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Hydrology and Earth System Sciences Discussions

Interactive comment on "On the relationship between large-scale climate modes and regional synoptic patterns that drive Victorian rainfall" *by* D. Verdon-Kidd and A. S. Kiem

D. Verdon-Kidd and A. S. Kiem

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The authors would like to thank the reviewer for their thoughtful comments. We believe that they have substantially improved our paper.

Detailed descriptions of how each of the reviewer's comments have been addressed are included below:

1. Reviewer 2 recommended that further analysis should be performed to identify the key regional synoptic patterns for different multi-decadal climatic epochs (in particular with respect to the mid 1940's and 1970's shift).

Response - The modulation of regional synoptic patterns by the IPO/PDO has been investigated as suggested by Reviewer 2. The results have been added in the revised manuscript (see Section 4.5). In addition, a discussion around the cause of these multi-decadal climate shifts has been inserted in the Introduction.

2. Reviewer 2 recommended that the authors should perform sensitivity analyses of using different sizes of spatial regions and different grid resolutions as they may affect the results of the frequency of occurrence tests between the regional synoptic patterns and large-scale climate modes.

Response - A variety of spatial regions and array sizes (e.g. 3x4, 4x5, 5x6 etc) were tested when carrying out the SOM to identify the key regional patterns. The final spatial region and array size (4x5) were chosen because SOM applied to SLP data across this region to obtain 20 synoptic types was found to capture the synoptic patterns known to influence the study area.

The SLP data set used in this study (NCEP/NCAR) has been widely used in similar studies (e.g. Cavazos, 2000; Cavazos et al., 2002; Hope et al., 2006; Hope, 2006) and is considered to be the best SLP data available for the study region and type of analysis (see Hope et al. (2006) for a detailed discussion). Alternate data sets with different grid resolutions have not yet been trialled, however may be an area of future work. However, since the patterns identified are physically interpretable it is unlikely that the relationship with large-scale drivers would change by using a different SLP data set, most likely inferior to the NCEP/NCAR dataset (Hope et al., 2006), with a different grid resolution.

A section stating the limitations of the study with respect to the choice of SLP data set has been added to Section 3 of the revised manuscript.

3. Reviewer 2 also commented that authors should explore other relationships which may occur between 20 key regional synoptic patterns and other large-scale climate modes, such as the relationship between the synoptic patterns and the Nicholls Dipole

HESSD

5, S2258–S2261, 2009

Interactive Comment

Index.

Response - The IOD index used in this study is based on SST anomalies over Indonesia (0-10oS, 120-130oE). This index was identified by Nicholls (1989) and relates to one of the 'poles'; of the Indian Ocean Dipole. This index is recognized and has been shown to be a good indication of winter rainfall in eastern Australia (Verdon and Franks, 2005). In fact, this index was found to relate better to east Australian rainfall than other IOD indices such as the DMI of Saji et al. (1999). When SSTs are anomalously cool over Indonesia, winter rainfall tends to be lower, while warm SSTs in the same region are related to higher winter rainfalls in eastern Australia. The text in Section 2.3.2 has been updated to clarify the use of the II to represent the IOD.

It is acknowledged that there are many indices the authors could have chosen to represent the various large-scale climate modes. However, the indices used in this study are well recognized (the standard in same cases (e.g. ONI)) and publicly available. Assessment as to which index 'best'; represents each climate mode and how the relationships identified here may or may not differ if alternate indices are used is beyond the scope of this paper, which simply aims to demonstrate that strong relationships do exist between large-scale climate modes and regional synoptic patterns. Whether the characteristics of these relationships can be refined, and our understanding improved, via the use of alternate indices requires further investigation.

4. Reviewer 2 commented that the paper needed a clear explanation on the statement on section 2.3.2 first paragraph: "An index based on SST anomalies over Indonesia (0-10S, 120-130E) is used in this study to represent climate variability in the Indian Ocean associated with the Indian Ocean Dipole (IOD)".

Response - The statement has been clarified.

5. Reviewer 2 recommended additional text explaining the results shown in Figure 5.

Response - The caption for Figure 5 has been revised to explain the symbols in the

HESSD

5, S2258–S2261, 2009

box plots. The last paragraph of Section 4.3 discusses how the rainfall associated with each synoptic type shows marked spatial variability (e.g. synoptic type 1 is associated with very wet conditions at Macalister and O'Shannassy but relatively dry conditions at all other sites). Readers are also now referred to Kiem and Verdon-Kidd (2009) where the spatial variability of the rainfall associated with each synoptic type, and the physical mechanisms behind this, is discussed.

6. Reviewer 2 recommended that the authors include in the conclusion section the limitations of the study such as the possibilities to apply other synoptic patterns from other dataset sources or apply different method instead of SOM to examine the synoptic types (see Pandora et al., 2006).

Response - As per Reviewer 2's recommendation comment on the limitations of the study has been added to the revised manuscript in the conclusions section. See also the response to Comment #3.

7. Reviewer 2 suggested making the subtitle fonts of Figures 4, 6, 7 and 8 larger.

Response - The authors acknowledge that the font size for Figs 4,6,7, and 8 could be larger. However, the 4x5 grids in Figs 4,6,7, and 8 are just a repeat of Fig 3 (in which the font size is clearly legible). The important aspect of Figs 4,6,7, and 8 is the text overlayed on the 4x5 grids (i.e. the frequency of each type within the various phases of the large-scale mode). Another important point we want to make is how the frequency of each synoptic type changes with each season - hence the need to keep font size small so to enable inclusion of four of the 4x5 arrays in each of Figs 4,6,7, and 8.

Captions for Figs 4,6,7, and 8 have been amended to point the readers back to Fig 3 for clarification on what the subtitles say.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 5, 2791, 2008.