Supplementary Materials

Table S1. The main climate indices used in this study.

Climate indices	**Definition**
Western Pacific Subtropical High Ridge Position Index	The average latitude of the subtropical high center (i.e., zonal wind =0 and ∂u/∂y >0) along each meridian in the 500hPa height field within the range of 10°N-60°N and 110°E-150°E.
Indian Subtropical High Ridge Position Index	The average latitude of the subtropical high pressure center (i.e., zonal wind =0 and ∂u/∂y >0) along each meridian in the 500hPa height field within the range of 10°N-60°N and 65°E -95°E.
South China Sea Subtropical High Ridge Position Index	The average latitude of the subtropical high pressure center (i.e., zonal wind =0 and ∂u/∂y >0) along each meridian in the 500hPa height field within the range of 10°N-60°N and 100°E-120°E.
Eastern Pacific Subtropical High Ridge Position Index	The average latitude of the subtropical high center (i.e., zonal wind =0 and ∂u/∂y >0) along each meridian in the 500hPa height field within the range of 10°N-60°N and 175°W-115°W.
North American Subtropical High Ridge Position Index	The average latitude of the subtropical high center (i.e., zonal wind =0 and ∂u/∂y >0) along each meridian in the 500hPa height field within the range of 10°N-60°N and 110°W-60°E.
North American-North Atlantic Subtropical High Ridge Position Index	The average latitude of the subtropical high center (i.e., zonal wind =0 and ∂u/∂y >0) along each meridian in the 500hPa height field within the range of 10°N-60°N and 110°W-20°W.
Northern Hemisphere Subtropical High Ridge Position Index	The average latitude of the subtropical high center (i.e., zonal wind =0 and ∂u/∂y >0) along each meridian in the 500hPa height field within the range of 10°N-60°N and 5°E-360°.
North African Subtropical High Ridge Position Index	The average latitude of the subtropical high center (i.e., zonal wind =0 and ∂u/∂y >0) along each meridian in the 500hPa height field within the range of 10°N-60°N and 20°W-60°E.
Atlantic Subtropical High Ridge Position Index	The average latitude of the subtropical high center (i.e., zonal wind =0 and ∂u/∂y >0) along each meridian in the 500hPa height field within the range of 10°N-60°N and 55°W-25°W.
Western Pacific Subtropical High Western Ridge Point Index	The westernmost longitude of the 5880 gpm contour in the 500 hPa height field within the domain of 10°N-60°N and 90°E-180°.
Eastern Pacific	The spatially integrated excess of the 500 hPa geopotential

Subtropical High Intensity Index	height above 5870 gpm over the region (10°N-60°N, 175°W-115°W) where the height is ≥ 5880 gpm.
North American Subtropical High Intensity Index	The spatially integrated excess of the 500 hPa geopotential height above 5870 gpm, calculated over the region (10°N-60°N, 110°W-60°W) where the height is ≥ 5880 gpm.
North Atlantic Subtropical High Intensity Index	The spatially integrated excess of the 500 hPa geopotential height above 5870 gpm, calculated over the region (10°N-60°N, 55°W-25°W) where the height is ≥ 5880 gpm.
Northern Hemisphere Polar Vortex Area Index	The area poleward of the characteristic contour line defining the southern boundary of the polar vortex in the Northern Hemisphere 500 hPa height field (0°-360°).
Asia Polar Vortex Area Index	The spherical area enclosed between the North Pole and the characteristic contour lines defining the southern boundary of the vortex.
Pacific Polar Vortex Area Index	The area north of the vortex's southern boundary within 150°E-120°W. This boundary is identified by characteristic contour lines in the Northern Hemisphere 500 hPa height field.
Northern Hemisphere Polar Vortex Intensity Index	The total air mass contained between the 500 hPa isobaric surface and the geopotential height surface marking the vortex's southern boundary, across the entire longitudinal range (0°-360°).
North American Polar Vortex Intensity Index	The total air mass contained between the 500 hPa isobaric surface and the geopotential height surface marking the vortex's southern boundary, across the 120°W-30°W region in the Northern Hemisphere.
Pacific Polar Vortex Intensity Index	The total air mass contained between the 500 hPa isobaric surface and the geopotential height surface marking the vortex's southern boundary, across the 150°E-120°W region in the Northern Hemisphere.
Northern Hemisphere Polar Vortex Central Longitude Index	The longitude of the low vortex center that exhibits the minimum geopotential height within the high-latitude region of the 500 hPa geopotential height field.
Northern Hemisphere Polar Vortex Central Latitude Index	The longitude of the low vortex center that exhibits the minimum geopotential height within the high-latitude region of the 500 hPa geopotential height field.
Northern Hemisphere Polar Vortex Central Intensity Index	The minimum 500 hPa geopotential height value located near the center of the polar vortex.
Atlantic-European Circulation W Pattern Index	The number of days with a W-shaped circulation pattern.

Atlantic-European Circulation E Pattern Index	The number of days with an E-shaped circulation pattern.
East Pacific 850mb Trade Wind Index	The standardized anomaly of the mean 850 hPa zonal wind averaged over the region 5°N-5°S, 135°W-120°W.
Mid-Eastern Pacific 200mb Zonal Wind Index	The standardized anomaly of the mean 200 hPa zonal wind averaged over the region 5°N-5°S, 165°W-110°W.
30hPa zonal wind Index	The spatially averaged zonal wind over the domain 60°S-60°N, 73°E-90°W.
Eurasian Zonal Circulation Index	The average of the zonal indices across five contiguous 30°-longitude sectors within the 45°N-65°N and 0°-150°E domain at the 500 hPa level.
Asian Zonal Circulation Index	The average of the zonal indices across five contiguous 30°-longitude sectors within the 45°N-65°N and 60°-150°E domain at the 500 hPa level.
Eurasian Meridional Circulation Index	The average of the meridional indices across five contiguous 30°-longitude sectors within the 45°N-65°N and 0°-150°E domain at the 500 hPa level.
Asian Meridional Circulation Index	The average of the meridional indices across five contiguous 30°-longitude sectors within the 45°N-65°N and 60°E-150°E domain at the 500 hPa level.
East Asian Trough Position Index	The mean meridional position of the 500 hPa trough line within the domain of 30°N-55°N and 110°E-170°E.
East Asian Trough Intensity Index	The sum of geopotential heights at all points along the trough line (within 30°N-55°N, 110°E-170°E at 500 hPa), from which the maximum height is subtracted and the minimum height is added.
North Pacific Pattern	The temporal coefficient of the fifth mode derived from an Empirical Orthogonal Function (EOF) analysis of the standardized 500 hPa geopotential height field over the Northern Hemisphere (20°N-90°N, 0°-360°).
Scandinavia Pattern	The temporal coefficient of the ninth mode derived from an Empirical Orthogonal Function (EOF) analysis of the standardized 500 hPa geopotential height field over the Northern Hemisphere (20°N-90°N, 0°-360°).
East Atlantic-West Russia Pattern	The temporal coefficient of the sixth mode derived from an Empirical Orthogonal Function (EOF) analysis of the standardized 500 hPa geopotential height field over the Northern Hemisphere (20°N-90°N, 0°-360°).
Polar-Eurasia Pattern	The temporal coefficient of the eighth mode derived from an Empirical Orthogonal Function (EOF) analysis of the standardized 500 hPa geopotential height field over the Northern Hemisphere (20°N-90°N, 0°-360°).

West Pacific Pattern	The temporal coefficient of the fourth mode derived from an Empirical Orthogonal Function (EOF) analysis of the standardized 500 hPa geopotential height field over the Northern Hemisphere (20°N-90°N, 0°-360°).
Antarctic Oscillation	The temporal coefficient of the first mode derived from an Empirical Orthogonal Function (EOF) analysis of the standardized 700 hPa geopotential height field over the Northern Hemisphere (20°S-90°S, 0°-360°).
South Indian Ocean Dipole Index	The difference in the regional mean sea surface temperature anomaly (SSTA) between the regions (45°S-30°S, 45°E-75°E) and (25°S-15°S, 80°E-100°E).
Tropic Indian Ocean Dipole Index	The difference in the regional mean sea surface temperature anomaly (SSTA) between the regions (10°S-10°N, 50°-70°E) and (10°S-0°, 90°-110°E).
Tropical Southern Atlantic SST Index	The regional mean sea surface temperature anomaly (SSTA) over the eastern tropical Atlantic (20°S-0°, 30°W-10°E).
Indian Ocean Warm Pool Area Index	The combined spherical area within the regions of 7°S-30°N, 41°E-98°E and 30°S-8°N, 41°E-120°E where the sea surface temperature (SST) exceeds 28.0°C.
NINO W SSTA Index	The regional mean sea surface temperature anomaly (SSTA) over the 0°-10°N, 140°E -180°E.
NINO 1+2 SSTA Index	The regional mean sea surface temperature anomaly (SSTA) over the 10°S-0°, 90°W -80°W.
Atlantic Multi-decadal Oscillation Index	The regionally averaged sea surface temperature anomaly (SSTA) over the domain 0°-70°N, 80°W-0°.

Table S2. The key predictors* for runoff prediction at Wudongde reservoir.

Month	**Predictors**				
Jan-Mar	19_ Atlantic Multi-decadal Oscillation Index	24_North African Subtropical High Ridge Position Index	29_Northern Hemisphere Polar Vortex Central Longitude Index	26_Atlantic-European Circulation W Pattern Index	
Apr	26_Northern Hemisphere Polar Vortex Area Index	10_Atlantic-European Circulation W Pattern Index	24_Indian Subtropical High Ridge Position Index	13_South China Sea Subtropical High Ridge Position Index	
May	15_South China Sea Subtropical	22_East Pacific 850mb Trade Wind Index	17_South China Sea Subtropical	18_Eastern Pacific Subtropical	21_Eastern Pacific Subtropical

	High Ridge Position Index		High Ridge Position Index	High Intensity Index	High Ridge Position Index
Jun	29_Asia Polar Vortex Area Index	12_Eastern Pacific Subtropical High Ridge Position Index	21_South Indian Ocean Dipole Index	31_Asian Zonal Circulation Index	
Jul	24_Pacific Polar Vortex Area Index	31_Eurasian Meridional Circulation Index	13_Atlantic Sub Tropical High Ridge Position Index	30_South China Sea Subtropical High Ridge Position Index	15_North American Subtropical High Ridge Position Index
Aug	18_Northern Hemisphere Polar Vortex Intensity Index	24_East Asian Trough Position Index	27_North American Subtropical High Ridge Position Index	31_North Pacific Pattern	
Sep	11_Northern Hemisphere Polar Vortex Central Latitude Index	29_North American-North Atlantic Subtropical High Ridge Position Index	20_Northern Hemisphere Subtropical High Ridge Position Index		
Oct	21_Northern Hemisphere Polar Vortex Central Intensity Index	18_Northern Hemisphere Subtropical High Ridge Position Index	27_Tropical Southern Atlantic SST Index	23_Asian Zonal Circulation Index	
Nov	19_Asian Meridional Circulation Index	24_Asian Zonal Circulation Index	22_Northern Hemisphere Polar Vortex Central Intensity Index		
Dec	17_Tropical Southern Atlantic SST Index	23_Scandinavia Pattern	25_Asian Zonal Circulation Index	20_East Atlantic-West Russia Pattern	22_Eurasian Meridional Circulation Index

* The number preceding each predictor denotes the lead month. For example, 19_ Atlantic Multi-decadal Oscillation Index represents the climate index value at a 19-month lead time

relative to the target month.

Table S3. The key predictors* for runoff prediction at the Three Gorges reservoir.

Month	Predictors				
Jan	25_Scandinavia Pattern	24_Northern Hemisphere Polar Vortex Central Longitude Index	26_East Asian Trough Intensity Index	26_South Indian Ocean Dipole Index	
Feb	18_Northern Hemisphere Polar Vortex Area Index	26_East Asian Trough Intensity Index	22_Indian Subtropical High Ridge Position Index	22_East Asian Trough Position Index	
Mar	26_Indian Ocean Warm Pool Area Index	28_Asia Polar Vortex Area Index	20_North American-North Atlantic Subtropical High Ridge Position Index	25_Northern Hemisphere Polar Vortex Central Longitude Index	23_Indian Subtropical High Ridge Position Index
Apr	16_North American Subtropical High Intensity Index	16_Northern Hemisphere Subtropical High Ridge Position Index	21_North American-North Atlantic Subtropical High Ridge Position Index	34_Asian Meridional Circulation Index	
May	33_Northern Hemisphere Subtropical High Ridge Position Index	13_South China Sea Subtropical High Ridge Position Index	29_North American Polar Vortex Intensity Index	30_Asia Polar Vortex Area Index	
Jun	19_Western Pacific Subtropical High Ridge Position Index	26_NINO 1+2 SSTA	14_Western Pacific Subtropical High Western Ridge Point Index	28_Indian Subtropical High Ridge Position Index	30_Eurasian Zonal Circulation Index

Jul	18_Polar-Eurasia Pattern	41_South China Sea Subtropical High Ridge Position Index	15_30hPa zonal wind index	15_North African Subtropical High Ridge Position Index	
Aug	30_Atlantic-European Circulation E Pattern Index	14_30hPa zonal wind index	35_East Asian Trough Position Index	16_South China Sea Subtropical High Ridge Position Index	17_Eurasian Meridional Circulation Index
Sep	18_North American Polar Vortex Intensity Index	13_Antarctic Oscillation	24_East Asian Trough Position Index	23_Tropic Indian Ocean Dipole Index	37_Western Pacific Subtropical High Western Ridge Point Index
Oct	30_West Pacific Pattern	20_Northern Hemisphere Polar Vortex Central Intensity Index	23_Eurasian Zonal Circulation Index		
Nov	22_North Atlantic Subtropical High Intensity Index	24_Pacific Polar Vortex Intensity Index	19_Northern Hemisphere Polar Vortex Central Longitude Index	18_Atlantic-European Circulation W Pattern Index	
Dec	24_Scandinavia Pattern	13_Atlantic-European Circulation W Pattern Index	34_NINO W SSTA	24_Mid-Eastern Pacific 200mb Zonal Wind Index	

* The number preceding each predictor denotes the lead month. For example, 25_Scandinavia Pattern represents the climate index value at a 25-month lead time relative to the target month.