Monitoring Boreal Ecosystem Phenology with Integrated Active/Passive Microwave Remote Sensing

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The important role of the high latitudes in the functioning of global processes is becoming well established. The size and remoteness of arctic and boreal ecosystems, however, pose a challenge to quantification of both terrestrial ecosystem processes and their feedbacks to regional and global climate conditions. Boreal and arctic regions form a complex land cover mosaic where vegetation structure, condition and distribution are strongly regulated by environmental factors such as moisture availability, permafrost, growing season length, disturbance and soil nutrients. The timing of spring thaw in particular, can influence boreal carbon uptake dramatically. With boreal forests accumulating 1% of their annual total accumulated carbon each day of the growing season, variability in timing of spring thaw can trigger total interannual variability in carbon uptake on the order of 30%.

We utilize active and passive microwave remote sensing measurements from spaceborne scatterometers and radiometers to examine interannual variability and multi-year trends in seasonal freeze/thaw cycles across the pan-boreal landscape. Ku-band backscatter data are available from the SeaWinds scatterometer on Quikscat for June 1999 to the present, and from the NASA scatterometer (NSCAT) from late 1996 through June 1997. Contemporary brightness temperature measurements are available from SSM/I, while SMMR brightness temperature measurements extend from the late 1970's. These data allow investigation of the synergistic use of active/passive microwave measurements, as well as longer-term assessments of the timing of spring thaw and associated growing season initiation in the boreal high latitudes. We extend our on-going work in applying spaceborne radars for monitoring boreal growing season dynamics to include application of contemporary and historic brightness temperature measurements from SSM/I and SMMR. We investigate the synergistic use of the active/passive measurement suite and we assess interannual variability in growing season initiation and length. Providing a useful measure for estimates of growing season timing, these data sets enable examination of historical spatial and temporal patterns in boreal growing season.

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