Mountain glaciers and ice caps have been diminishing in extent and volume over the last century. Their contribution to sea-level rise has grown over recent decades and is projected to remain an important component of eustatic sea-level rise for at least another century. However, all existing projections on global and regional scales rely on simplified models of glacier surface mass balance and scaling methods. Here we investigate how projections of glacier changes in western Canada (Yukon, Alberta and British Columbia) vary when using models of different complexities. The complex model is a radiation-indexed degree-day melt model coupled with a 2-D ice flow model and applied region-wide with a resolution of 200 m. The bed topography is provided by an inversion algorithm. The model with lower complexity combines a degree-day melt model with the volume-area scaling, and is applied to each individual glacier in the domain. The models are forced with a range of 21st century climate scenarios from six global climate models from the most recent IPCC report. Climate fields from the global climate models are statistically downscaled with two different methods: ‘delta-approach’ and ‘weather-typing’. All projections show substantial ice volume loss, with the majority of smaller glaciers (<5 km²) disappearing by the end of 2100. However, results are highly sensitive to the choice of the forcing GCM, downscaling method and glacier mass balance model. Ice volume losses range from 40 to 80%, contributing on average 3 mm to global sea level rise by the end of the 21st century.