

NORTHERN HEMISPHERE SNOW COVER

By

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INTRODUCTION

The purpose of this paper is to acquaint the research and user community with a new data base, a digitized archive of Northern Hemisphere snow cover. Weekly snow and ice charts have been prepared by the Synoptic Analysis Branch of the National Earth Satellite Service (NESS) on a continuous basis since November 1966. Based upon photo interpretation of 6 or 7 consecutive days of satellite imagery, the snow and ice boundaries are drawn on a 1:50,000,000 polar stereographic projection of the Northern Hemisphere. Each of these charts for the period November 1966 through December 1980 were digitized at the University of Nebraska utilizing an 89 x 89 element box grid overlaid on the polar stereographic map. The grid which was utilized was compatible with the satellite-based Earth radiation budget atlas of Winston et al (1979). The true geographic area of each grid box varies with latitude as a result of the polar projection. However, this was taken into account mathematically, so that a true areal coverage of snow could be determined for a chart or for a region on a chart.

EXAMPLES OF SNOW COVER CLIMATOLOGIES CREATED USING THIS NEW DATA BASE

The areal extent of snow cover was calculated for each week in the study period. A 14-year average was then calculated for each week. The actual observed weekly values during any specific snow cover year (defined as week number 36 of one year through week number 35 of the following year) could then be plotted against the 14-year mean to illustrate snow cover variability on an annual basis. Figure 1 illustrates an example of the weekly snow cover areas for the 1978-79 snow cover season. Analysis of this figure indicates that hemispheric snow cover in 1978-79 was above the mean throughout almost the entire snow cover season. A 52-week running mean of snow cover area was also plotted for the Northern Hemisphere as well as Eurasia and North America to reveal any trend in snow cover areas during the study period, Figure 2. The trend in hemispheric snow cover has been toward increased snow cover with two step-like increases occurring in 1970-71 and 1976-77.

Several snow cover frequency maps were generated using this new data base. These frequency climatologies can be described here, but space limitations prohibit illustrating them. Average weekly snow cover frequency maps were created by determining the frequency of snow cover for each week averaged over the study period. Figure 3 is an example of the weekly "climatology" of snow cover for week Number 10. An examination of the 100% boundary illustrates on a weekly basis where, for that week, there is always a snow cover. The 0% boundary on these charts is useful in expressing the maximum extent of snow cover which could be expected for any given week. Average monthly snow cover frequency maps were produced by averaging all of the observed weekly snow cover frequencies for the specific month in the entire study period. The data were grouped into seasons and seasonal snow cover frequency maps were generated for each of the four seasons during each of the 14 years of data. A seasonal average was calculated by averaging each season over the 14-year study period. The snow cover frequencies for each snow cover year were mapped and an overall or "master" frequency was then generated for the entire study

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period, Figure 4. This snow cover climatology compares favorably to previously produced annual snow cover climatologies and provides greatly enhanced data resolution for the mountainous and sparsely populated regions of the world. The individual snow cover years were compared to the "master" frequency and annual (snow cover year) anomaly maps were created. These anomaly maps outline the regions of above and below average snow cover frequency. The anomaly maps (which can also be produced on a monthly or seasonal basis) are ideal for examining snow cover-atmospheric circulation inter-relationships.

POTENTIAL USES OF THE DATA ARCHIVE

Numerous potential uses exist for this archive of weekly snow-cover data. For example, correlation analyses could be performed to statistically relate the snow cover area values to various atmospheric circulation parameters. Hydrological forecasting studies should greatly benefit from access to this data base. Radiation budget studies on a hemispheric scale will also be able to utilize these data. It is also anticipated that numerical modelers can use these snow cover data as an input parameter to their hemispheric circulation models. Using hindcasting techniques, both short range as well as long range (seasonal) forecasters can test to see if inclusion of snow cover data increases the accuracy of their forecast equations. Using contingency analysis it might also be possible to use snow cover anomalies of a given month to "forecast" snow cover conditions during the following month. And, as this digital archive continues to grow (NESS took over the production of the digitized maps as of January 1981), increased usage by those researchers interested in short-term climatic variability is expected.

AVAILABILITY OF DATA ARCHIVE

The digitized data are available on magnetic tape through two sources: World Data Center - A for Glaciology (Snow and Ice), University of Colorado, Institute for Arctic and Alpine Research, Boulder, Colorado, 80309 and the Environmental Data and Information Service (EDIS) of NOAA, Room 100, World Weather Building, Washington, D.C. 20233. The computer tape also contains documentation of the data format as well as Fortran programs for the display of the data. It should also be noted that this new data base is described in detail (including numerous illustrations and an appendix documenting how the digitized data are stored on the magnetic tape) in NOAA Technical Report NESS 87, "Satellite Observations of Northern Hemisphere Seasonal Snow Cover", December 1981, 83 pp., (Available from EDIS, NOAA, U.S. Department of Commerce, Rockville, MD 20852).

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Figure 1
1978-79 SNOW SEASON
NORTHERN HEMISPHERE

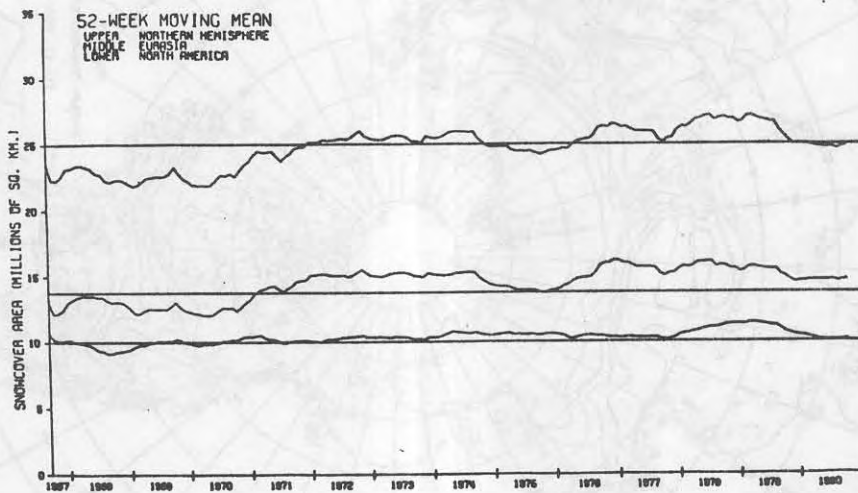
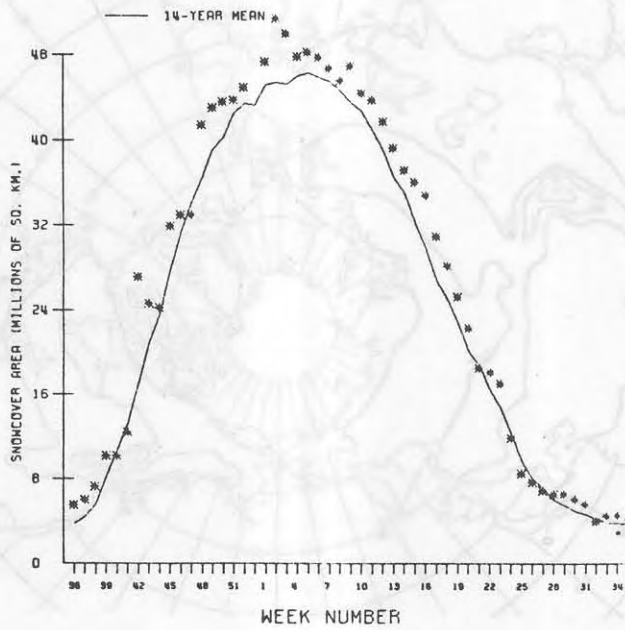


Figure 2

