Thermokarst modifies landscape, reroutes surface and groundwater flow, changesvegetation, increases wildfire susceptibility, and releases carbon dioxide and methane to the atmosphere. Understanding the physics of the thermokarst lifecycle– from incipient thaw to catastrophic drainage – is complicated by coupled thermal,hydrological, and mechanical feedbacks. Models representing how suprapermafrost zones evolve above degrading permafrost are limited by a lack of real-world observation. This project aims to calibrate existing thermokarst models through a controlled-warming experiment in Fairbanks, Alaska. During August – October 2016, we used 122 60-W vertical resistive heaters to ablate a 4-4.5m-deep, 140 m2 permafrost table by about 1 m, which resulted in as much as 10 cm of subsidence in some areas. A dense array of traditional and distributed fiber optic sensors captured different components of the thaw process at this interface. Surface and vertical slimhole temperature sensors (thermocouples and fiber optic distributed temperature sensing) were installed above and below the permafrost table to measure the thermal evolution of the suprapermafrost-permafrost interface. Electronic Distance Measurement (EDM), GPS, time-lapse photogrammetry, LiDAR, and fiber optic distributed strain sensing recorded the deforming surface topography. Passive ambient vehicular traffic and a surface orbital vibrator (SOV) active source were recorded by geophone, broadband, and fiber optic distributed acoustic sensing instruments, enabling measurement of changes in relative shear wave speed and dispersive surface wave propagation. Using this multifaceted dataset, we examine the timing and velocity of the suprapermafrost-permafrost interface as a consequence of heat transport, and examine the coupling between thermal erosion and mechanical deformation.