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Interactive comment on "Links between the Big Dry in Australia and hemispheric multi-decadal climate variability – implications for water resource management" *by* D. C. Verdon-Kidd et al.

B. Scanlon (Referee)

scanlonb@beg.utexas.edu

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This is a very interesting study assessing linkages between the long-term millennium drought in Australia in terms of multi-decadal climate variability with implications for water resources management. The comprehensive approach to the analysis is commendable. Changes in decadal climate related to IPO and IOD were examined throughout the S hemisphere, including AU, S Am., and S. Africa. The authors posit that the delayed drying response in SEA relative to that observed in SWWA since the mid 1970s can be explained by masking caused by more regional synoptic weather patterns impacting seasonal precipitation. The authors use both gridded data products and sta-

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tion data and show differences between the two when evaluating extreme events. The importance of considering interactions among drivers, such as IPO, IOD etc is emphasized in the study. The analysis of synoptic weather patterns is excellent. The use of self-organizing maps (SOM) seems particularly effective in identifying different seasonal precipitation patterns. The analysis of climate patterns that broke the drought is very valuable to assess the predictability of the end of droughts. The section on implications for water resource management is very interesting and these types of scenarios should be used more in the future to make systems more drought resilient. Use of average seasonal precipitation instead of observed wet seasonal precipitation on soil moisture and runoff is highly informative.

The general definition of precipitable water is "depth of water in a column of the atmosphere if all water in that column were precipitated as rain," i.e. the total column of water vapor and cloud water. The global distribution of precipitable water changes (Fig 2a and Fig 3a) was used to show the precipitation trends across the Southern Hemisphere, and the station-based rainfall observations (Fig 2b and Fig 3b) were shown to support the argument. However, precipitable water is not precipitation, and hence the precipitable water trend would be greatly different from precipitation trend. This would make readers wonder if the precipitable water in this paper is not the same as its common definition. If so, it would be helpful to make it clear; if not, it would be better to use gridded precipitation data (e.g. NOAA CPC data) to show the precipitation trends over the Southern Hemisphere.

Fig 2a and fig 3a show the global distribution of reanalysis data, but the paper only focuses on the trends in rainfall across Southern Hemisphere. It seems it is not necessary to show the pattern over the northern hemisphere without any discussion. It does not seem credible to conclude that weakened meridional winds and enhanced zonal winds since the mid-1970s would pull the storm tracks further north. Actually, it appears that the paper conveys a separation of large-scale circulation and synoptic-scale weather systems, which may not be the case. The changes in storm tracks can result in

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observed changes in meridional and zonal winds. The latter would not be understood to “pull” the storm track southward. It would be better to analyze the changes in stream function or geopotential height to see if there was a storm track migration across the southern hemisphere since the mid-1970s. There may be previous studies that already analyzed this. It would help to spell out the variable shown in the figures 8 and 9: sea level pressure. It is good to know the favorable synoptic patterns that account for wet autumns and winters during the mid-1980s to the early-1990s is SEA, but it seems that sea level pressure patterns (figures 8 and 9) can only reveal surface meteorological conditions. It is difficult to see any Subtropical Trough or Ridge that often refers to specific lower troposphere geopotential conditions and any monsoon depression from figures 8 and 9. It would be clearer to plot latitude and longitude on figures 8 and 9 and circle the troughs, ridges, and monsoon depressions discussed in the paper.

It seems there is no evidence that has been suggested to show that the Hadley cell expansion has resulted in the rainfall belt shift across the middle latitude. The Hadley cell is a zonal-mean meridional circulation, and it seems there is no evidence to show that the Hadley cell expansion has significant impacts on zonal mean precipitation over middle latitudes. The rainfall climatology over middle latitudes is also affected by the presence of continents and oceans.

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