InSAR detection of thermokarst after a tundra wildfire, using ALOS-PALSAR

*Go Iwahana[1], Masao Uchida[2], Tsutomu Yamanokuchi[3], Larry Hinzman[1]

1.International Arctic Research Center, University of Alaska, 2.National Institute for Environmental Studies, 3.Remote Sensing Technology Center of Japan

Through the subsidence of ice-rich permafrost upon thaw (thermokarst), the consequences of permafrost degradation for surface ecology, landscape evolution, and hydrological processes have been of great scientific interest and social concern. Part of a tundra patch affected by wildfire in northern Alaska (27.5 km2) was investigated here, using remote sensing and in-situ survey to understand permafrost thaw dynamics after surface disturbances. L-band InSAR with spatial resolution of less than ten meters detected ground subsidence triggered by the tundra fire. We introduced a calibration procedure comparing burned and unburned areas for InSAR subsidence signals to remove the noise from seasonal surface movement. In the first year after the fire, an average surface subsidence rate of 6.2 cm/year (vertical) was measured. Subsidence in the burned area continued over the following two years with decreased rates. These results suggest that this InSAR-measured ground subsidence is caused by the thaw of ice-rich permafrost (thermokarst), a feature supported by surface change observations from high-resolution optical images and in-situ ground level surveys. InSAR analysis clearly showed spatial variation in thermokarst subsidence at fine scale, enabling us to investigate dynamics of thermokarst processes and quantify permafrost degradation, and leading to accurate estimates of ground ice loss upon permafrost thaw.

