Understanding Atmospheric and Hydrologic Controls on Arctic Snowpack Variability

S. Stuefer¹, M. Tsukernik², G.E. Liston³, D. Yang¹
¹University of Alaska, Fairbanks, USA; ²Monash University, Melbourne, Australia; ³Colorado State University, Fort Collins, USA

Snow cover significantly affects hydrologic processes, particularly in cold regions, due to its direct impact on winter water storage and snowmelt runoff. The IPCC Report (2007) and the Arctic Climate Impact Assessment (2005) both project reduced snow accumulation and changes to the seasonal timing of snow accumulation and melt in the next few decades. The high sensitivity of snow to changes in temperature and precipitation suggests synoptic scale forcing may be responsible for snow-related processes at the watershed scale. This study investigates current weather-snow relationships in the Kuparuk River basin (Arctic Alaska) by defining specific events of snow accumulation, transport and melt and analyzing the underlying synoptic scale weather patterns. Snow processes are represented by SnowModel (Liston et al., 2006) simulations from 1979 to 2009 on grid increments of 1 km and temporal increments of 3-hours. SnowModel simulated processes include: snow accumulation, snow redistribution by wind, sublimation, snow-density evolution and snowmelt. For the atmospheric analyses, we utilize NCEP/NCAR Reanalysis for the SLP, 100-500 hPa thickness, 850 hPa winds, etc. Using an adapted version of the cyclone tracking algorithm by Serreze, we define synoptic scale features and classify specific cases responsible for snow accumulation and melt events in the Kuparuk River basin.