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Monitoring of the permafrost surface active layer in Quebec and in the Arctic using remote sensing

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Projected future warming is particularly strong in the Northern high latitudes. Increases of temperatures are up to 2 to 6°C in the northern high latitudes, and up to 3 to 8°C in the North Pole area. Permafrosts (grounds with negative temperatures at least two years in a row) are present on 25 % of the northern hemisphere lands and contain high quantities of « frozen » carbon, estimated at 1400 Gt (40 % of the global terrestrial carbon). Recent studies have shown that a significant part (50%) of the first meters of the permafrost could melt within 2050, and 90 % within 2100.
The aim of this study is to help understand the climate evolution in arctic areas, and more specifically of land areas covered by snow. We want to describe the ground temperature all year round even under snow cover. We hope to be able to deduce the active layer thickness evolution over the last ten years in northern Quebec.
With the use of satellite data (fusion of Modis land surface temperature « LST » and AMSR-E brillance temperature « Tb », land cover . . .), and with the assimilation of these observations in the Canadian Landscape Surface Scheme (CLASS, CLASS-SSA) and in a simple radiative transfert model (HUT), we try to benefit from the advantages of each one of the sources in order to complete two objectives : 1- build a solid methodology in order to retrieve the land surface temperature, with and without snow cover, in taïga and toundra areas ; 2 – from those retrieved land surface temperatures, describe the ground temperature during summer as well as in winter (under snow) so that we can have a better look at the summer melt of the permafrost active layer.
We have proposed a methodology that takes into account the evolution of two main input parameters of the CLASS model (air temperature and precipitations) in order to minimise the LST and Tb ouput. The proposed methodology seems to improve the results on the LST and Tb at 10 and 19 GHz in summer in a toundra environment. Further steps will be to aply this methodology with snow cover and in a taïga environment.
A better understanding of the permafrost evolution processes, and particularly the impact of the snow cover should enable us to better aprehend the impact of the global warming on the melt of permafrosts and the futur of their carbon stock.