

**Table 18-6** | Observed impacts of climate change reported since AR4 on rivers, lakes, and soil moisture, 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.

	Rivers, lakes, and soil moisture	References	Confidence in detection	Role of climate	Climate driver	Reference behavior	Confidence in attribution
Africa	Reduced discharge in West African rivers	d'Orgeval and Polcher (2008); Dai et al. (2009); Di Baldassarre et al. (2010)	Medium	Major	Reduced precipitation	No change	Low
	Lake surface warming and water column stratification increases in the Great Lakes and Lake Kariba	Section 22.3.2.2; Tierney et al. (2010); Ndebele-Murisa et al. (2011); Powers et al. (2011)	High	Major	Warming	No change	High
	Increased soil moisture drought in the Sahel since 1970, partially wetter conditions since 1990	Section 22.2.2.1; Hoerling et al. (2006); Giannini et al. (2008); Greene et al. (2009); Seneviratne et al. (2012)	Medium	Major	Change in precipitation	No change	Medium
Europe	Changes in the occurrence of extreme river discharges and floods	Section 23.2.3; Schmocker-Fackel and Naef (2010); Beniston et al. (2011); Cutter et al. (2012); Vorogushyn and Merz (2012); Kundzewicz et al. (2013)	Low	Minor	Change in precipitation; change in extreme precipitation	No change	Very low
Asia	Changes in water availability in many Chinese rivers	Table SM24-4; Zhang et al. (2007); Zhang, S. et al. (2008)	High	Minor	Change in precipitation	Changes due to land use	Low
	Increased flow in several rivers in China due to shrinking glaciers	Casassa et al. (2009); Li et al. (2010); Zhang, Y. et al. (2008)	High	Major	Warming	No change	High
	Earlier timing of maximum spring flood in Russian rivers	Section 28.2.1.1; Shiklomanov et al. (2007); Tan et al. (2011)	High	Major	Warming	No change	Medium
	Reduced soil moisture in North Central and Northeast China 1950–2006	Sections 24.3.1 and 24.4.1.2; Sheffield and Wood (2007); Wang, A. et al. (2011); Seneviratne et al. (2012)	Medium	Major	Warming; change in precipitation	No change	Medium
	Surface water degradation in parts of Asia	Section 24.4.1.2; Prathumratana et al. (2008); Delpla et al. (2009); Huang et al. (2009)	Medium	Minor	Warming; change in precipitation	Changes due to land use	Medium
Australasia	Intensification of hydrological drought due to regional warming in Southeast Australia	Table 25-1; Nicholls (2006); Cai et al. (2009)	Low	Minor	Warming	No change	Low
	Reduced inflow in river systems in southwestern Australia (since the mid-1970s)	Table 25-1; Section 25.5.1; Cai and Cowan (2006); Nicholls (2010)	High	Major	Change in precipitation; warming	No change	High
North America	Shift to earlier peak flow in snow dominated rivers in western North America	Barnett et al. (2008)	High	Major	Warming; change in snow	No change	High
	Runoff increases in the midwestern and northeastern USA	Georgakakos et al. (2013)	High	Minor	Change in precipitation; warming	No change	Medium
South and Central America	Changes in extreme flows in Amazon River	Section 27.3.1.1; Butt et al. (2011); Wang, G. et al. (2011); Espinoza et al. (2013)	High	Major	Change in precipitation; change in extreme precipitation	No change	Medium
	Changing discharge patterns in rivers in the Western Andes; for major river basins in Colombia discharge has decreased during the last 30–40 years	Section 27.3.1.1; Table 27-3; Vuille et al. (2008); Casassa et al. (2009); Poveda and Pineda (2009); Baraer et al. (2012); Rabatel et al. (2013)	Medium	Major	Warming	No change	Medium
	Increased streamflow in sub-basins of the La Plata River	Section 27.3.1.1; Pasquini and Depetris (2007); Krepper et al. (2008); Saurral et al. (2008); Conway and Mahé (2009); Krepper and Zucarelli (2010); Doyle and Barros (2011)	High	Major	Change in precipitation	Increase due to land use	High
Polar regions	Increased river discharge for large circumpolar rivers (1997–2007)	Section 28.2.1.1; Overeem and Syvitsky, (2010)	High	Major	Warming; change in precipitation; change in snow cover	No change	Low
	Winter minimum river flow increase in most sectors of the Arctic	Section 28.2.1.1; Tan et al. (2011)	High	Major	Warming; change in snow cover	No change	Medium
	Increasing lake water temperatures 1985–2009, prolonged ice-free seasons	Section 28.2.1.1; Callaghan et al. (2010); Schneider and Hook (2010)	Medium	Major	Warming	No change	Medium
	Thermokarst lakes disappear due to permafrost degradation in the low Arctic, new ones created in areas of formerly frozen peat	Section 28.2.1.1; Riordan et al. (2006); Marsh et al. (2008); Prowse and Brown (2010)	High	Major	Warming	No change	High
Small islands	Increased water scarcity in Jamaica	Gamble et al. (2010); Jury and Winter (2010)	Low	Minor	Change in precipitation	Increase due to water use	Very low