

Seasonal Snow Extent and Snow Mass in South America Using SMMR and SSM/I Passive Microwave Data (1979-2003)

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Popular Summary: Seasonal snow cover in South America was examined in this study using passive microwave satellite data from the Scanning Multichannel Microwave Radiometer (SMMR) on board the Nimbus-7 satellite and the Special Sensor Microwave Imagers (SSM/I) on board Defense Meteorological Satellite Program (DMSP) satellites. For the period from 1979-2003, both snow cover extent and snow depth (snow mass) were investigated during the coldest months (May-September), primarily in the Patagonia area of Argentina and in Chile, where most of the seasonal snow is found. Sharp year-to-year differences were recorded using the passive microwave observations. The average snow cover extent for July, the month with the greatest average extent during the 25-year period of record, is 320,700 km². In July of 1984, the average monthly snow cover extent was 701,250 km² – the most extensive coverage observed between 1979 and 2003. However, in July of 1989, snow cover extent was only 120,000 km². The 25-year period of record shows a sinusoidal like pattern, though there appears to be no obvious trend in either increasing or decreasing snow extent or snow mass between 1979 and 2003.

Significance Statement: This study continues the work presented by Foster et al (2002) on mapping the snow cover extent and snow mass in South America, where most of the seasonal snow in the Southern Hemisphere is found. This study demonstrates that passive microwave radiometry is especially useful in estimating the snow cover extent and snow mass in the Patagonia region of South America, where clouds are a major mapping problem and where the snow is often ephemeral in nature. The passive microwave observations show that there are sharp year-to-year differences that exist in the seasonal snow extent over the Patagonia region of South America. Snow cover extent in the month of July, the month typically having the greatest snow cover, varied during the 25-year period from a high of 701,250 km² in 1984 to a low of 120,000 km² in 1989. The greatest monthly snow mass varied from 2.41×10^{13} kg also in 1984 to 0.23×10^{13} kg in both 1989 and 1990. The building of the seasonal snow mass seems to correspond closely to the expansion of the snow cover. The average snow cover for August is approximately 94% of the average for July and also the average snow mass for August is more 93% of that for July. Similarly, the average snow cover for September is 0.80% of that of the average August snow extent, and the average September snow mass is 0.79 of the average August snow mass. The 25-year period of record shows a sinusoidal-like pattern, though there appears to be no obvious trend in either increasing or decreasing snow extent between 1979 and 2003. Now that a validated snow dataset is in place for South America, comparisons can be made with year-to-year variations of seasonal snow in the Northern Hemisphere. In addition, it is now possible to determine if statistically

meaningful relationships exist between seasonal snow parameters in Patagonia and climatic patterns such as El Nino, La Nina and the Circumpolar Antarctic Wave.

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ABSTRACT

Seasonal snow cover in South America was examined in this study using passive microwave satellite data from the Scanning Multichannel Microwave Radiometer (SMMR) on board the Nimbus-2 satellite and the Special Sensor Microwave Imagers (SSM/I) on board Defense Meteorological Satellite Program (DMSP) satellites. For the period from 1979-2003, both snow cover extent and snow depth (snow mass) were investigated during coldest months (May-September), primarily in the Patagonia area of Argentina and in Chile. Most of the seasonal snow in South America is in the Patagonia region of Argentina. Since winter temperatures in this region are often above freezing, the coldest winter month was found to be the month having the most extensive snow cover and also usually the month having the deepest snow cover as well. Sharp year-to-year differences were recorded using the passive microwave observations. The average snow cover extent for July, the month with the greatest average snow extent during the 25-year period of record, is 320,700 km². In July of 1984, the average monthly snow cover was 701,250 km² – the most extensive coverage observed between 1979 and 2003. However, in July of 1989, snow cover extent was only 120 km². The 25-year period of record shows a sinusoidal like pattern, though there appears to be no obvious trend in either increasing or decreasing snow extent or snow mass between 1979 and 2003.