NOAA SATELLITE MONITORING OF SNOW COVER IN THE NORTHERN
HEMISPHERE DURING THE WINTER OF 1977

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Northern Hemisphere snowcover has been monitored by NOAA/NESS since 1966. Weekly snow
and ice charts (Fig. 1) have been used to prepare mean monthly data on snowcover for
both North America and Eurasia. These data were then utilized to prepare simple
regressions of antecedent snowcover vs. January, February, February and January-through-
March snow-cover figures, demonstrating a number of statistically significant relations-
ships for Eurasia and the Northern Hemisphere (land surface only). These relationships,
despite the limited data sample (i.e., 10 years of record), indicate that higher-than-
average December snowcover tends to presage a winter of more-than-average snowcover.

Certainly, widespread snow raises the albedo of the Earth's surface and decreases the net
amount of long-wave radiation absorbed by that surface. The snowcover also tends to
cool the adjacent atmosphere, thereby inducing snow rather than rain in peripheral snow-
free areas.

It has been suggested that these simple regressions might be used to forecast continental
and hemispheric snowcover 50, 60, and 90 days in advance. On January 2, 1977, advance
estimates of snowcover (Table 1) were prepared to test and evaluate this Antecedent
Snow Cover Technique for the winter of 1977.

December 1976 snowcover was 36.5 million km\(^2\) in the Northern Hemisphere (1.4% above the
December 1975 figure). Eurasian snowcover made up 22.4 million km\(^2\) of this total, and
was 4.2% higher than in 1975. On the other hand, North American snowcover measured only
14.1 million km\(^2\) or 2.8% lower than December 1976.

The mean monthly snowcover in January 1977 for North America was 15.8 million km\(^2\), the
greatest mean monthly figure recorded in the 10-year satellite record. Approximately
65% of the North American continent was snow-covered during January.

Eurasia was likewise well covered by extensive snows in January. In fact, 26.5 million km\(^2\)
were covered by snow, making it the highest mean monthly snowcover for any January
of the 10-year satellite record. Thus, the Northern Hemisphere mean monthly snowcover
for January became the highest figure recorded for any month: 42.3 million km\(^2\).

February was rather different. The Northern Hemisphere total fell to 40.0 million km\(^2\)
of which North America recorded 14.4 million km\(^2\), a drop of 0.7% from February 1976, and
Eurasia accounted for the remaining 25.6 million km\(^2\), a gain of 5.4% over the February
1976 snowcover.

Northern Hemisphere March snowcover was only 32.1 million km\(^2\), a drop from March 1976 of
9.7%. Snowcover in both Eurasia and North America dropped; Eurasia dropped 12.7% and
North America dropped 4.5% from the March 1976 figures.

The regression equations continue to be reasonably valid with regard to Eurasia and the
Northern Hemisphere. Indeed, January 1977 advance estimates of above-average snowcover winter in Eurasia (+4.4% above 1976) correctly indicated the winter trend. The actual snowcover was 1.9% above the 1976 figure. Advance estimates of Northern Hemisphere winter snowcover also correctly indicated the trend. The estimate was for an increase (+1.9% over 1976). The actual snowcover was 1.5% above the 1976 figure. The estimate for North America, which called for a decrease of 2.8%, correctly indicated the trend as the actual 1977 figure was 0.5% less than the 1977 figure.

Snowcover during the winter of 1977, while severe locally, was the result of localized climatic variations caused by meteorological conditions. For example, in North America, January snowcover set a record, yet December 1976, February 1977, and March 1977 had less snowcover than in the preceding year. For Eurasia, it clearly was a high snowcover year, all months exceeding those of the preceding winter except for March which was greatly reduced.

Long-range predictions of severe global climatic change cannot be substantiated on the basis of satellite snowcover data during the winter of 1977. Nevertheless, over the 10-year period of record, snowcover does show a tendency to be increasing slightly. Continued satellite monitoring of this important climatic variable is clearly warranted.

BIBLIOGRAPHY


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<th>Period of Snowcover</th>
<th>Advance Estimate $(\times 10^6 \text{km}^2)$</th>
<th>Estimate Change from Prior Year (%)</th>
<th>Measured $(\times 10^6 \text{km}^2)$</th>
<th>Actual Change from Prior Year (%)</th>
<th>Difference (Estimate vs. Measured)</th>
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Fig. 1. Weekly Snow and Ice Cover chart of the Northern Hemisphere for the 7-day period December 29, 1974 through January 4, 1975 (scale: 1:50,000,000), prepared by Analysis Branch, NOAA/NESS. Note the various reflectivities and the areas of scattered mountain snow. Also note the "dark" area where visible data cannot be collected during the polar winter.
Fig. 2. Monthly mean snow cover chart of the Northern Hemisphere for March 1976 on a stereopolar projection at a 1:50,000,000 scale. This chart was prepared from the weekly charts.
Fig. 3. Graph of monthly mean winter snow cover of North America and Eurasia for the period 1966-1977.
Fig. 3. COES-1 satellite images comparing snow cover in North America for January 14, 1976 and January 31, 1977. The snowline is 500 to 600 km farther south in the 1977 image than in the 1976 image. Note the snow cover stretching from Texas to South Carolina in the 1977 image.
Percent of Eurasia and North America Covered by Annual Winter Snow

Eurasia (December-March Average)

North America (December-March Average)

Fig. 7. Graph showing the percentage of North America and Eurasia covered by average winter snow cover for the period 1966-1977.
Fig. 8. Regression analysis of Eurasian January snow cover vs. Eurasian December snow cover.
Fig. 9. Regression analysis of Northern Hemisphere January snow cover vs. Northern Hemisphere December snow cover.

NORTH HEMISPHERE

\[ y = 53x + 19.98 \]

\[ r^2 = 57 \]

SNOW COVER, DECEMBER \((10^6 \text{ KM}^2)\)

SNOW COVER, JANUARY \((10^6 \text{ KM}^2)\)
Fig. 10. Regression analysis of Eurasian February snow cover vs. Eurasian December plus January snow cover.
Fig. 11. Regression analysis of Northern Hemisphere February snow cover vs. Northern Hemisphere December plus January snow cover.
Fig. 12. Regression analysis of Eurasian January through March snow cover vs. Eurasian December snow cover.

Eurasia

\[ y = 2.85x + 9.56 \]

\[ r^2 = 0.77 \]
Fig. 13. Regression analysis of Northern Hemisphere January through March snow cover vs. Northern Hemisphere December snow cover.

NORTH HEMISPHERE
\[ y = 1.98x + 42.42 \]
\[ r^2 = .81 \]
Fig. 14. Graph comparing winter 1977 snow cover estimates vs. winter 1977 snow cover measurements.