**Potential of Detecting Freeze and Thaw States Using Microwave Land Surface Emissivity**

About more than one-third of the global land surface undergoes seasonal freezing and thawing process, which has profound impacts on the terrestrial water cycle, net primary productivity, the carbon cycle, surface energy budget and hence the global climate system. The seasonal freezing and thawing is controlled by temperature, soil texture, soil moisture content, vegetation, and microclimate. Transitions between freeze and thaw (FT) states depend on the amount of heat energy the surface receives or releases and on the corresponding change in seasonal and diurnal temperatures. Since ground-observations of FT states in boreal regions are generally sparse and inconsistent, the monitoring of FT process in these areas is difficult. Remote sensing applications in the active and passive microwave have shown to be reliable in monitoring dynamics at regional and global scales. Microwave remote sensing provides more frequent observations (at least twice a day and more frequent in the Polar regions) and is less affected by clouds. The dielectric changes between freeze and thaw states make the microwave remote sensing unique for characterizing the surface FT process. The change in dielectric can dramatically affect the brightness temperature (Tb) signal when water transits from the liquid to the solid phase. Therefore, PMW studies have been used to investigate thresholds to detect FT states and a global daily FT product has been developed. However, the problem with directly using Tbs from PMW sensors is that they are affected by water vapor in the atmosphere even if cloud-free measurements are utilized, especially at higher frequencies (above 19 GHz). Furthermore, Tbs depend on both the temperature and the emissivity values of the footprint. Emissivity can be representative of the surface state and change in dielectric. Since brightness temperatures (Tb) measured from the satellite-based passive microwave radiometers are affected by atmospheric water vapor and emissivity is free from atmospheric effects, emissivity is supposed to be better parameter for freeze and thaw states detection. This project aims to develop an algorithm for freeze-thaw detection for each land cover type and region.