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Submission to the inquiry into the importance of Antarctica to Australia's national interests

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Dear Committee Members
I am a hydroclimatologist who has worked for more than 24 years on understanding and managing the impacts of climate variability and change in the Asia-Pacific region. Of particular interest are hydrological extremes (e.g. floods and droughts) and how these may change in the future.

My interest in this inquiry relates to the need for hydrological modelling, water resources management, and water storage/supply policy and infrastructure to account for the impacts of climate variability and change. Australian-led, Antarctic ice core research (e.g. Vance et al., 2013, 2015, 2022; Udy et al., 2021, 2022) is being, and will continue to be, used to better understand and manage droughts, floods, and water supply variability in Australia and the wider Asia-Pacific region (e.g. Armstrong et al., 2020; Flack et al., 2020; Kiem et al., 2020; Iese et al., 2021; Falster et al., 2024).

Upholding the principles of the Antarctic Treaty System
No comment.

Conserving and protecting the unique biodiversity and environment of Antarctica
No comment.

Developing a better understanding of global environmental and climate science
Instrumental rainfall records in Australia only exist for the last ~120 years (i.e. since ~1900) at best and are typically available for less than ~70 years. Many existing studies (e.g. Allen et al., 2015a, 2015b, 2024; Ho et al., 2015a, 2015b; Vance et al., 2015, 2022; Tozer et al., 2016, 2018; Dixon et al., 2017, 2019; Kiem et al., 2020) demonstrate that this instrumental period is too short to obtain a realistic indication of the plausible range of hydroclimatic variability that is possible in Australia – meaning that the risk of extreme hydrological events (e.g. prolonged drought or flood dominated epochs) is misrepresented, and strategies (i.e. policy and infrastructure) designed to mitigate those risks are likely sub-optimal.

Australia has experienced serious droughts and floods during the ~120 years covered by the instrumental record. However, to enable design and implementation of policy and infrastructure that ensures climate resilience, it is important to properly understand the chance of similar or worse droughts and floods happening again. This requires an understanding and quantification of the

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impacts of interannual to multidecadal hydroclimatic variability beyond what is possible from instrumental records alone (e.g. Armstrong et al., 2020; Kiem et al., 2020; Falster et al., 2024). Hydroclimatic variability in the pre-instrumental past can be inferred from palaeoclimate proxies. However, in the Southern Hemisphere and Australia in particular, there are limited palaeoclimate records available that are relevant and useful for hydrological modelling and water resource management. Therefore, it is important to continue to develop and analyse the few sources of palaeoclimate information that do exist that are relevant to hydrological modelling and water resource management in Australia.

Ice cores from Antarctica preserve a vast and growing array of climate signals in the snowfall that accumulates over time. Scientific advances are increasing the amount and type of past climate information able to be recovered from ice cores. For example, the Law Dome ice core from East Antarctica provided the first 2000-year, accurately dated palaeorecords of Australian hydroclimate (rainfall, streamflow, drought) and showed drier and wetter centuries than the 20th century have occurred in the past (Vance et al., 2015, 2022). These Law Dome ice core records are being used to understand how the link between Australia and Antarctica functions and varies through time (Udy et al., 2021, 2022) and to better understand and manage droughts, floods, and water supply variability in Australia and the wider Asia-Pacific region (e.g. Armstrong et al., 2020; Flack et al., 2020; Kiem et al., 2020; Iese et al., 2021; Falster et al., 2024). However, Law Dome is only one ice core in space and time and thus only reveals part of the story about the plausible range of hydroclimatic variability that is possible in Australia. More ice cores from different parts of Antarctica that have synoptic connections to Australia are required to:

1. Establish the atmospheric mechanisms controlling the preservation of storm signals in ice core records, and to quantify the long-term behaviour of southern Indian Ocean storms and their input to atmospheric moisture budgets between Australia and Antarctica.
2. To determine (a) the long-term influence of southern Indian Ocean storms on Australian rainfall variability at annual-decadal-centennial scales and (b) the interplay between storm behaviour and climate modes of variability over time.

Recommendation 1: Continue and increase funding for research focused on the collection and analysis of ice cores from Law Dome and from different parts of Antarctica that have synoptic connections to Australia.

Recommendation 2: Integrate the insights from the new ice cores emerging from Recommendation 1 with existing palaeoclimate science to better determine the plausible range of hydroclimatic variability in Australian and the associated impacts on water security.

Contributing to Australia's economic and social development

The importance of Antarctica to Australia's national interests should not be underestimated when it comes to water security – especially given community-wide expectations of a reliable supply of clean, affordable water. The economic and social costs and impacts of severe water supply shortages threaten the fabric of urban and regional communities. The massive investment in water infrastructure following the Millennium drought (~1997-2010) testifies to Australia's risk aversion to such extremes.

Continued and increased funding for research focused on the collection and analysis of ice cores from Law Dome and from different parts of Antarctica that have synoptic connections to Australia is

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necessary to address two fundamental issues: (i) the need to more realistically quantify the chance of water supply shortages and (ii) the need for water supply agencies to guarantee current and future water security.

Limitations associated with current methods that depend on short instrumental records can be addressed by using insights from Antarctic ice core research to generate new knowledge about the chance of water supply shortages. This is needed to inform decision making about water security and will provide significant benefits such as (i) reduced uncertainty about the optimal type, size, and timing of water storage and supply investments worth hundreds of millions of dollars over the next 50 years and (ii) increased confidence in our ability to manage risks associated with droughts and floods.

Two examples I am aware of where insights from Antarctic ice core research are currently being, and will continue to be, used to inform Australia's economic and social development (and environmental sustainability) via increased climate resilience and improved water security are:

1. The New South Wales Regional Water Strategies (https://water.dpie.nsw.gov.au/our-work/plans-and-strategies/regional-water-strategies).
2. The Murray-Darling Basin Authority 2026 Basin Plan Review (https://www.mdba.gov.au/water-management/basin-plan/2026-basin-plan-review).

Recommendation 3: Continue and increase funding for research focused on maximising the value of Antarctic ice core research for increasing the climate resilience of Australia's water storage and supply policy and infrastructure.

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