Summary of expected climate-related changes in the Northern U.S. Rockies[1]

Climate variable	Changes experienced historically	Direction and range of change expected in the future	Seasonal patterns of change	Confidence
Temperature	+0.99°C increase in annual mean temperature between 1961-2006 in MT, WY and ID.	Annual mean temperatures are very likely to warm at a rate higher than the global average. Approximate annual mean temperature increases for a moderate greenhouse gas emissions scenario: +1.5-3.5°C by 2050; +2.5-5.5°C by 2100.	Warming has been greatest over the winter, spring and summer. Fall has experienced more modest increases in warmth.	Very likely, although exact rates and magnitudes of warming are not certain.
Precipitation	Annually there has been no significant trend; spring precipitation amount and variability has increased; modest reductions in summer.	No change to small increases (+5-10%) in annual precipitation. The increases in annual precipitation are expected to be driven by changes in seasonality with increases across the winter, spring, and fall, but drier summers overall.	General increases in winter (+0-10%); general decreases in summer (-0-10%); uncertain changes in spring and fall.	Increases in precipitation are most likely in winter, but highly uncertain in spring/fall.
Snowpack	Over last ~50 years: declines in snow cover area and April 1 snow-water equivalent; and ~2 weeks earlier onset of spring snowmelt.	Snow season length and snow depth are very likely to decrease.	Decline in winter snowpack and a hastening of the onset of snowmelt in the spring.	Temperature-driven declines in snow are very likely, although increases in winter precipitation may somewhat offset those declines at higher elevations.
Stream flow	Earlier runoff, lower summer baseflows.	Streams will continue to advance their runoff timing if air temperatures continue to increase. Summer flows may also continue to decrease, although this trend is dependent on trends in precipitation (which are uncertain – see above).		High confidence in streamflow advances. Medium confidence in summer flow trends.

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Stream temperature	From 1980-2009, the average annual stream temperature warming trend across the northwest US was 0.11°C/decade.	Streams will continue to get warmer if air temperatures continue to increase. The proportional gain in stream temperatures is about 60% that of air temperatures, except in winter for some streams where air temperatures are below zero.	From 1980-2009, stream temperatures cooled in the spring but warmed during the summer, fall, and winter across the northwest US. Summer temperature increases were fastest 0.22°C/decade.	High confidence that stream temperatures will continue to increase but the specific rate of warming depends on the rate of air temperature increases.
Extreme events: Flooding	Changes in magnitude of annual flood (higher in some streams, lower in others).	Trends in flood magnitude (both higher and lower) are highly likely to continue.		High confidence in streamflow advances and flooding trends.
Extreme events: Drought	Western U.S. experienced a prolonged drought from 1999-2004.	Drought frequency and severity likely to increase.	Greatest impacts in summer.	Changes in drought are primarily a function of increasing temperatures and therefore likely, even with significant (5-10%) increases in average precipitation.
Extreme events: Temperature	Longer growing or frost-free season; increases in warm events and decreases in cold events.	Increase in warm events; decrease in cold events.	Longer, more frequent and intense heat waves in summer; fewer, shorter, less intense cold extremes in winter.	Very likely since correlated to temperature increases.
Extreme events: Precipitation	Some increase in the frequency of heavy precipitation events.	Extreme precipitation events may increase, even with no change in mean precipitation amounts.	Increased heavy precipitation events may occur in the winter.	With warming, it is likely that there will be an increase in extreme precipitation events.

[1] Sources include: IPCC 2007 and references; PRISM historical climate data; Leppi et al. 2011; Luce & Holden 2009; Stewart et al. 2005; Rood et al. 2008; Hamlet and Lettenmaier 2007; Mantua et al. 2010; Isaak et al. 2012.