Preliminary Investigation of Multiyear Climate Prediction in Australia

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Australia experiences droughts and pluvials at multiyear timescales that have serious socio-economic impacts on a wide range of climate-sensitive sectors such as agricultural production, energy, and water management. Improved understanding and predictive capability of multiyear (1-5 years) climate variations are thus potentially of great value and is an emerging area of scientific research. As a preliminary investigation, we assess multiyear predictions of El Ni?o Southern Oscillations (ENSO) and rainfall and surface temperature anomalies with a focus on Australia based on two limited sets of multi-year hindcasts produced using the same coupled climate model (UKMO GC2), which has ~60km atmospheric resolution and ~25km oceanic resolution. One set was produced using the ACCESS-S2 system at the Bureau of Meteorology (BoM) and the other is based on the decadal prediction system DePreSys3 at the UK Met Office. For ACCESS-S2, a 6 member ensemble of hindcasts to 5 year lead time was produced every year from ~1 May for the period 1982-2014. For DePreSys3, a 10-member ensemble to 5-year lead time was generated ~every other year from 1 November for the period 1960-2014. Both systems were initialized with observed atmosphere-ocean states, although details of the ocean assimilation are different between the two systems. Both systems show similar biases, with the biases saturating largely in the first year. Biases in the mean state of the tropical Indian and Pacific Oceans impact the variability of the Indian Ocean dipole (simulated to be too strong) and ENSO (simulated to be too weak), which may be detrimental to long lead prediction capability. Preliminary analysis of skill indicates that ENSO is predictable to ~1.5 years lead time, but there is a very strong decadal variation of ENSO predictability. Both the systems show skill for annual mean SST (and surface air temperature) to lead times even up to 5 years in many areas of the globe, but this skill is shown to largely derive from predicting the trend. There is some indication of skill to predict annual mean eastern Australian rainfall (where the ENSO impact is large) for year 2 when initialized from 1 November, despite biases in the teleconnection from ENSO to Australian rainfall. The hindcasts struggle to reproduce the observed trend in Australian rainfall, which means a potential source of multiyear predictability is not captured. However, the cause of the missing trend is unclear. A major recommendation of this preliminary assessment is that more start times and more start years are required to fully diagnose the potential for multiyear prediction.