P2.15

SNOW COVER DATA FOR APPLIED CLIMATE STUDIES

David A. Robinson*
Rutgers University, Piscataway, New Jersey

1. INTRODUCTION

Whether investigating hydrologic conditions, biogeographical issues or conducting climate and global change studies, accurate and accessible information concerning snow extent, depth and water equivalent are extremely valuable. A research-quality snow cover dataset is being developed at Rutgers in support of meso to macro scale studies related to snow. Information from multiple observing systems is being incorporated into this Northern Hemisphere continental dataset. Included are visible and microwave satellite data and surface observations from the late 1960s through present. High-resolution, digital files of snow extent will be spatially and temporally complete, while depth and especially water equivalent will have regions and intervals where data are not available. This paper discusses the need for a blended dataset, reports on progress to date, and provides several examples of products that will be available online.

2. THE NEED FOR A BLENDED DATASET

In recent years, there have been considerable efforts to improve means of monitoring the distribution and variability of snow cover. Datasets have been developed using station observations, snow courses, visible satellite imagery, and microwave satellite returns. These data have been used in numerous studies that attempt to better understand the variability of snow cover, relationships between snow cover and other climate variables, and applied aspects of snow cover, especially related to hydrology. Despite the excellent advances in snow monitoring, individual datasets tend to focus on one source of data or one element (snow coverage, depth, or water equivalent), and many are limited in their spatial and temporal coverage. Our project will result in a research-quality dataset containing files of snow extent, depth and water equivalent, based on information from multiple observing systems. We expect and hope it will be used in support of numerous applied climate studies.

3. SNOW DATA

Station and satellite-derived snow observations are being assembled from a variety of sources covering the satellite era (late 1960s through present). NOAA hemispheric snow maps available from 1966 through present constitute the longest and most spatially complete dataset available for this project. These maps are constructed from visible satellite imagery and are displayed on the project website http://climate.rutgers.edu/snowcover. The site also contains climatological maps and a variety of tabular data. Examples of maps are seen in figures 1-4.

The project site will be expanded to include microwave and station derived maps. The latter two datasets are being developed in cooperation with Thomas Mote at the University of Georgia, and will begin to appear on the website later this year. A daily, gridded dataset is being developed from U.S. Cooperative Observer reports. Similar, though less spatially complete, sets will be constructed for Canada and the former Soviet Union.

Microwave maps of snow extent and depth are being produced from SSM/I and SMMR data. They are based on the land cover decision tree of Grody and Basist (1996), the Goodison and Walker (1995) snow water equivalent algorithm and the Walker and Goodison (1993) snow melt algorithm, augmented with a melt algorithm based on work by Mote and Anderson (1995). The SMMR to SSM/I crossover period in 1987 was used to create an SSM/I like brightness temperature field from the SMMR data, recognizing that the 85 GHz channel did not exist on SMMR. All datasets, each retaining their particular spatial and temporal resolutions, will be available through the project office.

*Corresponding author address: David A. Robinson, Rutgers University, Department of Geography, Piscataway, NJ 08854; e-mail: drobins@rci.rutgers.edu

4. BLENDED PRODUCT

All data sources will be imported into a geographic information system and differences in resolutions will be addressed. Maps produced for each data source will have common temporal (likely pentad (5-day) frequency) and spatial (likely $1^o \times 1^o$) resolutions. This will facilitate intercomparisons and blending, enabling us to learn more about the strengths and weaknesses of each product. It will also permit us to create the most accurate and complete map for a given variable during a selected period. Blended maps of snow extent will have complete spatial and temporal coverage from the late 1960s to present, while maps of snow depth and especially snow water equivalent will have less complete coverage. A color figure depicting a prototype for a pentad may be found at http://climate.rutgers.edu/snowcover/pentad.html. It shows general agreement between visible and microwave products over the vast majority of Eurasia and North America. However there are areas of disagreement along the margins of the snow pack and over the Tibetan Plateau. Station data shown in the online figure and previous studies suggest that the microwave product overestimates snow extent over the Plateau. In comparison to station observations, other satellite differences do not appear to favor one product over the other. Over the Mid-Atlantic States, the prototype map shows stations reporting snow cover where neither satellite product reports snow. This may be a result of cloud cover obscuring the surface, thus impacting charting using visible imagery, the pack being wet, thus interfering with snow recognition using microwave sensing, or it could be due to the differing timing of the various observations during the pentad.

5. CONCLUSION

By fusing and enhancing space and ground-based observations, the strengths of one means of snow cover monitoring will compensate for the weaknesses of others and vice versa. The Rutgers blended database will provide accurate information on snow cover that is critical for understanding the kinematics and dynamics of snow in the climate system, for developing accurate weather and hydrological forecasts, for parameterizing and verifying climate models and for a variety of other applications.

Acknowledgments: Thanks to Tom Mote for his ongoing contributions to this project and to Tom Estilow and Chad Shmukler for database development and mapping efforts. Support for this research is provided through NOAA Office of Global Programs grant NA06GP0566

REFERENCES

Goodison, B.E., and A.E. Walker, 1995: Canadian development and use of snow cover information from passive microwave satellite data. Passive Microwave Remote Sensing of Land-Atmosphere Interactions, B.J. Choudhury, Y.H. Kerr, E.G. Njoku and P. Pampaloni, Eds., VSP BV, Utrecht, 245-262.

Grody, N., and A. Basist, 1996: Global identification of snowcover using SSM/I measurements. IEEE Trans. Geosci. Remote Sensing, **34**, 237-249.

Mote, T.L., and M.R. Anderson, 1995: Variations in melt on the Greenland Ice Sheet based on passive microwave measurements. J. Glaciol., **41**, 51-60.

Walker, A.E., and B.E. Goodison, 1993: Discrimination of a wet snow cover using passive microwave satellite data. Ann. Glaciol., **17**, 307-311.

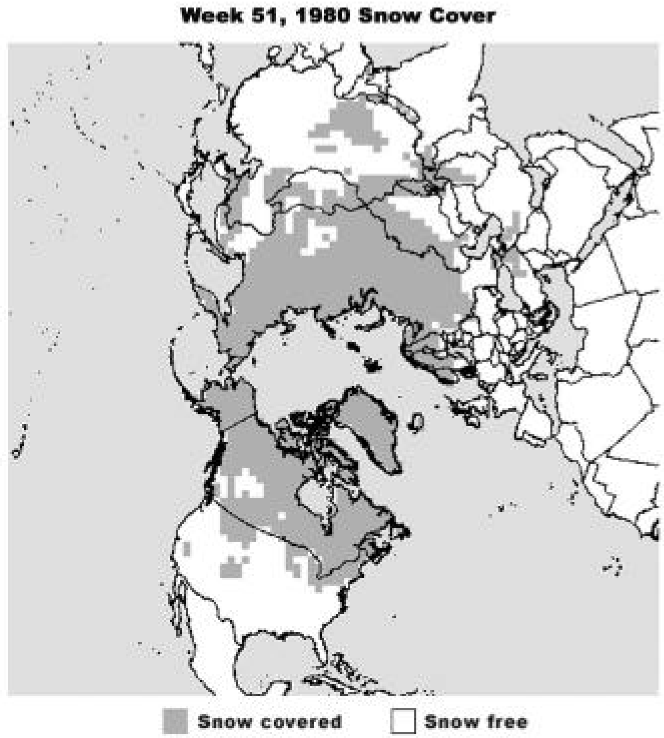

Figure 1. Snow extent over Northern Hemisphere lands for the 51st week of 1980 as mapped from visible satellite imagery by NOAA meteorologists. The map is displayed at the grid cell resolution used in the digitization of the original hard-copy map. All weekly maps from October 1966 to present are available on the project website (http://climate.rutgers.edu/snowcover).

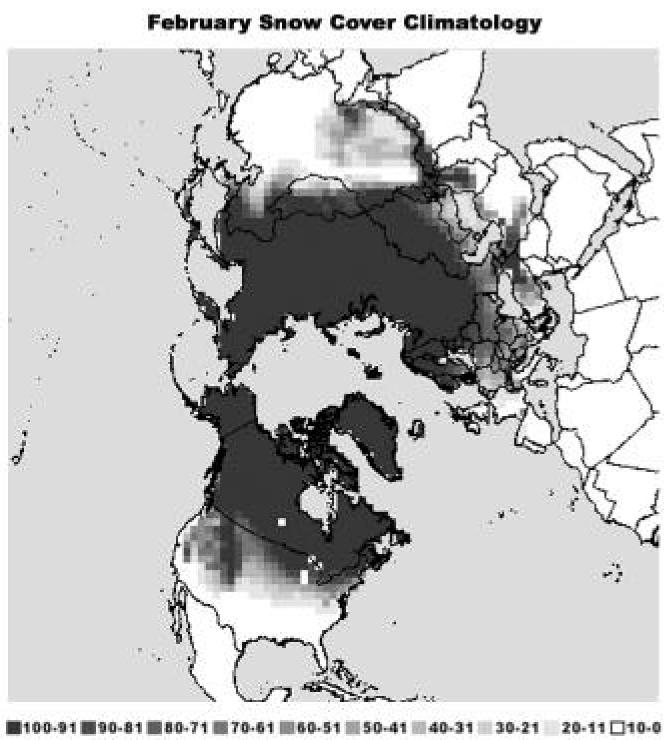

Figure 2. Mean February snow extent based on the 1966-1999, as derived from NOAA weekly maps. All monthly climatologies are available on the project website.

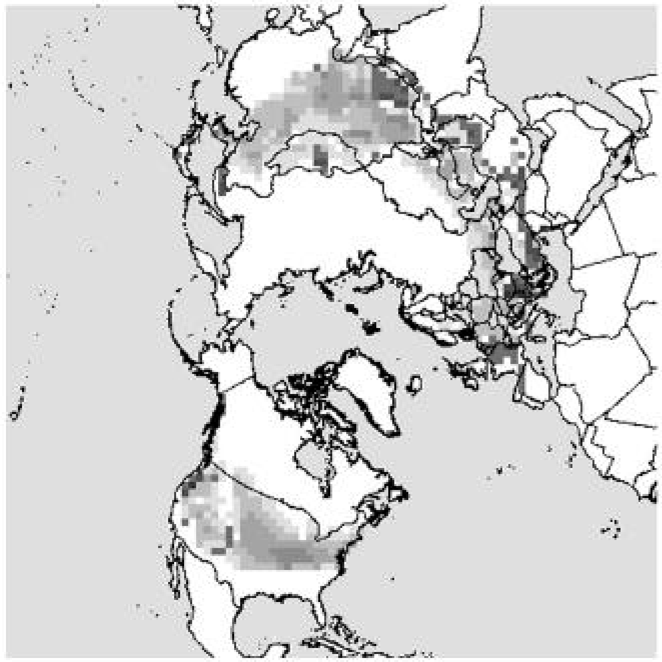

Figure 3. Departure of snow extent over Northern Hemisphere lands for February 1978, as derived from NOAA weekly maps. Departures are based on the mean for 1967-1999. Maps of monthly extents and departures from October 1966 to present are available on the project website.

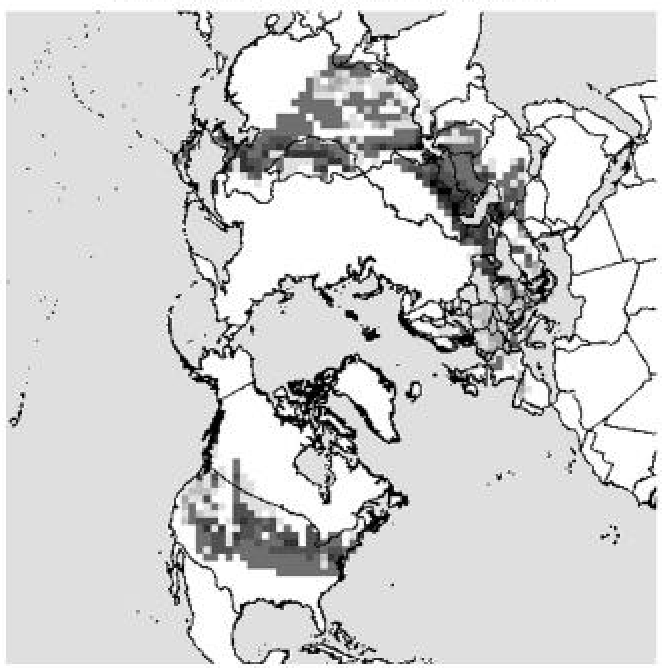

Figure 4. Same as figure 3, except for February 1999.