ABSTRACT: In 2001, a Permafrost Observatory was established within the Barrow Environmental Observatory in Barrow, Alaska under the auspices of the International Arctic Research Center of the University of Alaska Fairbanks. The observatory was established at the locations where permafrost temperatures were measured during the 1950s and early 1960s by M. Brewer of the U.S. Geological Survey to compare present permafrost temperatures with those obtained by M. Brewer. Those measurements were of very high quality, with a precision of generally 0.01°C. Comparison of permafrost temperature profiles obtained at the same location by Brewer on October 9, 1950 and by the UAF research group on October 9, 2001 shows that at the 15-meter depth (which is slightly above the depth of annual temperature variations) the permafrost temperature was warmer by 1.2°C in 2001 than in 1950. Since 2001, permafrost temperature at this depth increased additionally by 0.5°C. Most of this latest increase happened after 2005. Similar permafrost temperature dynamics during the last ten years was observed at the UAF Permafrost Observatories in the Prudhoe Bay region and could be explained both by an increase in air temperatures and in the snow depth at these locations. In 2012, the UAF permafrost observatory in Barrow was extended by installation of additional sensors at the three NGEE Arctic intensive research sites within the Barrow Environmental Observatory. The new installations allow establishing a two-dimensional view of the active layer and permafrost temperature dynamics at these locations.

A site-specific numerical model for the Barrow permafrost temperature regime was developed in the GI Permafrost Lab. The model was calibrated using data from shallow (down to one meter) soil temperatures obtained by K. Hinkel at a Barrow site with surface conditions similar to the Brewer site. No data from the Brewer sites were used for the calibration. Comparison of the modeling results and the Brewer’s measured data shows an excellent agreement. The daily air temperatures and snow cover thickness during the entire period of measurements (1924-2011) at the Barrow meteorological station were used as input data for this calibrated model. As a result, a time series of daily ground temperatures for the depths between 0 and 200 meters were obtained. Analysis of this time series will be used in this presentation to reveal the effect of changes in air temperature and in snow depth on permafrost temperature and on the active layer thickness. Possible changes in these parameters as a result of the predicted changes in climate during the 21st century will be also presented.