The Supplement includes all figures that are not shown in the paper. Figures present the performance of the representations of the three subsurface processes discussed in the paper under different climate conditions and soil properties of three sites, different scales, and different hillslope configurations. Figures compare modeled hydrological quantities in time series and correlation.

- The three subsurface processes discussed in this paper are:
  (1) assuming ice has equal density with liquid water
  (2) neglecting cryosuction effect in unsaturated soil during soil freezing
  (3) neglecting advective heat transport
- The three sites are:
  (1) Utqiagvik (Barrow Environmental Observatory)
  (2) the headwaters of the Sagavanirktok (Sag) River
  (3) the Teller Road Mile Marker 27 site on the Seward Peninsula of Alaska
- Model were setup based on two scales:
  (1) Column scale representing expansive flat regions
  (2) Hillslope scale representing hilly terrain
- Hillslope scenarios include four configurations:
  (1) Northern aspect, convergent hillslope
  (2) Northern aspect, divergent hillslope
  (3) Southern aspect, convergent hillslope
  (4) Southern aspect, divergent hillslope
- Quantities compared in figures:
  (1) Evaporation rate (mm/d)
  (2) Hillslope downstream outlet discharge (m^3/d)
  (3) Thaw depth (cm)
  (4) Total water saturation, including ice and liquid, at 5 cm beneath soil surface (m^3/m^3)
  (5) Surface temperature (K)
  (6) Soil temperature at 1 m beneath soil surface (K)