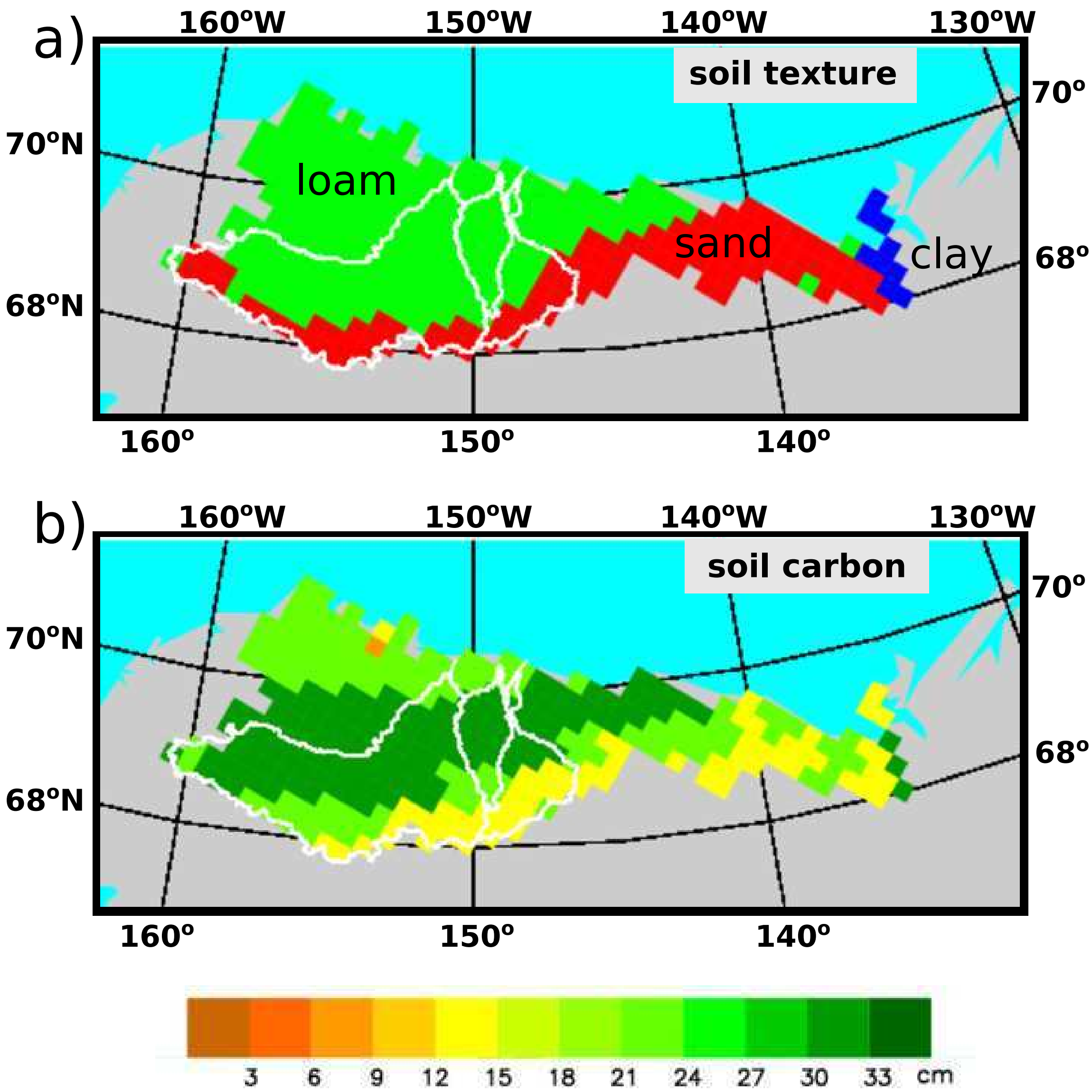

Figure S1: a) Soil texture classes and b) thickness of surface soil carbon layer used in model parameterizations. Soil carbon thickness includes all soil layers for which some amount of carbon is present. Primarily mineral soil exists downward over the remainder of the soil column.

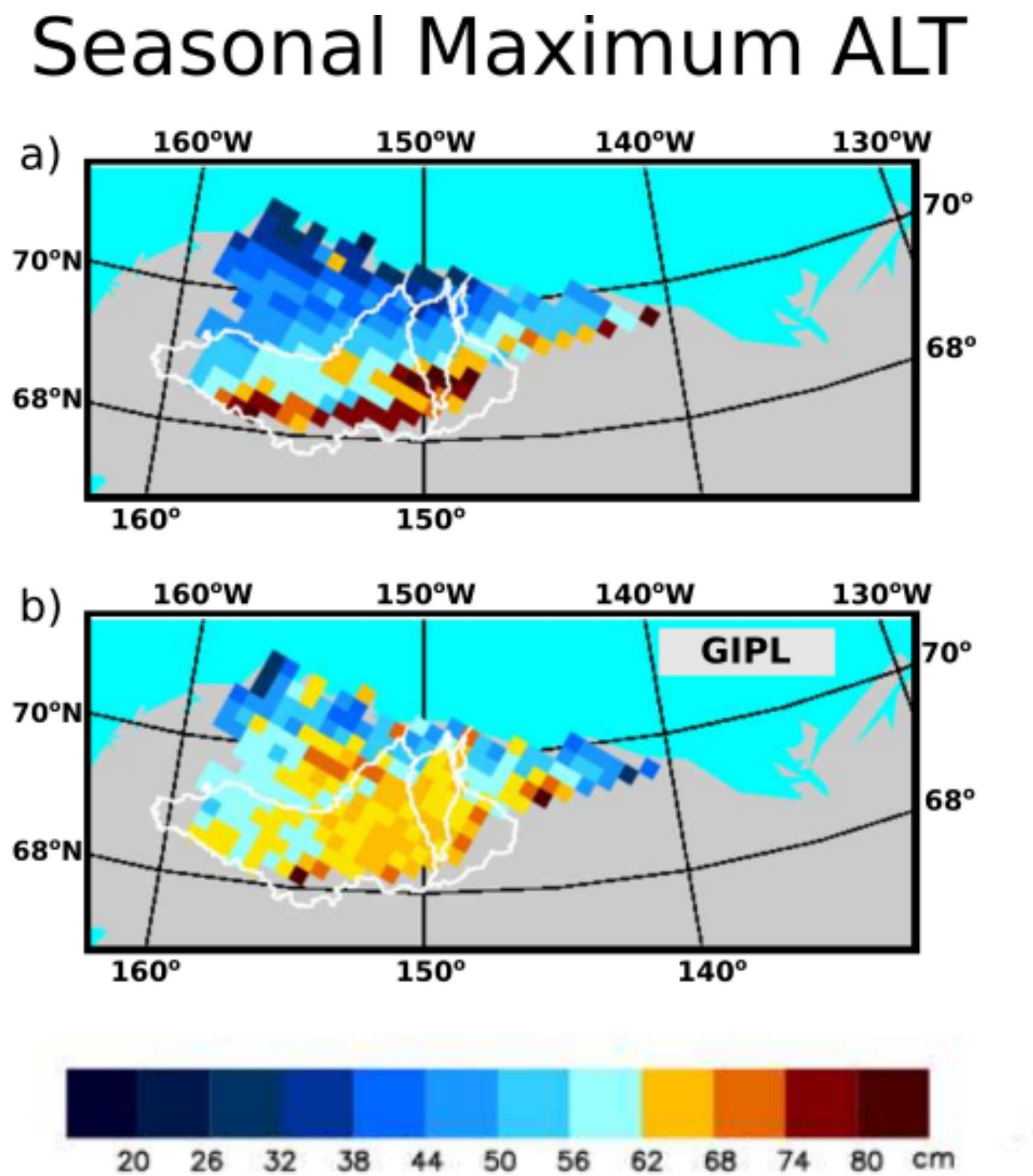

Figure S2: a) Seasonal maximum ALT (cm) as an average over the period 1981–2010 from a) PWBM and b) GIPL. Evaluations are made for the 217 (of 312) domain grid cells which have GIPL ALT data. For PWBM the seasonal maximum ALT is calculated as the depth to which the 0 °C penetrates each summer. Nicolsky et al. (2017) provides details on the GIPL ALT.

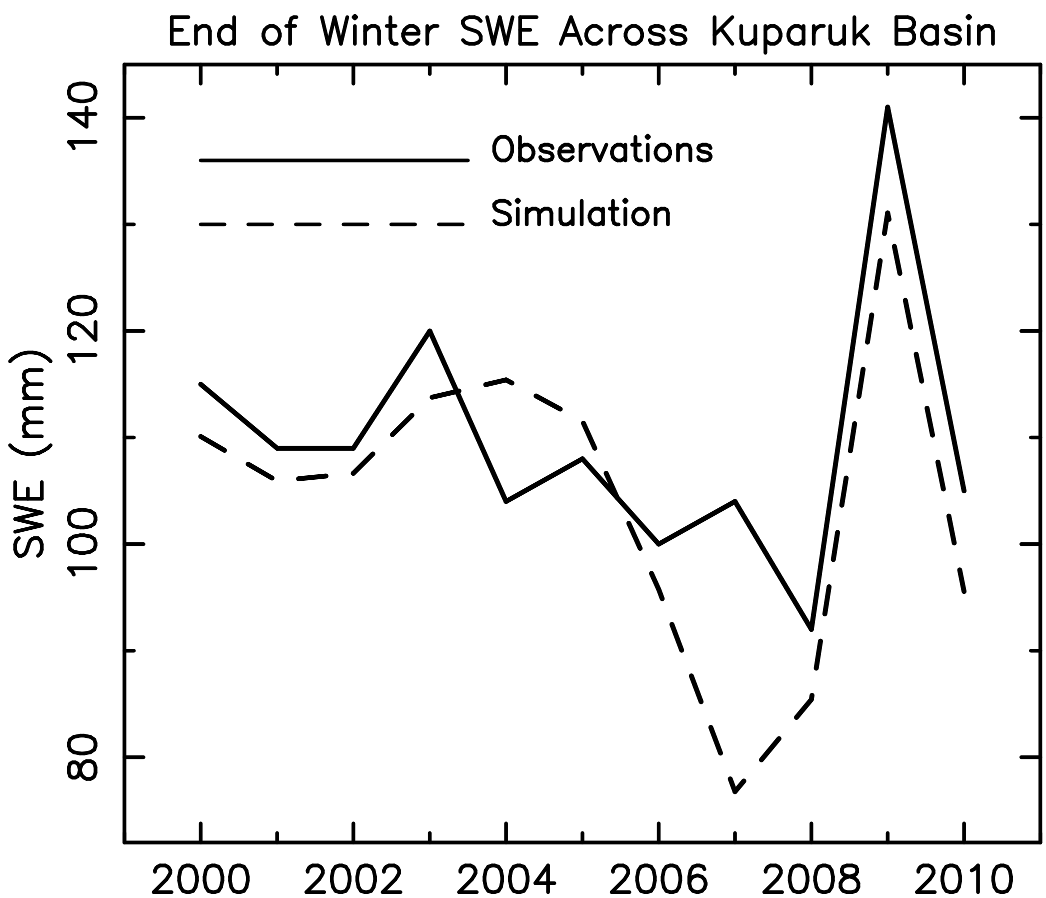

Figure S3: Observed and model simulated end of winter snow water equivalent (SWE, mm) for the Kuparuk River basin 2000–2010. Observed values represent an average of measurements made across the basin as described by Stuefer et al. (2013). Simulated end of season SWE is calculated as the average between 24 April and 7 May each year.

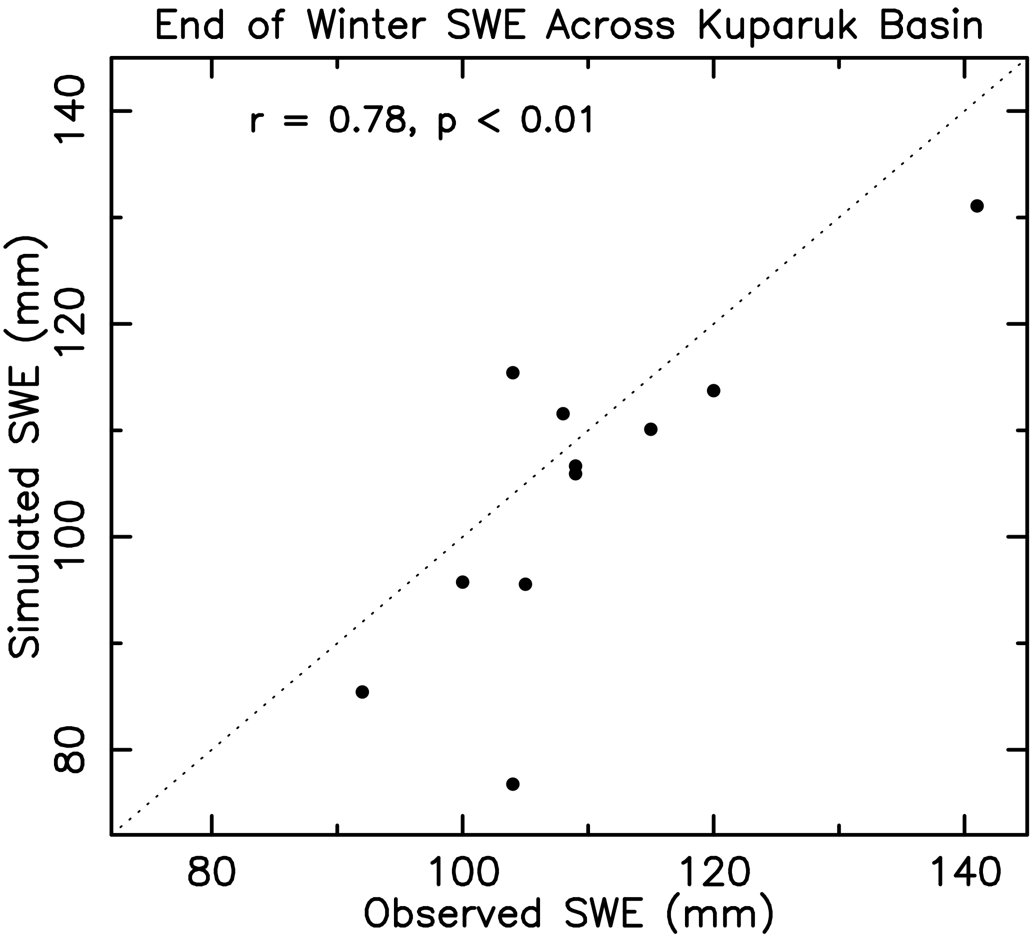

Figure S4: Observed and model simulated end of winter SWE (mm) for the Kuparuk Basin 2000–2010.

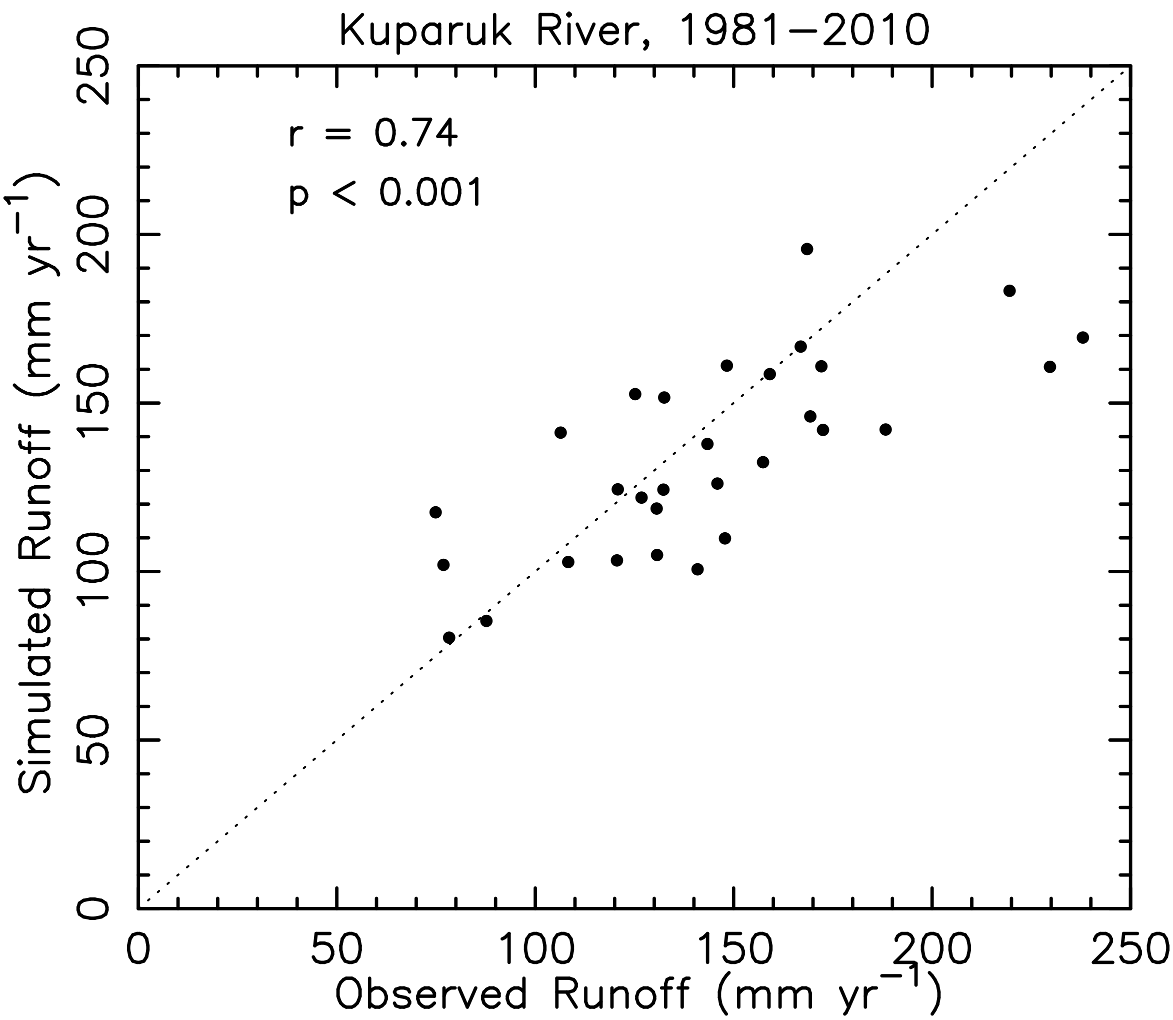

Figure S5: Simulated vs. observed annual total R (mm yr^{-1}) for the Kuparuk basin. Correlation coefficient (LLS) is $r = 0.73$ ($p < 0.001$).

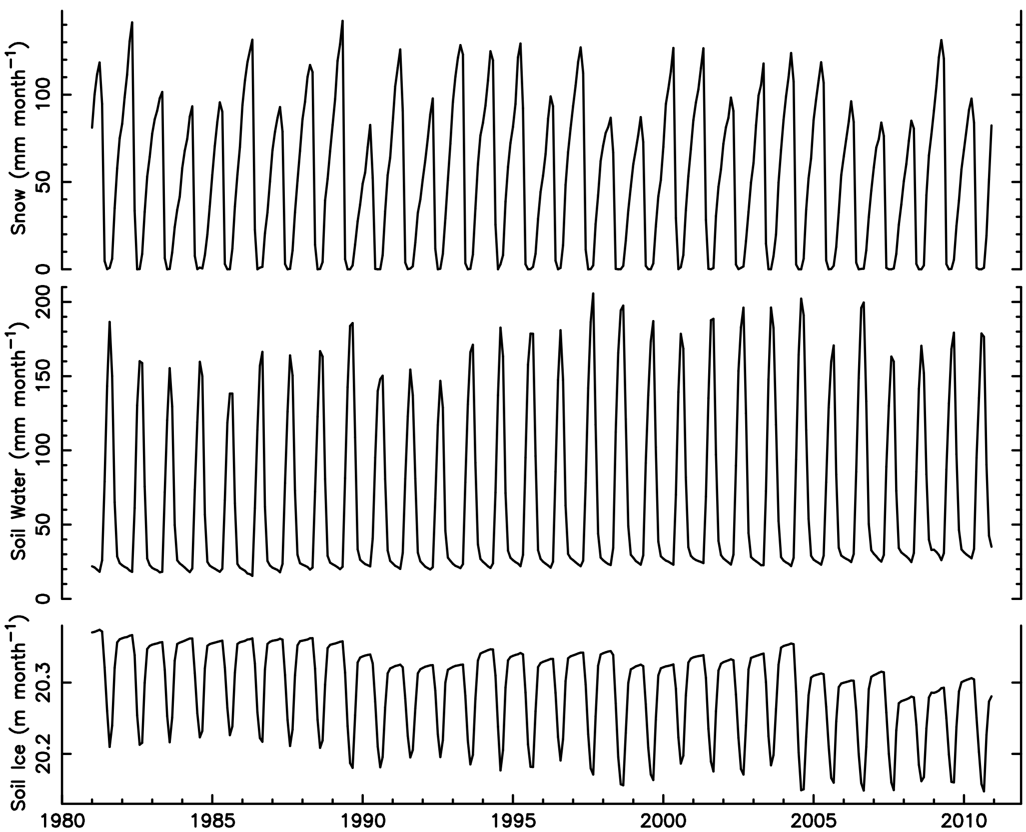

Figure S6: Monthly water storage for snow (solid and liquid portions, mm month^{-1}), soil water (mm month^{-1}), and soil ice (m month^{-1}) as an average across the North Slope drainage basin. Amounts are totaled over the full 60 m model soil column

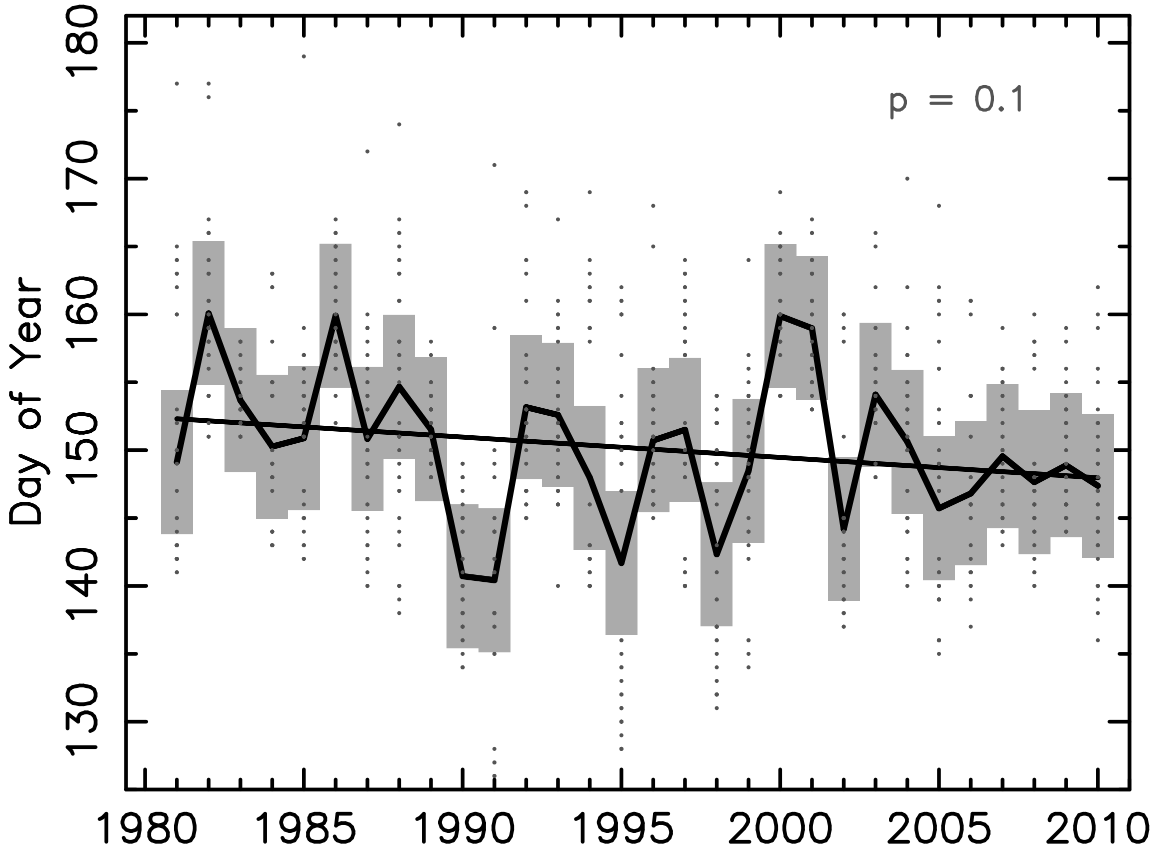

Figure S7: Date of maximum river Q 1981–2010 for all 42 North Slope rivers. Gray bar shows the 1-σ range around the average date (solid line). Dots indicate the date for each basin. Linear least squares trend shown. Significance of linear trend (GLM) is approximately p = 0.1