (LST) measurements to correct the model. Here, we explore ability of the NoahMP snow model in conjunction with the NASA Land Informatic System Framework (LIS or LISF) in order to predict surface snow density with and without LST assimilation at a range of spatial resolutions from 1 km to 30 m in Washington State. We evaluate against field surveys of surface snow density made in winter 2021 and 2022. Without assimilating LST, we have successfully predicted whether the density was greater or less than 275 kg m^3 for 80% of snow pits. We have now begun to assimilate MODIS LST measurements in order to correct the model predictions of meltwater within the snowpack and improve estimates. Furthermore, we have begun to analyze the SWE estimates from the model as well. We use the improved density results of the model and assimilation study to assess the possible utility of snow modeled density to predict snow wildlife dynamics.

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