Towards Development of a Multiyear Climate Prediction Framework for Australia

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The rainfall over Northern Australia exhibits strong variability on multiyear timescales (Sharmila and Hendon 2020), which significantly affects a wide range of climate-sensitive sectors such as agricultural production, energy, and water management. Since El Niño-Southern Oscillation (ENSO) is the largest source of predictable climate variability in regional Australia via atmospheric teleconnections, skilful long-range prediction of ENSO and its related climate impacts beyond a year is crucial for effective risk management in Australia. Despite the growing demand for long-range ENSO prediction and multiyear climate information in Australia, efforts on quantifying ENSO prediction skill at these lead times remain limited, partly due to inadequate long records of seasonal reforecasts. Here, we provide an assessment of the potential usefulness of 2-year lead climate predictions by utilising the 110-years of 24-month 10-member ensemble retrospective forecasts, or hindcasts, from the ECMWF coupled model (SEAS5-20C, Weisheimer et al. 2021) initialised on 1st Nov and 1st May where initial conditions were provided from CERA-20C for the period 1901-2010, as part of Northern Australia Climate Program (NACP; https://www.nacp.org.au/). In this presentation, we will show some of the ongoing research on this new aspect and provide crucial insights on some fundamental issues: such as the long-lead ENSO predictability, decadal variation of ENSO prediction skill, dependence of ENSO prediction skill on initial state, as well as teleconnections to Australian climate at longer lead-time. Overall, ENSO can be skilfully predicted up to ~18 lead months in Nov initialised forecasts, while skill drops at ~12 lead months for May starts that encounter the boreal spring predictability barrier in year 2. The high predictive capacity of ENSO events beyond one year based on ECMWF hindcasts provides motivation for extending the lead time of operational seasonal forecasts beyond one year up to 2 years. This will be valuable for developing future operational multiyear prediction framework using the Australian Bureau of Meteorology's climate forecast system, ACCESS-S, which will provide a new foundation for predicting multiyear climate in Australia.

Reference:

Sharmila, S., Hendon, H.H. (2020) Mechanisms of multiyear variations of Northern Australia wet-season rainfall. *Sci Rep* 10, 5086. https://doi.org/10.1038/s41598-020-61482-5

Weisheimer, A, Balmaseda M, Stockdale T, Mayer M, de Boisseson E, Senan R, Johnson S (2021) Retrospective two-year ENSO predictions during the 20th century. *ECMWF Newsletter*, 169, 7-8. https://doi.org/10.21957/fzf9-te33.