The impact of drought on land surface albedo

Wang S*, Davidson A*, Latifovic R*, and Trishchenko, A*

* Canada Centre for Remote Sensing, Natural Resources Canada, Ottawa, ON, Canada

Abstract

Albedo controls radiation partitioning of a surface and affects its physical, biological, and biogeochemical processes. Recent studies have indicated that climate change induced by the land surface albedo change due to land cover and land use changes can have similar or even greater magnitude than that induced by doubling atmospheric CO2 concentration. Land surface albedo can be changed by anthropogenic as well as natural factors. While anthropogenic changes involving changes in land use tend to be persistent, albedo changes caused by natural factors can be dynamic and difficult to quantify. For example, it is well known that albedo of water-stressed leaves tends to be higher than well-turgored leaves. However, how water-stressed ecosystem can affect land surface albedo at large scale has rarely been studied. This knowledge gap may cause great uncertainties in the climate model projections. We investigated the impact of drought on land surface albedo for four typical ecosystems in Canada: temperate grassland, cropland, boreal deciduous and conifer forests. The study region includes the whole Canada prairies and part of the boreal forest close to its north border. In 2001, precipitation was below historical average for most of the area. As a result, extensive drought occurred across the region. In 2003, precipitation was close to its normal for most of the region. The 1km resolution land surface albedo product from MODIS
onboard Terra was used. It was found that in 2001, visible band (VIS) albedo in some of the grassland and cropland areas reached as high as 15%, indicating low biomass and vegetation cover caused by drought. In 2003, however, most of the prairie area VIS albedo remained below 10% due to the better crop growing conditions. Water stress in 2001 also led to the higher near infrared (NIR) albedo for most of the prairie regions. For the forest areas, there were no significant differences found in both VIS and NIR albedos between the two years. In conclusion, albedo changes for the grassland and cropland caused by drought could exceed well above 5%. Although this difference seems small, it may be large enough to influence the surface energy balance, and ultimately climate. Therefore, albedo changes caused by drought could significantly feed back to climate on the local, and possibly global, scale.