

Supplementary Table S1. Summary of studies included in the synthesis (219 records)

Author/year	Title	Journal/ source	Study region	Permafrost type	Hydrological focus	Method	Spatial scale	Quantitative data
Aas et al., 2018	Thaw processes in ice-rich permafrost landscapes represented with laterally coupled tiles in a land surface model	The Cryosphere Discuss.	Siberia	Continuous, ice-rich	Permafrost thaw impacts	Numerical modeling	Regional	Yes
Abdelhamed et al., 2022	Hydrologic-land surface modelling of the Canadian sporadic-discontinuous permafrost	Hydrol. Process.	Canada (Northwest Territories)	Sporadic-discontinuous	Permafrost thaw impacts	Numerical modeling	Watershed	Yes
Adam and Lettenmaier, 2008	Application of new precipitation and reconstructed streamflow products to streamflow trend attribution in northern Eurasia	J. Climate	Northern Eurasia	Multiple	Permafrost thaw impacts	Numerical modeling, statistical analysis	Regional	Yes
Ahmed et al., 2024	A distributed modeling approach to water balance implications from changing land	GeoSus.	Tibetan Plateau	Multiple	Permafrost thaw impacts	Numerical modeling	Watershed	Yes

	cover dynamics in permafrost environments							
Ahmed et al., 2022	Variations in hydrological variables using distributed hydrological model in permafrost environment	Ecol. Indic.	Multiple	Multiple	Permafrost thaw impacts	Numerical modeling	Watershed	Yes
AMAP, 2017	Snow, Water, Ice and Permafrost in the Arctic (SWIPA) 2017	AMAP Report	Arctic (circumpolar)	Multiple	Multiple	Multiple (synthesis)	Regional	Yes
Andresen et al., 2020	Soil moisture and hydrology projections of the permafrost region—a model intercomparison	The Cryosphere	Northern Hemisphere permafrost region	Multiple	Permafrost thaw impacts	Numerical modeling (ensemble)	Regional	Yes
Arenson et al., 2022	Mountain permafrost hydrology—a practical review following studies from the Andes	Geosciences	Andes	Mountain permafrost	Permafrost thaw impacts	Review	Regional	No
Bai et al., 2012	Effects of elevated air temperatures on soil thermal and hydrologic processes in the active layer	J. Mt. Sci.	Tibetan Plateau	Continuous	Active layer processes	Field observations	Plot	Yes

Bense et al., 2009	Evolution of shallow groundwater flow systems in areas of degrading permafrost	Geophys. Res. Lett.	Multiple	Multiple	Permafrost thaw impacts	Numerical modeling	Regional	No
Bring et al., 2016	Arctic terrestrial hydrology: a synthesis of processes, regional effects and research challenges	J. Geophys. Res. Biogeo.	Arctic (circumpolar)	Multiple	Multiple	Review	Regional	No
Cao et al., 2018	Seasonal variation of soil hydrological processes of active layer in source region of the Yellow River	Adv. Water Sci.	Yellow River source region, Tibetan Plateau	Continuous	Active layer processes	Field observations	Hillslope	Yes
Cao et al., 2021a	Soil hydrological process and migration mode influenced by the freeze-thaw process in the active layer	Cold Reg. Sci. Technol.	Qinghai-Tibet Plateau	Continuous	Active layer processes	Field observations	Plot	Yes
Cao et al., 2021b	Differential response to rainfall of soil moisture infiltration in permafrost and seasonally frozen ground	Hydrolog. Sci. J.	Qinghai-Tibet Plateau	Continuous and seasonal frost	Active layer processes	Field observations	Watershed	Yes
Carpino et al.,	Detecting	Ecohydrol.	Northwestern	Discontinuous	Permafrost	Remote	Regional	Yes

2025	forest–wetland changes in northwestern Canada's discontinuous permafrost region using Landsat trend analysis		Canada		thaw impacts	sensing		
Chang et al., 2015	Seasonal dynamics of suprapermafrost groundwater and its response to the freezing-thawing processes of soil	Sci. China Earth Sci.	Qinghai-Tibet Plateau	Continuous	Active layer processes	Field observations	Watershed	Yes
Chang et al., 2024	Projected future changes in the cryosphere and hydrology of a mountainous catchment in the upper Heihe River, China	Hydrol. Earth Syst. Sci.	Qilian Mountains, Tibetan Plateau	Multiple	Permafrost thaw impacts	Numerical modeling	Watershed	Yes
Chen et al., 2014	A Cryosphere-Hydrology Observation System in a Small Alpine Watershed in the Qilian Mountains	Arct. Antarct. Alp. Res.	Qilian Mountains, China	Multiple	Surface runoff	Field observations	Watershed	Yes
Chen et al.,	Effects of cryospheric	J. Geophys.	Heihe River,	Multiple	Permafrost	Numerical	Watershed	Yes

2018	change on alpine hydrology: Combining a model with observations in the upper reaches of the Hei River	Res. Atmos.	Qilian Mountains		thaw impacts	modeling + observations		
Chen et al., 2019	Impacts of cryospheric changes on runoff in cold regions of western China	Science Press (book)	Western China	Multiple	Multiple	Review	Regional	No
Chen et al., 2024	Retrieving freeze-thaw states using deep learning with remote sensing data in permafrost landscapes	Int. J. Appl. Earth Obs. Geoinf.	Tibetan Plateau	Multiple	Permafrost thaw impacts	Remote sensing + machine learning	Regional	Yes
Cheng et al., 2019	Characteristics, changes, and impacts of permafrost on the Qinghai-Tibet Plateau	Chin. Sci. Bull.	Tibetan Plateau	Multiple	Permafrost thaw impacts	Review	Regional	No
Chiasson-Poirier et al., 2020	Seasonal evolution of active layer thaw depth and hillslope-stream connectivity in a permafrost watershed	Water Resour. Res.	Nunavut, Canada	Continuous	Surface runoff; Active layer processes	Field observations	Hillslope	Yes
Chuvilin et al., 2016	Influence of moisture content on	Earth's Cryosphere	Multiple	Multiple	Active layer processes	Laboratory experiments	Plot	Yes

	permeability of frozen and unfrozen soils							
Connon et al., 2014	Changing hydrologic connectivity due to permafrost thaw in the lower Liard River valley, NWT, Canada	Hydrol. Process.	Northwest Territories, Canada	Discontinuous	Permafrost thaw impacts	Field observations	Watershed	Yes
Connon et al., 2018	The influence of shallow taliks on permafrost thaw and active layer dynamics in subarctic Canada	J. Geophys. Res. Earth	Subarctic Canada	Discontinuous	Permafrost thaw impacts	Field observations	Hillslope	Yes
Cooper et al., 2011	The hydrology of the proglacial zone of a high-Arctic glacier (Finsterwalderbreen, Svalbard)	J. Hydrol.	Svalbard	Continuous	Surface runoff	Field observations	Watershed	Yes
Crites et al., 2020	Icings and groundwater conditions in permafrost catchments of northwestern Canada	Sci. Rep.	Northwestern Canada	Discontinuous	Permafrost thaw impacts	Field observations	Watershed	Yes
Cui et al., 2023	Non-monotonic changes in Asian Water Towers' streamflow at	Nat. Commun.	Tibetan Plateau and surrounding	Multiple	Permafrost thaw impacts	Numerical modeling	Regional	Yes

	increasing warming levels		mountains					
Cuo et al., 2015	Frozen soil degradation and its effects on surface hydrology in the northern Tibetan Plateau	J. Geophys. Res. Atmos.	Northern Tibetan Plateau	Multiple	Permafrost thaw impacts	Numerical modeling	Regional	Yes
Del Vecchio et al., 2024	Permafrost extent sets drainage density in the Arctic	P. Natl. A. Sci.	Arctic	Continuous	Surface runoff	Numerical modeling + observations	Regional	Yes
Del Vecchio and Evans, 2025	Climate and hydrogeological controls on water tracks in permafrost landscapes	Rev. Geophys.	Arctic and subarctic	Multiple	Surface runoff	Review	Regional	No
Derksen et al., 2018	Changes in snow, ice, and permafrost across Canada	Canada's Changing Climate Report	Canada	Multiple	Multiple	Review	Regional	No
Ding et al., 2000	Large-scale permafrost hydrological monitoring on the Qinghai-Tibet Plateau	Chin. Sci. Bull.	Tibetan Plateau	Multiple	Permafrost thaw impacts	Field observations	Regional	Yes
Ding and Xiao, 2013	Challenges in the study of cryospheric changes	Adv. Earth Sci.	Global	Multiple	Multiple	Review	Regional	No

	and their impacts							
Ding et al., 2017	Introduction to Cold Region Hydrology	Science Press (book)	Global cold regions	Multiple	Multiple	Review	Multiple	No
Ding et al., 2020a	The Principles of Cryohydrology	Science Press (book)	Global cryosphere	Multiple	Multiple	Review	Multiple	No
Ding et al., 2020b	Recent progress on studies on cryospheric hydrological processes changes in China	Adv. Water Sci.	China cryosphere	Multiple	Multiple	Review	Regional	No
Ding et al., 2020c	Hydrological basis and discipline system of cryohydrology	Front. Earth Sc.-Switz.	Global cryosphere	Multiple	Multiple	Review	Multiple	No
Douglas et al., 2020	Increased rainfall stimulates permafrost thaw across a variety of Interior Alaskan boreal ecosystems	npj Clim. Atmos. Sci.	Interior Alaska	Continuous	Permafrost thaw impacts	Field observations	Plot	Yes
Drake et al., 2018	Increasing alkalinity export from large Russian Arctic rivers	Environ. Sci. Technol.	Russian Arctic	Multiple	Permafrost thaw impacts	Field observations	Regional	Yes
Du et al., 2019	Effect of snowmelt infiltration on groundwater recharge in a seasonal soil frost area: A case study in Northeast China	Environ. Monit. Assess.	Northeast China	Seasonal frost	Active layer processes	Field observations	Watershed	Yes

Duan et al., 2017	Distinguishing streamflow trends caused by changes in climate, forest cover, and permafrost in a large watershed in northeastern China	Hydrol. Process.	Northeastern China	Discontinuous	Permafrost thaw impacts	Numerical modeling	Watershed	Yes
Ehlers et al., 2022	Past, present, and future geo-biosphere interactions on the Tibetan Plateau and implications for permafrost	Earth-Sci. Rev.	Tibetan Plateau	Multiple	Multiple	Review	Regional	No
Elshamy et al., 2025	Land surface hydrological modelling of the Mackenzie River Basin	J. Hydrol.	Mackenzie Basin, Canada	Multiple	Permafrost thaw impacts	Numerical modeling	Regional	Yes
Evans et al., 2015	Analysis of groundwater flow in mountainous, headwater catchments with permafrost	Water Resour. Res.	Rocky Mountains, USA	Discontinuous	Permafrost thaw impacts	Numerical modeling	Watershed	Yes
Fabre et al., 2017	Using modeling tools to better understand permafrost hydrology	Water	Siberian Arctic	Continuous	Permafrost thaw impacts	Numerical modeling	Regional	Yes
Fan et al., 2024	Impacts of permafrost	Sci. China	Himalayan	Multiple	Permafrost	Numerical	Regional	Yes

	degradation on streamflow in the northern Himalayas	Earth Sci.	region, Tibetan Plateau		thaw impacts	modeling		
Farquharson et al., 2019	Climate change drives widespread and rapid thermokarst development in very cold permafrost in the Canadian High Arctic	Geophys. Res. Lett.	Canadian High Arctic	Continuous	Permafrost thaw impacts	Field observations	Regional	Yes
Feng, 2020	Research on glacier and permafrost changes and their ecological and hydrological effects on the Qinghai-Tibet Plateau	Ph.D. Thesis, China Univ. Geosci.	Tibetan Plateau	Multiple	Permafrost thaw impacts	Multiple	Regional	Yes
Feng et al., 2021	Recent changes to Arctic river discharge	Nat. Commun.	Arctic (circumpolar)	Multiple	Permafrost thaw impacts	Remote sensing + observations	Regional	Yes
Fortier et al., 2023	Long-term, high-resolution permafrost monitoring reveals coupled energy balance and hydrogeologic controls on talik dynamics	Water Resour. Res.	Nunavik, Québec, Canada	Discontinuous	Permafrost thaw impacts	Field observations	Hillslope	Yes

Frey and McClelland, 2009	Impacts of permafrost degradation on Arctic river biogeochemistry	Hydrol. Process.	Arctic	Multiple	Permafrost thaw impacts	Review	Regional	No
Gagarin et al., 2022	Icings of the Kunlun Mountains on the Northern Margin of the Qinghai-Tibet Plateau	Water	Kunlun Mountains, Tibetan Plateau	Continuous	Surface water-groundwater interaction	Field observations	Regional	Yes
Gandois et al., 2019	Contribution of Peatland Permafrost to Dissolved Organic Matter along a Thaw Gradient in North Siberia	Environ. Sci. Technol.	North Siberia	Continuous	Permafrost thaw impacts	Field observations	Regional	Yes
Gao et al., 2016	Reduced winter runoff in a mountainous permafrost region in the northern Tibetan Plateau	Cold Reg. Sci. Technol.	Northern Tibetan Plateau	Continuous	Permafrost thaw impacts	Field observations	Watershed	Yes
Gao et al., 2018a	Impacts of the active layer on runoff in an upland permafrost basin, northern Tibetan Plateau	PLoS One	Northern Tibetan Plateau	Continuous	Active layer processes	Field observations	Watershed	Yes
Gao et al., 2018b	Change in Frozen Grounds and Its Effect on Regional	The Cryosphere	Heihe Basin, Qilian Mountains	Multiple	Permafrost thaw impacts	Numerical modeling + observations	Watershed	Yes

	Hydrology in the Upper Heihe Basin							
Gao et al., 2021	Permafrost Hydrology of the Qinghai-Tibet Plateau: A Review of Processes and Modeling	Front. Earth Sc.-Switz.	Tibetan Plateau	Multiple	Multiple	Review	Regional	No
Gao et al., 2022	Frozen soil hydrological modeling for a mountainous catchment northeast of the Qinghai-Tibet Plateau	Hydrol. Earth Syst. Sci.	Qilian Mountains, Tibetan Plateau	Multiple	Permafrost thaw impacts	Numerical modeling	Watershed	Yes
Gao and Coon, 2022	Evaluating Simplifications of Subsurface Process Representations for Field-scale Permafrost Hydrology Models	The Cryosphere	Multiple	Multiple	Permafrost thaw impacts	Numerical modeling	Hillslope	Yes
Ge et al., 2011	Exchange of groundwater and surface-water mediated by permafrost response to seasonal and long term air temperature variation	Geophys. Res. Lett.	Multiple	Multiple	Permafrost thaw impacts	Numerical modeling	Watershed	Yes

Gibson et al., 2019	Isotopic tracing of hydrologic drivers including permafrost thaw status for lakes across Northeastern Alberta, Canada	J. Hydrol. Reg. Stud.	Northeastern Alberta, Canada	Discontinuous	Permafrost thaw impacts	Isotopic tracers	Regional	Yes
Grewal et al., 2025	Water storage and release in permafrost catchments: Insights from hydrometrics, end-member mixing, and water age characterization	Water Resour. Res.	Permafrost catchments (general)	Multiple	Multiple	Multiple	Watershed	Yes
Guo et al., 2025	Hydrological changes caused by integrated warming, wetting, and greening in permafrost regions of the Qinghai-Tibetan Plateau	Water Resour. Res.	Tibetan Plateau	Multiple	Permafrost thaw impacts	Multiple	Regional	Yes
Halla et al., 2021	Ice content and interannual water storage changes of an active rock glacier in the dry Andes of Argentina	The Cryosphere	Andes, Argentina	Mountain permafrost	Permafrost thaw impacts	Geophysical techniques	Hillslope	Yes

Hilbich et al., 2022	Towards accurate quantification of ice content in permafrost of the Central Andes - Part 1	The Cryosphere	Central Andes	Mountain permafrost	Permafrost thaw impacts	Geophysical techniques	Regional	Yes
Hinzman et al., 2005	Permafrost hydrology	Encyclopedia of Hydrological Sciences	Global permafrost regions	Multiple	Multiple	Review	Multiple	No
Hirst et al., 2022	Seasonal changes in hydrology and permafrost degradation control mineral element-bound DOC transport	Global Biogeochem. Cy.	Permafrost regions	Multiple	Permafrost thaw impacts	Field observations	Regional	Yes
Hiyama et al., 2021a	Permafrost Hydrology: Linkages and Feedbacks	Springer (book chapter)	Global permafrost regions	Multiple	Multiple	Review	Multiple	No
Hiyama et al., 2021b	Groundwater age of spring discharges under changing permafrost conditions: the Khangai Mountains in central Mongolia	Environ. Res. Lett.	Khangai Mountains, Mongolia	Discontinuous	Permafrost thaw impacts	Isotopic tracers	Watershed	Yes
Hu et al., 2009	Response of soil heat-water processes to	Chinese Sci. Bull.	Yangtze and Yellow River	Continuous and seasonal frost	Active layer processes	Field observations	Plot	Yes

	vegetation cover on the typical permafrost and seasonally frozen soil		source region, Tibetan Plateau					
Hu et al., 2015	Modeling hydrothermal transfer processes in permafrost regions of Qinghai-Tibet Plateau	Chinese Geogr. Sci.	Tibetan Plateau	Continuous	Active layer processes	Numerical modeling	Plot	Yes
Hu et al., 2018	Soil infiltration processes of different underlying surfaces in the permafrost region on the Tibetan Plateau	Hydrolog. Sci. J.	Tibetan Plateau	Continuous	Active layer processes	Field observations	Plot	Yes
Ielpi et al., 2023	Large sinuous rivers are slowing down in a warming Arctic	Nat. Clim. Change	Arctic	Multiple	Surface runoff	Remote sensing	Regional	Yes
IPCC, 2007	Climate Change 2007: Impacts, Adaptation and Vulnerability	IPCC Report	Global	Multiple	Multiple	Review	Multiple	No
IPCC, 2019	IPCC Special Report on the Ocean and Cryosphere in a Changing Climate	IPCC Report	Global cryosphere	Multiple	Multiple	Review	Multiple	No
Jacques and Sauchyn, 2009	Increasing winter baseflow and mean annual streamflow	Geophys. Res. Lett.	Northwest Territories, Canada	Discontinuous	Permafrost thaw impacts	Field observations	Regional	Yes

	from possible permafrost thawing in the Northwest Territories, Canada							
Jiang, 2020	Quantifying the influence of groundwater discharge induced by permafrost degradation on lake water budget	J. Radioanal. Nucl. Ch.	Qinghai-Tibet Plateau	Multiple	Permafrost thaw impacts	Isotopic tracers	Watershed	Yes
Jin et al., 2022a	Permafrost degradation and its hydrogeological impacts	Water	Global permafrost regions	Multiple	Permafrost thaw impacts	Review	Multiple	No
Jin et al., 2022b	Impacts of permafrost degradation on hydrology and vegetation in the source area of the Yellow River	Front. Earth Sc.-Switz.	Yellow River source region, Tibetan Plateau	Continuous	Permafrost thaw impacts	Multiple	Regional	Yes
Jin et al., 2025	Evolution, modeling, and prospects of hydrological processes in high-altitude cold regions	Adv. Water Sci.	High-altitude cold regions	Multiple	Multiple	Review	Multiple	No
Jorgenson et al., 2013	Reorganization of vegetation, hydrology	Environ. Res. Lett.	Boreal North America	Multiple	Permafrost thaw impacts	Field observations	Regional	Yes

	and soil carbon after permafrost degradation across heterogeneous boreal landscapes							
Jorgenson et al., 2020	The roles of climate extremes, ecological succession, and hydrology in repeated permafrost aggradation and degradation in fens on the Tanana Flats, Alaska	J. Geophys. Res. Biogeo.	Tanana Flats, Alaska	Discontinuous	Permafrost thaw impacts	Field observations	Regional	Yes
Jorgenson et al., 2022	Rapid transformation of tundra ecosystems from ice-wedge degradation	Global Planet. Change	Arctic	Multiple	Permafrost thaw impacts	Review	Regional	No
Kalyuzhnyi and Lavrov, 2012	Basic physical processes and regularities of winter and spring river runoff formation under climate warming conditions	Russ. Meteorol. Hydro+	Russia (Volga basin)	Seasonal frost	Permafrost thaw impacts	Numerical modeling + observations	Regional	Yes
Kalyuzhnyi and Lavrov, 2016	Variability of frost depth in the Volga River basin and its	Russ. Meteorol. Hydro+	Russia (Volga basin)	Seasonal frost	Permafrost thaw impacts	Field observations	Regional	Yes

	impact on runoff formation							
Kalyuzhnyi and Lavrov, 2017	Mechanism of the influence of soil freezing depth on winter runoff	Water Resour+	Russia (Volga basin)	Seasonal frost	Permafrost thaw impacts	Field observations	Regional	Yes
Kane and Gieck, 2003	Impacts of surficial permafrost landforms on surface hydrology	Permafrost (book)	Arctic	Continuous	Surface runoff	Field observations	Watershed	Yes
Karra et al., 2014	Three-phase numerical model for subsurface hydrology in permafrost-affected regions (PFLOTRAN-ICE v1.0)	The Cryosphere	Multiple	Multiple	Permafrost thaw impacts	Numerical modeling	Multiple	Yes
Kim et al., 2024	Abrupt increase in Arctic-Subarctic wildfires caused by future permafrost thaw	Nat. Commun.	Arctic-Subarctic	Multiple	Permafrost thaw impacts	Numerical modeling	Regional	Yes
Kizyakov et al., 2024	Characterizing Batagay megaslump topography dynamics and matter fluxes	Geomorphology	Batagay, Siberia	Continuous	Permafrost thaw impacts	Field observations + remote sensing	Hillslope	Yes
Koch et al., 2022	Sensitivity of headwater streamflow	Environ. Res. Lett.	Arctic	Multiple	Permafrost thaw impacts	Field observations	Watershed	Yes

	to thawing permafrost and vegetation change in a warming Arctic							
Koch et al., 2024	The dominance and growth of shallow groundwater resources in continuous permafrost environments	P. Natl. A. Sci.	Arctic	Continuous	Permafrost thaw impacts	Field observations	Regional	Yes
Kurylyk and Walvoord, 2021	Permafrost hydrogeology	Springer (book chapter)	Global permafrost regions	Multiple	Permafrost thaw impacts	Review	Multiple	No
Lacelle and Vasil'chuk, 2013	Recent progress (2007-2012) in permafrost isotope geochemistry	Permafrost Periglac.	Global permafrost regions	Multiple	Multiple	Review	Multiple	No
Lafrenière and Lamoureux, 2019	Effects of changing permafrost conditions on hydrological processes and fluvial fluxes	Earth-Sci. Rev.	Arctic and subarctic	Multiple	Multiple	Review	Regional	No
Lan et al., 2015	Frozen soil degradation and its effects on surface hydrology in the northern Tibetan	J. Geophys. Res. Atmos.	Northern Tibetan Plateau	Multiple	Permafrost thaw impacts	Numerical modeling	Regional	Yes

	Plateau							
Langford et al., 2020	Transient and Transition Factors in Modeling Permafrost Thaw and Groundwater Flow	Groundwater	Canada	Discontinuous	Permafrost thaw impacts	Numerical modeling	Watershed	Yes
Lemieux et al., 2020	Groundwater dynamics within a watershed in the discontinuous permafrost zone near Umiujaq (Nunavik, Canada)	Hydrogeol. J.	Nunavik, Québec, Canada	Discontinuous	Permafrost thaw impacts	Field observations	Watershed	Yes
Lhosmot et al., 2025	Multi-scale water balance analysis of a thawing boreal peatland complex near the southern permafrost limit in northwestern Canada	Hydrol. Earth Syst. Sci.	Northwestern Canada	Discontinuous	Permafrost thaw impacts	Field observations	Regional	Yes
Li et al., 2009	Hydrological Process in a Typical Small Permafrost Watershed at the Headwaters of Yangtze River	J. Glaciol. Geocryol.	Yangtze River source region, Tibetan Plateau	Continuous	Surface runoff; Active layer processes	Field observations	Watershed	Yes
Li et al., 2010	Dominant climate factors influencing the	Acta Oceanol. Sin.	Arctic	Multiple	Permafrost thaw impacts	Statistical analysis	Regional	Yes

	Arctic runoff and association between the Arctic runoff and sea ice							
Li et al., 2016	Contribution from frozen soil meltwater to runoff in an inland river basin under water scarcity by isotopic tracing in northwestern China	Glob. Planet. Change	Qilian Mountains, China	Continuous	Permafrost thaw impacts	Isotopic tracers	Watershed	Yes
Li et al., 2020	Runoff dominated by supra-permafrost water in the source region of the Yangtze River using environmental isotopes	J. Hydrol.	Yangtze River source region, Tibetan Plateau	Continuous	Active layer processes	Isotopic tracers	Watershed	Yes
Liljedahl et al., 2016	Pan-Arctic ice-wedge degradation in warming permafrost and its influence on tundra hydrology	Nat. Geosci.	Arctic	Multiple	Permafrost thaw impacts	Field observations + modeling	Regional	Yes
Liljedahl et al., 2020	Arctic riparian shrub expansion indicates a shift from streams gaining water to those	Commun. Earth Environ.	Arctic	Multiple	Permafrost thaw impacts	Remote sensing + observations	Regional	Yes

	that lose flow							
Lindborg et al., 2013	Water balance and its intra-annual variability in a permafrost catchment	Hydrol. Earth Syst. Sci. Discuss.	Arctic	Continuous	Permafrost thaw impacts	Field observations	Watershed	Yes
Liu et al., 2003	Hydrological and geocryological response of winter streamflow to climate warming in Northeast China	Cold Reg. Sci. Technol.	Northeastern China	Discontinuous	Permafrost thaw impacts	Field observations	Watershed	Yes
Liu et al., 2020	Hydrological impacts of near-surface soil warming on the Tibetan Plateau	Permafrost Periglac. Process.	Tibetan Plateau	Multiple	Permafrost thaw impacts	Numerical modeling	Regional	Yes
Liu et al., 2023	Large-scale characteristics of thermokarst lakes across the source area of the Yellow River	J. Mt. Sci.	Yellow River source region, Tibetan Plateau	Continuous	Permafrost thaw impacts	Remote sensing	Regional	Yes
Lu et al., 2014	Changes of runoff of the Hailar River basin in the southern margin of permafrost zone, Northeast China	J. Glaciol. Geocryol.	Hailar River basin, Northeast China	Discontinuous	Permafrost thaw impacts	Field observations	Watershed	Yes
Luo et al., 2015	Thermokarst lake	Sci. Bull.	Beiluhe,	Continuous	Permafrost	Remote	Regional	Yes

	changes between 1969 and 2010 in the Beilu River Basin, Qinghai–Tibet Plateau		Tibetan Plateau		thaw impacts	sensing		
Luo et al., 2025	Observed talik development triggers a tipping point in marginal permafrost of the Qinghai-Xizang Plateau	Geosci. Front.	Qinghai-Xizang Plateau	Marginal permafrost	Permafrost thaw impacts	Field observations	Hillslope	Yes
Ma et al., 2019	Dissolved organic carbon in permafrost regions: A review	Sci. China Earth Sci.	Global permafrost regions	Multiple	Multiple	Review	Multiple	No
Ma et al., 2020	Impacts of degrading permafrost on streamflow in the source area of Yellow River	Adv. Clim. Change Res.	Yellow River source region, Tibetan Plateau	Continuous	Permafrost thaw impacts	Field observations + modeling	Regional	Yes
Ma et al., 2021a	New insights into water cycle in permafrost region of northern Greater Khingan Mountains, China	J. Radioanal. Nucl. Chem.	Greater Khingan Mountains, China	Discontinuous	Permafrost thaw impacts	Isotopic tracers	Watershed	Yes
Ma et al., 2021b	Control of the interactions between	J. Geophys. Res. Atmos.	Tibetan Plateau	Multiple	Permafrost thaw impacts	Field observations	Watershed	Yes

	stream and groundwater by permafrost and seasonal frost in an alpine catchment							
Makarieva et al., 2021	Perspectives of the development of complex interdisciplinary hydrological and geocryological research in the North-East of Russia	Vestn. St. Petersburg Univ. Earth Sci.	North-East Russia	Multiple	Multiple	Review	Regional	No
Mann et al., 2022	Degrading permafrost river catchments and their impact on Arctic Ocean nearshore processes	Ambio	Arctic	Multiple	Permafrost thaw impacts	Review	Regional	No
McClelland et al., 2004	Increasing river discharge in the Eurasian Arctic: Consideration of dams, permafrost thaw, and fires as potential agents of change	J. Geophys. Res.-Atmos.	Eurasian Arctic	Multiple	Permafrost thaw impacts	Statistical analysis	Regional	Yes
Mirzaei et al.,	4D imaging of frost	Appl. Phys.	N/A	N/A	Active layer	Laboratory	Plot	Yes

2025	heave and ice lens growth in silt using neutron and x-ray computed tomography	Lett.	(laboratory)		processes	experiments (X-ray)		
Mohammed et al., 2021	Dual-permeability modeling of preferential flow and snowmelt partitioning in frozen soils	Vadose Zone Journal	Multiple (model-based)	Multiple	Active layer processes	Numerical modeling	Plot	Yes
Nan et al., 2025	Glacier meltwater has limited contributions to the total runoff in the major rivers draining the Tibetan Plateau	npj Clim. Atmos. Sci.	Tibetan Plateau	Multiple	Permafrost thaw impacts	Numerical modeling + isotopic tracers	Regional	Yes
Nitzbon et al., 2020	Fast response of cold ice-rich permafrost in northeast Siberia to a warming climate	Nat. Commun.	Northeast Siberia	Continuous, ice-rich	Permafrost thaw impacts	Numerical modeling	Regional	Yes
Niu et al., 2011	Effect of permafrost degradation on hydrological processes in typical basins with various permafrost coverage in Western China	Sci. China Earth Sci.	Western China	Multiple	Permafrost thaw impacts	Field observations	Watershed	Yes
Niu et al., 2023	Three-dimensional	Int. J. Disast.	Beiluhe,	Continuous	Permafrost	Numerical	Hillslope	Yes

	numerical modeling of ground ice ablation in a retrogressive thaw slump	Risk Sc.	Tibetan Plateau		thaw impacts	modeling		
O'Donnell et al., 2012	Dissolved organic matter composition of winter flow in the Yukon River basin	Global Biogeochem. Cy.	Yukon River basin, Alaska/Canada	Multiple	Permafrost thaw impacts	Field observations	Regional	Yes
O'Donnell et al., 2019	Permafrost hydrology drives the assimilation of old carbon by stream food webs in the Arctic	Ecosystems	Arctic	Multiple	Permafrost thaw impacts	Field observations	Regional	Yes
O'Donnell et al., 2024	Metal mobilization from thawing permafrost to aquatic ecosystems is driving rusting of Arctic streams	Commun. Earth Environ.	Arctic	Multiple	Permafrost thaw impacts	Field observations	Regional	Yes
Painter et al., 2013	Modeling challenges for predicting hydrologic response to degrading permafrost	Hydrogeol. J.	Multiple	Multiple	Permafrost thaw impacts	Numerical modeling	Multiple	No
Pan et al., 2017	Contribution of supra-permafrost discharge to	J. Hydrol.	Northeastern Qinghai-Tibet Plateau	Continuous	Permafrost thaw impacts	Isotopic tracers + modeling	Regional	Yes

	thermokarst lake water balances on the northeastern Qinghai-Tibet Plateau							
Pohl et al., 2009	The summer hydrology of a small upland tundra thaw lake: implications to lake drainage	Hydrol. Process.	Arctic tundra	Continuous	Permafrost thaw impacts	Field observations	Watershed	Yes
Qin et al., 2017	Identification of the factors influencing the baseflow in the permafrost region of the northeastern Qinghai-Tibet Plateau	Water	Northeastern Qinghai-Tibet Plateau	Continuous	Permafrost thaw impacts	Statistical analysis	Regional	Yes
Qin et al., 2024	Links between seasonal suprapermafrost groundwater, the hydrothermal change of the active layer, and river runoff	Hydrol. Earth Syst. Sci.	Qinghai-Tibet Plateau	Continuous	Active layer processes; Permafrost thaw impacts	Field observations + modeling	Watershed	Yes
Quinton and Baltzer, 2013	The active-layer hydrology of a peat plateau with thawing permafrost (Scotty	Hydrogeol. J.	Scotty Creek, Northwest Territories, Canada	Discontinuous	Active layer processes	Field observations	Watershed	Yes

	Creek, Canada)							
Quinton et al., 2009	Peatland hydrology of discontinuous permafrost in the Northwest Territories: Overview and synthesis	Can. Water Resour. J.	Northwest Territories, Canada	Discontinuous	Multiple	Review	Regional	No
Rogger et al., 2017	Impact of mountain permafrost on flow path and runoff response in a high alpine catchment	Water Resour. Res.	Austrian Alps	Mountain permafrost	Permafrost thaw impacts	Numerical modeling	Watershed	Yes
Roulet and Woo, 1986	Hydrology of a wetland in the continuous permafrost region	J. Hydrol.	Canadian Arctic	Continuous	Surface runoff; Active layer processes	Field observations	Watershed	Yes
Rowland, 2023	Drainage network response to Arctic warming	Nat. Commun.	Arctic	Multiple	Permafrost thaw impacts	Remote sensing + observations	Regional	Yes
Şerban et al., 2021	Shrinking thermokarst lakes and ponds on the northeastern Qinghai-Tibet plateau over the past three decades	Permafrost Periglac.	Northeastern Qinghai-Tibet Plateau	Continuous	Permafrost thaw impacts	Remote sensing	Regional	Yes
Shirley et al.,	Near-surface	J. Geophys.	Sub-Arctic	Discontinuous	Multiple	Field	Watershed	Yes

2022	hydrology and soil properties drive heterogeneity in permafrost distribution, vegetation dynamics, and carbon cycling	Res. Biogeo.	watershed			observations		
Shojae Ghias et al., 2017	Controls on permafrost thaw in a coupled groundwater-flow and heat-transport system: Iqaluit Airport, Nunavut, Canada	Hydrogeol. J.	Iqaluit, Nunavut, Canada	Discontinuous	Permafrost thaw impacts	Numerical modeling	Hillslope	Yes
Sjöberg et al., 2021	Permafrost promotes shallow groundwater flow and warmer headwater streams	Water Resour. Res.	Alaska, USA	Continuous	Surface runoff; Active layer processes	Field observations	Watershed	Yes
Skovsholt et al., 2020	Changes in hydrology affects stream nutrient uptake and primary production in a high-Arctic stream	Biogeochemistry	High Arctic	Continuous	Permafrost thaw impacts	Field observations	Watershed	Yes
Smith et al., 2007	Rising minimum daily flows in northern Eurasian rivers: A growing influence of	J. Geophys. Res. Biogeo.	Northern Eurasia	Multiple	Permafrost thaw impacts	Statistical analysis	Regional	Yes

	groundwater in the high-latitude hydrologic cycle							
Smith et al., 2010	Thermal state of permafrost in North America: A contribution to the International Polar Year	Permafrost Periglac.	North America	Multiple	Permafrost thaw impacts	Field observations	Regional	Yes
Smith et al., 2012	Recent changes in climate and permafrost temperatures at forested and polar desert sites in northern Canada	Can. J. Earth Sci.	Northern Canada	Multiple	Permafrost thaw impacts	Field observations	Regional	Yes
Song et al., 2020a	Linkage between permafrost distribution and river runoff changes across the Arctic and the Tibetan Plateau	Sci. China Earth Sci.	Arctic and Tibetan Plateau	Multiple	Permafrost thaw impacts	Statistical analysis	Regional	Yes
Song et al., 2020b	Improving permafrost physics in a distributed cryosphere-hydrology model and its evaluations at the	J. Geophys. Res. Atmos.	Upper Yellow River Basin, Tibetan Plateau	Multiple	Permafrost thaw impacts	Numerical modeling	Watershed	Yes

	Upper Yellow River Basin							
Song et al., 2022	Divergent runoff impacts of permafrost and seasonally frozen ground at a large river basin of Tibetan Plateau	Environ. Res. Lett.	Tibetan Plateau	Multiple		Permafrost thaw impacts	Numerical modeling	Regional Yes
Spence et al., 2015	Evidence of a change in water chemistry in Canada's subarctic associated with enhanced winter streamflow	J. Geophys. Res. Biogeo.	Canadian subarctic	Discontinuous		Permafrost thaw impacts	Field observations	Regional Yes
Spence et al., 2025	Process synchrony a key control of resilience in a subarctic freshwater system	Earth's Future	Canadian subarctic	Discontinuous		Permafrost thaw impacts	Field observations	Regional Yes
Streletskiy et al., 2015	Permafrost hydrology in changing climatic conditions: seasonal variability of stable isotope composition in rivers in discontinuous permafrost	Environ. Res. Lett.	Discontinuous permafrost regions	Discontinuous		Permafrost thaw impacts	Isotopic tracers	Watershed Yes
Sun et al., 2020	Quantified	Sci. Total	Yellow River	Continuous		Permafrost	Numerical	Watershed Yes

	hydrological responses to permafrost degradation in the headwaters of the Yellow River (HWYR) in High Asia	Environ.	headwaters, Tibetan Plateau		thaw impacts	modeling		
Sun et al., 2025	Improving the moving-grid permafrost model to reveal ground deformation and hydrothermal effects	Environmen. Modell. Softw.	Yangtze River source region, Tibetan Plateau	Continuous	Permafrost thaw impacts	Numerical modeling	Regional	Yes
Tananaev et al., 2020	Permafrost hydrology research domain: Process-based adjustment	Hydrology	Global permafrost regions	Multiple	Multiple	Review	Multiple	No
Tananaev and Lotsari, 2022	Defrosting northern catchments: Fluvial effects of permafrost degradation	Earth-Sci. Rev.	Northern catchments (Arctic and subarctic)	Multiple	Permafrost thaw impacts	Review	Regional	No
Tananaev et al., 2022	Hydrological surface-subsurface connectivity in permafrost tundra environment, European Russian Arctic	IAHS Proceedings	European Russian Arctic	Continuous	Surface water-groundwater interaction	Geophysical techniques + isotopic tracers	Watershed	Yes

Tang et al., 2019	Streamflow change on the Qinghai-Tibet Plateau and its impacts	Chin. Sci. Bull.	Tibetan Plateau	Multiple	Permafrost thaw impacts	Multiple	Regional	Yes
Tang, 2025	Advances and Prospects of Artificial Intelligence in China's Polar Cryosphere Research	Advance in Earth Science	China's polar regions	Multiple	Multiple	Review	Multiple	No
Tape et al., 2022	Expanding beaver pond distribution in Arctic Alaska, 1949 to 2019	Sci. Rep.	Arctic Alaska	Multiple	Surface runoff	Remote sensing	Regional	Yes
van Huissteden, 2020	Thawing Permafrost	Springer (book)	Global permafrost regions	Multiple	Multiple	Review	Multiple	No
Varner et al., 2022	Permafrost thaw driven changes in hydrology and vegetation cover increase trace gas emissions	Philos. T. R. Soc. A	Stordalen Mire, Sweden	Discontinuous	Permafrost thaw impacts	Field observations	Watershed	Yes
Vonk et al., 2019	Integrating hydrology and biogeochemistry across frozen landscapes	Nat. Commun.	Frozen landscapes (global)	Multiple	Permafrost thaw impacts	Review	Regional	No
Walvoord and Striegl, 2007	Increased groundwater to stream discharge	Geophys. Res. Lett.	Yukon River basin,	Multiple	Permafrost thaw impacts	Field observations	Regional	Yes

	from permafrost thawing in the Yukon River basin		Alaska/Canada			+ statistical analysis		
Walvoord and Kurylyk, 2016	Hydrologic impacts of thawing permafrost—A review	Vadose Zone J.	Global permafrost regions	Multiple	Multiple	Review	Multiple	No
Walvoord et al., 2012	Influence of permafrost distribution on groundwater flow in the context of climate-driven permafrost thaw	Water Resour. Res.	Yukon Flats Basin, Alaska, USA	Multiple	Permafrost thaw impacts	Numerical modeling	Regional	Yes
Wan et al., 2019	Using tritium and ^{22}Rn to estimate groundwater discharge and thawing permafrost contributing to surface water	J. Radioanal. Nucl. Ch.	Qinghai-Tibet Plateau	Multiple	Permafrost thaw impacts	Isotopic tracers	Watershed	Yes
Wang et al., 2009	The influence of freeze-thaw cycles of active soil layer on surface runoff in a permafrost watershed	J. Hydrol.	Tibetan Plateau	Continuous	Surface runoff	Field observations	Watershed	Yes
Wang and Zhang, 2016	Ecohydrology in Cold Regions: Theory and	Science Press (book)	Cold regions	Multiple	Multiple	Review	Multiple	No

	Practice							
Wang et al., 2017	Processes of runoff generation operating during the spring and autumn seasons in a permafrost catchment on semi-arid plateaus	J. Hydrol.	Semi-arid plateau, Tibetan Plateau	Continuous	Surface runoff; Active layer processes	Field observations	Watershed	Yes
Wang et al., 2014	Effect of a thermokarst lake on soil physical properties and infiltration processes in the permafrost region of the Qinghai-Tibet Plateau	Sci. China	Qinghai-Tibet Plateau	Continuous	Permafrost thaw impacts	Field observations	Plot	Yes
Wang et al., 2018a	An estimation of ground ice volumes in permafrost layers in northeastern Qinghai-Tibet Plateau	Chin. Geogr. Sci.	Northeastern Qinghai-Tibet Plateau	Continuous	Permafrost thaw impacts	Statistical analysis	Regional	Yes
Wang et al., 2018b	Changes in river discharge in typical mountain permafrost catchments, northwestern China	Quat. Int.	Qilian Mountains, China	Continuous	Permafrost thaw impacts	Field observations	Watershed	Yes
Wang et al., 2018c	Exploring the ground ice recharge near	J. Hydrol.	Central Qinghai-Tibet	Continuous	Active layer processes	Isotopic tracers	Plot	Yes

	permafrost table on the central Qinghai-Tibet Plateau using chemical and isotopic data		Plateau					
Wang et al., 2018d	Quantifying the streamflow response to frozen ground degradation in the source region of the Yellow River within the Budyko framework	J. Hydrol.	Yellow River source region, Tibetan Plateau	Continuous	Permafrost thaw impacts	Statistical analysis	Regional	Yes
Wang et al., 2019	Response of low flows under climate warming in high-altitude permafrost regions in western China	Hydrol. Process.	Western China high-altitude permafrost regions	Continuous	Permafrost thaw impacts	Field observations	Watershed	Yes
Wang et al., 2021a	Permafrost dynamics and their hydrologic impacts over the Russian Arctic Drainage Basin	Advances in Climate Change Research	Russian Arctic Drainage Basin	Multiple	Permafrost thaw impacts	Statistical analysis	Regional	Yes
Wang et al., 2021b	Potential role of permafrost thaw on increasing Siberian river discharge	Environ. Res. Lett.	Siberia	Multiple	Permafrost thaw impacts	Statistical analysis	Regional	Yes
Wang et al.,	Insights into the	Sci. Total	Central Tibetan	Multiple	Permafrost	Isotopic	Watershed	Yes

2023	streamwater age in the headwater catchments covered by glaciers and permafrost, Central Tibetan Plateau	Environ.	Plateau		thaw impacts	tracers		
Wang et al., 2024a	Water budgets in an arid and alpine permafrost basin: Observations from the High Mountain Asia	Advances in Climate Change Research	High Mountain Asia	Continuous	Permafrost thaw impacts	Field observations + modeling	Watershed	Yes
Wang et al., 2024b	Spatial-temporal differentiation of supra- and sub-permafrost groundwater contributions to river runoff	Water Resour. Res.	Eurasian Arctic and Qinghai-Tibet Plateau	Multiple	Permafrost thaw impacts	Statistical analysis	Regional	Yes
Woo, 2008	Progress in permafrost hydrology in the new millennium	Permafrost Periglac. Process.	Global permafrost regions	Multiple	Multiple	Review	Multiple	No
Woo, 2012	Permafrost Hydrology	Springer (book)	Global permafrost regions	Multiple	Multiple	Review	Multiple	No
Woo, 2019	Cryohydrology in Canada: A brief history	Hydrol. Process.	Canada	Multiple	Multiple	Review	Regional	No
Wright et al.,	Thaw-induced impacts	Earth-Sci.	Taiga Plains	Discontinuous	Permafrost	Review	Regional	No

2022	on land and water in discontinuous permafrost: A review of the Taiga Plains and Taiga Shield	Rev.	and Taiga Shield, Canada		thaw impacts			
Wu et al., 2005	Using ground-penetrating radar to detect permafrost degradation in the northern limit of permafrost on the Tibetan Plateau	Cold Reg. Sci. Technol.	Northern Tibetan Plateau	Continuous	Permafrost thaw impacts	Geophysical techniques	Regional	Yes
Xiao et al., 2025a	Beyond carbon: Multi-scale thermal and hydrological feedback of permafrost on the Tibetan Plateau	Earth-Sci. Rev.	Tibetan Plateau	Multiple	Multiple	Review	Regional	No
Xiao et al., 2025b	Vegetation and permafrost interactions shape soil moisture stratification in marginal permafrost zones	Geoderma	Marginal permafrost zones, Tibetan Plateau	Marginal permafrost	Active layer processes	Field observations	Plot	Yes
Xu and Gao, 2022	Understanding the effects of cold and warm season air	J. Geophys. Res. Atmos.	Lancang River source region, Tibetan Plateau	Multiple	Permafrost thaw impacts	Numerical modeling	Watershed	Yes

	warming on the permafrost hydrology changes in the source region of the Lancang River							
Xu et al., 2024	Evolution trends and driving factors of groundwater storage, recharge, and discharge in the Qinghai-Tibet Plateau	J. Hydrol.	Qinghai-Tibet Plateau	Multiple	Permafrost thaw impacts	Review	Regional	No
Yamazaki et al., 2006	Seasonal changes in runoff characteristics on a permafrost watershed in the southern mountainous region of eastern Siberia	Hydrol. Process.	Eastern Siberia	Continuous	Surface runoff	Field observations	Watershed	Yes
Yang and Kane, 2021	Arctic Hydrology, Permafrost and Ecosystems	Springer (book)	Arctic	Multiple	Multiple	Review	Multiple	No
Yang et al., 2000	Hydrology in Cold Regions of China	Science Press (book)	China cold regions	Multiple	Multiple	Review	Regional	No
Yang et al., 2016	Evaluation of the hydrological contributions of	Glob. Planet. Change	Qinghai-Tibet Plateau	Continuous	Permafrost thaw impacts	Isotopic tracers	Regional	Yes

	permafrost to the thermokarst lakes on the Qinghai-Tibet Plateau using stable isotopes							
Yang et al., 2017	Unraveling of permafrost hydrological variabilities on Central Qinghai-Tibet Plateau using stable isotopic technique	Sci. Total Environ.	Central Qinghai-Tibet Plateau	Continuous	Permafrost thaw impacts	Isotopic tracers	Regional	Yes
Yang et al., 2019a	Delineating the hydrological processes and hydraulic connectivities under permafrost degradation on Northeastern Qinghai-Tibet Plateau	J. Hydrol.	Northeastern Qinghai-Tibet Plateau	Continuous	Permafrost thaw impacts	Field observations + isotopes	Watershed	Yes
Yang et al., 2019b	Using stable isotopes to illuminate thermokarst lake hydrology in permafrost regions on the Qinghai-Tibet plateau	Permafrost Periglac. Process.	Qinghai-Tibet Plateau	Continuous	Permafrost thaw impacts	Isotopic tracers	Regional	Yes

Yang et al., 2023	Insights into runoff changes in the source region of Yellow River under frozen ground degradation	J. Hydrol.	Yellow River source region, Tibetan Plateau	Continuous	Permafrost thaw impacts	Statistical analysis	Watershed	Yes
Ye et al., 2009	Variation of hydrological regime with permafrost cover Lena basin in Siberia	J. Geophys. Res. Atmos.	Lena Basin, Siberia	Multiple	Permafrost thaw impacts	Statistical analysis	Regional	Yes
Ye et al., 2011	Hydrological process change with air temperature over the Lena Basin in Siberia	IAHS Publ.	Lena Basin, Siberia	Multiple	Permafrost thaw impacts	Statistical analysis	Regional	Yes
Ye et al., 2012	The response of river discharge to climate warming in cold regions over China	Quat. Sci.	China cold regions	Multiple	Permafrost thaw impacts	Statistical analysis	Regional	Yes
Yi et al., 2021	Increasing annual streamflow and groundwater storage in response to climate warming in the Yangtze River source region	Environ. Res. Lett.	Yangtze River source region, Tibetan Plateau	Continuous	Permafrost thaw impacts	Statistical analysis	Regional	Yes
Yoshikawa et al., 2007	Spring and aufeis (icing) hydrology in	J. Geophys. Res.	Brooks Range, Alaska	Continuous	Surface water-groundw	Field observations	Regional	Yes

	Brooks Range, Alaska				ater interaction			
Young-Roberts on et al., 2021	Northern Ecohydrology of Interior Alaska Subarctic	Springer (book chapter)	Interior Alaska	Discontinuous	Multiple	Review	Regional	No
Zhang et al., 1999	Statistics and characteristics of permafrost and ground-ice distribution in the Northern Hemisphere	Polar Geogr.	Northern Hemisphere	Multiple	Permafrost thaw impacts	Statistical analysis	Regional	Yes
Zhang et al., 2006	Winter runoff in a typical alpine permafrost region, Tibet-Himalayas	Adv. Earth Sci.	Tibet-Himalaya s	Continuous	Permafrost thaw impacts	Field observations	Watershed	Yes
Zhang et al., 2016	Influence of frozen ground on hydrological processes in alpine regions: a case study in an upper reach of the Heihe River	J. Glaciol. Geocryol.	Heihe River, Qilian Mountains, China	Continuous	Surface runoff	Field observations	Watershed	Yes
Zhang et al., 2017	Response of the soil hydrothermal process to difference underlying conditions in the Beiluhe	Environ. Earth Sci.	Beiluhe, Tibetan Plateau	Continuous	Active layer processes	Field observations	Plot	Yes

	permafrost region							
Zhao et al., 2008	Regional changes of permafrost in Central Asia	Proc. 9th Int. Conf. Permafrost	Central Asia	Multiple	Permafrost thaw impacts	Field observations	Regional	Yes
Zhao et al., 2019	Permafrost Changes and Its Effects on Hydrological Processes on Qinghai-Tibet Plateau	Bull. Chin. Acad. Sci.	Qinghai-Tibet Plateau	Multiple	Permafrost thaw impacts	Review	Regional	No
Zhao et al., 2020	Changing climate and the permafrost environment on the Qinghai-Tibet (Xizang) plateau	Permafrost Periglac. Process.	Qinghai-Tibet Plateau	Multiple	Permafrost thaw impacts	Field observations	Regional	Yes
Zhao et al., 2023	Characterizing the changes in permafrost thickness across Tibetan Plateau	Remote Sens.	Tibetan Plateau	Multiple	Permafrost thaw impacts	Remote sensing	Regional	Yes
Zheng et al., 2019	Changing Arctic River dynamics cause localized permafrost thaw	J. Geophys. Res. Earth Surf.	Kuparuk River floodplain, Alaska, USA	Continuous	Permafrost thaw impacts	Field observations	Regional	Yes
Zhou et al., 2024a	Accelerating thermokarst lake changes on the Qinghai-Tibetan	Sci. Rep.	Qinghai-Tibetan Plateau	Multiple	Permafrost thaw impacts	Remote sensing	Regional	Yes

	Plateau							
Zhou et al., 2024b	Recent advances in hydrology studies under changing permafrost on the Qinghai-Xizang Plateau	Res. Cold Arid Reg.	Qinghai-Xizang Plateau	Multiple	Permafrost thaw impacts	Review	Regional	Yes
Zou et al., 2024	Estimation of permafrost ground ice to 10 m depth on the Qinghai-Tibet Plateau	Permafrost Periglac.	Qinghai-Tibet Plateau	Qinghai-Tibet Plateau	ground ice melt	Field observations	Regional	Yes
Zwieback et al., 2025	InSAR estimates of excess ground ice concentrations near the permafrost table	ISPRS J. Photogramm.	Kivalina, Northwestern Alaska, USA	Continuous permafrost	hydrological implications of ice melt	Remote sensing	Regional	Yes

Note: Review articles and books/book chapters are marked as “Review” in the Method column, with “No” in the Quantitative data column; entries covering multiple regions, permafrost types, or thematic foci are labeled “Multiple”. Information in this table was derived from publication titles and abstracts. The 219 records listed correspond to the studies retained for the final synthesis, as described in Section 2.2 of the main text.

Supplementary Table S2. Conference abstracts, methodological references, and non-permafrost comparative/background references excluded from the core evidence synthesis.

Author/year	Title	Journal/ source	Study region	Permafrost type	Hydrological focus	Method	Spatial scale	Quantitative data
Bayard et al., 2005	The influence of seasonally frozen soil on the snowmelt runoff at two Alpine sites in southern Switzerland	J. Hydrol.	Swiss Alps	Seasonal frost (non-permafrost)	Surface runoff	Field observations	Hillslope	Yes
Haddaway and Bayliss, 2015	Clarification on the applicability of systematic reviews	Front. Ecol. Environ.	N/A (methodologica l)	N/A	N/A	Review methods	N/A	No
Jones, 2014	Long-term trends in stream biogeochemistry and hydrology in watersheds underlain with discontinuous permafrost in the boreal forest of Alaska	AGU Fall Meeting Abstracts	Alaska, USA	Discontinuous	Permafrost thaw impacts	Field observations	Watershed	Yes
Karlsson et al., 2011	Arctic hydrology shifts with permafrost thawing and thermokarst lake changes	AGU Fall Meeting Abstracts	Siberia	Multiple	Permafrost thaw impacts	Remote sensing	Regional	Yes

Li et al., 2022	Globally elevated chemical weathering rates beneath glaciers	Nat. Commun.	Global glaciers	N/A (glaciers)	Surface runoff	Field observations	Regional	Yes
van Meerveld, 2024	The (ir)relevance of plot- and hillslope scale processes for catchment runoff	EGU General Assembly 2024	Multiple	Multiple	Multiple	Review	Multiple	No
Yoshikawa et al., 2006	Intrapermafrost water and hydrological chronology; a case study of aufeis and spring hydrology in continuous permafrost regions	AGU Fall Meet. Abstr.	Alaska, USA	Continuous	Surface water-groundwater interaction	Field observations	Watershed	Yes