Snow Datasets for Arctic Terrestrial Applications (SnowDATA)

Workshop Summary: 31 October – 1 November 2012
Fairbanks, Alaska

CIRA
Cooperative Institute for Research in the Atmosphere

Colorado State University

Workshop Prospectus

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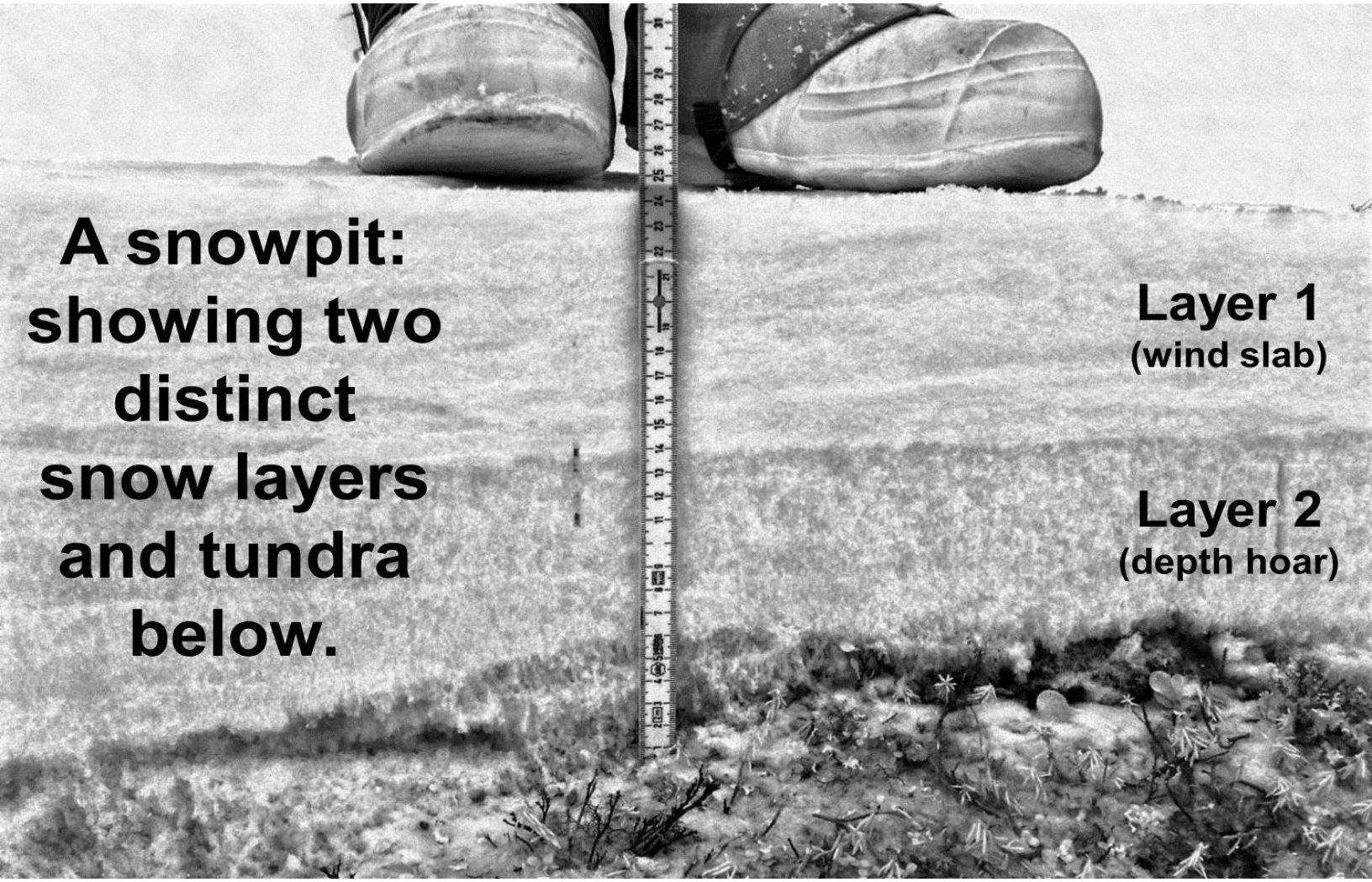
A workshop directed by Dr. Glen E. Liston to define Alaska snow datasets needed by ecologists and land managers.

Motivation: Snow conditions are extremely important to a wide range of hydrologic and ecosystem components and processes, including those related to surface energy and moisture stores and fluxes, vegetation, mammals, birds, and fish. The required snow datasets currently do not exist at the required spatial and temporal resolutions needed by end users such as scientists, land managers, and policy makers.

Goal: To hold a workshop attended by ecologists, biologists, and geophysicists from a range of agencies and universities in order to define the weather and snow information they require to successfully do their jobs and/or enhance their monitoring and research programs. Dr. Liston will use this information to custom-code his meteorological- and snow-evolution models to ingest appropriate datasets and to produce the required outputs; all with the goal of producing spatial maps of climate- and snow-related variables, for the past 30+ years, for northern Alaska that can be used in a wide range of climate, hydrologic, and ecosystem applications of interest to scientists, land managers, and policy makers.

Available Tools: Over the last 20 years, under a variety of NOAA, NSF, and NASA research programs, Dr. Liston has developed a snow-evolution modeling system that includes the MicroMet micrometeorological model, the SnowModel snow-process model, and the SnowAssim data assimilation model. These modeling tools can be thought of as physically-based mathematical descriptions that create value-added information (e.g., snow depth, snow density, snow hardness, rain-on-snow events, and snow cover duration) from basic meteorological variables (e.g., air temperature, humidity, precipitation, and wind speed and direction). The resulting products are based on our physical understanding of environmental processes and features, and their interactions with the atmosphere and surrounding land surface. SnowModel is unique in its representation of blowing snow processes; it includes SnowTran-3D, a model developed initially for Arctic Alaska applications, and arguably the most widely used snow transport model in the world. The model formulations are general enough to allow simulations over temporal domains spanning years to decades, and spatial domains spanning from small watersheds to all of Alaska. MicroMet can use atmospheric forcing ranging from individual meteorological stations, to gridded atmospheric (re)analysis products, to climate change scenario datasets. SnowAssim is able to ingest snow data ranging from ground-based snow observations to remote-sensing data.



Conclusions, Recommendations, and Priorities

SnowDATA Workshop Summary

- There is considerable overlapping interest and priorities among the represented groups: birds, caribou, other mammals, fish, hydrology, glaciers, vegetation, soils, and land managers.

- SnowDATA will focus on historical simulations (e.g., 1980-present) to allow improved understanding of snow-ecosystem relationships. The workshop also identified the importance of studying future snow-ecosystem interactions and impacts. SnowDATA will perform simulations driven by future climate predictions (e.g., 2050) if time allows.

- There is substantial and group-wide interest in the spatial distribution and temporal evolution of basic snow variables such as snow depth, snow density, snow-onset date, and snow-free date.

- Some new ecosystem-related snow variables (e.g., hardness and rain-on-snow icing events) will be produced as part of SnowDATA.

- Topography (digital elevation model) and land-cover data at sufficient quality and resolution are required for the model simulations of interest. In some applications, resolutions as high as a few meters are required.

SnowDATA Simulation Details

- Domain #1 (Fig. 1) will be simulated on a 2-km grid, 1980-present, to provide a general snow dataset for all users.

- Other domains (e.g., #2 and #3, Fig. 1; details such as exact locations and time periods TBD) will be simulated at higher spatial resolution (e.g., 5-100 m), and for more limited years, corresponding to existing snow-ecosystem datasets and interests. These spatial and temporal domains will be determined by communication with the Workshop participants after the Domain #1 simulations are completed. The group summaries provided in Section 5 of this document will be used to help define potential products that will be created as part of the higher resolution simulations. Decisions on additional domains will be coordinated by the Arctic LCC, and availability of partner funding will help define the ultimate scope of the higher resolution work.

- A wide range of snow-related variables will be produced and output on a daily time increment, e.g., air temperature, wind speed and direction, relative humidity, surface temperature, incoming solar radiation, albedo, incoming and outgoing longwave radiation, latent and sensible fluxes, rain and snow precipitation, snowmelt, blowing-snow and static-surface sublimation, blowing and drifting snow flux, snowmelt runoff, snow depth, snow density, snow water equivalent depth, snow hardness, snow trafficability index, rain-on-snow events, changes in snow and growing season lengths, hydrologic budgets, winter soil microbial activity, and snow thermal characteristics.

- At least two new snow-ecosystem related variables will be developed as part of this work: an intermediate-complexity Rain-On-Snow (ROS) variable, and a snow-hardness or collapse pressure variable that relates to snow trafficability. These variables will be included as part of the model simulations and output datasets.

- Domain #1 will also be simulated using future-climate atmospheric forcing, if project time allows.

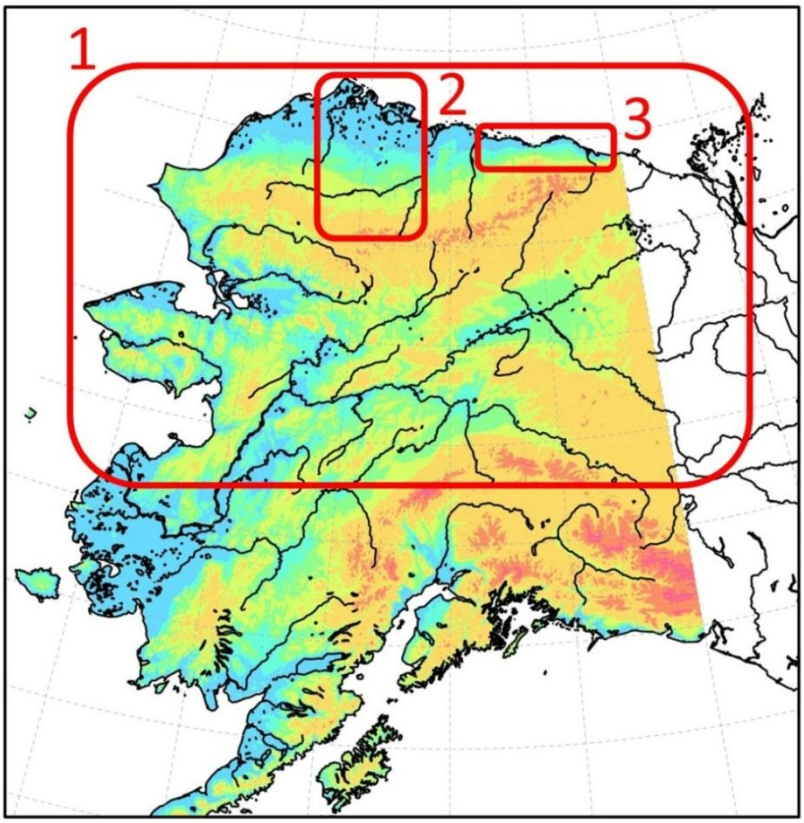


Figure 1. Example SnowDATA simulation domains. See text for discussion.