This data package provides data used to assess the roles of climate extremes, ecological succession, and hydrology in repeated permafrost aggradation and degradation in fens on the Tanana Flats, central Alaska. The package provides data on site environmental information, Fairbanks climate, vegetation cover, water levels and temperatures, as well as GIS files for fen change detection. The Site data include information on observers, locations, geomorphology, hydrology, soils, vegetation, and disturbance. The table has numerous fields that uses coding for class characteristics and these codes are described in the metadata as well as compiled in the ELS\_Arctic\_Boreal\_Site\_Soil\_Veg\_Code\_Sheet\_2020.docx. Alaska Climate records for Fairbanks (UAF Experiment Station) from 1904 to 2019 were acquired from the National Oceanic and Atmospheric Administration (https://www.ncdc.noaa.gov/cdo-web/). Additional data were obtained for the Nenana station (about 70 km southwest of Fairbanks), to fill in small data gaps (particularly precipitation/snow depth ruler measurements) in the Fairbanks record. We attributed the data with fields for summer (May-September) and winter periods (November-March) and hydrologic year (October-September) and calculated mean air temperature, precipitation, and snow depth by seasonal period (average of daily values) and year. The broad summer and winter periods were of interest because warmer and wetter summers increase soil heat input and warmer and snowier winters reduce soil heat loss. Fen hydrology data include information on fen water level/pressure and temperatures collected every two hours at seven sites within fens from 2011 to 2014. Vegetation composition and cover of fens, scrub, and forests was sampled to assess effects of thermokarst on vegetation change. Plant cover was determined by point-sampling at 100 points (including repetitive “hits” for all layers) distributed along 5 equally spaced rows (4-m long, 20 points per row) across the 10-m long plot. The plots were examined for additional species and a cover of 0.1% was assigned to all species not captured in the point sampling. Taxonomy follows that of the Flora of Alaska provisional checklist (https://floraofalaska.org/provisional-checklist/). The GIS files include two ArcMap GIS shapefiles on the systematically sampled widths of three large fen systems on the Tanana Flats. This 2019 dataset analyses change in fen widths by measuring widths of fens evident on high resolution imagery from 1949, 1978, 2003, and 2018.  The data were collected in conjunction with a project to assess patterns and rates of thermokarst in lowland ecosystems in central Alaska. The project was funded by the U.S. Army SERDP program.