

# Climate data for the Minimum Inflows project

Climate data plays a critical role in how the department plans for water security in NSW. The Minimum Inflows project is reviewing the assumptions used to estimate the lowest inflows into dams during drought, which underpin how much water is set aside to meet high-priority needs.

These assumptions are currently based on the worst drought on record prior to 2004 in the majority of the inland regulated systems, using observed climate data from the 1890s to 2004. This approach reflected the best available information at the time, but it does not account for more severe droughts that occurred before records began, or for the impacts of climate change.

Natural climate variability is greater than what the historical record shows, and climate change is altering the conditions that influence inflows. As a result, relying solely on past observations is no longer enough to ensure water reliability into the future.

This fact sheet outlines the updated climate data being used in the Minimum Inflows project. It explains how new datasets provide better understanding of the full range of possible climate conditions to support more resilient water planning.

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## Understanding climate variability and climate change

A key concept shaping the climate data scenarios used in the Minimum Inflows project is the distinction between climate variability and climate change.

- **Climate variability** describes the natural fluctuations in climate conditions over time, from year-to-year and decade-to-decade, driven by phenomena<sup>1</sup> such as the El Niño–Southern Oscillation (ENSO) and the Interdecadal Pacific Oscillation (IPO). These processes produce alternating periods of wet and dry conditions without demonstrating any long-term directional trend.
- **Climate change** refers to persistent, long-term shifts in average climate conditions resulting from human induced changes in the global climate system, as a result of increased greenhouse gas concentrations. These shifts alter baseline patterns of temperature, rainfall, and drought risk over decades and centuries.

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<sup>1</sup> <https://www.bom.gov.au/climate/about/>

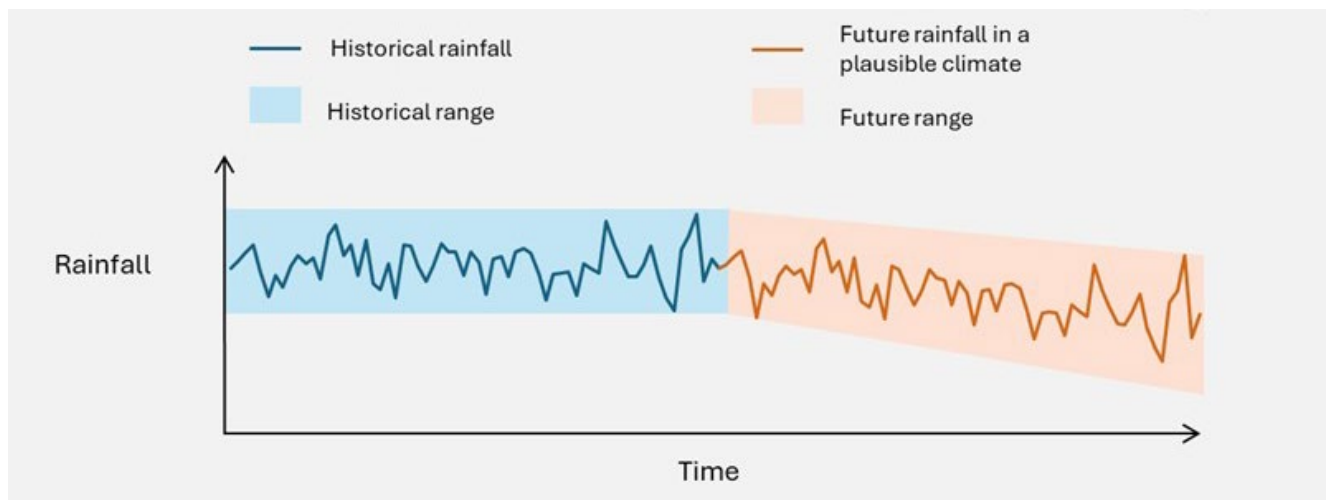


Figure 1: Illustrative example of rainfall patterns – climate variability vs climate change. Climate variability refers to natural ups and downs in rainfall over time. Climate change is the long-term trend that shifts the overall pattern. Source: MDBA Sustainable Yields 2025 Summary Report

In the short to medium term, natural climate variability is the main driver of inflows to NSW river systems. Over longer timescales, climate change introduces a trend that shifts the conditions in which that variability occurs. The climate data used in the Minimum Inflows project combines long-term records of past climate variability with the latest climate change projections. This approach helps capture both the natural fluctuations and the long-term changes that influence future inflows.

## A long-term baseline of natural climate variability

Instrumental climate records cover a little over 100 years, a comparatively short timeframe in the history of the Earth's climate. To understand how our rivers behave and the variability in inflows that have occurred, we need to look well beyond this short window of modern climate records.

To extend our records, scientists have developed a 'paleo-stochastic' dataset that represents a long-term baseline of natural climate variability. This dataset represents 10,000 years of daily rainfall and evapotranspiration for NSW river valleys drawing on three key sources:

- observations from climate gauges across NSW
- information from natural archives like tree rings, ice cores, and other records that record centuries of wet and dry cycles before measurements began
- advanced statistical modelling to recreate realistic daily and seasonal patterns and long-term climate variability, including the influence of large-scale cycles like the IPO.

The paleo-stochastic dataset has undergone rigorous scientific review to ensure its accuracy and usefulness. The Office of the NSW Chief Scientist & Engineer (OSCE) has assessed the methods,

data sources, and modelling approaches used to create it, and has formally endorsed<sup>2</sup> it as consistent with best-practice approaches to climate risk management.

## Why it matters

The paleo-stochastic data shows that NSW has experienced droughts and wet periods far more extreme than those captured in instrumental records. This means the historical 'drought of record' may not reflect the full range of dry conditions that can occur. While the dataset improves our understanding of past extremes, it does not account for climate change. To assess future risks, it needs to be used alongside climate projections.

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## NARClIM2.0 climate projections and scenario selection

NARClIM2.0 is NSW's official climate projection dataset. It is based on the latest generation of global climate models (CMIP6) and refined to a high resolution of 4 km, allowing for better representation of topography, coastlines, and local weather patterns reducing errors in rainfall and temperature estimates.

The dataset provides continuous climate simulations from 1951 to 2100 under three different global greenhouse gas scenarios:

- SSP1-2.6 – a low-emissions pathway
- SSP2-4.5 – a medium-emissions pathway
- SSP3-7.0 – a high-emissions pathway

## Choice of emissions scenario

For the Minimum Inflows project, rainfall and evapotranspiration projections from NARClIM2.0 scenario SSP2-4.5 (medium-emissions) are applied to the paleo-stochastic dataset to create plausible future climate sequences for hydrological modelling.

The project uses SSP2-4.5 as the emissions pathway, as it best reflects current global trends and is considered the most realistic for medium-term planning. The low (SSP1-2.6) and high (SSP3-7.0) pathways were not modelled because, in the near term, the differences in projected change between emissions scenarios are small. Until around 2050, climate projections are similar across all three pathways, so using a single, median-based scenario is appropriate for planning purposes.

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<sup>2</sup> [https://www.chiefscientist.nsw.gov.au/\\_data/assets/pdf\\_file/0018/1593/Independent-Review-Climate-Risk-Methods-For-RWS\\_Main-Report.pdf](https://www.chiefscientist.nsw.gov.au/_data/assets/pdf_file/0018/1593/Independent-Review-Climate-Risk-Methods-For-RWS_Main-Report.pdf)

## Global surface temperature change relative to 1850–1900

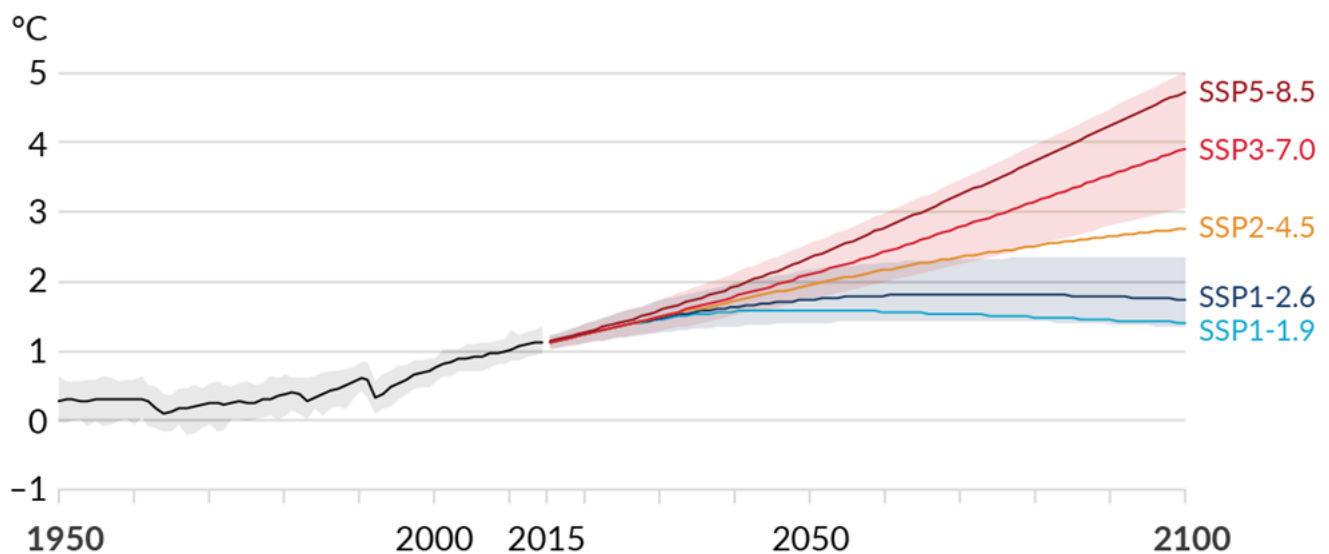


Figure 2: Projected changes in surface temperature under different emissions scenarios, relative to 1850-1900. The scenarios remain similar until about 2050, after which they diverge. This means the choice of emissions scenario is less important for understanding near-term climate conditions. Source: Figure SPM.8 in IPCC, 2021: Summary for Policymakers. <https://www.cambridge.org/core/books/climate-change-2021-the-physical-science-basis/summary-for-policymakers/8E7A4E3AE6C364220F3B76A189CC4D4C>

## Key climate scenarios for the Minimum Inflows project

The Minimum Inflows project uses 2 timeframes to test how NSW's water systems might perform under different plausible climate futures. Both are based on the historical palaeostochastic dataset, which represents the full range of natural climate variability. NARClIM2.0 projections are then applied to this baseline data, creating climate sequences that reflect future conditions. Neither scenario is a forecast. They are planning tools designed to explore a range of possible outcomes.

### Current climate scenario (Series 4)

This scenario represents a realistic view of near-term climate conditions for planning purposes. It applies the **2035** SSP2-4.5 median projection from NARClIM2.0 as a scaling factor to the palaeostochastic baseline. The result is climate data suitable for everyday operational modelling and short-term policy decisions over the next decade.

### Future Trajectory scenario (Series 5)

This scenario tests system resilience under a plausible longer-term climate outlook. It applies the **2050** SSP2-4.5 median projection from NARClIM2.0 as a scaling factor to the palaeostochastic baseline. The 2050 horizon is used to check whether today's strategies will remain effective if the climate continues to change along the current global emissions trajectory.

## Supporting reference scenarios

To help compare future climate scenarios with past conditions, we also modelled a set of historical baseline scenarios. These show how water systems have performed under real-world climate variability, including past droughts and long-term natural patterns, providing important context for understanding potential impacts.

- **Observed Data (1895–2004/2009):** Reflects conditions under existing water sharing plan rules, providing a baseline for comparison.
- **Observed Data (1895–2020):** Extends the dataset to include more recent droughts, offering insight into how recent extreme events compare.
- **10,000-Year Paleo-stochastic Dataset:** Represents a long-term baseline of natural climate variability without the influence of climate change.

These reference scenarios help compare the impacts of climate change against both a no-climate-change case and historical conditions.