

SNORTEX. Abstract

The aim of the SNORTEX investigation is to measure the Bidirectional Reflectance Distribution Function (BRDF) of the European boreal ecosystem on a seasonal basis with the presence of snow. The mixture formed by the dyptique forest-snow yields a complex medium because the two entities own quite distinct directional and angular optical signatures. For such, the radiometric signal collected by a sensor observing boreal canopies will show fast changes of BRDF characteristics during a springtime period covering snowmelt. Remote sensing observations are very useful in this regard since they offer a mean to monitor the life of the boreal ecosystem at an appropriate coarse scale resolution and on a routine basis. However, the frequency of imagery information is severely constrained at short wavelengths by the high cloud coverage in this region of the world. On the southern part of the boreal region, this issue can be circumvented by the use of geostationary satellites whereas polar systems with daily multiple orbit passes contribute to document the northern part. The problem arises for a latitude band typically comprised between 65° and 75° where occurs important meteorological phenomena.

Climate events at high latitudes are primarily driven by the surface albedo which shows for the visible spectrum the more observable temporal variations, ranging typically from 0.90 in wintertime for open snow targeted areas to around 0.10 in summertime for high stems densities. Then, the dynamic of the springtime surface albedo is stretched between these two scenarios, which time and duration show in fact a high level of inter-annual variability. It follows that the surface temperature arising from the relative quantity of absorbed down-welling solar radiation may also vary rapidly, which yields serious implications in numerical weather prediction.

An accurate assessment of the surface albedo requires an a priori knowledge of the anisotropic properties of this surface in which an incoming radiation beam hitting an element of this surface is scattered after it has suffered a single or multiple interactions. The problem is complex in the case of boreal species since they yield a detailed architecture with different levels of clumping. It turns to be even more difficult when the understorey is a snow layer, which enhances the scenario of multiple bouncing for light ray trapped within the forest layer. Actually, the difficulty relies on the fact to find equivalent optical properties for such binary medium from the strict point of view of the radiation transfer theory devoted to homogeneous canopies. It is then necessary to consider gap probabilities of light penetration within and between crowns. In fact, the number of small sun flecks on the ground is quite high and they play an important role in the snow melting process. For such reason, it appears important to get measurements of the radiation regime at a few meters resolution with corresponding BRDF acquisition.

The instrumental design of the OSIRIS sensor allows to obtain an accurate sampling of relevant directional signatures like the hot spot effect – the maximum of reflectance observed in the sun direction – associated to the forests, and the specular effect – the forward scattering peak – characterizing the snow metamorphism. The OSIRIS instrument and two pairs of pyranometers will be attached to a helicopter to measure simultaneously the BRDF and the broad band albedo of the forested and open snow covered areas in the surroundings of FMI-ARC in Sodankylä, Finland. At the same time the snow properties will be measured at the ground. Experimental campaigns will be arranged in spring 2008, 2009 and 2010. Both midwinter and melting periods will be covered.