Submitted Abstract

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Abstract

Societies and ecosystems that reside within and downstream of mountains rely on seasonal snowmelt to satisfy their water demands. Anthropogenic climate change has reduced mountain snowpacks worldwide, altering snowmelt magnitude and timing. Here, the global warming level leading to widespread and persistent mountain snowpack decline, termed low-to-no snow, is estimated for the world's most latitudinally contiguous mountain range, the American Cordillera. These estimates are derived from a recent high-resolution Earth system model ensemble (HighResMIP) that include six simulations covering 1950-2100, under a high-emissions scenario, and using atmospheric model intercomparison project (AMIP) protocols. We show a combination of dynamical, thermodynamical, and hypsometric factors results in an asymmetric emergence of low-to-no snow conditions within the midlatitudes of the American Cordillera. Low-to-no snow emergence occurs approximately 20 years earlier in the Southern Hemisphere, at a third of the local warming level, and coincides with runoff efficiency declines in both dry and wet years. Prevention of a low-to-no snow future in either hemisphere requires the level of global warming to be held to, at most, +2.5 deg C.