SATELLITE SCATTEROMETER OBSERVATIONS OF SNOW OVER THE NORTHERN HEMISPHERE

S. V. Nghiem and G. Neumann
Jet Propulsion Laboratory
California Institute of Technology
4800 Oak Grove Drive, MS 300-235
Pasadena, CA 91109
Tel: 818-354-2982, Fax: 818-393-3077
E-mail: nghiem@solar.jpl.nasa.gov

Results of snow remote sensing obtained from satellite scatterometer data are presented in this paper. Hemispheric-scale backscatter data have been collected over snow seasons by the past NASA Scatterometer (NSCAT) in 1996-1997 and by the current SeaWinds Scatterometer on the QuikSCAT Satellite (QuikSCAT/SeaWinds) since 1999. Furthermore, future satellite scatterometer missions have been planned, and long-term global backscatter data can be acquired for snow monitoring. Seasonal trends in backscatter of snow and vegetation are analyzed together with field data to point out differences between signatures of snow and vegetation. Field observations over taiga and tundra regions in Newfoundland, Canada are shown. An algorithm is then developed to monitor snow accumulation patterns over the northern hemisphere. With measurements from an Alaska snow field experiment (March-April 1999) the relationship between Ku-band backscatter and snow properties, a snow melt detection and monitoring method is developed. We derive daily global maps of dry snow extent, melt/refrozen snow zones, and snow retreat over the northern hemisphere on the daily basis. SeaWinds/QuikSCAT snow results compared well with in-situ measurements from the global network of weather stations. Time-series comparison of SeaWinds/QuikSCAT signature with seasonal snow field observations at Ivotuk, Alaska indicates the scatterometer can determine the local snow melt onset time, duration of diurnal melt-refreeze cycles, and snow departure time. We show the evolution of seasonal snow cover over the northern hemisphere in 1999-2001 with animations of time-series QuikSCAT/SeaWinds imagery. Scatterometer results reveal the anomalous warming event coincident with the 1999 winter solstice in Alaska, and rapid snow melt process across the Canadian Arctic archipelago in late spring of 2000. Initial geophysical model for snow depth is developed based on the 1999-2000 snow season at Umiat in Alaska, and the model is applied to retrieve snow depth at that region for the 2000-2001 snow season. Advantages and limitations of scatterometer applications to snow remote sensing are discussed. We indicate that extensive snow experiments with accurate in-situ measurements are necessary to develop quantitative geophysical models for snow parameter retrieval and to validate results obtained from satellite data.

This paper is invited for Session on Snow and Glacier Monitoring by Barry Goodison

---