

Table 18-5 | Observed impacts of climate change reported since AR4 on mountains, snow, and ice, over the past several decades, across major world regions, with descriptors for (1) the confidence in detection of a climate change impact; (2) the relative contribution of climate change to the observed change, compared to that of non-climatic drivers; (3) the main climatic driver(s) causing the impacts; (4) the reference behavior of the system in the absence of climate change; and (5) the confidence in attribution of the impacts to climate change. References to related chapters in this report are given as well as key references to other IPCC reports and the scientific literature. Absence of climate change impacts from this table does not imply that such impacts have not occurred.

	Mountains, snow and ice	References	Confidence in detection	Role of climate	Climate driver	Reference behavior	Confidence in attribution
Africa	Retreat of tropical highland glaciers in East Africa	Mölg et al. (2008, 2012); Taylor et al. (2009)	<i>Very high</i>	Major	Warming, drying	No change	<i>High</i>
Europe	Retreat of Alpine, Scandinavian, and Icelandic glaciers	WGI AR5 Section 4.3.3; Bauder et al. (2007); Björnsson and Pálsson (2008); Paul and Haeberli (2008); WGMS (2008); Zemp et al. (2009); Andreassen et al. (2012); Marzeion et al. (2012); Gardner et al. (2013)	<i>Very high</i>	Major	Warming	No change	<i>High</i>
	Increase in rock slope failures in western Alps	Sections 18.3.1.3 and 23.3.1.4; Fischer et al. (2012); Huggel et al. (2012a)	<i>High</i>	Major	Warming	No change	<i>Medium</i>
Asia	Permafrost degradation in Siberia, Central Asia, and the Tibetan Plateau	WGI AR5 Section 4.7.2; Section 24.4.2.2; Romanovsky et al. (2010); Yang et al. (2013)	<i>High</i>	Major	Warming	No change	<i>High</i>
	Shrinking mountain glaciers across most of Asia	WGI AR5 Section 4.3.3; Section 24.4.1.2; Box 3-1; Bolch et al. (2012); Cogley (2012); Gardelle et al. (2012); Kääh et al. (2012); Yao et al. (2012); Gardner et al. (2013); Stokes et al. (2013)	<i>High</i>	Major	Warming	No change	<i>Medium</i>
Australasia	Substantial reduction in ice and glacier ice volume in New Zealand	WGI AR5 Section 4.3.3; Table 25-1; Chinn et al. (2012)	<i>High</i>	Major	Warming	No change	<i>Medium</i>
	Significant decline in late-season snow depth at three out of four alpine sites in Australia 1957–2002	Table 25-1; Nicholls (2006); Hennessy et al. (2008)	<i>High</i>	Major	Warming	No change	<i>Medium</i>
North America	Shrinkage of glaciers across western and northern North America	WGI AR5 Section 4.3.3; Gardner et al. (2013)	<i>High</i>	Major	Warming	No change	<i>High</i>
	Decreasing amount of water in spring snowpack in western North America 1960–2002	Stewart et al. (2005); Mote (2006); Barnett et al. (2008)	<i>High</i>	Major	Warming	No change	<i>High</i>
South and Central America	Shrinkage of Andean glaciers	WGI AR5 Section 4.3.3; Section 27.3.1.1; Table 27-3; Vuille et al. (2008); Bradley et al. (2009); Jomelli et al. (2009); Poveda and Pineda (2009); Marzeion et al. (2012); Gardner et al. (2013); Rabatel et al. (2013)	<i>High</i>	Major	Warming	No change	<i>High</i>
Polar regions	Decreasing Arctic sea ice cover in summer	WGI AR5 Section 4.2.2.1; ACIA (2005); AMAP (2011)	<i>Very high</i>	Major	Air and ocean warming, change in ocean circulation	No change	<i>High</i>
	Reduction in ice volume in Arctic glaciers	WGI AR5 Section 4.3.3; ACIA (2005); Nuth et al. (2010); AMAP (2011); Gardner et al. (2011, 2013); Moholdt et al. (2012)	<i>Very high</i>	Major	Warming	No change	<i>High</i>
	Decreasing snow cover across the Arctic	Section 28.2.3.1; AMAP (2011); Callaghan et al. (2011)	<i>High</i>	Major	Warming	No change	<i>Medium</i>
	Widespread permafrost degradation, especially in the southern Arctic	Section 28.2.1.1; AMAP (2011); Olsen et al. (2011)	<i>High</i>	Major	Warming	No change	<i>High</i>
	Ice mass loss along coastal Antarctica	WGI AR5 Sections 4.3.3, 4.4, and 10.5.2.1; Gardner et al. (2013); Miles et al. (2013)	<i>Medium</i>	Major	Warming	No change	<i>Medium</i>